Capgemini RESEARCH INSTITUTE

AI meets the grid

Shaping the data center power play

Make it real.

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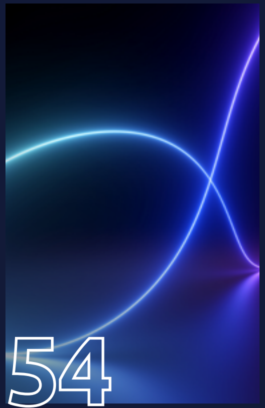

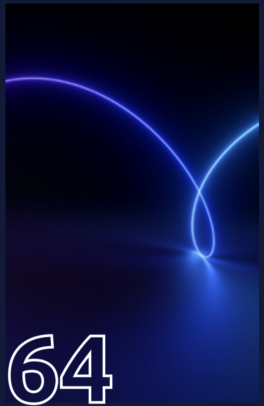

We'd like to extend our sincere thanks to our panel of industry executives for sharing their valuable insights with us.

Saurabh Chaugule
Global Head - Strategy & Business Development for Energy, Utilities & AI

Shalabh Jhalawad
Head – Global Power and Energy Solutions at AWS

Cameron McInnes
Global Head of Engineering at Barclays

Raj Raheja
CFO at Camus Energy

Ethan Tiao
Product Manager at Emerald AI

Inês Muggli
Market Development Manager at SSE plc

Jason Jackson
Programme Director at Siemens Energy

Pedro Almeida Fernandes
An executive in the Iberian gas and power market

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Rigor Lois Alamar
Senior Account Manager at Shell Energy

Alyson Freeman
Director, Data Center Sustainability at Dell Technologies

Bijit Ghosh
Managing Director/CIO and Head of Architecture and Engineering at Wells Fargo

Kevin Marquardt
Director of Energy Policy and Regulatory Affairs at CyrusOne

Wilson Laia
Head of LATAM at the International Data Center Authority (IDCA)

Matthieu Gallego
Owner at The Blob Company

Executive summary

AI turns every data center into a volatile industrial load: 80% of utilities expect more extreme and less predictable demand spikes, directly impacting grid resilience

The rapid rise of digital infrastructure, especially data centers running AI workloads, is straining power systems worldwide. A large majority of industry leaders – 70% of electricity executives and 83% of data-center executives – expect high-density AI-led data center sites to significantly increase regional power demand within the next 3–5 years. Moreover, nearly 80% of electricity executives anticipate far greater volatility and load "peakiness" as AI usage grows.

As a result, electricity companies see a widening supply–demand gap: 77% fear that data-center demand will grow faster than their ability to expand supply, and 68% even foresee electricity shortfalls in some regions within the next few years. These pressures are playing out differently across regions. In the US, while pockets of excess generation remain, data-center-driven load growth is now outpacing available generation and deliverable capacity.[1] In Europe, grid constraints have emerged as the primary barrier in established data-center hubs.[2] Meanwhile, in APAC, access to energy itself is widely seen as the most immediate constraint on further data-center expansion.[3]

The challenge is not only the sheer scale of new demand but its geographic concentration: massive clusters of new data centers are straining local grids. More than half of electricity executives cite this localized load clustering as a major obstacle to reliable service.

Yet AI is not only driving demand; it is also part of the solution: More than 60% of utilities expect AI to unlock significant efficiency and operational gains

For energy providers, AI is emerging as a force multiplier for grid planning and reliability: at least six in ten power executives in our global survey expect >10% improvements in failure reduction, operational productivity, and outage prevention from advanced AI analytics. However, only 45% of utilities today are using AI or machine learning for grid optimization and reliability, revealing significant opportunity to scale digital and AI-driven operations to keep pace with booming demand. Capturing AI's benefits at scale across load forecasting, predictive maintenance, real-time grid control, and beyond will be critical to powering the next phase of digital growth. Ultimately, scaling AI will depend on advances in climate tech to deliver reliable, affordable, and sustainable power, while AI itself will play a central role in making energy systems more efficient and resilient.

Executive summary

Grid modernization speed now determines time to value: 78% of data center leaders point to grid infrastructure construction timelines as the critical constraint

Energy companies also recognize that meeting this booming demand will require unprecedented speed, but they face a perfect storm of infrastructure and execution challenges that limit their ability to respond quickly. Key constraints include:

- **Aging infrastructure:** Outdated grids are a top concern for reliable data-center power delivery, cited by 74% of electricity executives globally (79% in US and 75% in Europe)
- **Connection and permitting delays:** 84% of power executives globally and in Europe report slow or difficult permitting for new projects, and 76% globally (79% in Europe) are frustrated by lengthy grid interconnection studies, bottlenecking capacity expansion
- **Thin reliability margins:** 84% say insufficient reserve margins have become a challenge as large always-on loads tighten available buffers; this worry is especially acute in Europe (raised by 90% of European electricity executives)
- **Supply-chain pressures:** 74% are facing rising costs and equipment delays for critical infrastructure (with European executives reporting even higher incidence, 78%)

How to plan power demand and allocate capital efficiently when ~20% of data center load requests may never happen, according to ~two-thirds of our survey respondents?

As data-center power demand surges, electricity organizations must also manage uncertainty. Not all load requests are credible. Two thirds (67%) of electricity executives believe that around one fifth (19%) of data-center load requests received never materialize. Due to these speculative requests, 77% of electricity executives globally (and 79% in US) say they struggle to forecast demand accurately. Over forecasting due to speculative requests can misallocate capital and create excess capacity: 60% of electricity executives cite the risk of stranded assets due to speculative requests.

Data centers turn to on-site power, reshaping the utility relationship: 29% have already deployed and 39% plan to add on-site capacity within one to two years

Facing these grid constraints and delays, data-center operators are increasingly generating power on-site or near-site – a move from backup diesel generators toward primary behind-the-meter (BTM)[4] energy solutions. What began as a stopgap is fast becoming a strategic imperative for growth and reliability. In our research, 29% of data-center executives globally say they already deploy on-site generation (from gas turbines and fuel cells to

Executive summary

renewables and hybrid microgrids), and another 39% plan to add on-site or BTM power within the next one to two years. More than seven in ten data-center leaders expect to significantly reduce their reliance on the grid through such solutions in the next five years.

This trend marks a structural shift in the energy ecosystem, effectively creating a cooperate–and–compete dynamic between utilities and their largest customers. On one hand, on-site generation can help power companies by serving demand that the central grid cannot immediately accommodate – acting as a valuable complement to grid supply in constrained areas. On the other hand, widespread self-generation erodes grid visibility and control: uncoordinated switching of data centers onto backup power can complicate dispatch, reserve management, tariff structures, and real-time balancing of the system. Electricity companies will need new approaches to integrate these customer-owned resources, or risk losing load and revenue and seeing fragmented "shadow grids" operate outside their purview.

No single source is enough: 82% of data center and 66% of utility leaders support a balanced, firm, and cleaner energy mix

Both electricity and data-center leaders agree that no single energy source can reliably power the next wave of high-density computing. A majority: 82% of data-center executives globally (86% in US) and 66% of electricity executives globally (69% in Europe) say a balanced, diversified energy mix is essential for long-term reliability and resilience.

- **Rapid renewables growth cannot meet always-on data-center demand:** While new renewable capacity is critical and is growing, 78% of power providers and 73% of data-center operators acknowledge that renewables alone cannot yet ensure 24/7 power for large-scale data centers and AI workloads. Many organizations are therefore investing in energy storage to firm up renewables: over half of power sector executives (54%) and 56% of data-center leaders report deploying battery energy storage systems (BESS) to help bridge intermittency gaps.
- **Nuclear timelines remain misaligned:** Next-generation nuclear could provide clean baseload capacity, but expectations for its near-term role remain low – 82% of electricity executives (and 61% of data-center executives) believe even small modular reactors (SMRs) will not be deployable at the pace needed to support data centers in the next 3–5 years.
- **Natural gas fills near-term gaps:** As a result, a strong majority (68% of energy and data-center leaders globally, and more than seven in ten in the US) view natural gas critical for meeting urgent capacity needs and rapid development timelines. However, this reliance on gas is a triple-edged sword: nearly 60% of energy industry

Executive summary

executives admit that greater use of gas conflicts with their decarbonization commitments; it also risks increasing CO_2 emissions from AI and data-center operators, creating additional sustainability pressure. Moreover, large lead times for gas-turbines and ongoing geo-political tensions are challenging reliance on gas reliance in certain regions.

The real talent shortage isn't electricians—it's leaders who can integrate grid engineering, digital intelligence, and value creation as a single system

Powering the next phase of data center growth requires proactive system stewardship across demand planning, capital sequencing, and grid modernization—with capital efficiency as the unifying discipline. Equally, data center leaders must prioritize energy-efficiency levers across hardware, infrastructure, and software to curb rising power demand at source. Our research points to five priorities:

- **Build next-gen, resilient and cost-efficient supply chains** by diversifying suppliers, using forward contracts, managing risks, scaling digitalization, and reinforcing cybersecurity
- **Deepen utility–data-center collaboration** beyond early planning into shared flexibility and co-investment for system-level impact
- **Integrate community and sustainability considerations** into planning

Operationalize AI and scale future-ready talent

- **Scale AI across planning and operations** through unified data platforms, strong governance, and secure hybrid or sovereign cloud architectures
- **Adopt a multi-pronged talent and skills approach** that combines ecosystem partnerships, targeted upskilling, and closer collaboration with digital and demand-side partners

Enable intelligent supply chains and orchestrate ecosystems

Move from reactive requests to proactive, portfolio-level demand foresight

- **Institutionalize portfolio-level demand intelligence** through scenario-led forecasting, standardized customer screening, contractual safeguards, portfolio-level pipeline visibility, and capital planning aligned to credible demand
- **Steer data-center growth to power-ready locations** by prioritizing spare grid capacity, grid access, flexibility-enabled zones, and early coordination to fast-track sites

Secure capacity and speed through portfolio rebalancing and infrastructure transformation

- **Rebalance the generation portfolio** by optimizing existing assets, scaling renewables prioritizing grid-connected generation for predictable demand, preserving flexibility and evaluating emerging low-carbon options
- **Accelerate grid modernization** by prioritizing upgrades in high-growth load pockets, real-time monitoring, and unlocking latent capacity
- **Deploy decentralized solutions** in grid-constrained areas

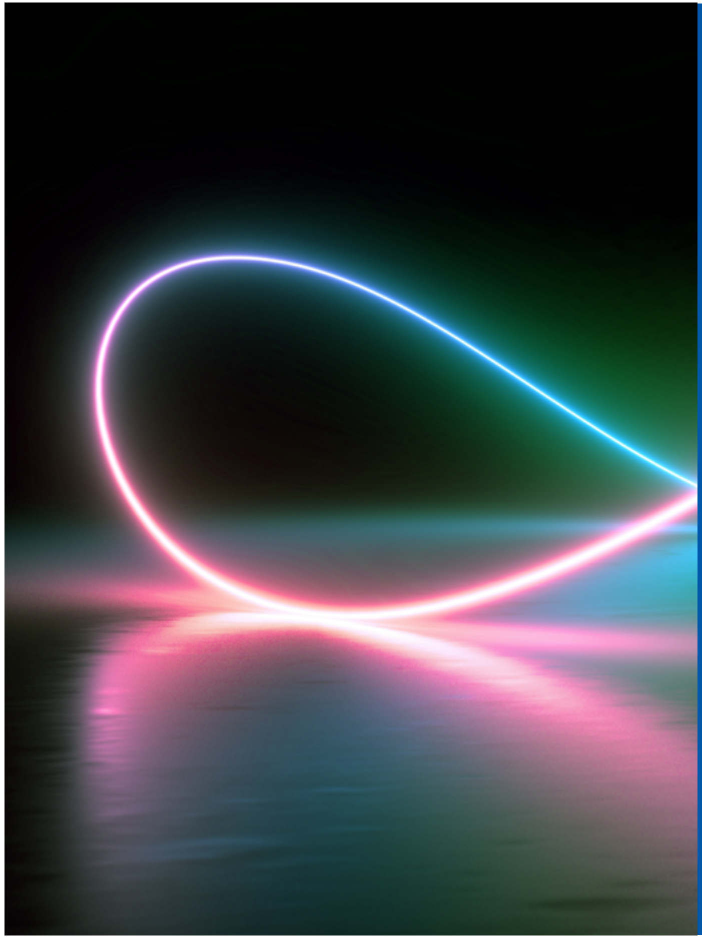
Simplify connections, modernize tariffs, and enable demand-side participation

- **Make interconnection faster** by standardizing processes, improving queue visibility, and using AI-assisted studies to cut delays
- **Modernize tariffs** by offering curtailable options, flexibility-linked pricing, and long-term clean-energy contracts where regulations permit
- **Enable flexibility** by jointly defining flexible load, offering custom DR, and using AI

"The data center clients will drive exponential demand over the next decade, and energy companies that fail to adapt will be quickly left behind. There are barriers, no doubt – but that's the game, and adapting is no longer optional. The winners will be those who execute flawlessly, choose the right projects, engage with new clients early, and offer the right mix of grid access, reliable power, and competitive solutions."

Pedro Almeida Fernandes

an executive in the Iberian gas and power market



Who should read this report and why?

Who?

This report is intended for CXOs and senior leaders across energy organizations, including integrated utilities, power producers and developers, grid organizations, energy suppliers and aggregators, and energy-service providers. It is particularly relevant to leaders responsible for strategy, investment priorities, system planning, grid operations, reliability, and growth. Beyond energy companies, regulators and policymakers, data-center owners, operators, and hyperscalers, energy-procurement and sustainability leaders, investors, developers, original equipment manufacturers (OEMs), and supply-chain partners will also find the insights valuable.

Why?

This report examines how rapidly growing data-center operations, particularly from AI workloads, is reshaping electricity demand. It analyzes the key challenges facing energy organizations and how they are responding. It explores the role of renewables, natural gas, and small modular reactors (SMRs) in powering future data centers, and highlights how advanced technologies such as AI, generative AI (Gen AI), and AI agents can create value.

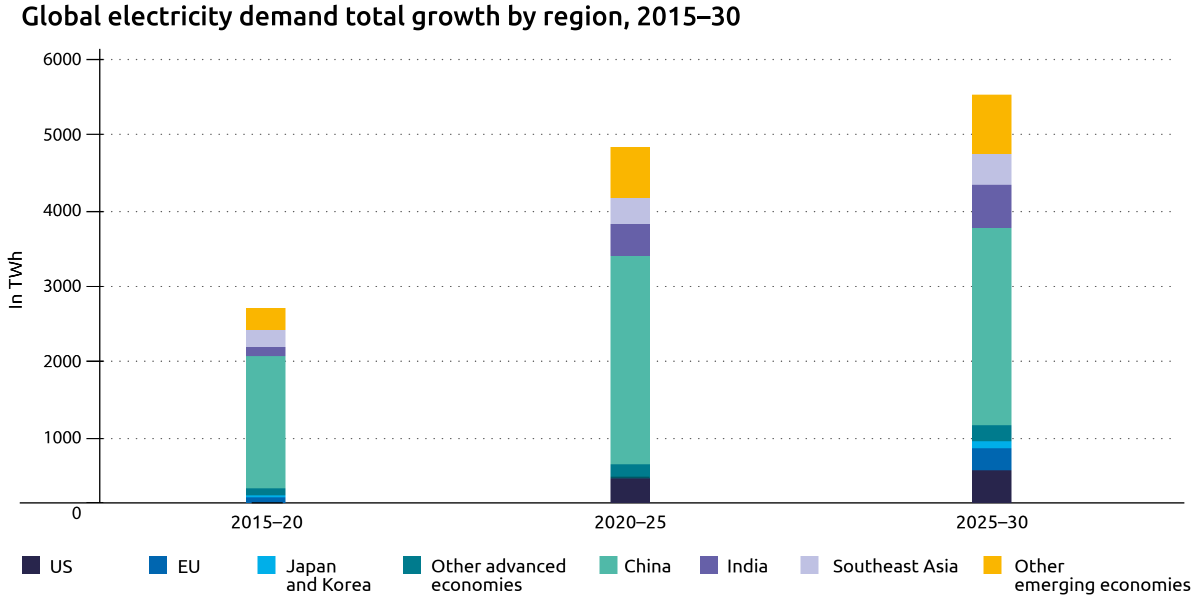
The report presents a detailed proposal for powering the data centers of the future. It draws on comprehensive research, internal expertise, and a survey of 612 senior executives (director level and above) at energy organizations with annual revenue above $500 million that are already active in data centers. It also includes findings from a survey of 175 senior industry executives from organizations that own or operate data centers with annual revenue above $250 million. These organizations are based across 21 countries in North America, Europe, APAC, and Latin America. The report also incorporates qualitative insights from ~20 industry leaders.

01 Data centers are powering the surge in electricity demand

1.1. Electricity demand is accelerating

With widespread electrification across industry, transport, and buildings, as well as the rapid expansion of electric vehicles (EVs) and digital infrastructure, including data centers, and AI-driven technologies, global electricity demand is growing, with a 3% rise in 2025, following a 4.4% increase in 2024.[5] This is nearly double the average annual increase from 2013 to 2023.[6] While emerging economies remain the main drivers of growth, electricity demand in advanced economies is rising again following 15 years of stagnation, accounting for nearly 20% of global demand growth in 2025, up from 17% in 2024 (see Figure 1).[7]

Figure 1.
Advanced-economy electricity demand is growing again



Source: International Energy Agency.

In our research, almost six in ten (58%) electricity executives report surging demand over the past three years. A majority of these executives (75%) attribute this increase to digitalization and the growth of data centers, followed by industrial expansion (68%), onshoring or reshoring of manufacturing and supply chains (67%), and the electrification of mobility solutions (65%) (see Figure 2). A vice president and head of sourcing, procurement and supply strategy from a leading global integrated energy solution provider agrees: *"Cooling requirements have increased significantly in Asia and Africa because of climate changes, and as economies improve, more people can afford air conditioners. At the same time, rapid industrialization and the growth of data centers, along with the back-up required for cryptocurrencies, have further accelerated electricity demand."*

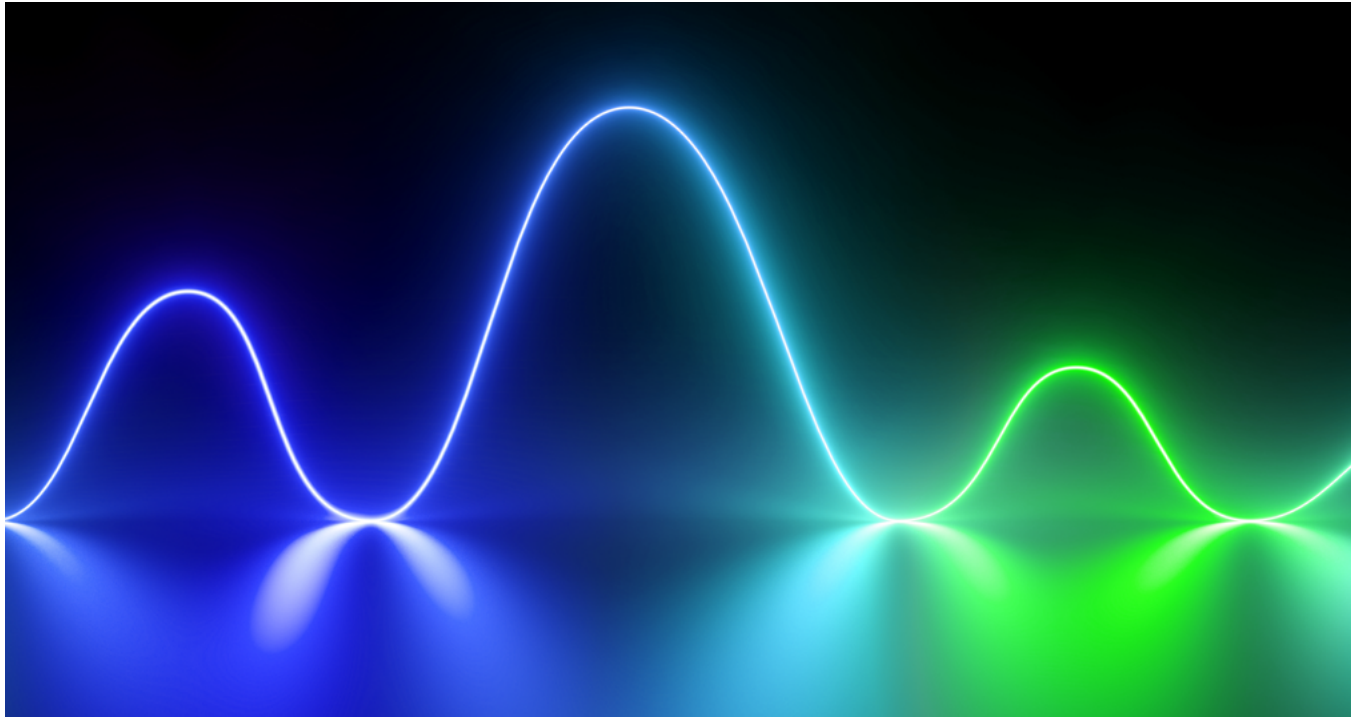
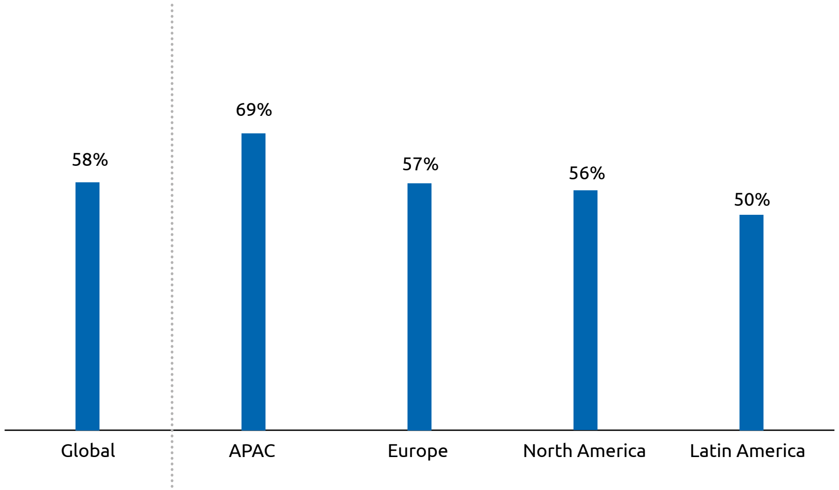


Figure 2.
Digitalization and data center growth are driving electricity demand

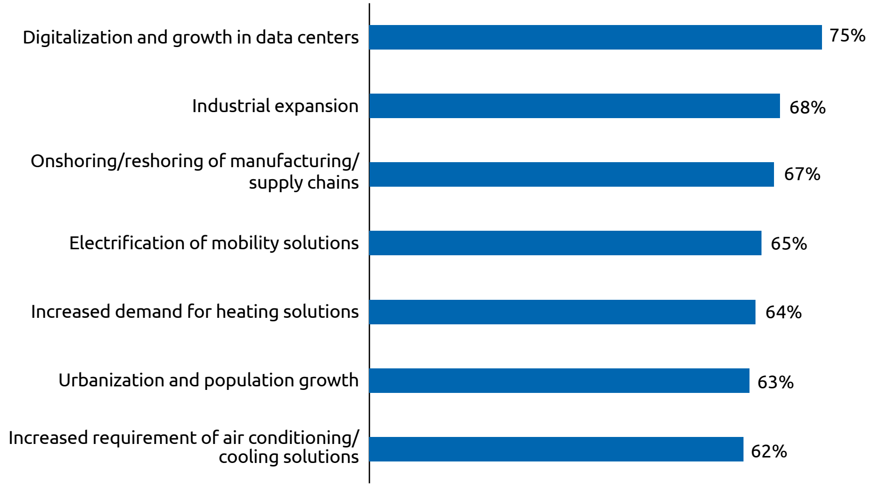
% of executives who say electricity demand has increased in the past three years



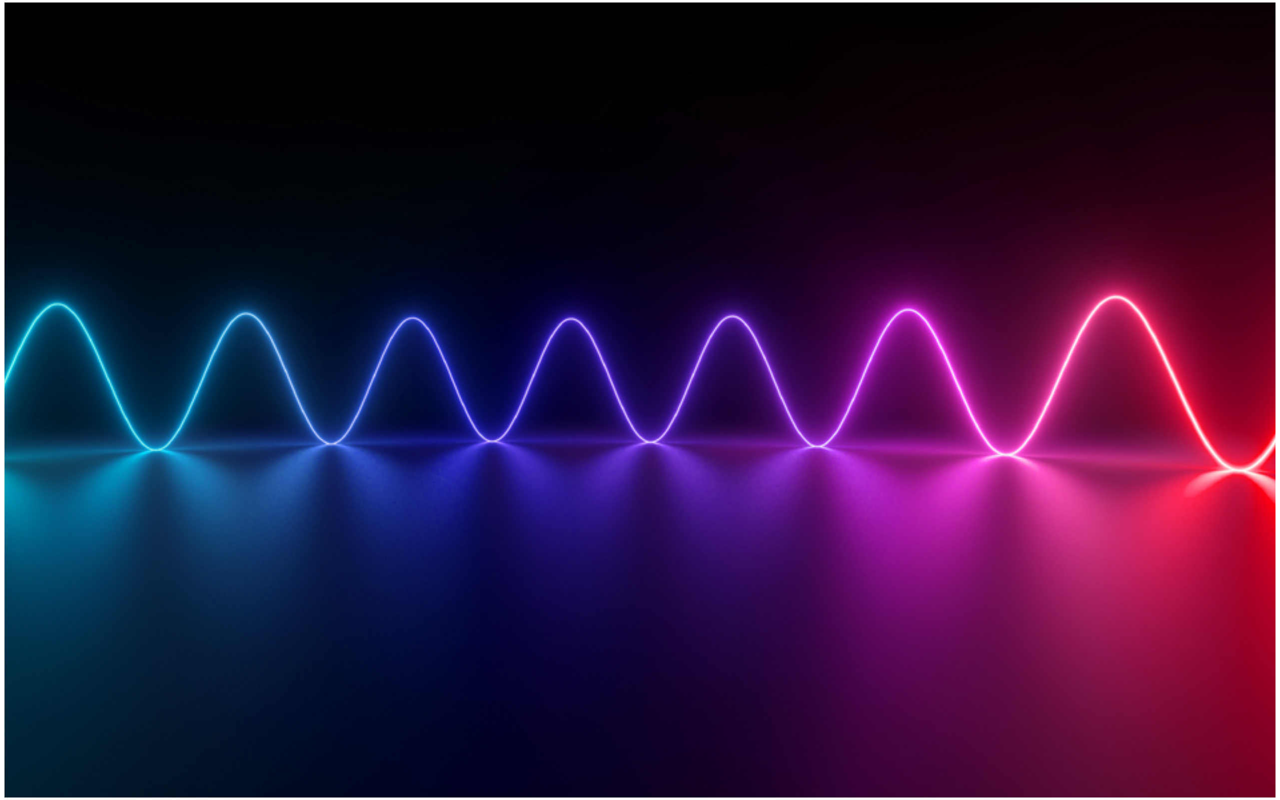
*Note: In the survey, APAC includes Australia, New Zealand, China, Japan, Singapore, and India; Europe includes UK, France, Germany, Spain, Italy, Sweden, Norway, Finland, Denmark, Ireland, Iceland, and Netherlands; North America includes US and Canada; Latin America includes Mexico, Brazil, Argentina, Peru, and Costa Rica.

Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations (North America: 232; Europe: 220; APAC: 90; Latin America: 70).

% of executives rating the following factors as having the highest impact on electricity demand growth over the past three years



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 352 executives globally from electricity organizations who have seen an increase in electricity demand in the past three years.



