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The evolving landscape of data centers in the United States

The U.S. data center industry is undergoing a significant transformation, driven by the increasing demands of artificial intelligence (AI), cryptocurrency mining, blockchain applications, and advanced encryption technologies. These workloads require unprecedented levels of power density, cooling capacity, and operational flexibility, challenging the capabilities of legacy facilities. In this overview article, we examine the factors propelling this shift, the technical requirements reshaping data center design, and the long-term implications for the market.

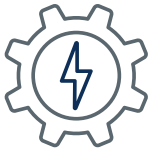
Historically, data center growth has aligned with the introduction of new IT service models — outsourcing, hosting, colocation, and cloud computing — that encouraged enterprises to transition from in-house facilities to professionally managed centers. This trend led to the rapid expansion of regions such as Northern Virginia, now known as “Data Center Alley” due to its access to affordable land, reliable power, and high-speed fiber optic network infrastructure.

Traditionally, data centers were designed around predictable workloads, with electrical distribution, HVAC systems, and auxiliary power engineered to support uniform power consumption and cooling requirements. However, the rise of high-performance applications is challenging these legacy designs, necessitating a reevaluation of data center infrastructure.

Disruptive technologies and their demands

The past decade has witnessed the emergence of technologies such as blockchain, cryptocurrency mining, AI-driven analytics, and advanced encryption. These applications often rely on specialized hardware — GPUs (Graphics Processing Units), ASICs (Application-Specific Integrated Circuits), and other accelerators — optimized for performance, which in turn increases power and cooling demands. While the long-term adoption of blockchain remains uncertain, cryptocurrency mining and AI deployments are driving immediate demand for dedicated, large-scale facilities. These projects typically favor new-build campuses designed for flexibility, scalability, and high-density power and cooling capabilities.

Key requirements reshaping data centers



Power density
Traditional enterprise data centers often operated within a power density range of 2–5 kW per rack. In contrast, AI and cryptocurrency applications may require 20–50 kW per rack equivalent or more. Supporting such densities necessitates replacing virtually every electrical component in a facility, from switchgear and transformers to cabling and racks. For many operators, retrofitting existing facilities is impractical, making new construction the preferred option.

Cooling technologies
Increased power density leads to higher heat output. Standard air conditioning systems alone are insufficient for these demands, especially when workloads vary in thermal requirements. New data centers are adopting hybrid cooling solutions, including air cooling, chilled water, direct-to-chip liquid cooling, and immersion systems. Implementing these new cooling technologies in legacy facilities is often unfeasible without completely disrupting operations.

Backup and auxiliary power
Traditional UPS systems and diesel generators are inadequate for hyperscale operations. Alternatives such as gas turbines and battery energy storage systems (BESS) are being explored. Each option presents unique operational challenges; for example, gas turbines can require up to 10 minutes to reach full load, placing additional strain on UPS systems. Operators must carefully evaluate redundancy and responsiveness when selecting backup power solutions.

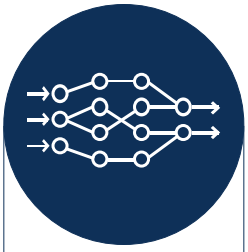
Grid and utility access
Access to reliable and abundant power is perhaps the most critical factor in data center site selection. Data centers are increasingly planned around available power sources. Where legacy facilities required single-digit megawatt capacity, new hyperscale data centers may demand hundreds — or even gigawatts — of power. Few utilities can accommodate such large-scale demands, necessitating grid upgrades and direct partnerships with power producers. In some cases, operators are exploring on-site power generation to ensure a stable energy supply. To secure power supplies, major technology companies are investing in power generation technologies, including gas turbines, fuel cells, and renewables. Small modular reactors (SMRs) stand out as a reliable carbon-free energy source and are sparking a potential "nuclear resurgence," but they take a long time to build.

Several other issues are also impacting locating these massive data centers, including:

Resource availability: Access to water for cooling and land for expansion.

Climate risks: Exposure to extreme weather events and natural disasters.

Regulatory environment: Compliance with local zoning laws and environmental regulations.



Infrastructure: Proximity to transportation networks and telecommunication hubs.

Community impact: Considerations regarding noise, emissions, and visual aesthetics.

Implications for the insurance industry

The shift toward hyperscale, high-density data centers carries significant implications for the insurance industry, particularly property and equipment breakdown carriers.

Higher severity of losses: With power densities reaching 20–50 kW per rack, the failure of a single electrical component such as a transformer or switchgear can cascade into widespread outages, creating much higher insured losses than in legacy facilities.

Increased equipment complexity: The adoption of liquid cooling systems, advanced UPS technologies, gas turbines, and potentially small modular reactors introduces unfamiliar equipment into the risk profile. Insurers must expand technical expertise to underwrite these risks accurately.

Business interruption exposure: Given the scale of AI operations, downtime can result in extraordinary financial losses. Insurers will need to reassess policy limits, waiting periods, and exclusions to account for the heightened exposure.

Infrastructure dependencies: As site selection becomes increasingly dependent on high-capacity power grids and water resources, external infrastructure failures — outside the data center's control — may become major loss drivers, complicating risk modeling and policy coverage.

Sustainability and liability risks: Community and regulatory scrutiny of energy and water usage could result in new liability exposures. Carriers may need to account for environmental liabilities in addition to traditional property and equipment risks.

For insurers, this evolving landscape represents both a challenge and an opportunity. Carriers that invest in technical expertise and develop tailored coverages for hyperscale operators will be well-positioned to capture premium growth. However, those who fail to adjust underwriting models to reflect these new realities risk significant exposure to catastrophic claims.

Long-term market outlook

The demand for high-density power will continue to drive the data center market. As hyperscale facilities become more prevalent, older data centers may be repurposed for legacy applications or decommissioned. Economies of scale will become increasingly important, with larger facilities offering cost advantages in power procurement and operational efficiency.

Operators are also exploring innovative solutions such as colocating with power generation assets, including nuclear facilities or natural gas turbines, to secure a reliable energy supply. However, these approaches raise new considerations regarding sustainability and environmental impact. They are also subject to regulatory approvals.

At the same time, global supply chain constraints are delaying the delivery of critical equipment such as gas turbines, transformers, and switchgear. Sustainability concerns are also intensifying, as communities question the environmental footprint of massive power-hungry facilities.

Conclusion

The U.S. data center industry is at a pivotal juncture. Driven by the needs of AI, cryptocurrency, and other high-performance applications, operators are investing in new facilities designed to meet unprecedented power and cooling demands. The future success of the industry will depend not only on technological innovation but also on the ability to secure sustainable and reliable energy sources while navigating regulatory, community, and insurance considerations.

For insurers, this transformation signals a new era of risk complexity. As hyperscale campuses become the backbone of the digital economy, property and equipment breakdown carriers must evolve their underwriting strategies, enhance technical expertise, and prepare for higher-severity loss scenarios to remain viable partners in this rapidly changing landscape.

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2026-012 (New 2/26 ES611)