
VERTIV.
The world
depends on data
we power and cool™

Infrastructure Solutions
EMEA Masterclass 2025

Wednesday, April 9

Registrations	Sheraton Hotel & Kaptol Boutique Cinema	**8:00**	
Bus Transfer	Sheraton Hotel ► Kaptol Boutique Cinema	**8:50**	
Morning Session	Kaptol Boutique Cinema	**9:30**	
Welcome Introduction	**Viktor Petik**, Senior Vice President Infrastructure Solutions		20'
How does AI affect Data Center Design	**Krešimir Krpan**, Senior Director of Solution Architecture & Business Development		30'
Designing Power Infrastructure for AI	**Denis Namlić**, Director Product Engineering & PMO; **Andrea Ferro**, VP Channel IT & EDGE EMEA		30'
Designing Cooling Infrastructure	**Piergiorgio Tagliapietra**, Director EMEA Application Engineering Thermal; **Marin Pajić**, Lead Engineer		30'
Coffee Break		**11:10**	20'
Vertiv Unify – BMS & EPMS Solution	**Nikola Rosić**, Director Design Engineering; **David Lam**, EMS Business Development Director		30'
Connecting the Pieces	**Krešimir Krpan**, Senior Director of Solution Architecture & Business Development		10'
Product Development and Innovations	**Denis Rančić**, Director of Offering for Infrastructure Solutions		30'
Lunch Break		**12:40**	60'
Afternoon Session		**13:40**	
Guest Speaker (Nvidia)	**Vladimir Prodanović**, Principal Program Manager at NVIDIA		45'
Expert Panel - Infrastructure for AI Era	**Krešimir Krpan**, **Andrea Ferro**, **Piergiorgio Tagliapietra**, **Jonathan Beresford**, Project Commercial Manager EMEA**; Vedran Brzić,** VP Infrastructure Solutions EMEA		60'
Closing Remarks	**Viktor Petik**		10'
Free Time / City Tour	Zagreb	**15:45**	
Dinner & Networking	El Toro Restaurant	**19:30**	

Thursday, April 10

Bus Transfer	Sheraton Hotel ► Rugvica	**9:00**
Factory Tour	Rugvica	**9:30**
Infrastructure Solutions Factory Tour	**Marko Škara**, Plant Manager	
Return Transfers Ⓐ	Rugvica ► Sheraton Hotel	**11:30**
Ⓑ	Rugvica ► Zagreb Airport	**11:30**

VERTIV.

VERTIV.

keep it humming™

Infrastructure Solutions

Viktor Petik

Senior Vice President, Infrastructure Solutions

Global presence, local expertise

Worldwide

Manuf. and Assembly Locations: **22**
Service Centers: **240+**
Service Field Engineers: **3,500+**
Technical Support/Response: **190+**
Customer Experience Centers/Labs: **19**

Americas

Manuf. and Assembly Locations: **8**
Service Centers: **100+**
Service Field Engineers: **1,600+**
Technical Support/Response: **70+**
Customer Experience Centers/Labs: **5**

Europe, Middle East, and Africa

Manuf. and Assembly Locations: **9**
Service Centers: **60+**
Service Field Engineers: **600+**
Technical Support/Response: **100+**
Customer Experience Centers/Labs: **5**

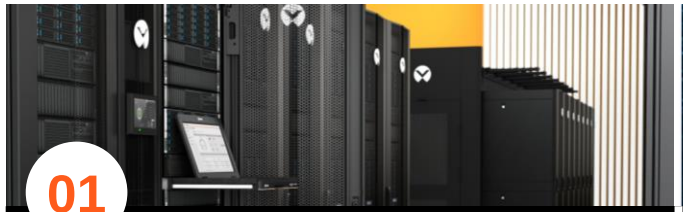
Asia Pacific

Manuf. and Assembly Locations: **5**
Service Centers: **80+**
Service Field Engineers: **1,300+**
Technical Support/Response: **20+**
Customer Experience Centers/Labs: **9**

Note: company information as of December 31, 2023.