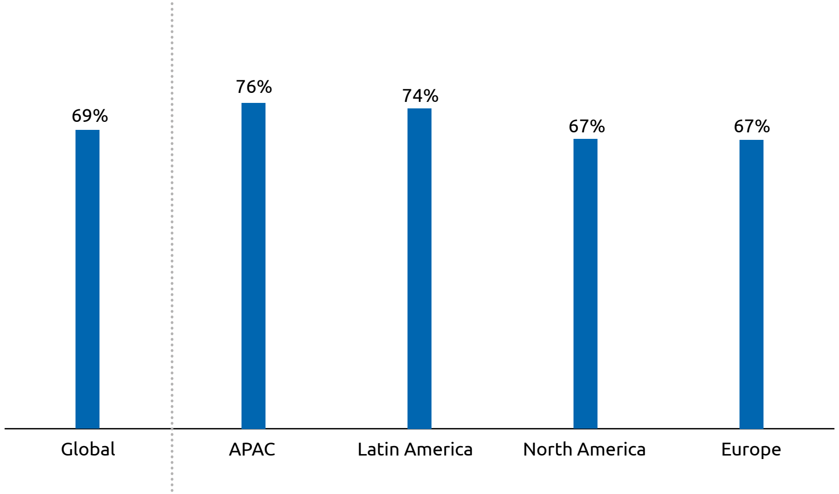
The IEA expects future growth in electricity demand to accelerate incrementally. Annual demand across sectors is projected to grow about 50% faster in 2026–30 than over the preceding decade.[8] Seven in ten (69%) electricity executives who participated in our survey also expect an increase in electricity demand in the next three to five years, driven primarily by data centers (see Figure 3).

58%

of electricity executives say electricity demand has increased in the past three years.

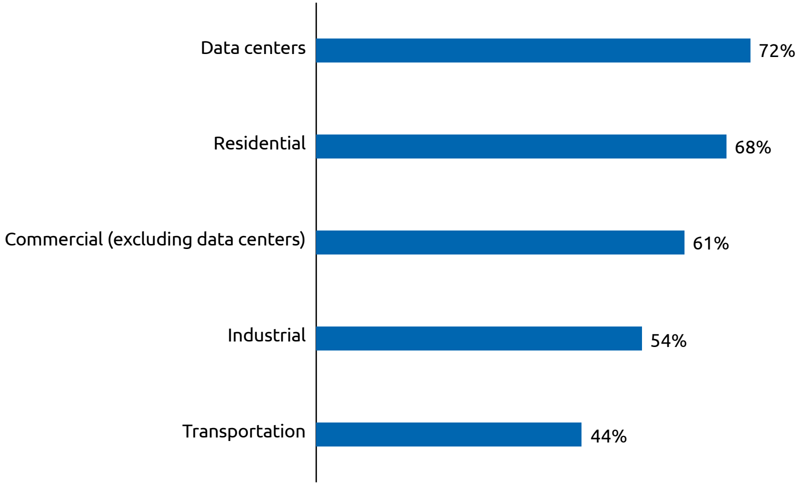
Figure 3.
Data centers are expected to drive electricity demand over the next 3–5 years

% of executives expecting an increase in electricity demand in the next 3–5 years



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations (North America: 232; Europe: 220; APAC: 90; Latin America: 70).

Which sectors will see a surge in electricity demand in the next 3–5 years? (Top 3 rank order)



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 424 executives globally from electricity organizations who expect electricity demand to increase over the next 3–5 years.

1.2. Data-center electricity demand is poised to grow by ~30% over the next 3–5 years

Global data-center capacity expanded nearly fivefold in 2005–25, reaching an estimated 114 gigawatts (GW).[9] This growth has been driven by rapid cloud adoption, the rising use of AI and Gen AI, and the explosion of data from digital services and enterprise systems. Increasing demand for digital services, remote and hybrid work, and enterprise digital transformation continues to accelerate this trend, while low latency and data localization requirements, hyperscaler expansion, regulatory pressures, and advances in 5G and fiber connectivity further fuel capacity growth. Forecasts suggest that there will be investment of around $3 trillion in 2026–30, meaning nearly 100 GW of new data-center capacity will be added, effectively doubling global capacity.[10]

This unprecedented expansion of data-center facilities naturally pushes up power demand. In 2018, data centers worldwide consumed only around 200 terawatt-hours (TWh; around 1% of global electricity), despite internet traffic tripling and workloads more than doubling.[11] By 2025, data centers accounted for around 448 TWh (1.5% of the world's electricity consumption). And it is expected to more than double to 980 TWh by 2030, which will be slightly more than Japan's total electricity consumption today.[12] By 2035, data centers globally are expected to account for more than 4% of electricity demand – enough that, if they were a country, they would rank fourth in power consumption, behind only China, the US, and India.[13]

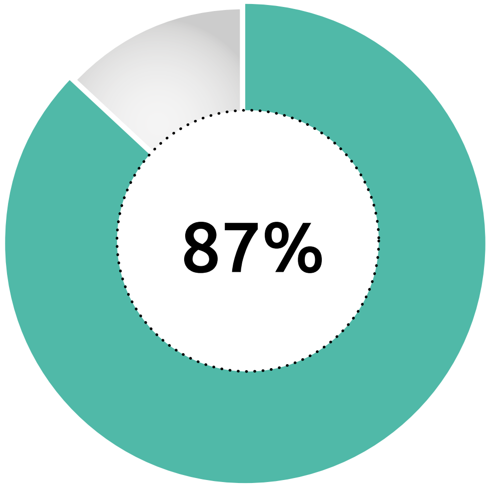
- The US Department of Energy forecasts 20 GW of new data-center load by 2030 and predicts data centers will consume 6.7–12% of total US power production by 2028, up from 4.4% in 2023.[14] While pockets of excess generation exist, data center-driven load growth is now outpacing available generation and deliverable capacity.[15]
- European data-center power demand also reached 96 TWh in 2024 and is projected to hit 168 TWh by 2030. In 2024, demand from data centers in Europe accounted for 3.1% of total power demand, and five countries (Germany, France, UK, Ireland, and Netherlands) accounted for over 60% of that European power demand.[16] Grids have emerged as the primary barrier to traditional data-center hubs. In recent years, Dublin and Amsterdam have had to pause new projects, citing lack of grid availability and inability to integrate new large power loads.[17] In Belgium, regulators are discussing limiting new grid connections for new digital campuses, while in the Nordics, grid operators have warned that they may face faster-than-expected capacity constraints due to rising data center demand.[18]
- In Asia-Pacific, lower-end data-center demand is estimated to reach 493 TWh by 2030, up from 267 TWh in 2025.[19] Energy access is seen as the most immediate constraint on data-center expansion in the APAC region.[20] Following a previous moratorium, Singapore is expanding data center capacity under a tightly controlled, sustainability-led framework, driven by land constraints and carbon goals, with applicants required to meet stringent energy-efficiency standards and source at least 50% of power from green energy.[21]

In our research, most (87%) data-center executives expect their electricity consumption to increase by around 30% over the next three to five years (see Figure 4). As shared by a project director at GE Vernova Hitachi Nuclear Energy: *"The data-center industry is being squeezed from both sides. AI chips are 30–50% more power-hungry, and data centers keep getting larger. The demand curve is almost exponential now."*

Water consumption of data centers is also rising rapidly. Estimates from market research firm Mordor Intelligence highlight that North American data centers used nearly one trillion liters of water in 2025, roughly equivalent to the annual demands of New York City,[22] with usage expected to rise to nearly 1.7 trillion by 2030.[23] This rapid growth is amplifying pressure on local water systems, particularly in regions already facing structural water stress.

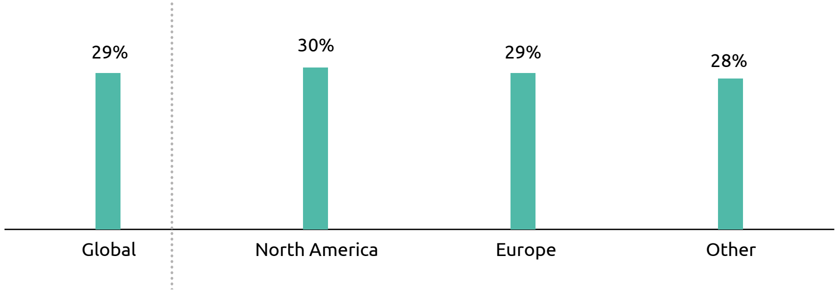
Figure 4.
Data-center executives expect ~30% increase in electricity use within 3–5 years

% of data-center executives who expect their electricity consumption to increase in the next 3–5 years



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

Expected increase in data center electricity consumption over the next 3–5 years



*Note: "Others" includes executives from APAC and Latin America.

Source: Capgemini Research Institute, Powering data centers, January 2026, N = 153 executives globally from data centers owning/operating organizations (North America: 64; Europe: 65; APAC: 21; Latin America: 3) who expect electricity consumption to increase over the next 3–5 years.

1.3. AI workloads are set to transform data-center power demand

AI could represent nearly 60% of all data-center workloads in the next 3–5 years

Our previous research revealed that adoption of Gen AI surged from 6% in 2023 to 30% in 2025, with 93% of organizations across sectors now exploring, piloting, or partially/fully enabling Gen AI capabilities. Adoption of AI agents is also advancing rapidly. In 2025, 14% of organizations had already deployed them at partial or full scale, while another 23% were piloting them. Among those scaling AI agents, nearly 45% were also piloting or expanding multi agent systems.[24]

Published estimates suggest that in 2025, AI represented about a quarter of all data-center workloads, with training driving demand. However, a significant shift is anticipated by 2030, when AI could represent half of all workloads, with inference becoming the primary driver.[25] Our research corroborates this. As Figure 5 shows, electricity consumption from AI training and inferencing is expected to rise from 25% to 60% of total demand in the next three to five years, largely displacing other IT workloads.

AI inferencing is projected to become the dominant workload in data centers over the next three to five years, but AI training will also remain significant.

- Only 22% of data-center executives believe major AI training will be completed in the next three to five years.
- Instead, more than half (53%) expect AI training to continue at scale – with stronger conviction in Europe (63%) than in the US (48%).

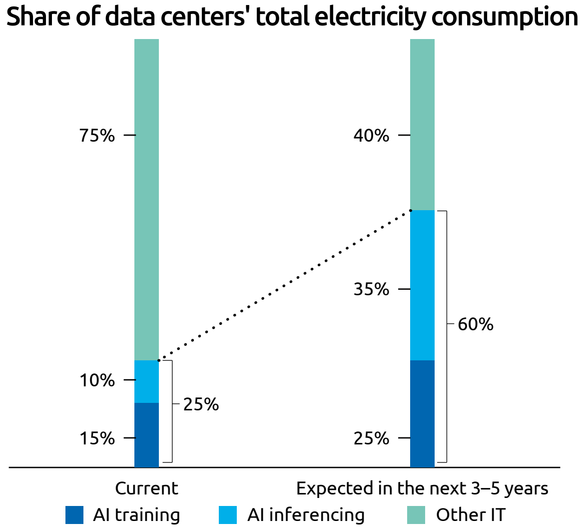
AI data centers will see a surge in the next 3–5 years

Nine out of ten (90%) data-center executives believe AI data centers will represent the fastest-growing segment of the market over the next three to five years. We see tech giants making significant investments:

- Amazon's AI spending is expected to reach $200 billion in 2026, leading among hyperscalers. In February 2026, Amazon revealed its plan to invest $12 billion in AI data centers in Louisiana, US.[26] In March, total investment of €33.7 billion ($38 billion) was announced by Amazon to expand its data centers and boost AI innovation in Spain.[27]
- In its most recent earnings call, Google announced plans for up to $185 billion in AI-related capital expenditure for 2026, more than double the $90 billion it spent in 2025.[28]

Figure 5

AI workloads are expected to dominate data-center electricity consumption in the next 3–5 years



Capgemini Research Institute, Powering data centers, January 2026, N = 77 executives globally from data centers owning/operating organizations that are already hosting AI workloads; N=140 executives globally from data centers owning/operating organizations that are currently hosting or planning to host AI workloads in the next 12 months.

- Microsoft has announced an $80 billion investment in building and expanding AI-optimized data centers through 2028.[29]
- OpenAI and NVIDIA have formed a strategic partnership to deploy at least 10 GW of AI data centers.[30] OpenAI and Oracle have also entered into an agreement to develop 4.5 GW of additional Stargate data-center capacity in the US.[31]

The explosion of high-density AI data centers also requires massive amounts of electricity, both to run their computing hardware and to keep systems cool – five to ten times more power than traditional data centers.[32] Some US facilities draw more than 1 GW of continuous power, roughly equivalent to the electricity needed to serve 850,000 households.[33]

A March 2025 forecast by AI lab Anthropic estimates that 50 GW of new power capacity will be needed by 2027 just to train the latest AI models in the US, with substantially more required to operate them. In our research, 70% of electricity executives and 83% of data-center executives say that AI data centers will significantly increase electricity demand in their region in the next three to five years. As Figure 6 shows, a slightly larger percentage of European executives agree with this.

An IT Manager at a global electricity company, shares: *"We believe data centers will continue to see year-on-year growth in energy consumption, even as certain areas achieve efficiency gains. Much of this growth is driven by the rapid expansion of high-performance computing [HPC], and the densification of legacy IT workloads, which are experiencing exceptionally strong acceleration."*

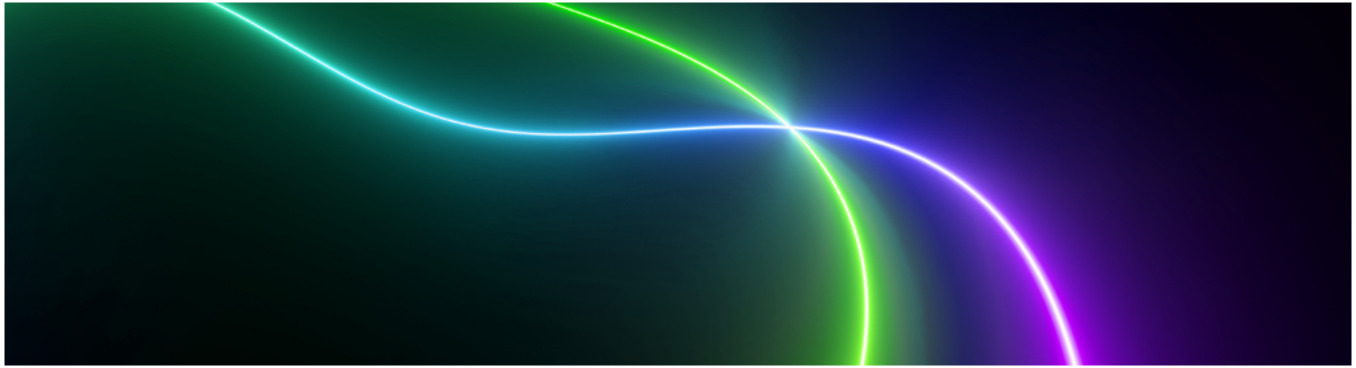
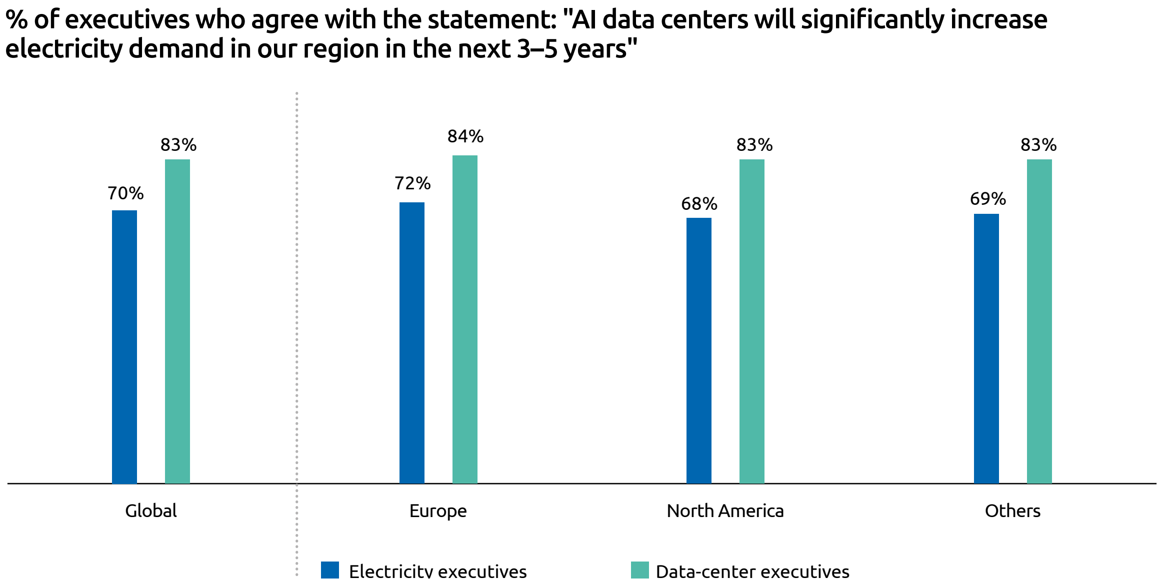


Figure 6.
Most electricity and data-center executives expect AI data centers to drive electricity demand growth



*Note: “Others” includes executives from APAC and Latin America.

Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations (North America: 232; Europe: 220; APAC: 90; Latin America: 70), N = 175 executives globally from data centers owning/operating organizations (North America: 75; Europe: 70; APAC: 25; Latin America: 5).

83%

of data-center executives say that AI data centers will significantly increase electricity demand in their region in the next three to five years.

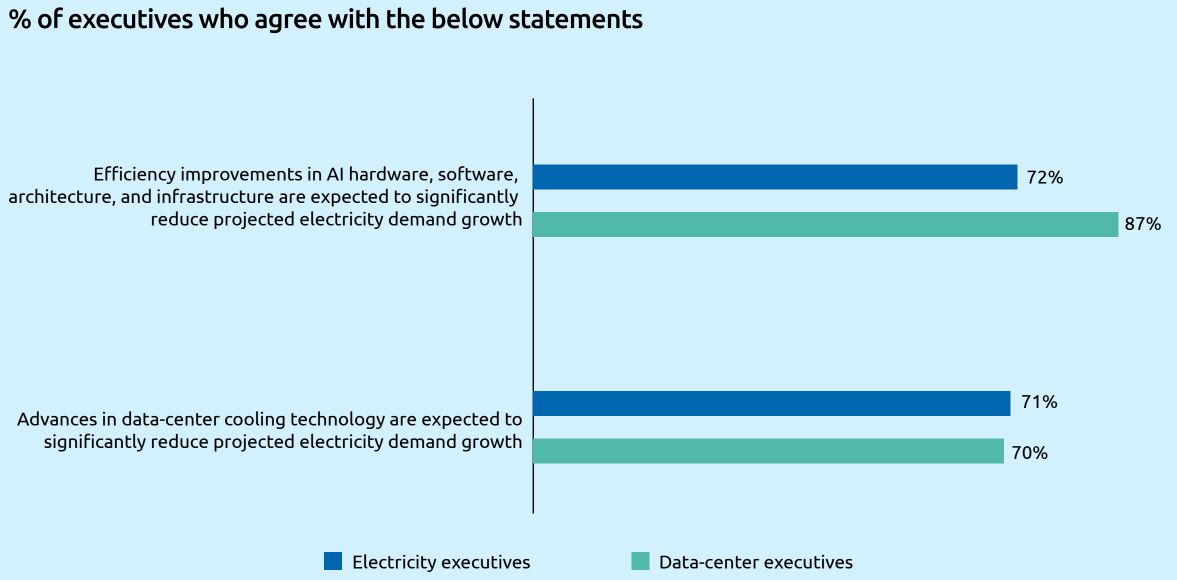
Efficiency gains in technology could reduce power use in data centers

While data-center and AI energy demand is rising sharply, executives see efficiency gains as an important moderating force. As Figure 7 shows, nearly three-quarters of electricity executives (72%) and 87% of data center executives believe that improvements across the data-center technology stack, spanning AI hardware, software, system architecture, and infrastructure design, will help curb escalating electricity requirements. In addition, more than 70% of executives are optimistic about advances in cooling technology.

However, efficiency gains will not translate into one-for-one reductions in electricity demand. As AI systems become more energy-efficient and less costly to operate, organizations are likely to deploy significantly more workloads, expand model complexity, and accelerate AI adoption across new use cases. This rebound effect, often referred to as Jevons Paradox, means that lower energy intensity per unit of computation can stimulate substantially higher total compute demand, partially or fully offsetting efficiency gains.

Figure 7.

More than 7 in 10 executives see efficiency and cooling breakthroughs moderating data-center energy growth



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations, N = 175 executives globally from data centers owning/operating organizations.

Innovation across the data-center stack is nonetheless progressing rapidly:

- **Hardware and architecture:**
  - NVIDIA's new Blackwell chip comes with 30× improved performance for large-language-model (LLM) workloads and 25× lower energy consumption than the preceding iteration.[34]
  - Researchers at the Technical University of Munich have developed the AI Pro chip, a neuromorphic processor inspired by the structure of the human brain, which enables secure, energy-efficient on-device AI without reliance on cloud servers or internet connectivity.[35]
  - Qualcomm's AI200 and AI250 chips extend its Hexagon NPU architecture into rack-scale data-center deployments enabling power-efficient AI inference, with the AI250 claiming over 10× higher effective memory bandwidth at lower power consumption.[36]
  - Google's seventh-generation Ironwood TPU is nearly 30× more efficient than its first Cloud TPU from 2018, while the sixth-generation Trillium offers 67% higher energy efficiency and up to 14× more compute per watt than early-generation models.[37]
- **Software and workload management:** Hyperscalers are already using model-optimization techniques such as model pruning (removing unimportant parameters to reduce model size), quantization (reducing precision where possible), and distillation (transferring knowledge from a large to a smaller model) to reduce cost and energy-consumption.

  Beyond large models, growing adoption of smaller, more efficient models and improved workload orchestration is further lowering energy requirements per task.

  Microsoft's machine learning (ML)–based Project Forge software helps schedule AI model training and inferencing workload during periods when the hardware has available capacity, enhancing utilization rate by 80–90%.[38]
- **Cooling:** Energy majors such as Shell, Exxon, and BP are investing heavily in advanced coolants for data centers. Two-phase direct-to-chip cooling has emerged as a mainstream solution for managing the rising thermal demands of AI workloads and high-density server racks. Looking further ahead, immersion cooling can deliver up to 75% higher efficiency than traditional air-cooling methods.[39]

Historical trends reinforce both the promise and the limitation of efficiency gains. *Koomey's Law* shows that computational efficiency has doubled roughly every 18 months over several decades, driving a sharp decline in energy use per unit of computation. At the same time, *Jevons Paradox* suggests that efficiency-driven cost reductions can accelerate demand, particularly as AI workloads scale across industries and geographies.[40]

Taken together, these dynamics indicate that efficiency and cooling breakthroughs are likely to moderate – but not eliminate – data center energy demand growth. Technology gains must therefore be paired with grid expansion, flexible operating models, and power-first planning approaches to prevent efficiency gains from being overwhelmed by the scale and speed of AI-driven workload growth.

Variability of AI is a significant challenge

The demand placed on AI systems and the cost of executing AI tasks fluctuate significantly across time, users, models, and environments. AI workloads are highly variable because they depend on unpredictable data, dynamic model behavior, bursty user demand, specialized hardware, and constantly evolving systems. Real-world inputs, ML model behavior, and human demand patterns are all unpredictable, and AI tasks vary dramatically in computational intensity, making the total load highly volatile. Consequently, two user queries using the same model may have drastically different compute demands.

More than six in ten executives (62% from electricity organizations and 60% from data centers) believe that AI and Gen AI workloads will become even more variable and less predictable in the next three to five years.

- 79% of electricity executives believe that variability of data centers' demand will be challenging over the next three to five years.
- 72% say that the rise of AI/Gen AI will require electricity organizations to rethink how they forecast, plan, and deliver electricity to data centers.

1.4. "Phantom" data-center load requests are distorting demand forecasts

As utilities prepare for a surge in data-center power demand, they must also manage uncertainty. Not all load requests are realistic. Data-center developers are now selling out capacity two to three years in advance and are being forced to plan and provision electricity supply as far as five to seven years ahead.[41] Driven by uncertainty around project maturity and early grid-capacity reservation, electricity providers are being flooded with speculative, "phantom" load requests, complicating electricity demand planning and capital allocation. Even where the capital is committed, execution constraints remain. Bloomberg recently reported that nearly half of US data-center projects planned for 2026 are now expected to be delayed or canceled, with shortages of critical electrical equipment, such as transformers, switchgear, and batteries, emerging as a primary bottleneck.[42] Moreover, community and political resistance is increasingly influencing data-center delivery timelines. A recent analysis finds that nearly $64 billion worth of US data-center projects have been blocked or delayed over the past two years, driven largely by local opposition related to electricity supply, environmental impact, water use, and affordability concerns.[43] For electricity companies, this means announced pipelines cannot be treated as firm demand—they must filter signal from noise and stage investments to reflect uncertainty.

As Figure 8 shows, two-thirds (67%) of electricity-industry executives believe that at least 19% of data-center load requests they receive will never materialize.

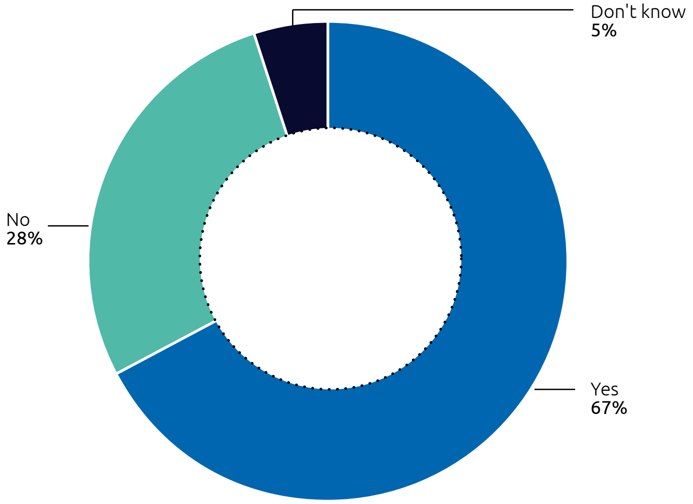
19%

of data-center load requests received by electricity companies might never materialize.

Figure 8.

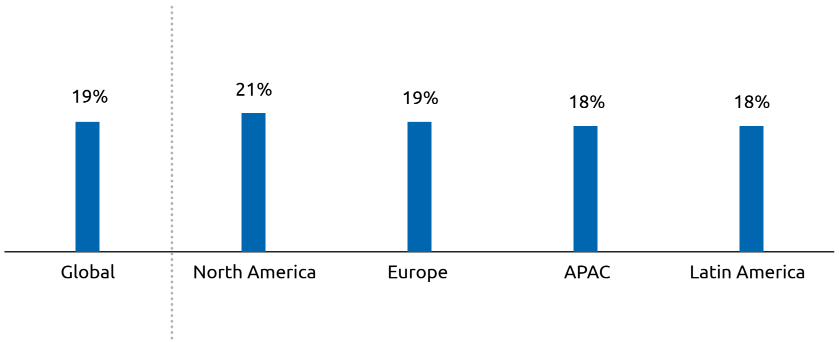
Utilities estimate that nearly one-fifth of data-center load requests will not materialize

% of electricity organizations that believe some data-center load requests are speculative



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 400 electricity executives globally from integrated utilities, power producers, and grid organizations.

