Engineering Data Center Design for the Rapidly Advancing AI Environment

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Today, the landscape of data center construction is undergoing rapid transformation, driven by AI workloads and their unprecedented power demands. This paradigm shift is transforming the design, construction, and operation of data centers.

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Digitalization

CTS Gro

Redefining Data Centers as Critical Facilities

Critical Infrastructure

Data centers have gained recognition as Critical National Infrastructure in certain EU countries.

Leading Countries

Ireland, UK, Germany, France, Netherlands, and Spain have already made this classification.

Growing Trend

Italy, Norway, Sweden, Finland, Denmark, and Belgium, are in the process of similar classification.

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Benefits of Critical Infrastructure Classification

Protection

This classification helps protect critical data infrastructure from various threats.

Reassurance

Provides healthcare facilities government, and businesses with greater reassurances in our digital world.

AI Data Center Use Cases

Security

AI-driven facial recognition revolutionizes identity verification and surveillance by analyzing unique facial features.

Machine learning (ML)

is a subfield of artificial intelligence where computer systems learn from data, identify patterns, and make decisions or predictions without explicit programming

Healthcare

Platforms like Atomwise accelerate drug discovery while Viz.ai analyzes medical images to identify critical conditions.

Understanding AI Training

From **Data Center** to **Compute Center**

AI training relies on GPUs, consuming significantly more power than traditional CPUs used in data centers.

Power Density Shift

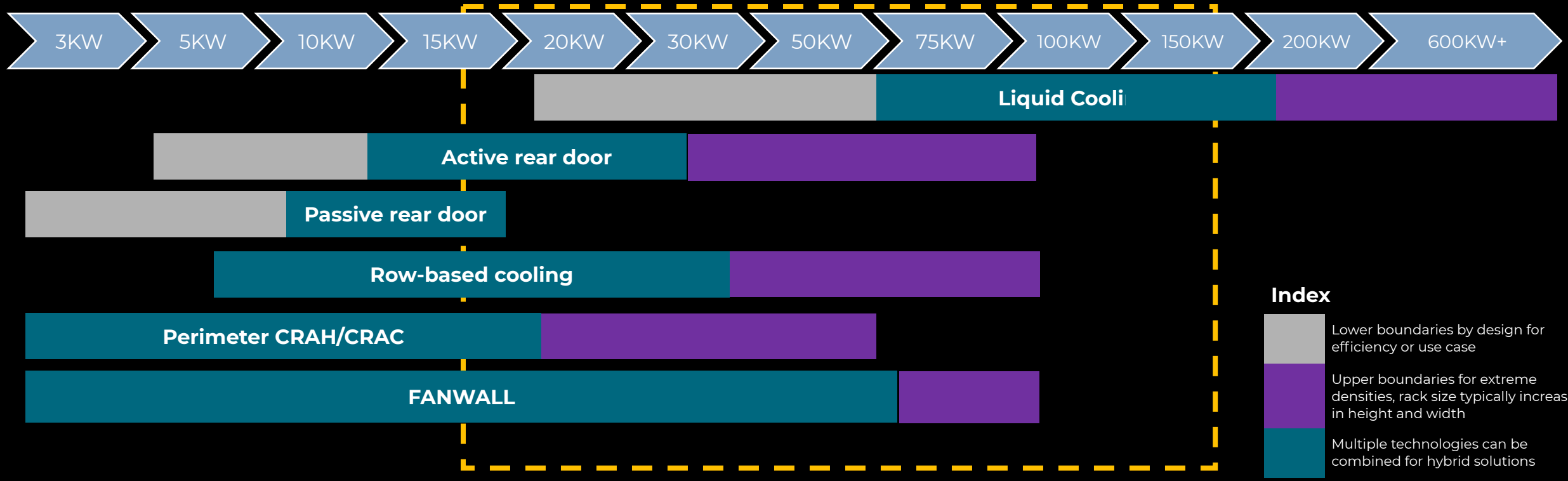
Traditional data centers focused on storage with 10 kW/rack. AI requires 40-600 kW/rack for compute-heavy applications.

New Requirements

While HPC sites are optimized for raw computational power, AI inference workloads need high availability and lightning-fast response times.

