

10 trends driving the global data center market

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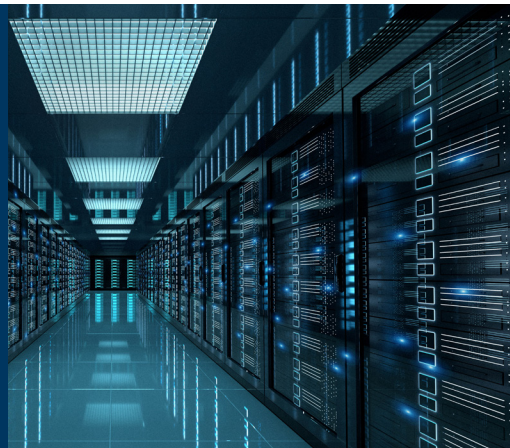
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AT-A-GLANCE

1. AI is driving enormous increases in demand—and massive densification.
2. Cloud keeps growing, too.
3. Cloud providers are building new availability zones.
4. Meeting new demand requires a huge amount of capital, which is now more expensive.
5. Operators are kicking their sustainability efforts into high gear.
6. Supply chain constraints are easing...
7. ... but power is increasingly constrained.
8. Souring public sentiment has made it more difficult to get approval to build.
9. Data center operators are looking to new power and cooling technologies.
10. Data center operators are designing to meet today's needs – and tomorrow's.

1. AI is driving enormous increases in demand—and massive densification.

Artificial intelligence (AI) workloads, such as machine learning and natural language processing, are exceptionally computationally intensive. Training sophisticated AI models like GPT-4 can require thousands of specialized processors running for weeks. As AI proliferates across industries, the need for infrastructure to support these workloads is skyrocketing.

In a single 90-day period in 2023, end users in the U.S. signed data center leases totaling a staggering 2.1 GW, according to research by TD Cowen.¹ That’s about 20 percent of the size of the entire third-party U.S. data center market. Data center capacity is set to more than triple by 2030, and AI could drive data center demand up much more than that. (Dell CEO Michael Dell predicts that AI will drive a 100x increase in data center demand over the next 10 years.)²

In parallel, AI is pushing data center density to new heights. The Graphics Processing Units (GPUs) and other accelerators used for AI are far more power-hungry than traditional CPUs, often consuming over 1000W per chip. AI racks can require 50-100kW, compared to 5-10kW for typical enterprise workloads. This means data centers must provide significantly more power and cooling capacity per square foot to keep up with AI demands. As next-generation AI training hardware rolls out to support even larger and more sophisticated models, data center operators will be challenged to deploy ultra-high density racks at scale.

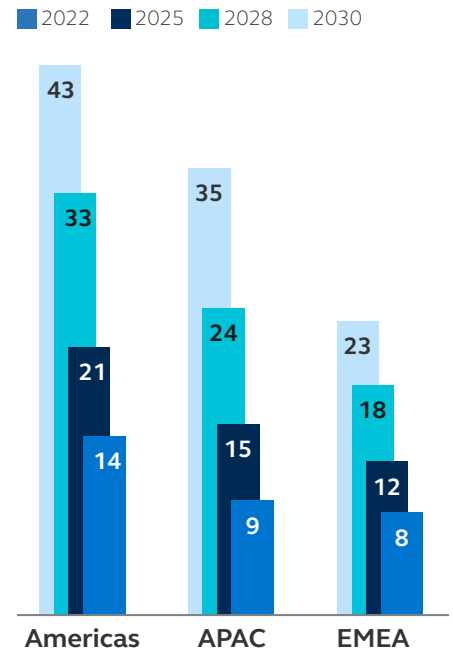
¹ Source: TD Cowen. “A TSUNAMI OF AI DEMAND HITS THE DATACENTER MARKET,” July 24, 2023.

² Source: Data center dynamics. “AI to drive data center demand up 100x over next 10 years,” March 2024.

EXHIBIT 1: Data center capacity is set to more than triple by 2030

World live capacity projection

Capacity, GW



Source: IDC 2022, Principal Real Estate, December 2023.

