EQUITIES

Powering America: Investing in the Nation's Energy Future

Sung Cho
Portfolio Manager
Fundamental Equity

Ty York
Client Portfolio Manager
Fundamental Equity

Key Takeaways

1. **AI and Reshoring Driving Power Demand**
   Economic security considerations and data centers' power needs are driving surging demand for electricity in the US.
2. **A Diverse Electricity Mix**
   Renewable energy is growing in the mix of power generation sources, but we believe natural gas is best positioned to capture the majority of incremental capacity growth, while nuclear's impact will not be felt this decade in our view.
3. **Powering Portfolios with Potential Opportunities**
   We believe industry players that can cater to complex energy needs of data centers should stand to benefit, as well as direct plays on natural gas demand, and providers of specialty products and services to the energy sector.

Major economies are moving towards energy sources that are affordable, reliable and sustainable. At the same time, developed markets are reaching a power demand inflection point due to the rise of energy-intensive artificial intelligence (AI), the need for more AI-ready data center capacity, and the reshoring of manufacturing. A broader "electrification of everything" trend is also driving power consumption as fuel-based systems switch to electric-powered alternatives, like boilers being replaced with heat pumps and the growth of electric vehicles (EVs).

In a world of geopolitical tensions, we believe energy independence and resilience are at the center of efforts by nations to ensure overall economic security. The US has made significant strides in this regard. We observe faster adoption of renewable power generation across the country, as well as the build-out of energy efficient electrical infrastructure, re-thinking around traditional power generation methods and a drive to develop frontier technologies.

In this article, we look at potential long-term investment opportunities related to both power generation and the infrastructure needed to support it, including opportunities arising along energy generation value chains and short- and medium-term energy sources, notably renewables and natural gas.

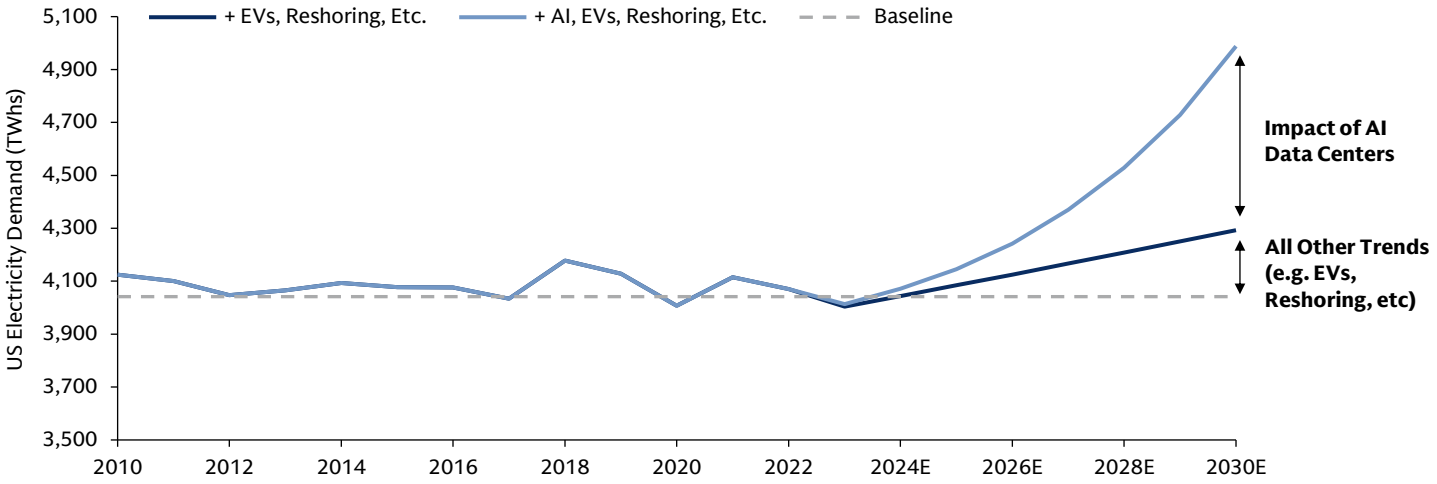
Economic Security and Soaring Power Demand

The timeless pursuit of resources is acquiring a new dimension. Access to energy has resurfaced as a key component of resource security, with vital characteristics—availability and reliability of supply. Post-pandemic and amid geopolitical tensions, considerations of independence and resilience are equally important to those of costs. National security agendas are driving economic reality and investment opportunities are emerging in sectors that have been dormant for decades.