Robust global operations, supply chain and service presence

Supporting the most impactful market segments



01

Data Centers

Data traffic explosion and accelerating AI demand

+

Speed and scale acceleration

+

Increasing complexity and unpredictable requirements

02

Communication Networks

Mobile Technology Deployment

+

Convergence of mobile networks, IoT and cloud

03

Commercial & Industrial

Nearshoring and demand for reliable and high-quality power

+

Digitalization and automation

Enabling the world of critical digital infrastructure

Leading innovator with most complete critical digital infrastructure portfolio

Power Management

Power Train - We have all the "cars"

Medium- and Low-Voltage Switchgear/Switchboard

3-Phase Uninterruptible Power Supply (UPS) Systems

Power Distribution, Transfer Switches

Busbar

DC Power

Thermal Management

Thermal Chain - We have all the "links"

Air Handlers

Direct Expansion

Chillers

In-Room Cooling

Rear-Door Heat Exchangers

Direct-to-Chip Coolant Distribution

Immersion Cooling

IT Systems

IT Systems Set - We have the components from distributed IT to GW data center sites

1-Phase UPS

Rack PDU

Racks and Enclosures

Rack Cooling

IT Mgmt. Devices, Software, High-Performance KVM

Infrastructure Solutions

INFRASTRUCTURE SOLUTIONS

We pull together full Vertiv portfolio to create prefabricated & modular solutions for data centers

Power Modules

SmartMods

MegaMods

Prefab Hybrid – OneCore

Services

Project and Lifecycle Services

extend value of install base and maximizes market expertise

Lifecycle Services

Project Services

Digital Services

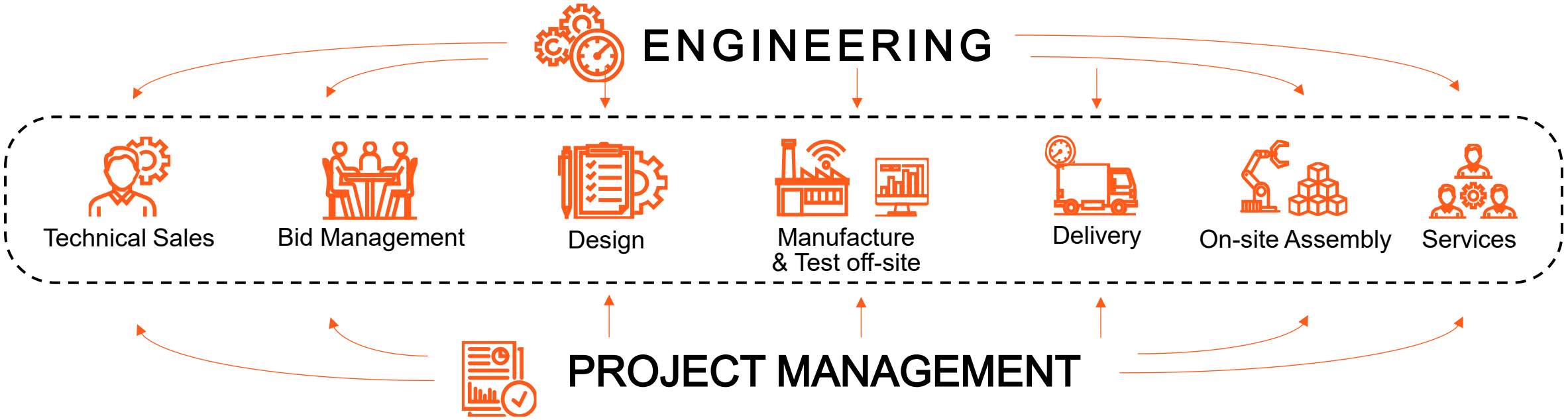
Portfolio strength and uniqueness with end-to-end coverage

About Infrastructure Solutions

The experts for Infrastructure Solutions

We are:

Specialized in designing data centers by integrating all Vertiv products into comprehensive solutions, utilizing the entire Vertiv portfolio to create prefabricated and modular solutions for AI and legacy data centers.



We own the entire process!

Infrastructure Solutions Value Proposition

MARKET DRIVERS

VERTIV STRENGTHS

Accelerating Deployment Cycles

- Repeatable factory-integration to **reduce deployment** up to 50% and 50% less on-site work (including commissioning)
- Global supply-chain and service **delivery footprint**

Maximizing Building Blocks & Space Optimization

- **Modular and hybrid solutions in** multi-MW sizes
- Module design-practice **unlocks up to 30% space**

Reduce Field Work and Improve Build Quality

- Productizing non-repeatable field work in the factory, improving build-quality and customer's total cost of ownership up to 25%

Manufacturing Facilities:

AMER

Pelzer Point, USA

Tijuana, Mexico

EMEA

Letterkenny, Ireland

Rugvica, Croatia

Nove Mesto, Slovakia

Ras-al-Khaiman, UAE

Asia

Johor Bahru, Malaysia

Innovation Hubs:

