Optimized cooling solutions for data centers

Meeting the increased power demands for IT rack loads.

Global demand for data center power is increasing, with a report from Boston Consulting Group estimating that growth will reach approximately 16% on a compound annual basis from 2023 to 2028, which is 33% faster than the growth observed from 2020 to 2023. By 2028, demand is expected to reach approximately 130 gigawatts (GW), indicating a need for higher-capacity cooling solutions.

The increased rack-load power demand in data centers also results in higher data center power consumption, increased cooling capacity, and higher energy costs.

The adoption of AI in hyperscale and colocation data centers significantly increases IT-rack heat loads, with current AI rack densities ranging from 50 to 200 kW per rack and projected to grow annually. This intensifying heat generation requires optimized

Data centers consumed about 4.4% of total U.S. electricity in 2023 and are expected to consume approximately 6.7 to 12% of total U.S. electricity by 2028.

Department of Energy 2024 Report

cooling solutions, such as liquid cooling (direct-to-chip and immersion) or hybrid cooling (combining liquid and air methods).

With hybrid cooling setups, direct-to-chip cooling will remove 75-80% of the heat load directly from high power AI GPUs/CPUs, while air cooling removes the remaining 25-20% off the AI GPU/CPUs as well as the heat generated off other IT equipment in the rack. The air cooling units could be a rear door heat exchanger (RDHx), or a CRAC cooling system in combination with a hot air containment (HAC).

Global data center power required to serve projected computing demand (GW)[1]
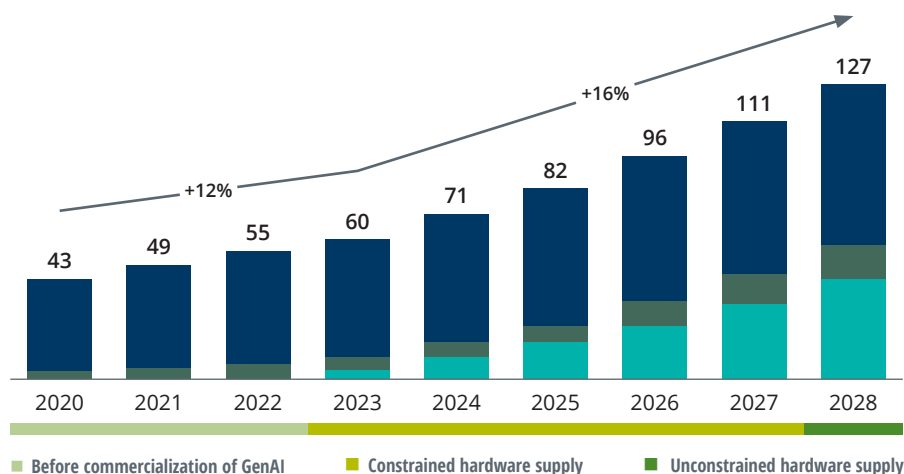
Workload segments	CAGR 2020–2023 (%)	CAGR 2023–2028 (%)
Traditional	**9**	**7**
Other AI+HPC	**18**	**20**
GenAI	**n/a**	**65**

Sources: BCG Global Data Center Model; expert interviews; MLPerf; Nvidia quarterly earnings; press releases; product datasheets.

Note: AI= artificial intelligence; CAGR= compound annual growth rate; GenAI= generative artificial intelligence; GW= gigawatt; HPC= high-performance computing; n/a= not applicable.

[1.] Data in this exhibit reflects the base case scenario, with hardware supply constrained through 2027 and unconstrained in 2028. Growth projections for data center demand do not include the impact of the bitcoin sector.

■ Before commercialization of GenAI   ■ Constrained hardware supply   ■ Unconstrained hardware supply

Eaton's sustainable approach: Partnering for energy efficiency

High-efficiency cooling solutions are not only required in AI data centers but also within small and medium-sized data centers and edge computing environments. The increased demand for data center power creates a growing opportunity for sellers to partner with providers offering energy-efficient solutions. By aligning with Eaton as a forward-thinking partner, sellers not only enhance their offerings but play a pivotal role in the journey toward a more sustainable future.
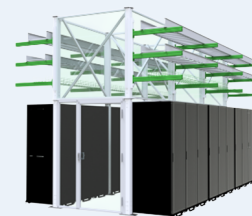
As a leader in sustainable solutions, Eaton collaborates with select channel partners to gather customer insights on the best-in-class products designed to meet the growing demands of data centers. Leveraging this feedback, Eaton offers a comprehensive line of precision cooling products that can deliver up to 25 kW per rack, with higher capacity products on the horizon, benefiting channel partners and their end customers.