Estimated share of data-center load requests that may not materialize

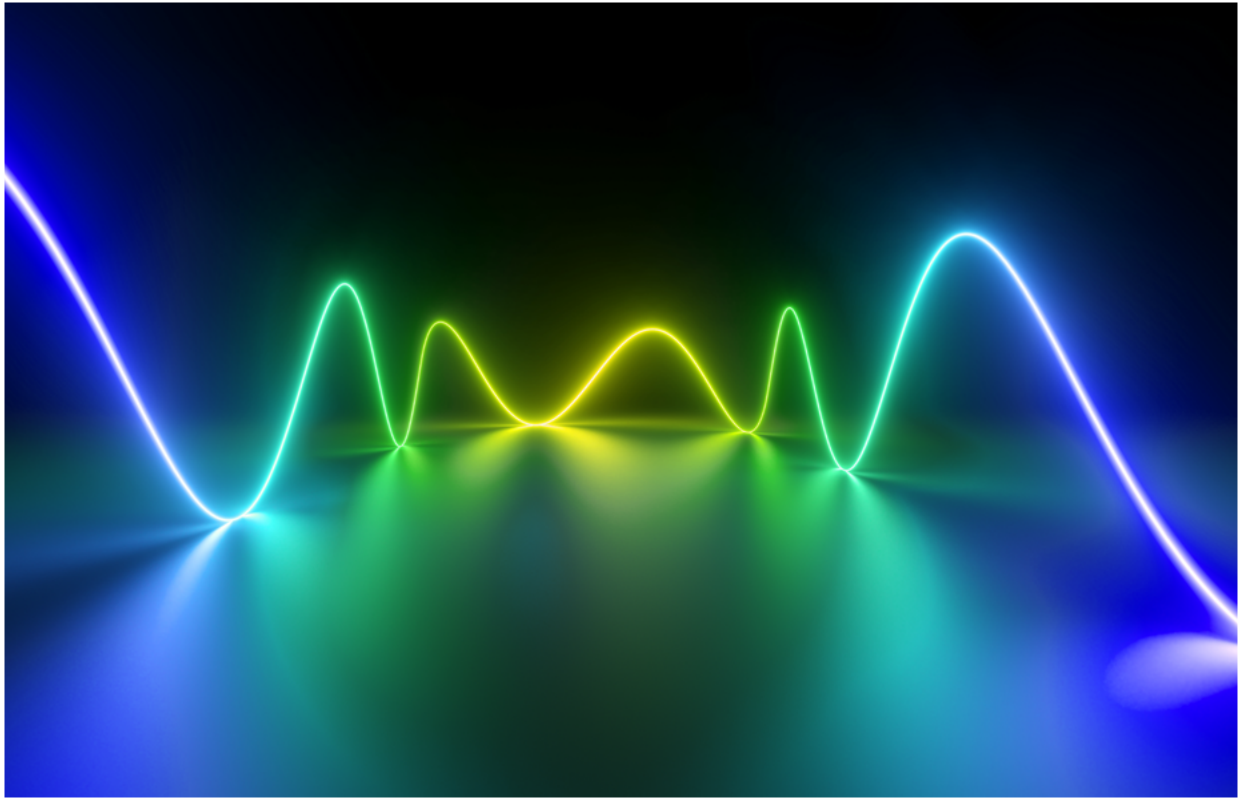


Source: Capgemini Research Institute, Powering data centers, January 2026, N = 269 electricity executives globally (North America: 99; Europe: 100; APAC: 44; Latin America: 26) who agree that there is some degree of speculative load requests from data-center developers.

"Energy companies can leverage a new wave of breakthrough innovation across hardware (such as advanced storage or superconducting technologies) to next-generation software optimization and AI-driven orchestration to enable data centers to dynamically minimize energy consumption, unlock flexibility, and operate as adaptive systems."

Florent Andrillon

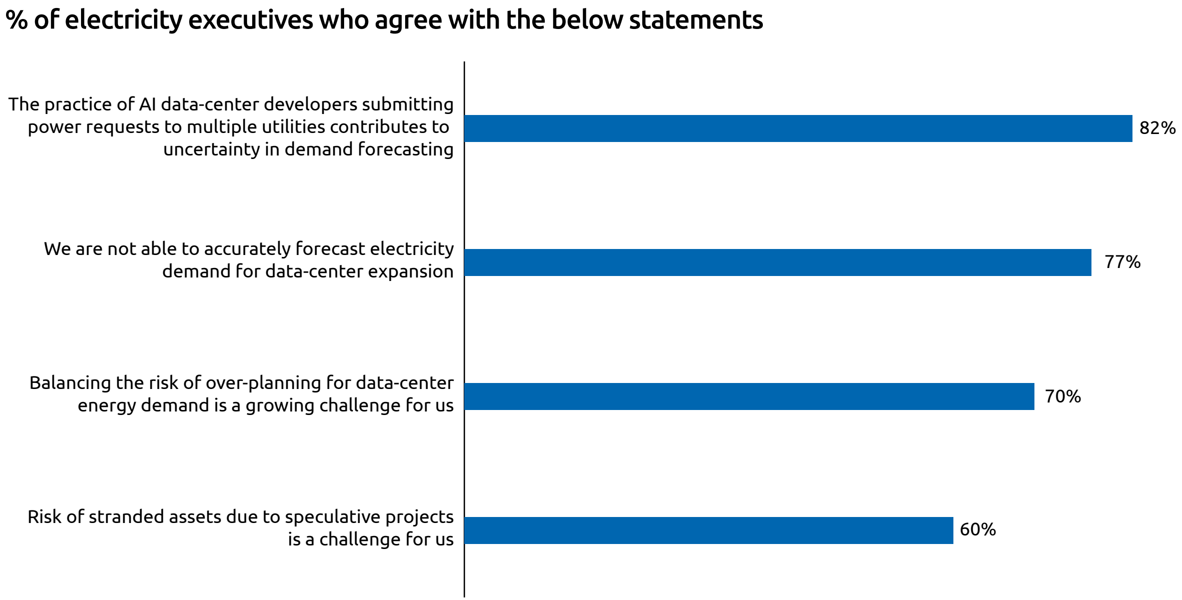
EVP, Group Head Climate Tech at Capgemini



Speculative load requests also slow grid development for committed customers, undermine economic and decarbonization goals, delay fossil retirements, and, if poorly managed, expose electricity organizations to regulatory scrutiny, disallowances, or penalties. These impacts ultimately translate into higher planning risk and sub-optimal capital deployment decisions. As Figure 9 shows:

- Most (82%) believe that the practice of AI data-center developers submitting power requests to multiple electricity companies to secure "speed-to-power" intensifies competition for scarce grid capacity and amplifies forecast inflation, contributing to uncertainty in demand forecasting. As a result, 77% of executives from electricity organizations globally, and 79% in the US, say they struggle to forecast demand accurately.
- Over-forecasting due to speculative requests can misallocate capital, draw regulatory scrutiny, and create stranded assets or excess capacity that raise costs for utilities and ratepayers. If capital investments are later deemed unnecessary or oversized, regulators may block cost recovery – shifting financial risk onto balance sheets and ultimately onto customers. A majority (70% globally and 79% in North America) of electricity executives say balancing the risk of over-planning for data-center electricity demand is a growing challenge for their organization. Additionally, 60% say that “risk of stranded assets due to speculative projects” is significant.

Figure 9.
Electricity organizations struggle to forecast demand



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations.

Rapid demand growth projections are raising concerns about grid reliability and fair cost allocation, as utilities place speculative bets on data center demand that risk inflating electricity costs for all customers. Electric companies are beginning to adopt more realistic demand forecasts – for example, American Electric Power (AEP) Ohio has sharply revised its data center outlook, reducing projected load by more than half, from around 30 GW to just 13 GW.[44] In some regions, regulators are placing greater emphasis on reviewing the assumptions behind load projections. Pennsylvania's Load Forecast Accountability Act allows regulators to vet demand forecasts before they drive up capacity prices,[45] while new legislation in Texas requires data center developers to disclose overlapping power requests and demonstrate firm financial commitment before progressing.[46]

These dynamics reinforce the need for more advanced planning tools, particularly AI-driven analytics and scenario modeling, to support demand forecasting, stress-test multiple build-out scenarios, and guide capital-allocation decisions.

02 Data-center power demand tests grid limits and redefines utility priorities

2.1. Data center–driven load growth is creating supply strains

Providers, including utilities, grid operators, power generators, and energy retailers, must sustain uninterrupted power supply amid increasing stress on power grids and transmission and distribution infrastructure. Seven in ten electricity executives acknowledge that rising data-center electricity demand has already placed significant strain on their operations.

As Figure 10 shows, in the next three to five years: more than three-quarters (77%) of electricity executives believe that **data-center demand will grow faster than supply**, and 68% anticipate shortages as a result. PJM Interconnection, which manages about 180 GW of power across 13 US states, has warned that surging data-center demand could create power shortfalls of up to 60 GW in the coming decades, and strain capacity and planning reserves as early as 2027.[47] **NERC in US has warned that data centers are increasing the risk of power outages and blackouts.[48]**

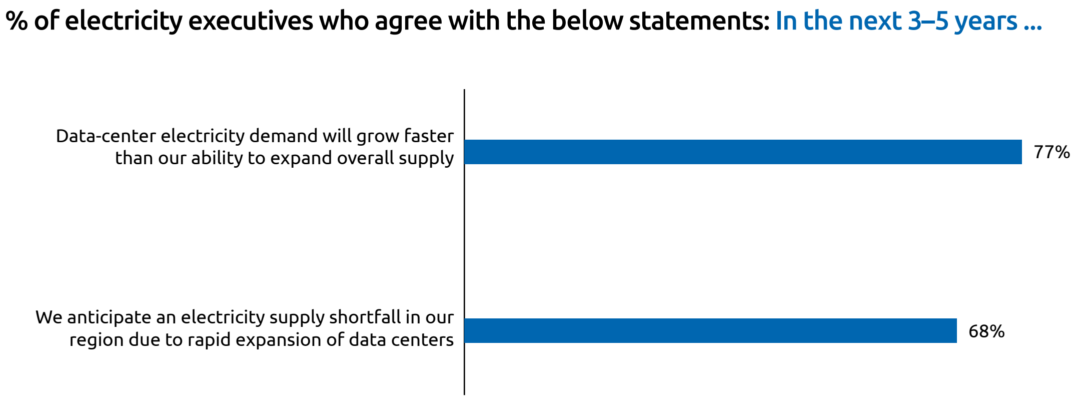
Data center–driven load growth is increasingly geographically clustered, placing disproportionate pressure on local generation, transmission, and distribution infrastructure, and forcing utilities to prioritize investments in high-load areas, potentially leaving other regions with higher costs, slower infrastructure development, and weaker grid resilience. Over half (55%) of electricity executives point to this concentration as a major challenge over the next three to five years.

In Germany, concentration is translating into system-level strains. In major hubs such as Frankfurt, home to the country's highest density of data centers, available grid-connection capacity is already largely allocated for the coming years, intensifying pressure on local networks and electricity costs.[49]

77%

of electricity executives believe that data-center demand will grow faster than supply.

Figure 10.
Electricity organizations expect data-center demand to outpace supply expansion



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations.

2.2. Electricity organizations must prepare for a multi-dimensional challenge

Electricity organizations point to converging infrastructure, execution, reliability, and supply chain constraints that are limiting their ability to meet rapidly growing data-center electricity demand. In 2025, Exelon reported a 33 GW pipeline of data center load across its multi-state territory, with 17 GW already in the interconnection queue and another 16 GW entering formal studies. Yet only 10% of this capacity is expected to be operational by 2028, rising to one-third by 2030 and roughly three-quarters by 2034, highlighting the growing mismatch between demand growth and grid readiness.[50]

Aging **grid infrastructure** is already struggling to keep pace with industrial growth and electrification, not to mention the global energy transition. According to the European Commission, 40–55% of low-voltage lines in the EU will be more than 40 years old by 2030, while total grid-line length grew by just 0.8% between 2021 and 2022. The Commission estimates that more than €1.2 trillion ($1.39 trillion) in grid investment will be required by 2040.[51] On April 28, 2025, a sudden voltage surge triggered grid instability and cascading outages across the Iberian Peninsula, resulting in a nearly

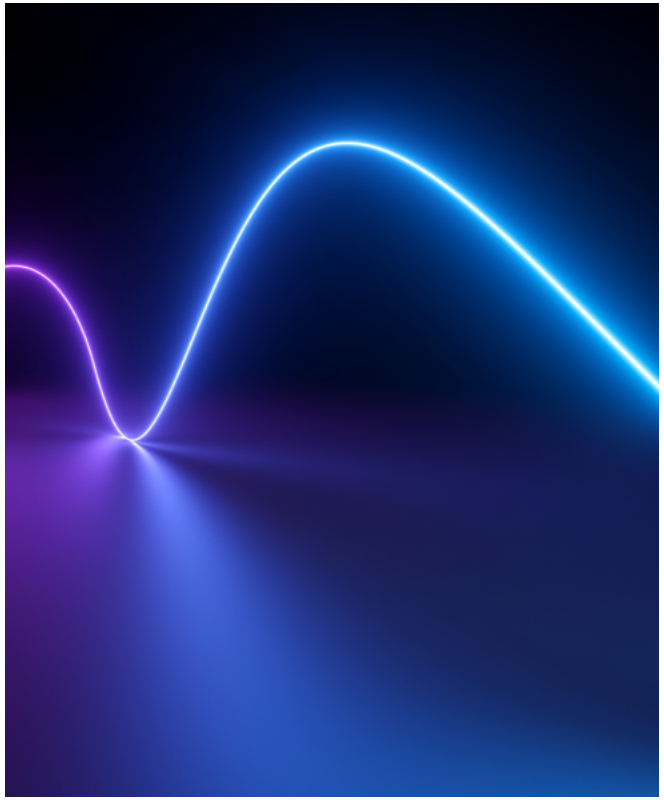
12-hour blackout that was worsened by misaligned voltage controls, slow manual response, limited voltage tolerance, and insufficient reactive power.[52] Against this backdrop, the rapid expansion of data centers will further intensify pressure on constrained grids. Reflecting this challenge, 74% of electricity executives in our research cite outdated grid infrastructure as a key challenge (see Figure 11).

Long and **increasingly congested connection queues** exacerbate grid constraints. The IEA estimates that more than 2,500 GW of projects worldwide, including renewables, storage, and data centers, are currently stalled in connection queues, threatening delays to around one-fifth of planned data-center capacity.[53] As Figure 11 shows, 84% of electricity executives cite delays in securing new permits for infrastructure upgrades, and 76% point to lengthy interconnection study timelines as material challenges to bringing capacity online.

These infrastructure and execution challenges extend to **reliability**. As Figure 11 highlights, 84% of electricity executives say insufficient reserve margins[54] are a challenge, reflecting tighter operating buffers as large, always-on data-center loads scale faster than deliverable capacity. North American Electric Reliability Corporation (NERC) warns that, despite efforts to expedite new capacity, demand from data centers could erode resource margins below targets later in the decade.[55]

Electricity providers are also facing mounting **supply-chain constraints**. A sharp rise in gas-turbine orders over the past two years has outpaced manufacturers' limited production capacity, resulting in multi-year delivery delays and pushing order backlogs at major suppliers such as GE Vernova and Mitsubishi into 2028 and even 2030.[56] At the same time, higher tariffs on steel and aluminum – key inputs for wind turbines – have driven up project costs, as illustrated by Dominion Energy's 2.6-GW Coastal Virginia offshore wind project, where capital costs rose from $10.9 billion to $11.2 billion following recent tariff increases.[57] As Figure 11 shows, 74% of executives report increased costs of infrastructure components as a challenge.

Rigor Lois Alamar, Senior Account Manager at Shell Energy, explains: *"Data centers are powerful economic catalysts, driving investment, jobs, and critical skills, which is why enabling hyperscale growth has become a shared priority for energy providers, developers, and governments. The real challenge lies in scale and speed – hyperscalers are no longer planning for 30 or 50 megawatts, but for rapid ramp-ups to 100 or even 300 megawatts within one to two years, stretching existing infrastructure and grid readiness."*

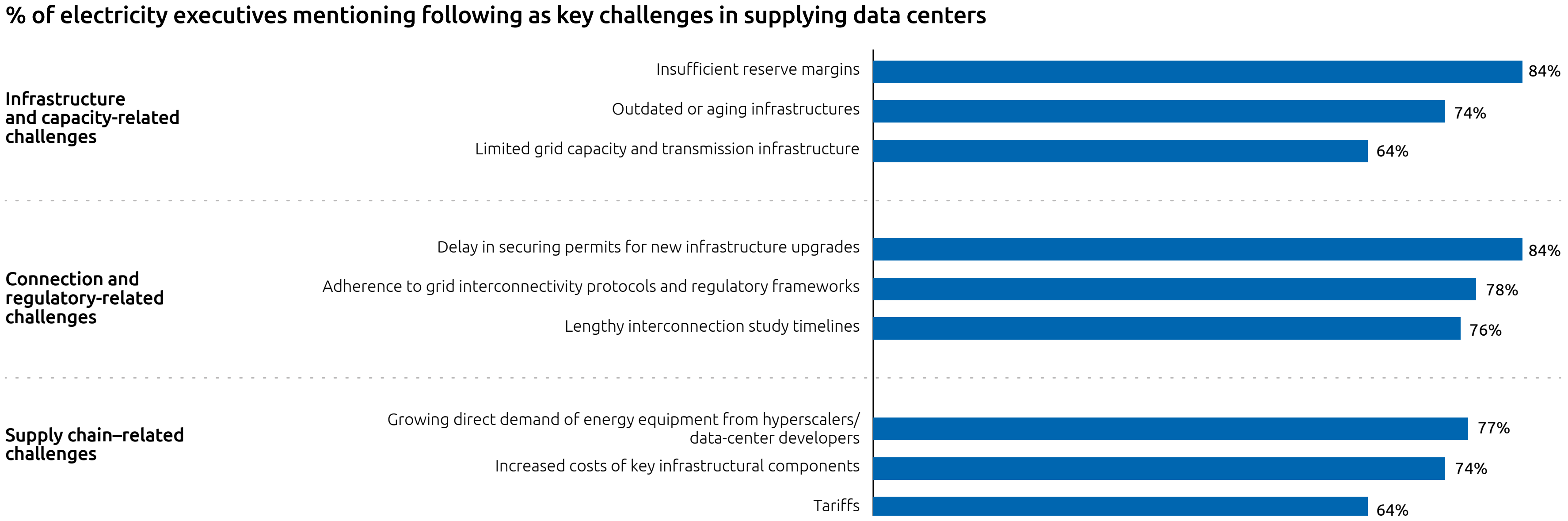


"Data centers are powerful economic catalysts, driving investment, jobs, and critical skills, which is why enabling hyperscale growth has become a shared priority for energy providers, developers, and governments. The real challenge lies in scale and speed – hyperscalers are no longer planning for 30 or 50 megawatts, but for rapid ramp-ups to 100 or even 300 megawatts within one to two years, stretching existing infrastructure and grid readiness."

Rigor Lois Alamar,

Senior Account Manager at Shell Energy

Figure 11.
Several structural and operational barriers are constraining electricity supply



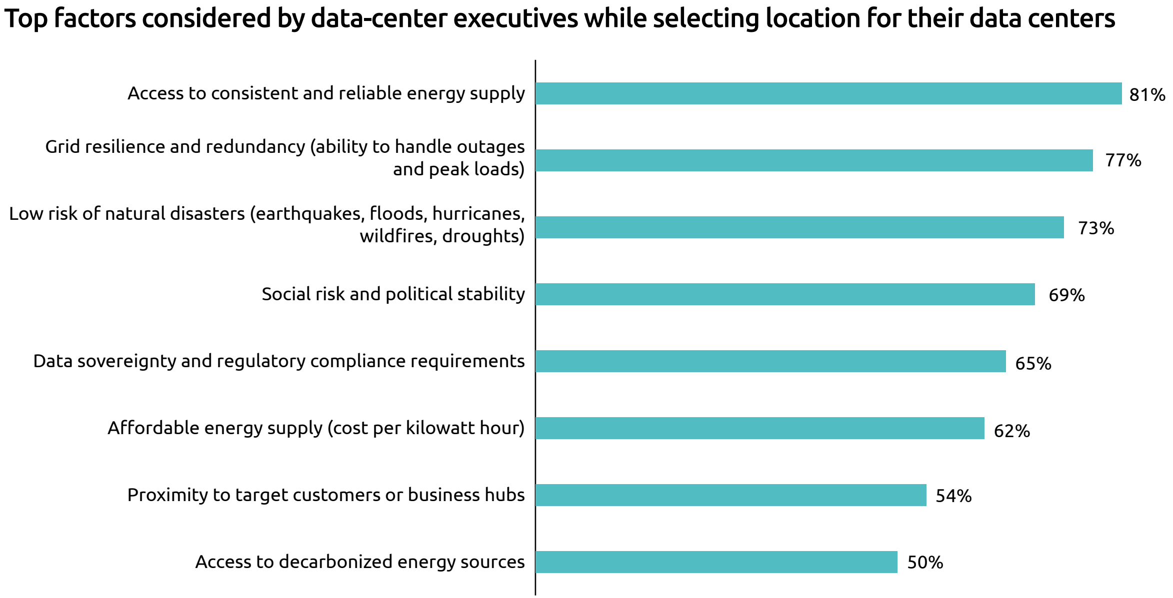
Source: Capgemini Research Institute, Powering data centers, January 2026, N = 400 electricity executives globally who responded to infrastructure and capacity-related challenges question; N = 511 electricity executives globally who responded to connection and regulatory-related challenges question; N = 612 electricity executives globally that responded to supply chain–related challenges question.

2.3. Power reliability and grid resilience now drive data-center location decisions

As grid capacity tightens and delivery constraints persist, power reliability and resilience have become decisive factors in where data-center investment flows. Matthieu Gallego, Owner at The Blob Company, specializing in Data Center Project Development across EMEA and GCC, explains: *"AI companies tend to follow the electrical paths, as time to market is critical and access to reliable power with minimal downtime is a key driver in location decisions."*

Data centers run continuously with near-zero tolerance for outages. Electricity providers that can approach this level of reliability may be able to negotiate incentives. Conversely, regions where power is unreliable will struggle to attract data-center investment.[58] Even brief data-center outages can have severe financial consequences, with downtime costs reaching up to $9,000 per minute.[59] As Figure 12 shows, data-center location decisions now hinge on continuous availability, grid resilience, and redundancy.

Figure 12.
Data-center operators are selecting locations and partners based on continuous supply, resilience, and redundancy

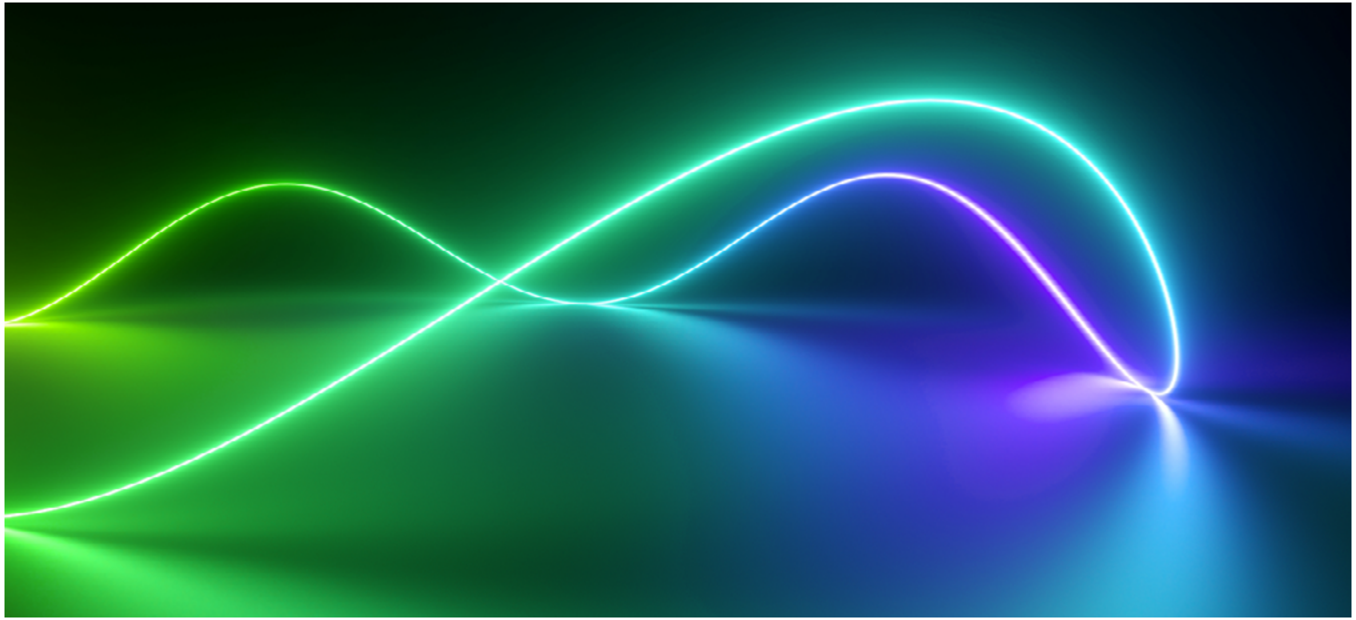


Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives from data centers owning/operating organizations.

To become preferred locations for data-center investment, electricity organizations are increasingly expected to deliver:

- Uninterrupted power supply (near-zero downtime)
- Rapid fault detection and recovery, including priority restoration during grid disturbances
- Stable voltage and precise frequency control to protect sensitive IT equipment
- Transparency and predictability on capacity availability, upgrade timelines, and service levels (including SLAs)

Utilities must embed resilience controls, contingency pathways, and real-time system visibility into grid planning and operations to safeguard system stability. Data-center demand is no longer simply another large load; it represents a system-wide reliability risk that is accelerating the need for flexible generation, advanced storage, and digitally enabled grid controls, fundamentally reshaping planning, operations, and investment priorities.



03 On-site and diversified energy to the fore

3.1. On-site power gains favor

Data centers and similar facilities often maintain on-site backup power for use in the event of grid outages. However, our research indicates that a huge 86% of data-center executives are concerned that power-availability issues will limit AI's potential over the next three to five years. Wilson Laia, Head of LATAM at the International Data Center Authority (IDCA), elaborates: *"Data centers are the foundational infrastructure of the digital economy – effectively the "heartbeat" of today's technology-driven world. Without sufficient and reliable power, both the resilience of digital services and the economic growth of nations are at risk. From AI-driven workloads and hyperscale computing to cloud platforms and real-time digital ecosystems, virtually all modern innovation depends on interconnected, resilient data centers designed with sufficient redundancy to ensure continuous, reliable operations."*

Expanding connection queues, aging grid infrastructure, substantial delays due to extended utility approval processes, and, in many cases, community opposition, mean UK data-center developers are waiting as long as 10 years for a grid connection.[60] In the EU, long delays in establishing power-grid connections are also challenging data-center owners and operators.[61]

Moreover, "bring your own generation" frameworks are evolving in some regions, shifting greater responsibility for capacity, reliability, and flexibility onto large-load customers:

- PJM Interconnection, the largest power-grid operator in the US, recently unveiled a plan in which new large power users (such as data centers) would either bring their own new generation to the grid or limit usage at peak times-effectively encouraging data centers to co-locate with dedicated power sources (e.g., gas, nuclear, or renewables) or secure direct supply, reducing reliance on the existing grid.[62] Texas Senate Bill 6 (SB6), passed in June 2025, also shifts connection costs and reliability obligations onto large-load customers (≥ 75 MW).[63]
- In December 2025, Ireland's Commission for Regulation of Utilities (CRU) introduced policy requiring any data center seeking a grid connection to install on-site generation or battery systems that can fully meet its electricity needs. In addition, data-center operators will be required to feed excess power back to the national grid, when necessary.[64]
- South Korea has also introduced mandatory on-site generation requirements for large data-center facilities, starting at 2% and increasing to 20% of each facility's power supply by 2040.[65]

In this landscape, data centers are looking at on-site generation and behind-the-meter (BTM) solutions, not only for back-up power, but as a strategic enabler of growth and operational resilience. Kevin Marquardt, Director of Energy Policy and Regulatory Affairs at CyrusOne, shares: *"Speed and scale are now the defining metrics of successful project execution. Access to energy and time to power have become the critical enablers, whether the solution is grid-supplied, behind-the-meter, or co-located with an existing large generator. The ability to secure reliable capacity quickly will determine how fast projects can be delivered and how broadly growth can be achieved."* Omdia predicts that, by 2030, more than 35 GW of data-center power will be self-generated.[66] Many data centers are either considering or actively deploying on-site baseload or bridging power[67] to allow large campuses to operate pending multi-year grid upgrades:

- **Vertical integration through IPP acquisition or co-development:** In December 2025, Google's parent company, Alphabet Inc., announced an agreement to acquire independent power producer (IPP) Intersect Power LLC, strengthening its ability to bring data center and energy capacity online faster while leveraging Intersect's multi-gigawatt pipeline of integrated energy and data center projects.[68]
- **Interim (bridging) on-site generation for time-to-power:** In 2024, Elon Musk's xAI brought a data center in Memphis, Tennessee online in a matter of months (rather than the usual years), by using dozens of portable natural-gas generators, allowing it to largely bypass the grid.[69] Meta plans for its Ohio data center to be powered by a dedicated BTM natural-gas plant to be built and operated by natural-gas supplier Williams, following state approval.[70] OpenAI and Oracle's Stargate project in Texas also uses modular natural-gas turbines.[71]

"Data centers are the foundational infrastructure of the digital economy – effectively the "heartbeat" of today's technology-driven world. Without sufficient and reliable power, both the resilience of digital services and the economic growth of nations are at risk. From AI-driven workloads and hyperscale computing to cloud platforms and real-time digital ecosystems, virtually all modern innovation depends on interconnected, resilient data centers designed with sufficient redundancy to ensure continuous, reliable operations."

