

Less is more: Which energy efficiency enablers could prosper as AI data centers proliferate?



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Key takeaways

- Energy efficiency gains are key to the buildout of artificial intelligence (AI). By making each watt go further, companies can sidestep power-availability roadblocks and continue to grow their computational power.
- This creates opportunities across a broad range of industries that can help data centers operate more efficiently, such as advanced semiconductor technology, as well as batteries and backup power.
- The acceleration in energy demand that AI is creating could also serve as a major catalyst to modernize the electricity grid, invest in low-carbon energy generation and ultimately build a more sustainable energy system.

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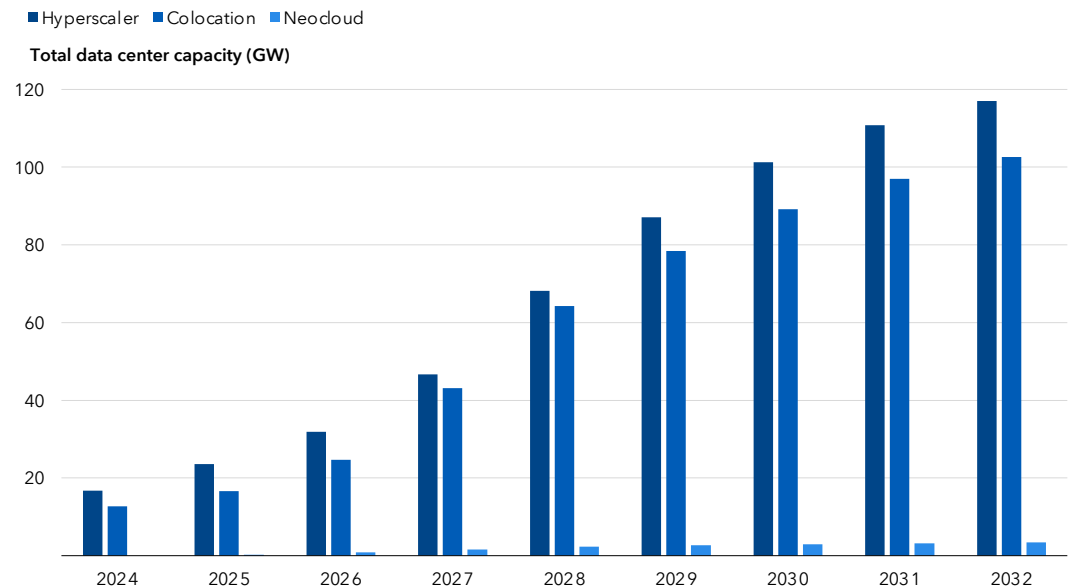
Introduction

Artificial intelligence's growth is becoming increasingly tied to access to electricity. Building new generation and grid infrastructure will remain important, but supply expansion alone is unlikely to keep pace in the near term. That makes energy efficiency an essential part of the equation and creates investment opportunities in a broad range of companies.

Even under conservative assumptions, projected data center electricity demand appears likely to exceed available power in several markets over the next few years. Utilities and power producers are moving to add capacity, but grid connection wait times currently exceed five years in many key U.S. regions.

Hyperscale growth

U.S. data center capacity is projected to grow more than five times by the early 2030s



Source: Capital Group, with data from SemiAnalysis, as of January 2026. Data for 2024 and 2025 were actual, and data for 2026 onward are forecast by SemiAnalysis based on announced plans from data center developers. Hyperscalers refer to technology companies that develop and operate large data centers. Neocloud refers to specialized cloud infrastructure providers dedicated to AI workloads. Colocation data centers lease space for hardware that customers own.

To meet their growth ambitions, hyperscalers, or tech companies that develop and operate large data centers, will need to deliver more computational capacity from the power they already have. Improvements in chip design, memory bandwidth, networking and energy management can reduce costs and support faster scaling. The capex spending needed to achieve those improvements could create opportunities in semiconductors, memory suppliers, optical components, batteries and backup power.

Packing a punch: Chip design addresses power constraints

Large opportunities for AI power efficiency improvements lie within a new chip design concept known as advanced packaging, or integration of multiple chips into a single enclosed package for better performance and energy efficiency.

