Principal Real Estate

Data center viability requires design flexibility

Existing data centers are still viable. For the data centers being built today—to support use cases we cannot even imagine—flexibility is essential.

Authors:

SEBASTIAN DOOLEY, CFA
Senior Fund Manager

PAUL LEWIS
Managing Director
European Data Centres

MATT HACKMAN
Portfolio Manager

CASEY MILLER
Managing Director, Portfolio Management

AT-A-GLANCE

The industry has shifted considerably in the almost two years since we wrote Data centers: Viable for the long term

- Data center designs have evolved to accommodate the dramatically higher (and still rising) densities associated with AI training deployments
- In Europe in particular, sustainability-focused regulations are driving new designs and approaches to data center development and operations

Amid all this change, the data centers built five, ten, fifteen years ago have not become obsolete

- Existing data centers support traditional workloads (including cloud), which continue to grow
- Where land and power are growing increasingly constrained, existing facilities are ever more valuable—even as their existing mechanical, electrical, and plumbing (MEP) infrastructure ages
- In some cases, additional value can be created by retrofitting existing data centers to support new workloads and/or meet new regulatory requirements

New data centers are being designed with flexibility to adapt to future changes, ensuring long-term viability

Data center designs continue to evolve

Data center designs have evolved to accommodate two key challenges: the increasingly high (and still rising) power densities required for AI training, and new sustainability regulations, particularly in Europe.

Data center designs have evolved to accommodate increasingly high (and still rising) power densities

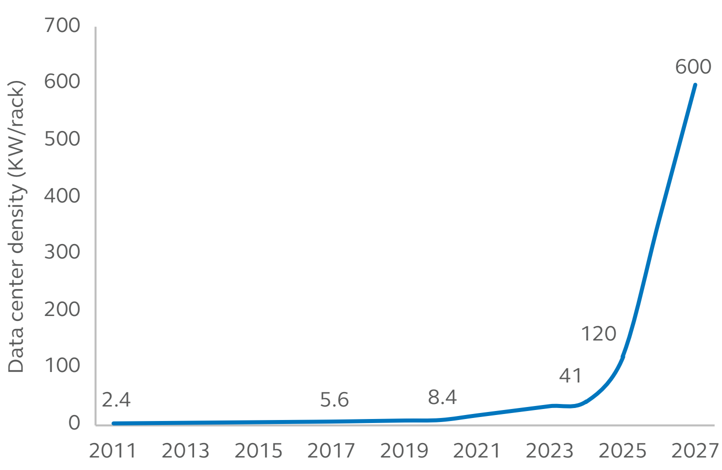
Compared to traditional workloads, AI workloads (in particular, AI training) are considerably more power intensive, and deployments are at much higher densities. (Learn more in AI is transforming the data center.) Exhibit 1 demonstrates how density increases have dramatically accelerated as AI training architectures continue to evolve. For example, Nvidia's 2024-era graphics processing unit (GPU) architecture, Hopper, was designed for a density of 41 kW per rack. The very next generation, Blackwell, is architected for 120 kW. In March 2025, Nvidia CEO Jensen Huang announced a roadmap for 600 kW racks by the end of 2027.[1]

Among the most significant impacts of rising density is the need for new cooling technologies. Specifically, liquid cooling is necessary to handle the extreme heat densities of AI and other advanced workloads. By bringing coolant directly to server racks, liquid cooling can support much higher power densities than traditional air cooling.

Will power requirements and densities continue to rise? For example, the Chinese AI company DeepSeek claims to have created a sophisticated machine learning model using 10-40 times less energy than similar U.S. AI technology, though the jury is still out on the validity of those claims and the methods DeepSeek used. Regardless, efficiency gains would most likely raise utilization and maintain or even increase power demands, cluster sizes, and rack densities—just as adding lanes to a freeway encourages more drivers to use the road.

EXHIBIT 1: AI calls for massively denser rack deployments

Data center density



Source: 2011, 2017, and 2020 data points reflect average density per rack as reported by Uptime Institute in December 2020. 2024, 2025, and 2027 data points reflect Nvidia GPU architecture specifications.