Wilson Laia,

Head of LATAM at the International Data Center Authority (IDCA)

- **Permanent on-site private power systems:** In Germany, CyrusOne has partnered with E.ON to develop a 61-MW on-site gas-fired power system at its FRA7 data center in Frankfurt. Under this preferred partner agreement, E.ON will build the IQ Energy Center, comprising multiple 4.5-MW gas-engine modules, with full buildout expected by 2029.[72] In Dublin, Pure Data Centre Group and AVK have launched Europe's first large-scale (110-MW) on-site data-center microgrid, designed to provide dispatchable power prior to full grid connection.[73]
- **Hybrid microgrids and flexible energy systems:** In China, Tencent's Tianjin data center has inaugurated a microgrid combining solar power, battery storage, and AI energy management to cut grid dependence and pivot toward green energy. With a total capacity of 10.54 MW, the microgrid is poised to generate an estimated 12 million kWh of electricity annually, equivalent to sustaining 6,000 households.[74]

Our research also shows that 29% of data centers surveyed have implemented some form of BTM power (see Figure 13). An additional 39% plan to explore on-site power generation in the next one to two years. Cameron McInnes, Global Head of Engineering at Barclays says, *"As part of the strategy to modernize our freehold data centers with a strong focus on decarbonization and efficiency, we're maximizing on-site solar across three data centers, two in the US and one in the UK, with funding progressing for approval. We're deliberately moving away from gas and fossil fuels, prioritizing renewables and electrification."*

To build these 'bring-your-own-power' solutions, most data-center owners and operators plan to form partnerships with either renewables developers (51%) or energy service organizations (32%).

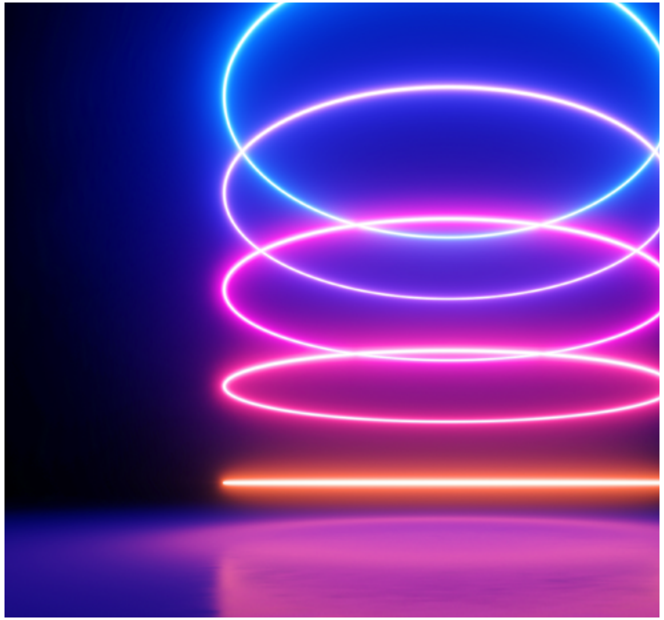
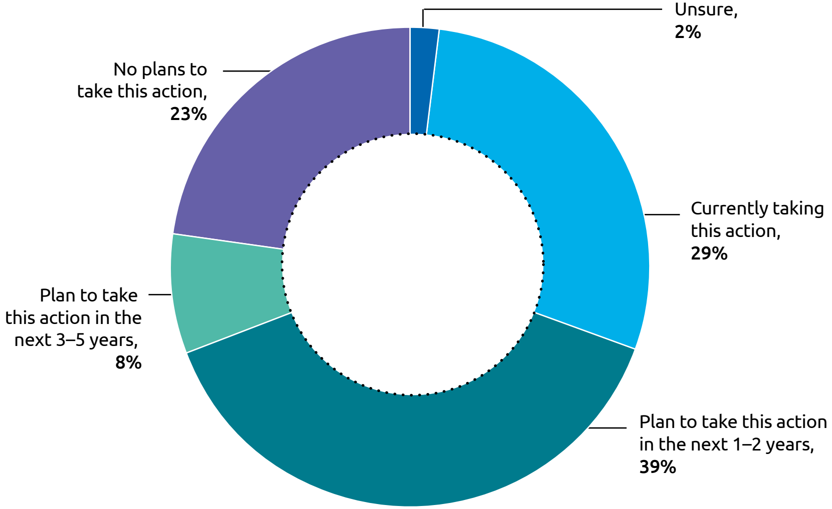


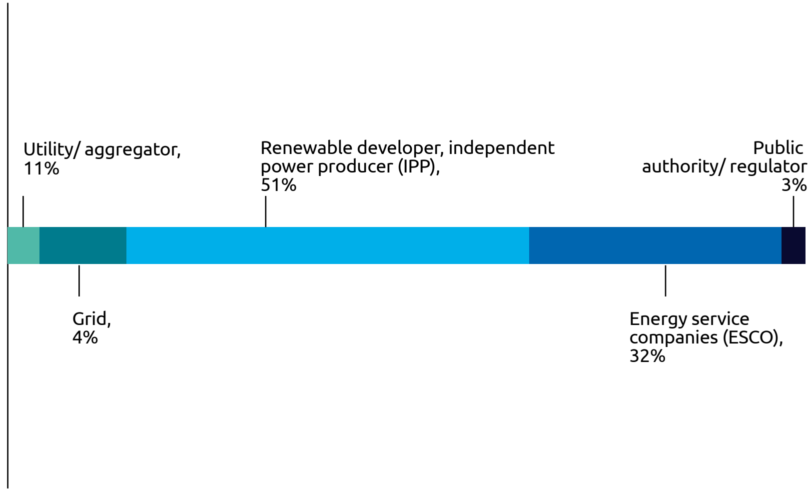
Figure 13.
Nearly 3 in 10 data centers already engage in BTM power partnerships

% of data centers engaging in BTM or on-site generation partnerships



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

% of data centers that are currently/planning to collaborate with the below partners for BTM or on-site generation



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 132 executives globally from data centers owning/operating organizations that are already engaging in/planning to engage in BTM or on-site generation partnerships.

"As part of the strategy to modernize our freehold data centers with a strong focus on decarbonization and efficiency, we're maximizing on-site solar across three data centers, two in the US and one in the UK, with funding progressing for approval. We're deliberately moving away from gas and fossil fuels, prioritizing renewables and electrification."

Cameron McInnes,

Global Head of Engineering at Barclays

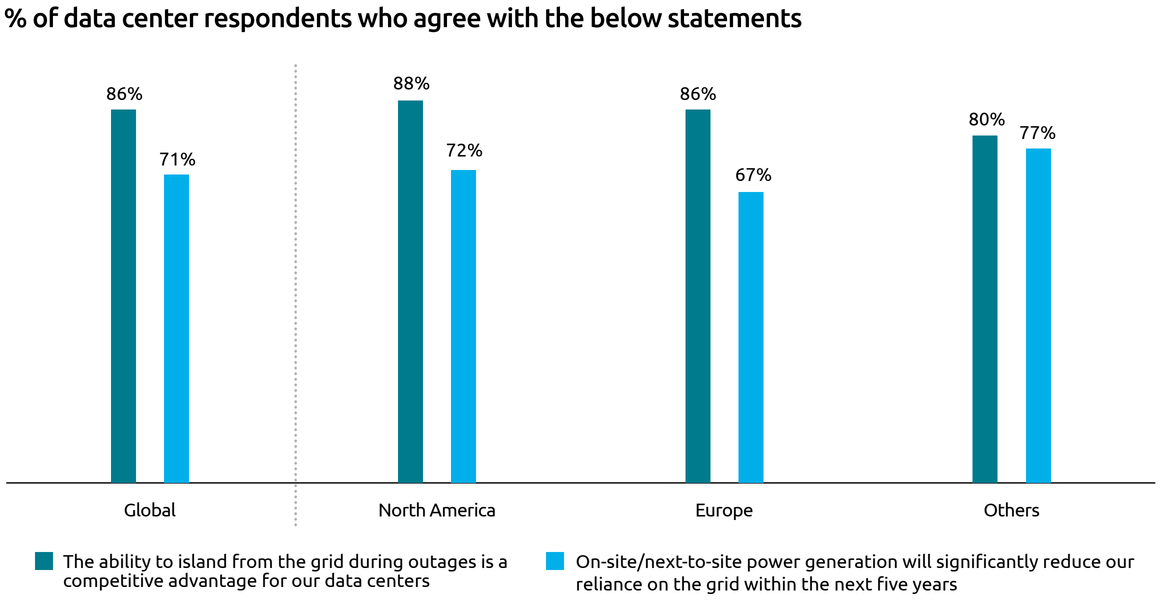
Our research also shows that 86% of data-center executives globally and 88% in North America view the ability to "island" from the grid during outages as a critical competitive advantage. Moreover, more than seven in ten say on-site or next-to-site power generation will significantly reduce reliance on the grid within the next five years (see Figure 14).

71%

of data-center executives say on-site or next-to-site power generation will significantly reduce reliance on the grid within the next five years.

Figure 14.

Most data centers expect on-site power to cut grid reliance and boost resilience



*Note: "Others" includes executives from APAC and Latin America.

Source: Capgemini Research Institute, Powering data centers, January 2026, N = 171 executives globally from data centers owning/operating organizations (North America: 75; Europe: 66; APAC: 25; Latin America: 5).

The growing adoption of on-site power models by data centers marks a structural shift, positioning **on-site power as both a cooperation and competition model for electricity organizations:**

- On one hand, on-site generation – whether fuel cells, gas turbines, or hybrid systems – offers a pragmatic pathway to serve demand that the grid cannot immediately accommodate, particularly in regions constrained by limited transmission capacity or connection delays. When visible, governable, and integrated into grid operations, utility-owned or jointly operated on-site generation provides bridging capacity, generates contracted revenue, protects the rate base, and ensures visibility of critical loads. These assets can also be enrolled into demand-response (DR) and virtual-power-plant (VPP) programs, allowing electricity organizations to dispatch flexibility during periods of system stress. Over time, such assets can be integrated into the wider grid to provide supplemental capacity and strengthen localized resilience – transforming large, high-demand customers into long-term system assets rather than short-term planning risks.
- On the other hand, widespread on-site power deployment introduces new operational and market challenges. Uncoordinated switching between grid supply, DR/VPP participation, and fully islanded operation reduces load predictability, complicating dispatch, reserve planning, and real-time balancing.

  In the US, Northern Virginia's Data Center Alley, home to over 200 data-center facilities, illustrated this risk during the summer of 2025, when routine safety triggers caused around 60 data centers to switch simultaneously to on-site generators. This created excess power that forced PJM and Dominion Energy to curtail generation to prevent wider outages. The frequency of such "near-miss" events has increased sharply as the penetration of large, partially self-supplied data-center loads has grown.[75]

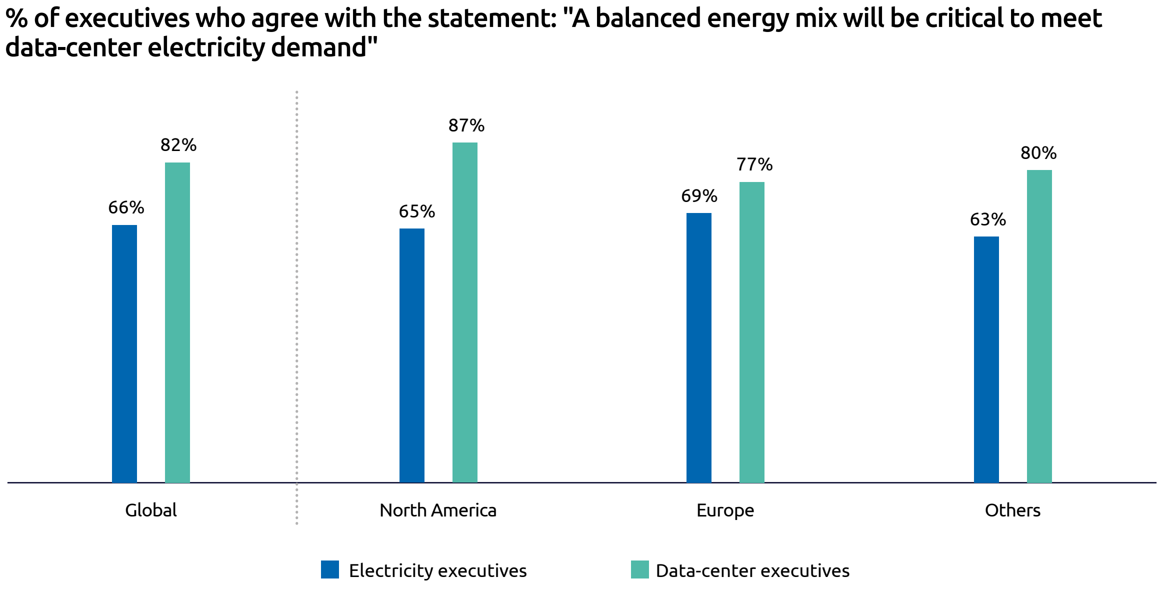
  If poorly coordinated, on-site generation can fragment demand, erode electricity-organization revenues, and shift costs onto other customers. This reinforces the need for electricity organizations to actively orchestrate hybrid supply models, by defining clear DR/VPP participation rules, switching protocols, telemetry standards, and emissions constraints, rather than remaining passive grid providers.

3.2. Sustainable data-center growth demands a balanced, diversified energy mix

Both electricity and data-center executives believe that no single energy source can meet growing demand. Gyaneshwar Payasi, Executive Director and Board Director for multiple subsidiaries of Power Grid Corporation of India Limited, shares: *"Data centers may need a mix of different power sources to manage their variability, meet green-energy requirements, and control commercial implications, alongside solutions for long duration energy storage and ramping power capacity."*

As Figure 15 shows, more than four in five data-center professionals (82% globally and 86% in the US) believe that maintaining a balanced energy mix will be essential to meeting data centers' electricity demands. This view is also shared by 66% of global and 69% of European electricity executives.

Figure 15.
Most electricity and data-center executives agree that a balanced energy mix is required



*Note: "Others" includes executives from APAC and Latin America

Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations (North America: 232; Europe: 220; APAC: 90; Latin America: 70), N = 175 executives globally from data centers owning/operating organizations (North America: 75; Europe: 70; APAC: 25; Latin America: 5).

Rapid renewables growth cannot meet always-on data-center demand

Utilities and data centers are expanding their renewables fleets to try to accommodate rising demand sustainably:

- According to the IEA, global electricity generation from renewables, driven by record solar photovoltaic (PV) installations, now surpasses coal.[76]
- TotalEnergies landed a massive solar deal to power Google's expanding Texas data centers. The organization signed two long-term power purchase agreements (PPAs) totaling 1 GW of capacity, or about 28 TWh of electricity over 15 years. This is the largest renewables PPA TotalEnergies has signed in the US to date.[77]

But demand for electricity is also rising rapidly, outpacing renewable energy's ability to deliver consistent, high-density power. Due to intermittency and seasonal changes, variable renewables, without firming resources such as storage, nuclear, or natural gas, face challenges in meeting the continuous high-load requirements of data centers and AI workloads. As Figure 16 shows, three-quarters of executives (78% of electricity executives and 73% of data-center executives) concede that renewable energy alone cannot meet data-center demand. Delays in the permitting process for renewable energy farms are also cited by 74% of utilities and 68% of data-center organizations. In our research, 65% of generation and grid organizations highlight intermittency of renewables as a key supply challenge.

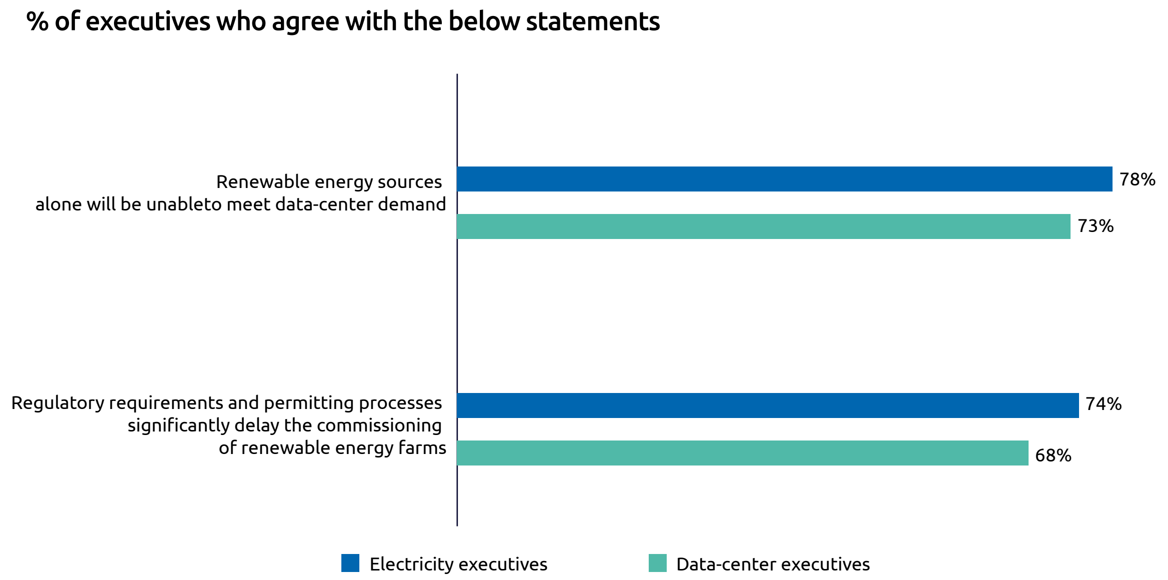
The battery energy storage system (BESS) market saw a 44% expansion in 2024, with more than 69 GW of new BESS capacity installed globally.[78] Battery storage is a key component in AI-era infrastructure, supporting power reliability and quality, grid stability, data-center load management, and enabling future grid-data center collaboration models. Investment firm Jefferies found that "hyperscalers present a 20-GW opportunity" for BESS through 2035.[79]

In our research, more than half (54% of electricity and 56% of data-center executives) are investing in energy storage solutions to compensate for the intermittency of renewable sources. Brian Nelson, an electrical engineer at ABB who works on grid infrastructure and power systems, says: *"Flexibility is going to become a form of currency. The good news is that limited demand shifting, combined with storage, can delay or eliminate the need for costly grid upgrades. On-site storage allows operators to maintain power quality, ride through disturbances, and continue operating during outages."*[80]

Nuclear momentum is building – but timing and scalability are challenges

IEA estimates that nuclear energy, together with renewables, will generate about half of all global electricity by 2030, up

Figure 16.
Three in four executives say renewables alone cannot reliably meet data-center demand



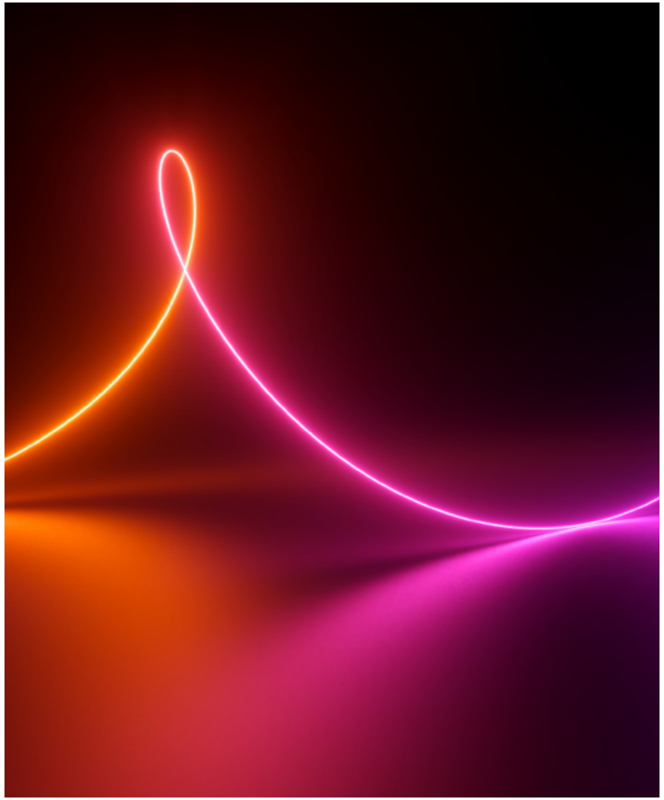
Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations, N = 175 executives globally from data centers owning/operating organizations.

from 42% today.[81] The European Commission projects European nuclear installed capacity to increase from 98 GW in 2025 to 109 GW by 2050.[82] A project director at GE Vernova Hitachi Nuclear Energy elaborates on nuclear's land-efficiency advantage: *"Nuclear or gas turbines can produce 1,000 MW from just 40 acres, while wind or solar with batteries would require about 20,000 acres."* GE Vernova and Hitachi have signed a memorandum of understanding (MoU) to pursue BWRX-300 SMR deployments in Southeast Asia.[83] In our research, 41% of data-center executives say that SMRs are a key investment area for their organization.

- In January 2026, Meta signed a two-decade power deal to secure up to 6.6 GW of nuclear capacity.[84]
- In October 2025, Google partnered with NextEra Energy to reopen a decommissioned nuclear plant in Iowa.[85] Google has also partnered with Kairos Power, an SMR startup, to deploy an advanced nuclear plant connected to the Tennessee Valley Authority's electricity grid by 2030.[86]
- In 2024, Microsoft inked a $16-billion deal with Constellation Energy to restart the Three Mile Island plant in Pennsylvania.[87] In 2023, Microsoft also signed a PPA tied to a planned fusion facility developed by Helion Energy, reflecting a willingness to invest in high-density energy at scale.[88]
- Amazon led an approximately US$500-million investment round in X-energy, which is pioneering advanced SMRs and high-assay low-enriched uranium (HALEU) fuel.[89] Shalabh Jhalawad, Head – Global Power and Energy Solutions at AWS, shares, *"Nuclear energy is a critical pillar of our carbon free energy strategy because it provides safe, reliable, and abundant baseload power at scale, essential for 24/7 data center operations. In 2024, we made a major commitment with Energy Northwest to develop our first SMR, expected to come online in the early 2030s. In parallel, we have secured near-term carbon-free baseload capacity through projects such as a 960-megawatt existing nuclear facility in Pennsylvania, and we are working with additional utilities to explore how SMRs can be deployed at scale in the future."*

But nuclear energy (encompassing both large reactors and SMRs) still faces several formidable hurdles to progress from high costs, long construction timelines, supply-chain constraints, and waste-management issues. Experts agree that nuclear power, particularly SMRs, would take years to deploy at scale. As Figure 17 shows:

- Most (82% of electricity and 61% of data-center executives) believe SMR deployment timelines lag expected data-center hypergrowth over the next three to five years.
- Most (78% of electricity and 66% of data-center executives) also believe that supply-chain limitations could slow SMR and advanced nuclear deployment, limiting their near-term role in powering data centers.

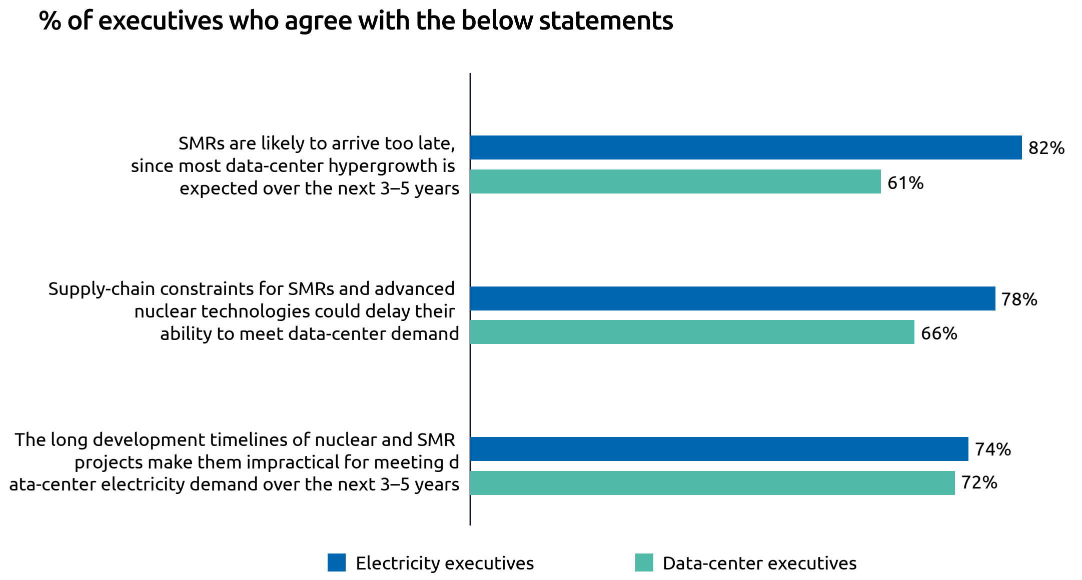


"Nuclear energy is a critical pillar of our carbon free energy strategy because it provides safe, reliable, and abundant baseload power at scale, essential for 24/7 data center operations. In 2024, we made a major commitment with Energy Northwest to develop our first SMR, expected to come online in the early 2030s. In parallel, we have secured near-term carbon-free baseload capacity through projects such as a 960-megawatt existing nuclear facility in Pennsylvania, and we are working with additional utilities to explore how SMRs can be deployed at scale in the future."

Shalabh Jhalawad

Head – Global Power and Energy Solutions at AWS

Figure 17.
Most executives say nuclear and SMRs won't scale fast enough



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations, N = 175 executives globally from data-centers owning/operating organizations.

Utilities and data centers are looking at natural gas as a near-term solution

Globally, 68% of electricity and data-center executives agree that faster development timelines for natural gas position it as a key power source for data centers over the next three to five years. This view is even more pronounced in the US, where 71% of electricity executives and 73% of data-center executives share this perspective. Data-center executives also emphasize the importance of gas-generation flexibility: 77% say the flexibility of gas power plants is critical to offsetting intermittency of renewable assets. Additionally, 72% agree that gas plant flexibility is essential to managing the variability of IT loads.

