NIAGARA SUMMIT 2026

SEAMLESS CONNECTIVITY, POWERFUL INTELLIGENCE

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1:00PM – 1:50PM | THURSDAY

RETROFITTING DATA CENTER LEGACY INFRASTRUCTURE FOR THE AI ERA

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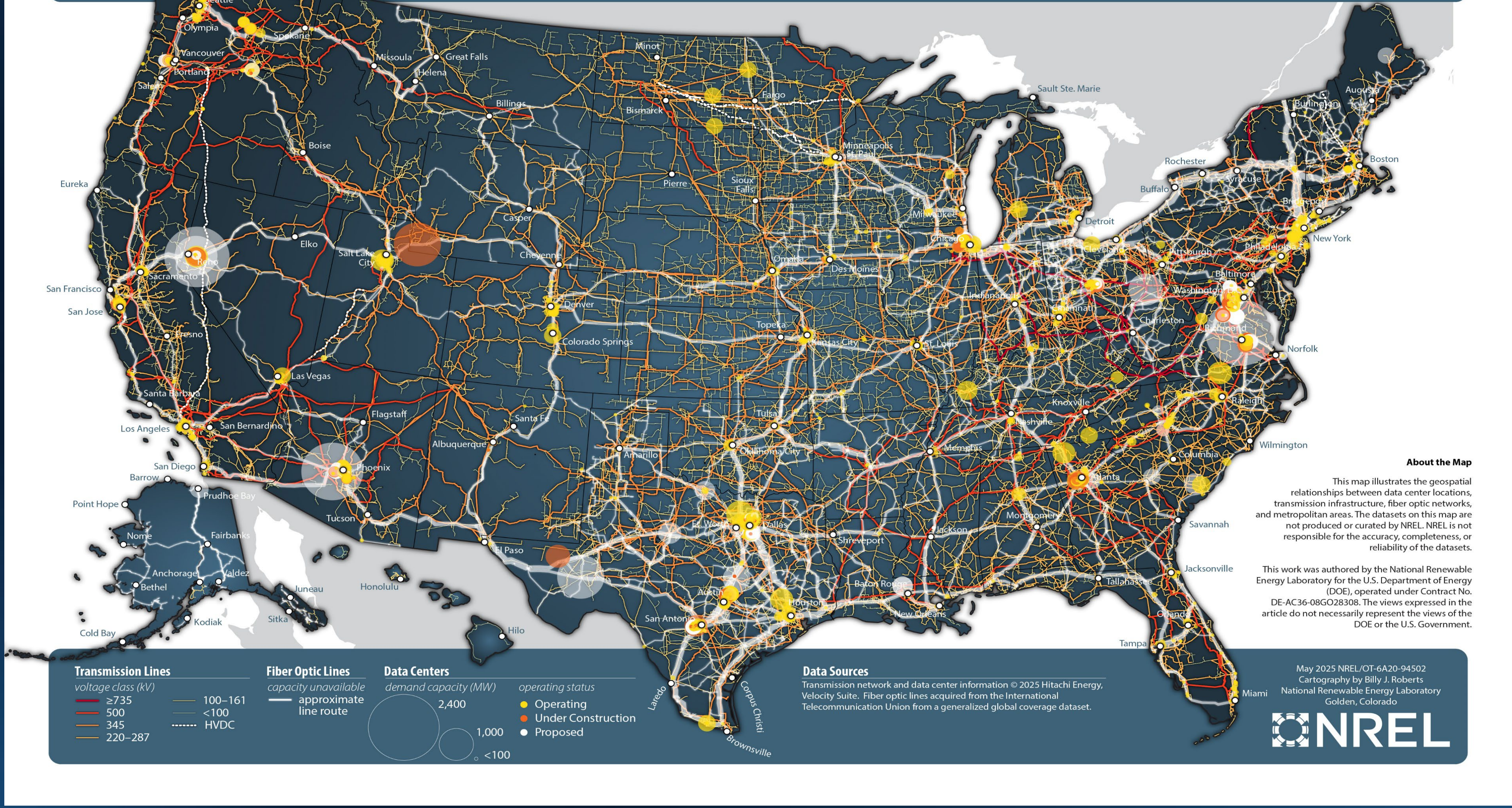
Data Center Infrastructure in the United States, 2025



