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Powering America's Future

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After roughly two decades of essentially flat electricity demand, the United States is entering a new phase of growth. Artificial intelligence and the data centers that support it, the electrification of transportation and buildings, the reshoring of advanced manufacturing, and continued population and economic growth are together accelerating electricity demand in a way that is projected to persist over the next several decades.

No single energy source is likely to meet that demand. Meeting it will likely require a pragmatic, diversified strategy that draws on the country's domestic resource base, technological capabilities, and capital markets. This paper explores the principal sources of new electricity demand, the role each major energy source is projected to play in meeting it, and the physical constraints, including transmission, pipelines, critical minerals, and labor, that will determine how quickly new supply can reach end users. It concludes with the implications of what is likely to be a multi-decade buildout.

Key Takeaways

- **US electricity demand is growing again.** After nearly two decades of flat use, EIA projects demand could rise 25%-50% by 2050. Meeting peak demand would require 50%-90% more generating capacity.
- **Data centers lead near-term growth, but they are not the only driver.** US data centers used more than 4% of the nation's electricity in 2024. The IEA expects them to account for almost half of US demand growth through 2030. Electric vehicles, manufacturing, and population growth add a broader base of new load.
- **No single energy source can meet the need.** Natural gas remains the largest single fuel source and supplies most of the flexible power. Renewables are the fastest-growing source. Nuclear provides round-the-clock power, but new plants are slow and costly to build.
- **Deliverability is the binding constraint.** Transmission, interconnection, pipelines, equipment, critical minerals, and skilled labor are all expanding more slowly than demand. About 2,060 GW of projects are waiting to connect to the grid, more than one and a half times the nation's installed capacity.
- **Federal support has become less predictable.** Legislation passed in 2025 ended tax credits for new electric vehicles and phased out credits for new wind and solar projects. Credits for nuclear, geothermal, and battery storage remain in place for longer.
- **The more durable opportunities may be the ones that relieve bottlenecks.** The grid and power equipment may offer a broad opportunity, because nearly all new supply must connect to the same system. Demand forecasts are uncertain and many valuations have risen, so entry price and contract structure matter as much as the theme.

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A New Era of Electricity Demand

Energy has returned to the center of the national economic and investment conversation. Electricity is one part of total energy use, which also includes fuels burned directly in vehicles, buildings, and factories. The core challenge is one of timing. There is a widening gap between accelerating electricity demand and a supply system that takes years to expand. Large new loads can be announced quickly, while power plants, transmission lines, pipelines, mines, and equipment factories take years to permit, finance, and construct. Utilities, grid operators, and policymakers now plan around this mismatch. This mismatch is also relevant to how investors evaluate the energy buildout.

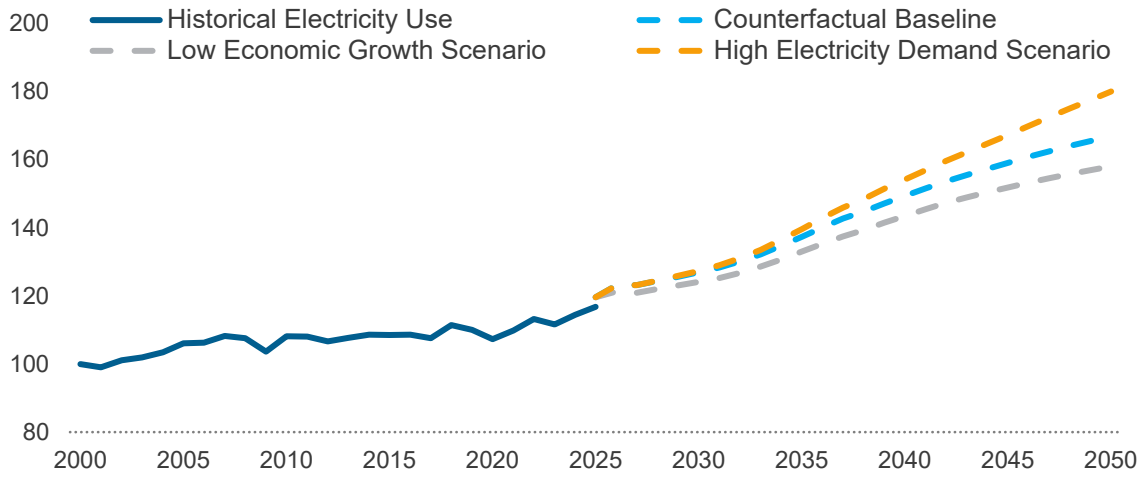
Beginning in the mid-2000s, total US electricity consumption remained relatively stable even as the economy expanded, because of efficiency gains in vehicles, buildings, and industrial processes (see Figure 1). Electricity demand was nearly flat from 2008 to 2023. That period of flat electricity demand appears to have ended. US electricity demand grew by an average of 2.1% per year over the five years through 2025.[1] Major demand drivers, including artificial intelligence ("AI") and data centers, electrification, industrial reshoring, and population growth, together are now accelerating America's electricity needs. In recent outlooks, the US Energy Information Administration ("EIA") projected US electricity sales to total 4,135 billion kilowatt-hours ("BkWh") in 2026, a nearly 2% increase from 2025, and to rise nearly another 2% to 4,211 BkWh in 2027.[2] By 2050, overall US electricity demand is projected to grow 25%-50% cumulatively, meaning total installed generating capacity would have to grow 50%-90% to meet that demand.[3]

Artificial Intelligence and Data Centers

Data centers are expected to be the largest single source of US electricity demand growth through 2030. Major technology companies, including Amazon, Alphabet, Meta, and Microsoft, together spent more than $400 billion on capital expenditures in 2025, much of it on data centers and the equipment inside them.[4] According to the Electric Power Research Institute ("EPRI"), US data centers consumed roughly 184 terawatt-hours ("TWh") of electricity in 2024, about twice the 2021 level and more than 4% of total US electricity use.[5] Projections for future electricity demand from data centers vary widely, reflecting uncertainty about chip efficiency, the pace of AI adoption, and how much of the announced development pipelines is ultimately built. EPRI's scenarios range from roughly 380 TWh to nearly 800 TWh by 2030, implying substantial growth in electricity consumption as new capacity is built and deployed. The International Energy Agency ("IEA") puts the data center share at almost half of US demand growth from 2024 to 2030. By 2030, the IEA expects the US to use more electricity for data centers than for producing aluminum, steel, cement, chemicals, and all other energy-intensive goods combined.[6]