Learn more in our recent paper [AI is transforming the data center.](#) →

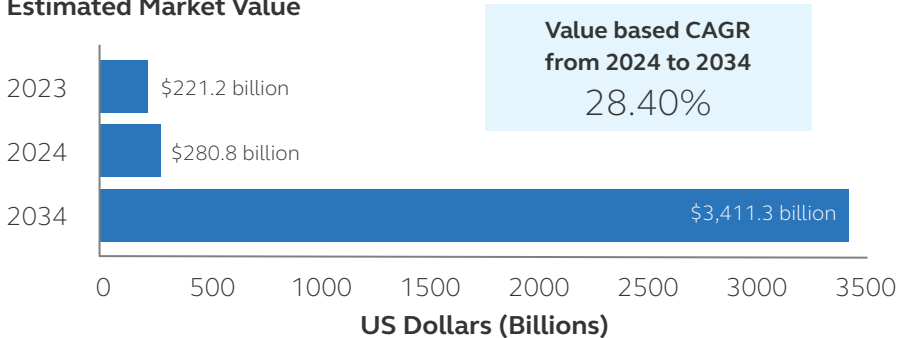


2. Cloud keeps growing, too.

Demand for data centers to support AI is additive to demand for data centers to support traditional and cloud workloads, which continue to grow rapidly as enterprises migrate an ever-growing portion of their IT workloads. Spending on cloud infrastructure is projected to reach \$156.7 billion by 2027, according to IDC—over a third of total compute and storage infrastructure spend.³

EXHIBIT 2: Cloud market value expected to grow 28.4% annually Compound annual growth rate (CAGR)

Estimated Market Value



Source: Future Market Insights Inc., December 2023.

Enterprises are growing more sophisticated in their approach to the cloud. Resiliency is a top priority, guiding enterprises to spread their workloads strategically across multiple cloud platforms and their own data centers. This hybrid, multi-cloud strategy enables enterprises to optimize cost, performance, and uptime for each application while hedging against the risk of cloud vendor lock-in and cloud provider outages.

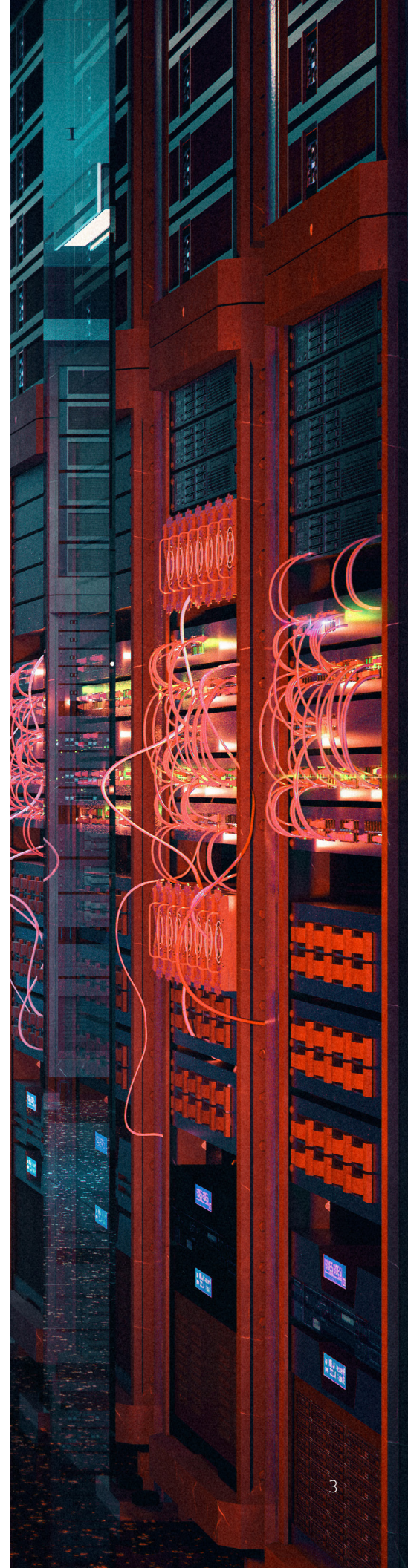
Geography also influences enterprise cloud decisions, with data residency regulations (primarily in Europe) and latency considerations dictating the need to keep certain data and applications in specific regions. The result is a more distributed, interconnected IT environment spanning public clouds, private data centers, and edge locations—all working in concert to ensure continuous operations for the digital enterprise.

3. Cloud providers are building new availability zones.

To meet rising demand, cloud providers are aggressively expanding their global footprints—including by launching new cloud regions and availability zones (AZs) where they've outgrown existing regions and zones. (A cloud region has one or more availability zones within it, and an availability zone has one or more data centers.)

Distributing cloud instances across multiple AZs allows providers to deliver low-latency services to customers in more geographies while providing built-in redundancy and failover capabilities. By replicating workloads across multiple AZs within a region, cloud providers can ensure high availability and protect against localized disruptions.

