

Energy Storage Across the Modern Data Center:

Evolving Standards, Sustainability, and AI-Related Power Quality

OCP Educational Webinar Series

September 30, 2026



Community-driven hyperscale innovation for all

Energy Storage Across the Modern Data Center

James Kelly

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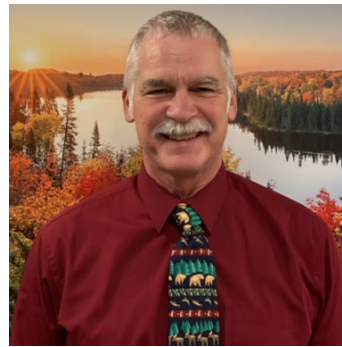
OCP Foundation



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Research Director, Sustainability and Energy

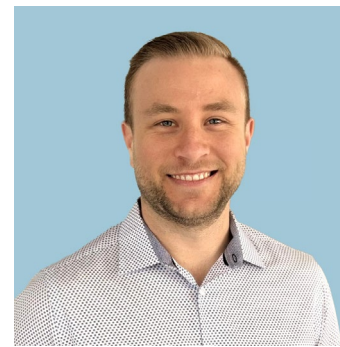
Uptime Institute



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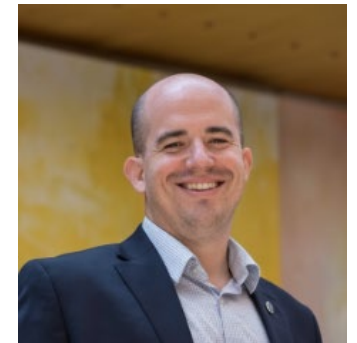
ZincFive



Dr. Matthew Raiford

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Agenda Overview

Growth Trends, Power Profiles, & Sustainability

Problem: AI Loads Can Cause Voltage and Demand Issues

Solution Overview: Battery Energy Storage as BESS and DERs

Fire Safety & UL Standard Evolution

ZincFive Capabilities and Product Fit

Final Points

Live Q&A

Agenda: Growth Trends, Power Profiles, & Sustainability

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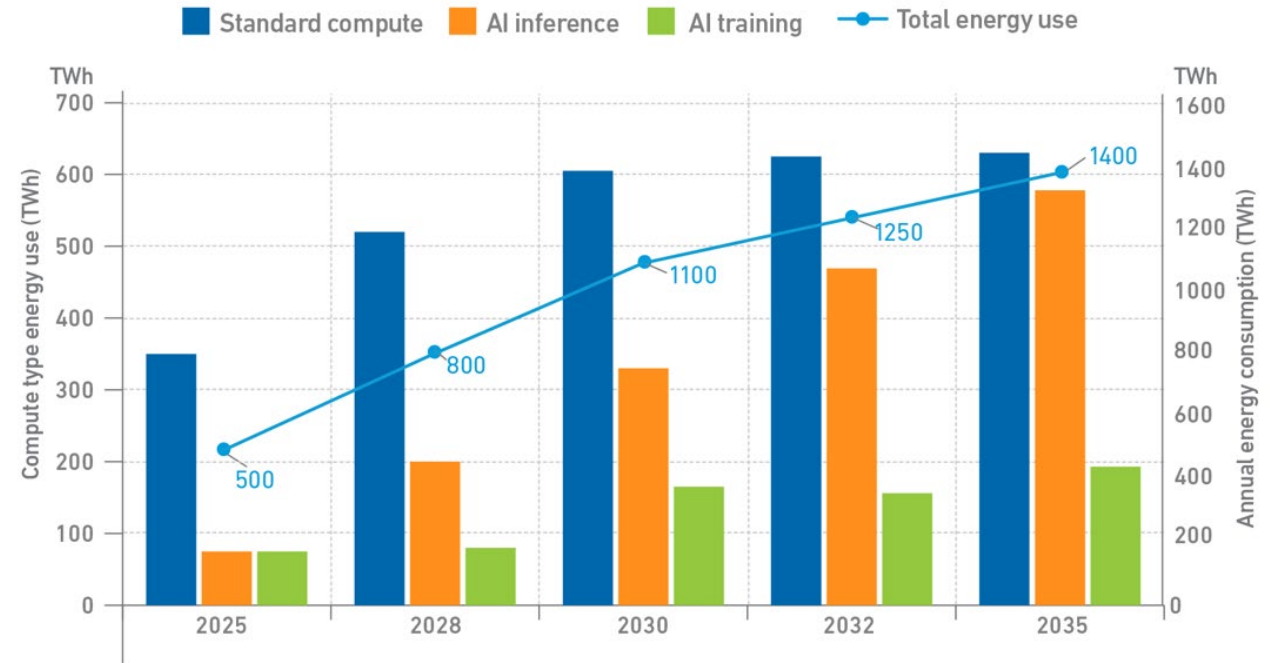
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The data center growth is accelerating – infrastructure is mixed

- Construction of AI data centers has doubled to tripled the capacity growth rate.
 - More large campuses (500 MW+)
 - 5 to 50 MW data centers still prevalent
- IT infrastructure growth is a mix of standard compute, AI inference and AI training
- UPS and Battery Energy Storage Systems (BESS) will have multiple roles
 - Power quality management
 - Grid fault ride-through
 - Alternate/standby power source

Projected data center global energy consumption 2025-2035



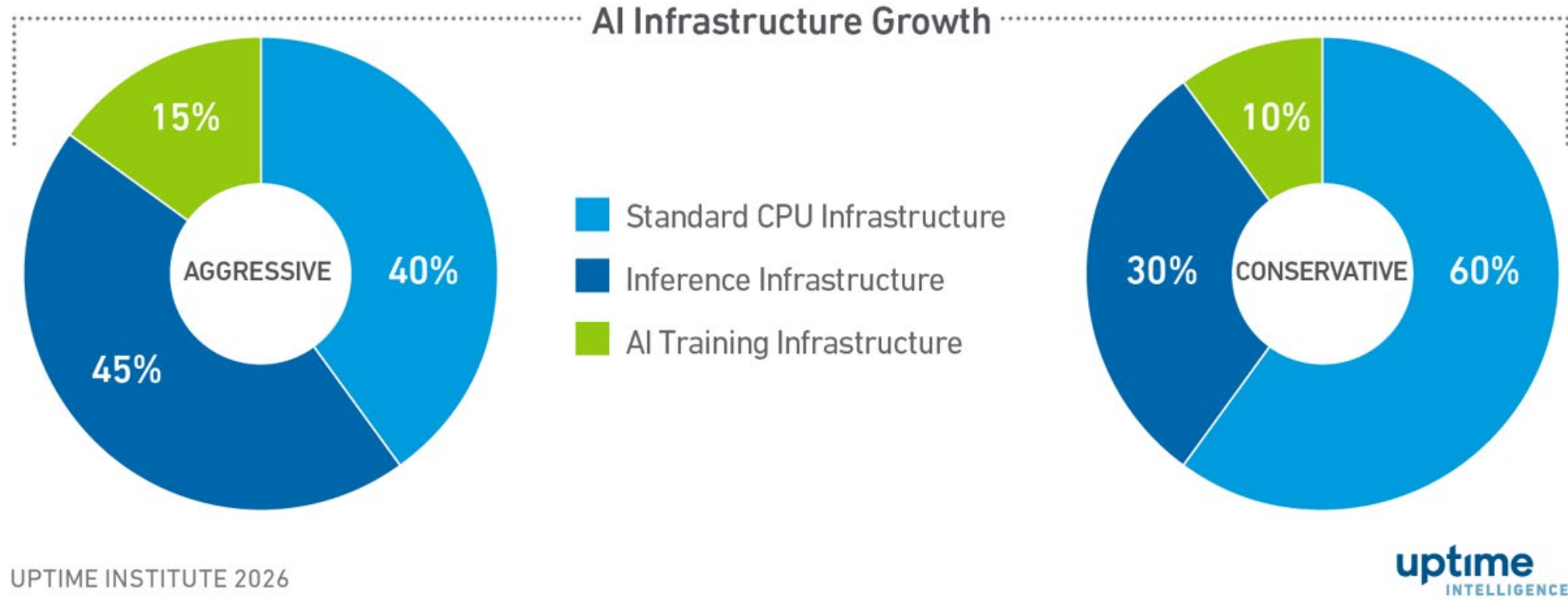
Uptime Intelligence estimate drawing on data from seven major studies and market deployment knowledge.
Estimates include on-site generation and grid power.