Figure 1

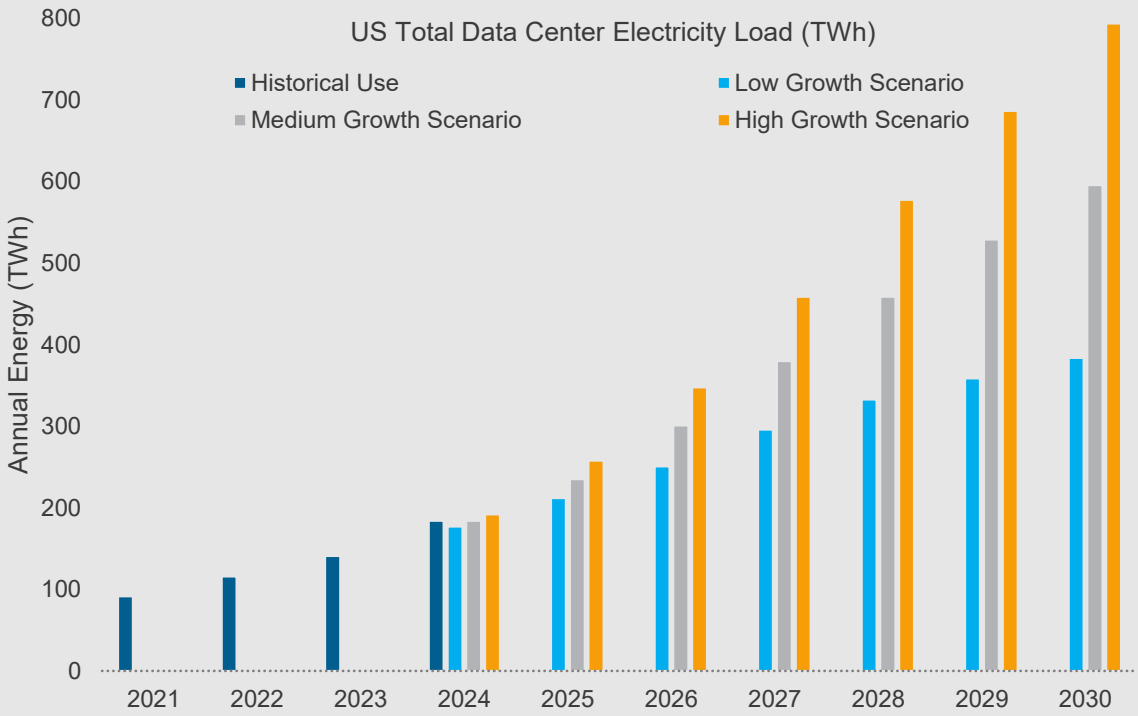
US Electricity Use: Historical vs. Projected (Index, 2000=100)



Source: US EIA, "Monthly Energy Review," and US EIA, "Annual Energy Outlook 2026." Historical data sourced from August 2026 Monthly Energy Review: Electricity End Use and Electric Vehicle Use, as of August 26, 2026. Projected data sourced from Table 8: Electricity Supply, Disposition, Prices and Emissions. The Counterfactual Baseline case (formerly the Reference case) represents how energy markets would operate assuming laws and regulations as of December 2025 and US GDP compound annual growth rate of 1.7%. Low Economic Growth scenario assumes a 1.2% compound annual growth rate for US GDP. High Electricity Demand scenario assumes growth in installed stock of AI servers follows an exponential trend and electricity use to support data centers is more intensive than the Counterfactual Baseline case. For more information on methodology, see "Annual Energy Outlook 2026."

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Figure 2
US Data Center Historical and Projected Electricity Consumption



Source: Electric Power Research Institute, "Powering Intelligence 2026," February 2026. Historical estimates through 2024. Projections reflect different assumptions about the share of planned data center projects completed by 2030. The low growth scenario assumes most projects under construction and 25% of those in advanced planning are fully operational by 2030; the medium growth scenario assumes all projects under construction, 75% of those in advanced planning, and 10% of those in early planning are operational; the high growth scenario assumes all projects under construction or in advanced planning, and 30% of those in early planning, are operational.

Where the demand shows up matters as much as how much there is. The concentration of new data centers in a limited number of regions places disproportionate strain on grids that are increasingly congested. Northern Virginia, the world's largest data center market, had reported grid waits of up to seven years as of August 2024. The IEA estimates that about 20% of planned global data center capacity by 2030 is at risk of grid-related delay.[7] Developers are also targeting markets such as PJM Interconnection, the Midcontinent Independent System Operator ("MISO"), the Electric Reliability Council of Texas ("ERCOT"), and the western US. Speed to power, meaning how quickly a project can secure reliable electricity, has become a priority for data center developers.

Data center developers are using more than one approach. Generation that connects to the utility grid, known as front-of-the-meter, may be a lower-cost option where interconnection is available. In constrained markets, generation built next to the data center, known as co-located, can deliver power faster.[8] Battery storage increasingly accompanies both, helping manage swings in load and providing backup power. The right mix depends on grid capacity, regulatory posture, and urgency. In many cases, the binding constraint is less the availability of energy (i.e., power generation) than the ability to deliver it where demand is emerging, whether through transmission lines, pipelines, or the turbines and transformers needed to connect new supply.[9]

Electrification

Electrification refers to the shift from energy uses that have traditionally burned fossil fuels directly, such as gasoline in vehicles, natural gas and heating oil in furnaces and water heaters, and fuel-fired heat in industrial processes, toward electricity. This trend has been supported by the efficiency of electric technologies: electric vehicles are roughly two to four times more energy efficient than conventional vehicles, and heat pumps roughly three to five times more efficient than fossil-fuel heating.[10] Unlike data center demand, which is concentrated in a relatively small number of locations, electrification adds load across households, commercial buildings, factories, and transportation networks.

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Transportation is likely to be the largest contributor to electrification-driven demand. In the US, electric vehicles are projected to use about 90-140 TWh of electricity in 2030, up from about 30 TWh in 2025. The low end assumes the 2024 federal tailpipe emissions standards are removed. Either way, electric vehicles would be a meaningful source of new demand.[11] The pace of adoption remains sensitive to policy. The federal tax credit for new electric vehicles expired in September 2025, and EIA's projections already reflect that change.[12] Even a gradual transition toward electric vehicles and electrification of building systems would add meaningful demand over time.

Industrial Reshoring

A third driver is the reshoring of advanced manufacturing, most visibly semiconductor fabrication. Supported by both federal legislation and private funding, new semiconductor plants, battery factories, clean-technology manufacturing, and chemical facilities are adding energy-intensive industrial capacity across the country. As of January 2025, the Department of Commerce had awarded $30.7 billion in grants and $5.5 billion in loans to 19 companies supporting 40 commercial fabrication projects under the CHIPS and Science Act of 2022.[13] By mid-2025, semiconductor supply-chain companies had also announced more than half a trillion dollars of private investment intended to expand US chipmaking capacity through 2032.[14] Semiconductor fabrication is particularly electricity-intensive, and a single large campus can create a concentrated load on the grid.

Population and Economic Growth

Finally, underlying economic and demographic growth provides a steady baseline for electricity demand. For most of the past two decades, that growth did not visibly translate into higher electricity use. Between 2000 and 2025, the US population grew by roughly 20% and real GDP by more than 70%, while electricity consumption rose by only about 17%, as efficiency gains and the economy's long shift from manufacturing toward services largely offset the increases.[15] What has changed is that the new sources of increasing load are now layered on top of this baseline, compounding the effects over time. Geography reinforces this effect. The population of the South grew 6.0% from 2020 to 2025, nearly double the national rate of 3.1%.[16] This is notable because several of the largest data center markets, including Virginia, Texas, and Georgia, are also in the South.[17]

Energy Security as Economic Security

Reliable, affordable energy underpins economic growth. Countries with abundant and dependable energy supplies have historically enjoyed stronger industrial competitiveness and greater geopolitical flexibility than those that rely on outside suppliers for critical fuels.

The United States' own history illustrates both sides of this relationship. Dependence on imported oil left the country exposed to supply disruptions originating abroad, most visibly during the 1973-1974 OPEC oil embargo and the 1979 energy crisis. Those episodes triggered fuel shortages, price controls, and recessions that reshaped US energy policy. The shale revolution of the mid-2000s helped reverse that dependence by unlocking previously inaccessible oil and natural gas resources. In 2019, the US exported more energy than it imported for the first time since 1952, with petroleum accounting for the majority of those exports.[18]

Greater self-sufficiency provides flexibility during geopolitical disruptions, but it does not insulate US consumers from global prices. Oil and liquefied natural gas ("LNG") trade in global markets, and most regions of the country remain net importers of petroleum products even though the nation as a whole is a net exporter.[19] Global supply chains, meanwhile, remain highly vulnerable to disruptions. Roughly one-fifth of the world's oil consumption and LNG trade typically passes through the Strait of Hormuz, leaving global markets exposed to a single geopolitical chokepoint.[20] For the US, geopolitical conflicts and disruptions are more likely to show up as price volatility and shifting export demand than as physical shortages.