AMER

Pelzer Point, USA

Delaware, USA

EMEA

Letterkenny, Ireland

Zagreb, Croatia

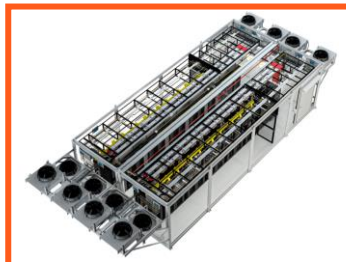
Asia

Kuala Lumpur, Malaysia

Melbourne, Australia

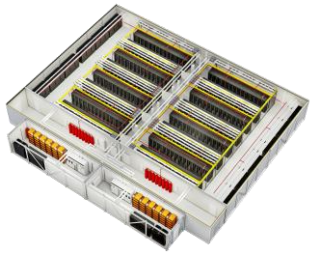
Vertiv Infrastructure Solutions Portfolio

MODULAR DATA CENTERS



- All-in-one configurable data centers
- Vertiv Power, Thermal Management and Racks
- Up to 104 racks

Vertiv™ SmartMod™ Family



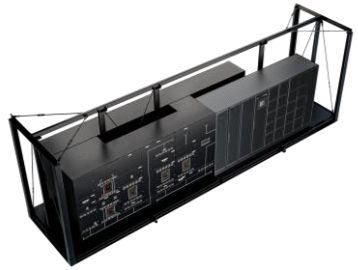
- Scalable standardized multimodule Data Center
- Building block approach
- **Vertiv™ MegaMod™ CoolChip (**Liquid Cooling)

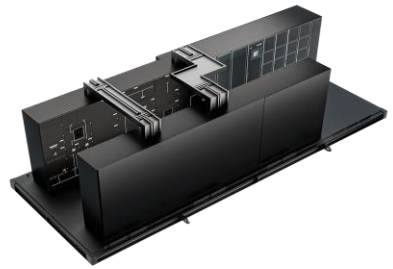
Vertiv™ MegaMod™

- Scalable custom design
- 200 – 300 racks
- >1MW

Custom

POWER INFRASTRUCTURE

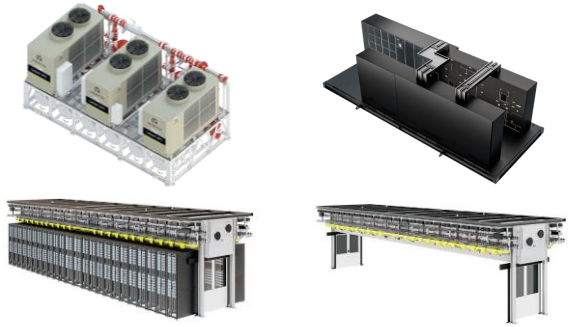




Power Modules & Skids

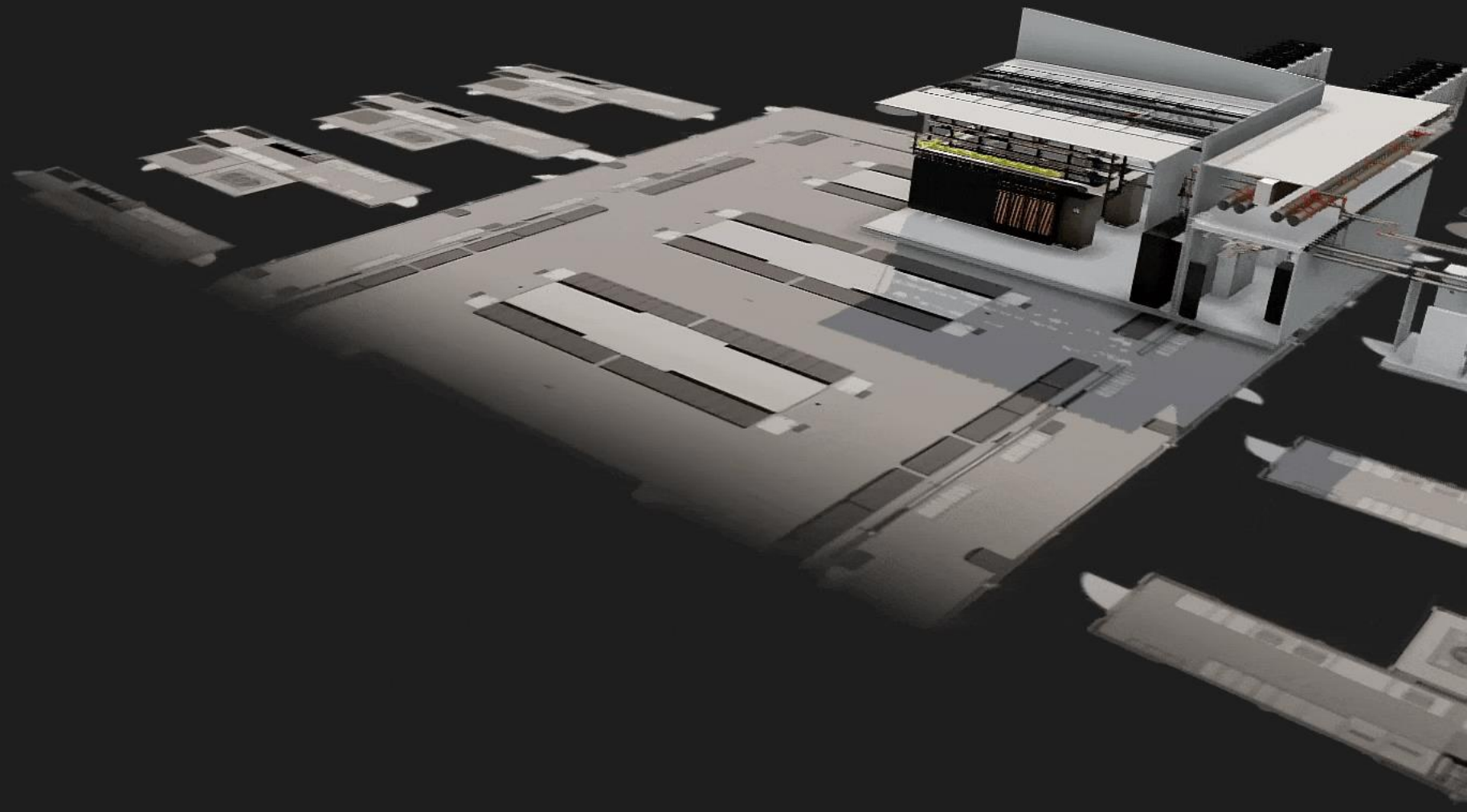
- LV & MV Power Modules and Skids
- Vertiv Power (Distribution panels, UPS, batteries), Thermal Management
- Different ratings and reference designs
- N, N+1, 2N redundancy levels