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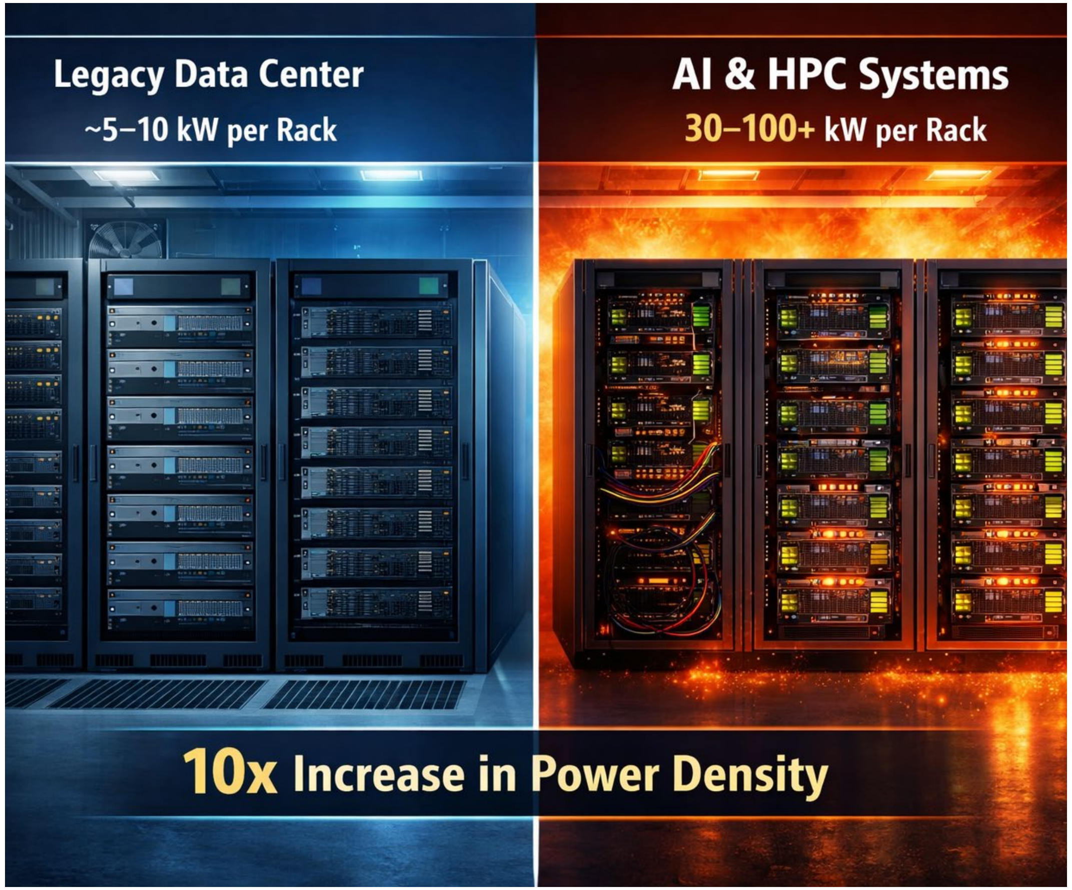
The AI Shift – Why Retrofit?