Power Density Shift

- IT cooling challenges continue escalating as new server-accelerated compute technologies, machine learning, artificial intelligence, and high-performance computing drive higher heat densities in the data center environment.
- Liquid cooling is rapidly emerging as the technology for efficiently handling power-dense hot spots.
- As the chart shows, as rack density increases in the data center, air is not as effective as liquid in cooling the load.



AI's Specific Requirements for Data Centers

High Performance Computing

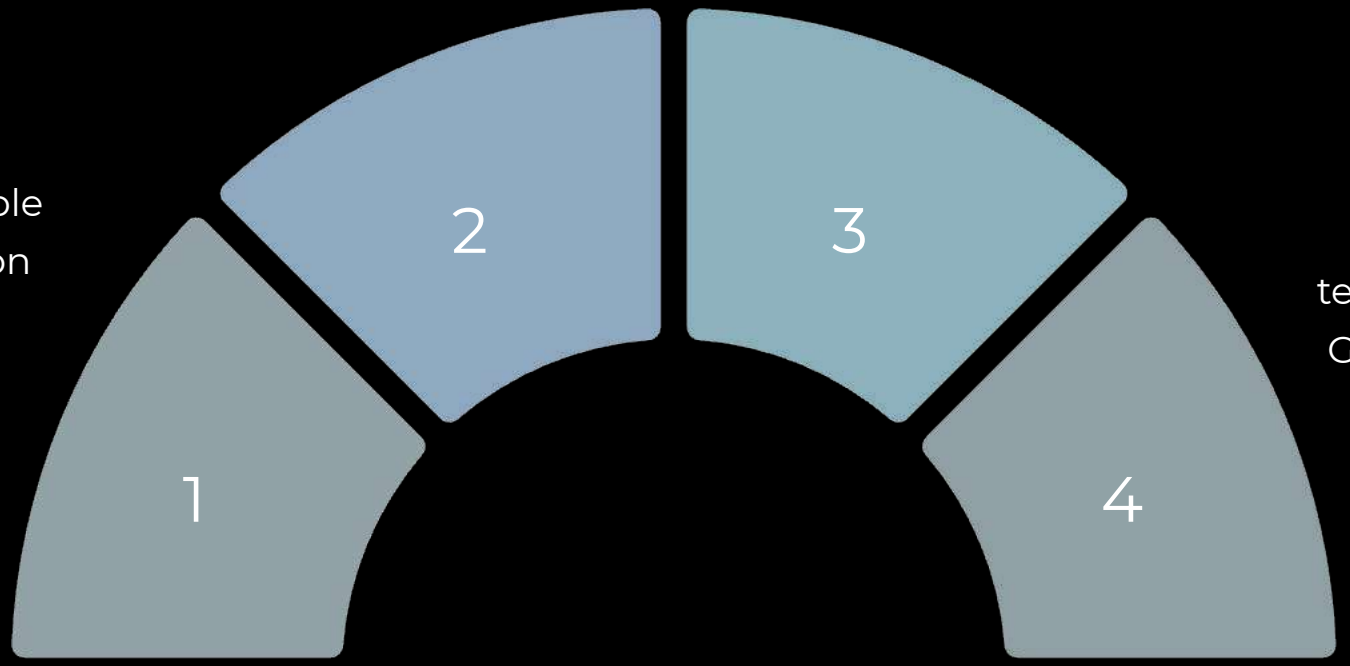
Systems running at speeds one million times faster than commodity systems.

Machine Learning

Enabling machines to learn from data and improve performance without explicit programming.

Tier III Facilities

Concurrently maintainable with multiple distribution paths for power and cooling, no shutdown needed during maintenance.



Liquid Cooling

Methods to lower temperature of CPUs and GPUs, essential for high-density computing.