³ Source: IDC, Cloud Infrastructure Spending Continued to Grow in the Second Quarter of 2023 Led by Spending on Shared Cloud Infrastructure, October 2023.



4. Meeting new demand requires a huge amount of capital, which is now more expensive.

Meeting the staggering demand for data center capacity will require massive capital investment. Data centers are getting bigger, on average, and can now cost upwards of a billion dollars. While traditional models like self-funding and debt financing remain important, more data center operators are turning to unique strategies to fund projects—including portfolio pruning, forward sales, joint ventures, and sale leasebacks.

5. Operators are kicking their sustainability efforts into high gear.

Sustainability is a key corporate priority, as companies recognize the importance of reducing their environmental footprint to mitigate climate change, manage risk, meet customer expectations, and attract investors. Across industries, companies are taking steps to improve their sustainability, including by setting science-based emissions reduction targets, investing in renewable energy, and working to reduce carbon impact across their supply chains.

Accordingly, data centers operators are implementing a range of measures to minimize their environmental impact—from deploying energy- and water-efficient equipment to using AI-powered tools to optimize resource consumption. Renewable energy is a particular focus, with data centers increasingly powered by solar, wind, and other clean sources. In some cases, operators are building their own renewable energy plants.

Learn more in our paper [Data centers: The growing importance of sustainability.](#) →



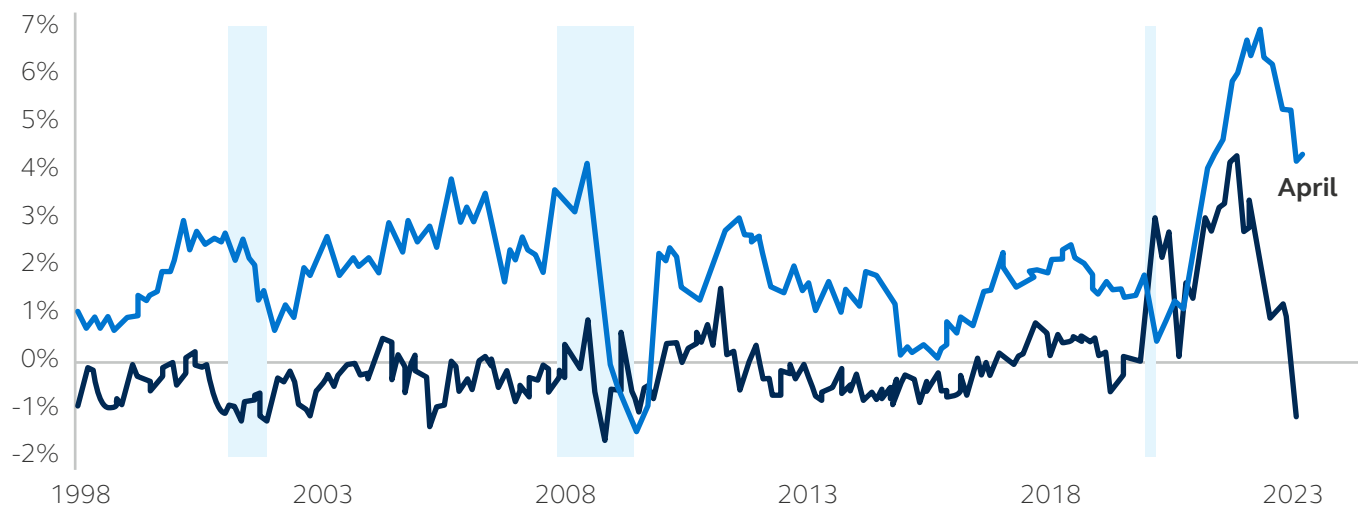
6. Supply chain constraints are easing ...

Manufacturing and transportation bottlenecks arising from COVID-19—exacerbated by exponentially rising demand—caused data center supply chain timelines to balloon. The industry average lead time for generators, as just one example, spiked from 20-30 weeks to 72-104+ weeks.

In general, supply chain constraints are easing, as manufacturers and logistics providers work through backlogs and ramp up capacity to meet rising demand. According to [research](#) by the Federal Reserve Bank of San Francisco, supply chain pressures began easing substantially in mid-2022. However, lead times for some data center critical infrastructure remain significantly extended; generators and transformers, for example, are still two years out.

EXHIBIT 3: Global supply chain pressures are easing

— PCE headline inflation — Global Supply Chain Pressure Index



Source: FRB New York, Bureau of Economic Analysis, and authors' calculations. Light blue shading indicates NBER recession dates.