- AI is fundamentally changing data center demands.
  - AI/ML workloads = extreme power density (30–100+ kW per rack)
  - Legacy data centers designed for ~5–10 kW racks
  - Cooling + power systems are now the bottleneck
  - Speed to market favors retrofits over new builds

Key Challenges in Legacy Facilities

Where legacy infrastructure falls short

- **Cooling limitations**
  - Air cooling inefficiency at high densities
- **Power constraints**
  - UPS, switchgear, and distribution limits
- **Controls & visibility gaps**
  - Limited real-time monitoring and automation
- **Space & layout issues**
  - Raised floor vs slab, airflow constraints

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Retrofit Strategies That Work

Practical solutions:

- **Hybrid cooling approaches**
  - Door heat exchangers
  - In-row cooling
  - Liquid cooling integration
- **Power upgrades**
  - Busway extensions
  - Modular UPS upgrades
- **Controls modernization**
  - Advanced BMS/DCIM integration
  - Predictive analytics
- **Phased deployment**
  - Minimize downtime, retrofit live environments

Role of Automation & Controls

- Real-time thermal and power monitoring
- Automated load balancing
- AI-assisted optimization of cooling systems
- Integration of IT and facility systems
- Digital twins for scenario planning

Controls are no longer support systems—they are core infrastructure.

Key Takeaways & Future Outlook

- Retrofitting is faster and cost-effective vs new builds
- Cooling innovation is critical for AI readiness
- Controls and automation unlock performance
- Flexibility is the new design standard

The data centers that adapt fastest will power the AI future.

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THE LEGACY DATA CENTER MARKET

https://im3.pnnl.gov/datacenter-atlas

Legacy Data Center Importance

Pre-2020 data centers form the backbone of digital infrastructure with critical urban and edge locations.

Challenges of Modern Workloads

Original designs for static loads must adapt to dynamic, high-density, and variable IT demands.

Retrofit as Practical Solution

Replacing infrastructure is costly and disruptive; retrofit enables responsible evolution of existing assets.

Focus on Control and Coordination

Modernization depends on managing operations carefully to ensure reliability during upgrades.

RELIABILITY, CAPACITY, AND ENERGY ARE ONE SYSTEM OPPORTUNITY

Interconnected Challenges

Reliability, capacity, and energy efficiency in legacy data centers are deeply interconnected and must be addressed together.

Cooling Instability Risks

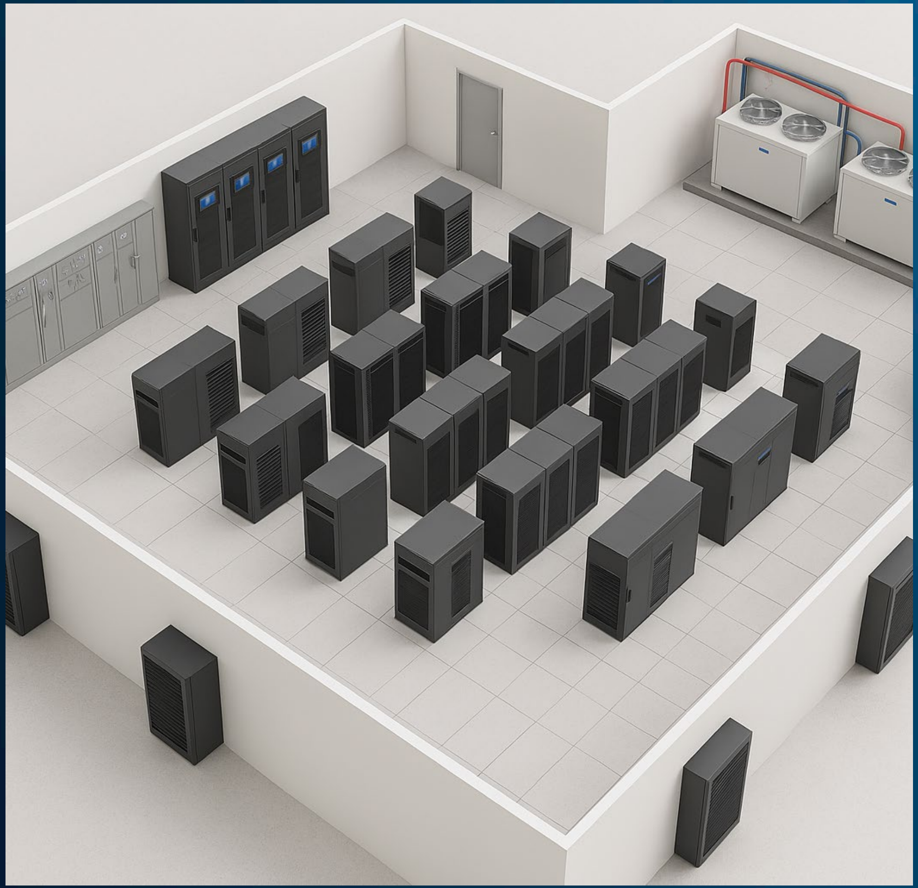
Uncoordinated control of CRAH and CRAC units causes cooling instability, leading to higher downtime risks and economic impacts.

