KPMG

From crisis to opportunity:

How collaboration fuels AI and a sustainable energy revolution

2024 Data Center Survey

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Contents

01 Introduction

The exponential growth of artificial intelligence (AI) is not merely a hallmark of technological advancement but also a significant contributor to increased energy demand, particularly for powering data centers. These facilities, which house the computing systems and components necessary for AI's voracious and growing data processing and storage needs, are rapidly becoming more prevalent and expansive to accommodate the massive surge in computational requirements. This dynamic is placing a tremendous strain on power grids as well as local community resources.

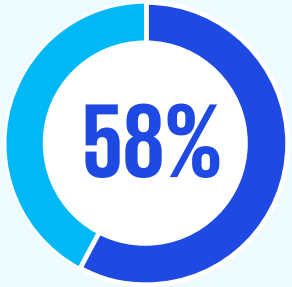
The increase in electricity usage has created unanticipated challenges for hyperscalers, regional data center owners, utility companies, and communities. Not only is AI-related demand doubling every six months,[1] there is also no end in sight.

Data centers are caught between the need to get energy wherever they can find it and investor expectations to drive decarbonization. Utilities, in addition to managing their own sustainability concerns, are wondering if data center load will materialize while also worrying about their generation and delivery capabilities. For their part, communities are often leery of hosting data centers, which consume resources but produce relatively few jobs.

And for every stakeholder, acknowledging and proactively addressing community concerns regarding land use, water consumption, and potential impact to the environment and property values is vital.

These linked yet unaligned constituencies can no longer operate in silos or pursue piecemeal fixes. Instead, they must work together to consider the needs of the entire data center energy ecosystem. The good news is that data center owners and utilities recognize the inherent value of partnership: The KPMG LLP 2024 Data Center Survey found that 88 percent are at least somewhat eager to collaborate, and most—58 percent—are very eager.

Openness for collaborative solutions between hyperscalers and utilities



58% of survey respondents are very eager to create collaborative solutions across the data center energy ecosystem.

Note: Sum of percentages may not add up to 100 due to rounding
Source: 2024 Data Center Survey

[1] Microsoft CEO Satya Nadella, AI Tour Keynote, October 21, 2024.

Given the vast acceleration of electricity usage, it is not a surprise that this strategic energy concern is a top priority at the federal level. In a recent report, a diverse cross-section of electricity and information technology stakeholders within the US Department of Energy outlined recommendations around three specific issues: energy efficiency and power dynamics, an operational flexibility framework, and more accurately projecting ongoing and future power needs.[2] Although energy efficiency and peak load management are necessary, as AI becomes more prevalent in everyday life, those tools won't be enough to solve this problem. Instead, the energy and data center industries must collaborate.

We've spent much of the past year attending multiple industry events and conducting workshops, share forums, and interviews around these topics with utility industry executives and data center owners. This report is informed by the concerns, challenges, issues, and approaches we've discussed with these constituencies, as well as the results of the survey we conducted in September.

The pressure is on. But by leveraging these and other innovative levers, and working together, stakeholders can contribute to an effective and environmentally friendly approach to meeting the burgeoning energy demands of data centers in the AI era. This effort is not only about mitigating challenges but also about seizing the opportunity to lead in the development of a future-ready energy infrastructure while engendering sustainable and efficient energy production, transmission, and usage.

Key improvement strategies identified by survey respondents

Community support

Adopting an environmental conservation plan to protect local ecosystems and resources	75%
Energy efficiency initiatives to reduce local energy consumption	73%
Supporting community infrastructure improvements	68%

Site selection process

Securing strategic partnerships between operators and utilities	78%
Co-locating data centers with energy generation sites	77%
Enhancing data & analytics (i.e., better site scoring algorithms)	77%

[2] Secretary of Energy Advisory Board, Recommendations on Powering Artificial Intelligence and Data Center Infrastructure, US Department of Energy, July 30, 2024

02 The supply and demand gap

Simply training an older generative AI large language model like GPT-3 requires nearly 1,300 megawatt hours (MWh) of electricity—the same amount that could power about 130 US homes. That doesn't include usage, and newer models are even more powerful and energy hungry. The need for electricity is urgent: The power necessary to sustain AI's ongoing development and rising demand is doubling every 100 days.[3]