With physical conflicts escalating around the world and increasing talk of trade wars, securing a reliable supply of critical resources has become a matter of national concern. To avoid the impact of potential supply disruptions and resulting price shocks, both the US government and corporates are moving to diversify their energy sources to mitigate dependence on any single one and ensure they have reliable and sufficient supply of electricity.

As of 2023, electricity consumption in the US was up only 10% from the turn of the century, having grown at 0.41% per year.[1] In the last decade, the growth was close to zero. While overall demand had been increasing, the lack of growth was due to efficiency gains, the move from energy intensive traditional to more efficient cloud-based data centers, innovation by and consolidation among hyperscalers. However, since 2020 efficiency gains decelerated[2] while new elements of demand emerged, including factories to produce previously offshored critical components (such as semiconductors and EV batteries) and AI-related data centers. The US electrical power demand is now expected to return to growth and rise at 2.4% CAGR through 2030.[3] AI-related demand is expected to comprise approximately two thirds of the incremental power demand in the country.[4]

Estimates Call for an Additional ~700 Terawatt-Hours of Power Demand by 2030 in the US



Source: International Energy Agency (IEA), EuroStat, and British Department for Business - Energy & Industrial Strategy. As of December 31, 2022. The economic and market forecasts presented herein are for informational purposes as of the date of this publication. There can be no assurance that the forecasts will be achieved. Please see additional disclosures at the end.

The US has the largest number of data centers in the world, followed by Germany with 10 times fewer.[5] Goldman Sachs Global Investment Research (GIR) forecasts a 15% compound annual growth rate (CAGR) in the data center power demand from 2023-2030, a 160% increase in data center power demand by this decade.[6]

[1] US Energy Information Administration, data and stats, accessed on January 6, 2025.
[2] Goldman Sachs Global Investment Research. "The push for the "Green" data center and investment implications." As of November 3, 2024.
[3] Goldman Sachs Global Investment Research. "The push for the "Green" data center and investment implications." As of November 3, 2024.
[4] Raymond James Energy: "Can the US generate enough electricity for the AI boom?" As of April 24, 2024.
[5] Statista. Leading Countries by Number of Data Centers. 5,381 in the US, 521 in Germany. Data as of March 2024. Accessed on January 6, 2025.
[6] Goldman Sachs Global Investment Research. AI data centers' global power surge and sustainability impact. As of April 2024. The economic and market forecasts presented herein are for informational purposes as of the date of this presentation. There can be no assurance that the forecasts will be achieved. Please see additional disclosures at the end of this presentation.

Data Centers' Evolving Energy Requirements

The ever-growing quantity of digital data requires an expansion and evolution of data centers to process and store it. Firstly, the number of data centers is rapidly increasing—demand for AI-ready data center capacity globally may more than triple between 2023 and 2030.[7] Even at that rate of expansion, tight supply is already apparent in the market, with new capacity due over the next two to three years already being leased out. Prices charged by co-location providers rose by 35% between 2020 and 2023.[8]

Secondly, data centers themselves and their energy requirements are evolving,[9] driven by the computing power required for anticipated AI workloads. Data centers are becoming larger in size—"traditional" data centers demand approximately 5-10 megawatts (MW), but large hyperscale data centers, which are increasingly common, have power demands of 100 MW or more.[10]