Capacity Constraints from Control

Outdated control strategies limit capacity despite existing infrastructure, leaving thermal and electrical capacity unused.

Energy Efficiency Opportunity

Static control sequences waste energy; coordinated control offers major efficiency improvements and reliability benefits.



KEY ASPECTS- CONTROLS-AI IMPLEMENTATION

01 Site Qualification

Not all halls are equal — systematic assessment gates group control entry; AI and wireless sensors bridge gaps.

02 Group Control

Coordinated zone management eliminates unit conflict and creates the data foundation for AI optimisation.

03 Serviceability -Niagara Platform

Open, serviceable, globally trained — a future-proof alternative to proprietary lock-in.

04 UI

Architectural separation of UI from hardware eliminates operator disruption during controller lifecycle events.

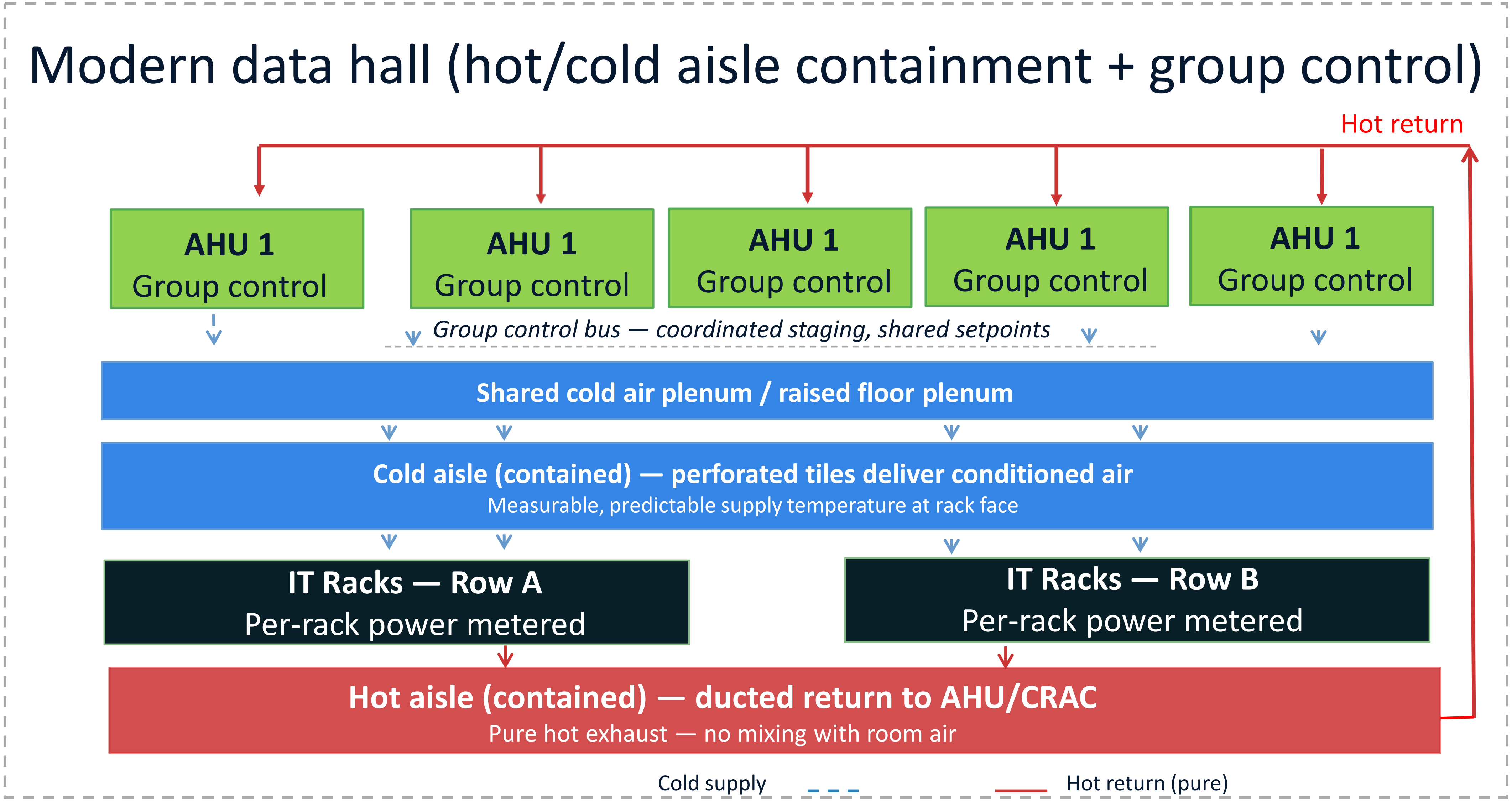
05 Fault Tolerance

Star-topology supervision replaces dense peer-to-peer mesh — cleaner, more resilient, easier to diagnose.

06 Ontology and Semantic Relations

Semantic tagging turns raw time-series into machine-readable intelligence — the AI data layer is built in from day one.

THE CASE OF DUCTED SUPPLY-DUCTED RETURN



GROUP CONTROL- WHY IT IS NEEDED ?

Group Control treats all cooling units serving a thermal zone as a single coordinated entity — balancing load dynamically, eliminating simultaneous heating/cooling conflicts, and optimising energy use across the entire hall rather than per-unit.

Energy Efficiency

Unit-level PID loops fight each other, wasting energy. Coordinated setpoint management eliminates redundant work.

Thermal Stability

Reactive hunting causes temperature swings. Group algorithms dampen oscillations and stabilise hall temperature.