Estimates suggest that data center power demand in the US could total upwards of 200–400 terawatt hours (TWh) by 2030.[4] The speed and scope of this growth, largely unplanned by the energy sector, will require about 50 gigawatts (GW) of new generation capacity and investments of approximately $60 billion for generation and $15 billion for transmission through 2030 alone.[5]

In a recent report, the Federal Energy Regulatory Commission estimated total data center capacity in the US will be 21GW in 2024 and 35GW by 2030.[6] In terms of demand, 76 percent of both data center owners and utilities are forecasting usage growth of at least 10 percent every year for 10 years, according to the KPMG Data Center Survey. However, the KPMG survey also found that nearly 60 percent of all respondents do not believe the current pace of energy deployment is sufficient to meet the demand.

[3] Eleni Kemene, Bart Valkhof, and Thapelo Tladi, "AI and energy: Will AI help reduce emissions or increase demand? Here's what to know," World Economic Forum, July 22, 2024
[4] "Net Zero 2050: Sensitivity analysis and updated scenarios," LCRI Low Carbon Resources Initiative, EMRI and GTI Energy, December 18, 2024
[5] Aneesh Prabhu and Sudeep Kesh, "Data Centers: Surging demand will benefit and test the U.S. power sector," S&P Global, October 22, 2024
[6] Staff, 2024 Summer energy market and electric reliability assessment, Federal Energy Regulatory Commission, May 23, 2024

Challenges around data center development

Current landscape

57% Disagree or somewhat disagree that the current pace of energy deployment in the US is sufficient to meet the added energy demand due to growth in AI

Future landscape

46% Believe electricity usage in data centers will increase by 10–14% annually over the next 10 years

30% Believe electricity usage in data centers will increase by 15% or more annually over the next 10 years

Energy technologies to be used over the next 3–5 years

Plan to increase use of solar + storage solutions	84%
Plan to increase use of wind + storage	63%
Plan to increase use of hydroelectric	54%
Plan to increase use of natural gas + CCUS	52%
Plan to decrease use of unabated coal—or not use at all	75%

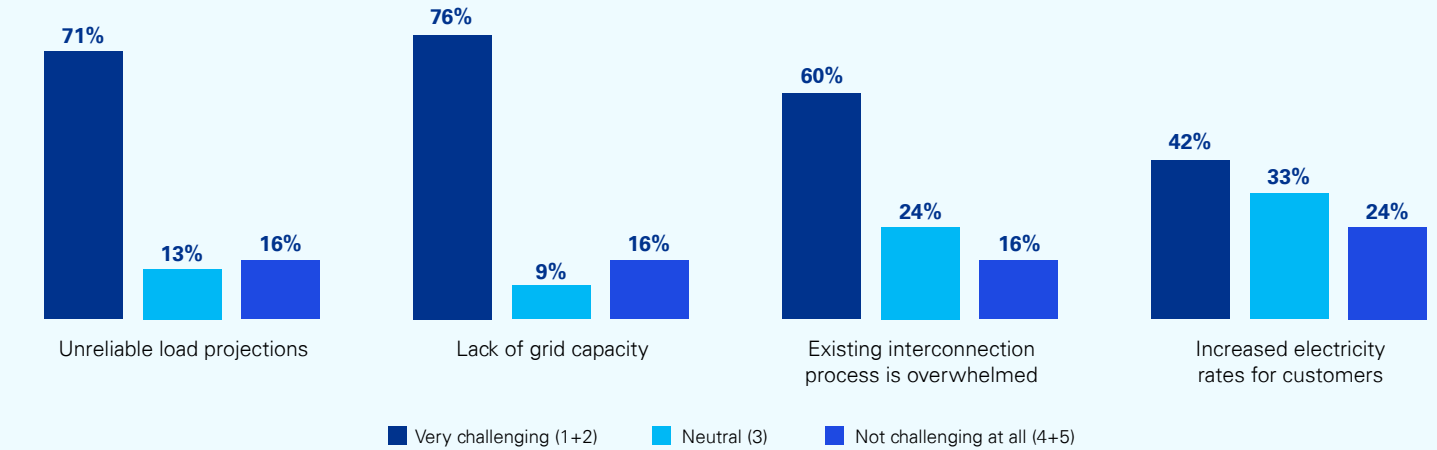
Note: Sum of percentages may not add up to 100 due to rounding
Source: 2024 Data Center Survey