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Data Center Compute Type: 2032 Global Outlook



- Standard compute remains a significant percentage of the IT infrastructure
- Inference will constitute up to 80% of the AI infrastructure

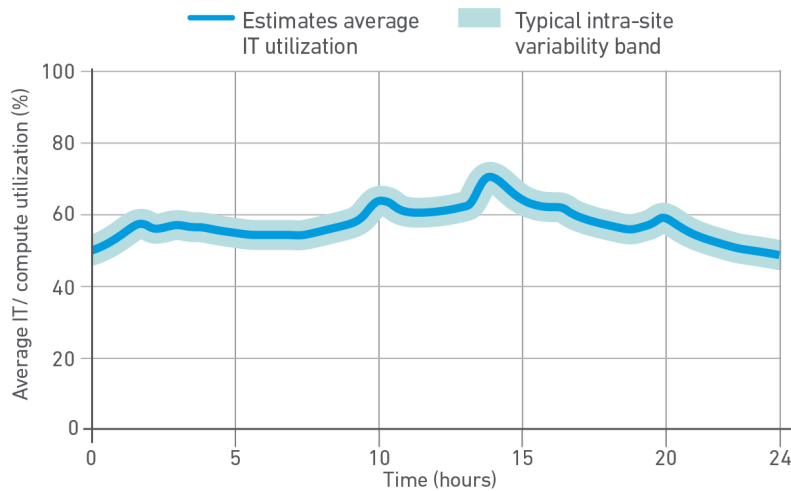
Audience Poll Question

- Led by OCP host
- What percentage of the **AI infrastructure** will be inference-specific systems by 2030?
 - < 20%
 - 20-39%
 - 40-59%
 - 60-79%
 - > 80%

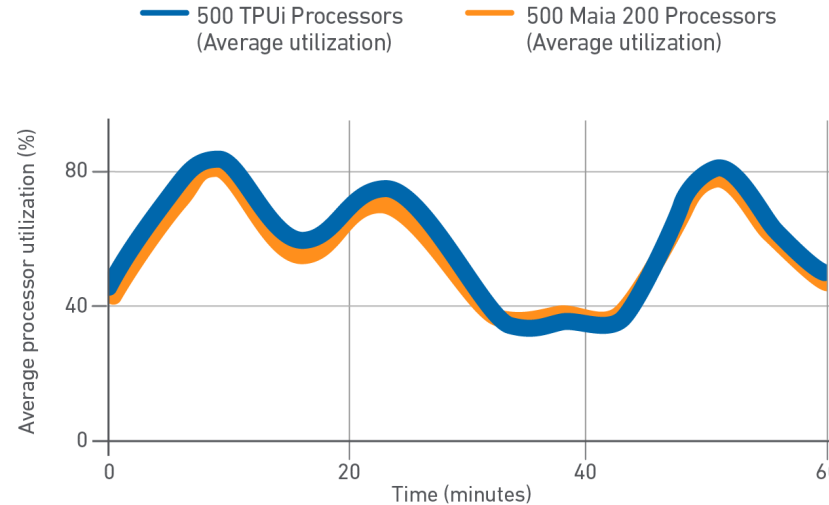
Audience Poll Results

- Some discussion facilitated by host and analyst of the results with optional comments from sponsors

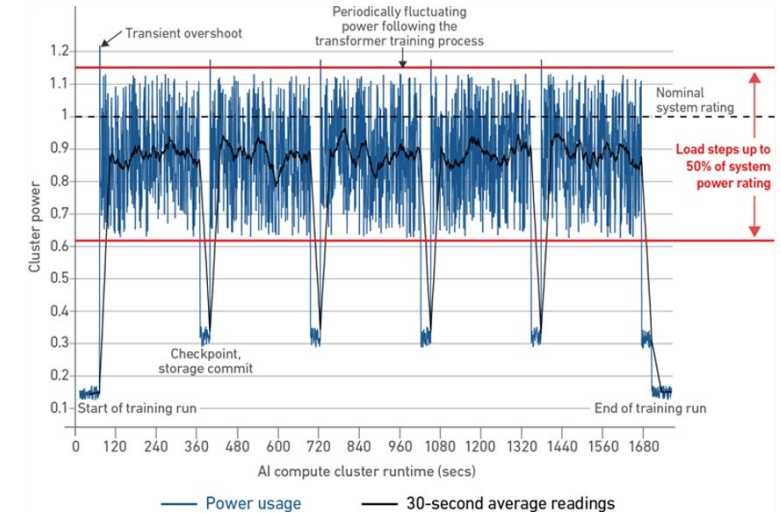
Rack level power profiles



STANDARD COMPUTE



AI INFERENCE



AI TRAINING

Source: Uptime Intelligence with assistance from AI

- Standard compute and AI ASIC Inference workloads have a 'smooth' power profile.
- GPU-based inference (not shown) will be less 'choppy' than training; many random, independent queries
- AI training will require infrastructure for power quality management
- The different hardware profiles will require different power quality management solutions, whether facility or rack

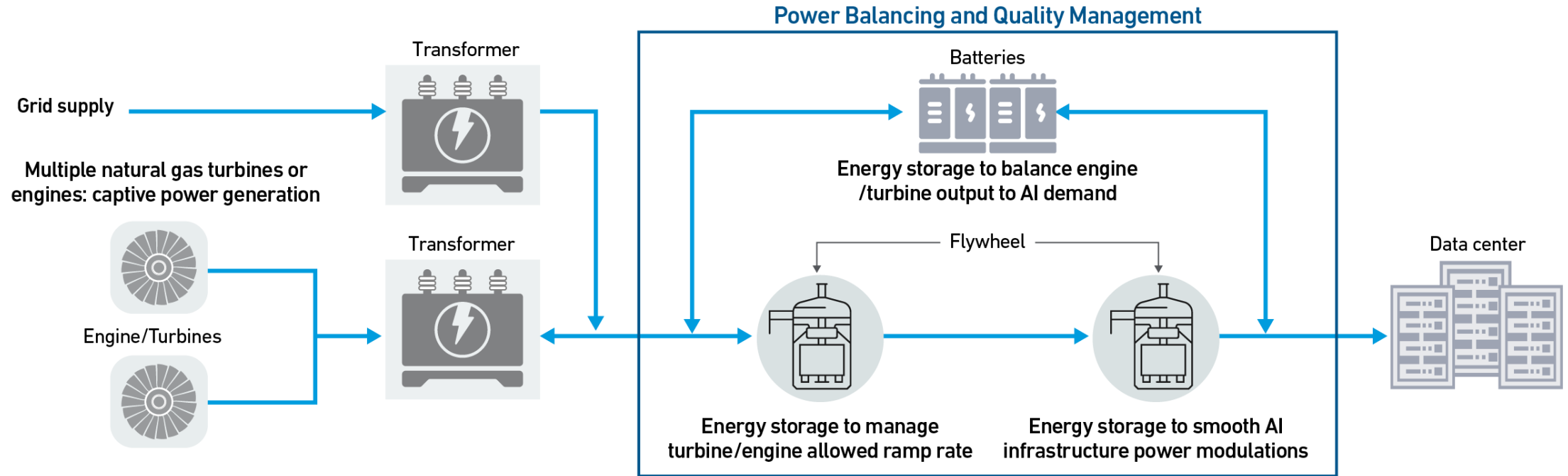
Audience Poll Question

- Led by OCP host
- What will be the common voltage level of the following workloads by 2030?
(12V, 48V, +/- 400V, or 800V)
 - AI Training
 - AI Inference