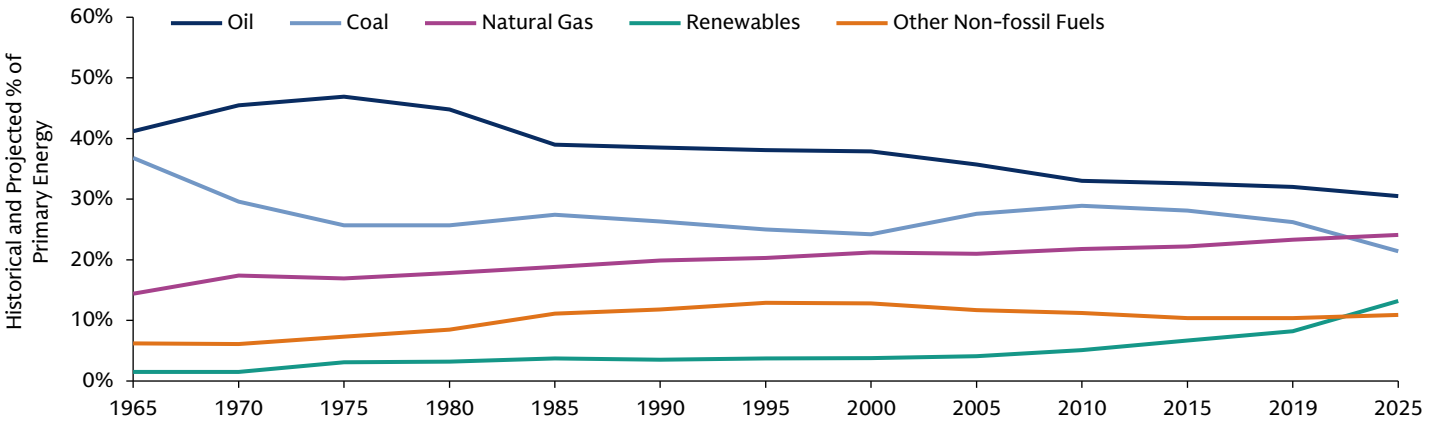
Enabling the computation power of vast AI models is only part of the high electricity demand of data centers. Critical equipment that is running continuously generates a lot of heat, which makes cooling and air flow management critical for the safety and efficiency of the IT operating environment. Cooling and air flow management accounts for most of the non-IT energy consumption and by some estimates it represents ~30% of total power consumption in a data center.[11]

Not only is the energy demand rising in volume, but its nature is changing, too. The pattern of power usage of AI-related data centers is different to other types of businesses or residential electricity demand. Continuity and reliability of electricity is mission-critical—data centers require 24/7, continuous uptime, and are highly sensitive to even a second of energy outage. Under disaster scenarios of most metropolitan areas, they rank after hospitals and key government institutions to maintain the supply of power to keep their generators running.

Who Will Provide the Power? Energy Sources and Beneficiaries of Rising Demand

The mix of power sources to produce electricity has been steadily changing. Natural gas and non-hydro renewables (such as wind and solar) have grown from 33% and 8% in 2015 to an estimated 42% and 20% in 2025, respectively, while nuclear and conventional hydro declined, and coal dropped dramatically (from 33% to an estimated 13%).[12]

Energy Sources Are Becoming Increasingly Diversified, With Renewables and Natural Gas Being the Primary Beneficiaries



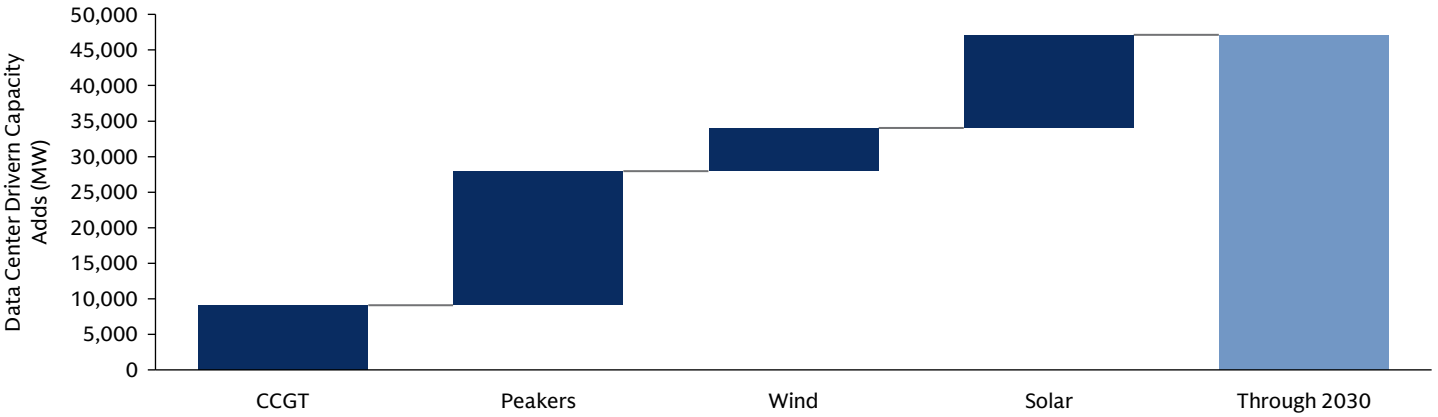
Source: Goldman Sachs Asset Management, BP Energy Outlook 2022, BP Statistical Review of World Energy. As of March 2022. The economic and market forecasts presented herein are for informational purposes as of the date of this publication. There can be no assurance that the forecasts will be achieved. Please see additional disclosures at the end.

