INTELLIGENCE UPDATE

New power architectures to reshape data center design

Daniel Bizo 29 Jan 2026

Data center electrification will see major technical developments in response to the growing power density and size of facilities in the coming years. The continued build-out of supersized AI infrastructure is spearheading this shift, but the broader data center industry will also benefit from advances in power technologies. Operators will see more design and engineering choices to optimize power topologies and facility layout as average rack densities continue to rise in tandem with increasingly powerful IT hardware.

Equipment vendors intend to introduce a slate of new electrical distribution products in 2026-2027 and beyond to align with the deployment of the next generation of dense AI compute systems. Many of these new products will be enhanced versions of existing products, which are aimed at ultra high-density environments.

More importantly, new power architectures will begin to take shape in 2026. Engineering efforts are focused on three primary areas to enable new power architectures:

- Direct current (DC) power delivery to IT.
- Expanded use of medium-voltage (MV) site power distribution.
- Solid-state transformers (SSTs).

These increased development and industrialization efforts coincide with a sharp increase in global spending on data center infrastructure, which is expected to continue across the industry.

Funding is secured

Despite limited visibility beyond a 2-year horizon for sustained AI investment levels, 2025 strengthened confidence in the development and industrialization plans for new electrical products designed to address the power needs of large-scale AI training systems.

Major data center power distribution vendors, including ABB, Eaton, Schneider Electric, Siemens and Vertiv and others, see sufficient interest and buying commitments from large infrastructure buyers to fund the development of new electrical equipment. Across the wider business landscape, there is also robust confidence around AI investments. Notably the outlook for AI workload growth shows no signs of weakening: the semiconductor industry is expecting another bumper year with record capital expenditure to expand chipmaking capacity.

What drives the development of new equipment is the technical challenges of powering many extremely dense racks — hundreds of kilowatts each across dozens or even hundreds of racks. The size of the conductors and the footprint of the electrical systems relative to the technical IT space will swell. Operators can expect vendors to introduce even higher capacity UPS systems, more choices in high-amperage (2,000A and above) open-track busways, larger breakers and tap-off units, and more powerful distribution units to address these challenges. Prefabricated structural systems for power distribution can reduce difficulties arising from the size and weight of the conductors.

AI is powering DC adoption

The concept of using DC power in data centers — much like telecommunication switching facilities — has been around for decades. Although the approach is reasonably common in China, it has never really taken hold elsewhere.

This is about to change. Originally, the incentive for using DC was to reduce costs and distribution losses and improve overall system reliability by reducing the number of components in the electrical chain. However, alternating current (AC) systems have advanced significantly in addressing these issues, rendering the benefits of a complex switch (also involving IT hardware vendors) to DC to be arguably marginal. Electrical equipment vendors ABB and Eltek (now owned by Delta Electronics) both tested market reception with UPS systems supporting 380V DC many years ago, to limited commercial success.

This time truly appears different: IT hardware, not facilities, will drive the change. Activity around DC electrification surged after Nvidia decided to adopt an IT power architecture using 800V distribution in the rack to support compute rack densities above 200 kW, with a path towards 1,000 kW.

Nvidia's rationale is to decouple much of the power electronics from IT hardware and to dramatically reduce the amount of copper conductors needed in the rack compared to today's 48V DC power rails. All the conductors, transformers, capacitors and power semiconductors, together with cooling fans in the individual server power supply units (PSUs), occupy considerable space and introduce conversion inefficiencies — they are all parasitic components of the IT load.

Decoupling the PSUs to a separate cabinet using 800V power rails is arguably the main attraction for this move. It frees up valuable rack space, allowing Nvidia to pack GPU and memory silicon more tightly. It also creates an opportunity to increase total PSU capacity for a rack and optimize its architecture for overall system efficiency, including AC-DC conversion, thermal management and redundancy design.

These power cabinets, also known as "sidecars," will maintain compatibility with today's standard three-phase alternating current (AC) power distribution (e.g., 400V or 480V). Depending on the configuration, they will each supply power to multiple AI compute racks on a secondary delivery system using 800V DC. Higher voltage and DC both help deliver considerably more power at the same conductor size (total cross-section) and weight.