Audience Poll Results

- Some discussion facilitated by host and analyst of the results with optional comments from sponsors

UPS/BESS: Ride-through and power quality management



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- AI voltage and frequency oscillations require UPS/BESS hardware to protect generation systems (on-site and grid)
- Operators deploying one or two flywheel or battery systems with management software (the secret sauce)

Large loads and the Grid

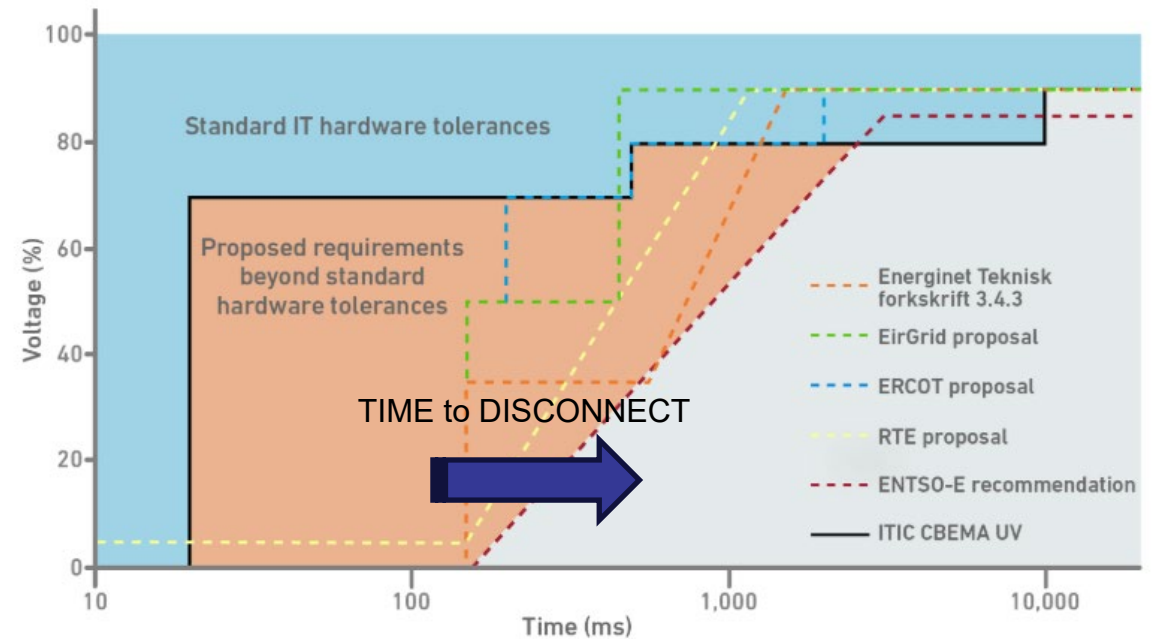
- TSOs/regulators in over 10 countries/regions planning new rules to manage:
 - Fault ride-through (150 to thousand+ ms)
 - Grid disconnect/reconnect process
- UPS and in-rack power systems must support new requirements
- Worldwide, TSOs setting requirements for on-site power generation and fault ride-through

A New Threat to Power Grids: Data Centers Unplugging at Once

Dozens of data centers abruptly dropped off the power grid in recent Virginia incidents, forcing operators to take emergency action

THE WALL STREET JOURNAL

PROPOSED FAULT RIDE-THROUGH REQUIREMENTS



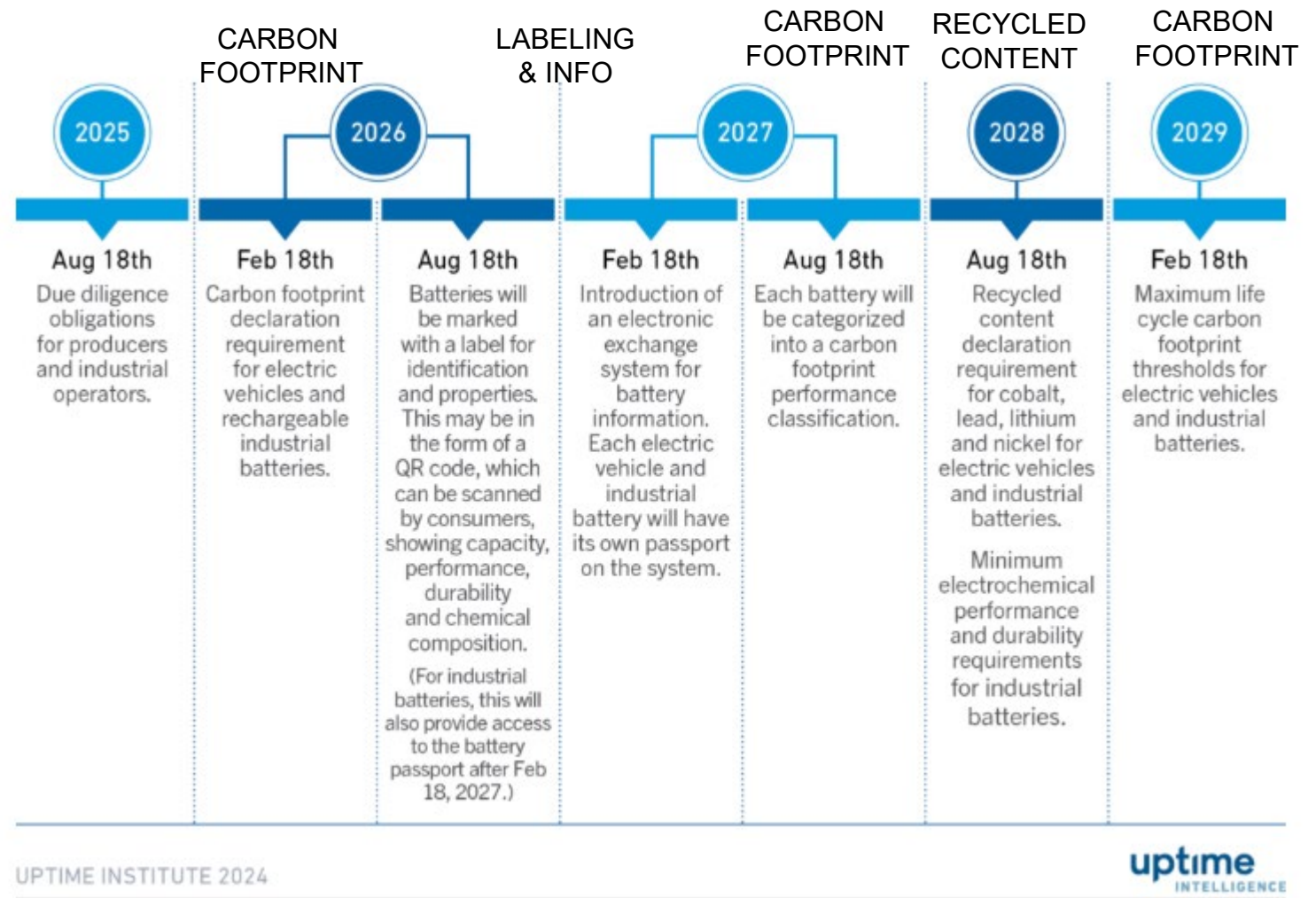
SOURCE: EATON

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Sustainability Issues

- EU battery passport (Regulation 2023/ 1542)
- Two Scope 3 categories are applicable to battery systems:
 - Embedded GHG emissions and water use estimates
 - Emissions are highly uncertain
 - End-of- life management
 - Can key materials be efficiently reclaimed?
- Other considerations:
 - Capacity degradation
 - BESS to replace generators for standby power