Liquid Cooling Technology

Key Technology

Efficiently handles power-dense hot spots in data centers

Superior Efficiency

Water heat capacity per cm^3 is 3,400 times higher than air heat capacity per cm^3

Precise Control

CDUs provide temperature control and redundancy

TCS

Provides separation to the Facility Water System, allowing a higher level water quality to the racks

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CDU Integration for Controlled Cooling

Circulation System

CDU circulates coolant in a closed-loop system

Efficiency Boost

Introduced where heat exceeds air-cooling capability

Heat Exchange

Transfers heat between building systems and CDU loop

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DATA CENTER BUILDING – FAN WALL / CDU MECHANICAL – Cooling System Diagram

Fan Wall System

Provides cooling by air for the Data Hall air cooled racks

CDU Integration

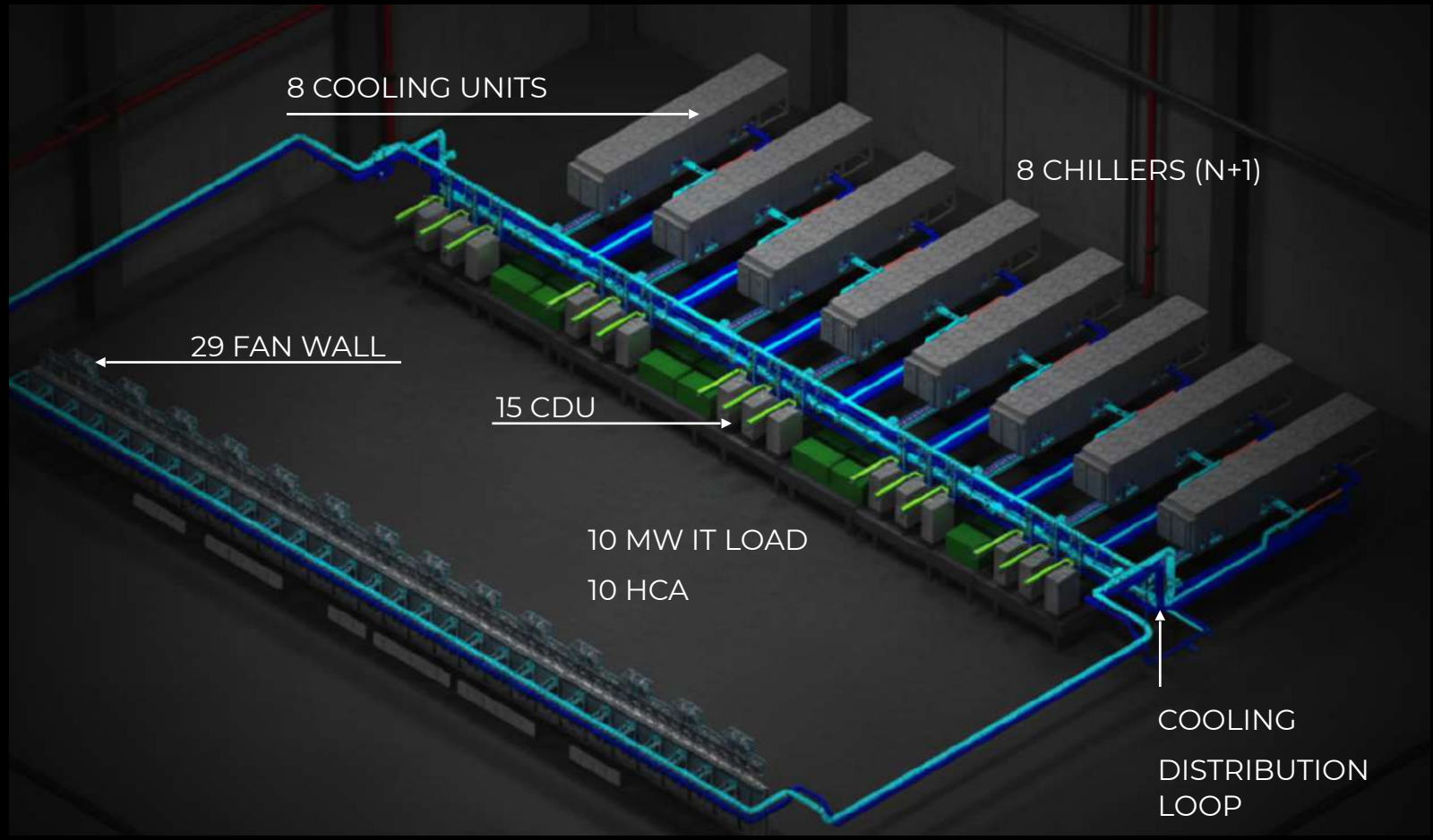
Cooling Distribution Units deliver cooling to liquid cooled racks