ONECORE - Prefabricated Hybrid Data Center Design



- Prefabricated critical components - Power Modules / Cooling Modules / IT Modules
- Traditional - constructed building
- Scalable design
- 450 – 1500 racks

OneCore - Prefabricated Hybrid Construction



VERTIV.

keep it humming™

AI Impact on Datacenter Design

Krešimir Krpan

Senior Director of Solution Architecture & Business Development

Macro trends creating challenges for data centers

Key Data Center Market Trends

Data Growth

~24%

Global Data 2023-2028 CAGR[1]

Server Growth

~16%

Global Server Market Spending 2023-2028 CAGR[2]

Infrastructure Capex Growth

~8 - 9%

Global Total Physical Infrastructure Capex 2023-2028 CAGR[3]

New Power Capacity Added

>100 GW

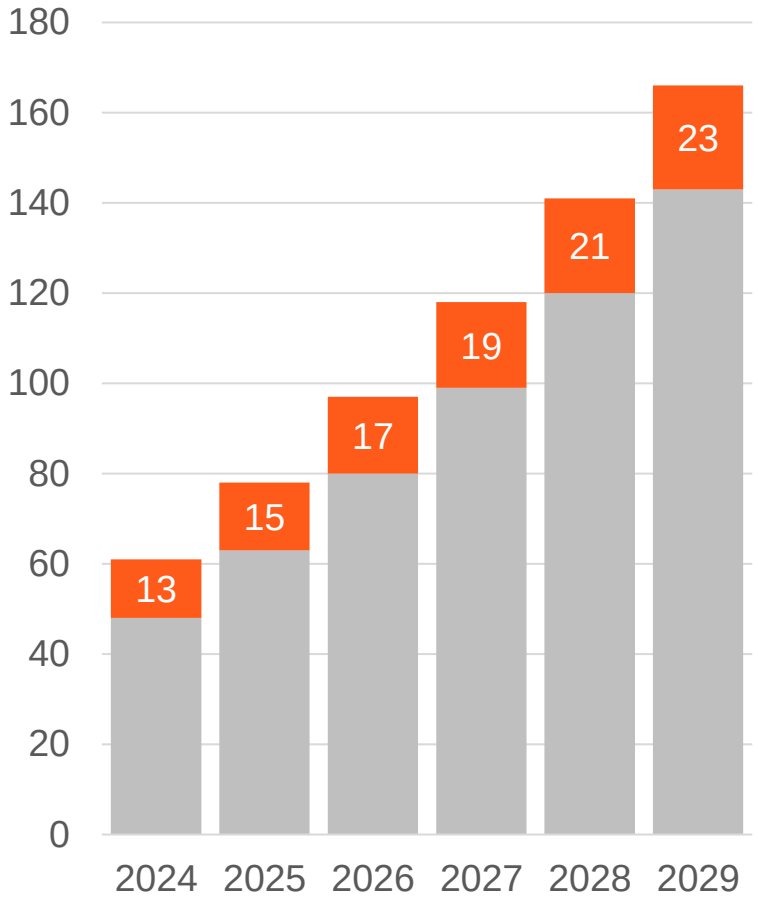
Cumulative Power Added from 2023 to 2029[4]

From **13 GW** to **23 GW**

Annual Power Added Per Year[4]

External Industry Forces

Exogenous constraining factors like power availability, permitting, regulations, skilled build and commissioning labor, etc.