03 Poor transparency contributes to collaboration challenges

A lack of transparency has created issues on both sides. In addition to their increasing desperation over demand, data center owners are confronting the task of scaling their operations sustainably. Utilities do not have clarity or certainty of the true demand for power generation and grid infrastructure, leaving them considering when—or even whether to—invest in new capacity and transmission upgrades. As AI models grow in complexity, the imperative to adopt energy-efficient technologies and practices becomes even more critical. This includes innovations in cooling systems, server architecture, and overall facility design to optimize energy use without compromising on computational power or speed. The dilemma has reached a point in some regions where utilities are simply saying they cannot meet the current demand for power.

To solve the challenges around meeting increasing energy demand, the key players must develop integrated strategies that account for the entire data center energy ecosystem. This would entail deploying a range of levers to drive solutions— from enhancing energy efficiency to pursuing strategic collaboration and community investment initiatives.

Key challenges faced by utilities to connect data centers to the grid identified by survey respondents



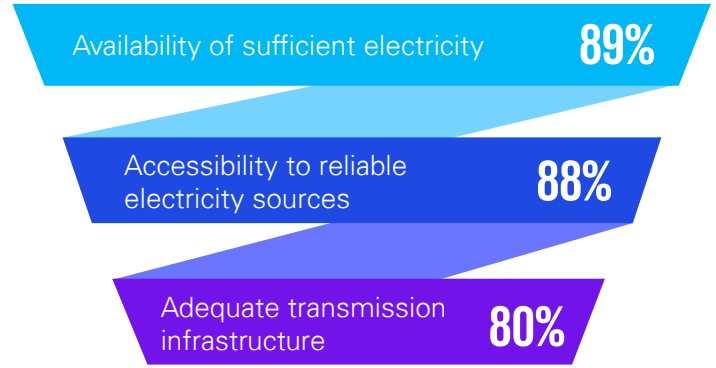
Note: Sum of percentages may not add up to 100 due to rounding off
Source: 2024 Data Center Survey

Data centers

Data centers have strict power requirements, including 24/7/365 uptime. This need for perpetual power places enormous pressure on the electrical grid, making it challenging for data centers to shift energy consumption to off-peak times, straining the grid and increasing the need for utilities to burn fossil-based fuels.[7] In many instances, the data center owners are circumventing the utilities—for example, by negotiating deals with independent power producers or old nuclear facilities, or planning to build their own small modular reactors (SMRs).

Future revenue is perhaps the key consideration. Some estimates suggest meeting global data center demand could require trillions of dollars in new energy generation resources[8]—and that's as much a problem for the data center owners as for the utilities. From a data center owner's perspective, not being able to meet capacity commitments will fundamentally impact the overall business, including share price. Secondarily, by working directly with utilities, data center owners can get help meeting their sustainability requirements while supporting a reliable grid for the entire community.

Factors influencing optimal site selection identified by survey respondents



[7] Tyler Willis, "Solving the data center electrical grid burden," Dynamic Ratings, July 24, 2024
[8] Paul Ciampoli, "Meeting global data center demand could cost more than $2 trillion in new generation resources," American Public Power Association, October 22, 2024

Utilities

Utilities are under pressure to modernize, decarbonize, and improve their ability to generate and supply power. If utilities can't meet the increased demand, then there is a strong likelihood data center owners will turn to on-site generation and alternative energy suppliers. This could result in the utilities missing out on the opportunity to partner with data center owners to improve aging infrastructure, grid reliability, and sustainability goals, thus affecting their ability to deliver sustainable power seamlessly to all customers in the future.

In many instances, utilities aren't making strategic decisions or investments for fear that data center owners might ultimately decide not to build in the region after all or, in a year or two, start generating energy through alternative means, such as renewables or nuclear through an SMR.