System Flow

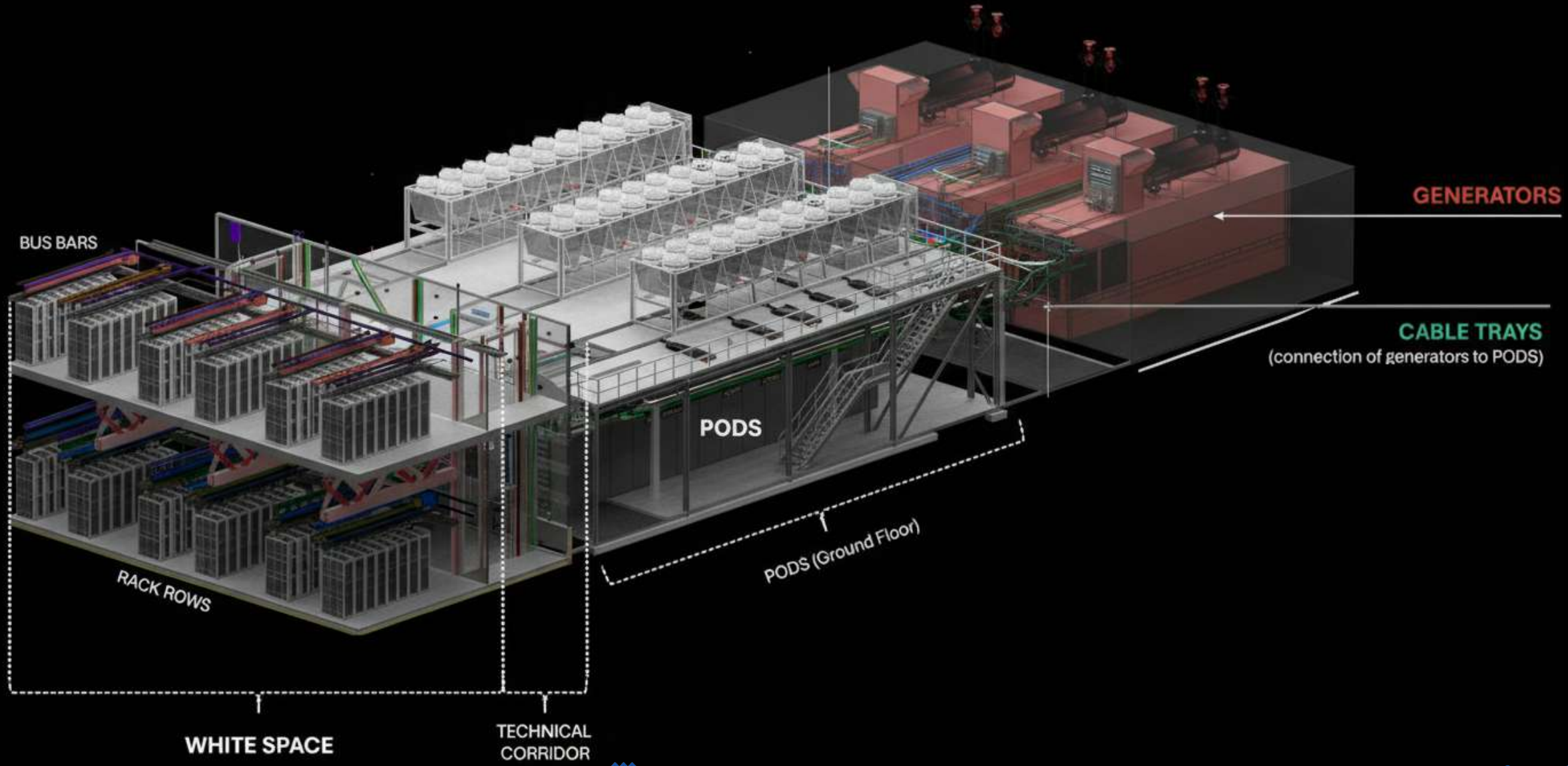
Ensures efficient air cooling distribution

Temperature Control

Maintains optimal air operating conditions



ELECTRICAL – Power Supply System Diagram
CONNECTION OF GENERATORS TO PODs & PODs to DATA HALL



The Future of AI Data Centers

Current AI Factories

Today's AI factories prioritize zero-latency performance, featuring single Data Halls with massive ITE power concentrations. This achieves unprecedented density per square foot, significantly reducing the Data Hall to MEP infrastructure ratio and improving power/cooling efficiency.