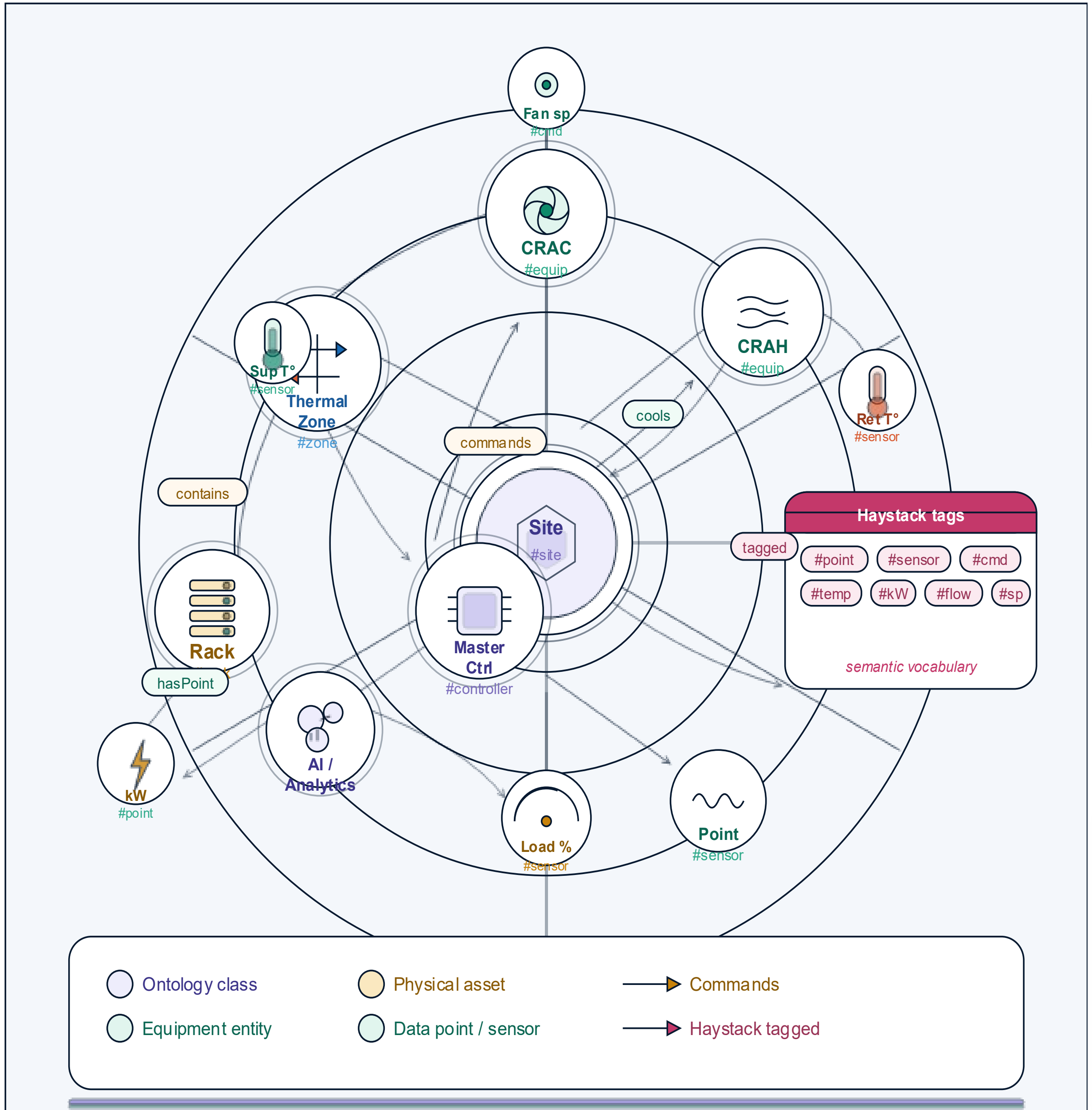
Capacity Optimisation

Surplus cooling capacity is invisible to individual units. Group awareness enables load-sharing and capacity headroom visibility.

AI-Ready Foundation

Group Control creates the unified data model needed for AI optimisation,
predictive pre-cooling, and demand-response integration.

NEED FOR ONTOLOGY AND SEMANTIC LAYER



Ontological Structure

Each cooling unit, sensor & setpoint is described by its class and relationships.
CRAC → cools → ThermalZone → contains → Rack.
Structured graph = machine-queryable, not just data-logger output.

AI & Analytics Benefit

AI models train on semantically labelled data — no manual feature engineering.
Cross-site benchmarking becomes possible with common tagging.
Audit trails, digital twin sync & BIM handover simplified.

Project Haystack

Open-source tagging standard for building & infrastructure data.
Key tags: site, equip, point, sensor, cmd, sp, air, temp, humidity, kW, flow.
Enables plug-and-play integration with analytics engines.

AI MODEL DEVELOPMENT AND DEPLPLOYMENT

Continuous · Autonomous · Safe

1 Data Collection

- Rack inlet temps (per rack)
- PDU kW — real-time power
- CRAH fan speed, valve, DAT
- Outdoor weather & CHW temps

2 Model Creation

- ML / Reinforcement Learning
- Predicts optimal DAT & fan speed
- Assigns Group or Individual mode
- Re-decides every 5–15 minutes

3 Inference (Runtime)

- Continuous thermal prediction
- Optimal DAT: 18.5 °C
- Optimal fan speed: 72%
- Group C1–C4 · Indiv C5–C6