Consider, also, that expanding the grid takes time under the best of conditions. Lingering pandemic-driven supply chain issues for critical electrical equipment have increased timelines even further. For example, a decade ago it took around 18 months to acquire a gas turbine; today, delivery takes much longer.[9] Internal utility processes can be protracted, but external processes such as permitting, regulatory approvals, and supply chain constraints can take years, particularly for larger data centers that require more than 100 megawatts of electricity.[10] And, nuclear or renewable on-site generation, although ultimately more environmentally friendly and cost effective, is not an overnight solution either.[11]

Making things more complicated for utilities is the requirement to protect other ratepayers. The grid already needed upgrading even before the emergence of AI, and utilities need to invest in a way that keeps rate increases as low as possible. There's potential for good news here: Every gigawatt of power provided to a data center through an appropriately structured tariff may lower the current customers' utility bills. The bad news is that utilities are reluctant to invest in data center-related upgrades until hyperscalers agree to cover the cost and there is a mechanism in place to protect rate payers. But if utilities take advantage of this situation, think more strategically, and work more proactively with the hyperscale data center owners, then they can generate the revenue to pay for the necessary transmission infrastructure upgrades—a huge opportunity that few utilities are operationalizing.

Challenges around data center development

- 60% of all respondents say **access to the lowest cost electricity sources** is a high priority—which is relatively low compared to other considerations
- Electric producer/utility respondents (84%) are more likely than hyperscaler/developer respondents (53%) to prioritize **availability and affordability of land**
- Electric producer/utility respondents (80%) are more likely than hyperscaler/developer respondents (50%) to prioritize **ease of permitting/regulatory requirements**

Key challenges making project delivery more complex

Greater technical complexity of data centers **77%**

Increasing size and scale of data center projects **76%**

Supply chain issues were the **least significant challenge** **58%**

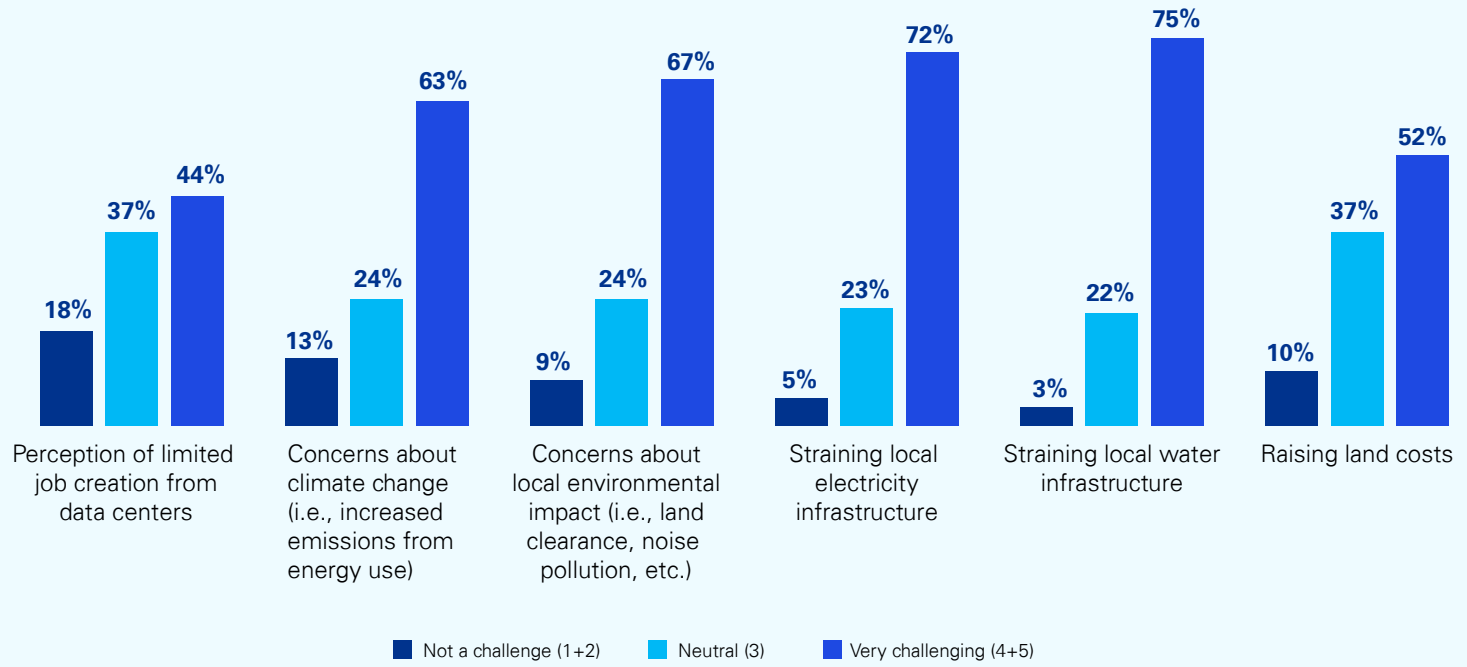
[9] Ethan Howland, "Gas-fired generation likely needed to maintain reliability for years: SPP, Black Hills," Utility Dive, November 13, 2024
[10] Josh Saul, "Data centers face seven-year wait for dominion power hookups," EUCI, August 29, 2024
[11] Peter Judge, "How to build when the power isn't there," Data Center Dynamics, September 15, 2023