[7] McKinsey. "AI power: Expanding data center capacity to meet growing demand." As of October 29, 2024.
[8] CBRE. "Global data center trends 2024: Limited power availability drives rental rate growth worldwide". As of June 24, 2024.
[9] McKinsey. "AI power: Expanding data center capacity to meet growing demand." As of October 29, 2024.
[10] International Energy Agency, "What the data center and AI boom could mean for the energy sector". As of October 18, 2024.
[11] Morgan Stanley. "Data Center Equipment. A Key Piece in the AI Puzzle." As of March 28, 2024. The economic and market forecasts presented herein are for informational purposes as of the date of this presentation. There can be no assurance that the forecasts will be achieved. Please see additional disclosures at the end of this presentation.
[12] Raymond James. "Energy: Can US generate enough electricity for the AI boom?" As of April 24, 2024.

With electricity demand soaring, a combination of power generation sources will be required to meet it. Approximately 50% of data centers' projected demand will need additional generation capacity of 47GW, comprising 60% natural gas, 25% solar and 15% wind.[13]

We Forecast Roughly 47 GWs of Incremental Capacity Related to Data Center Power Demand, With the Bulk Being Natural Gas Capacity

Overall Net Capacity Additions Through 2030 by Source, MW



Source: Goldman Sachs Global Investment Research. As of January 12, 2025. "GW" refers to Gigawatt. "MW" refers to Megawatt. "CCGT" refers to combined cycle gas turbine. The economic and market forecasts presented herein are for informational purposes as of the date of this publication. There can be no assurance that the forecasts will be achieved. Please see additional disclosures at the end.

Renewables

Hyperscalers have expressed commitment to minimizing emissions and many have set sustainability goals.[14] This may support growth in solar, onshore wind, battery storage as well as nuclear power in the longer-term.

However, data centers pursue around the clock clean power due to their downtime sensitivity.[15] Renewables alone cannot currently match their demand for an uninterrupted energy supply. Besides, the ramp-up of new capacity may be lengthy—the geographic footprint of wind and solar development involve complex grid interconnections, which tends to delay the permitting and execution process. Data centers are looking to augment renewable energy usage with battery storage systems and natural gas.

A new cohort of Power Purchasing Agreements (PPAs) – long-term contracts between an electricity generator and a utility, government or a company - will play an important role in renewables' uptake. So-called clean, 24/7 PPAs offer 100% green energy matching customers' power needs on an hourly basis. These PPAs are set to represent about 30% of data center power demand in 2028-2030.[16] However, energy producers behind clean PPAs must rely on diverse generation assets to build and manage a resilient supply portfolio, which "traditional" single-solution energy providers may have limited capacity to do, in our view.

In this context, we view vertically integrated Utilities and independent power producers (IPPs) as especially well positioned to benefit from the demand for reliable green power, the transition to a more complex, systemic approach to power supply, and hyperscalers' appetite for 24/7 clean PPAs. One of the largest energy generators in the US, a Florida-based utility with an unregulated renewables subsidiary, operates a large wind and solar portfolio with installed capacity of 69GW[17] as well as cutting-edge energy storage systems.

[13] Goldman Sachs Global Investment Research, "AI/data centers' global power surge: five drivers of upside/downside and the Reliability investment tailwind". As of January 12, 2025.
[14] Goldman Sachs Global Investment Research, "Virginia Data Center Trip: Reiterate Multi-Year Bullish Outlook for Power Demand and Capital Spending". As of June 27, 2024.
[15] McKinsey, How Hyperscalers Are Fueling the Race for 24/7 Clean Power. As of December 18, 2024.
[16] Goldman Sachs Global Investment Research, Virginia Data Center Trip: Reiterate Multi-Year Bullish Outlook for Power Demand and Capital Spending." As of June 27, 2024.
[17] Company investor presentation, June 2024. Data as of March 31, 2024. Any reference to a specific company or security does not constitute a recommendation to buy, sell, hold or directly invest in the company or its securities.

