Iron-Sodium Batteries for Emissions-Free Backup and Load-Leveling at AI Data Centers

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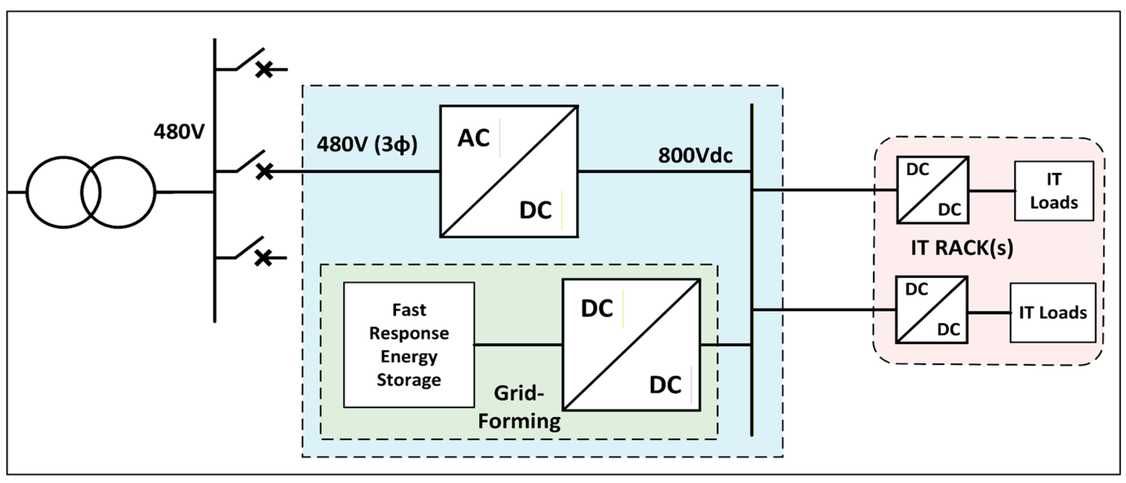
AI power demand straining infrastructure

AI training clusters cause fast, synchronized power swings that challenge grid stability, interconnection times, and traditional power architectures (diesel-UPS).
This work shows how long-duration iron-sodium storage, integrated into an 800V DC microgrid, provides simultaneous load smoothing, peak-shaving, and emissions-free backup in one system.

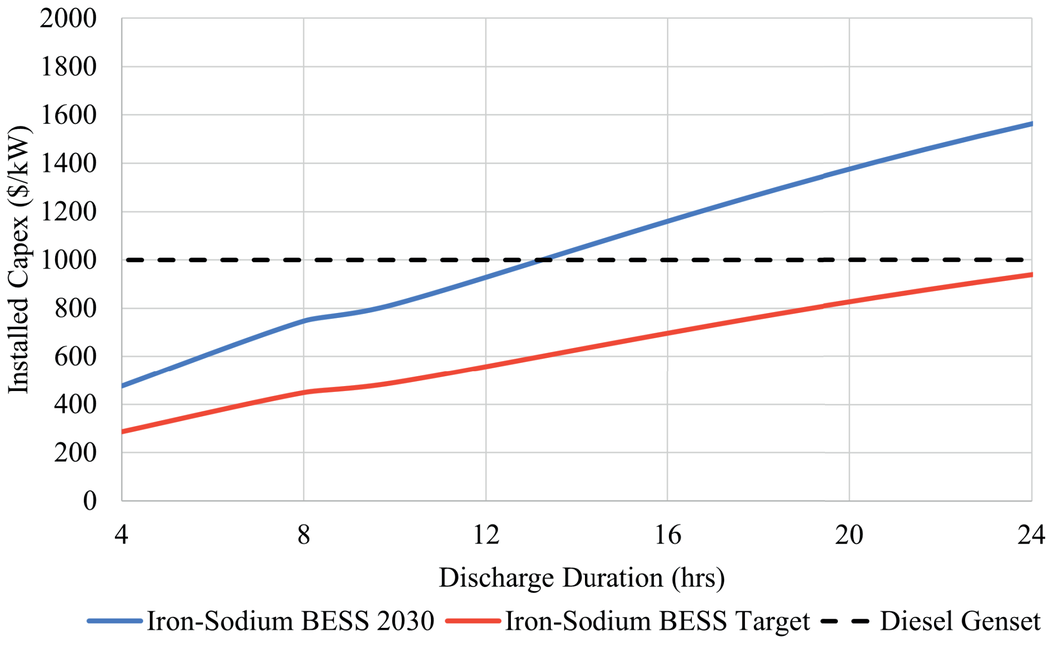
Multifunctional ESS Reference Architecture



24 hour cost competitive storage

Iron-sodium storage simplifies the data-center powertrain by replacing diesel generation, short-duration UPS systems, and separate peak-shaving storage. This technology moves beyond the need for traditional diesel and UPS. Direct DC coupling further enhances efficiency by reducing conversion losses and providing real-time stabilization for dynamic AI workloads.
Iron-sodium systems offer significantly more value than diesel generators and boost asset utilization by providing data center flexibility and rapid degradation free microcycling.