EU Battery Passport Implementation Timeline



Agenda: Problem: AI Training Loads Can Cause Voltage and Demand Issues

Growth Trends, Power Profiles, & Sustainability

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Solution Overview: Battery Energy Storage as BESS and DERs

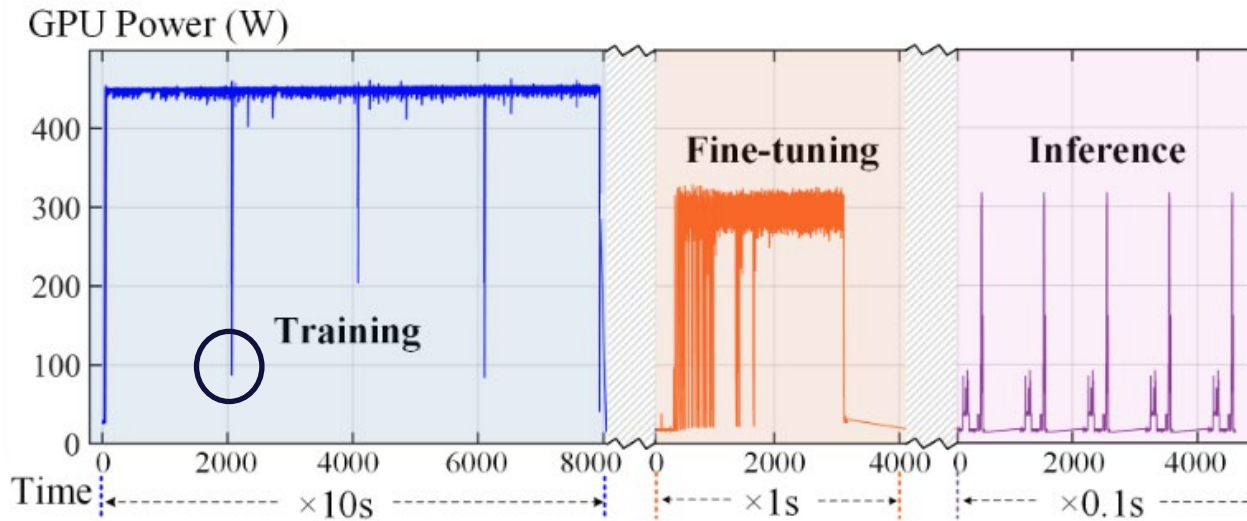
Fire Safety & UL Standard Evolution

ZincFive Capabilities and Product Fit

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Problem: AI Loads Can Cause Voltage and Demand Issues



As an example: Chen, X.; Wang, X.; Colacelli, A.; Lee, M.; Xie, L. **2025**.
arXiv:2509.07218v1 [eess.SY] 08 Sep 2025

- The progression of server racks from 10 kW $\rightarrow$ 100 kW $\rightarrow$ **1MW (Big if...)** combined the current unpredictable nature of training loads has created serious voltage regulation and instantaneous power demand issues at the data center and **rack level**.
- Millisecond to second response time to these events is required to address the issue.

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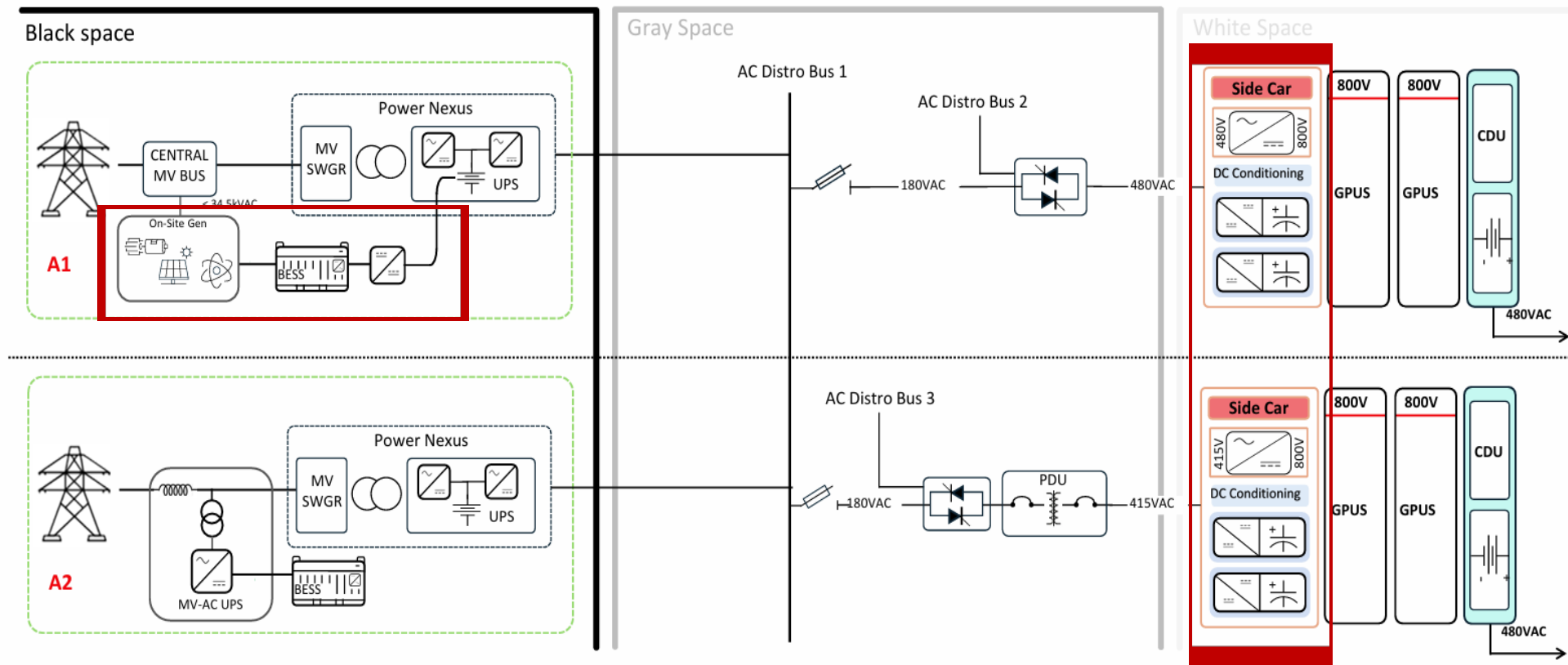
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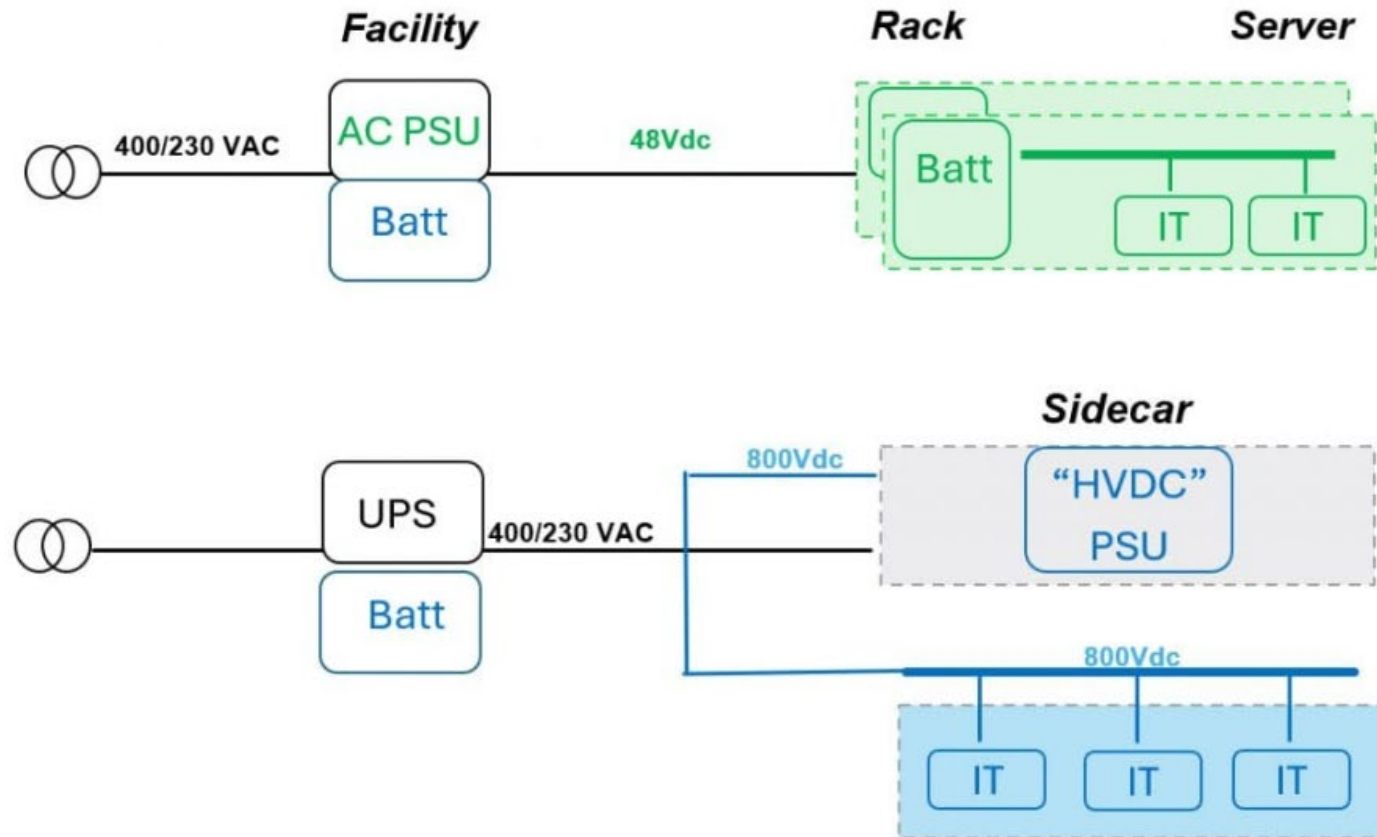
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Battery Energy Storage as BESS and DERs