With significant inventory available at competitive prices, Eaton ensures the quick setup and easy deployment of portable, rack-mounted, in-row, and self-cooling racks, as well as cold air and hot air aisle containment systems. Each of these systems is also designed to deliver optimal performance and exceptional reliability, which is particularly crucial in data centers that utilize edge computing.
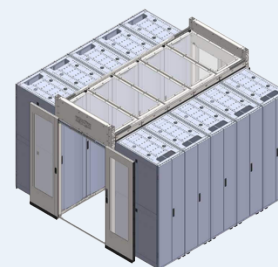
Optimizing edge computing: Three key advantages of Eaton's cooling solutions

Small to large enterprises, financial, government and educational institutions utilize edge computing to optimize performance by positioning computing resources closer to the source of data generation, thereby minimizing latency and optimizing the computing performance. At the edge, we are seeing increasing rack heat loads, which require highly reliable and compact, self-contained cooling rack solutions with small footprints and remote management capabilities. Edge compute does not necessarily need to be remote, Edge could be distributed throughout.
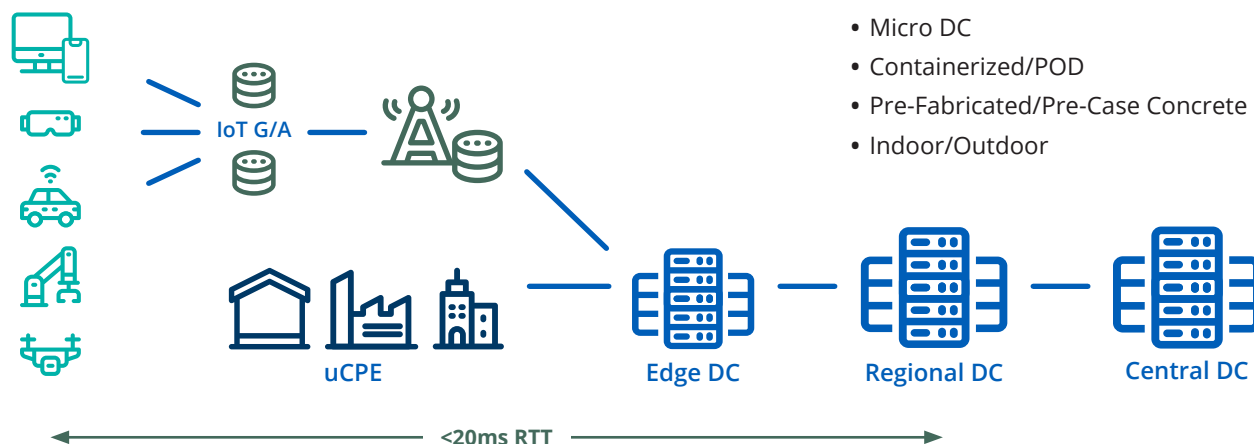
Hot Aisle Containment (HAC)

Cold Aisle Containment

In-Row Cooling

Eaton In-Row Precision Cooling Systems (12kW or 25kW)

- Micro DC
- Containerized/POD
- Pre-Fabricated/Pre-Case Concrete
- Indoor/Outdoor

IoT G/A

uCPE   Edge DC   Regional DC   Central DC

<20ms RTT

Note: DC= Data Center; POD= Performance Optimized Datacenter; IoT= Internet of Things; uCPE=universal Customer Premises Equipment; RTT= Round-Trip Time   **Source:** Omdia Telco Edge Survey, October 2018

Eaton's catalogue of cutting-edge cooling systems addresses these challenges by providing energy-efficient and sustainable solutions critical for today's rapidly evolving technology landscape. These cooling systems safeguard micro data centers (MDCs) and small to medium-sized data centers from overheating risks, preventing potential equipment failures, costly downtime, and helping to control operational expenses.

Enhanced infrastructure reliability:

Improved temperature regulation ensures consistent and reliable operation of critical IT infrastructure.

Optimized airflow management:

Efficient airflow strategies can reduce energy costs by minimizing fan power consumption and equipment overheating and shutdowns.

Extended equipment lifespan:

Preventing overheating can increase the longevity and performance of critical IT equipment, thereby reducing long-term operating costs. Eaton also provides equipment startup and service contracts that include on-site parts and labor.

Looking ahead at cooling for AI data centers

The rise of artificial intelligence (AI) and machine learning demands more than traditional air cooling. These AI-driven data centers require liquid cooling solutions to efficiently manage high-power AI GPUs, such as NVIDIA H100 and GB300. Therefore, Eaton is exploring the best liquid cooling options to support AI IT loads ranging from 50 kW to over 250 kW per rack.

Currently, Eaton is working to introduce RapidPod HAC solutions with SKU-based, pre-configured models, which will streamline the quoting and configuration process. Additionally, Eaton's inventory of self-cooling racks, in-row cooling, Hot Aisle Containment (HAC), and cold-aisle containment provides thermal cooling solutions for micro data centers to hyperscale data centers, making Eaton an ideal choice for channel partners serving data center clients.

Looking ahead, channel partners can eagerly anticipate Eaton's advancements and investments in meeting the ever-increasing power density require-ments of racks, which are essential for all data centers, including those focused on artificial intelligence (AI). As Eaton introduces new products to the market, the company will continue to offer high-level training sessions to partners, providing key product knowledge and resources to enable and equip channel partners to sell Eaton cooling solutions to their end-customers.

As global demand for computing surges, Eaton leads with energy-efficient and sustainable cooling solutions tailored for small data centers and server rooms, with plans to expand in scale and offerings. Explore how Eaton can support your equipment needs by visiting <u>our site</u>**.**

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