Communities

Development plans for new power infrastructure often faces community opposition, particularly in relation to the sight of high-voltage lines, perceived real estate value and health implications, and the potential for outages and brownouts. When it comes to greenhouse gas emissions, fossil fuel-based infrastructure (gas-fired power plants and transmission lines) are more likely to face pushback, but even projects aimed at driving sustainability, such as solar and wind farms, face challenges, too.

The key is to benefit the community by laying out a long-term plan with strategic utility partners in the regions in which they plan to build data centers (which can be done under nondisclosure agreements). This allows utilities to make investment decisions with more certainty, supports a holistic vision for the energy grid, and helps create a regional development plan that is aligned with community interests.

Key barriers to community acceptance of data centers identified by survey respondents



Note: Sum of percentages may not add up to 100 due to rounding off
Source: 2024 Data Center Survey

04 Developing a collaborative framework for action

Data center connection requests are numerous—hundreds to thousands, depending on the location. Utilities, most of which have small teams handling these requests, have not experienced load growth on this scale since the broad adoption of air conditioning in the 1950s and 1960s. They are overwhelmed. In this environment, data centers are coming to the utilities on exceedingly short notice with connection requests on very aggressive time frames.

Utilities need data center owners to commit to a strategic alliance that allows utilities to invest to bring the necessary capacity online. Utilities need clarity and certainty around what the data center owners are looking to achieve long term so they can determine whether they can deliver within the agreed-upon timeline.

On the topic of clarity and certainty, data center owners should be more transparent and realistic about the development schedule and energy uptake needs. Similarly, they should be more forthcoming about the energy mix, the amount of power they plan to generate on-site versus what they need from the grid, and their sustainability requirements. They also need to surface any additional environmental development criteria from the community in which they're planning to build.

Too often, the data center owners and developers approach utilities with very limited information in their requests—for example, 1 gigawatt of power on a particular date and little more. This creates confusion around the actual timing of need. Is it 100 megawatts now, 300 megawatts six months later, and a gigawatt a year later? Will the data center start pulling power from an SMR halfway through the data center campus development?

The lack of firm, detailed commitments from data center owners leaves utilities hesitant to invest in grid upgrades because they have limited visibility into ongoing and future demand.

Top strategies for

Enhancing project delivery identified by survey respondents

1. Using new and innovative contract strategies, e.g., partnerships with contractors
2. Increasing internal project management capabilities/maturity
3. Improving design approaches, such as using building information modeling (BIM) to resolve barriers
4. Standardization of designs
5. Enhancing regulatory compliance processes and capabilities
6. Increased oversight and monitoring of projects

Note: Sum of percentages may not add up to 100 due to rounding off
Source: 2024 Data Center Survey

Big demand, big disconnects

There needs to be a clear recognition by utilities and data center owners of the need for a combined approach encompassing both on-site and grid-generated power.

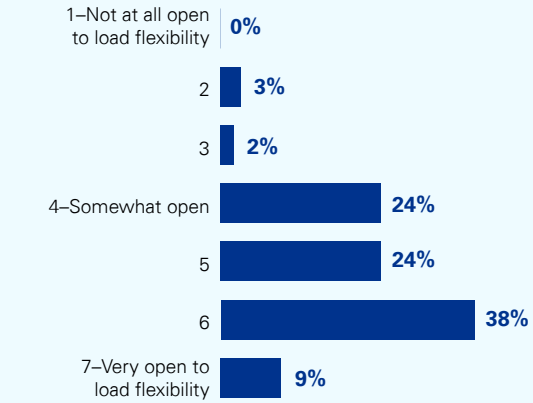
The challenge is creating a rate structure that benefits both parties. Some utilities are creating a tariff structure, but they are doing so in isolation. There is an opportunity via the tariff model for a win-win if utilities and data centers start to think creatively and collaboratively.