In this environment, resilient domestic supply chains have become an increasingly important pillar of energy security and economic stability. Energy security has also broadened in scope. It was once understood mainly as reliable access to oil and natural gas. It now extends to the minerals, processing capacity, and manufactured equipment needed to produce and deliver energy. Domestic resource abundance offers limited protection if essential processing or components are concentrated elsewhere.

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This concentration has fed a rise in resource nationalism. Today, producing countries are using export restrictions and domestic-processing requirements to capture more value from their resources or to gain leverage over trading partners. Importing countries have responded by giving up some efficiency in exchange for security, as governments and companies place greater weight on reliability. In the US, policymakers in both parties have continued to prioritize supply-chain security, and that focus now extends beyond fuels to minerals, grid equipment, and manufacturing. Rebuilding processing and manufacturing capacity in higher-cost countries, however, raises the cost of the buildout and makes project economics more dependent on trade policy. It also means that meeting rising demand depends on resilient infrastructure, equipment, and supply-chain materials.

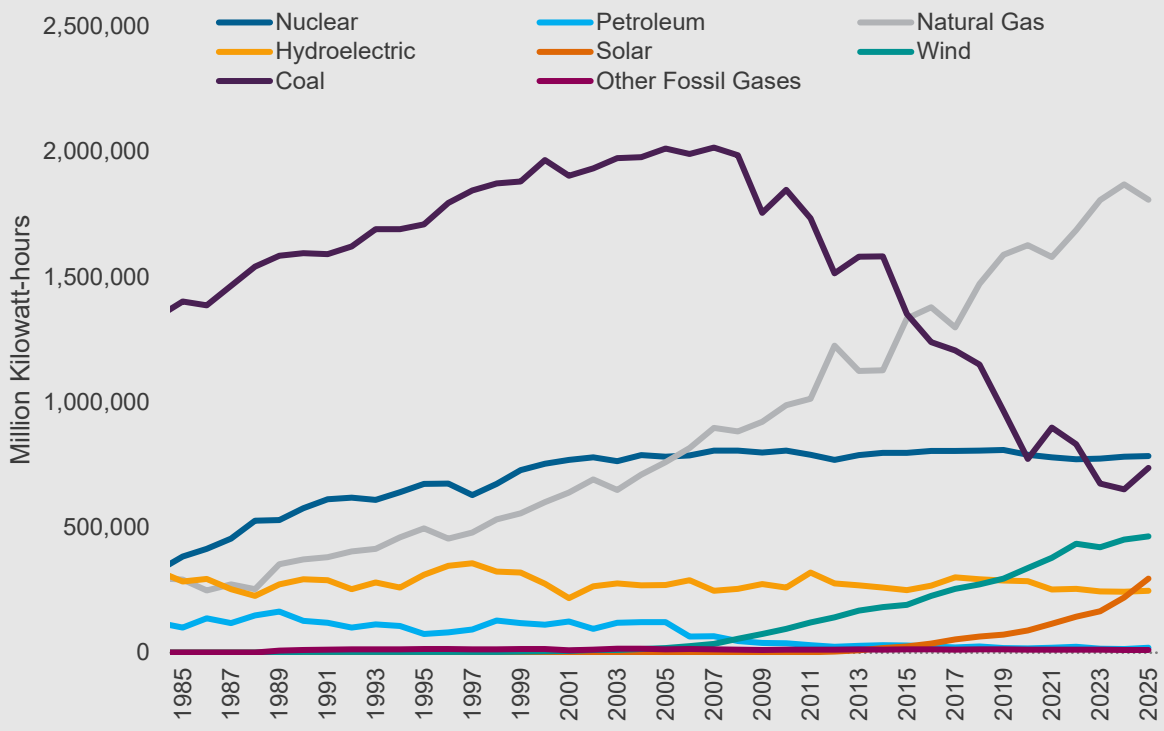
Powering the Grid

The US generation mix has become considerably more diverse over the past two decades (see Figure 3). Coal, which supplied roughly half of US electricity in 2000, has steadily declined as aging plants have been retired and lower-cost alternatives have emerged. Natural gas filled much of that gap and has been the largest source of US generation since 2016. The shift from coal-fired generation to natural gas has also been the largest single contributor to the decline in US power-sector carbon dioxide emissions. Because a modern gas plant emits roughly half as much carbon dioxide per unit of electricity as a legacy coal-fired plant, coal-to-gas switching accounted for an estimated 65% of the reduction in power-sector emissions between 2005 and 2019.[21] More recently, wind and solar have grown into significant contributors, supported by falling technology costs and continued investment in generation and transmission.

No single source has carried the US power system, and long-term projections suggest none will for the foreseeable future. In EIA's baseline case, natural gas supplies roughly 40% of US generation in 2050, renewables more than 45%, and nuclear power about 13%, while coal falls to a negligible share.[22]

Figure 3
Electricity Generation by Source

Source: US EIA, "Electricity Net Generation: Total," as of December 31, 2025.



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The Foundation: Oil and Natural Gas Still Matter

While the US energy mix is evolving, oil and natural gas remain central to the country's energy system. The shale revolution made the US the engine of global oil and gas supply growth over the past 15 years.[23] Natural gas remains the single largest fuel source for US electricity generation, providing roughly 40% of generation in 2025, and EIA projects a similar share in 2026.[24]

The United States remains the world's largest crude oil producer, producing approximately 13.6 million barrels per day in 2025, roughly 40% higher than either of the next two largest global producers, Russia and Saudi Arabia.[25] The Permian Basin of West Texas and southeastern New Mexico has been the primary engine of that growth, producing roughly 48% of total US crude output, while the Eagle Ford (South Texas) and Bakken (North Dakota and Montana) formations each contribute roughly 9%.[26] Oil is used to generate very little US electricity, but it remains essential to the broader economy through transportation, where petroleum products supplied about 89% of US energy use in 2025.[27] Domestic production therefore matters for energy security even where it has little direct bearing on the power grid.

US marketed natural gas production reached a record 118.5 billion cubic feet per day ("Bcf/d") in 2025, an increase of 5.3 Bcf/d over 2024. Appalachia, home to the Marcellus and Utica shale formations, together with the Permian and the Haynesville, accounted for 67% of production and 81% of the year's growth.[28] Appalachia remains the largest producing region, while the Haynesville's proximity to Gulf Coast export terminals continues to attract investment despite comparatively higher well costs.