Near Future AI Factories

Next-gen ITE will push boundaries further, with rack-level loads reaching 600 kW to 1 MW. This creates extreme power densities, further compressing the Data Hall to MEP ratio. Revolutionary approaches to power distribution, liquid cooling, and thermal management at the rack level will be essential.

High Performance Computing Centers

HPC data centers will utilize advanced ITE for scientific computing, financial modeling, and research. They will adopt similar high-density principles to serve specialized computational workloads needing maximum processing power and interconnect performance.

Traditional Cloud & Storage

Conventional cloud and storage data centers remain vital. These facilities will maintain lower-density ITE configurations for traditional enterprise applications, web services, and storage where extreme compute density is not critical.

Infrastructure Planning Implications

This divergent evolution creates distinct facility types with fundamentally different infrastructure requirements:

- **Power Systems:** AI factories need robust electrical distribution for 600kW-1MW per rack.
- **Cooling Infrastructure:** Liquid cooling becomes mandatory for high-density deployments.
- **Space Efficiency:** Shrinking Data Hall to MEP ratios demand innovative mechanical design.
- **Network Architecture:** Zero-latency requirements drive new interconnect strategies.

Technical Architecture Comparison

NVIDIA GB200 NVL72

Blackwell Platform

- Optimized for LLM training and inference and also high demanding applications
- 192GB HBM3E memory configuration
- Liquid cooling architecture
- Superior energy efficiency vs air-cooled systems
- Production-ready for current AI workloads

NVIDIA GB300 NVL72

Blackwell Ultra Platform

- Enhancement from GB200
- 288GB HBM3E with 12-layer stacking
- Integrated power smoothing power shelf, addressing synchronous ITE operation
- Higher throughput per megawatt ratio
- Advanced grid load management capabilities

The GB300's Blackwell Ultra architecture delivers substantial improvements in memory capacity and reasoning performance. The integrated power shelf with batteries and supercapacitors represents a breakthrough in data center power management, smoothing demand spikes and reducing operational costs during peak grid usage.

Performance and Infrastructure Impact

Memory Architecture

GB300 features 50% more memory capacity with 288GB HBM3E, enabling larger model deployments and improved inference throughput for complex reasoning tasks.

Power Efficiency

Advanced power management system reduces peak grid demand while delivering higher compute throughput per watt, critical for sustainable AI infrastructure scaling.

Cooling Innovation

Liquid cooling enables exceptional compute density while maintaining optimal operating temperatures, supporting continuous high-performance workloads.

Infrastructure Considerations

Both components require specialized data center infrastructure including liquid cooling distribution, enhanced power delivery, and optimized rack configurations. The GB300's energy storage integration provides additional grid stability benefits for large-scale deployments.

The GB300's Blackwell Ultra platform specifically targets AI reasoning workloads where the additional memory capacity and enhanced architecture deliver measurable performance improvements over the already powerful GB200 configuration.

AI Data Centers – Meeting the Challenge

- As artificial intelligence becomes the norm, these data centers will become vital to the operation of critical infrastructures.

- **Design, engineering, construction, and operations** must stay ahead of the curve and grasp their significance so that you can navigate the future.

- **CTS Group** is meeting the *paradigm shift* head-on to ensure that the rapidly advancing AI environment is accommodated.

