*Published in **Institutional Investing In Infrastructure (i3)**, an **IREI** publication*

Access to power

As growing data center demand competes with outdated power grids, investment professionals are navigating challenges and finding opportunities

by Kali Persall

In sprawling, windowless warehouses across the world, armies of servers hum like digital heartbeats. Rows of memory chips, snaking multicolored cables, winding circuits and rapidly spinning fans communicate ceaselessly to process exponential amounts of data in real time, powering everything from cloud storage to artificial intelligence (AI) systems. These concrete fortresses are at the backbone of global connectivity, and their prevalence is multiplying.

But not without a cost. Data centers are one of the fastest-growing industries worldwide. They have become as commonplace as grocery stores in places such as Northern Virginia, Arizona and Nevada, consuming as much electricity as a small town. And this is only set to increase due to the ongoing institutionalization of the data center segment and its strong industry fundamentals.

According to the *2024 CBRE Global Data Center Investor Intentions Survey* released in June, 92 percent of respondents are allocating more than $100 million to the data center sector, and 44 percent are allocating more than $500 million, up from 85 percent and 32 percent, respectively, in 2023.

As important as this buildout is for connectivity, it also has tangible implications, particularly when it comes to the uptick in AI usage. For example, a single query to AI uses 10 times the electricity of a traditional Google search, according to a May white paper from the Electric Power Research Institute (EPRI). And OpenAI's ChatGPT uses 500 milliliters of water for every five to 50 prompts or questions — roughly the amount of water in a standard 16-ounce bottle, notes a researcher at the University of California, Riverside. Indeed, staggering amounts of energy and resources are being required to keep our digital ecosystem alive. As data centers continue to devour electricity at an unprecedented rate, questions are being raised about whether the world's outdated power grids can support the tech-driven future, and how data center stakeholders will overcome the associated challenges.

Grid constraints

Experts say aging infrastructure, rising demand and regulatory hurdles seem to be the biggest contributors to power grid constraints, which are hampering data center development.

A report released by the International Energy Agency (IEA) in October 2023 reveals the world must add or replace 80 million kilometers (nearly 50 million miles) of electrical grids by 2040, equal to all grids globally, to meet national climate targets and support energy security. According to the report, grids are failing to keep pace with the rapid growth of key clean-energy technologies such as solar, wind, electric cars and heat pumps.

Compounding the issue is the sharp rise in global electricity demand, which is expected to grow by an average of 3.4 percent annually through 2026, according to the IEA. And data centers' total electricity consumption could reach more than 1,000 terawatt-hours in 2026, up from 460 terawatt-hours in 2022. If the grid is not upgraded in tandem with their expansion, it can lead to overloads and blackouts during peak times, among other issues.

But expanding or a power grid, which consists of three main grid systems — the Eastern Interconnection, Western Interconnection and Texas' ERCOT — which are almost completely electrically isolated from each other.

"Much of the [U.S.] grid was built decades ago, with many transformers, transmission lines and other components now approaching or exceeding their intended lifespans," explains Jeffrey Kanne, president and CEO of National Real Estate Advisors. "The average age of much of this infrastructure is 40 to 50 years, which severely limits its ability to meet the demands of a modern, increasingly electrified economy."

Modernization also will require a significant amount of capital. In fact, the annual investment in grids, which

https://irei.com/publications/article/access-to-power-as-growing-data-center-demand-competes-with-outdated-power-grids-investment-professionals-are-navigating-challenges-and-finding-opportunities/

has remained broadly stagnant, needs to double to more than $600 billion a year by 2030, according to the IEA.

“We live with a power grid that was built for the previous century,” stresses Goncalo Bernardo, an investment partner at Palistar Capital. “So, even if we have enough power generation, the power can’t get from where it’s produced to where it’s needed.” He says the grid wasn’t built for a world where 1-gigawatt data centers are becoming commonplace. “The data center side of the equation has also become more complex, as data centers went from these predictable and somewhat stable consumption cloud compute loads to AI that can turn on and off in a second.”

Grid modernization is key. (As Bernardo puts it, “Not updating the electrical grid while we try to go away from fossil fuels is like giving everyone a Ferrari but not building roads for it to drive on.”) But the question is how to do it sustainably.