At its most rudimentary level, the tariff model says: *X* amount of energy demand requires *Y* equipment upgrades, so data center owners pay *Z* to enable utilities to address the grid. The tariff is essentially an extra charge imposed by the utility and paid by the data center owner to cover the cost of grid updates. The tariff is designed to keep data center-related infrastructure costs from being passed on to other ratepayers. It's a way to isolate the cost of grid upgrades (which may have already been needed due to aging infrastructure and reliability requirements). This approach helps ensure other ratepayers aren't forced to pay for data center-driven expenses; in many instances other ratepayers may actually benefit from the data center-driven updates through reduced future investment needs.

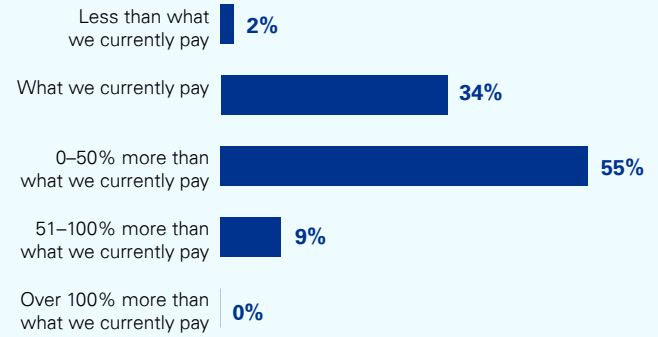
But, clearly, there is a disconnect. Many utilities we've spoken with are unclear about how to most effectively structure the tariffs and they have limited engagement with data center owners. Conversely, the data center owners we've spoken with have largely acknowledged a willingness to pay higher tariffs if they can be reasonably confident the energy supply will be there consistently, and, more importantly, drive renewable energy investment and supply. However, they want input into how the tariffs are structured.

Ultimately, the utilities must determine how much they need to invest in new transmission and capacity strategies, processes, and equipment. The lack of clarity regarding demand is leading to mistrust. If a utility has a large request from a single data center developer, then they should initiate negotiations and be clear about the necessary commitments to create certainty around long-term power needs and generation requirements. The utility can request an agreement that identifies the bare minimum load the data center is going to request, what alternate energy solutions they are pursuing, and the transmission schedule. The utility can then develop alternative energy supply and grid investment scenarios based on the timing of investment decisions, working with data center owners to align on the key milestone dates and investment cost impacts. This enables utilities and data center owners to create transparency and accountability around commitments and timelines—important when communicating changes, such as shifting to on-site generation or changing energy timing uptake.

Data center openness to electricity load flexibility...



...and paying more for consistent grid supply (i.e., tariffs)



Note: Sum of percentages may not add up to 100 due to rounding off
Source: 2024 Data Center Survey

Success pillars

Employing innovative strategies and fostering partnerships can expedite data center project timelines, enhance energy cost effectiveness, and boost positive sentiment within the communities in which data centers are built. Successful collaboration can produce several timely benefits, particularly an increase in confidence around overall project viability; significantly shorter project delivery timelines; and reduced project costs through better-managed permitting, design/redesign, and infrastructure and equipment. Utilities and data centers are encouraged to explore new approaches for the future of the large electrical load connections data centers require.

1 Utility and data center partnerships

Focusing on:

- **Collaborative planning** – Early-stage project development and joint investment in grid enhancements to help ensure both parties' needs are met
- **Integrated services** – Data center-focused services such as energy supply, cooling solutions, and backup power, all managed through a single reliable point of contact
- **Project sustainability goals** – Joint commitments to develop common environmental objectives, such as the use of a defined level of renewable energy sources

2 Flexible connection for on-site generation

- **Dynamic grid integration** – Efficient, seamless connection of on-site generation capabilities to the utility grid
- **Real-time energy management** – Real-time monitoring and control of energy flows from data center to grid to optimize energy use, reduce costs, and enhance supply stability
- **Resilience and redundancy** – Incorporation of multiple energy sources to help ensure continuous operation, even during outages or other disruptions