Such companies, with large land banks and large-scale renewable energy projects already queued to be connected to the grid, hold key positions in the power transmission as more renewable projects are onboarded across the nation.

Natural Gas

Natural gas will benefit significantly from the rising electricity demand and its changing nature, in our view. Natural gas generators are designed to provide continuous operation and are a good option for data centers to operate off-grid. It is most flexible to turn on/off among all energy sources and a key solution to the energy demand/supply imbalance in the short and medium term. Importantly, it is also an abundant domestic resource. With inflation-adjusted prices currently at their lowest in three decades, combined cycle natural gas is currently the lowest-cost power solution in the US that provides the required 24/7 reliability.[18] We believe this should stimulate demand and encourage increased production. The US natural gas demand is expected to grow at a 2.9% CAGR from 2024 to 2030.[19]

Natural gas is also important from an energy transition standpoint because it is technically transition-ready—hydrogen can be used in all natural gas turbines that produce electricity. Companies with longer term transition targets can make investments in natural gas with the understanding that from a science-based targets approach, they can still commit to emission reductions over longer periods assuming the potential scale-up of these technologies. Furthermore, gas has much smaller land footprint than renewables and therefore avoids permitting issues.

The primary beneficiaries are companies focused on exploration, development and production of natural gas resources, as well as owners and operators of gas pipelines. Their assets should benefit from further expansion and rising gas prices, as well as higher terminal valuations, which will make them more attractive investments. Assets located in the Northeast are particularly well placed, given proximity to a large portion of the data center build-out—Virginia with its "data center alley" in Loudon County is larger than the next five biggest markets in the US combined.[20]

An example of an upstream beneficiary that is highly levered to the expected growth for gas demand is the largest, low-cost producer of natural gas in the Appalachian basin in the Northeast. We believe the company may be positioned to capture a meaningful share of the capacity increase given its advantaged cost position and inventory. A local utility in Northern Virginia is a transmission-levered player at the forefront of this theme. The data center power demand in its service territory is forecast to increase by 109% by 2030.[21]

We see interesting potential investment opportunities among high-quality midstream companies that operate large-scale gas infrastructure in key geographies and provide logistics solutions such as field gathering, processing, mainline long-haul expansions, greenfield long-haul additions, and storage and marketing services.

Nuclear

The world is currently in the innings of a nuclear revival: by 2025, global nuclear generation is forecast to exceed its previous record set in 2021.[22] The US is the world's largest producer of nuclear power, accounting for about 30% of worldwide generation of nuclear electricity, with the country's nuclear reactors producing 18% of total electrical output as of 2022.[23] Nuclear energy has bipartisan support, and a new bill aimed at growing the country's nuclear capabilities was signed into law in July 2024.[24] It supports such developments as re-starting mothballed plants, delaying decommission and willingness to consider new large-scale nuclear reactors by some utilities. With hyperscalers embracing nuclear opportunities, some power companies already operating nuclear capacity are prime beneficiaries of their interest.

[18] Goldman Sachs Global Investment Research. "The push for the "Green" data center and investment implications". As of November 3, 2024. This statement assumes that carbon capture is not required. Per current rules set by the US Environmental Protection Agency (EPA), natural gas power plants running at a greater than 40% capacity factor will be required to deploy carbon capture technology to capture 90% of carbon dioxide from 2032. This has been challenged in courts. It remains to be seen if the new Republican administration makes any changes to this policy.
[19] Wells Fargo. "AI power surge – Quantifying upside for renewables and natural gas demand." As of March 21, 2024.
[20] Goldman Sachs Global Investment Research. "Generational growth – AI, data centers and the coming US power demand surge. As April 28, 2024.
[21] Goldman Sachs Global Investment Research,"Generational Growth: AI, data centers and the coming US power demand surge", April 28, 2024
[22] International Energy Agency, Electricity 2024 - Analysis and forecast to 2026. As of January 2024.
[23] World Nuclear Association. "Nuclear Power in the USA." As of August 2024.
[24] The US Department of Energy. Announcement for The Advanced Nuclear for Clean Energy (ADVANCE) Act. As of July 2024.