Although the shift to renewable energy may be a step in the right direction long term, for now it is only adding to the complexity. In its *2023 Global Forecast Study,* the U.S. Energy Information Administration (EIA) says it expects potential renewable-electricity generation to reach 14,430 terawatt-hours by 2028, an increase of almost 70 percent from 2022. Solar and wind are forecast to account for 96 percent of renewable power capacity additions by 2028.

Indeed, around 160 gigawatts of fossil fuel power generation capacity has been taken offline in the past 10 years, and there are no large-scale utility projects utilizing fossil fuels currently planned to start operating before 2026.

“Integrating renewable-energy sources is challenging, as grids must balance growing demand with decarbonization goals,” explains Michael Hochanadel, managing director and head of digital assets at Harrison Street. “The result is a grid struggling to expand and modernize quickly enough, slowing progress toward sustainable energy adoption and increasing reliance on fossil fuels to meet immediate needs.”

Decarbonization efforts will rely on utility providers switching from fossil fuels to renewable-energy sources, emphasizes Heather Fernstrom Border, co-founder and managing partner of Alliance Global Advisors, a consulting firm focused on developing strategic growth solutions for real asset investment managers. However, in many markets, a reliance on older, fossil fuel–using power plants persists. Many utility companies are struggling to meet demand pressures through renewables.

“Typical utilities are facing divestiture and early retirement of significant thermal assets such as gas, coal and nuclear,” explains Nic Bustamante, CTO at Corscale, Affinius Capital’s data center development affiliate that delivers some of the largest DC campuses. “Replacing these assets with renewables helps with decarbonization but does not increase supply. In fact, it typically significantly decreases supply while increasing costs. Utilities and regulators alike need to take a balanced approach to fuel and generation to continue adding to supply. In tandem, DC developers and operators need to be comfortable challenging utilities to allow them to participate in solutions.”

Ultimately, the consensus is the data center and power industries will need to come together to rethink the grid in the context of data center demand. In some cases, this could mean thinking independently of the grid altogether. Dr. Hua Fang, managing director of Black & Veatch Management Consulting, says some hyperscale data centers have begun either finding their own power by colocating with existing power plants or developing their own power sources by constructing or contracting for onsite power. But this puts stakeholders in a double bind. “The former will put more pressure on grid reliability by taking existing base load power resources off the grid, while the latter could offset decarbonization progress made in the power sector when the chosen onsite technology is natural gas,” explains Fang.

The U.S. market

As of March 2024, there were approximately 10,655 data centers globally, and more than half of them — 5,381 — were in the United States, reports EPRI. They are one of the most energy-intensive building types, consuming 10 to 50 times the energy per floor space of a typical commercial office building, the U.S. Department of Energy notes, and it has become

increasingly common to see new centers being built with capacities from 100 to 1,000 megawatts.

Between 2017 and 2021, electricity used by tech giants Meta, Amazon, Microsoft and Google more than doubled. This is putting strain on traditional data center clusters such as Northern Virginia, leading to transmission bottlenecks.

Michael Coleman, managing director of Wafra, an alternative investment manager focusing on strategic partnerships, real estate and real assets, has observed power constraints forcing customers and data center companies in North America to reevaluate how they approach siting and network design. “Demand signals from the hyperscale community have shifted from tens of megawatts to hundreds of megawatts at a single location, and the U.S. electric grid today is not designed to deliver that density of power to a handful of geographically bound markets,” says Coleman.

Coleman notes significant demand is elevated in key markets, with customers willing to pay generously for the ability to access the key hubs. “In 2018/2019, competition for tenants in Northern Virginia was fierce and pricing was tight,” he explains. “That paradigm has flipped, and today that same capacity can be leased for at least two times the rate, if not higher.”

Today, Northern Virginia is the largest data center market in the world, with nearly 300 facilities. But due to saturation levels, data center operators are being forced to look to outlying submarkets or seek innovative ways to work around the demand crunch.

National Real Estate Advisors knows something of this. Data centers are a cornerstone of the firm’s real estate and infrastructure strategy, and the firm’s National Data Center Fund (NDCF) provides institutional access to Sabey Data Centers, one of the largest privately owned data center operators globally. Kanne admits power transmission challenges delayed the delivery of one of the firm’s buildings in Ashburn, Va. Although substantial completion was originally slated for mid-2024, power delivery for this building was pushed back to mid-2026 National decided to accelerate development in Austin, where power availability was more favorable. The firm secured a site there within six months of initiating the search, and the first phase of the fully pre-leased campus was completed in under 36 months, from land acquisition to delivery.