The Role of Natural Gas

Natural gas plays a role in the power system that is both distinct from, and complementary to, renewables and nuclear power. Gas-fired plants are dispatchable, meaning operators can raise or lower their output on demand, which makes them well suited to serving peak demand and to filling gaps when wind and solar output is limited. Batteries increasingly handle short-term fluctuations, but gas plants can sustain output through extended periods of extreme cold, extreme heat, or low renewable generation. Despite the growing role projected for wind, solar, and battery storage, the EIA expects natural gas to remain the largest single fuel source of US electricity generation through 2050.[29]

The Power Grid and Peak Demand

Understanding the role of natural gas requires an understanding of how the electric grid operates. Electricity must be generated and consumed simultaneously, requiring grid operators to continuously balance supply and demand in real time. Power plants generate electricity and deliver it through transmission and distribution networks to consumers (e.g., homes, businesses, and industrial users). While batteries can store electricity for limited durations, large-scale electricity storage remains relatively constrained and expensive compared with overall system needs, so generation must continually adjust to match demand as it fluctuates throughout the day and across seasons. Demand is typically lowest overnight, rises in the morning as activity picks up, and spikes during extreme weather when heating or cooling needs surge.

This is why generation and capacity represent different measures. Generation refers to the amount of electricity produced over a period of time, whereas capacity is the maximum amount of electricity a plant could generate when operating at 100%. Grid operators must maintain sufficient generating capacity to meet periods of peak demand, even if that capacity is only needed for a limited number of hours each year. Peak demand (i.e., the highest level of electricity use in a given year) is therefore a key measure of whether a power system has adequate resources. A useful way to think about the electric grid is that it must be built for the busiest hour, not the average hour.

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Renewables: Expanding America's Energy Portfolio

Renewable energy is a growing share of the US power system. Renewables, including hydropower, wind, solar, geothermal, and biomass, provided about 24% of US utility-scale electricity generation in 2025[30] and almost one-third of utility-scale generating capacity.[31] Solar and battery storage have led new capacity additions in recent years, and US utility-scale battery capacity grew by roughly two-thirds in 2024 alone.[32]

Several factors support continued renewable deployment. Wind and solar projects have benefited from low operating costs, no fuel requirements, and shorter development timelines than other generation sources. In many regions, new utility-scale wind and solar projects are among the most cost-competitive sources of incremental electricity, and batteries are increasingly paired with them to manage short-term fluctuations in supply and demand. Federal support for new wind and solar has weakened, however, as recent legislation phased out their tax credits.

Their principal limitation is variability. Wind and solar output varies by time of day, season, and weather, so their value to the grid depends less on how much capacity is installed than on when that power is produced and whether it can be delivered when needed. Data center procurement illustrates the gap. Where solar generation alone is contracted to match 100% of a facility's annual electricity use, it typically covers only 35% to 45% of that facility's demand on an hourly basis, and other sources must supply the rest.[33]

Maintaining a reliable balance between electricity supply and demand depends on several complementary sources to address different limitations. Battery storage shifts electricity across hours, charging when generation exceeds demand and discharging when power is needed, although most systems are designed to run for only a few hours and cannot cover multi-day or seasonal shortfalls. Transmission can move electricity between regions, allowing surplus output in one area to serve demand in another and reducing exposure to local weather conditions. Natural gas plants can raise or lower output as conditions change. Nuclear plants provide steady output that is not dependent on the weather. Renewables are therefore likely to account for a growing share of US electricity generation, but alongside other sources rather than in place of them.

Figure 4

Power Generation Comparison

Characteristic	Natural Gas	Nuclear	Wind	Solar
Dispatchability	High	Low to Moderate	Low	Low
Typical capacity factor*	~58% (combined cycle)	~91%	~34%	~24%
Fuel requirement	Natural gas	Uranium	None	None
Typical construction period	2-4 years (combined cycle)	5-15 years (new build); 2-5 years (restart)	2-5 years (onshore)	1-4 years
Operating emissions intensity	Moderate	Low	Low	Low
Seasonal/weather variability	Low	Low	High	High

Sources: Capacity factors from US EIA, Electric Power Monthly, February 2026 (preliminary 2025 data). Construction periods from IEA, "Energy and AI," April 2025. Dispatchability, fuel requirement, emissions intensity, and seasonal/weather variability are Meketa characterizations.

* Capacity factor is the ratio of a power plant's actual electricity output over a period to the maximum it could have produced had it run at full capacity for the entire period. A plant with a 100% capacity factor means it operated at full output continuously. Capacity factor differs across sources because of maintenance and refueling schedules, fuel availability, weather conditions, and how grid operators dispatch each plant. A higher capacity factor generally indicates more consistent output. Figures are preliminary 2025 annual averages. Source: US EIA, Electric Power Monthly, February 2026, Tables 6.07.A and 6.07.B.

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Nuclear Energy: Restarts, Upgrades, and New Reactors

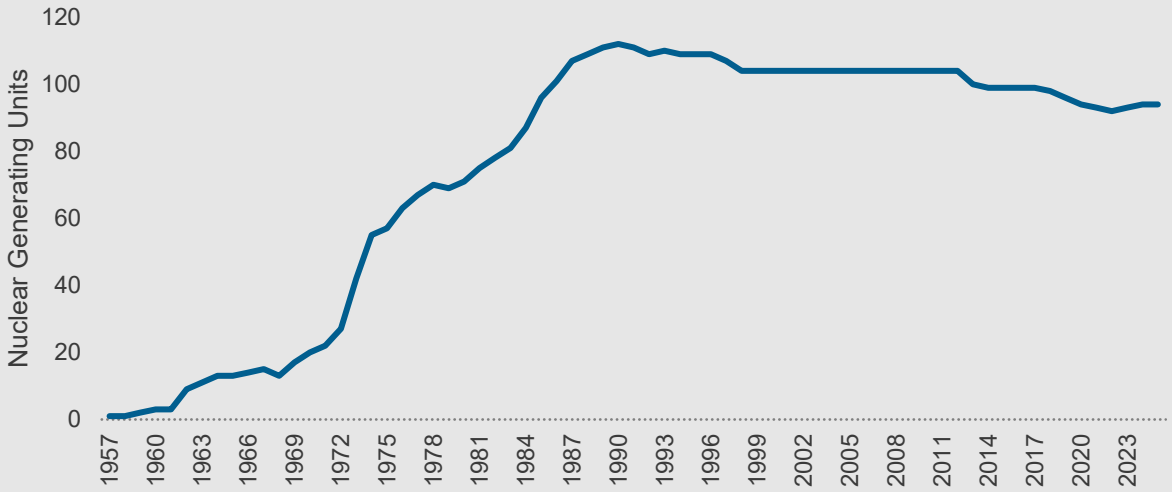
Nuclear power has long been a meaningful part of the US electricity system, despite relatively limited new construction in recent decades. The US operates the world's largest commercial nuclear fleet, consisting of 94 reactors with approximately 100 gigawatts ("GW") of generating capacity, which together supply roughly one-fifth of US electricity. Nuclear reactors operated at an average capacity factor of about 91% in 2025, higher than any other major source, allowing them to provide reliable, around-the-clock output with minimal direct carbon emissions.[34] Although much of the existing fleet was built during the 1970s and 1980s (see Figure 5), license extensions and capacity upgrades have prolonged the operating lives of existing plants and added generation without requiring the construction of entirely new facilities.