The US had the largest share of gas-fired power capacity in development in 2025, totaling almost 252 GW, accounting for nearly one-quarter of the world's total. More than one-third of this capacity is slated for on-site sources for data centers.[90] In our research, 62% of US-based integrated utilities, power producers, and energy services organizations are investing in natural gas to meet future data-center demand. New natural-gas capacity, both in utility-owned assets ("front-of-the-meter") as well as data-center-owned electricity supply (BTM), is growing:

- Dominion Energy in Virginia, US, has delayed the closure of Clover Power Station, a coal-powered "peaker" plant.[91]

In addition to delaying peaker retirements, Dominion has proposed building new gas-powered generation, including a 1-GW peaker plant in Chesterfield.[92] Houston-based NRG Energy plans to double its power-generation capacity by acquiring 18 natural-gas power plants from LS Power in a deal valued at $12 billion.[93]

- When it comes to BTM gas-based generation, Boom Supersonic, which is developing the world's fastest airliner, inked a $1.25-billion agreement with developer Crusoe, which is building a suite of data centers for OpenAI. Boom agreed to provide Crusoe with 29 jet-engine gas turbines that the developer could position at data centers across the US.[94] Meta's data center in El Paso, Texas, will draw fuel from more than 800 different mobile mini-turbines. For the initial five-year "bridge period" (starting in 2027), the data center would remain unconnected to the grid and would run behind-the-meter.[95]

The opportunity is significant, but the execution risks remain. As mentioned previously, lead times for large gas turbines are extending, which limits the speed at which new plants can be built. Moreover, the ongoing geo-political tensions are also challenging reliance on gas for certain regions. Before the current crisis, around 20% of the world's supply of natural gas transited the Strait of Hormuz in the form of liquified natural gas (LNG). Global LNG prices have climbed by roughly 80% since the conflict began on February 28, 2026.[96]

Executives also acknowledge sustainability-related challenges with natural gas. In our research, 59% of electricity executives and 63% from data centers say that increased reliance on gas generation in key markets conflicts with their decarbonization commitments. Natural gas with carbon capture, utilization, and storage (CCUS) offers one possible demand solution while simultaneously achieving decarbonization goals. In October 2025, Google announced a 400 MW gas-fired power plant with carbon capture in Illinois, explicitly positioning gas with CCS as a critical source of clean, firm power for future data center growth.[97] However, this is a technically and economically challenging path. Low utilization rates, dispersed plant locations, and high transport and capture costs mean deployment at scale is still limited.

Most executives (75% in electricity and 63% in data centers) view natural gas primarily as a **transitional solution** until renewable energy and storage technologies can scale. This perception directly shapes investment concerns: 79% of electricity and 58% of data-center executives believe that investments in natural-gas infrastructure today could create significant stranded-asset risks within the next decade.

68%

of electricity and data-center executives agree that faster development timelines for natural gas position it as a key power source for data centers over the next three to five years.

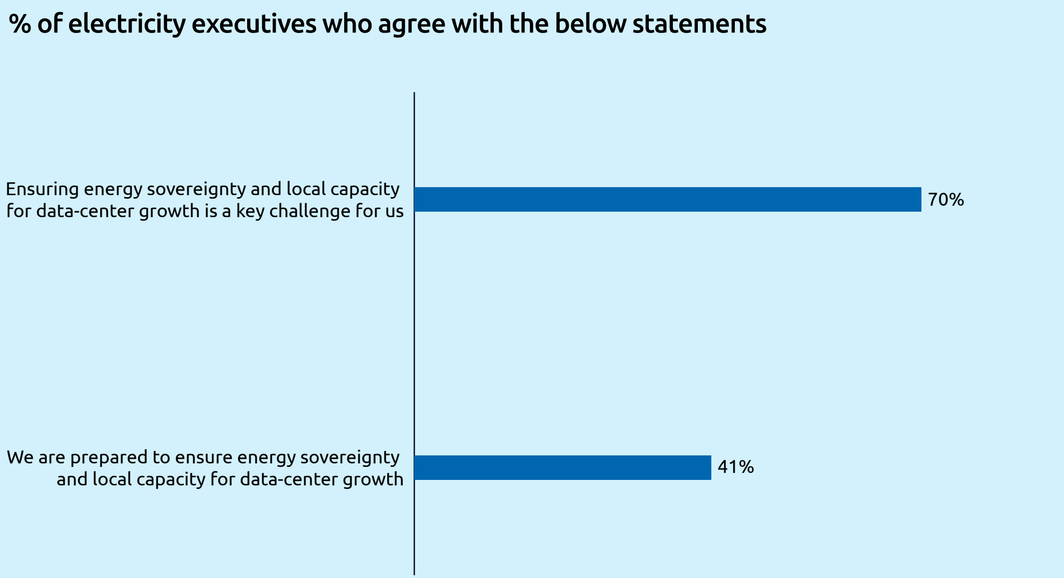
Energy sovereignty emerges as a strategic priority

Geopolitical conflicts continue to exacerbate volatility in global energy markets and disrupt maritime logistics across key chokepoints (for example, the Strait of Hormuz, as a result of the recent war in Iran). In response, energy sovereignty has moved up national agendas, with governments prioritizing domestic supply security, resilient supply chains, and greater control over critical energy and cleantech assets.

This shift is reshaping electricity-industry economics. China's dominance across clean-energy manufacturing and critical minerals has heightened concerns over import dependence, prompting Europe to push sovereignty-driven policies to localize supply chains, while pursuing decarbonization. In contrast, the US is combining a sovereignty-first stance with climate skepticism, favoring domestic fossil fuels, liquefied natural gas (LNG) exports, and nuclear, alongside tighter trade and tariff regimes.[98]

For electricity organizations, these dynamics are translating into longer equipment lead times, greater cost dispersion, and growing pressure to diversify technologies, fuels, and suppliers to reliably support data-center expansion. The importance of energy sovereignty is being felt most acutely by Europe-based

Figure 18.
Most European electricity organizations see energy sovereignty as a major challenge



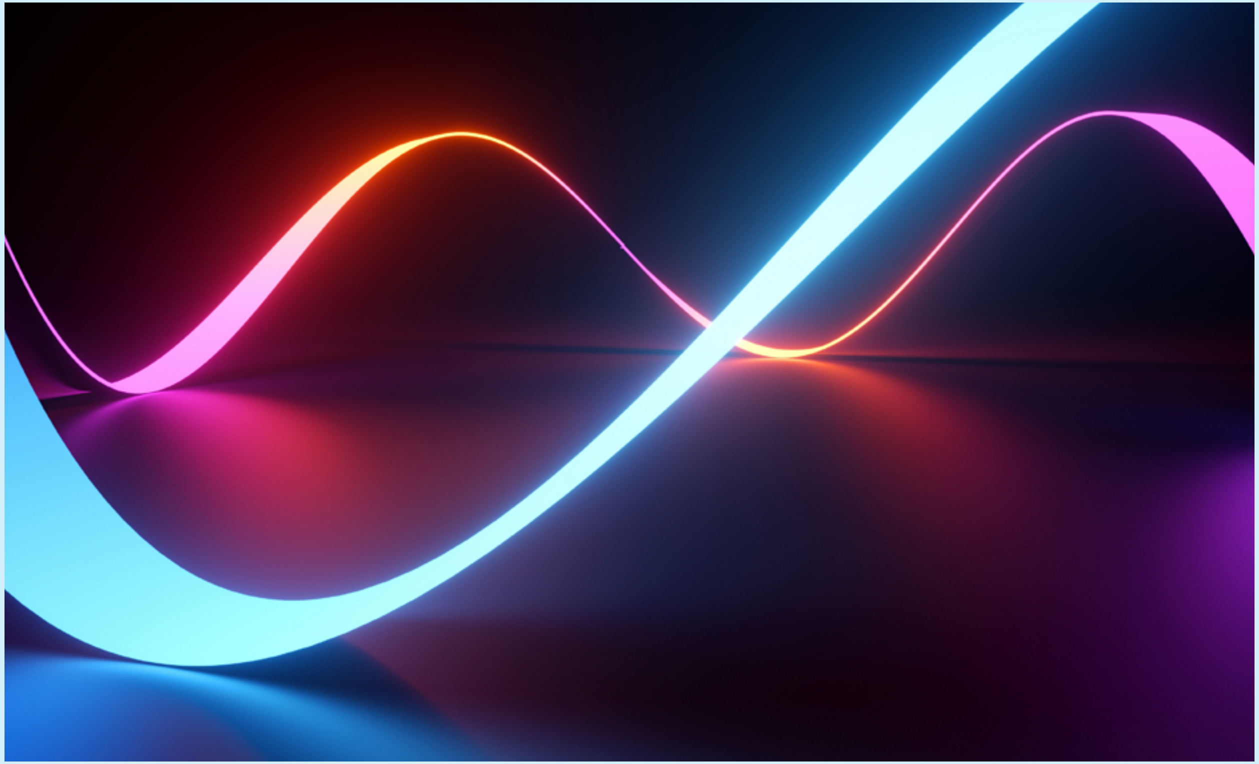
Source: Capgemini Research Institute, Powering data centers, January 2026, N = 220 executives from European electricity organizations.

electricity organizations: nearly three in four (70%) executives from European electricity organizations in our research acknowledge that ensuring energy sovereignty and local capacity for data-center growth is a key challenge today, and only 41% feel prepared for it (see Figure 18). Preparedness levels are slightly higher in France, where 50% of executives feel prepared, but significantly lower in Germany, where only 26% report being prepared.

European electricity companies need to strengthen energy sovereignty by speeding up renewables deployment, diversifying supply sources, and modernizing grids to improve efficiency, security, and reduce reliance on imported fossil fuels. Organizations that embed sovereignty considerations into procurement, technology choices, and capacity planning will be better positioned to power data centers reliably.

41%

of executives from European electricity organizations say they are prepared to ensure energy sovereignty and local capacity for data center growth.



04 AI promises to power the future

4.1. AI could unlock major efficiency and operational gains

AI is both a pressure point and a problem-solver. It enables more flexible operations, earlier risk detection, and better-informed decision-making, and is becoming integral to complex grid operations. According to the IEA, AI-enabled operations and maintenance could deliver up to $110 billion in annual cost savings by 2035 and free up 175 GW of additional transmission capacity on existing lines, strengthening both system reliability and operational efficiency.[99] The US Department of Energy estimates that AI-enabled improvements in energy-storage operations could reduce renewable energy curtailment by up to 50% over the next decade.[100]

AI is expected to significantly boost network resilience and grid performance. In our survey, at least six out of ten electricity executives anticipate significant gains (>10%) in reducing failures, improving productivity, and restoring outages (see Figure 19).

AI can also unlock major efficiencies across grid operations and asset performance by optimizing power flows in real time and balancing supply and demand in renewables-heavy networks. AI-driven systems dynamically manage voltage, frequency, and congestion, strengthening stability and enabling faster fault detection. This, in turn, cuts downtime and improves customer experience (CX). A vice president and head of sourcing for procurement and supply strategy from a leading global integrated energy solution provider comments: *"We use AI and ML for power- and gas-price forecasting, combining weather, load, renewables output, and market data. This has reduced forecasting errors by 15–30% and improved our response to price spikes and regime shifts."*

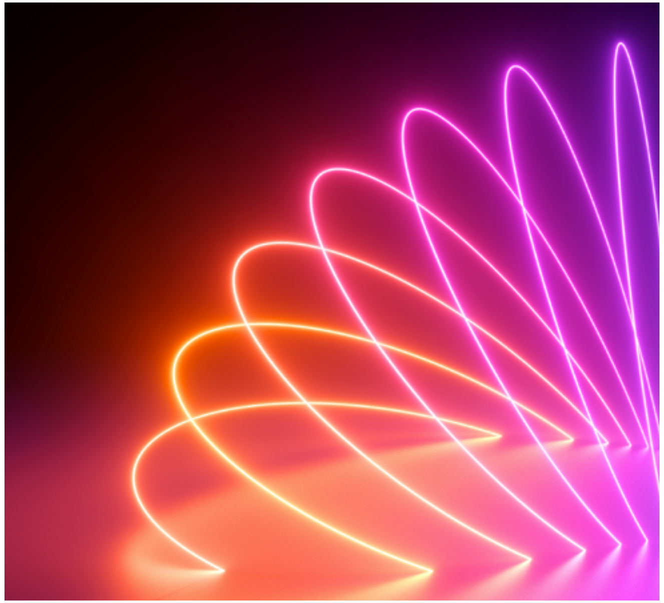
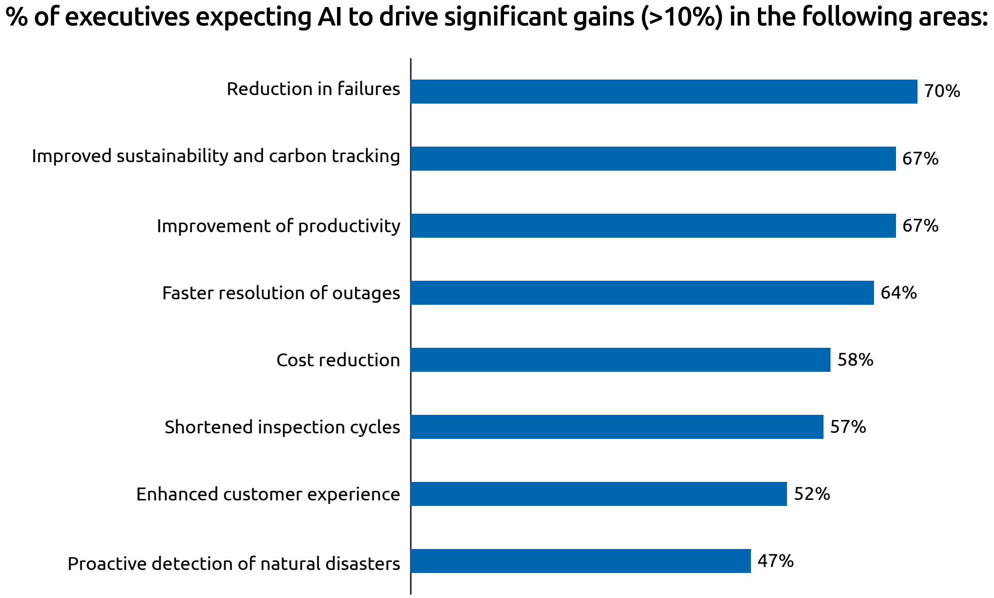


Figure 19.
Most organizations expect AI to reduce failures and enhance reliability and asset performance



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations.

Below are some examples of the benefits derived:

- A major utility used ML models to monitor vibration data across 500+ transformers, detecting bearing failures three to four weeks early, cutting emergency repairs by 60%, and delivering $8 million in annual savings on a $2 million investment, while preventing outages affecting over 50,000 customers.[101]
- Canadian utility Hydro-Québec's AI-enabled load-forecasting model improved visibility into sudden demand shifts and overall system reliability. During a 2024 heatwave, Hydro-Québec reported that legacy models failed to capture an atypical load pattern, requiring ~1,500 MW of manual corrections, while the AI-based model correctly anticipated the issue.[102]

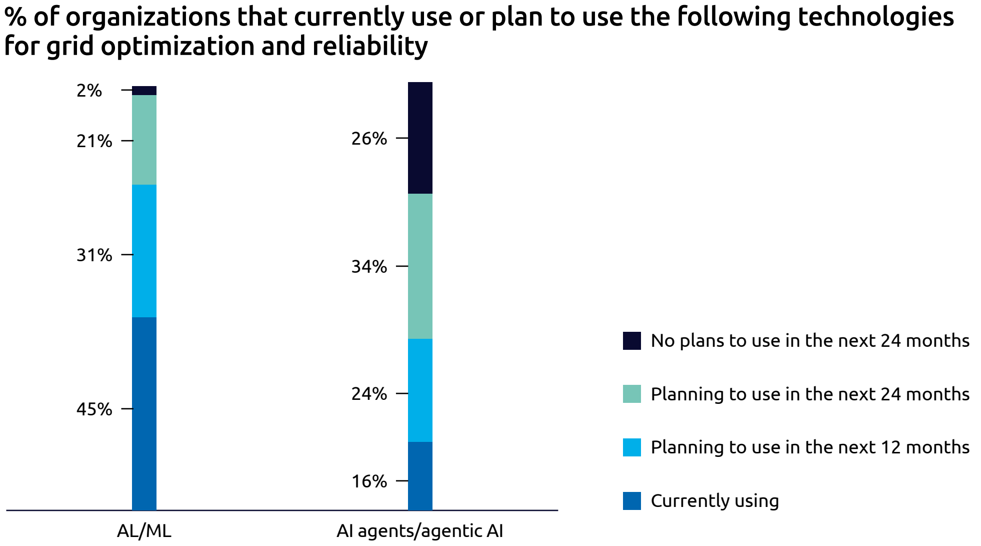
4.2. Despite growing interest, most electricity utilities are yet to reach advanced AI maturity

AI is generating significant momentum across the energy sector, especially for managing data-center energy demand. For example, National Grid Partners has invested in Aina Climate AI Ventures as part of its $100 million commitment to backing AI-driven energy startups.[103] Aina's flagship startup, GridCARE, uses AI to identify underutilized grid capacity, enabling faster data-center deployment in low-demand areas and easing grid strain from data centers and EV charging.[104]

However, current adoption levels show that electricity organizations are just beginning to operationalize these technologies. Gartner projects that, even by 2027, only 40% will have AI driven operators in their control rooms, reflecting the sector's cautious approach.[105] As shown in Figure 20:

- 45% of executives from electricity organizations say they are currently using AI/ML (including PoCs, pilots, and partially or fully scaled initiatives) for grid optimization and reliability, while 51% plan to adopt it in the next couple of years.
- Adoption of AI agents/agentic AI remains nascent; only 16% currently use these technologies (across PoCs, pilots, and partially or fully scaled initiatives) for grid optimization and reliability, while 58% plan to deploy them over the next two years.

Figure 20.
Less than half of electricity organizations currently use AI/ML for their grid optimization



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations.

4.3. Picking the winning use cases: From pilot to impact

In a sector where reliability is non-negotiable, organizations should focus on use cases directly tied to operational KPIs and supported by strong governance and safety controls. It is also important to identify use cases where functionality justifies the cost, enabling organizations to prioritize investments based on clear returns and affordability.

The examples shown in Figure 21 illustrate how AI is being embedded into the core of energy infrastructure, supporting not just automation, but adaptive, context-aware systems that can respond to dynamic conditions.[106]

45%

of executives from electricity organizations say they are currently using AI/ML for grid optimization and reliability.

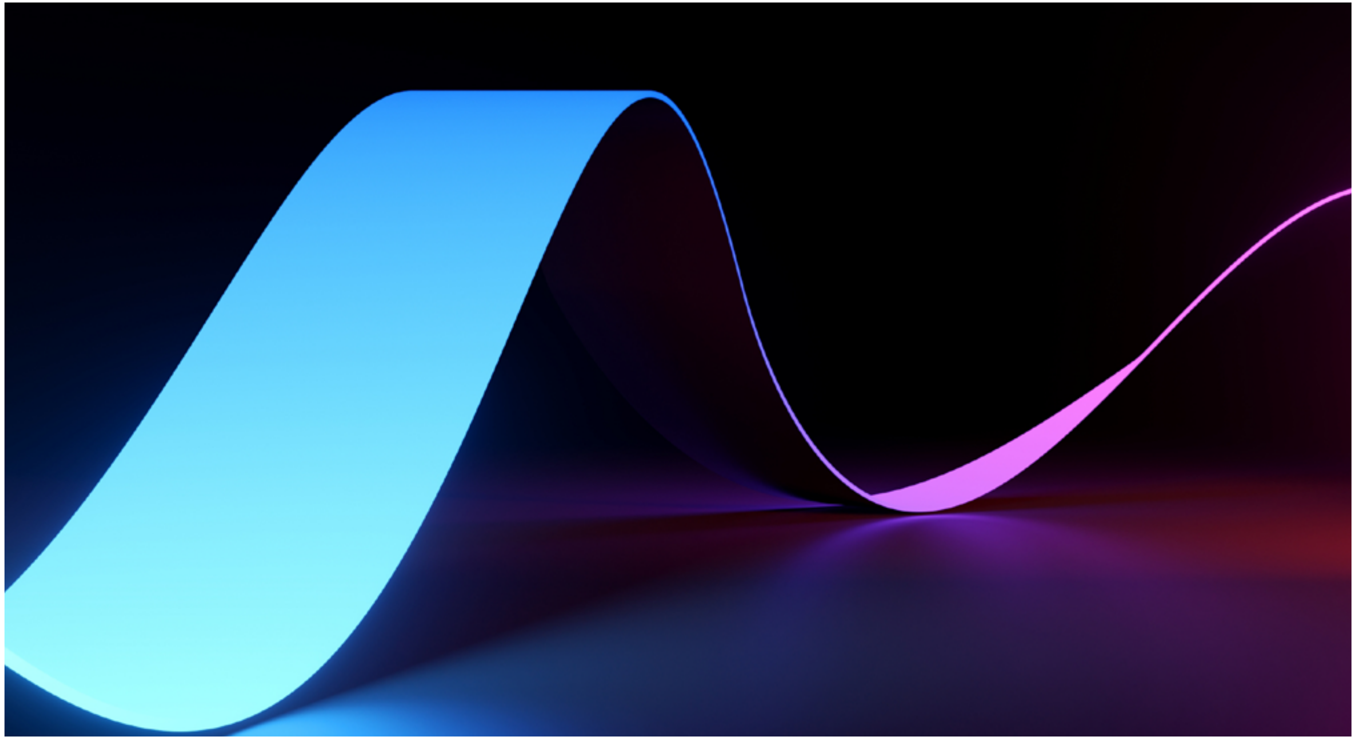


Figure 21.
Examples of AI use cases across energy organizations

Use case	Organization	Application	Benefits
Energy demand prediction	UK Power Networks, a UK distribution system operator (DSO)	Anticipates energy demand using weather, time-of-use, and user behavior	Improves real-time supply-demand balance[107]
Predictive maintenance	AES, a US energy organization	Analyzes existing data from wind-turbine manufacturers and harnesses physics-based models, which, combined with the H2O AI Cloud, generates predictive diagnostics	Reduces outages and improves maintenance efficiency[108]
Crisis scenario simulation	Siemens Energy and NVIDIA	Uses AI-powered digital twins to simulate grid disturbances	Optimizes utility operations, maintenance, and response plans for emergencies and natural disasters[109]
Operator decision support	RTE, a French electricity transmission system operator (TSO)	Invests in Apogée, a smart assistant that screens information and uses AI to convey top-priority data to dispatchers	Enables faster, more informed decision-making in critical situations[110]
Renewable energy optimization	BP, a British multinational oil and gas organization	Applies AI-driven analytics to predict output from its solar and wind operation	Optimizes energy flow and ensures efficient integration into the grid[111]
Capital allocation modeling	A multi-energy company	Uses AI to target 35% of its investments toward low-carbon initiatives, assessing each project not just for financial return, but for its contribution to the energy transition	Aligns capital allocation with decarbonization goals while optimizing returns and risk[112]

"We're using AI-based tools and mean-average modeling to produce five-year energy forecasts, and it's proving very effective. AI has had a significant impact on how we analyze and predict consumption, improving both accuracy and decision-making."

Jason Jackson,

Program Director at Siemens Energy

Our research shows that electricity organizations already deploying AI/ML/agentic AI technologies are concentrating on a small number of high-impact use cases today. As Figure 22 shows, six out of ten electricity organizations already using AI use it to **forecast loads and anticipate demand shifts**, while an additional 38% plan to do so in the next 12–24 months. Jason Jackson, Program Director at Siemens Energy, shares, *"We're using AI-based tools and mean-average modeling to produce five-year energy forecasts, and it's proving very effective. AI has had a significant impact on how we analyze and predict consumption, improving both accuracy and decision-making."*

Predictive maintenance also enables utilities to reduce downtime by more than half and extend asset life by up to 40%.[113] More than half (54%) of electricity organizations already using AI do so for predictive maintenance, while 41% expect to follow in the next 12–24 months. Pacific Gas & Electric deployed ML models that combine historical asset performance with real-time sensor data to predict equipment failures, reducing unplanned downtime by 30%.[114]

Additionally, AI-powered platforms learn continuously from operational data to detect anomalies, prevent unauthorized access, and enable faster, more autonomous cyber-risk response. India is preparing to embed AI into the operations of its national electricity grid – the largest unified power grid in the world – to enable real-time risk detection, fault prediction, and market manipulation surveillance. *"We are seeing the threat perimeter blur. A cyberattack or price manipulation at one node can ripple across the system in seconds. AI will be essential to watch for patterns humans can't spot in real time,"* says Samir Chandra Saxena, Chairman and Managing Director of Grid-India.[115] In our research, 30% of electricity organizations already using AI do so for cyber-threat detection.

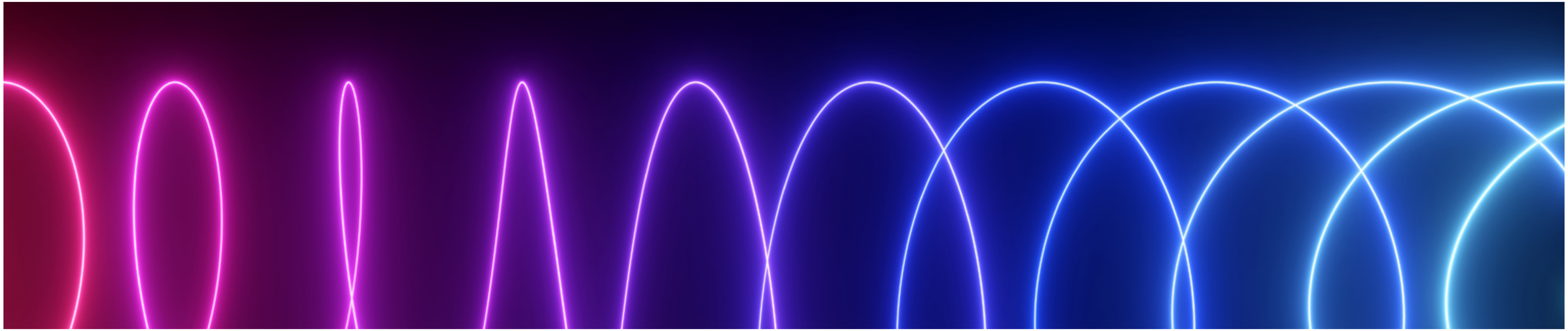
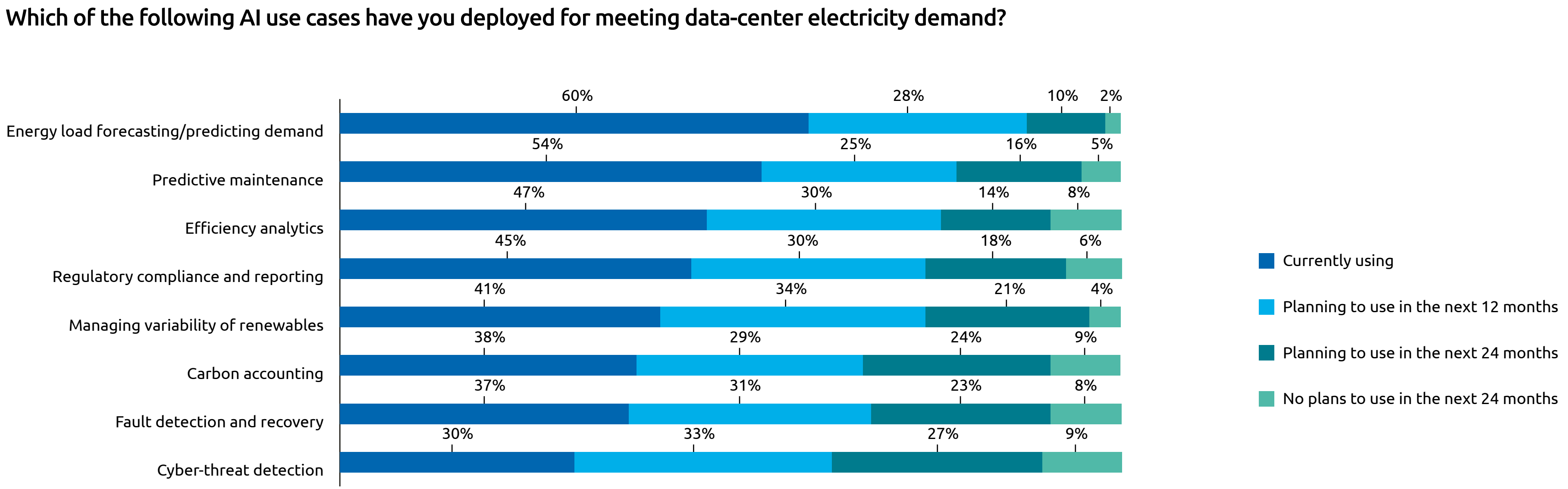


Figure 22.
Electricity organizations are focusing on various high-value use cases for AI implementation



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 341 executives globally from electricity organizations that are currently using AL/ML or AI agents/agentic AI or who agree with the statements: "We are using AI-driven tools and analytics to optimize grid capacity and manage rising data-center demand" or "We are using AI as a decision-support tool, rather than an autonomous controller."