Source: [1]IDC Global Data Sphere 2023-2028 CAGR - May 2024; [2]IDC Worldwide Server Market Spending Insights 2023-2028 - Sept 2024; [3]Omdia Data Center Capex 2023-2028 CAGR - April 2024; [4]Managements estimates as of November 18, 2024, Investor Event

Digitalization is driving foundational changes in customer experiences, manufacturing innovation, business operation and infrastructure

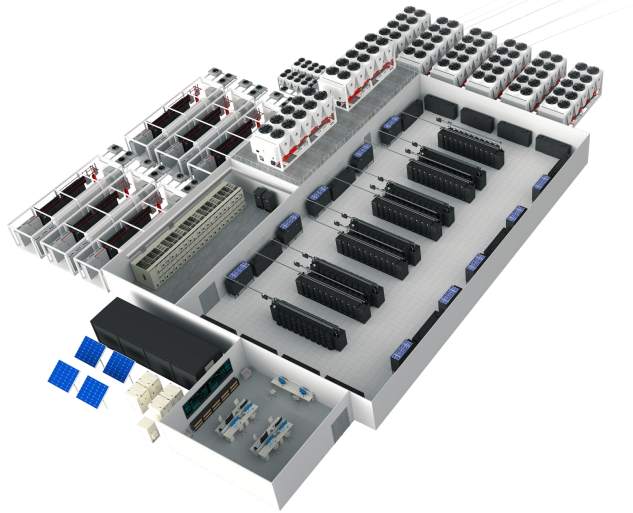
AI and data center densification roadmap

	2025	2026	2027	2028	2029 +
*Anticipated **AI** Multi-Node **Peak Density** [1]*	~ 130 – 250 kW		~ 250 – 500 kW		600 kW +
*Estimated **AI POD Average** Multi-Node **Density** [2]*	~ 40 – 100 kW		~ 100 – 250 kW		+
Design Paradigm	*Disparate Systems*			***Unit of Compute***	
*Projected Industry **Average Rack Density** [3]*	~15 – 25 kW		~25 – 50 kW		~50 kW+

Note: Projections. Rack density varies by application. [1] Management Estimates, assuming a multi-node is a system domain of multiple interconnected GPUs and CPUs in a rack-scale footprint ; [2] Management Estimates, assuming an AI POD consisting of 18 racks (9 per row) including 8 GPU multi-nodes at higher peak density and 10 networking racks; [3] Management Estimates; average densities of data center rack installations across Cloud, Colocation and Enterprise/Distributed IT.

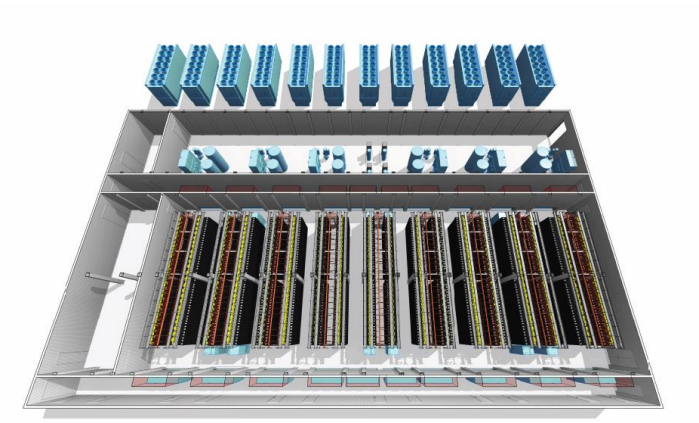
Data Center Design and GPU roadmaps point to accelerating density that require disparate power, cooling and compute systems designed as ONE

