FINANCIAL MARKET SNAPSHOT

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Energizing the Future: The Impact of AI and Data Centers on Global Energy Demand

In this month's edition of the Market Snapshot, we've taken a brief look at how artificial intelligence (AI) and data center growth is expected to impact energy demand in the US and Europe.

AI continues to be ubiquitous in the news and top-of-mind with investors, as headlines often highlight its transformative impact across a multitude of industries. From advancements in healthcare and finance to breakthroughs in autonomous vehicles and natural language processing, AI's influence is expected to be pervasive and continually growing. This widespread coverage underscores the technology's significance and the rapid pace at which it is evolving. Data centers – which power artificial-intelligence technology – are set to give electric utilities the biggest demand jump in a generation. Along with data centers to run AI computing, America's grid is increasingly being challenged by the reshoring of factories and the electrification of everything from vehicles to heat pumps, keeping energy demand robust.

Data centers are already a major consumer of electricity, accounting for more than 1% of global electricity use. As AI technologies continue to advance and data centers expand to support this growth, the demand for energy is expected to rise significantly over the next decade. The increased power needs of AI data centers stem from the substantial computational resources needed to train and run complex AI models. According to recent studies, training these models is extremely energy intensive. For instance, a single ChatGPT query consumes approximately ten times more energy than a standard Google search query. This high energy usage is driven by the need for continuous and stable power to run thousands of high-performance servers, each consuming significant amounts of electricity. The demand for power is further amplified by the necessity for advanced cooling systems to prevent overheating, as these servers generate considerable heat during operation.

Additionally, AI workloads often involve processing vast amounts of data, needing continuous and intensive computational effort. This results in higher energy consumption compared to traditional data centers. As AI applications become more prevalent and sophisticated, the energy requirements of these data centers are expected to grow, needing innovative solutions to manage and optimize power usage effectively. According to Boston Consulting Group, electricity consumption at US data centers alone is poised to triple from 2022 levels, to as much as 390 terawatt hours by the end of the decade. They forecast total data center electricity usage will account for about 7.5% of the nation's projected total demand by 2030.

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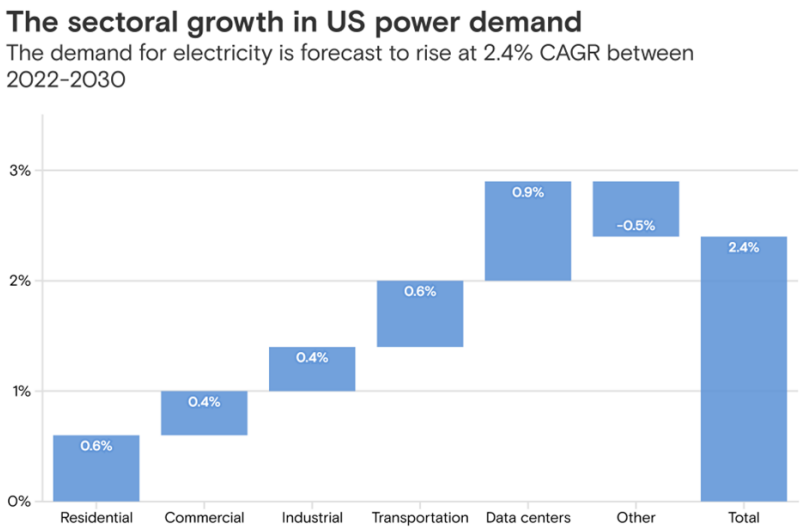
Similarly, analysts at Wells Fargo recently forecast that U.S. electricity demand is expected to grow as much as 20% by 2030, with AI data centers alone potentially adding about 323 terawatt hours of electricity demand by the beginning of the next decade. For comparison, New York City's annual electricity consumption is about 50 terawatt hours. A recent report from Goldman Sachs Research found that AI-ready data center racks – equipped with resource-hungry GPUs – are likely to require 40-60kW per rack, compared to the 10-14kW needed for traditional data center racks. This means that overall consumption of data centers across the US is likely to reach 35GW by 2030, up from 17GW in 2022 according to their forecast.

In their report, Goldman Sachs found that over the last decade, US power demand growth has been roughly zero, despite increases in population and economic activity. Technological advancements have played a significant role in improving efficiency and saving energy. For example, LED lights have driven lower power use, consuming at least 75% less energy and lasting up to 25 times longer than incandescent bulbs. Another example is the adoption of smart thermostats, which learn users' schedules and automatically adjust heating and cooling settings, optimizing energy use, and enhancing comfort. However, some analysts are questioning the long-term impact of these technological improvements, especially with the expected rapid adoption of AI into daily life.

As the chart below shows, between 2022 and 2030, Goldman Sachs projects that demand for power will rise at a compound annual growth rate of about 2.4% – with around 0.9 percent points of that figure tied to data center usage.



Source: Goldman Sach Research and the U.S. Energy Information Administration

That kind of spike in power demand hasn't been seen in the US since the early years of this century. While incremental power demand will be stoked partly by electrification and industrial reshoring, the primary driver is forecast to be AI. Like Boston Consulting Group, Goldman Sachs expects data centers will assume about 8% of total U.S. electricity consumption by 2030. They further forecast that US utilities will need to invest around $50 billion in new generation capacity just to support data centers alone. In addition, their analysts expect incremental data center power consumption in the US will drive around 3.3 billion cubic feet per day of new natural gas demand by 2030. For decades, US electricity demand rose by less than 1% annually. But utilities and grid operators have doubled their annual forecasts for the next five years to about 1.5%, according to Grid Strategies, a consulting firm that based its analysis on regulatory filings. That's the highest since the 1990s, before the US stepped up efforts to make homes and businesses more energy efficient.