Sites that offer a balance of proximity to key regions, growing infrastructure and favorable conditions for scalable data center development make them prime spots for future investment, according to Hochanadel. He believes Reno and Northern Indiana stand out as emerging markets due to their power availability, favorable climate and connectivity. Other markets on Harrison Street’s radar include New Albany, Ohio; Nashville, Tenn.; Charlotte, N.C.; Salt Lake City, Utah; and Louisville, Ky. A number of large-scale developments also have been announced in Idaho, Montana, North Dakota and Minnesota. Experts say the Pacific Northwest, with its abundance of hydroelectric power, also is helping hyperscale tenants lower operational costs while aligning their operations with sustainability targets.

While this may sound promising, entering a new data center market poses its own set of challenges. For one, these markets typically are “underserved with infrastructure,” points out Bustamante. Even if large-scale power transmission lines are nearby, everything else likely isn’t, he says, including human talent. Challenges such as these can hinder development and operations, leading to miscalculated delivery schedules, delays and major cost overruns.

Bustamante notes in the past it was common for substation, transmission and power capacity to take three to four years to completely deliver. Bustamante is seeing that number pushed to five years, and there is active discussion about seven years.

Looking to Asia and Europe

Other regions are taking steps to navigate the global energy conundrum, and the United States could potentially learn from their examples. Some countries have placed moratoriums on data center construction to help ease the burden on the grid. Other regions are embracing new technologies and innovations to assist with their decarbonization efforts.

Established markets such as Singapore, Beijing, Shanghai, Hong Kong, Sydney and Tokyo continue to grow their data center capacity despite challenges for

available land and power, according to the Cushman & Wakefield *2024 Global Data Center Market Comparison.*

Singapore, notably, has come to be regarded as one of the top data center hubs in Asia due to its significant market size, excellent fiber connectivity and availability of cloud services. With more than 1.4 gigawatts of data center capacity, the island country is home to more than 70 cloud, enterprise and colocation data centers, which host cloud platforms, digital services and higher-intensity workloads for AI, according to The Infocomm Media Development Authority (IMDA), a statutory board in the Singapore government focused on driving Singapore's digital transformation efforts.

But due to its relatively small physical size, Singapore's energy network has come under strain. In 2019, the city-state enacted a moratorium on new data center development to curb growth. This was lifted in 2022 and replaced with new guidelines, including stricter requirements for energy efficiency and a focus on innovative cooling technologies and renewable-energy sources.

Joachim Kehr, portfolio and regional manager, real estate securities, at CenterSquare Investment Management, likens the data center frenzy to a "gold rush." He has observed countries such as Malaysia benefiting from the moratorium in Singapore as demand spilled over to neighboring regions.

"When the moratorium in Singapore came into play, it stopped new supply of data centers in Singapore, but it obviously didn't stop any of the demand continuing to grow," he notes. "So, a lot of the companies that were looking for data center demand in Singapore had to look elsewhere."

Actis is developing a data center in Johor Bahru, a city in Malaysia, through its Asia data center platform Epoch Digital. Thomas Liu, head of greater China and Asia data center, real estate at Actis, says the need for sufficient space is driving data center players to nascent markets such as Johor and Navi Mumbai in India. Liu also believes cities such as Tokyo, Osaka, Seoul, Taipei and Jakarta will continue to be hot spots in Asia.

When it comes to the European market, Camille Mueller, managing director of Cube Infrastructure Managers, says power constraints have been a significant challenge in high-demand areas such as the FLAP-D markets (Frankfurt, London, Amsterdam, Paris and Dublin).

Indeed, Ireland's Central Statistics Office released data showing power consumption from data centers increased by 31 percent in the country in 2022, accounting for 18 percent of all electricity used in Ireland. Thus, the same year, Irish electric grid operator EirGrid imposed a ban on new construction of data centers in Dublin.

Cube recently invested in operators in Frankfurt (Firstcolo), Sweden and Finland (GleSYS). Frankfurt, in particular, has come to be regarded as Germany's top data center market and is one of Europe's largest data center hubs. Although the city has not yet imposed a formal moratorium on data center development, Mueller says recent builds of hyperscalers and colocation providers in Frankfurt have been expanded to the outskirts of the city, where they can benefit from the adjacency to the internet exchange interconnection despite the power constraint.

