Powering high density architectures

Vertiv™'s AI-ready UPS and EnergyCore Lithium Battery Cabinet Solutions

Powering AI workloads: Vertiv's UPS portfolio and Vertiv™ EnergyCore™ Lithium Battery Cabinets, AI-ready by design

The technical challenge of AI load surges

Artificial Intelligence (AI) and machine-learning workloads present a unique power profile

They are driven by parallel compute architectures-clusters of GPUs or AI accelerators working simultaneously to process massive datasets. This parallelism enables high-speed model training and real-time inference but also results in unpredictable, highly irregular, pulsating power demands.

Unlike traditional IT loads, AI racks,often packed with GPUs or TPUs, can draw anywhere from 30 to over hundreds of kW or more per rack, compared to just 5-10kW for a typical enterprise IT rack. During training cycles, GPUs run intensive iterative computations at near-maximum capacity, while inference bursts occur when models process predictions in short, high-power surges. During training cycles, GPUs typically operate at sustained high utilization for extended periods, creating a consistently heavy power draw rather than frequent spikes. In contrast, inference bursts drive rapid transitions from idle to full load in milliseconds, often exceeding 150% of nominal power and repeating every few seconds.

Why is this a problem?

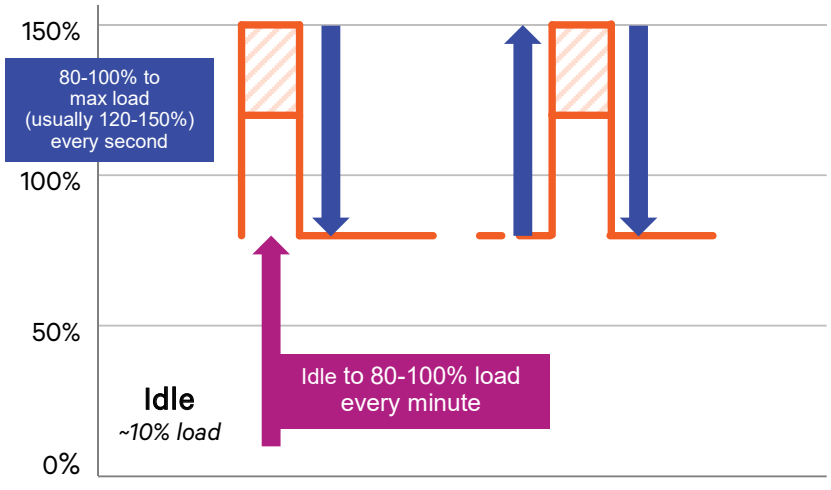
Standard UPS systems, designed for gradual load changes or occasional outages, may experience voltage sags or frequency dips or be forced into bypass mode when faced with sudden spikes. Meanwhile, backup batteries risk premature aging due to constant micro-cycling. Upstream, generators and utility feeds often struggle to keep up with the variable power demand, leading to instability and potential outages. The traditional response, oversizing UPS systems, battery banks and upstream equipment is one way to cope- but it's expensive, inefficient and not scalable.

Vertiv understands the challenges posed by dynamic AI workloads and has developed an integrated solution to address them: a portfolio of UPS systems, including Vertiv™ Liebert® APM2, Vertiv™ Liebert EXL S1, Vertiv™ PowerUPS™ 9000, and Vertiv™ Trinergy™- featuring built-in AI load management capabilities, paired with intelligent Vertiv™ EnergyCore lithium-ion battery cabinets.

Vertiv's integrated UPS and Vertiv EnergyCore solution handles AI power surges efficiently, eliminating oversizing, preserving runtime, and protecting battery health. The strategy has two main pillars:

- Using resilient AI ready UPS design with Battery shield smart firmware feature
- Use UPS input power smoothing coordinating with Batteries to minimize the impact on grid or generators

This dual capability sets Vertiv apart, delivering intelligent, reliable power tailored for high performance computing environments.



AI load profile example: loads can jump from ~10% to 150% in as little as 1ms during compute-intensive operations.

Vertiv's unified AI-ready UPS platform

Vertiv's portfolio of three-phase UPS systems, including Vertiv™ Liebert® APM2, Vertiv™ Liebert® EXL S1, Vertiv™ PowerUPS 9000, and Vertiv™ Trinergy™, is built on a unified design philosophy tailored for high-density, dynamic AI workloads. While these models vary in capacity and deployment scale, they deliver consistent performance through a set of shared AI features:

- **Battery shield**: enabling to manage rapid AI load transients without engaging the battery. This design prevents micro-cycling of batteries during frequent AI related surges, helping preserve battery health and allowing runtime to be reserved for actual power outages.
- **Input power smoothing**: Vertiv™ EnergyCore lithium-ion battery cabinets operate in tandem with Vertiv™ UPS systems to buffer sudden power surges and maintain a steady input current drawn from the grid or generator. This feature protects upstream infrastructure from AI load fluctuations, reducing stress on generators and utility feeds.