Rising electricity demand and the search for reliable, low-carbon power have renewed interest in nuclear energy among utilities, industrial users, and technology companies, and federal goals have grown more ambitious. Because nuclear plants can run around the clock regardless of weather, they can provide a stable foundation for power systems that rely more on intermittent renewable resources such as wind and solar. Long-term outlooks generally anticipate growth in nuclear generation capacity, particularly as rising electricity consumption coincides with efforts to reduce emissions from the power sector. In 2024, the Biden administration set a target of tripling nuclear capacity by 2050, and in 2025 the Trump administration set a goal of 400 GW, roughly four times the capacity of today's fleet.[35] A major challenge, however, is that traditional large-scale nuclear construction in the United States remains difficult. New reactors face long construction timelines, high upfront costs, specialized workforce requirements, and complex regulatory approvals, all of which have limited new construction. Meeting the 400 GW goal would require roughly 15 GW of new capacity each year from 2030 to 2050, compared with a historical peak of 10.5 GW commissioned in 1974 and only about 6 GW added in total since the early 1990s.[36] Estimated costs for new nuclear plants range from roughly $6,400 to $12,700 per kilowatt, compared with about $3,000 per kilowatt for natural gas.[37]

On the other hand, restarting retired reactors can cost a fraction of new construction. One estimate puts the cost of restarting three plants with roughly 2 GW of combined capacity at about $6.2 billion, or roughly $3,100 per kilowatt. At the cost range above, a new plant of similar size would cost roughly $13 billion to $25 billion.[38] However, only a few retired reactors are realistic candidates for restart, so restarts can add only a few gigawatts. Fuel supply may pose an additional constraint. The United States relies on foreign sources, including Russia and China, for a meaningful share of its enriched uranium, and domestic production of the high-assay low-enriched uranium ("HALEU") required by many advanced reactor designs remains limited.[39] In 2024, Congress approved $2.7 billion to expand domestic enrichment capacity of both HALEU and conventional low-enriched uranium.[40]

Figure 5
US Nuclear Generating Units, 1957–2025

Source: US EIA, "Nuclear Energy Overview," as of 2025.



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Small Modular Reactors

Small modular reactors ("SMRs") have emerged as a potential alternative to traditional large-scale nuclear projects. Generally defined as reactors producing less than 300 megawatts of electricity, roughly one-third the generating capacity of a conventional reactor, SMRs are designed around standardized components that can be manufactured in a factory and deployed in smaller increments. The approach can reduce construction complexity and upfront capital requirements while allowing capacity to be added in stages as demand grows. Their smaller footprint may also expand the range of locations where nuclear power can be deployed, particularly in regions experiencing rapid growth in electricity demand or constraints on existing grid infrastructure.

Major technology companies, including Amazon, Google, and Meta, have signed agreements to support advanced nuclear and SMR development as part of broader efforts to secure electricity supply for growing demand.[41] Federal government support for domestic SMR technology has also increased. In December 2025, the US Department of Energy selected the Tennessee Valley Authority and Holtec to receive up to $400 million each for early SMR projects in Tennessee and Michigan.[42]

Commercial deployment, however, remains in its early stages. Although SMRs may offer lower costs and greater flexibility than conventional nuclear projects, these advantages have not yet been demonstrated on a commercial scale.

The Hidden Backbone: Critical Minerals and Materials

Expanding the US energy system also depends on the materials used to build it. Copper is needed throughout the electric grid, from transmission lines and transformers to motors and data center electrical systems. Batteries rely on lithium, nickel, cobalt, and graphite. Rare earth elements are used in permanent magnets found in many wind turbines and electric motors, and nuclear plants depend on uranium. As investment in generation and the grid accelerates, the availability of these materials will increasingly influence how quickly new capacity can be developed.

America's Resource Base

The US has meaningful domestic resources, including lithium in Nevada, copper in Arizona, nickel and related minerals in Minnesota, uranium in Wyoming, and a range of mineral deposits in Alaska. Resource availability, however, does not necessarily translate into near-term production. New mines often require lengthy permitting and development periods. Moreover, the US lacks much of the processing and refining capacity needed to convert raw materials into usable inputs for many critical minerals. Refining is also where global supply remains highly concentrated. The IEA found that geographic concentration in refining increased for nearly all key energy minerals in recent years, particularly nickel and cobalt, and that reversing the trend is likely to be slow.[43] The main constraint is often not geology. It is the ability to permit, process, and deliver materials at competitive prices.

Figure 6
Critical Mineral Requirements Across Energy Technologies

Energy Technology	Minerals Required
Transmission & Grid Infrastructure	Copper, Aluminum
Battery Storage	Lithium, Nickel, Cobalt, Graphite
Electric Vehicles and Motors	Copper, Rare Earth Elements
Wind Turbines	Copper, Rare Earth Elements
Solar Panels	Silicon, Silver, Copper
Nuclear Power	Uranium
Data Center Infrastructure	Copper, Aluminum, Rare Earth Elements

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Supply-Chain Risks

Supply-chain concentration compounds the challenge. The US was once a major mineral producer, but limited investment in domestic mining, refining, and processing over several decades has left it reliant on imports for many critical inputs (see Figure 7). China, for example, was a major import source for 14 of the 33 critical minerals for which the US most depends on imports, and minerals mined elsewhere are frequently shipped to China for refining.[44] Access to critical minerals has become a recurring source of leverage in trade negotiations,[45] and dependencies on one country for mining and another for processing can create multiple points of vulnerability within a single supply chain.

Energy independence now also requires secure supplies of minerals and materials. Expanding domestic mining is one part of the solution, but investment in processing, refining, recycling, transportation, and long-term supply agreements will also be necessary.

Building the Infrastructure Required for Growth

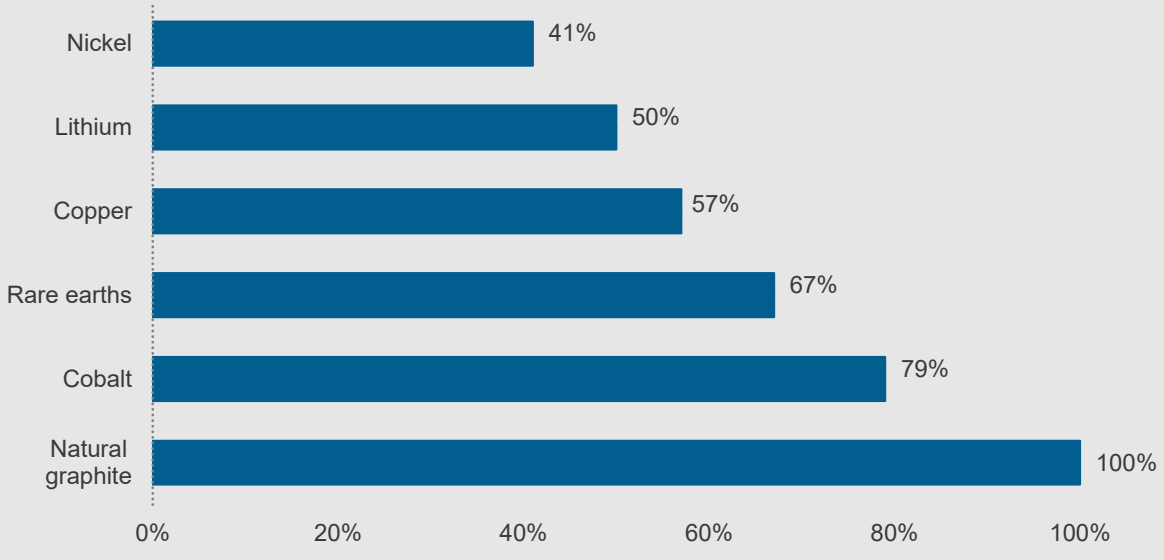
Increasing generating capacity and securing critical minerals are necessary steps toward meeting America's growing energy needs. But increasing supply alone will not prove sufficient. The electric grid, natural gas pipeline network, and domestic manufacturing base must expand in parallel, and each currently represents a meaningful constraint on the pace at which new supply can reach end users.