7. ... but power is increasingly constrained.

In both the U.S. and Europe, while supply chain constraints have eased, power constraints have worsened as demand from the data center sector and other sectors grows more rapidly than utilities can keep up with.

In many markets, it can take years to get power utility interconnection at a data center site. In Northern Virginia, the world's largest data center hub, developers face a multi-year backlog for new electricity connections. In Dublin, new data center development has been stymied by power shortages. (But power constraints are a damper on supply development; they're not shutting it down completely.)

Overcoming these challenges requires close collaboration between data center operators, utilities, and policymakers. Solutions like on-site generation, energy storage, and grid-interactive infrastructure can help alleviate constraints. Nevertheless, as demand continues to grow, ensuring sufficient power supply will remain a defining challenge for the industry.

8. Souring public sentiment has made it more difficult to get approval to build.

Public perception is becoming an increasingly important factor in data center development, as communities grapple with the rapid growth of digital infrastructure in their midst. Concerns about data centers' impact on local resources and quality of life have led to tensions between developers and residents and officials. Fears about noise, water usage, and strains on the power grid are causing some communities to view data centers as more of a burden than a benefit.

These perceptions are now influencing policy. Amsterdam and Singapore have implemented restrictions on data center development due to resource constraints and local opposition. In the world's largest data center market (Virginia), lawmakers have proposed a wave of legislation restricting development. In Georgia, the legislature suspended the state's sales tax exemption for data centers for two years—during which time a state commission will examine the impact of data centers on Georgia's state power grid.

Beyond overt regulatory restrictions, permitting processes are becoming more complex and time-consuming as well, with some jurisdictions requiring extensive environmental impact studies and public hearings before approving new data center projects. Developers must increasingly engage with local stakeholders and emphasize the economic and social benefits of data centers to build support. Addressing public concerns and building trust will be essential for the long-term success of the data center industry.

9. Data center operators are looking to new power and cooling technologies.

Driven by sustainability considerations, public perception, and power constraints, developers are exploring new power technologies. As noted previously, on-site generation and storage could mitigate power constraints—and also improve sustainability (if generation is carbon-free). On-site nuclear generation via small modular reactors (SMRs) is gaining interest, though in many communities it would likely generate even more public backlash and regulatory scrutiny than developers already face.

Microgrids, which combine on-site generation, storage, and intelligent control systems, are also attracting interest. By enabling data centers to operate independently of the grid when needed, microgrids can enhance uptime and reduce reliance on diesel generators. Fuel cells, which generate electricity through a clean electrochemical process, are another emerging power option. None of these are quick solutions. For example, SMRs are in their infancy, likely 7+ years from implementation.

Driven by the need to support much higher densities and reduce water consumption, developers are also implementing new cooling technologies. Specifically, liquid cooling will soon be a prerequisite for handling the extreme heat densities of AI and other advanced workloads. By bringing liquid coolant directly to server racks, liquid cooling can support much higher power densities than traditional air cooling while significantly reducing energy consumption.

10. Data center operators are designing to meet today's needs—and tomorrow's.

The nine trends described here are changing how data centers are sited, designed, developed, and operated. But they're not rendering existing facilities obsolete, and operators will have to continue to support the workloads of yesterday alongside the workloads of today and tomorrow.

Data center developers are embracing a 'system of systems' approach to make their facilities more adaptable and future-proof—incorporating new technologies incrementally, without expensive and disruptive overhauls. For example, an operator might deploy a new cooling system in one data hall while leaving the rest of the facility unchanged. Standardized, interoperable components are key to this flexibility.

Learn more in our paper [Data centers: Viable for the long term.](#) →

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- Over 190 development and value-add projects since 2014, valued at nearly \$16.8 billion. Invested more than \$3 billion in 28 data center transactions.³
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- Demonstrated ability to source and close significant volume of high-quality investments.⁴
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¹ Principal Real Estate Investors became registered with the SEC in November 1999. Activities noted prior to this date were conducted beginning with the real estate investment management area of Principal Life Insurance Company and, later, Principal Capital Real Estate Investors, LLC, the predecessor of Principal Global Investors Real Estate.

² Managers ranked by total worldwide real estate assets (net of leverage, including contributions committed or received, but not yet invested; REOCs are included with equity; REIT securities are excluded), as of 30 June 2023. "The Largest Real Estate Investment Managers," Pensions & Investments, 9 October 2023.

³ Based on gross asset value as of 31 December 2023.

⁴ Past performance is not indicative of future results and should not be relied upon to make an investment decision.

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