"AI in energy is not just a technology upgrade—it is a fundamental shift in how the system is designed, planned, and operated. To capture its full value, companies must build strong data foundations, rationalize their workflows to enable faster decision-making within their safety framework, and deliver real operational value. When done right, AI enables a new level of grid intelligence—making power systems more predictive, more flexible, and able to manage the growing complexity of data-center demand. For the first time, we can optimize the energy value chain end-to-end—combining engineering, digital, and capital efficiency to balance growth, volatility, and sustainability at scale."

Claire Gauthier,

EVP, Global Energy & Utilities Leader, Capgemini

05 How energy firms must evolve for the next phase of data-center growth

Drawing on our survey analysis and interviews with energy organizations, data-center owners and operators, and industry experts, as well as our own experience in this area, we recommend the following actions for electricity organizations to power the next phase of data-center growth.

Figure 23.
A five-pillar recommendations framework

01	02	03	04	05
Anticipate and shape demand: Move from reactive requests to proactive, portfolio-level demand foresight	**Secure reliable and resilient energy supply:** Ensure capacity and speed through portfolio rebalancing and infrastructure transformation	**Unlock flexibility:** Simplify connection, modernize tariffs, and enable demand-side participation	**Strengthen ecosystems:** Enable intelligent supply chains and ecosystem-wide coordination	**Build a future-ready operating model:** Operationalize AI and scale future-ready talent
Institutionalize demand forecasting and customer screening	Rebalance the energy portfolio to meet data-center load profiles	Streamline connection and regulatory processes	Build resilient, intelligent supply chains for grid and data-center delivery	Scale AI and digital technologies across planning and operations
Steer data-center growth toward power-ready locations	Accelerate grid and infrastructure modernization	Introduce simplified, innovative tariff and pricing models	Deepen ecosystem collaboration across the data-center value chain	Build the talent and capabilities required for system transformation
	Deploy decentralized capacity to accelerate delivery	Expand demand response and flexibility programs for data centers	Integrate community and sustainability considerations into planning	

Source: Capgemini Research Institute analysis.

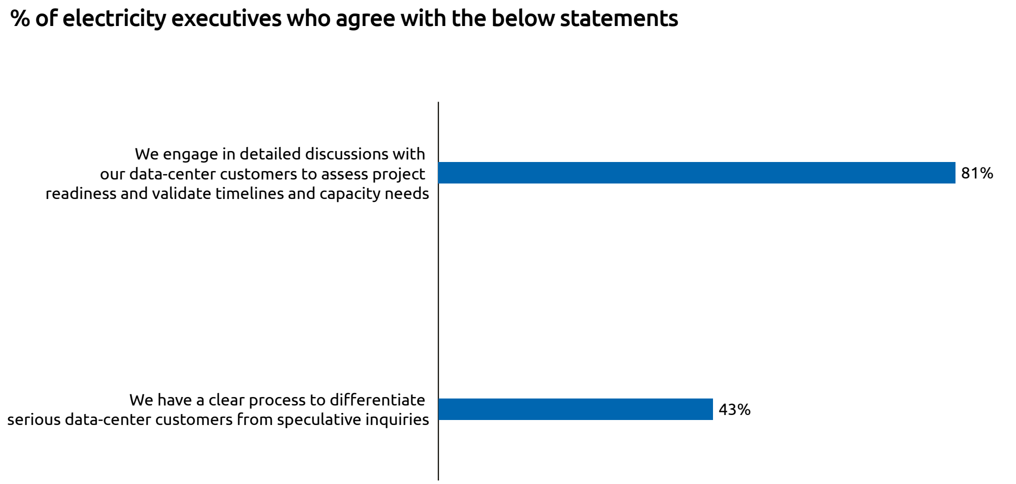
5.1. Anticipate and shape demand: Move from reactive requests to proactive, portfolio-level demand foresight

Institutionalize demand forecasting and customer screening

Accurate demand forecasting enables electricity organizations to prevent outages, strengthen grid security, and plan infrastructure investments more efficiently, delivering long-term cost and reliability benefits. Yet data centers frequently file parallel connection requests with multiple utilities, and only a fraction of proposed projects actually get built. These “phantom loads” cloud pipeline visibility raise the risk of both over- and under-planning for grid operators and regulators.

While most (81%) electricity organizations say they hold detailed discussions with data-center customers to assess project readiness, requirements, and timelines, less than half (43%) report having a clear, codified process to differentiate serious projects from speculative inquiries (see Figure 24).

Figure 24.
Only 43% of electricity organizations have a clear process to identify serious data-center customers



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations.

Utilities should institutionalize demand intelligence by:

- **Applying scenario-led demand forecasting** to stress-test capacity needs across AI growth, location, and timing uncertainties
- **Standardizing customer screening and gating** to clearly separate committed demand (MW, timelines, financing, permits) from speculative inquiries
- **Introducing readiness scoring and milestone-based queue management** to prioritize credible projects and release capacity tied to stalled ones
- **Requiring deposits and "truthful MW" declarations**, supported by standardized data exchange with data-center customers
- **Embedding contractual rightsizing and penalty clauses** to discourage speculative requests and enable mid-course capacity adjustments as projects evolve
- **Maintaining portfolio-level visibility of the demand pipeline** to improve allocation of constrained capacity and reduce stranded-asset risk
- **Aligning capital planning with demand intelligence**

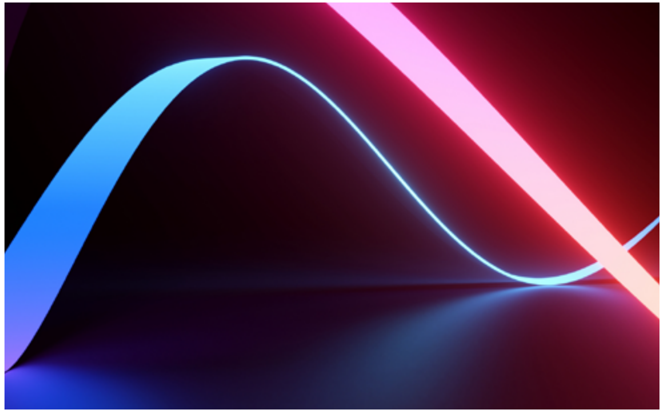
CyrusOne's Marquardt elaborates on industry expectations: *""Utilities should embrace a more forward-looking policy framework that proactively contemplates grid and data center flexibility, identifies constrained capacity, and advances targeted solution sets, including grid-enhancing technologies to relieve transmission congestion and strategically sited upstream battery storage to manage system peaks and valleys driven by broader customer demand. At the same time, utilities should modernize grid-planning practices and reform interconnection processes to better distinguish viable projects from speculative requests, recognizing that industry investment cycles are now moving far faster than traditional five-year planning horizons."*

Steer data-center growth toward power-ready locations

Prioritizing "ready-to-go" power-enabled zones helps electricity organizations to manage data-center growth by improving grid reliability, optimizing capital allocation, accelerating connections, and aligning expansion with sustainability and local resource constraints.

Yet only a third of electricity organizations are actively identifying and promoting such zones (see Figure 25). Collaboration is also immature: just 36% report working with data-center customers on site/location selection, with another 31% planning to do so in the next one to two years.

"Electricity providers need to shift from reactive connection models to proactive planning by developing pre-approved, fast-track data center zones where grid capacity, substations, and electrical infrastructure are secured in advance. De-risking power availability upfront is essential to accelerate deployment and support the rapid growth of AI-driven demand," says Matthieu Gallego from The Blob Company.



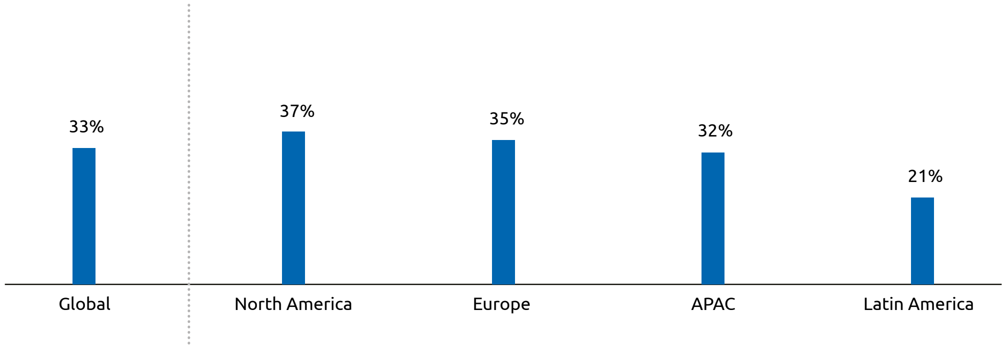
43%

of electricity organizations say they have a clear, codified process to differentiate serious projects from speculative inquiries.

Figure 25.

. Only a third of energy organizations are optimizing data-center location

% of electricity organizations identifying and promoting 'ready-to-go zones' for data-center development



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations.

Electricity organizations should:

- **Prioritize zones with spare substation and feeder capacity** or clear near-term upgrade headroom that can support phased load growth with incremental grid upgrades over the long term.
- **Encourage data-center development near high-voltage transmission lines and primary substations** to cut connection costs and timelines, while reducing permitting and construction risks.
- **Assess and publish grid reliability indicators** to steer data-center siting toward resilient, low-congestion areas and away from zones with single points of failure, unless upgrades are planned.
- **Promote flexibility-enabled zones,** with solutions such as on-site or near-to-site storage, demand response, and BTM generation to integrate large, variable loads without compromising grid stability.
- In order to promote power readiness, **work with local authorities** to pre-zone industrial land and fast-track sites with pre-cleared environmental approvals, and ensure water availability, cooling feasibility, fiber, transport, and skilled workforce access.

5.2. Secure reliable and resilient energy supply: Ensure capacity and speed through portfolio rebalancing and infrastructure transformation

Rebalance the energy portfolio to meet data-center load profiles

Electricity organizations must rebalance their energy portfolios to align with the scale, volatility, and reliability needs of data-center demand. This requires an agile, scenario-led approach that allows utilities to adapt to evolving demand, technology, and policy conditions.

In practice, this means optimizing existing generation assets while accelerating investment in expanding renewables, paired with firming solutions, including flexible gas capacity, energy storage, and other dispatchable resources. In our research, 64% of electricity organizations say they are investing in long-duration energy storage (or LDES, commonly defined as storage capable of discharging for eight hours or more) to address reliability gaps during high-demand periods and reduce renewables curtailment.

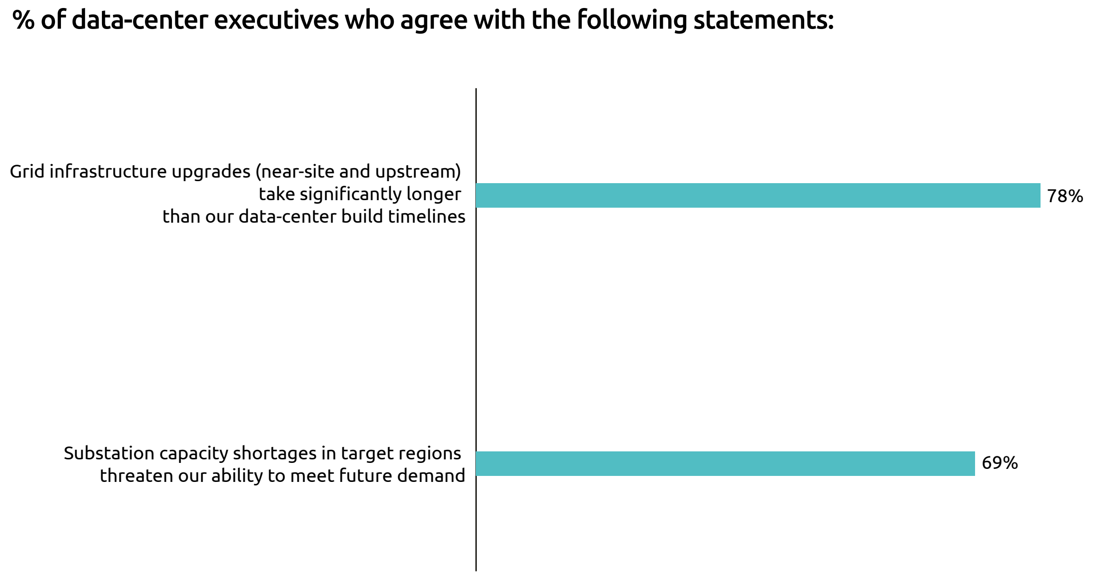
Portfolio rebalancing decisions should also inform how demand is met, prioritizing centralized, grid-connected supply for large, predictable baseload requirements, while retaining flexibility to deploy alternative or modular configurations where demand timing, uncertainty, or system constraints increase investment risk.

Over the longer term, utilities should also evaluate the possibility of using emerging low-carbon options (such as SMRs), to ensure the supply portfolio remains reliable, scalable, and investment-efficient as data-center demand accelerates.

Accelerate grid and infrastructure modernization

Energy organizations must accelerate grid and infrastructure upgrades to relieve renewable-energy bottlenecks and accommodate rapid demand growth from AI data centers and electrification, while reducing congestion and connection delays for new loads.

Figure 26.
For many data centers, grid upgrades lag data-center construction timelines



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

Below are the actions we believe electricity organizations should prioritize:

- **Direct grid investments toward high growth loads with large, predictable baseload demand**, such as AI data centers, EV hubs, industrial clusters, and renewables zones. Align investment models with long-term demand by enabling anticipatory grid builds through innovative tariffs (where feasible) and regulation.
- **Modernize and digitize grids** with smart substations, automation, and real-time monitoring, supported where appropriate by non-wire alternatives to manage variability and congestion. ESB Networks completed a rapid 24-week upgrade at its Portlaoise substation, doubling transformer capacity from 31.5 MVA to 63 MVA to support new customer connections, improve network reliability in the Midlands, and enable growing demand and renewables integration as Ireland advances its low-carbon transition.[116]
- **Unlock capacity from existing assets** before pursuing new builds by retrofitting lines with advanced, high capacity conductors, increasing transmission capacity by 50–100% without new towers or lengthy permitting. *"If we can squeeze one percent more efficiency out of a plant or a line, that's a win. It's not free, but it's a lot cheaper than building new generation. Data analytics and modeling help us understand how to optimize everything – from what's being drawn down at a meter to what a power plant is producing,"* says Richard Donaldson, Senior Vice President and Chief Information Officer for US-based Duke Energy.[117]

"The biggest bottleneck right now is how interconnection requests are processed. The system is designed to be first in, first out, with no selective treatment, and that worked well when demand and new projects were limited. But that same regulatory and ISO RTO framework isn't working today, when we have roughly 1,200 to 1,400 gigawatts of installed capacity in the US, and a backlog of around 2,600 gigawatts in interconnection queues."

Saurabh Chaugule,

Global Head - Strategy & Business Development for Energy, Utilities & AI

- **Accelerate grid delivery through collaboration** with regulators, local authorities, and communities early to shorten approvals. Partner with large customers and developers to co-develop infrastructure through shared investment models and long-term agreements.

Deploy decentralized capacity to accelerate delivery

Energy organizations should also accelerate decentralized solutions to relieve grid congestion, add capacity where grid expansion is constrained, improve resilience, and increase system flexibility, while enabling customers and communities to play a more active role in energy management and infrastructure investment.

While 70% of electricity organizations say they are accelerating investments in transmission and distribution infrastructure to meet data-center load growth, progress on decentralized alternatives remains uneven. Only 47% of electricity organizations are deploying microgrids in high-demand zones.

Decentralized solutions, including distributed energy resources, microgrids, virtual power plants (VPPs), and flexible demand assets, enable local generation, faster capacity additions, and more responsive load management. Utilities increasingly assess on-site and behind-the-meter solutions for data centers where speed to power, resilience requirements, or permitting and grid-connection delays make centralized builds impractical in the near term. When deployed at scale, these options reduce reliance on long-distance transmission, improve grid stability, integrate renewables more effectively, and provide a faster, lower-risk complement to traditional grid expansion.[118] Where technically and regulatorily feasible, surplus decentralized capacity can also be shared with the broader grid, supporting nearby communities during peak demand periods or local system stress.

Energy leaders increasingly view decentralization as part of a broader, portfolio-based response to grid constraints. *"Our priority is getting power to data centers faster in an increasingly constrained system. That means pursuing multiple pathways, from grid connections and behind-the-meter solutions to new build generation and repowering existing assets to unlock capacity and accelerate data center energization. But speed alone isn't enough – the power we deliver must also support data centers on their journey to net zero, while creating lasting value for the communities where they operate,"* says Inês Muggli, Market Development Manager at SSE plc.

5.3. Unlock flexibility: Simplify connection, modernize tariffs, and enable demand-side participation

Streamline connection and regulatory processes

Streamlining connection processes cuts delays, helps clear grid queues, and unlocks stalled renewable and storage capacity. This, in turn, enables faster, lower-cost data-center growth with improved reliability, lower system costs, and accelerated renewables integration, and strengthens overall market efficiency and competitiveness.

But 77% of data-center executives say long connection queues are delaying new capacity deployment. Saurabh Chaugule, Senior Manager – Global Strategic Partnerships – Energy and Utilities at AWS, shares, *"The biggest bottleneck right now is how interconnection requests are processed. The system is designed to be first in, first out, with no selective treatment, and that worked well when demand and new projects were limited. But that same regulatory and ISO RTO framework isn't working today, when we have roughly 1,200 to 1,400 gigawatts of installed capacity in the US, and a backlog of around 2,600 gigawatts in interconnection queues."*

"Getting more out of existing grid capacity comes down to smarter data, better insight into grid conditions, faster and more targeted investments, and using digital tools, tariffs, and demand-side flexibility to actively control and optimize the system."

Rene Kerkmeester,

Global VP Energy transition & Utilities Integrated Power, Capgemini

Electricity organizations also recognize the challenge: 85% are planning major upgrades to substations and connection points for large-load customers, and 80% report actively engaging regulators to shorten permitting and approval timelines (see Figure 27).

Yet progress on process and technology modernization remains uneven:

- Only 49% of electricity organizations say they are simplifying interconnection processes.
- Just 36% are using AI or automation to accelerate interconnection studies.

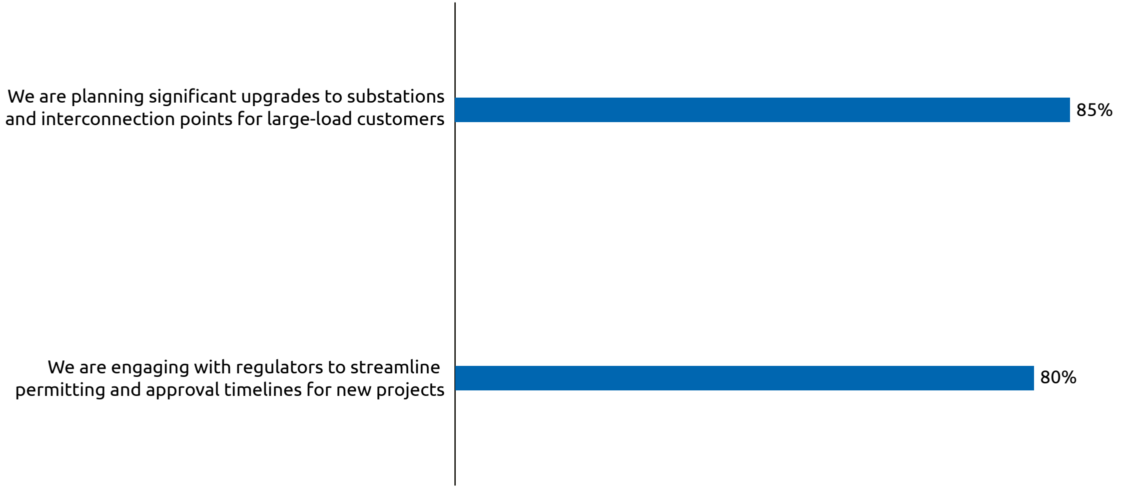
To close this gap, electricity utilities should:

- Shift from manual, fragmented processes to **data-driven, standardized, and time-bound connection models** (including clearer timelines, standardized data requirements, and fewer handoffs)
- Improve **data transparency** by creating regularly updated, publicly accessible views of grid capacity, constraints, and upgrade requirements
- Shorten and **standardize interconnection studies** to improve predictability, reduce delays, and lower overall cost

Figure 27.

Electricity organizations acknowledge connection bottlenecks

% of electricity executives who agree with the below statements



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 400 electricity executives globally from integrated utilities, power producers, and grid organizations.

Introduce simplified, innovative tariff and pricing models

Data-center operators need predictable, long term energy pricing to support investment planning and rapid capacity expansion. Yet in our survey, 68% of data-center customers cite a range of tariff structures across jurisdictions as a major challenge, complicating cost forecasting and investment decisions. This complexity is compounded by limited utility readiness to respond. In our research, just 37% of electricity executives say their organizations are prepared to explore innovative pricing and financing models for data-center customers.

Simplified and standardized pricing models can reduce cost volatility and improve long-term financial planning, while better aligning with data centers' distinctive load profiles – high baseload demand, rapid scale-up needs, and growing flexibility from workload shifting, cooling optimization, and on-site assets.

Where regulatory frameworks allow, electricity utilities should offer a limited set of clear, standardized pricing and contracting structures that make flexibility investable while preserving uptime and reliability. These include:

- Capacity-based or capacity-reservation structures, providing predictable pricing and clearer capacity signals in constrained locations or time windows
- Interruptible or curtailable structures, offering lower fixed charges in exchange for tightly bounded, pre-defined curtailment rights with safeguards for critical operations
- Flexibility-linked pricing structures, where charges, rebates, or credits are tied to verified load shifting or congestion relief at specific nodes and periods

In regulated markets, these structures are typically implemented through tariffs, while in competitive and hybrid markets, similar outcomes are often achieved through long-term PPAs or structured bilateral contracts with embedded flexibility provisions. Pricing models that bundle renewable supply, long-term PPAs or low-carbon premiums can also help data-center operators meet decarbonization goals, while providing electricity organizations with stable demand signals to support clean-energy investment.

Expand demand response and flexibility programs for data centers

Demand response (DR) mechanisms are incentive-based programs where large consumers such as data centers reduce or shift their electricity usage during specific, high-stress times, such as peak demand hours or grid emergencies. A recent analysis highlights that, in the US, deploying load-shifting flexibility over the next decade could reduce peak demand by 60–200 GW – orders of magnitude relevant to data-center-driven growth.[119] DR can be set up in months and materially offset peak demand growth at far lower cost than new generation or major grid builds (which can take over five years because of permitting, equipment backlogs, and connection delays).

However, data-center participation in flexibility programs remains limited, as operators prioritize uptime and service-level commitments for critical IT workloads. In practice, flexibility is mostly confined to on-site, behind-the-meter assets that can reduce grid demand without disrupting core IT workloads. As a result, meaningful participation typically comes from options such as limited workload shifting or optimization of supporting infrastructure, rather than from core services. Cameron from Barclays shares, *"The financial incentives of demand response are often outweighed by operational and reputational risks, especially when the cost of downtime far exceeds any potential savings."*

50%

of electricity utilities say they are designing data-center-specific DR programs.

To expand participation, electricity companies should focus on:

- **Jointly defining what constitutes "flexible load,"** clearly separating non-shiftable core services from eligible sources of flexibility. Shalabh Jhalawad from AWS emphasizes the importance of collaboration for demand response (DR) and flexibility programs: *"By design, data center load is not inherently flexible – many core cloud services cannot be shifted without impacting customers. Defining what effective load flexibility should look like will require close collaboration among policymakers, utilities, grid operators, data center operators, and customers relying on our cloud services."*
- **Offering tailored DR programs to data-center customers** with performance-safe options; short, pre-booked events; and latency-bounded shifts. Today, only 50% of electricity utilities say they are designing data-center-specific DR programs.
- **Enabling "bring-your-own-flex" participation at scale,** allowing data centers to enroll BTM batteries, back-up generation, and thermal storage into DR/VPP programs, with clear telemetry, baseline definition, and settlement rules. Three-quarters (75%) of electricity organizations in our research acknowledge the need for greater agility in their DR data-center partnerships.
- **Using AI and automation to enable flexibility across both program and system levels.** AI can make demand-response participation more predictable and verifiable through improved forecasting, orchestration, and measurement. AI can also support system-level flexibility by enabling geographic and temporal workload mobility – allowing eligible workloads to shift across regions based on power availability and grid constraints, subject to latency, data-sovereignty, and customer SLAs.

"With National Grid, we are exploring how data centers can become active participants in grid operations, rather than passive loads. If data centers can offer flexibility during a limited number of peak-stress hours each year, grid operators can unlock significantly more capacity from existing infrastructure, accelerating time-to-power while avoiding years of incremental grid build-out."

Ethan Tiao,

Product Manager at Emerald AI

Innovative startups redefining grid–data center collaboration

A growing ecosystem of innovative startups is reshaping the grid–data center interface, supporting closer collaboration between data-center operators and electricity utilities while also improving efficiency, flexibility, and time-to-power across the value chain. Many of these innovations sit at the intersection of AI and climate tech, enabling more efficient and resilient energy systems. Here we have highlighted a few selected examples:

- In the UK, National Grid announced a strategic partnership with startup **Emerald AI** to demonstrate how AI data centers can work with the transmission network to optimize the use of existing capacity and support the UK's growing digital needs. Emerald AI's system acts as a smart mediator between the grid and the data center, enabling flexible management of energy demand.

  Ethan Tiao, Product Manager at Emerald AI, says: *"With National Grid, we are exploring how data centers can become active participants in grid operations, rather than passive loads. If data centers can offer flexibility during a limited number of peak-stress hours each year, grid operators can unlock significantly more capacity from existing infrastructure, accelerating time-to-power while avoiding years of incremental grid build-out."*

- Connecting a new data center to the power grid often takes five to seven years – not because the grid lacks capacity, but because of how utilities plan for new large customers. Traditional utility planning assumes every new customer could draw maximum power at the exact moment the grid is already under its heaviest stress. That worst-case assumption triggers expensive upgrades that take years to build. **Camus**, a US-based startup, offers a different path. Its FlexConnect platform helps utilities approve new connections sooner by accounting for the fact that data centers can run on their own energy resources, such as batteries and on-site generators, or shift AI training loads during the <100 hours each year when the grid is under strain. The rest of the time, they operate on full grid power.

  Raj Raheja, CFO at Camus Energy, says: *"The gap between utilities and data centers comes down to one assumption: that data center demand may spike at the exact time when the grid is most stressed. But AI data centers have real flexibility. If you make that flexibility a condition of interconnection rather than an afterthought, utilities can connect more customer demand using existing grid capacity. Data centers can get power years sooner, and all customers see bill savings as the fixed costs of the grid are spread across more ratepayers. Everyone gets more of what they need."*

- Estonia-based energy-storage firm **Skeleton Technologies** has launched GrapheneGPU, a new power shelf for data centers that uses its graphene-based supercapacitors to target energy inefficiencies in AI data centers. The system reduces AI energy consumption by up to 45% and lowers power-connection requirements by 44%, while delivering 40% higher computing performance.