Electric Grid Expansion

The US electric grid moves power from where it is generated to where it is ultimately consumed, and it has three principal layers. Power plants generate electricity. High-voltage transmission lines carry that electricity over long distances, from power plants to population and industrial centers. The lower-voltage distribution network then delivers it to homes and businesses. Substations and transformers connect the layers, stepping voltage up for efficient long-distance transmission and back down for local distribution. Before a new power plant or large customer can connect to the grid, it must go through an interconnection process in which grid operators determine the project's impact on the system and identify whether any upgrades are required.

Much of this infrastructure was built for a different era, when demand grew slowly and generation was concentrated in large, centralized plants. Advances in conductor materials, power electronics, sensors, and grid-management technology have increased the amount of electricity that can be moved through existing transmission corridors while improving efficiency and reducing constraints. Still, roughly 70% of US transmission lines and power transformers are more than 25 years old, and industry estimates suggest that distribution transformer capacity may need to grow 160%-250% by 2050 to keep pace with rising load.[46] Transmission congestion and insufficient transfer capability between regions are projected to create major reliability and cost challenges through 2040.[47]

Figure 7
US Net Import Reliance on Critical Minerals



Source: US Geological Survey ("USGS"), "Mineral Commodity Summaries 2026 Data Release, Figure 3: Major Import Sources," May 2026. Category Used: Net Import Reliance as Percentage of Apparent Consumption. Lithium is reported as >50%, plotted as a lower bound, not as a point estimate. Net import reliance is measured as imports less exports, with applicable stock adjustment, as a share of apparent consumption; the precise definition varies by USGS methodology by mineral.

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That aging network now faces an accelerating volume of proposed generation and storage. At the end of 2025, roughly 8,200 projects with about 2,060 GW of capacity were seeking to connect to the US grid. That is more than one and a half times the nation's installed generating capacity of about 1,280 GW.[48] If history is a guide, most of these projects will likely be withdrawn rather than built. Only about 19% of projects entering queues between 2000 and 2020 reached commercial operation.[49] Those that are completed are waiting far longer than they once did: the median project reaching commercial operation in 2025 spent roughly five years from interconnection request to commercial operation, up from slightly under two years in 2008.[50]

Bottlenecks appear at nearly every layer. New high-voltage lines often cross several states, each with its own siting and permitting process, and interregional projects must also settle how costs will be shared. Interconnection studies and the network upgrades they require can add years and substantial cost to a project. The equipment needed to build and connect new capacity, particularly large power transformers, is in short supply, as discussed below. In many regions, the binding constraint on new supply is not the availability of energy resources but the grid's ability to deliver power where and when it is needed.

Natural Gas Infrastructure

The largest constraint on natural gas as a fuel source is less the availability of natural gas than the infrastructure required to move it. Production from Appalachia, the Permian, and the Haynesville is expected to continue rising, but gathering systems, interstate pipelines, storage facilities, and export terminals take years to permit and build. Where takeaway capacity is limited, abundant resources can remain effectively stranded, restricting access to supply even as demand grows.[51]

Growing LNG exports from the Gulf Coast are expected to draw more gas from producing regions, particularly Appalachia and the Haynesville. Not every region can reach the export terminals equally. Without adequate midstream infrastructure, abundant domestic resources may not translate into reliable energy supply or export growth. There is currently a projected gap of about 5 Bcf/d between expected supply growth and the combined growth in LNG exports and regional demand by 2030.[52]

Equipment and Labor

Expanding America's energy system will require capital, along with the industrial capacity and skilled labor needed to build, install, and maintain critical infrastructure. Across the energy sector, shortages of key equipment and skilled workers are emerging as significant constraints on the pace of development.

Demand for transformers, turbines, batteries, switchgear, and other electrical equipment has increased rapidly as utilities modernize the grid and developers add new generation capacity. Gas turbines are a clear example. Major manufacturers report that new orders may not be delivered until 2028 or later, and some developers face waits of up to seven years.[53] Large power transformers face similar delays. Average lead times reached about 128 weeks in 2025, and prices have risen about 77% since 2019.[54] Expanding domestic manufacturing of this equipment may be as important to the timeline of the energy buildout as any single generation or resource decision.

At the same time, the industry faces a growing labor challenge. In 2025, more than half of energy-sector employers reported serious hiring bottlenecks, with shortages most pronounced among workers needed for large-scale energy projects.[55] Building transmission lines, pipelines, power plants, LNG facilities, and manufacturing plants requires engineers, electricians, welders, pipefitters, line workers, and other specialized technicians. Labor shortages raise construction costs and lengthen timelines, which affects returns on nearly every asset discussed in this paper.

Investment Considerations

The return of US electricity demand growth may support a prolonged investment cycle across the energy value chain. Meeting that demand will require more than additional generating capacity; it will also require substantial investment in transmission and distribution networks, natural gas infrastructure, electrical equipment, energy storage, and domestic manufacturing capacity. Many of the more durable opportunities may lie in assets that relieve the system's bottlenecks or service them on an ongoing basis. These opportunities span public equities, private infrastructure, natural resources, private equity, and private credit.

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The electric grid and power-equipment supply chain may represent a broad opportunity because nearly every form of new generation must connect to the same transmission and distribution system. Regulated utilities, equipment manufacturers, and infrastructure strategies may benefit from spending on transmission lines, substations, transformers, switchgear, and related components. Midstream and LNG-linked infrastructure may provide additional exposure as rising power demand and exports require greater natural gas transportation, processing, and storage capacity.[56] Existing power plants and other operating assets with established interconnections may also become more valuable as lengthy permitting, construction, and interconnection timelines limit the pace of new development. Secured interconnection rights and site control are scarce, because capital alone cannot create grid capacity.

Renewable generation (e.g., wind and solar) and energy storage present a similarly varied opportunity set. Because contracted wind and solar projects have no fuel costs, their returns may be relatively insulated from commodity price volatility. Battery storage may expand the opportunity set by helping manage intermittent generation, providing grid services, and potentially supporting the integration of large new loads. Hybrid generation and storage projects may also offer shorter deployment timelines than alternatives such as new natural gas generation. Wind and solar projects that did not begin construction by July 4, 2026, must now be in service by the end of 2027 to qualify for federal tax credits.[57] Battery storage keeps its credits for longer. Project economics, however, remain highly sensitive to tax-credit eligibility, supply-chain concentration, restrictions on foreign-sourced equipment, permitting costs, interconnection requirements, location, and project design.

As intermittent generation grows, the value of flexible and firm capacity may increase during periods of low renewable output. Natural gas peaking plants, which operate only during periods of elevated system demand or constrained supply, may therefore benefit from providing dispatchable capacity as electricity demand rises and renewable integration increases. The investment case for these assets may depend less on maximizing generation than on the value placed on reliability and operational flexibility.

Nuclear opportunities span a wide range of risk and return, and they are likely to develop over different time horizons. Existing nuclear facilities, plant upgrades, reactor restarts, and nuclear fuel services generally offer more predictable, nearer-term cash flows, given their established technology, existing sites, and interconnections. Small modular reactors offer greater potential upside, but with meaningful risks related to technology, licensing, and commercial reliability at scale.

Critical minerals present a similar range: processing, refining, and recycling assets may offer more targeted, nearer-term exposure to domestic supply-chain constraints. Early-stage mining carries geological, permitting, and price risk, but it typically retains the most direct exposure to commodity prices.