Historically, semiconductor advances have been primarily driven by shrinking the size of transistors — key building blocks of chips that are essentially microscopic switches that control electrical power — and cramming more of them onto a chip. The industry is reaching its limit on physically diminishing transistors, just as demand for computational capabilities from AI has increased rapidly.

Moving data to and from the core compute processor is the largest bottleneck and greatest power drain within AI hardware today. Longer distance traveled by data increases latency, generates more heat and wastes electricity. Advanced packaging addresses this problem by bringing components physically closer together.

Growing demand for advanced packaging could benefit key players in relevant parts of the semiconductor value chain, including leading chipmakers such as Taiwan Semiconductor Manufacturing Company Limited (TSMC), inspection and testing companies such as KLA Corporation, and suppliers of specialized equipment for advanced packaging such as ASMPT Limited. Advanced Micro Devices, Inc. (AMD), NVIDIA Corporation, Apple Inc. and Broadcom Inc. have incorporated elements of advanced packaging into their product roadmaps for 2026 and beyond.

High-bandwidth memory (HBM), a key component of advanced packaging, addresses a major source of energy inefficiency in AI systems.

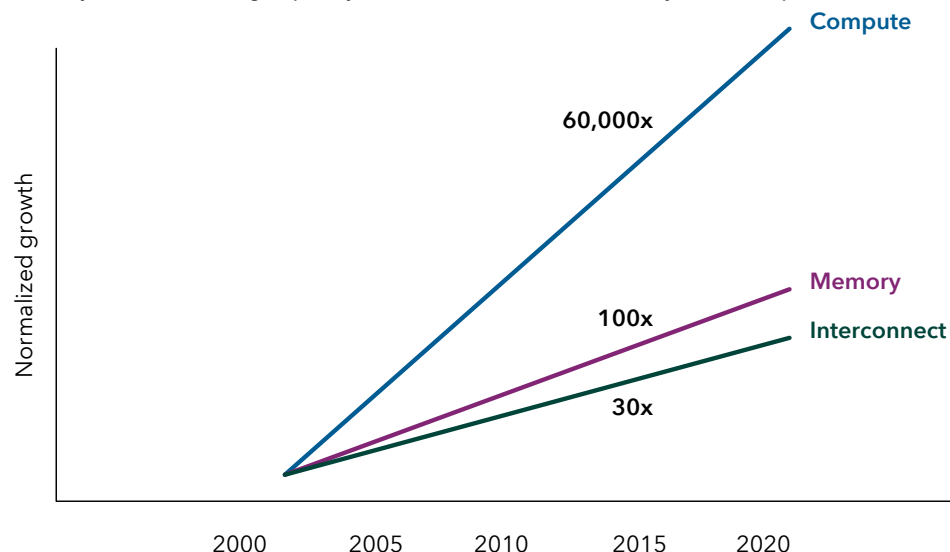
In many AI workloads today, processors run well below full utilization because memory cannot deliver data quickly enough, a bottleneck commonly referred to as the “memory wall.” In practical terms, that means expensive processing capacity often sits idle while still consuming power.

Instead of spreading out memory chips horizontally, HBM places them side-by-side or stacks them vertically; and uses more efficient “interconnect,” or electrical connection, which shortens the distance to move data, improves performance and energy efficiency.

Leading memory suppliers like SK Hynix Inc., Micron Technology, Inc. and Samsung Electronics Company Limited have already benefited from the surge in AI spending, and they appear likely to remain attractive for investors as advanced packaging technologies, including HBM, are deployed at scale.

Growing bottleneck

Memory and networking capacity has scaled much more slowly than compute



For illustration purposes only. Source: Capital Group analysis using data from Gholami, Amir, Zhewei Yao, Sehoon Kim, Coleman Hooper, Michael W Mahoney, and Kurt Keutzer. 2024. “AI and Memory Wall.”

Data center networking: How to move more data with less power

Power efficiency improvement at the chip level is critical, as up to 60% of an AI center's power demand comes from processors and memory. The second-largest power consumer: networking, or systems and technologies that connect servers, storage and applications within a data center, to enable reliable data movement and support large-scale workloads. Networks for AI training could exceed 20% of total power consumption at data centers, according to Lumentum Holdings Inc.¹

Traditional electrical, copper-based cables can handle high data volumes, but they become less efficient as bandwidth demands increase and operators try to limit heat and power consumption.