Mueller believes FLAP-D areas will remain highly attractive markets for data center investment due to their strategic positions. Similar to the spillover effect taking place in Asia Pacific, Cube also expects to see the emergence of a number of European secondary data centers markets, such as Marseille and Lisbon, arising from the FLAP-D gradual saturation.

Building the data centers of the future

As data center demand continues to push the limits of the world's energy grids, it has become a priority of many to make the facilities themselves more sustainable and efficient.

Some, such as Harrison Street's Hochanadel, believe power conservation efforts reside with the tenant rather than the developer or operator, because the amount of power these facilities draw is based upon the applications the servers are running. Others, such as Timothy Lin, partner and co-founder of The Digital Infrastructure Collective (Asia) and former head of

data center consulting for Asia Pacific at CBRE, believe the pressure is on for data center operators to help major hyperscale cloud service providers — their biggest customers — meet ambitious sustainability commitments.

The practice of building sustainability into the facility's architecture is also on the rise, with innovative cooling methods becoming more widespread. Graphics processing units (GPUs) and high-density racks supporting AI workloads consume more power than previous technology, which, in turn, generates more heat. Liquid cooling technology is growing in popularity, as it consumes about 10 percent less energy than traditional air cooling, according to Enconnex, a data center and IT infrastructure products provider, and can help drive down power usage effectiveness (PUE), a key metric to assessing the overall efficiency of data centers. (The lower the PUE value, the higher the efficiency of the facility.)

Industry players also are taking action within their strategies and investments. Brian Betel, head of direct asset transactions at ActivumSG, a private equity investment manager headquartered in Germany, highlights innovative cross-energy heating agreements through the colocation of data centers with other sites that have high heating power demands. "There have been some examples in northern Europe where they set up data centers nearby to beer breweries that purchase the excess heat produced by the data center, substantially reducing power requirements for cooling technology, as the operator doesn't need to cool the heat themselves," he explains. "There is also a possibility to apply this technology by colocating sites with other developments with high-energy needs such as housing and infrastructure."

Companies such as National Real Estate Advisors are employing behind-the-meter power solutions — energy that is generated and consumed on-site rather than drawn from the grid. The firm is actively exploring solar, wind and biofuels as viable sources of behind-the-meter power at one of NDCF's expansion campuses. These renewable sources can either replace or supplement grid power, helping to mitigate the risks of grid shortages while supporting sustainability goals.

Governments, too, which have increasingly come to recognize the essential role data centers play in their broader economic development strategy, will likely have a hand in decarbonizing the industry. Singapore's government recently launched a Green Data Centre Roadmap that aims to provide at least 300 megawatts of additional capacity in the near term to build out sustainable data centers in the country. And in September 2023, the German Parliament passed the Energy Efficiency Act (EnEfG) to reduce overall energy and fossil energy consumption in the data center space.

On a more local level, despite the huge energy burden AI is placing on the grid, AI adoption itself may help solve some of the efficiency challenges of data centers. "Yes, AI requires immense energy, but it also has the power to drive energy efficiency," says Jenny Gerson, senior director of sustainability at DataBank, an IT service management company that offers colocation, cloud and managed services to enterprises. "Since electricity is the biggest operational cost for data centers, as an industry, we have every incentive to lower our power usage. Already, we're seeing experimentations in using AI for tasks like smart facility control, load prediction and demand response. As we reach AI maturity, we'll see data center operators and power providers take advantage of AI to drive energy costs down."

At the end of the day, we are just beginning to tap into the potential of data centers, and it's important to remember this process will probably involve some growing pains. As professionals balance competing objectives, balance will be key.

Lin encapsulates this notion well: "Data centers lie at the heart of two major trends: digitalization and sustainability," he says. "While data centers provide the critical infrastructure for a digital world, they are also significant consumers of energy, seemingly at odds with action against climate change. As we enter the AI revolution, energy-guzzling data centers will become an easy 'scapegoat.'

"However, we also need to look beyond the 'data center footprint' to focus on the 'internet handprint' — the beneficial, positive effects brought about by the digital transformation," he reminds. "Our real challenge is in integrating and actualizing both

digitalization and sustainability goals, and there is real danger in prioritizing or minimizing one over the other."

Kali Persall is editor of *Institutional Investing in Infrastructure (i3).*