> "Training AI models more efficiently will actually increase AI utilization. The biggest impact of DeepSeek's likely use of other large language models to help train its own will be faster and cheaper AI training that gets us to the inference stage sooner. We're going to see a massive increase in inference deployments, and that will be a huge data center demand driver."
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> *Matt Hackman, Portfolio Manager*

Bottom line: AI training architectures will continue to evolve, deployments for AI inference will continue to grow, and data centers must be ready to support the evolution.

[1] In Exhibit 1, the 2011, 2017, and 2020 data points reflect average densities reported by data center operators across a wide range of deployments. The 2024, 2025, and 2027 data points are not reported densities but Nvidia design specifications, and it's hard to imagine widespread deployments at densities of 600 kW per rack in just two years. But data center developers are currently being asked to support design specifications in the 120 kW+ range, and Exhibit 1 is a fair illustration of the incredibly massive and rapid increase in density.

Data center designs have evolved to accommodate new sustainability regulations

In Europe in particular, sustainability-focused regulations are driving new data center designs and approaches to development and operations. For example, in Germany the Energy Efficiency Act makes power efficiency targets obligatory for data centers, depending on their initial operational date. (Learn more in Evolving data center sustainability and the role of the capital partner.) To comply with Power Usage Effectiveness (PUE) requirements, operators will need to construct new data centers with energy-efficient designs, while existing facilities may require renovations and upgrades to meet these standards.

> "There are still many unknowns with the new PUE regulations, but the direction is clear: inefficient data centers will have to improve, and new data centers will have to be designed for greater efficiency. Data center developers and operators have to be more focused on environmental, social, and governance (ESG) considerations. As another example, there is regulatory pressure across Europe to build new data centers with mechanisms for waste heat capture, which requires quite different design considerations."
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> *Paul Lewis, Managing Director - European Data Centers*

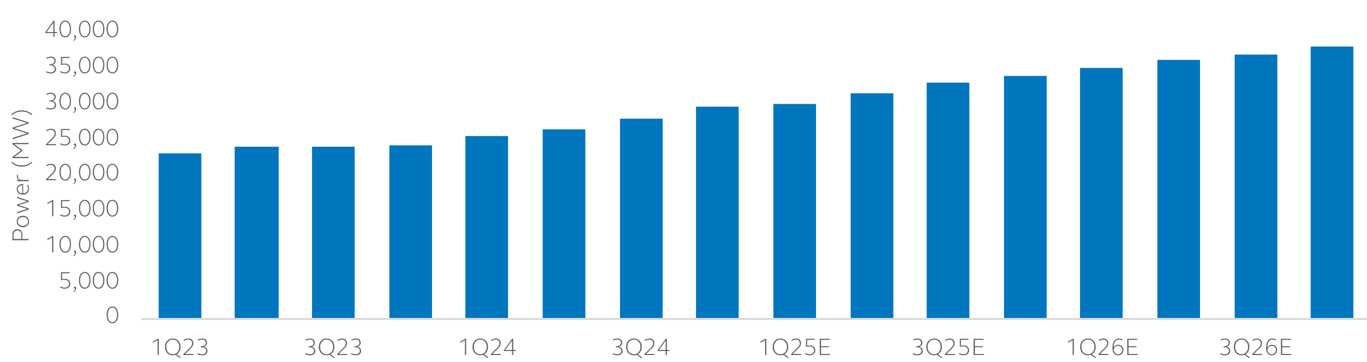
Amid all this change, existing data centers have not become obsolete

The data centers built five, ten, fifteen years ago are supporting traditional workloads, which continue to grow. In many primary markets, land and power are increasingly constrained, making existing facilities ever more valuable despite their aging MEP infrastructure. In some cases, existing data centers are being retrofitted to support new workloads and/or meet new regulatory requirements.

Traditional workloads are still growing

Demand for data centers to support AI is adding to, not replacing, the existing demand for data centers that support traditional and cloud computing needs. These traditional deployments continue to expand rapidly, driven by multiple factors: the growing demand of cloud-based AI applications, data residency regulations (primarily in Europe), and the need to maintain servers in specific regions to minimize latency for local users.

EXHIBIT 2: Cloud demand expected to grow 14% annually 2023-26



Source: 451 Research - part of S&P Global Market Intelligence, Goldman Sachs Global Investment Research. E= estimate.