AC Distribution with Decentralized Rectifiers (A1 & A2)



Rack Level Storage: From BBU to Sidecar



Battery Requirements in Data Centers

- Meet the specified profile – in this case **high power over a short timescale**.
- Have all relevant UL certifications.
- Meet sustainability goals (AWS, Meta, and Google).
- Require little custom integration – **fault tolerant**.
- Have “approachable and smart” monitoring and/or management.
 - Software and filtering to take care of fluctuations and harmonics!!!!!!
- The lower the maintenance the better – **TCO!**

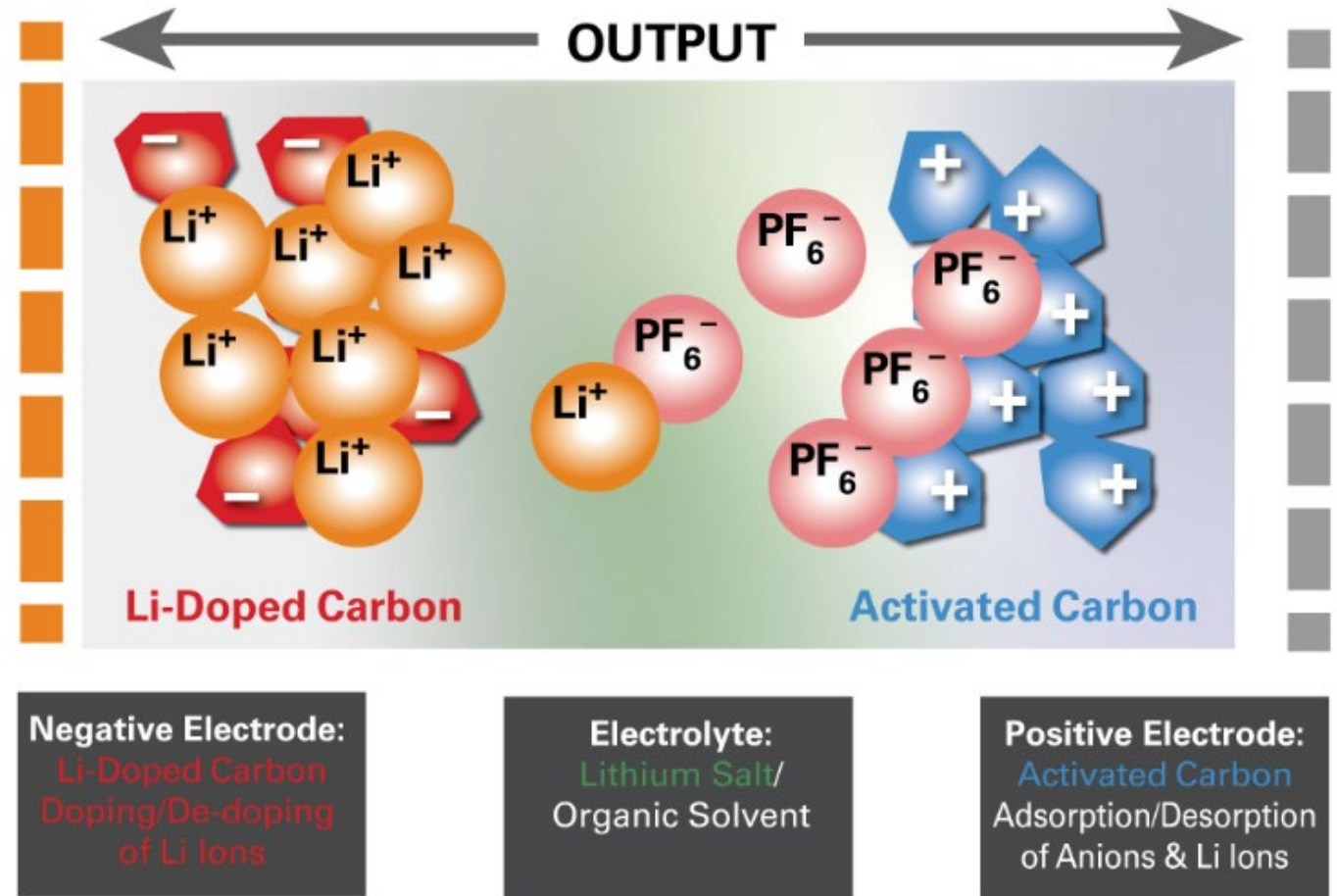
Performance

● Poor ● Moderate ● Better ● Best

	Performance			Footprint		Cost		Safety	Product availability	Sustainability		
	Power Density	Volumetric Energy Density (cell level)	Micro-cycling	With Fire Code	No Fire Code Enforced	Acquisition	Maintenance	Thermal Runaway Intensity	Production	Supply Chain	Recyclability	Carbon Footprint
NiZn	●	●	●	●	●	●	●	●	●	●	●	●
LFP	●	●	●	●	●	●	●	●	●	●	●	●
LiTi ₂ O ₇ (LTO-LTO)	●	●	●	●	●	●	●	●	●	●	●	●
Li Hybrid Super Capacitor	●	●	●	●	●	●	●	●	●	●	●	●
Advanced Pb-VRLA	●	●	●	●	●	●	●	●	●	●	●	●
Pb-bipolar	●	●	●	●	●	●	●	●	●	●	●	●
NiCd	●	●	●	●	●	●	●	●	●	●	●	●