Higher demand alone does not make a good investment. Location and connectivity determine whether energy can reach end users, while contract structure and counterparty quality determine the visibility of future cash flows. Policy support may facilitate development, but it does not substitute for commercial viability. Assets with credible permitting and interconnection pathways, manageable financing requirements, and contractual or regulatory mechanisms that support cost recovery may be better positioned. Examples may include long-term offtake agreements with investment grade counterparties. The energy buildout may create opportunities across public and private markets, but execution, manager selection, and valuation discipline will determine which investments convert growth into durable returns.

Risks to the Opportunity Set

The investment case rests on demand forecasts, and those forecasts are uncertain. EPRI's high scenario for data center electricity use in 2030 is roughly twice its low scenario (see Figure 2). Utility load forecasts may also be inflated. Some developers request grid connections for the same project in several regions, and many of those projects may never be built. Gains in chip and cooling efficiency could reduce the power needed for each unit of computing. A slowdown in AI spending would weaken the near-term demand outlook quickly.

Rising demand also does not guarantee attractive returns. Retail electricity prices rose 5.3% in 2025, outpacing inflation.[58] Higher bills could lead regulators to

limit the costs that utilities can recover from customers. Several states are also considering whether large new loads, such as data centers, should pay a greater share of new grid costs.[59] Assets built for demand that does not arrive could become stranded.

Finally, much of this growth may already be reflected in prices. Valuations for some public and private assets tied to rising power demand may already reflect growth expectations. Entry price will matter as much as the theme itself.

The Role of Federal Policy

Federal policy touches nearly every part of the energy buildout, from tax incentives and trade policy to permitting, interconnection rules, and nuclear licensing. It shapes how quickly new supply can come online. Under both the Trump and Biden administrations, policymakers have deployed substantial incentives, financing programs, tax credits, and industrial policy initiatives aimed at expanding domestic energy production, manufacturing capacity, grid infrastructure, and critical mineral supply chains.[60] That support has not been steady, however. The One Big Beautiful Bill Act of 2025 ended federal tax credits for new electric vehicles after September 30, 2025. It also phased out credits for new wind and solar projects. To qualify, those projects must have started construction by July 4, 2026, or be in service by the end of 2027.[61] Credits for nuclear, geothermal, and battery storage remain in place for longer. The law also restricts the use of components from China and other "foreign entities of concern." For investors, federal policy is a source of risk as well as support. Incentives can change faster than the assets they support can be built.

America as an Energy Exporter

The opportunity facing the United States extends well beyond meeting its own demand growth. The country has been a net total energy exporter since 2019, with record exports in 2024 supported by LNG and refined petroleum products.[62] Additional LNG capacity is expected to strengthen that position, while US nuclear technology, grid equipment, and other electricity technologies could provide further export opportunities as other countries seek reliable energy and alternatives to concentrated or state-controlled supply chains.

America's competitive advantages extend beyond its natural resources. Deep capital markets, strong legal protections, established research institutions, and technological innovation provide a foundation for financing and developing capital-intensive energy projects. These strengths can support growth across LNG, advanced nuclear, grid infrastructure, and energy manufacturing. On the other hand, construction and labor costs in the US are high relative to many competing countries, and permitting regimes can be lengthy and unpredictable, particularly for projects that cross multiple jurisdictions.

Conclusion

After two decades of nearly flat demand growth, the US power system has to grow again. Data centers are driving the first wave. Electric vehicles, new factories, and population growth will add to demand over time. The US has substantial resources to draw on: abundant natural gas, a growing renewable fleet, the world's largest nuclear fleet, and deep capital markets.

The harder problem is delivery. New demand can be announced in months, but the infrastructure to serve it takes years. Turbines and transformers have multi-year backlogs. New transmission lines and pipelines take years to permit and build. Critical mineral supplies depend heavily on China, and skilled workers are scarce. Federal incentives can change faster than these assets can be built. How quickly the US clears these bottlenecks will set the pace of the buildout.

For investors, the opportunity is broad but uneven. Assets that relieve bottlenecks, such as grid equipment, transmission, pipelines, and mineral processing, may be better positioned. Projects with secure grid connections and long-term contracts may also be attractive. However, demand forecasts could prove too high, and many related assets are already priced for strong growth. Entry price, contract terms, and manager selection are likely to influence whether a multi-decade buildout translates into durable returns.

End Notes

[1] Source: US Energy Information Administration ("EIA"), "Annual Energy Outlook 2026," April 8, 2026.

[2] Source: US EIA, "Short-Term Energy Outlook," as of September 9, 2026. One BkWh could supply roughly 90,000 average US homes for one year, depending on household usage.

[3] Source: US EIA, "Annual Energy Outlook 2026," April 8, 2026. Installed generating capacity must grow faster than demand for two reasons. First, the power system is sized for peak demand, the highest level of consumption during the year, rather than for average demand. Second, wind and solar, which account for much of the new capacity in EIA's scenarios, produce far less electricity per unit of capacity than nuclear or natural gas plants. A system that relies more heavily on renewables needs more installed capacity to generate the same amount of electricity.

[4] Sources: Amazon.com, Alphabet, Meta Platforms, and Microsoft, Form 10-K and Form 10-Q filings. Figures reflect calendar-year 2025 capital expenditures.

[5] Source: Electric Power Research Institute (EPRI), "Powering Intelligence 2026," February 2026. One terawatt hour is equivalent to one billion kilowatt hours (BkWh).

[6] Source: IEA, "Energy and AI," April 2025, Executive Summary.

[7] Sources: Bloomberg, "Data Centers Face Seven-Year Wait for Dominion Power Hookups," August 29, 2024; Virginia Mercury, "Data centers want to build their own gas turbines. Would that skirt state renewable energy laws?," July 20, 2026; IEA, "Energy and AI," April 2025, "AI and energy security" chapter.

[8] Sources: Baker Botts, "FERC Issues Order Providing Guidance for 'Co-locating' Power Plants with Data Centers within PJM," December 2025; Davis Graham, "Battery Storage for Data Centers in 2026: FEOC Compliance, FERC Co-Location, and the Deals Getting Done Now," April 2026; Virginia Mercury, "Data centers want to build their own gas turbines. Would that skirt state renewable energy laws?," July 20, 2026.

[9] See Meketa's white paper, "A Primer on Investing in Data Centers," 2026, for more information.

[10] Source: IEA, "Electrification Special Report," September 2026.

[11] Source: US EIA, "Annual Energy Outlook 2026," April 8, 2026, Counterfactual Baseline and Alternative Transportation cases. Figures reflect residential and commercial electric vehicle charging, converted from quadrillion BTU to TWh.

[12] Source: One Big Beautiful Bill Act, Pub. L. No. 119-21, July 4, 2025.

[13] Source: Congressional Research Service, "Semiconductor Fabrication Facilities Funded by the CHIPS Act: Project Status and Considerations for Congress," July 2026. The CHIPS and Science Act of 2022 is a federal initiative aimed at expanding US semiconductor manufacturing and research capacity.

[14] Source: Semiconductor Industry Association, "2025 State of the US Semiconductor Industry," July 2025.

[15] Sources: US Census Bureau population estimates; US Bureau of Economic Analysis, real gross domestic product; electricity consumption from EIA, "Monthly Energy Review."

[16] Source: United States Census Bureau, "Populations in All Age Groups Growing in the South, Driven by Outlying Counties in Metro Areas," June 25, 2026.

[17] Source: CBRE, "North America Data Center Trends H1 2026," 2026. Northern Virginia, Atlanta, and Dallas-Fort Worth were the three largest North American data center markets by inventory.

[18] Source: US EIA, "Despite the US becoming a net petroleum exporter, most regions are still net importers," February 2, 2020, and "The United States is a major energy exporter and importer, especially for petroleum," May 27, 2026.