Vertiv™ APM2 (60-600kW)

Vertiv™ Liebert® EXL S1 (250-1200kW)

Vertiv™ PowerUPS 9000 (625-1250kW)

Vertiv™ Trinergy™ (1500-2500kW)

Vertiv™ EnergyCore Lithium 5 (263kW) / Lithium 7 (222kW)

Integrated AI ready solutions

Vertiv's integrated solution of UPS and Vertiv's EnergyCore Lithium-ion battery system combines two key AI- Ready Features, making the entire power train AI ready.

Scalable architecture

Modular and parallel-ready designs allow seamless deployment from edge to hyperscale. Whether it's a 300 kW APM2 or a 2.5 MVA Vertiv™ Trinergy™, the AI-ready features remain consistent across the portfolio.

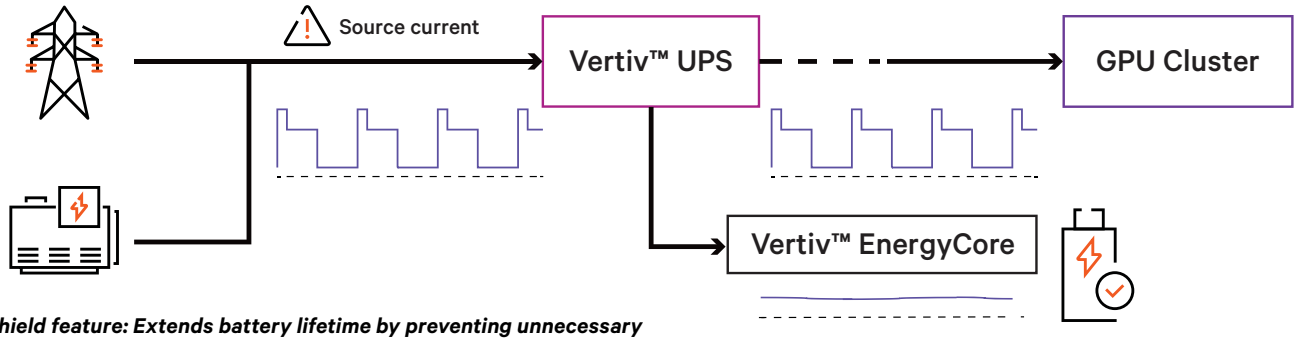
AI-ready by design: stable, scalable, efficient power for high-density compute

Battery shield

In standard operation, the fast AI load transitions would be partially absorbed by the batteries, resulting in frequent micro-discharges that accelerate battery aging and reduce overall battery lifetime.

The Battery Shield feature mitigates this issue by managing these power steps internally on the UPS without engaging the batteries. This allows the UPS to absorb 0-100% power steps directly, protecting the energy storage system from unnecessary stress. When power demand exceeds rated thresholds, Battery Shield minimizes battery exposure. Vertiv laboratory tests demonstrated zero battery draw during frequent AI surges.

By preserving the batteries from unnecessary cycling, Battery Shield keeps backup energy always available when it truly matters during grid outages, while extending in the meantime battery lifetime, reducing maintenance needs.



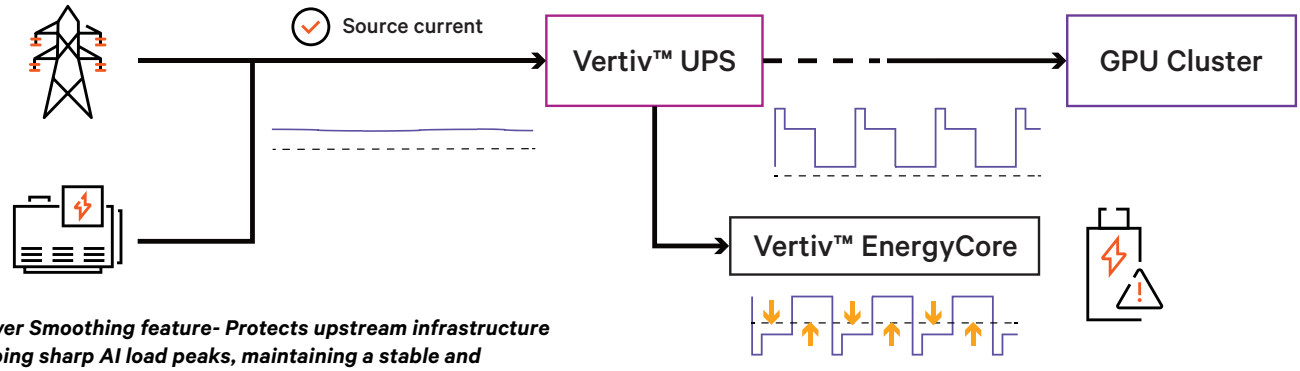
Battery Shield feature: Extends battery lifetime by preventing unnecessary cycling during rapid, high-intensity load steps typical of AI workloads