3 Innovative tariff structures and risk sharing

- **Performance-based tariffs** – Potentially lower rates to incentivize data centers to operate more efficiently, such as avoiding peak demand periods
- **Risk-sharing agreements** – Shared financial risks and rewards, including co-investments in renewables and joint energy storage ventures
- **Incentives for green energy** – Data centers that commit to the use of a certain level of green energy or invest directly in green energy sources that interconnect with the grid could receive financial incentives or preferential rates

4 Construction-ready locations

- **Proactive planning** – Development of infrastructure investments in specific locations to accommodate future growth over the next decade
- **Preapproved sites** – Utility- and local government-approved sites that have already undergone environment assessments and zoning approval
- **Infrastructure readiness** – Accelerate data center operability by helping ensure reliable power, water supply, and high-speed internet are in place
- **Community engagement** – Regular local community communication to address any concerns and highlight the benefits of data center developments

05 Conclusion

The advancements that AI has enabled has also brought about big challenges from an energy perspective: One large data center in northern Virginia could consume as much electrical energy as 30,000 homes in the US, for example.[11] If the number of AI data centers continues to grow, as estimates suggest, then securing consistent, sustainable data center power will be an energy sector-defining achievement.

We envision a future in which the key players in this nexus acknowledge each other's objectives, concerns, and priorities and cooperate. With proactive collaboration and innovation, it's possible to ensure the growth of AI contributes positively to our technological, business, and environmental landscapes. Electrical utility companies and data center owners are at the core of this transformation, holding the keys to a future where AI and energy sustainability coexist in harmony.

[11] "AI is already wreaking havoc on global power systems," Bloomberg, June 21, 2024

06 About the survey

Survey demographics

n=115

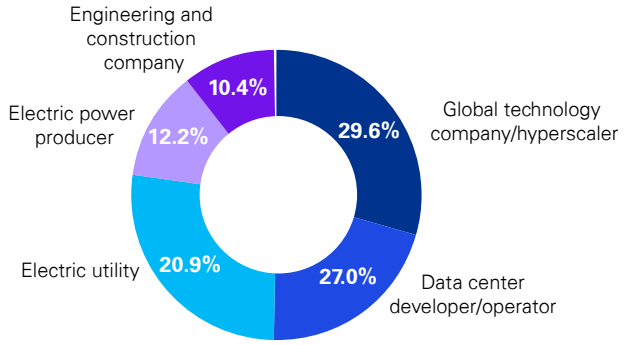
100%

Based in the U.S.

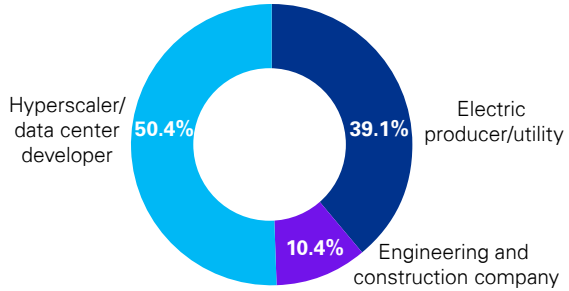
100%

Involved in data center operations/planning or related energy issues

Respondent type by company



Respondent type by major groups



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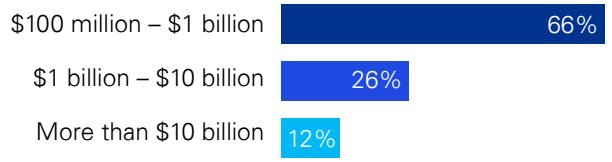
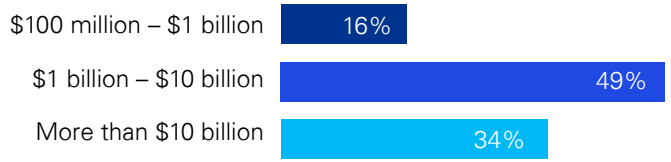
Source: 2024 Data Center Survey

Data center CAPEX spend over next year (hyperscalers/developers)