Na PBA	●	●	●	●	●	●	●	●	●	●	●	●
Na PVF	●	●	●	●	●	●	●	●	●	●	●	●

Performance – Capacitors, Batteries, HSCs?

- Batteries are not the only possible solution, supercapacitors and more importantly hybrid super capacitors are being scrutinized as well.
- The more costly tech could provide the high-power, long-term option necessary – especially when deployed with batteries in a sidecar.



Audience Poll Question

- Led by OCP host
- What energy storage types are you considering to use for higher power AI rack-level solutions? (select all that apply)
 - NiZn
 - LFP
 - LTO
 - Pb
 - Sodium-based
 - Li-Super/Hybrid Cap
 - EDLC Cap
 - Other

Audience Poll Results

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Agenda: Fire Safety & UL Standard Evolution

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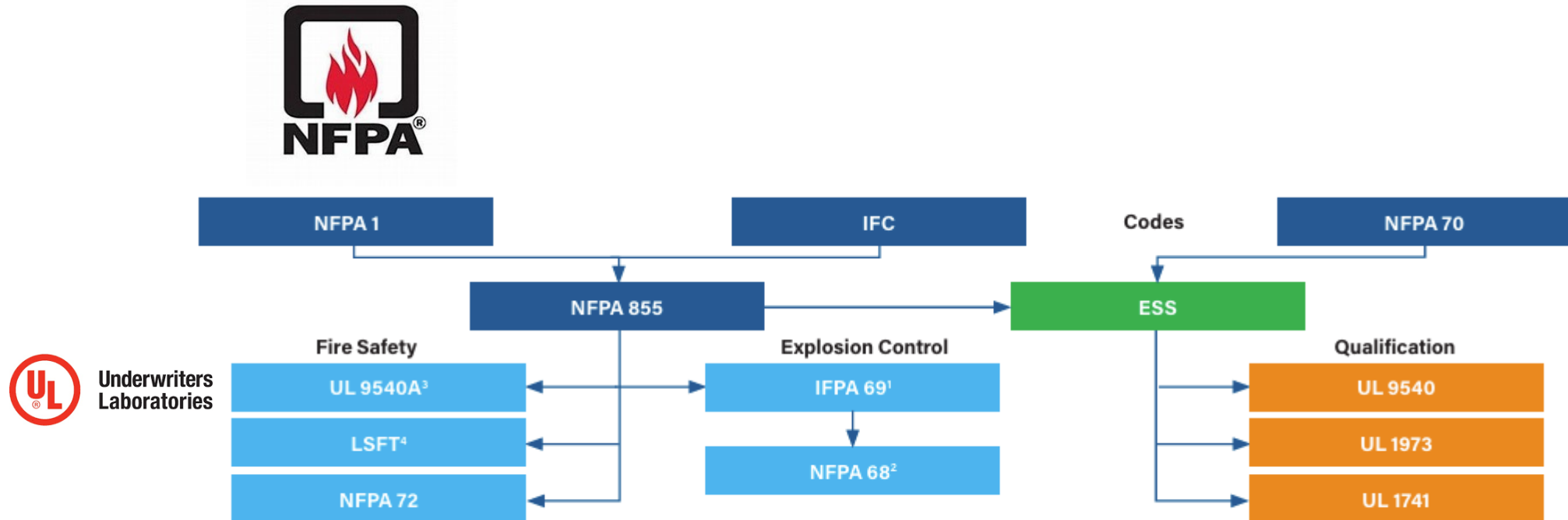
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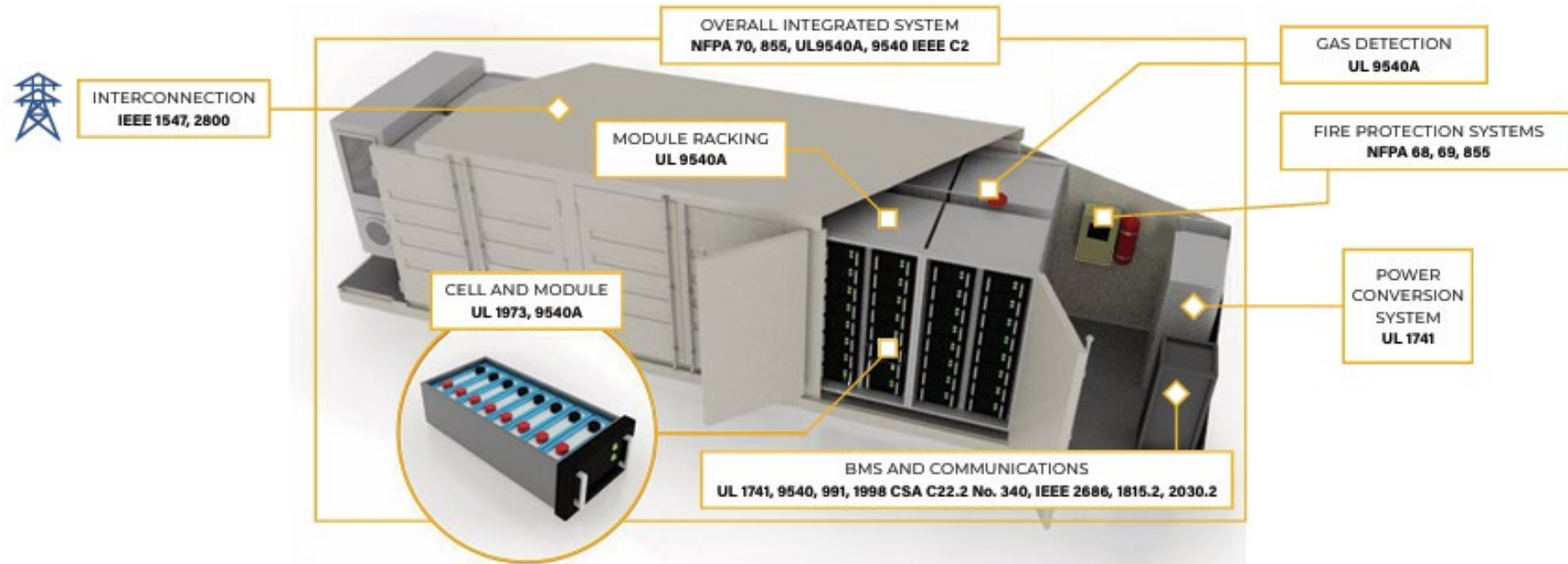
Live Q&A

Fire Safety, UL, and You



- NFPA 855 2026, a code (re)developed primarily in response to fire incidents caused by Li-NMC, recommends ESS and UPS type systems adhere to UL 9540A.
 - IFC (International Fire Code) also does so.