AI vs Cloud



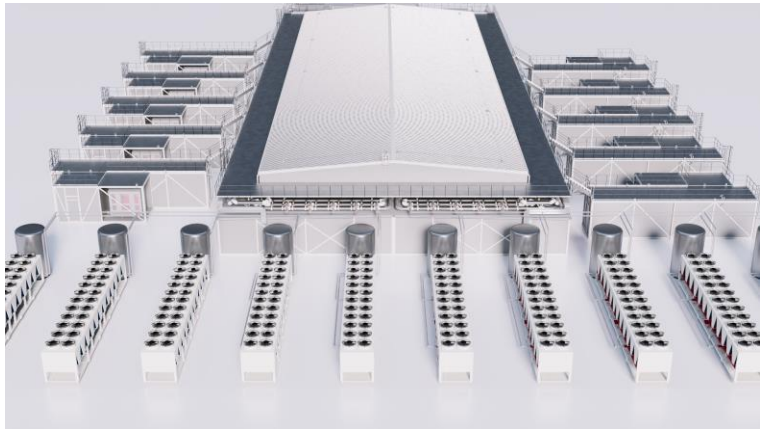
Cloud Colocation

- 8-12 kW/ rack, ~250 kW/row
- ~24 racks / row
- Concurrently maintainable



Hybrid Cloud/AI

- 8-130kW/ rack, ~500kW/row
- ~24 racks / row
- Concurrently maintainable



AI Factory

- 20-130kW/ rack, ~1250kW/row
- ~24 racks / row
- Concurrently maintainable

Row density (kW) 2x 2.5x

AI VS CLOUD - EFFECTS

- Density increase ~5x average compared to cloud environment!
- Infrastructure complexity increase (SFN, busbars, fiber trays)
- Infrastructure vs IT whitespace ratio change
- Densification of infrastructure
- Efficiency is not just a „PUE” KPI

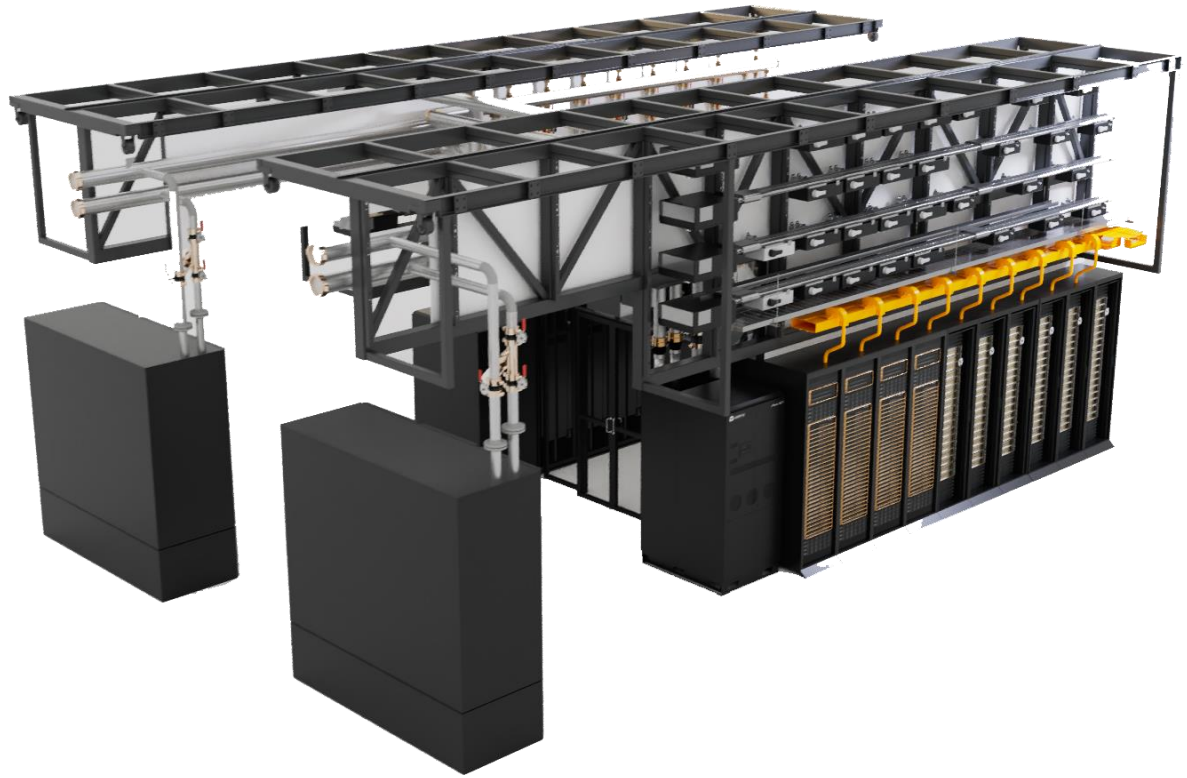
WHAT'S IMPACTED?