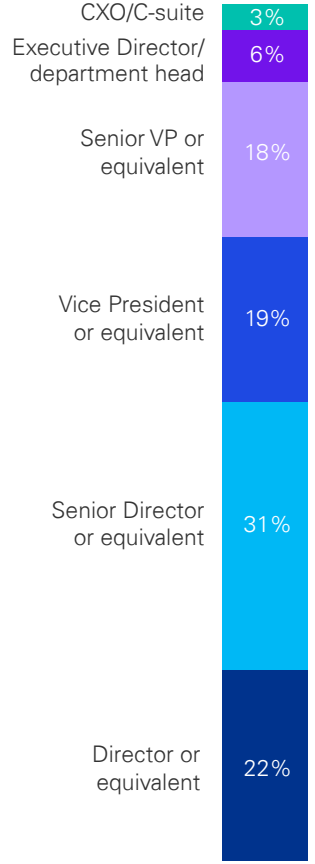


Respondent company's approximate annual revenue



Between September 12 and September 20, 2024, KPMG LLP surveyed 115 technology, data center, utility, and engineering/ construction executives in the US to examine how they are managing data center supply and demand challenges.

Respondent titles



07 How KPMG can help

KPMG can be the connection between data center owners and utilities to help solve data center energy challenges. With experience and perspective across both the technology and energy sectors, we understand the development lifecycle on the data center side and what it takes for a utility to increase capacity for transmission upgrades. Complex issues, like the growing demand for data center energy, must be examined holistically, with the needs and priorities of the entire ecosystem in mind.

Clients need a strategic adviser to be able to bridge that gap. KPMG offers sector-spanning advisory services that encompass:

- Leadership support such as energy transition planning
- Site selection/development/construction analysis
- Community impact analysis and economic development engagement
- Contract strategy development for data centers and utilities
- Stakeholder management
- Finance and tax planning, such as tax credits
- Partnership and alliance strategy
- Program optimization and oversight

KPMG is recognized as a leader in AI

KPMG ranks #1 for Quality in AI Advice and Implementation

The source study, "*Perceptions of Consulting in the US in 2024*," gathered insights from 700 senior executives, directors, and senior managers in the U.S.

Source conducted the survey to understand how clients perceive consulting firms at different stages of engagement. The respondents, representing a wide range of sectors and business functions, were asked to identify three firms they were familiar with, resulting in 2,100 responses about different firms. Notably, 90 percent of the respondents worked in organizations generating over $500 million in revenue.

For more information please visit: https://www.sourceglobalresearch.com/

visit.kpmg.us/ai

08 About the authors

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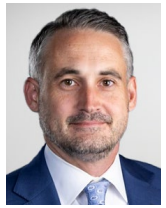
Reid has over 19 years of project management, construction management, project accounting and contract administration. He has performed all aspects of the construction process from performing project due diligence, planning, risk management, design, cost analysis, environmental analysis, contract negotiations, construction management and construction administration.



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Colin has over 20 years of engineering and construction experience. He has delivered cutting-edge programs and projects, including in support of numerous Fortune 500 technology companies, energy companies, and utilities. He focuses on strategy and capital planning, analytics and AI, project delivery, and risk and compliance. Prior to joining KPMG, he delivered high-tech projects for engineering and construction companies.

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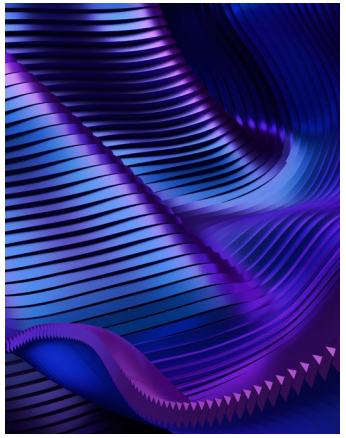
Evgeny has over 14 years of immersive experience in energy infrastructure, combining the analytical depth of research with management consulting and in-house utility experience. His tenure at organizations such as KPMG and National Grid has provided him with unparalleled insights into the energy sector, equipping him with a unique skill set that spans across critical areas of energy infrastructure development, strategy formulation, and implementation.

We would like to thank our contributors:
Lisa Bigelow, Ranajit Dey, Shubham Durga, Valeriya Kramarenko, Andreas Marathovouniotis, Sarah McEwen, Brennan Morris, Gary Regenstreif, Michael Thayer, Alison Wentley, and Katherine Wheeler.

Related thought leadership



[DeepSeek: A breakthrough moment for AI]

[KPMG 2024 technology and telecommunications CEO outlook]

[KPMG global tech report 2024]

Recommended reading

- Data centers, AI and energy confluences: expected regulatory shifts in the new administration
- The evolving technology landscape of energy supply

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