[19] The Gulf Coast is the only net petroleum-exporting region in the US, and its net exports outweigh the combined net imports of all other regions.

[20] Source: US EIA, "Amid Regional Conflict, the Strait of Hormuz Remains Critical Oil Chokepoint," Today in Energy, June 16, 2025.

[21] Source: US EIA, "Electric Power Sector CO_2 Emissions Drop as Generation Mix Shifts from Coal to Natural Gas," June 9, 2021.

[22] Source: US EIA, "Annual Energy Outlook 2026," Table 8: Electricity Supply, Disposition, Prices, and Emissions, Counterfactual Baseline case. This case represents how energy markets would operate under laws and regulations as of December 2025.

[23] See Meketa's white paper, "Exporting Liquefied Natural Gas (LNG): America's Emerging Energy Arsenal," September 2025, for more information.

[24] Source: US EIA, "Short-Term Energy Outlook," as of December 2025.

[25] Source: US EIA, "The United States produced more crude oil than any other country in 2025," July 2026.

[26] Source: US EIA, "US crude oil production rose in 2025, setting new record," March 2026.

[27] Source: US EIA, "Use of Energy Explained: Energy Use for Transportation," as of April 2026.

[28] Source: US EIA, "US natural gas production reached a new record in 2025," March 2026.

[29] Source: US EIA, "Annual Energy Outlook 2026," April 2026. These projections reflect the counterfactual baseline case.

[30] Utility-scale plants have at least one megawatt of capacity. Including EIA's estimate of small-scale solar generation, such as rooftop systems, raises renewables' share of 2025 US electricity generation to about 26%. Source: US EIA, Electric Power Monthly, February 2026 (preliminary 2025 data); US EIA, "Electricity Explained: Electricity Generation, Capacity, and Sales in the United States," 2026.

End Notes (continued)

[31] Source: US EIA, "Electricity explained: Electricity in the United States," 2026.

[32] Source: US EIA, "Solar, battery storage to lead new US generating capacity additions in 2025," February 2025; US EIA, "US battery capacity increased 66% in 2024," March 2025.

[33] Source: IEA, "Energy and AI," April 2025.

[34] Sources: US EIA, Electric Power Monthly, February 2026, Table 6.07.B (preliminary 2025 capacity factors); US EIA, "Electricity Explained: Electricity Generation, Capacity, and Sales in the United States," 2026; US EIA, "How many nuclear power plants are in the United States, and where are they located?" (FAQ), March 2026.

[35] Sources: The White House, "Safely and Responsibly Expanding US Nuclear Energy: Deployment Targets and a Framework for Action," November 2024; Executive Order 14300, "Ordering the Reform of the Nuclear Regulatory Commission," May 23, 2025.

[36] Source: T. Rowe Price, "Restoring America's Nuclear Energy Capacity-Digging in to Potential Impacts and Implications," June 2025.

[37] Sources: Arclight/S&P Global Intelligence, data as of October 2025 (natural gas); Deloitte Insights, "Nuclear energy's role in powering data center growth," April 2025 (nuclear).

[38] Source: Deloitte Insights, "Nuclear energy's role in powering data center growth," April 2025 (nuclear).

[39] A US ban on imports of Russian enriched uranium took effect in August 2024, although waivers are allowed through 2027. Source: Prohibiting Russian Uranium Imports Act, Pub. L. No. 118-62, May 13, 2024; US Department of Energy, "Russian Uranium Ban Waiver Guidance."

[40] Source: Deloitte Insights, "Nuclear energy's role in powering data center growth," April 2025 (nuclear).

[41] Sources: Amazon, "Amazon signs agreements for innovative nuclear energy projects to address growing energy demands," October 16, 2024; Google, "New nuclear clean energy agreement with Kairos Power," October 14, 2024; Meta, "Meta Announces Nuclear Energy Projects, Unlocking Up to 6.6 GW to Power American Leadership in AI Innovation," January 9, 2026.

[42] Source: US Department of Energy, announcement of Generation III+ small modular reactor awards to the Tennessee Valley Authority and Holtec, December 2, 2025.

[43] Source: IEA, "World Energy Outlook 2025," November 2025.

[44] Source: US Geological Survey, "Mineral Commodity Summaries 2026," February 2026. The final 2025 US List of Critical Minerals, published in November 2025, includes 60 minerals.

[45] In April 2025, China imposed export licensing requirements on several rare earth elements and related magnets in response to US tariffs, and it broadened those controls in October 2025. The restrictions led some manufacturers to curtail production and became a central issue in US-China trade negotiations. Under the trade truce reached in late 2025, China suspended its measures for one year, a suspension scheduled to expire in November 2026. Critical minerals remain a key topic in trade discussions between Washington and Beijing.

[46] Source: American Society of Civil Engineers, "2025 Report Card for America's Infrastructure," March 2025.

[47] Source: US Department of Energy, "National Transmission Needs Study," October 20, 2023.

[48] Source: US EIA, "Electricity explained: Electricity generation, capacity, and sales in the United States," 2026. Figure reflects utility-scale generating capacity at the end of 2025.

[49] Source: Lawrence Berkeley National Laboratory, "Queued Up: 2026 Edition, Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2025," June 2026.

[50] Source: Ibid.

[51] New England illustrates this point. New England sits within a few hundred miles of the Marcellus and Utica shale formations, yet the region has no underground gas storage and limited pipeline capacity into it, and proposed pipeline expansions that would have carried more Appalachian gas into the Northeast have been blocked or cancelled, resulting in the region relying on imported LNG to meet demand.

[52] Source: Natural Gas Intelligence ("NGI"), "Northeast Natural Gas Revival Seen Cutting Gulf Coast Supply Short," May 2026, citing Tudor, Pickering, Holt & Co.

[53] Source: S&P Global Commodity Insights, "US gas-fired turbine wait times as much as seven years; costs up sharply," May 2025.

[54] Source: Wood Mackenzie, "Transformer troubles: manufacturing and policy constraints hit US transformer supply," 2025. Lead time reflects Wood Mackenzie's second-quarter 2025 survey.

[55] Source: IEA, "World Energy Employment 2025," December 2025.

[56] See Meketa's white paper, "Midstream Energy Investments," 2019, for more information.

[57] Source: One Big Beautiful Bill Act, Pub. L. No. 119-21, July 4, 2025.

[58] Source: Lawrence Berkeley National Laboratory, "Retail Electricity Price Trends and Drivers: 2026 Edition," March 2026.

[59] Source: Smart Electric Power Alliance, "Stretching the Possibilities: Where Large-Load Tariffs Fit in the Future of Data Center Flexibility," 2026. As of the second quarter of 2026, SEPA tracked 69 approved and 35 proposed utility tariffs targeting large-load or data center customers across 37 states.

End Notes (continued)

[60] The Inflation Reduction Act, CHIPS and Science Act, the One Big Beautiful Bill Act, FERC Order 2023, FERC Order 1920, and the SPEED Act, all within the past few years have demonstrated examples of growing emphasis on expanding and enabling energy production and infrastructure development.

[61] Source: One Big Beautiful Bill Act, Pub. L. No. 119-21, July 4, 2025; Clean Energy States Alliance, "OBBBA Tax Credits Summary Diagram," 2025. Wind and solar projects that began construction by July 4, 2026, generally have four years to be placed in service under the continuity safe harbor.

[62] Source: US EIA, "US Energy Facts Explained: Imports and Exports," accessed October 2026.

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