Fire Safety, UL, and You



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The Power of Good Chemistry™



ZincFive

The **world leader** in innovation and delivery of nickel-zinc (NiZn) batteries and power solutions

+80 patents on NiZn architecture and manufacturing

Trusted **mission-critical solutions provider** approved with large UPS OEMS

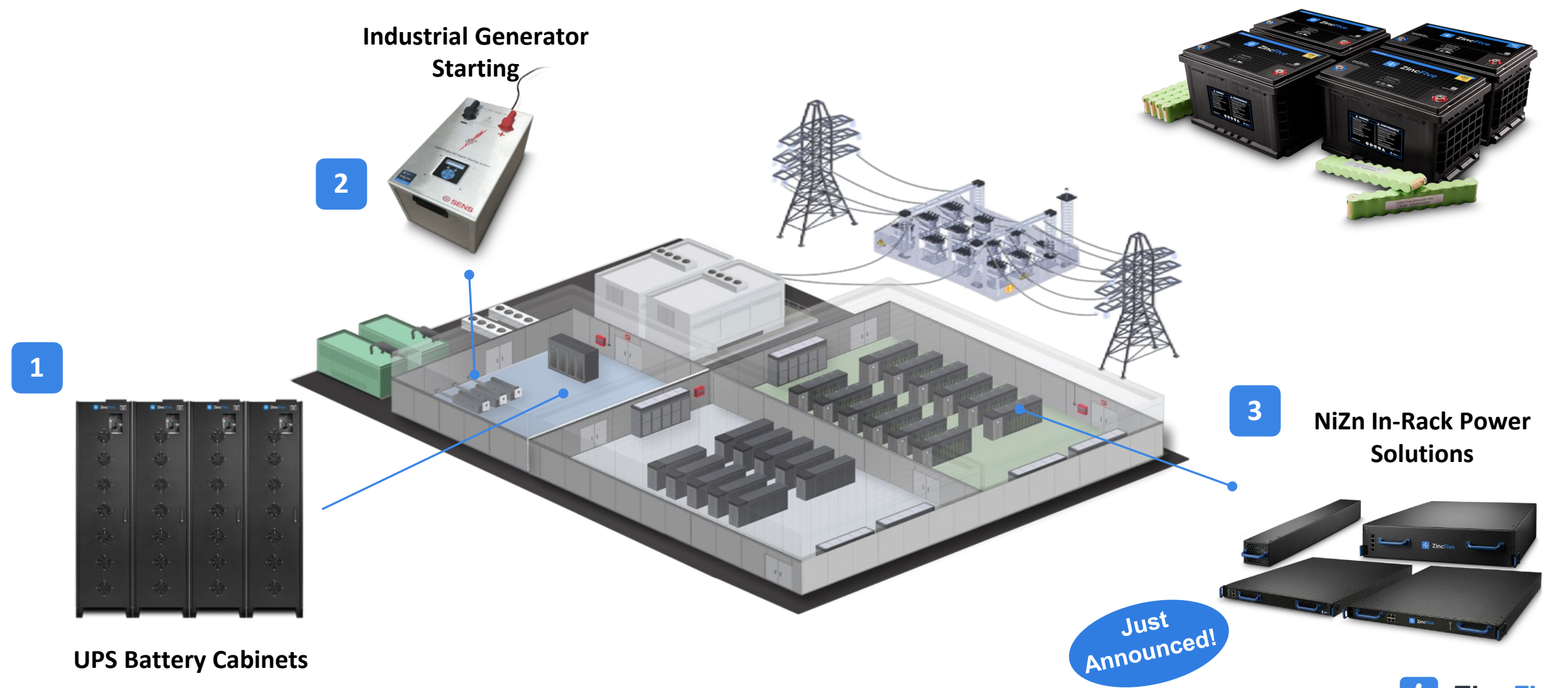
>2.0 GW of battery deployments globally (480V, 3 Phase market)



+2GW Globally



Current Data Center Applications: UPS & Gen Start



ZincFive – Proven Nickel-Zinc Energy Storage

The **world leader** in innovation and delivery of nickel-zinc (**NiZn**) batteries and power solutions.

Safety



Aqueous Electrolyte
Incapable of Thermal
Runaway

Sustainability

Climate Impact Score: 9.4/10



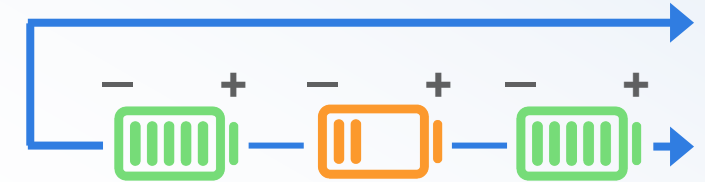
1 – LOW Per Unit Impact 10 – HIGH

Recyclable
Nickel-Zinc Chemistry

Source: Boundless Climate Impact, 2020.

Reliability

Strong NiZn Cells Discharge
Through Weak NiZn Cells



Weak NiZn Cells Show
Lower Voltage & Impedance

Resilient Continuous
Operation

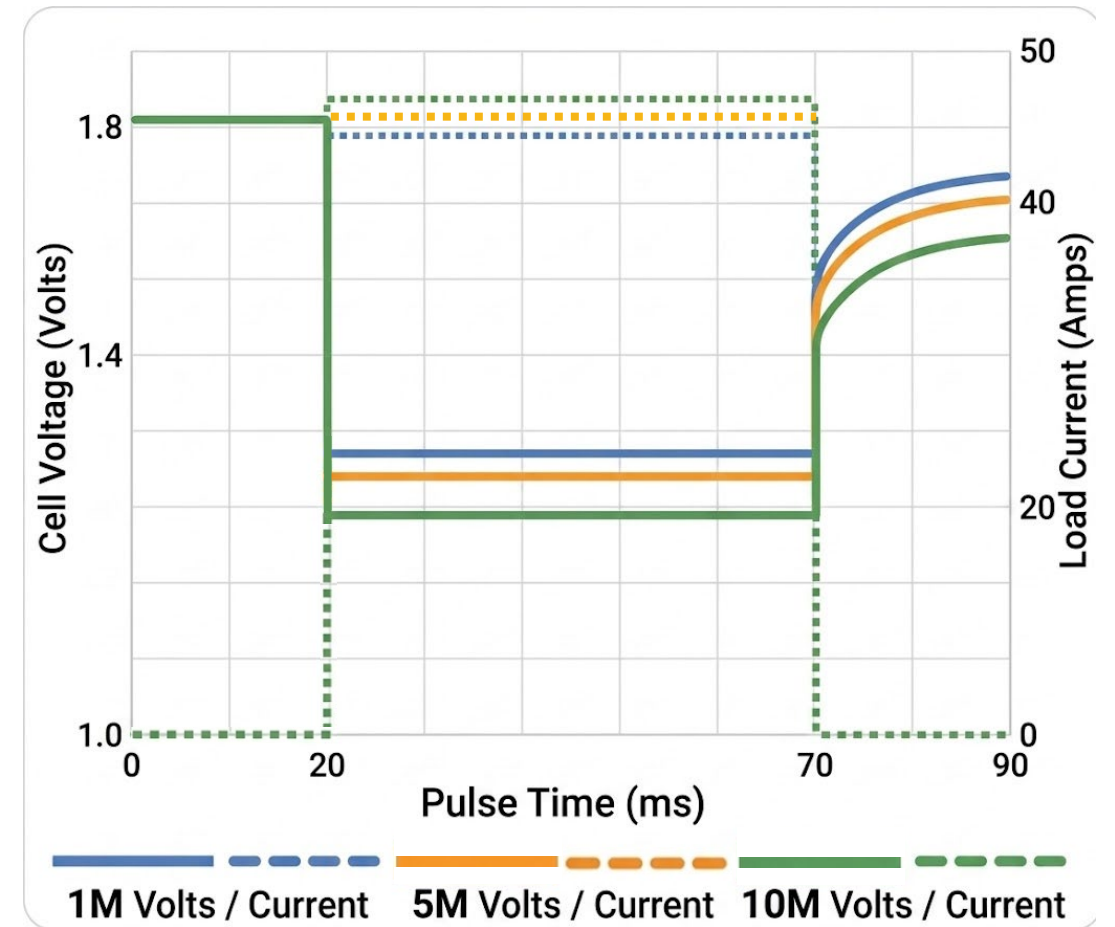
From Centralized Backup to In-Rack Resiliency