"While many new data centers are built specifically for high-density AI training, there is still a growing need for less-dense deployments such as for cloud and AI inference. If anything, higher-density AI deployments coming into the cloud are increasing requirements for less-dense cloud deployments as well. As developers decide how to meet growing needs for all types of workloads, they're looking for the most cost-efficient way to meet both high-density and traditional-density needs, whether that's building new data centers specifically for high-density or retrofitting existing facilities to support different densities—or most likely, both."

Sebastian Dooley, CFA, Senior Fund Manager

In constrained markets, land and power are a data center's most valuable assets

Even in cases where a data center's MEP equipment is inadequate for modern computing needs, there is often significant value in the facility's land and access to utility power. Land and power are constrained in many primary markets (learn more in How data center developers are powering AI). As a result, land and power have become existing data centers' most valuable assets.

A recently reconfigured facility in Georgia provides a good example. The data center was built with high redundancy, with each data hall supporting 1.2 megawatts (MWs) of IT load. The new tenant, a leader in AI cloud-computing, was seeking much higher power density—8 MWs per data hall. Since the facility had adequate utility power available, increasing rack density was achievable by installing additional power infrastructure. Within one year, we repositioned the facility from a highly redundant, low-density data center into a high-density AI deployment.

Existing data centers are being retrofitted

In some cases, existing centers are being retrofitted to support new workloads and/or meet new regulatory requirements. A notable example is a facility that was originally commissioned nearly 15 years ago as a bank-owned data center. While initially designed for high redundancy and low-density computing, the facility's robust power and cooling infrastructure made it valuable for modern needs. Through strategic upgrades, the data center was retrofitted and fully leased to a specialty cloud service provider to deploy an AI/ML strategy that, upon full deployment, will rank among the world's largest supercomputers.

"Strategic land location with access to multiple fiber lines and utility power is critical for long-term success, even if initial facility configurations require future modifications. A primary challenge for adding critical capacity will likely be securing adequate space for additional infrastructure equipment. In some cases, tenants may be willing to accept lower levels of redundancy in exchange for more IT power."

Casey Miller, Managing Director, Portfolio Management

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New data centers are being designed with flexibility

With the rapid evolution of AI applications and the increasing density of AI training architectures, predicting data center requirements even five years into the future is quite challenging. So, developers are designing with flexibility to adapt to both current and future tenant requirements. This adaptability is especially important for data centers that may need to support high-density AI training operations today, while being able to transition to lower-density AI inference in the future.

Given that data centers are designed for a 20+ year useful life and most lease terms are 15 years, future-proofing to support new use cases is essential, and requires flexible design. To support both high-density and lower-density deployments, one of our development partners invented a pre-engineered integrated solution for both air and liquid cooling. The solution enables both AI and traditional workloads in the same facility, and the transition to direct liquid cooling without significant added expense, operational disruption, or delays. For example, at the partner's Phoenix data center, which was originally designed for air cooling, the modular cooling system can be easily deployed in a data hall to deliver liquid cooling directly to server racks.

Principal Real Estate: A partner to navigate the evolving data center sector

Not every data center developer is well equipped to support current and future tenant requirements, and not every investor has relationships with developers that are well equipped.

Experience and access are critical to successful execution. As an active commercial real estate investor for more than 60 years—including more than 17 years in the data center sector—we have witnessed the asset class evolve and adapt to the changing needs of data center tenants.[2] We have relationships with many of the data center developers successfully supporting both traditional and AI workloads, retrofitting existing facilities to support new needs, and designing new facilities with flexibility to adapt to future technological changes.

[2] Principal Real Estate Investors become registered with the SEC in November 1999. Activities noted prior to this date were conducted beginning with the real estate investment management areas of Principal Life Insurance Company and, later, Principal Capital Real Estate Investors, LLC, the predecessor of Principal Global Investors Real Estate.

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Data center properties and will only be attractive to a unique type of tenant. A limited tenant base increases the risk of vacancy. Additionally, a property designed to be a data center property, may be difficult to relet to another type of tenant or convert to another use and will be more likely to become functionally obsolete when compared to other properties. For example, if converted to industrial use, the expected rents would be lower than that projected for data centers. Thus, if operating a data center were to become unprofitable, the liquidation value of properties may be substantially less than would be the case if the properties were readily adaptable to other uses.

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