New technologies have emerged to address the challenge. For example, optical networking uses optic fiber to transmit data, and co-packaged optics (CPO) technology integrates optics, such as lasers, and electronics into one circuit package.

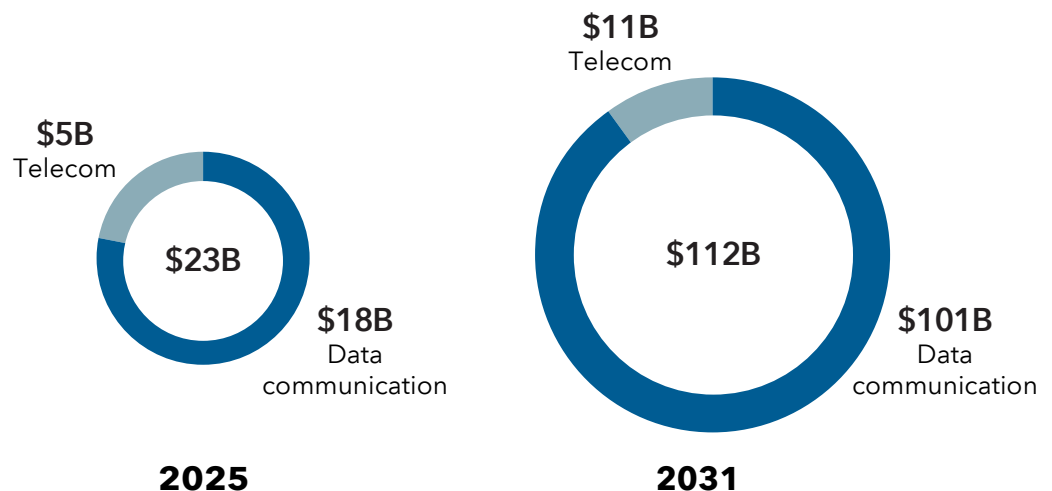
Optical networking, including CPO, can improve graphics processing unit (GPU) utilization, meaning fewer processors sit idle waiting for data, enabling data centers to produce more output without drawing more electricity.

The transition from copper to optical networking in data centers is still in its early days, but the need for more bandwidth, higher speed and lower power consumption points to demand growth for various optical products. For example, the market for optical transceivers, tiny devices that convert data between electrical and optical formats, is poised to grow rapidly through the early 2030s, according to Yole Group.²

Share prices of pure-play companies along the optics supply chain have rallied, such as laser manufacturers Lumentum and Coherent Corporation, and fiber optics supplier Corning Inc. Our investment professionals see further upside potential, as 2027 and 2028 could be another important inflection point for revenue growth as CPO adoption

Bright optics

Total optical transceiver market size, 2025 vs. 2031



Source: Yole Group. "AI redefines the optical transceiver market." June 2026.

Footnotes/Important information:

¹Lumentum Holdings Inc. "Energy-Efficient AI Networks Lead to Dramatic Reduction of Environmental Impact." 2024.

²Yole Group. "AI redefines the optical transceiver market." June 2026.

Flexible power demand management can go a long way

Another key to improving AI power efficiency is using electricity more intelligently. If AI data centers can occasionally reduce power demand from the grid in peak hours, the existing U.S. infrastructure could absorb a surprisingly large amount of additional demand.

This does not necessarily mean shutting down a data center facility. In practice, it can mean delaying non-urgent workloads, moving tasks between sites, or temporarily relying on on-site generation or battery storage. Case in point: Batteries in data centers are shifting from idle backup systems to actively managing AI-driven power volatility and supporting grid reliability. If a hyperscaler can offer a utility a credible flexibility commitment, it may be able to connect new facilities to the grid faster. The rising energy demand from AI could also serve as a major catalyst to invest in low-carbon energy generation and ultimately build a more sustainable energy system.

There are still hurdles, particularly around market design, contract terms and operational reliability. But backup power providers, battery storage companies, energy management software vendors, and utilities that can structure flexible-load contracts all stand to benefit.

Final thoughts

As data center buildouts accelerate and grid capacity remains limited, it may be cheaper and easier to unlock power capacity through efficiency gains versus building and connecting new power generation capacity. Our investment professionals' deep fundamental research capability allows them to dig deep into different segments of the AI data center value chain — from foundries to battery producers — to seek companies that are better positioned to capture growing demand for products and solutions that enable data center power efficiency.

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