NiZn Cylindrical Cells Demonstrated +10M AI Pulse Cycles (50 msec/sec)

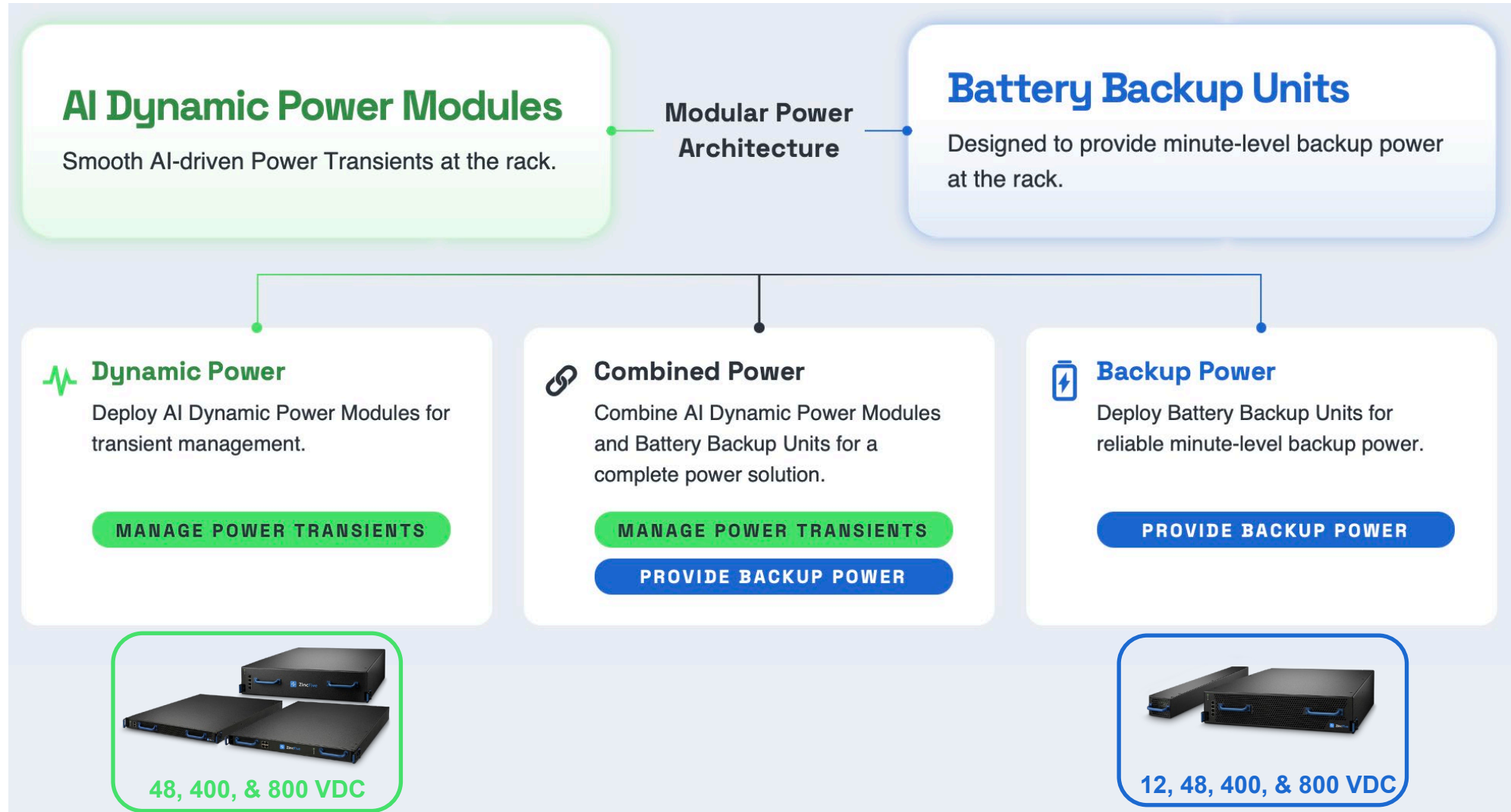
- Profile: **20C** Discharge Rate (60 WPC)
- **87% State-of-Health (SOH)** after 10M Pulse Cycles
- Capacity turnovers at 10M cycles equates to > **2,777**

Measurement	Results (Average)
1 M Cycle Temp Rise	4.5 °C
5 M Cycle Temp Rise	6.6 °C
10 M Cycle Temp Rise	8.3 °C
1 M Cycle Coulombic Efficiency	85.0%
5 M Cycle Coulombic Efficiency	83.0%
10 M Cycle Coulombic Efficiency	76.7%
10 M Cycle Capacity Turnovers	> 2,777
SOC and SOH at 10 M Cycles	71.6% SOC, 87% SOH

Full whitepaper found in resources section (top-right of screen)



NiZn In-Rack Power Solutions



ZincFive: Purpose-Built for Dynamic AI Infrastructure



Safe



Sustainable



Pulse-Capable

**From milliseconds to minutes, ZincFive helps
keep AI Infrastructure running.**

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Takeaways

- Traditional compute, AI inference, and AI training workloads create distinct power demands and power quality challenges.
- UPS and energy storage must evolve from backup power to power quality and ride-through assets.
- Rack-level energy storage can offer deployment, efficiency, and responsiveness advantages
- Energy storage technologies require trade-offs across:
 - Response time & location
 - Power density, energy density, & footprint
 - Cycle life
 - Total cost of ownership
 - Safety
 - Sustainability

Agenda: Live Q&A

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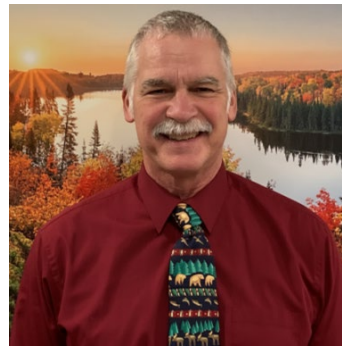
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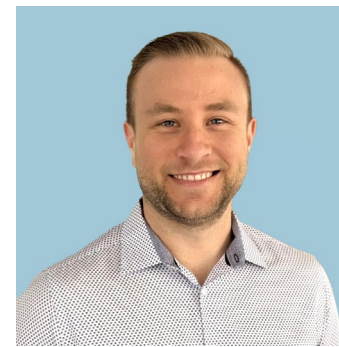
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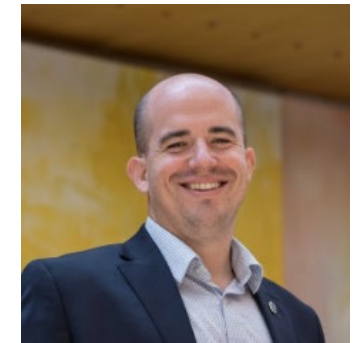
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