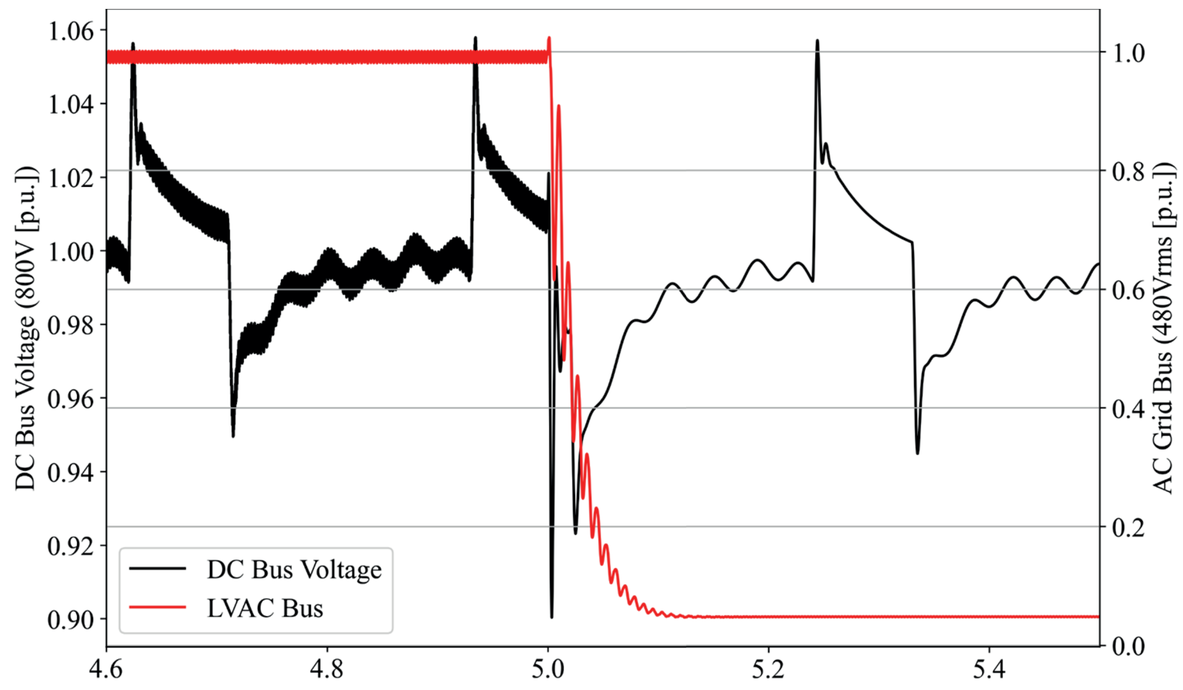
Iron Sodium Cost Curve vs. Diesel



Solution provides outage ride through

In simulated AI load conditions, the long-duration storage provided seamless ride-through and voltage stabilization. This resilient operation also simplifies electrical infrastructure by eliminating the need for rack-level UPS hardware.

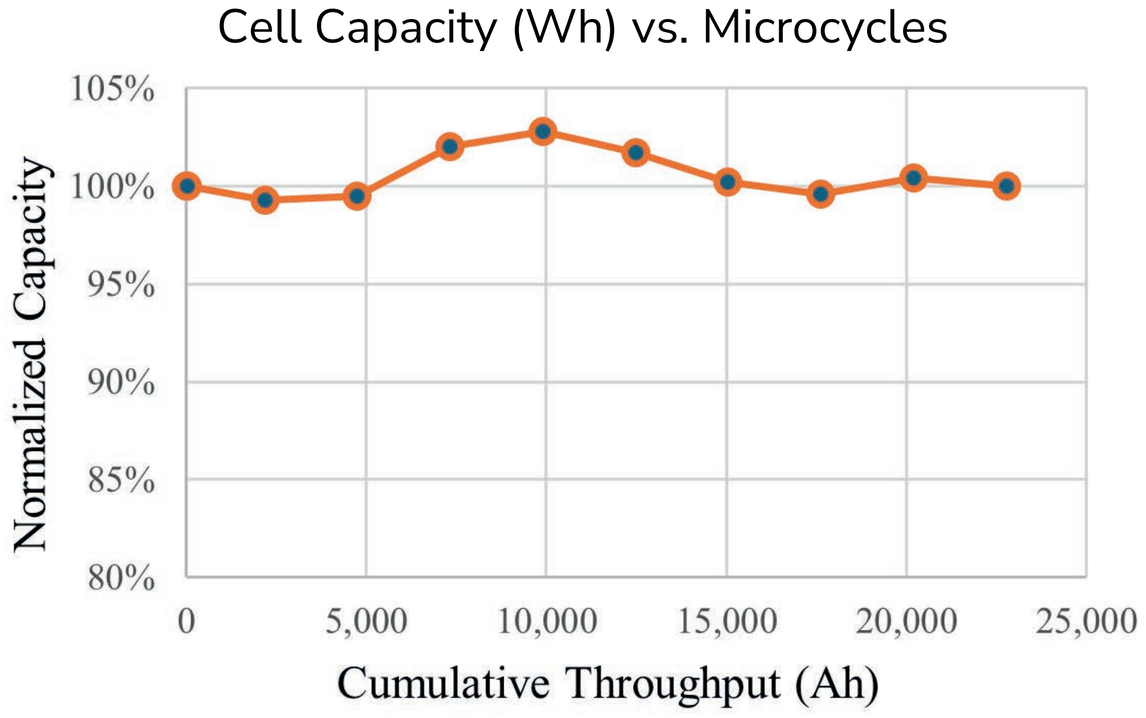
DC Grid Buffering Response of 800VDC Architecture During AC- Grid Outage



No degradation from continuous microcycling

Cell-level tests involving rapid charge-discharge (0.5s/0.5s) cycling reveal no capacity fade, supporting viability for high cycling throughput. This inherent durability and fast response supports millisecond scale smoothing of AI workloads.

Cell Capacity (Wh) vs. Microcycles



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