"AI data centers currently use twice the energy they should need, and this is because they are wasting energy. By adopting peak shaving and intelligent energy management, we could save tens of billions annually," says Skeleton's Co-Founder and CEO, Taavi Madiberk.[120]

- US-based startup **Phaidra** uses agentic AI to continuously monitor data-center conditions and autonomously adjust cooling infrastructure to reduce energy consumption. In the Middle East, a pilot project involving the UAE Ministry of Energy and Infrastructure, state-owned Khazna Data Centers, and logistics firm Agility is testing Phaidra's AI control technology across selected data-center campuses and district-cooling systems. The initiative aims to reduce cooling energy use, increase IT capacity, and improve operational reliability in high-temperature environments.[121]
- US-based **VEIR** is developing next-generation superconducting power delivery systems that enable 5–10x higher capacity at the same voltage while reducing line losses by ~90%, helping unlock transmission capacity for grid resilience, decarbonization, and high-demand sectors such as AI data centers and heavy industry.
- US-based startup **GridStrong** provides a compliance-automation platform for grid-connected assets. It simplifies NERC, ISO/RTO, and transmission compliance through automated workflows, intelligent file management, and real-time collaboration – reducing cost, complexity, and risk while accelerating the energy transition. For data centers, the platform supports faster, more accurate compliance management and grid-connection processes.[122]

"The gap between utilities and data centers comes down to one assumption: that data center demand may spike at the exact time when the grid is most stressed. But AI data centers have real flexibility. If you make that flexibility a condition of interconnection rather than an afterthought, utilities can connect more customer demand using existing grid capacity. Data centers can get power years sooner, and all customers see bill savings as the fixed costs of the grid are spread across more ratepayers. Everyone gets more of what they need."

Raj Raheja,

CFO at Camus Energy

5.4. Strengthen ecosystems: Enable intelligent supply chains and ecosystem-wide coordination

Build resilient, intelligent supply chains for grid and data-center delivery

As electrification accelerates, timely access to critical equipment has become essential to grid expansion, renewables deployment, and data-center growth. But the frequency of supply-chain disruption makes delays and cost overruns a growing threat to infrastructure delivery.

Our research confirms these pressures: 77% of electricity organizations cite rising direct demand for equipment as a major challenge; 74% point to increasing costs of key infrastructure components; and 70% highlight vulnerabilities in vendor and supplier systems.

Electricity organizations are responding pragmatically:

- 84% are diversifying suppliers
- 73% are pre-ordering long-lead items such as transformers and switchgear
- 61% are using forward contracts to reduce delivery risk and secure capacity

However, digital adoption remains limited. Only 38% of electricity utilities use digital tools to track supplier and inventory risks in real time; 30% address supply-chain cybersecurity; and just 26% deploy AI- or Gen AI–enabled supply-chain solutions. Scaling AI, analytics, and Internet of Things (IoT) can improve visibility of equipment availability, enable earlier risk detection, and support faster, better-coordinated responses. Combined with deeper supplier partnerships and ongoing ecosystem coordination, intelligent supply chains help stabilize costs and keep grid and data-center projects on track.

Deepen ecosystem collaboration across the data-center value chain

As data-center demand accelerates, electricity organizations must evolve from power providers to system orchestrators, coordinating infrastructure, land access, supply portfolios, and flexibility across the ecosystem. Early, structured collaboration with data-center owners and operators is essential to align infrastructure build-out with accelerating demand, improve system efficiency, and enable reliable, cost-effective growth. Bijit Ghosh, Managing Director/CIO and Head of Architecture and Engineering at Wells Fargo, expands: *"Strong partnerships can help reserve grid capacity over multi-year horizons, design dedicated substations and transmission links, and structure long-term PPAs to ensure reliability and continuity."*

Yet in practice, collaboration across the data-center value chain remains fragmented and uneven, with electricity organizations and data-center operators often engaging too late in the development cycle, after siting decisions, load assumptions, and upgrade scopes are already defined. This misalignment is reflected in cost expectations: 76% of data-center customers view grid-upgrade costs as a significant financial burden.

Figure 28 shows that while collaboration is emerging at the early planning stage, it drops sharply for deeper, system-level engagement.

- **Power-first siting and early planning alignment:** Over one-third (34%) of data-center organizations are already engaging electricity organizations in site selection, early alignment on land availability, grid headroom, upgrade pathways, and timelines.
- **Shared flexibility and reciprocity models:** Just one in four (26%) data centers are acting as grid-scale energy-storage or system-support partners, and 22% are participating in virtual power plants (VPPs).
- **Co-investment in shared grid infrastructure:** Despite the scale and concentration of data-center loads, only 18% of data-center customers report participating in joint infrastructure development, such as co-funded substations or transmission upgrades.

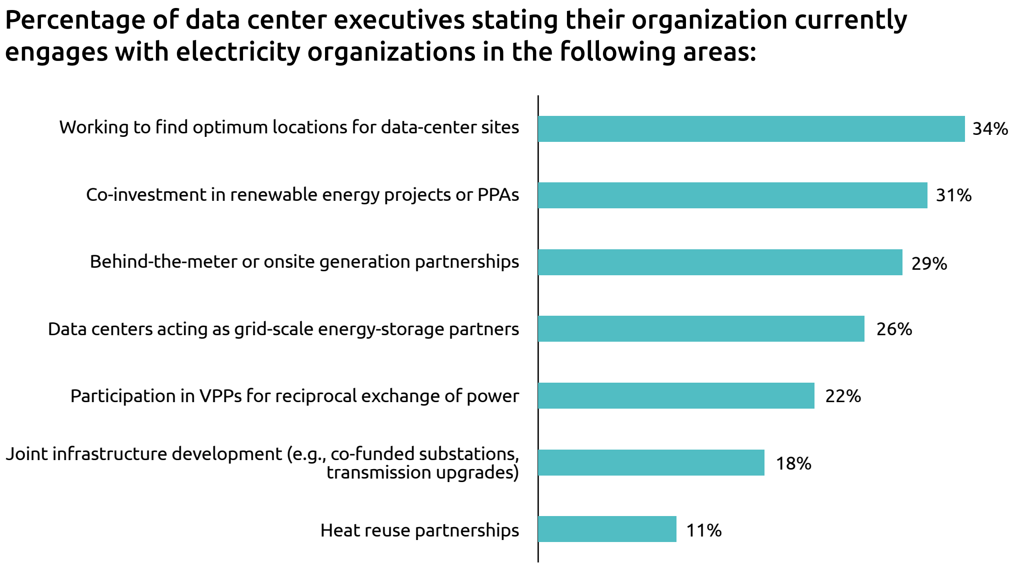
"Strong partnerships can help reserve grid capacity over multi-year horizons, design dedicated substations and transmission links, and structure long-term PPAs to ensure reliability and continuity."

Bijit Ghosh,

Managing Director/CIO and Head of Architecture and Engineering at Wells Fargo

Figure 28.

Collaboration between data centers and electricity organizations remains limited



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/ operating organizations.

Encouragingly, recent industry partnerships suggest leading utilities and hyperscalers are moving toward "power-first" collaboration models, aligning early on land, grid access, and supply options to accelerate development and reduce risk. Examples include:

- NextEra Energy and Google, which are partnering to develop multiple-gigawatt data-center campuses with early alignment on land acquisition, grid interconnection, and supporting generation, including nuclear capacity to strengthen long-term supply.[123]
- Through a $20-billion partnership with Intersect Power and TPG Rise Climate, Google is developing data-center campuses co located with clean energy.[124]
- In France, EDF is leasing its former thermal-power plant sites for data center development, offering quickly deployable land with strong grid connectivity, tailored electricity supply and services, and end to end project support, significantly reducing development timelines.[125]

IDCA's Laia explains the benefits: *"Large-scale data centers often require dedicated substations and deep integration with energy providers. Close collaboration across the ecosystem is essential to ensure power availability and scalability. Shared infrastructure investments accelerate deployment timelines, enabling faster go-live and improved ROI. When executed effectively, this collaborative model creates value for all stakeholders involved."*

Integrate community and sustainability considerations into planning

As data-center projects become larger, more visible, and more energy-intensive, community acceptance is increasingly influencing delivery timelines, particularly in regions sensitive to electricity prices and environmental constraints. Electricity organizations with high public exposure should therefore move beyond reactive engagement and integrate affordability, sustainability, and transparency considerations earlier in data-center siting and project planning. This includes:

- **Engaging proactively with local communities and policymakers** to explain grid impacts, mitigation measures, and long-term system benefits, rather than responding late in the permitting cycle
- **Integrating sustainability metrics**, such as emissions intensity, water stewardship, and flexibility contributions into data-center connection, siting, and supply discussions
- **Partnering with data-center operators** to demonstrate how cleaner supply, demand-side participation, and efficient design can reduce local impacts while supporting growth

5.5. Build a future-ready operating model: Operationalize AI and scale future-ready talent

Scale AI and digital technologies across planning and operations

Electricity organizations are under pressure to deploy AI at scale across planning and operations, but progress is constrained by foundational readiness gaps in data, architecture, governance, and trust.[126]

AI's effectiveness in grid operations hinges on high-quality, harmonized data. Yet many utilities still face data-quality and governance challenges, such as siloed asset-management systems, inconsistent naming conventions, and outdated geographic information system (GIS) records. Our previous research highlighted that just 18% of energy and utilities organizations have high maturity across all aspects of data-readiness, including data governance, data infrastructure, data quality, data integration, and interoperability.[127]

Moreover, electricity organizations deploying AI must account for data residency and cybersecurity mandates, which can constrain architecture choices and increase the need for secure, segmented environments. In addition, regulatory frameworks (e.g., the EU AI Act and GDPR) reinforce requirements for explainability, bias mitigation, strong governance, and human-in-the-loop oversight – increasing the importance of robust model controls, auditability, and clear accountability in operational AI deployment.

To fully realize the transformative potential of AI in energy systems, the sector must address foundational readiness gaps around people, policy, and trust, starting with data. As shared by a vice president of digital transformation at a leading European multinational electric utility company: *"Utilities need a pragmatic, step-by-step roadmap that delivers value while building capabilities over time. Most importantly, this starts with investing early in strong data foundations – unified data platforms, standardized models, and real-time pipelines – to create clean, structured, and reliable historical data. Then comes classifying data by sensitivity – keeping critical operational data local, placing sensitive data in sovereign or hybrid clouds, and using public cloud for non-sensitive, aggregated data."*

- **Operationalize AI across the energy value chain:** AI should be embedded into core operational systems across the energy value chain to drive optimization, enhance asset performance, and streamline market participation.
- **Institutionalize AI governance:** Utilities need robust, cross-functional governance to manage AI across its lifecycle. This includes model validation, monitoring, and risk thresholds, especially for Gen AI and agentic AI, where traceability and human oversight are critical.

"As data centers become a core growth segment, we are evolving the skills we value across the organization. Beyond traditional asset and generation expertise, we are strengthening customer-centric capabilities and skills – where our people can better understand demand-side requirements and tailor solutions, rather than relying on one-size-fits-all models."

Inês Muggli,

Market Development Manager at SSE plc.

- **Harmonize data ecosystems:** To enhance forecasting and resilience, utilities must integrate external data, such as weather, satellite, and market signals, into operational platforms. This requires interoperable architectures and real-time data pipelines across operational technology (OT) and IT systems.
- **Establish sovereignty of data and cloud architecture:** As cloud adoption grows, utilities must ensure compliance with data residency laws and maintain control over telemetry and AI environments. Sovereignty should be embedded into digital strategy through secure, flexible, and resilient architectures.

Build the talent and capabilities required for system transformation

Future competitiveness will depend on talent that combines deep energy-domain expertise with advanced digital skills. In our research, 76% of electricity executives acknowledge the need for this hybrid skills mix; however, only 40% say they currently have these capabilities in-house. The convergence of energy and digital roles is accelerating, with smart grids, automation, data-driven efficiency, and cybersecurity now central to core operations.

Talent scarcity is already constraining progress. Recent analysis highlights intensifying competition between data-center developers and electricity organizations for electricians, technicians, grid engineers, and power-plant operators – roles that are essential to building, commissioning, and operating energy-intensive digital infrastructure at scale.

In our research too, 72% of electricity organizations report shortages in technology and data skills, while 56% cite workforce aging as a major challenge. These gaps are widening as utilities create new roles, such as energy-data scientists, digital grid and automation engineers, AI specialists, and cybersecurity professionals, to support modernized, software-defined energy systems.[128]

To close these gaps, utilities must adopt a multi-pronged talent strategy:

- Use ecosystem partnerships to access scarce digital talent and accelerate capability building, an approach already used by 68% of electricity organizations in our research.
- Scale targeted upskilling and reskilling, aligned with evolving roles and future system needs.
- Collaborate with hyperscalers and data-center customers to build shared energy–digital expertise and system-level skills, an opportunity currently pursued by just 33% of electricity organizations.

Inês Muggli from SSE adds, *"As data centers become a core growth segment, we are evolving the skills we value across the organization. Beyond traditional asset and generation expertise, we are strengthening customer-centric capabilities and skills – where our people can better understand demand-side requirements and tailor solutions, rather than relying on one-size-fits-all models."*

Ultimately, winning utilities will be those that treat talent as a strategic enabler, not a support function, and mobilize capabilities as deliberately as they deploy capital.

"There is no sustainable AI without sustainable data centers; they are the hidden engine of responsible innovation. As AI models scale in complexity and demand, the environmental footprint of digital infrastructure becomes a strategic concern, not a technical afterthought. Energy-efficient, low-carbon, and water-responsible data centers ensure that AI growth aligns with climate and resource goals. In this way, sustainable infrastructure turns AI ambition into long-term business and societal value."

Maik Schwalm,

Global Sustainability Lead, Cloud Infrastructure Services, Capgemini

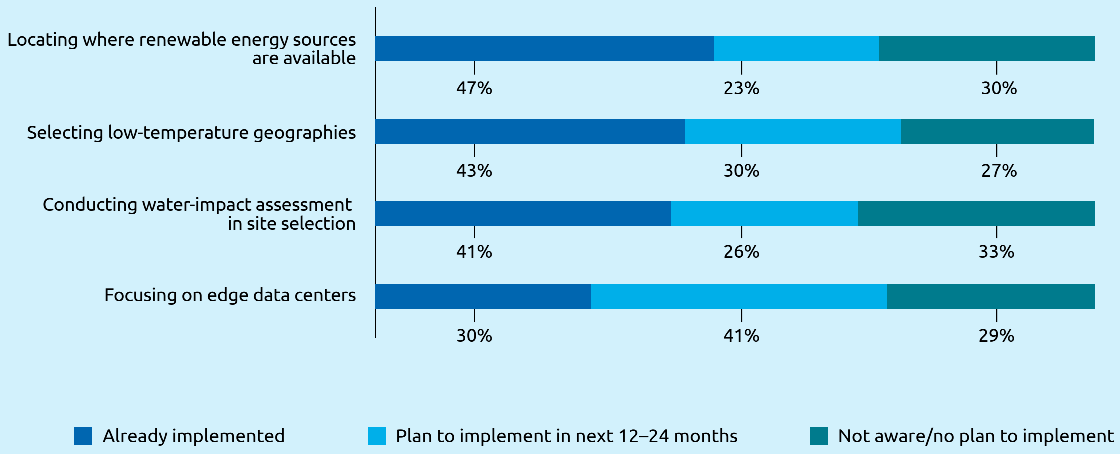
Energy and water efficiency – A strategic imperative for data centers

Data centers must streamline energy and water efficiency to manage rising power demand and costs from AI and cloud growth, navigate grid and connection constraints, and reduce exposure to water scarcity and regulatory risks. Efficient cooling and power use improve reliability and resilience during extreme weather, while lowering emissions and resource intensity. Together, these measures strengthen community acceptance and increasingly serve as a source of competitive differentiation, helping attract sustainability-focused customers, while also meeting expectations from investors and regulators for low impact, sustainable data-center operations.

For data center executives, this means **treating sustainability as a first-class design requirement**, on par with cost, security, availability, performance, and operationalizing it through continuous measurement, demand reduction, platform choices, lifecycle thinking, and clear governance/accountability. Alyson Freeman, Director, Data Center Sustainability at Dell Technologies, says: *"Creating more efficient data centers requires looking at the entire system, from energy sourcing and facility-level water management to how efficiently compute infrastructure is operated over its lifetime. The biggest environmental impact comes during the use phase, which is why using diverse energy sources, closed-loop water systems, smarter cooling, and software-driven workload optimization are critical. When these elements come together, data centers can scale rapidly without proportionally increasing their energy and water footprint."*

Below, we outline key takeaways to reduce energy and water intensity across the data-center lifecycle. While innovative examples are beginning to emerge, the maturity of these measures remains uneven and largely nascent across most organizations (as shown in the figures below).

Adoption maturity of location-related measures

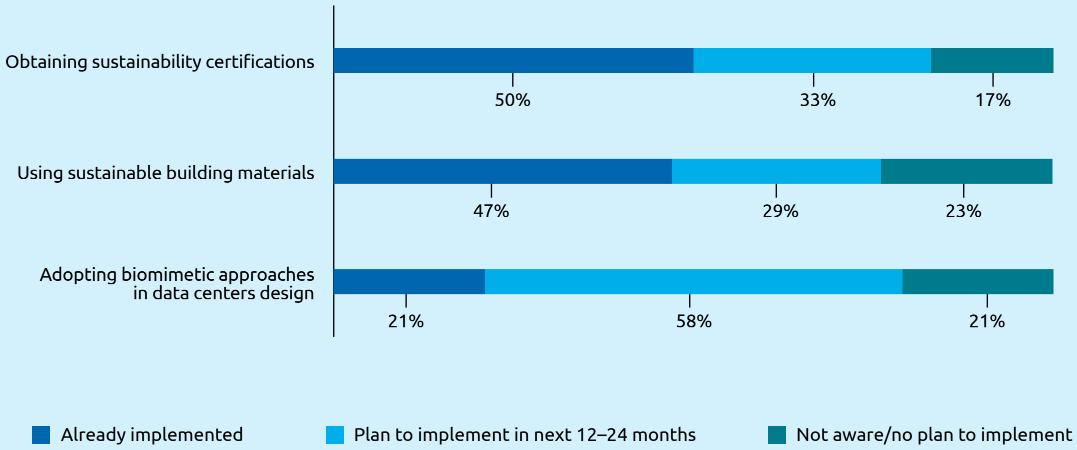


Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

- **Embed sustainability in siting decisions:** Renewable-aligned siting, cooler climates, and water-impact assessments help data centers cut energy and water use, lowering costs, environmental impact, and risk, while strengthening resilience and stakeholder acceptance. For example, the Lefdal Mine data center in Norway, which is built 150 meters underground in a former olivine mine, is powered entirely by locally sourced renewable energy. By using cold seawater from a nearby deep fjord for cooling, it delivers around 30–40% lower energy consumption than traditional data centers, while reducing water stress.[129]

  Looking ahead, some operators are exploring more radical location concepts to further decouple data-center growth from terrestrial constraints. Elon Musk's SpaceX has filed plans with the Federal Communications Commission (FCC) for up to one million "orbital data center" satellites.[130]

Adoption maturity of design and building–related measures



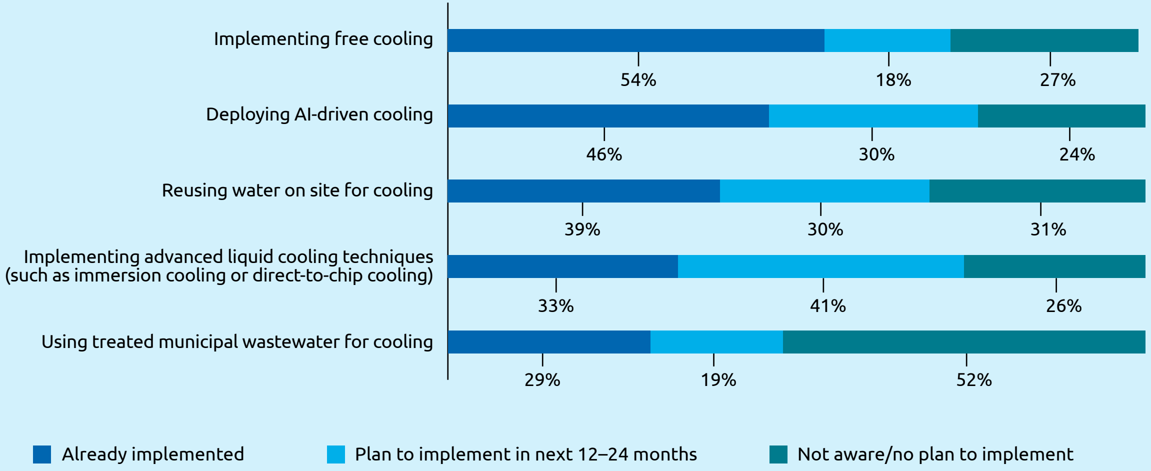
Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

- **Design and operate energy- and water-efficient data centers:**
  - **Building-related measures:** Increasingly, data-center operators are using sustainability certifications such as LEED, BREEAM, ISO 14001, and ISO 50001 to improve energy and water efficiency. Alongside this, low-carbon materials and modular construction reduce embodied resource use, lower lifecycle emissions, and enhance credibility with stakeholders. In late 2024, Microsoft began touting efforts to use wood in the construction of data centers.[131]

– **Cooling-related measures:** Free cooling uses naturally cool air or water to reduce reliance on energy intensive chillers, lowering electricity use, operating costs, water consumption, and emissions, especially in suitable climates. Complementing this, AI driven cooling systems use real time sensor data to dynamically optimize airflow, set points, and equipment use, cutting consumption while improving reliability and resilience during peak loads and heatwaves. Advanced liquid cooling techniques, such as immersion cooling or direct-to-chip cooling, are also gaining traction. In the AI data centers Oracle is building today, including those in New Mexico, Michigan, Wisconsin, and Texas, the company uses an evolution of closed-loop designs, featuring direct-to-chip, closed-loop, non-evaporative cooling systems.[132] In November 2025, Meta announced a $1 billion+ investment in an AI-optimized campus in Wisconsin featuring dry-cooling technology to achieve zero water demand for cooling.[133]

Wells Fargo's Ghosh also discusses a hybrid approach to cooling: *"We're moving toward a next-generation hybrid cooling architecture across both our own facilities and hyperscaler sites. This includes air cooling for general workloads, liquid cooling for AI clusters, and immersion cooling for ultra-high-density deployments. This approach allows us to segment workloads effectively and optimize the economics across different cooling methods."*

Adoption maturity of cooling-related measures



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

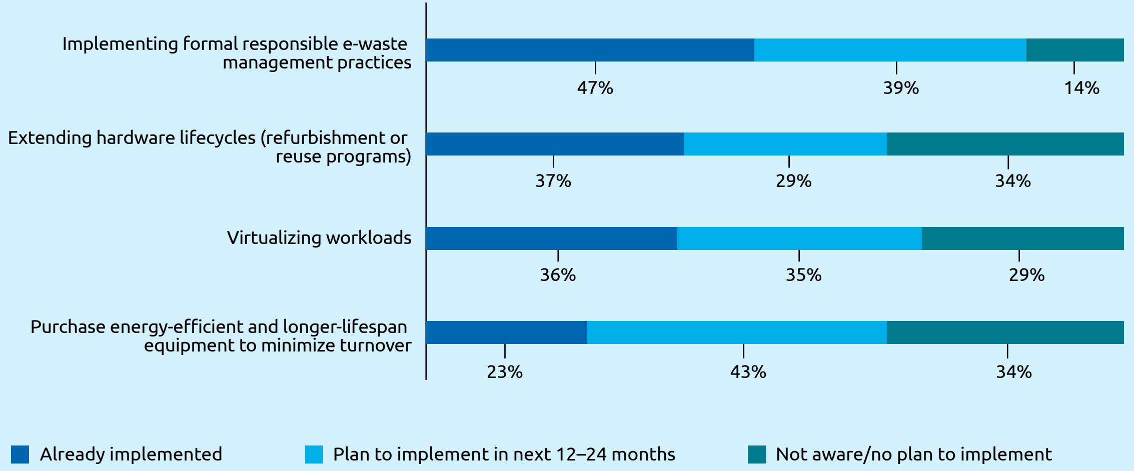
Data centers are also exploring recycling local municipal wastewater and desalination as alternative sources to reduce demand for potable water. For example, Google claims it uses reclaimed or non-potable water at more than 25% of their data center campuses.[134]

- **Circularity-related measures:** AWS has extended average expected server lifetime in its data centers from five to six years. When hardware reaches the end of its operational life, AWS employs its re:Cycle Reverse Logistics hubs to recover, repair, and reuse components. In 2024, 23.5 million components were either recycled or sold on the secondary market.[135] Using energy-efficient and recyclable hardware specifically designed for AI/Gen AI applications helps reduce the operational carbon footprint as well as embodied carbon footprint.

• Reduce demand before optimizing supply

- **Simplify and rationalize demand at the application layer:** Simplify application landscapes by retiring redundant systems, consolidating overlapping workloads, and eliminating unnecessary or idle environments, while addressing chronic over-provisioning by aligning capacity with actual usage.

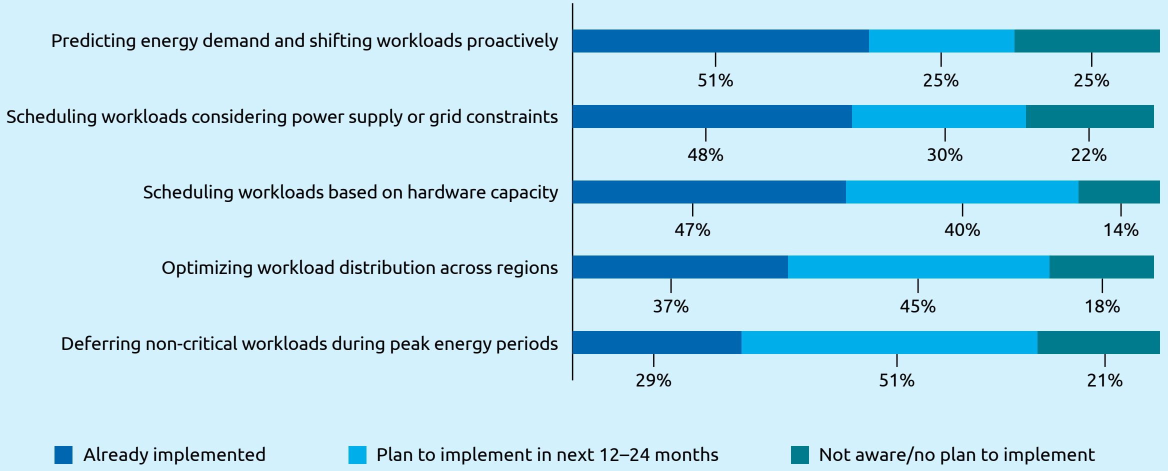
Adoption maturity of circularity-related measures



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

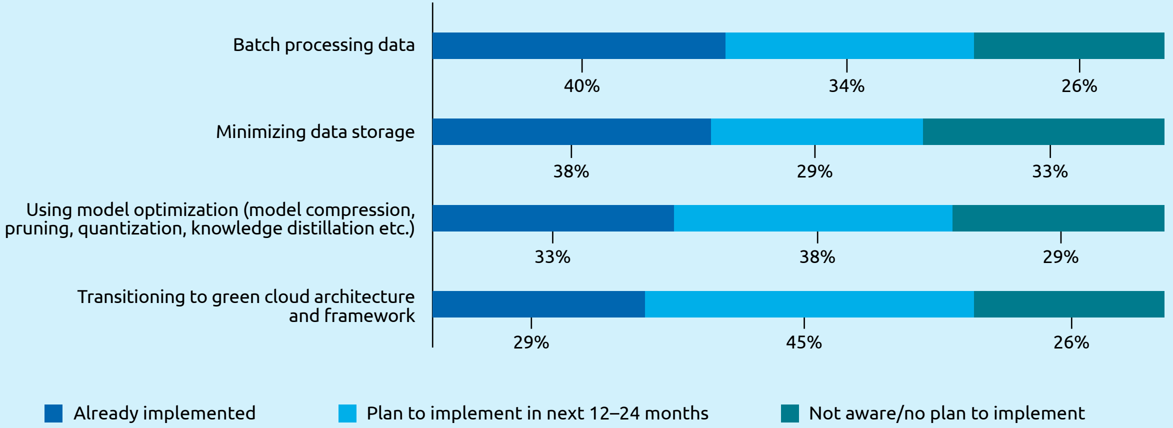
- **Shift workloads to more efficient compute platforms (cloud where appropriate):** Shift suitable workloads to structurally more efficient hyperscale platforms that benefit from higher utilization and optimized infrastructure. Combine cloud migration with application rationalization to avoid lifting legacy inefficiencies into the cloud.
- **Dynamically manage and schedule workloads using AI:** Data-center operators are increasingly using AI-driven forecasting and analytics to predict energy demand, enabling flexible workloads to be shifted across time or locations. By aligning workloads with real-time hardware utilization, thermal capacity, power availability, grid constraints, and renewables supply, operators reduce peak electricity use, cooling and water demand, congestion costs, and emissions. Salesforce trained its AI models in lower-carbon data centers, powered by electricity that emits 68.8% less carbon than the global average.[136]

Adoption maturity of operational measures



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 73 technology executives from data centers owning/operating organizations.