CTS Group is Meeting the Challenge of AI

Paradigm Shift

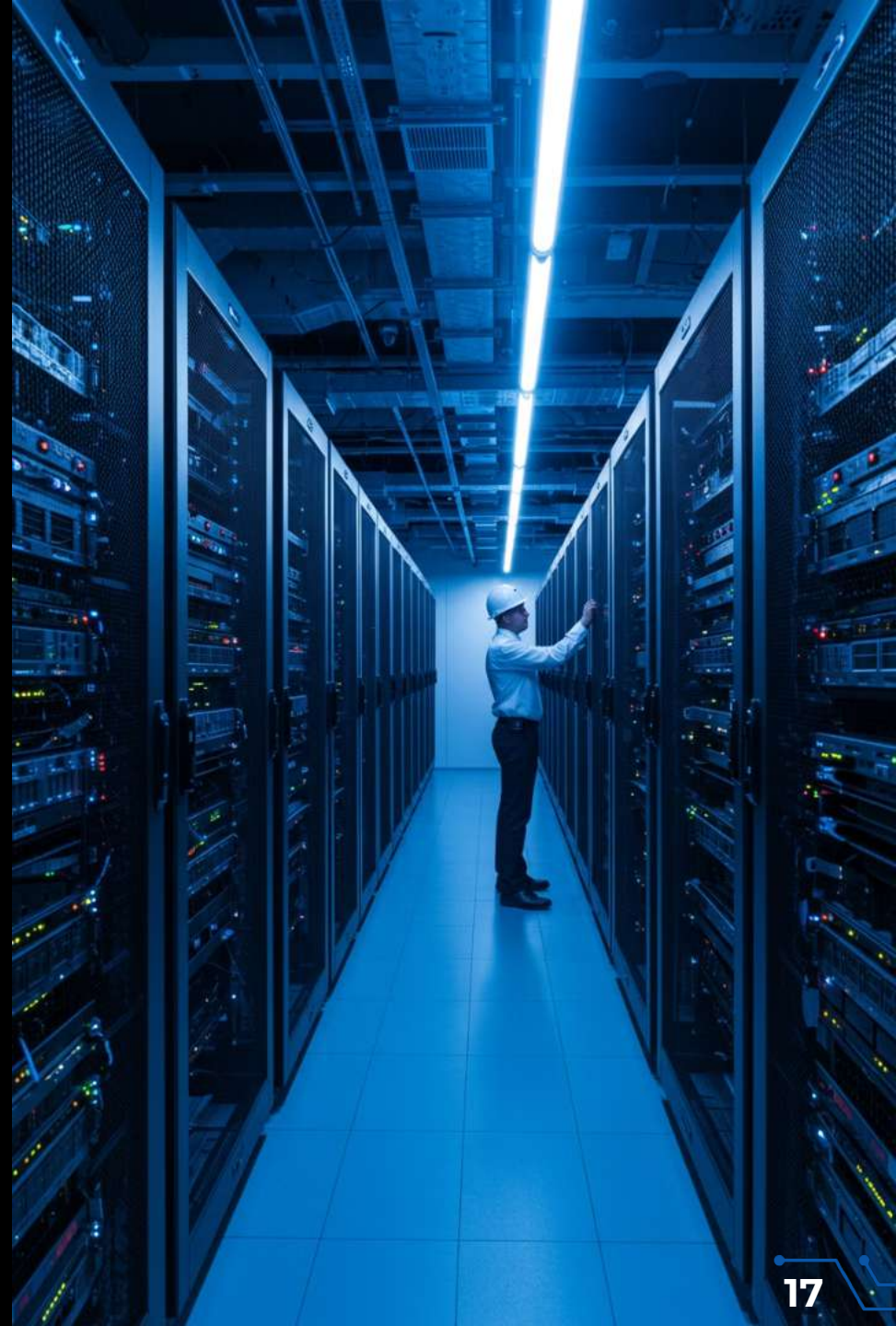
AI applications across industries are driving a recalibration of priorities in data centers.

Key Challenges

Available power, time to market, sustainability, and escalating costs are formidable hurdles.

Balancing Act

Securing equilibrium between innovation, environmental stewardship, and financial viability is imperative.



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Implementation of New Technologies to meet AI Demand

To meet the growing demand of AI we need to be at the leading edge of Technology

CTS Group is leading the way in the DC environment thru early adoption of technology by ensuring we understand what is available on the market and how effective this technology can be to help to deliver Faster, Better and Cheaper Design and Build data centers

CTS invests heavily its retained earnings to ensure we are providing the highest-quality product within the shortest period of time, to the highest standard.