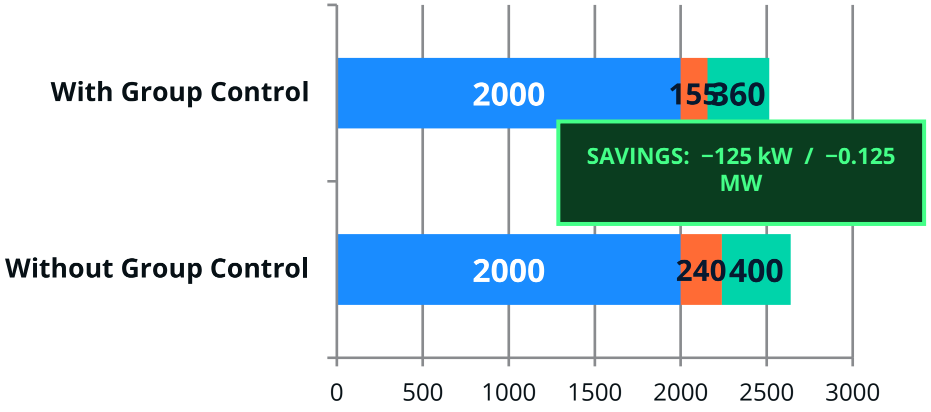
4 Control Execution

- AI writes setpoints only
- Niagara enforces all limits
- Safety interlocks always active
- AI failure → Niagara fallback

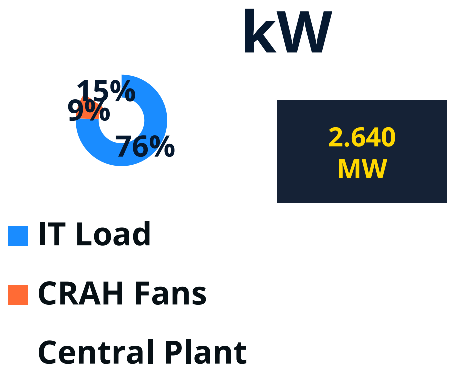
AI generates setpoints · Niagara retains full control authority · Zero manual intervention required

THE ECONOMICS
2 MW IT Load Air-Cooled Data Hall

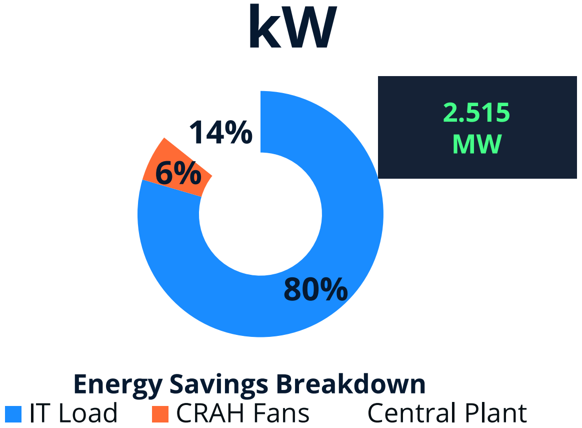
Power Breakdown (kW / MW)



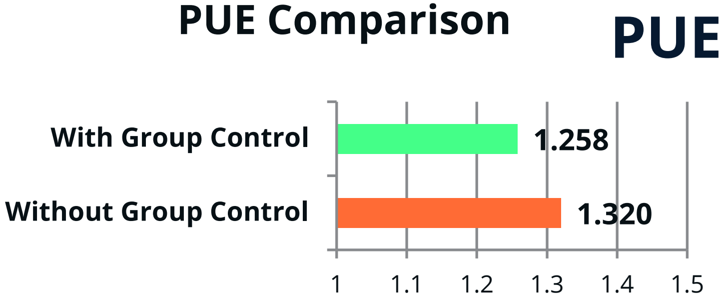
Load Share – WITHOUT Group Control



Load Share – WITH Group Control



PUE Comparison



Δ PUE −0.062 improvement (−4.7%)

IT LOAD	CRAH SAVINGS (GROUP CTRL)	CENTRAL PLANT SAVINGS	TOTAL ENERGY SAVED	PUE IMPROVEMENT	PAYBACK PERIOD
2,000 kW 2.000 MW	−85 kW (~35% reduction)	−40 kW (~10% reduction)	−125 kW −0.125 MW	−0.062 (−4.7%)	< 2 years (1–1.5 yr typical)

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Q&A

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