It's not just the explosion in data centers that has power companies scrambling to revise their projections. The Biden administration's initiative to establish new factories for electric cars, batteries, and semiconductors is further straining the nation's already stressed electricity grid. More notably, the average age of the US electric utility infrastructure is approaching 40 years. This aging system is essentially a patchwork of regional networks, often lacking sufficient transmission lines in key areas, complicating the integration of new power sources from wind and solar farms.

Recent commentary from state government agencies and major U.S. utility operators highlights the increasing energy demand driven by data centers:

- Southern Co: Serving around 9 million customers in the Southern U.S., Southern Co expects electricity sales growth of 1-2% annually this year and next, increasing to 6% annually from 2025 to 2028, largely due to data center expansion.

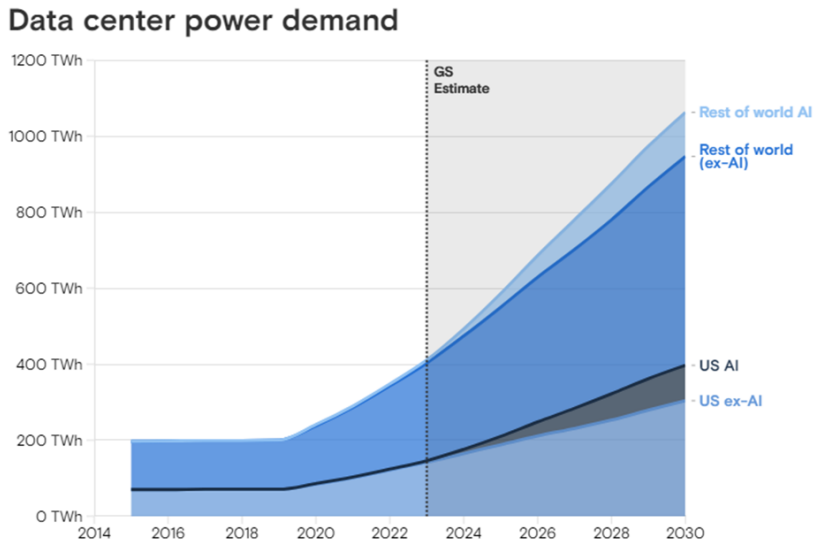
- Duke Energy: Operating in six Southeastern states, Duke Energy has seen significant demand growth due to data centers, factories, and electric vehicles (EVs). The company plans to seek regulatory approval to build more gas-fired and solar power projects by the early 2030s but warns that if demand growth exceeds expectations, there could be delays in meeting customer needs.

- Texas (ERCOT): The Electric Reliability Council of Texas (ERCOT) forecasts that by 2030, peak day demand could reach 152 gigawatts, nearly double the current capacity. Data centers and crypto miners are major contributors to this demand. However, data centers lack the flexibility to reduce consumption during high demand periods, unlike Bitcoin miners. Additionally, Texas faces grid strain due to population growth, electrification of oil and gas operations, and hydrogen production plans. There's a significant risk of power emergencies and rolling blackouts, especially during extreme weather and times when renewable energy supply is low, indicating the need for new power generation capacity.

European Energy Demand

Other parts of the world are also seeing big increases in power demand. China's electricity need is forecast to grow about 6% this year, driven by the manufacturing of things like EVs and solar equipment; in India it's set to almost double in the decade through to 2032. And London's aging electricity grid is also struggling to add more data centers. In fact, the International Energy Agency (IEA) forecasts that global data center electricity demand will more than double from 2022 to 2026, with AI playing a significant role in that increase. According to their report, AI is expected to represent about 19% of data center power demand by 2028.

For years, data centers displayed a remarkably stable appetite for power, even as their workloads mounted. Now, as the pace of efficiencies in electricity use appears to have slowed and the AI revolution gathers momentum, Goldman Sachs Research estimates that data center power demand will grow 160% by 2030. Goldman estimates that at present, data centers worldwide consume 1%-2% of overall power, but this ratio will likely double, rising to 3%-4% by the end of the decade.



Source: Goldman Sachs Research

Between 2023 and 2033, thanks to the expansion of data centers, Europe's power demand could grow by 40% and perhaps even 50%, according to Goldman Sachs Research. Today, around 15% of the world's data centers are in Europe. By 2030, the power needs of these data centers will match the current total consumption of Portugal, Greece, and the Netherlands combined.

Perhaps more notably, Europe has the oldest power grid in the world, so keeping new data centers electrified will require more investment. Their analysts expect nearly €800 billion ($870 billion) in spending on transmission and distribution will be required over the coming decade, as well as nearly €850 billion in investment on solar, onshore wind, and offshore wind energy.

Innovation Could be the Offset

While forecasts predict a significant rise in energy consumption by data centers through 2030, it's important to remember that human ingenuity often leads to unexpected advancements. Historically, similar concerns have been mitigated by breakthroughs in technology and efficiency. For example, in the early 2000s, there were fears about the rapid growth of internet traffic overwhelming infrastructure. However, innovations in fiber optics and data compression technologies allowed the internet to scale efficiently.

Similarly, ongoing advancements in renewable energy, cooling technologies, and AI-driven optimizations are likely to enhance the energy efficiency of data centers. Perhaps ironically, AI itself may find some alternative solutions to alleviate this problem, such as optimizing energy use in real-time or developing new, more efficient algorithms.

Companies are already investing heavily in green energy solutions and more efficient hardware. This trend suggests that the projected energy consumption might be overestimated, as future innovations could significantly reduce both the demand forecast and environmental impact. While the challenge ahead is significant, history has taught us that human creativity and problem-solving have consistently turned potential crises into opportunities for growth and improvement – and might not be all that different!

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