Adoption maturity of data and model efficiency–related measures



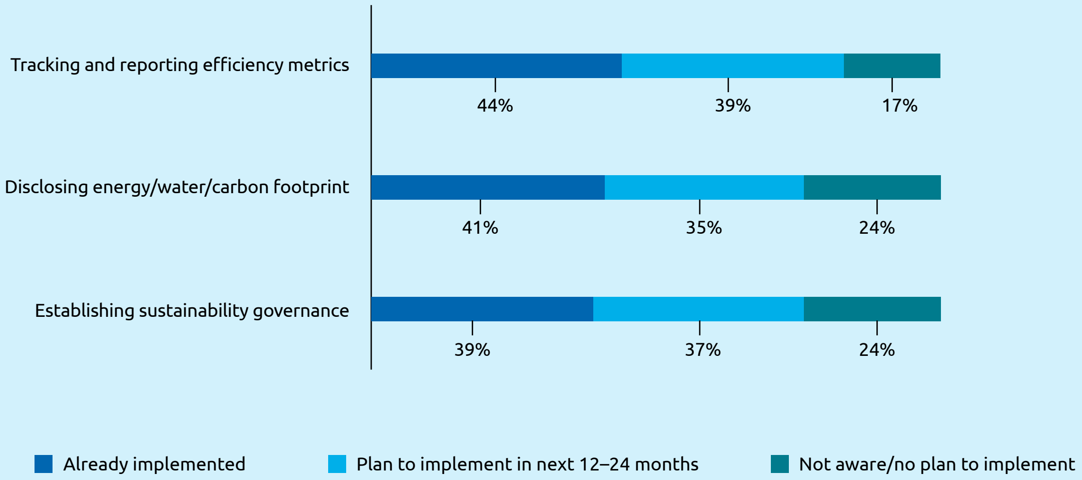
*Note:
o Model compression is a technique that reduces the size and complexity of large neural networks, making them more suitable for deployment on resource-constrained devices such as mobile phones.
o Model pruning is removing unimportant parameters from a neural network model to reduce the model size.
o Quantization is a model size reduction technique that converts model weights from high-precision floating-point representation (32-bit FP) to low-precision FP or integer representations (8-bit).
o Knowledge distillation is the process of transferring knowledge from a large model to a smaller one.

Source: Capgemini Research Institute, Powering data centers, January 2026, N = 73 technology executives from data centers owning/operating organizations.

- **Right-size models and optimize data**
  Rightsizing AI models through model-optimization techniques (such as compression, quantization, distillation, and pruning) can help to trim power and resource requirements. In April 2025, AI startup Multiverse Computing rolled out compressed AI models based on Meta's Llama and Mistral, using its CompactifAI algorithm to cut compute costs and boost energy efficiency by 84%, with only a 2–3% loss in accuracy.[137]

  Processing data in batches also improves computational efficiency. Rahul Sareen, Global Leader, AI and Industry Solutions and GTM from AWS, says: *"Customers can use SageMaker distributed libraries such as data parallelism and pipeline parallelism to run parallel computing across multiple GPUs or instances. And some of these approaches help maximize GPU utilization by splitting the training batches into micro batches."*[138] Meta has developed AI Research Store (AIRStore) to help optimize data transfers and minimize cross-region data traffic with end-to-end encryption.[139]

Adoption maturity of measurement and governance–related measures



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

- **Operationalize sustainability governance for data centers:**
  - **Measure and report key metrics:** Establish continuous monitoring and reporting of recognized metrics such as Power Usage Effectiveness (PUE), Water Usage Effectiveness (WUE), Carbon Usage Effectiveness (CUE), or Energy Reuse Effectiveness (ERE). Granular sub-metering of IT versus facility loads helps enable real-time analytics and performance management. Benchmarking performance against peers helps to identify gaps and prioritize investment. In the US, the federal government is planning to require large data centers to disclose their energy use.[140] Such disclosure regimes are likely to accelerate investment in granular measurement, AI-driven efficiency, and continuous performance management across data-center operations.
  - **Set up cross-functional governance teams:** Multi-disciplinary sustainability teams spanning IT, facilities, procurement, and ESG, with clear accountability, help drive ownership and coordinated decision-making. Capgemini's data center sustainability assessment helps organizations identify emissions and power hotspots, optimize efficiency, track performance, and demonstrate measurable sustainability gains.

- **Strengthen community outcomes:**
  - **Partner for heat reuse:** In Paris, excess heat from an Equinix data center was used to warm swimming pools during the 2024 Olympics. One of Meta's data centers in Denmark supplies heat to a district heating network serving roughly 11,000 local homes. The municipal utility of the German city of Norderstedt has also begun repurposing waste heat from its own data center into a local district heating network.[141] In Colorado, the National Laboratory of the Rockies recovers heat from its high-performance computing systems to warm building spaces and melt snow.[142] Our research shows that only 38% of data centers are currently providing waste heat to nearby facilities.
  - **Mitigate local electricity-price impacts:** Anthropic has committed to cover electricity-price impacts linked to its data centers by paying 100% of required grid-upgrade costs, procure net-new power generation to match its electricity demand and invest in curtailment and grid-optimization measures to reduce strain during peak periods.[143]

"Creating more efficient data centers requires looking at the entire system, from energy sourcing and facility-level water management to how efficiently compute infrastructure is operated over its lifetime. The biggest environmental impact comes during the use phase, which is why using diverse energy sources, closed-loop water systems, smarter cooling, and software-driven workload optimization are critical. When these elements come together, data centers can scale rapidly without proportionally increasing their energy and water footprint."

Alyson Freeman,

Director, Data Center Sustainability at Dell Technologies

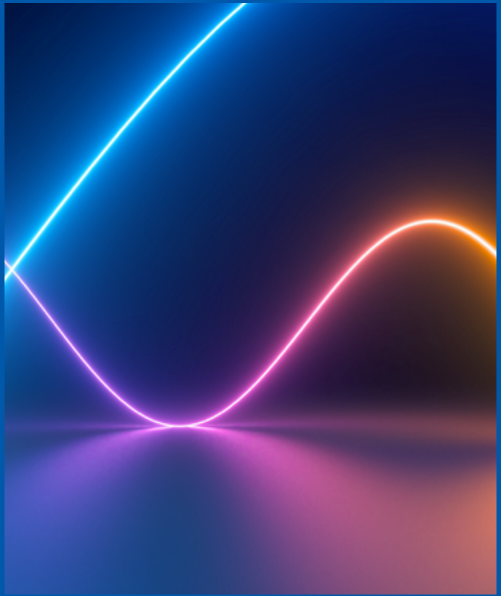
Conclusion

This report highlights a defining moment for the electricity industry. For much of the last decade, electricity demand in many mature markets grew at a modest pace, as efficiency gains and shifting energy use kept overall consumption relatively stable. That equilibrium is now changing. Data centers, accelerated by AI training and inference, are becoming system-defining customers. Their scale, geographic concentration, and near-zero tolerance for outages are testing grid capacity, connection processes, reserve margins, and price stability. At the same time, "phantom" load requests and AI workload variability are complicating forecasting and capital planning, increasing the risk of sub-optimal investment outcomes: both underinvestment and stranded assets.

Meeting this phase of electricity-demand growth will require a fundamental shift from reactive accommodation to proactive system stewardship. Electricity organizations must strengthen demand intelligence, screen requests more rigorously, and steer growth toward power-ready locations to reduce planning volatility and capital misallocation. Supply strategies must move beyond incremental additions toward portfolio rebalancing, combining renewables with storage and firming resources, near-term flexible generation, decentralized capacity (where appropriate), and longer-term options such as advanced nuclear (where viable). Addressing water and supply-chain constraints must be a first-order consideration.

Execution will be decisive. Utilities and system operators must modernize and digitalize networks, streamline connection and permitting, and unlock flexibility through fit-for-purpose tariffs, demand response, and coordinated BTM solutions. Success will also depend on tighter coordination across ecosystems, supported by more resilient and intelligent supply chains.

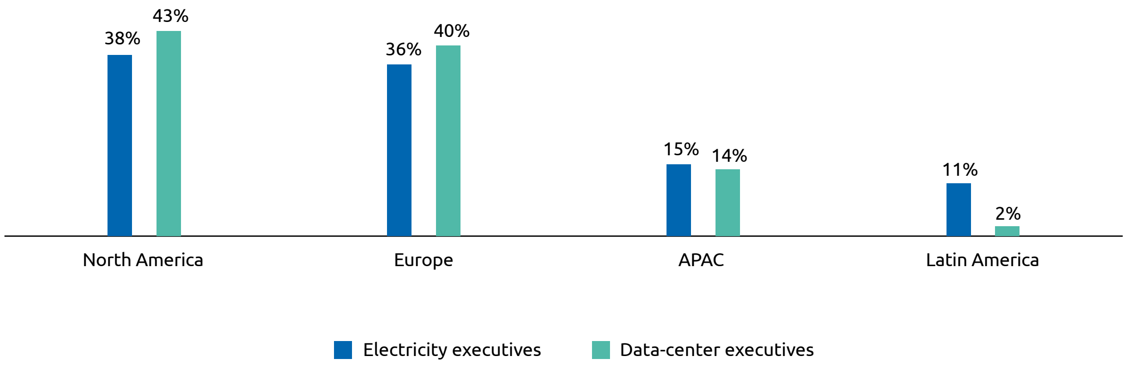
Ultimately, the electricity organizations that combine disciplined demand shaping with faster, more flexible delivery – underpinned by AI-powered operations and future-ready talent capabilities – will be best positioned to power the next phase of data-center growth, delivering reliability, resilience, affordability, and sustainability at AI-era speed.



Research methodology

For this research, we surveyed 612 senior electricity executives (director level and above) from organizations with annual revenue exceeding $500 million that are actively working with data centers. It also incorporates insights from 175 senior executives at data-center-owning and -operating organizations with revenue above $250 million. Respondents represent 21 countries across North America, Europe, APAC, and Latin America. The global survey took place in January 2026. Lastly, we conducted interviews with nearly 20 senior industry executives at leading global organizations.

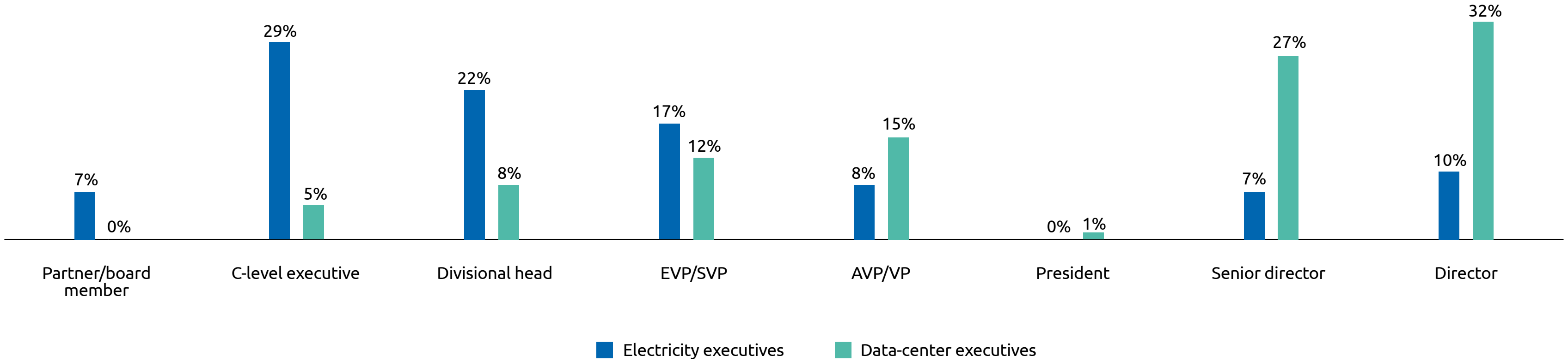
Percentage of executives by location of headquarters of current organization



*Note: In the survey, APAC includes Australia, New Zealand, China, Japan, Singapore and India; Europe includes UK, France, Germany, Spain, Italy, Sweden, Norway, Finland, Denmark, Ireland, Iceland, and Netherlands; North America includes US and Canada; Latin America includes Mexico, Brazil, Argentina, Peru, and Costa Rica.

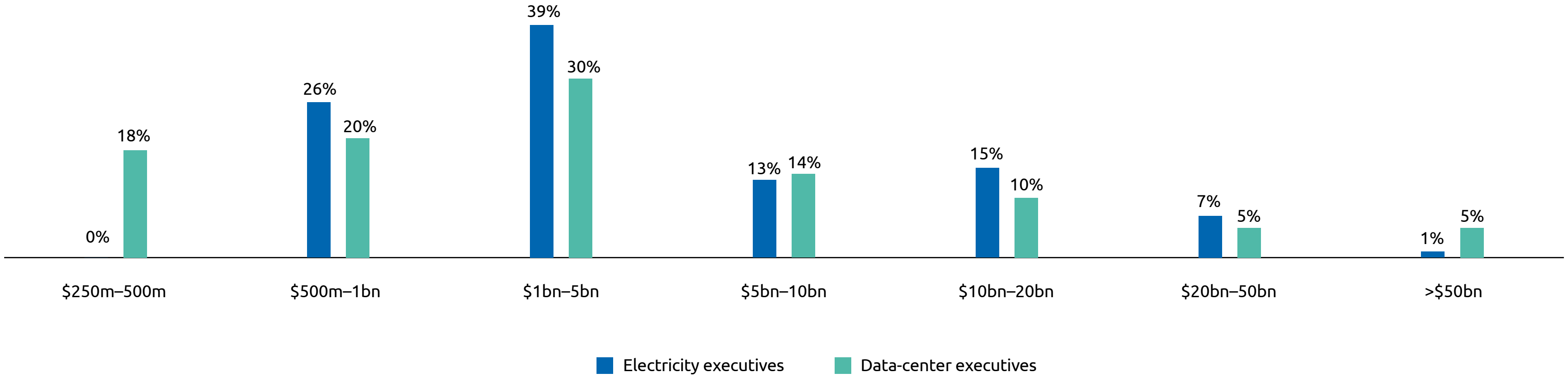
Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations, N = 175 executives globally from data centers owning/operating organizations.

Percentage of executives by current job title/role



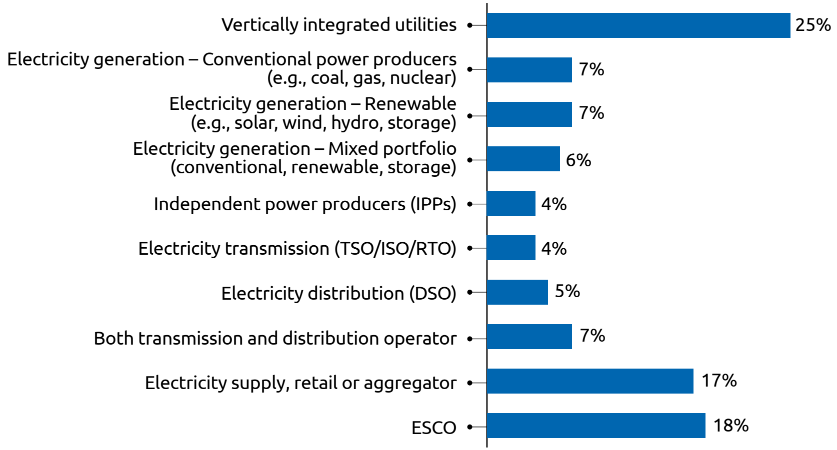
Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations, N = 175 executives globally from data centers owning/operating organizations.

Percentage of executives by annual revenue of organization



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations, N = 175 executives globally from data centers owning/operating organizations.

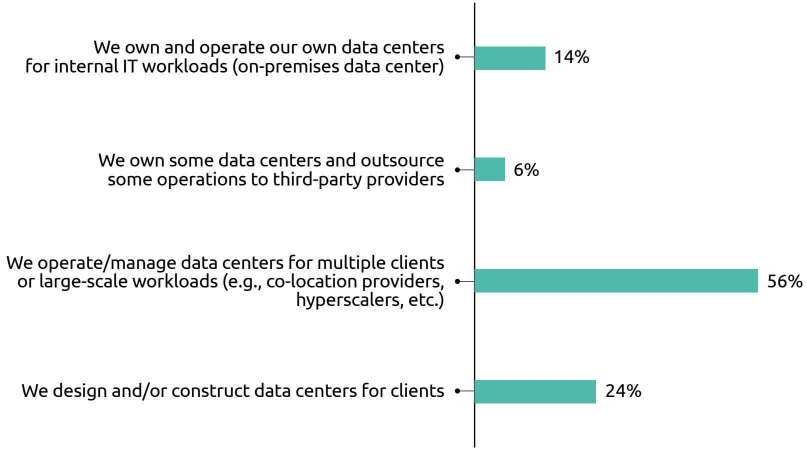
% of electricity executives by type of electricity organization



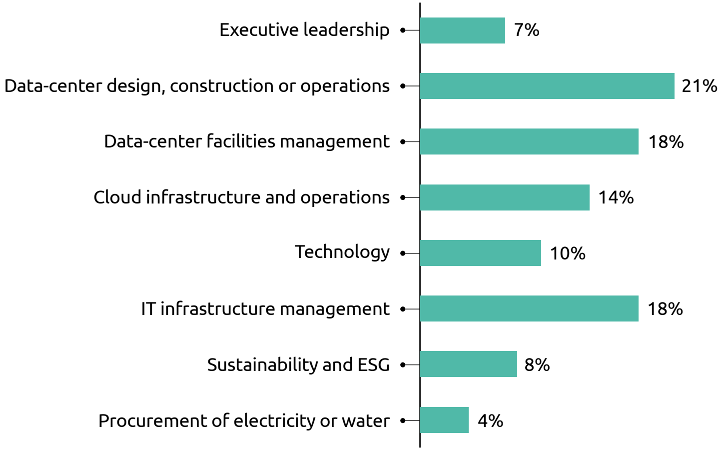
% of electricity executives by business function

Source: Capgemini Research Institute, Powering data centers, January 2026, N = 612 executives globally from electricity organizations.

% of data-center executives by type of data center



% of data-center executives by business function



Source: Capgemini Research Institute, Powering data centers, January 2026, N = 175 executives globally from data centers owning/operating organizations.

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Authors

Meet the experts

Claire Gauthier
EVP, Global Energy & Utilities Leader, Capgemini
claire.gauthier@capgemini.com

As Executive Vice President leading Capgemini's global Energy & Utilities business, Claire Gauthier brings over two decades of experience across power, oil & gas, and emerging energy technologies, working across five continents.

From natural gas and renewables to energy efficiency and grid services, Claire has led strategic transformations and large-scale programs across the energy value chain—from investment through operations and performance improvement.

With a strong global track record of translating strategy into execution, she combines engineering, digital, and capital allocation experience to help organizations navigate disruption and scale technology-enabled long-term value, aligned with evolving market and investor expectations.

Florent Andrillon
Head of Group Climate Tech, Capgem
florent.andrillon@capgemini.com

Florent has more than 20 years of experience in the energy and utilities sector, helping companies achieve their sustainability goals and transition to a low-carbon economy. He advises companies across sectors on their climate, environment, and energy transition strategies. Florent graduated from EM Lyon in France and started his career in the energy industry, before joining Capgemini in 2005. He is a frequent speaker and panelist at the World Climate Foundation events including the World Climate Summit.

Hariharan Krishnamurthy
VP, E&U Industry Leader, Capgemini Engineering
hariharan.krishnamurthy@capgemini.com

Hari Krishnamurthy, a seasoned leader with 25 years in Energy & Utilities, drives transformation through technology. As Global Head of Industry for Energy & Utilities at Capgemini Engineering, he shapes strategy, fosters customer engagement, and leads solutions, large deals, and partnerships to align with market trends.

Alain Chardon
VP, Energy, Climate and Resource Transition, Capgemini
alain.chardon@capgemini.com

Alain helps his clients prepare their next steps on energy, climate and resources transition, from strategy to implementation. He works with corporates in all sectors, as well as professional organizations and public authorities. He has delivered many strategy projects based on collaborative approaches and quantitative modeling, including with Capgemini's systemic modeling platform BFPM. He is proud to have coordinated and delivered innovative reports such as 55 TECHS FIT FOR NETZERO retwitted by Bill Gates, strategic approach to circular economy , such as RACES, presented at DAVOS 2023, and Low carbon circular economy, with the French Institut National de l'Economie Circulaire, 2022.

Authors

Meet the experts

Peter King
VP, Energy Transition and Utilities,
Capgemini Invent
peter.king@capgemini.com

Peter focuses on Energy System change, working with our clients to deliver business and technology transformations into complex environments, including Regulation, Executive Alignment, Transformation Programmes, and Industry Thought Leadership where Pete was is the lead editor for the 2025 edition of our annual World Energy Markets Observatory Report. He publishes regular blogs on a variety of energy and utility related topics.

Maik Schwalm
Global Sustainability Lead, Cloud Infrastructure Services, Capgemini
maik.schwalm@capgemini.com

Maik Schwalm embeds sustainability at the core of cloud and digital transformation initiatives. His work focuses on decarbonizing IT, optimizing cloud environments, Sustainable AI and delivering measurable business, cost, and sustainability outcomes. With deep expertise in Sustainable IT, Maik enables organizations to reduce environmental impact while improving performance, resilience, and long term value through responsible and innovative use of technology.

Fiona Oliver
Leader, Grid Modernization Strategic Advisory,
Capgemini
fiona.oliver@capgemini.com

Fiona brings 25 years of experience at the nexus of energy and the environment, consistently prioritizing a customer-centric approach. Her background includes executive roles at utilities (first Energy Transition leader at Enbridge Gas) and energy companies internationally, and recently a Board position at the Independent Electricity System Operator. She led the first Integrated Resource Plan for Enbridge Gas, the multi-year Demand Side Management plan and a billion-dollar carbon compliance portfolio. Fiona's work spans strategic planning to project execution in energy markets and infrastructure, creating cohesion from disparate pieces, and consistently delivering bottom-line results.

Authors

Meet the Capgemini Research Institute

Jerome Buvat
Head of the Capgemini Research Institute
jerome.buvat@capgemini.com

Jerome is the head of the Capgemini Research Institute. He works closely with industry leaders and academics to help organizations understand the business impact of emerging technologies.

Subrahmanyam KVJ
Senior Director,
Capgemini Research Institute
subrahmanyam.kvj@capgemini.com

Subrahmanyam is a Senior Director at the Capgemini Research Institute. He loves exploring the impact of technology on business and consumer behavior across industries in a world being eaten by software.

Nancy Manchanda
Director, Capgemini Research Institute
nancy.manchanda@capgemini.com

Nancy has over 16 years of experience in market research, consulting and digital transformation. She collaborates with business leaders to understand challenges and opportunities relating to technology, people and sustainability transformation.

Amrita
Senior Manager,
Capgemini Research Institute
amrita.a.amrita@capgemini.com

Amrita has extensive experience in market research and consumer insights across industries and geographies. Her doctoral work was an amalgamation of key interests, exploring consumer behavior and digital payments, with focus on mobile wallets.

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For more information, please contact:

Global

Claire Gauthier
EVP and Global Energy & Utilities Leader, Capgemini
claire.gauthier@capgemini.com

Cyril Garcia
Head of Global Sustainability Services and Corporate Responsibility, Capgemini
cyril.garcia@capgemini.com

Florent Andrillon
Head of Group Climate Tech, Capgemini
florent.andrillon@capgemini.com

Vincent Charpiot
Executive Vice President, Head of Group Sustainability Business Accelerator, Capgemini
vincent.charpiot@capgemini.com

Thomas Hernandez
VP, Energy and Utilities, France, Capgemini Invent
thomas.hernandez@capgemini.com

Hariharan Krishnamurthy
VP, Global Head of Energy & Utilities - Capgemini Engineering
hariharan.krishnamurthy@capgemini.com

Rene Kerkmeester
VP, Integrated Power Lead, Capgemini
rene.kerkmeester@capgemini.com

Jordi Josep Benet Nebot
Global Head for Data Center Transformation, Infrastructure Services, and Networks Service Line
jordi.benet@capgemini.com

Maik Schwalm
Global Lead of Sustainability, CIS, Capgemini
maik.schwalm@capgemini.com

Izzet Biyikbeyoglu
Portfolio Lead for Data Center Transformation, Infrastructure Services, and Networks Service Line
izzet.biyikbeyoglu@capgemini.com

For more information, please contact:

Regional

Australia & New Zealand
John Wareing
john.wareing@capgemini.com

Belgium
Filip Travers
filip.travers@capgemini.com

Canada
Luke Oregan
luke.oregan@capgemini.com

France
Xavier Henrion
xavier.henrion@capgemini.com

Germany
Sandro Lindner
sandro.lindner@capgemini.com

India
Ananth Chandramouli
ananth.chandramouli@capgemini.com

Italy
Alberto Matassino
alberto.matassino@capgemini.com

LATAM
Ricardo Fernandez
ricardo.fernandez@capgemini.com

Norway
Eivind Gjesteland
eivind.gjesteland@capgemini.com

Portugal
Paulo Fão
paulo.fao@capgemini.com

Spain
Ana Mosquera Gonzalez
ana.mosquera@capgemini.com

The Netherlands
Bas Morselt
bas.morselt@capgemini.com

UK
Paul Haggerty
paul.haggerty@capgemini.com

USA
Brian Miller
brian.miller@capgemini.com

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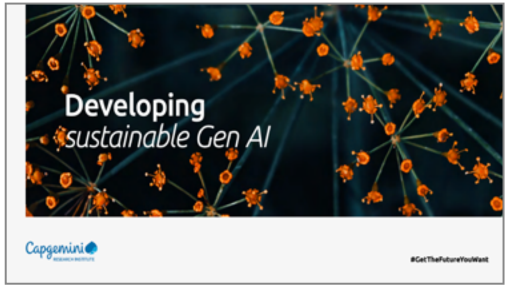

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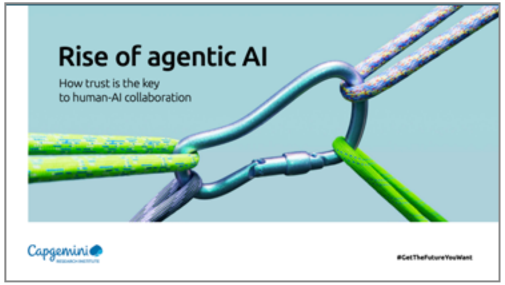

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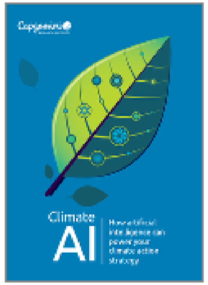

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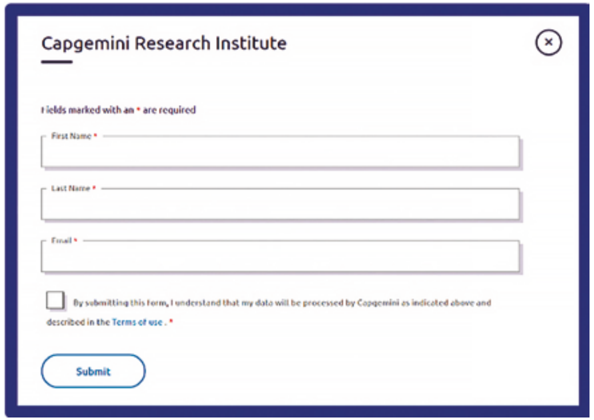
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