This is only the first step towards broader DC power adoption. For the next step, electrification vendors are considering multiple options. One is the commercialization of DC UPS systems that natively output 800V DC, eliminating the need for sidecars. For multi-megawatt installations, dedicated 800V DC UPS systems make practical sense, but the trade-off is complexity in addition to the AC power infrastructure, and they can still result in stranded capacity. DC loads will coexist with a significant amount of AC load for a period. Some IT hardware will still require AC power: such as development and application servers, storage systems and network devices.

Other approaches will aim to avoid duplication of all the power conditioning, conversion and energy storage infrastructure for DC power. One option is to install step-up transformers combined with large rectifiers to convert standard AC output from the UPS to 800V DC closer to the IT racks that require it. This approach will perform the same function as a sidecar, but outside the data hall. The benefit of this option, compared to sidecars, is to free up IT floor space, while establishing a clear division between facility and IT jurisdictions for the maintenance of electrical equipment.

High-frequency transformers: a solid choice

A third major option to support DC electrification of IT will be enabled by the development and industrialization of solid-state transformers (SSTs). These devices are a type of high-frequency transformers (tens or hundreds of kHz), distinct in their core operating principle from that of conventional low-frequency transformers. SSTs use switching power electronics that promise to extend the miniaturization, cost and efficiency benefits of semiconductor technologies to large-scale power conversion — up to megawatt scale.

SSTs are also attracting increased attention as their manufacturers promise to address chronic shortages in transformer manufacturing capacity. A large number of transformers are necessary to support renewable energy generation and electrification of industries and transportation. The rollout of electric vehicle charging stations alone will require hundreds of thousands of multi-megawatt transformers globally.

In data center applications, interest in SSTs centers on promoting the extended use of medium-voltage (MV) AC. In MV systems, site power is distributed at thousands of volts (typically above 10 kV and up to 35 kV in the future). Using MV UPS systems, design constraints on site layout can be eased because power distribution over longer distances becomes cheaper and more efficient (less compensation needed for losses). This is especially valuable as power capacity needed for a data hall shoots up with AI training, but is also rising in general.

Even with current generation AI compute systems (at average densities of 80 kW per rack), the low-voltage (LV) power conditioning and distributions systems (e.g., UPS systems, batteries, switchboards) occupy at least as much space as the IT equipment it supports. In the future, the ratio will skew heavily towards larger electrical rooms. Not having to position large amounts of electrical infrastructure close to IT will open up possibilities for more efficient facility layouts.

SSTs promise to help MV UPS adoption by offering a compact and efficient way to convert MV AC power to either 400V/480V AC or 800V DC — or both. SSTs occupy less than half the footprint of a comparable set of low-frequency transformers and rectifiers.

Uptime Intelligence spoke with both major and specialist firms throughout 2025, and several have expressed interest in or are actively developing SSTs and SST-based power chains. There appears to be a consensus that SSTs for up to 15 kV nominal voltage levels are now nearing volume production and show good technical readiness in performance, reliability and manufacturability.

Uptime Intelligence will dive deeper into the technical details of DC power delivery, MV distribution, SSTs and the conceptual new power architectures they enable, in future reports.

The Uptime Intelligence View

Elevated levels of infrastructure investments due to the generative AI race have accelerated the development of electrical equipment, including new systems and components that will provide novel opportunities for data center designers and operators to rethink their data center power architectures. Initially, this will require extra efforts to overcome organizational inertia, as they represent departure from established design, engineering and procurement practices. Unlike previous attempts to overhaul critical power systems, the incentives this time will be far more powerful.

ABOUT THE AUTHOR

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29 Jan 2026

Over the past 15 years, Daniel has covered the business and technology of enterprise IT and infrastructure in various roles, including industry analyst and advisor. His research includes sustainability, operations, and energy efficiency within the data center, on topics like emerging battery technologies, thermal operation guidelines, and processor chip technology.

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