Time to Market is Client Critical

Implementation of New Technologies

Concept Design → Execution Design → Production Pre-Fabrication → Execution/Build → Testing & Balancing + Commissioning → Operations

Concept Developed in CTS Nordics HQ Oslo - Revit

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BIM models creation for analysis, evaluation and simulations

- Integrated Database
- Calculations
- BIM / Revit
- List of Material

100% Digital, easy to interact and flexible

100% Clash free, improve and redefficiencyuce costs

Design

Unique database for documents, 3D models, specifications, costs.
Automated production of
- BoD
- BoQ
- Drawings
- Submittals

Real Time model update

Execution

Staying on-schedule and on-budget using 3D quality recognition and project controls.
Real-time understanding of the schedule
Onsite accuracy and daily progress by 3D visualization

Production

Prefab components, Data will be integrated in the production plan and execution

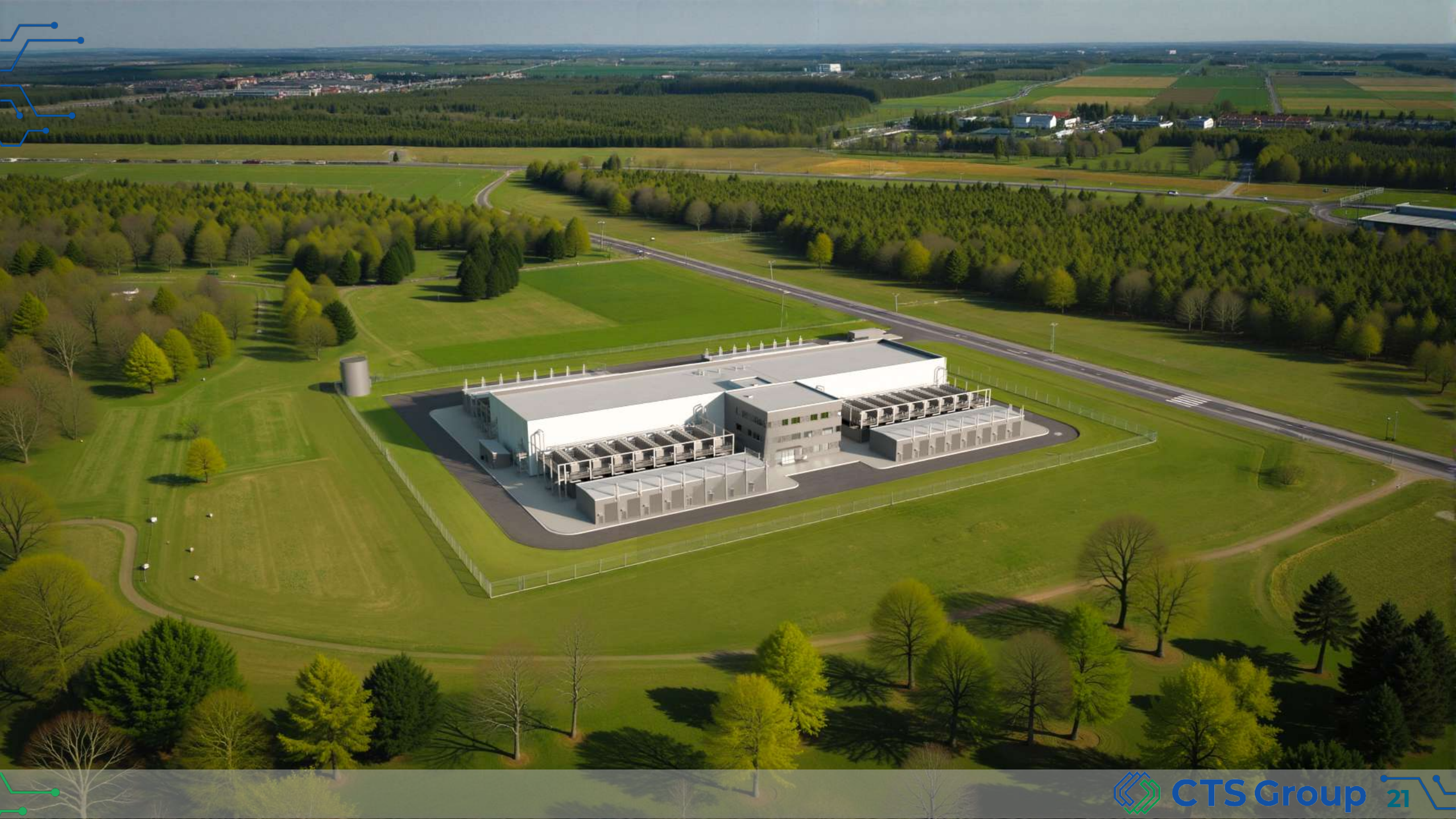
Software integration for all disciplines
- Eplan for electrical
- BFS for logistics
- Naviate for civil