Frontier technologies are behind small nuclear reactors (SMRs), which may represent a longer-term solution for data centers. SMRs are being designed for modular manufacturing, portability and scalable deployment onsite.[25] Currently, there are only two countries operating SMRs, China and Russia[26], but projects to develop them in the US are abound, with hyperscalers backing many of them.

While promising in the long-term, project lead times, potentially high costs and execution risks mean it is unlikely that nuclear power generation capacity will be impactful until the 2030s.[27]

Some existing players may benefit sooner by combining natural gas and nuclear capabilities and adding to their portfolio of renewable resources. Thus, early January 2025 brought an announcement of a landmark acquisition by the biggest US nuclear plant operator of a privately held natural gas and geothermal company. The combined company will become the largest US independent power provider[28] and stands to benefit from the rising all-in power demand.

Who Will Provide Support? Grid Infrastructure, Power Generation Equipment and Electrical Components

We believe the US infrastructure needs updating to accommodate the unprecedented growth of power demand. Transmission is one of the major bottlenecks for the clean energy transition and the addition of data centers can exacerbate this. More than $700 billion of grid investment is expected in the US through 2030.[29] Construction work for power plant new builds and transmission/distribution systems is handled by grid services providers such as a company based in Houston, Texas— in our view one of the most attractive datacenter hubs in the country. The company engages in the provision of specialty contracting services, offering infrastructure solutions to the electric power, oil and gas, and communication industries. It also focuses on the design, installation, upgrade, repair, and maintenance of infrastructure within each of the industries it serves.

Furthermore, the development of large gas-fired power plants requires turbines and other components, as well as services, from diversified power technology providers. A company headquartered in Cambridge, Massachusetts, is a leading player in this market; its installed base of turbines (gas, steam, nuclear, wind and hydro) helps generate ~30% of the world's electricity.

Some interesting niche players can be found among technology and service providers to power infrastructure. One example is a producer of servers utilizing fuel cells—a technology that can convert any gas directly to electricity onsite without the need for combustion. Fuel cells have lower or zero emissions compared to combustion engines.[30] In successful deployment for over a decade, this technology found itself uniquely positioned to cater to data centers' power needs—it operates 24/7, can be deployed quickly, is scalable and can run off the existing natural gas grid.

Among electrical components players, a multinational Ohio-based power management company is a leader in electrical distribution and backup power equipment. Starting with the incoming power that comes from a utility and goes to the substation, to a data center campus and down to the rack, it provides transformers, switchboards, panelboards and voltage assembly products, as well as services for power distribution equipment.

Strong Power Demand Generating Opportunities Across Public Equities

Underinvestment over the last decade has led to compelling opportunities across multiple sectors of public equities addressing power demand and aging grid infrastructure. We believe that while certain parts of the energy ecosystem may be more attractive than others at various times, it will take several types of energy sources rather than one to meet incredibly strong demand. In our view, we are still in the

[25] The Nuclear Energy Agency (NEA) SMR Dashboard, Second Edition. As of February 2024.
[26] International Energy Forum (IEF) "Nuclear Small Modular Reactors (SMRs): Key Considerations for Deployment". As of May 2024.
[27] Goldman Sachs Global Investment Research, "The push for the "Green" data center and investment implications". As of November 3, 2024. The economic and market forecasts presented herein are for informational purposes as of the date of this publication. There can be no assurance that the forecasts will be achieved. Please see additional disclosures at the end.
[28] Reuters. "Constellation Energy to Buy Calpine in Blockbuster $16.4 billion US Power Deal." As of January 10, 2025.
[29] Goldman Sachs Global Investment Research. "Americas Utilities: Power: Energy, Clean Tech & Utilities Conference — Key Takeaways on Power/Utilities." January 8, 2025.
[30] The US Department of Energy. "Fuel Cells." As of January 21, 2025.

early stages of strong, durable power demand due to structural tailwinds from AI to supply chain reshoring. Moreover, many of these sectors account for small portions of market-cap weighted benchmarks, making active management critical when trying to gain access to these compelling opportunities, in our view.

GLOSSARY

An AI-ready data center is one where the amount of computing power the center has can adequately support the high-density, power-intensive AI workload.

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