Input power smoothing

AI workloads propagate impulsive and repetitive fluctuations across all the power electrical infrastructure. Without mitigation this can translate into sudden input power spikes, increasing stress on generators, transformers, switchgear, and the utility grid.

The Input Power Smoothing feature addresses this challenge by leveraging the UPS battery system as an active power buffer. Instead of reflecting the fast and irregular GPU-driven load steps to the input, the UPS dynamically absorbs or injects power from the batteries, so that the input side sees a stable and smoothed power demand.

By shaping the power profile on the UPS input, Input Power Smoothing protects upstream infrastructure from short-term load transients, reduces thermal and electrical stress on critical components, and helps facilities comply with grid operator constraints. For installations supported by generators, it improves stable operation and minimizes the impact of sudden load variations that could otherwise cause generator instability or load rejection.



Input Power Smoothing feature- Protects upstream infrastructure by absorbing sharp AI load peaks, maintaining a stable and predictable input power flow

Vertiv UPS and Vertiv™ EnergyCore : Joint impact on AI power resilience

Vertiv's integrated UPS and Vertiv™ EnergyCore lithium-ion battery system offers a comprehensive solution to the challenges of powering AI workloads. Together, they provide clean, stable power to IT equipment while smoothing input to utility and generator sources ,eliminating fluctuations, voltage dips, and upstream stress. The UPS maintains output quality even during rapid load surges, while Vertiv EnergyCore buffers those surges to protect critical infrastructure.

Battery health is preserved through intelligent control: Battery Shield prevents unnecessary cycling. This keeps batteries ready for backup and enables them to achieve full-service life with minimal wear, even under frequent AI load fluctuations.

By flattening the power profile seen by upstream sources, the system reduces the need for oversizing feeders, generators, and switchgear, saving capital costs and improving energy efficiency.

Backed by Vertiv's patent-pending control logic and validated through Vertiv™ UPS laboratory testing, this solution positions operators to confidently support high-density compute without compromising reliability or infrastructure. It transforms power volatility into a non-event, making the electrical foundation of AI-ready data centers both resilient and well-prepared for evolving demands.

Real-time UPS–battery coordination

- A high-speed, real-time data exchange with minimal latency provided by CAN bus link enables continuous communication between the UPS and Vertiv EnergyCore's battery management system (BMS), making it ideal for mission-critical systems where fast, accurate coordination between the UPS and battery management system is essential.
- The system maintains a reserve State of Charge (SoC) to guarantee backup availability.
- If SoC drops too low, smoothing automatically tapers off to prioritize runtime protection without compromising reliability.

Intelligent battery management

- Vertiv-designed and manufactured EnergyCore BMS is optimized for AI-centric capabilities. The BMS uses real-time cell-level current, voltage, and temperature measurements for accurate real-time computation of State of Charge (SoC) and State of Health (SoH).
- High-accuracy SoC enables coordinated operation between Vertiv™ UPS and EnergyCore battery systems for normalization of AI load power peaks and required backup runtime. Vertiv™ UPS uses the real-time SOC communicated by EnergyCore BMS to control charging and discharging within limits helping reduce thermal and electrical stress on the battery system.
- High-accuracy SoH computation enables utilization aligned with actual battery condition to support informed maintenance planning over the lifecycle of battery system.

Optimized cycling for longevity

- Internal tests show negligible capacity loss, even after hundreds of thousands of micro-cycles.
- The battery remains actively engaged in power conditioning while always ready for full backup supporting AI load management without compromise.

Vertiv's AI-ready UPS and Vertiv EnergyCore solution delivers future-ready power infrastructure for modern data centers- combining reliability, efficiency and scalability with advanced power management algorithms. The integrated solution handles the volatility of AI workloads without compromising uptime or battery health, making it a strategic enabler for high-performance computing.

With Vertiv, power becomes one less thing to worry about, ready to support the future of AI and next-generation compute environments.

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