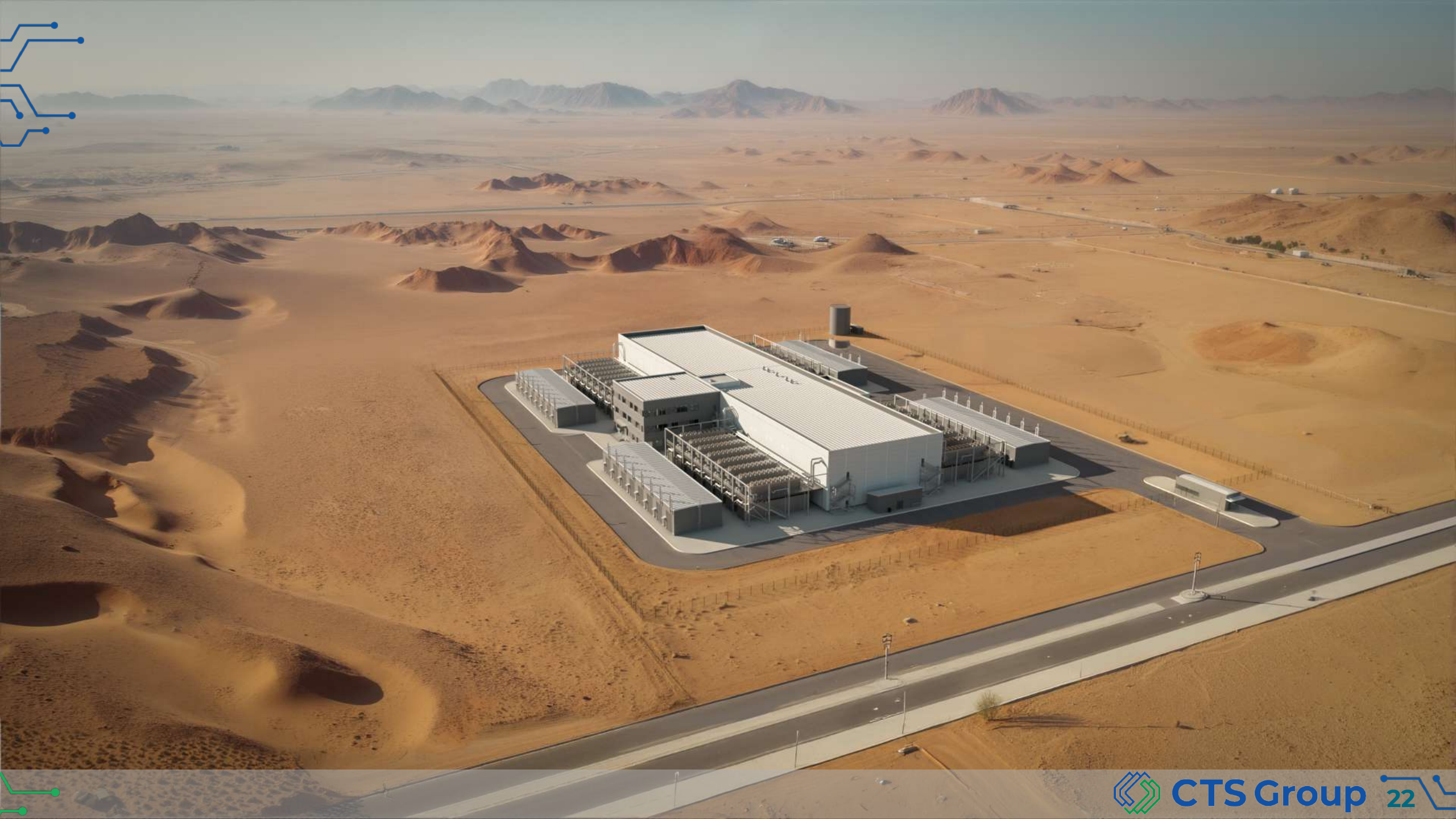
Operation

Fully integrated platforms:
- PMS
- BMS
- CMMS
- Security
- Fire Detection

Central Control Room, optimizing the operation of different Data Centers.

CTS Group - Project Dragonfly






CTS Group
Staying Ahead of the Technology Curve
THANK YOU!