Whitespace:

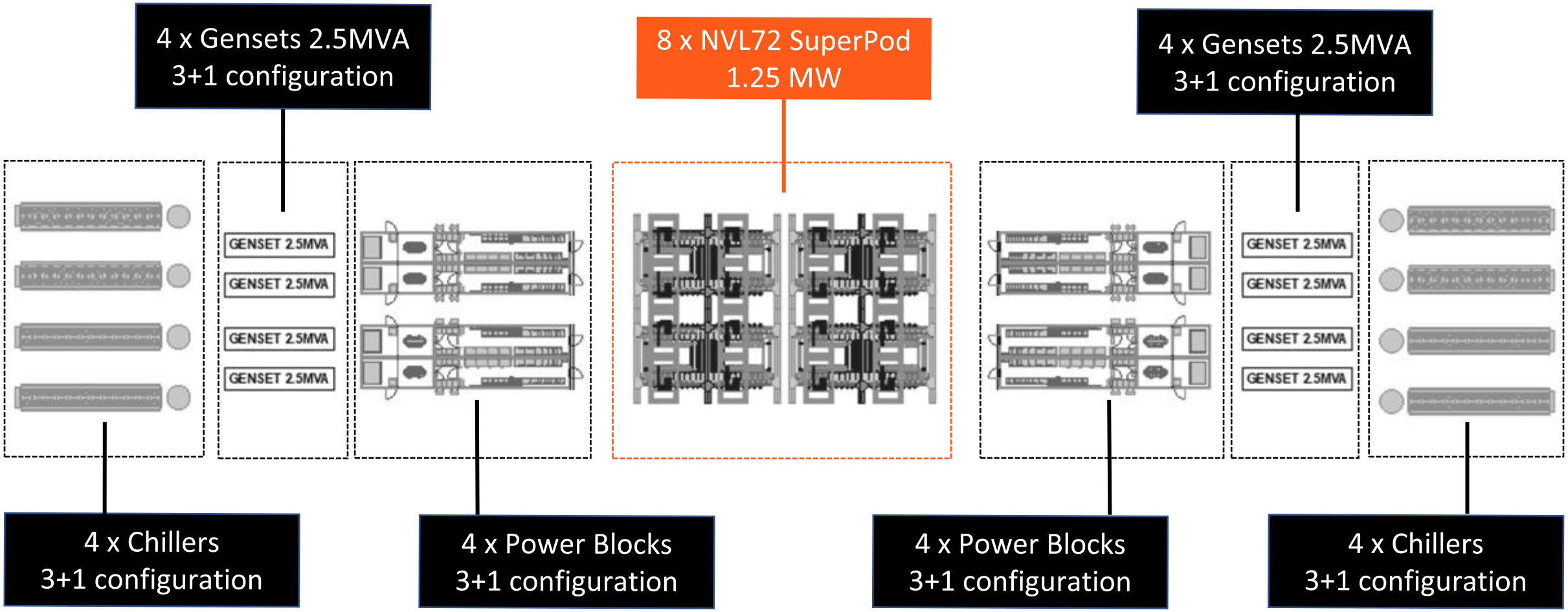
- Nvidia SuperPOD Architecture
- Power to rack, feeds per rack (A+B → 3+1 configuration)
- Secondary Fluid Network (SFN) above/below racks
- Rack/Layout variations based on Vendor
- Indoor height

Infrastructure:

- Higher water temperatures
- Power & UPS sizing

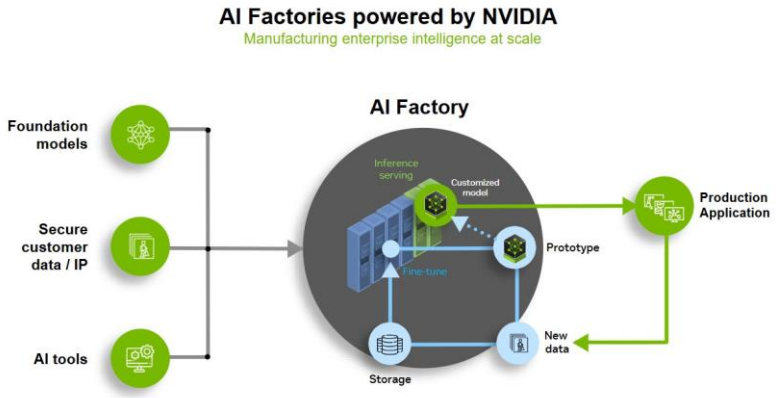


Prefabricated blocks for AI datacenters – 10MW example



Scale Out / Scale UP – AI Factories

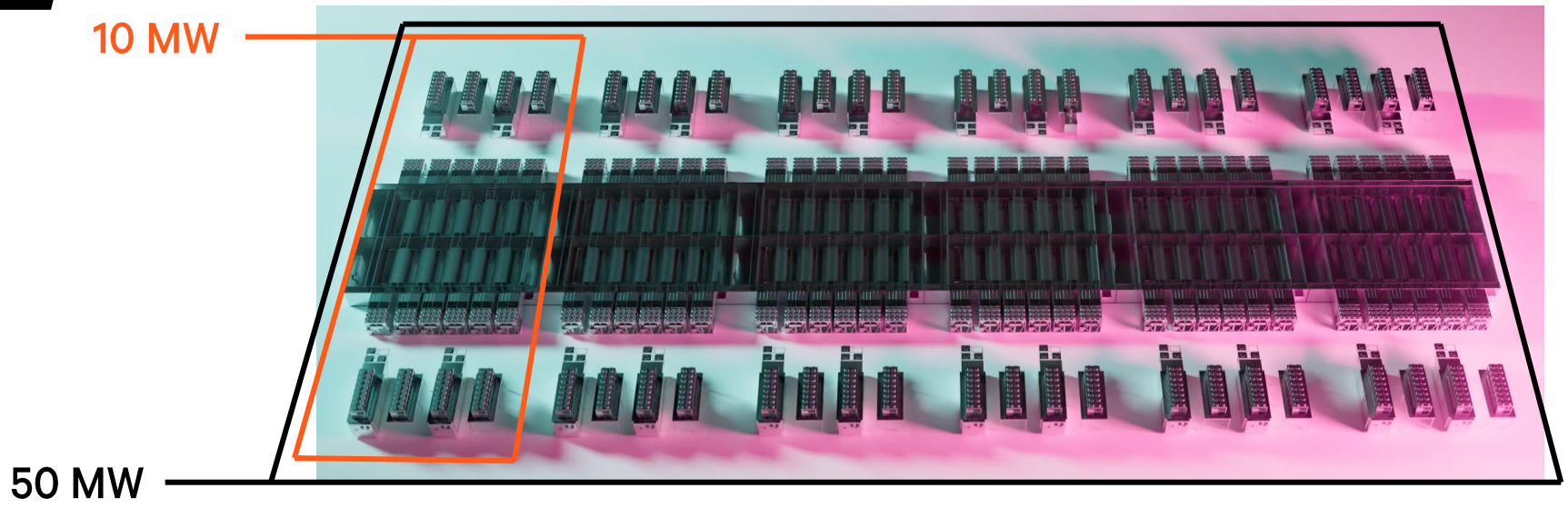
- Changing the scale at which datacenters are built
- Push towards „AI Factories" instead of datacenters
- Retool the factories for next generation of chips/servers
- Power availability becoming the key factor due to scale
- New power generation technologies considered
- What is the „right" block size? Blast radius considerations
- Networking limitations

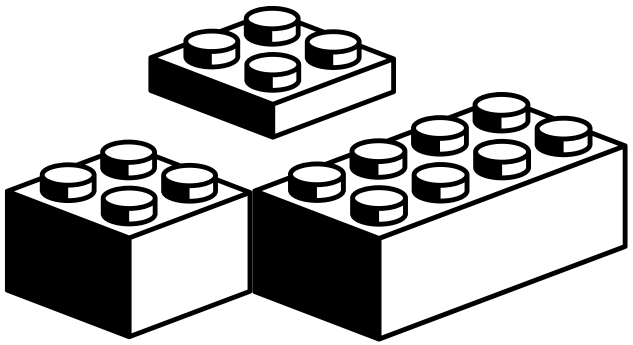


Source: Nvidia Blog – AI Factory

Rendering of META AI Factory in Louisiana
Source: Datacenter Frontier

50 MW AI Cluster





Building Block	Qty per **10 MW**	Qty per **50 MW**	Qty per **500 MW**
NVL72 SuperPod	8	40	400
Power Blocks	8	40	400
Chillers with buffer tanks	8	40	400
Gensets 2.5 MVA	8	40	400
Plot area approx.	-	36.000m2	365.000m2

VERTIV.

Prefabricated data center for NVIDIA DGX | AI solutions

VERTIV.

Designing Power Infrastructure for AI

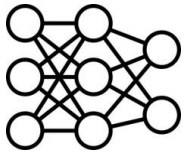
Andrea Ferro

VP Power & IT Systems EMEA

Denis Namlić

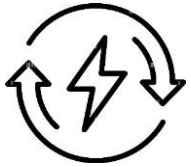
Director Product Engineering & PMO

Power Management: Evolving Critical Power Needs



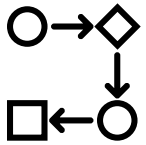
AI Densification & Load Management

- Dynamic AI workload management
- Impact on Data Center Powertrain



Power Availability & Sustainability

- Enable BYOP and Microgrid strategies to complement grid
- Coordination with on-site generation
- Implement sustainable and cycling energy storage solutions

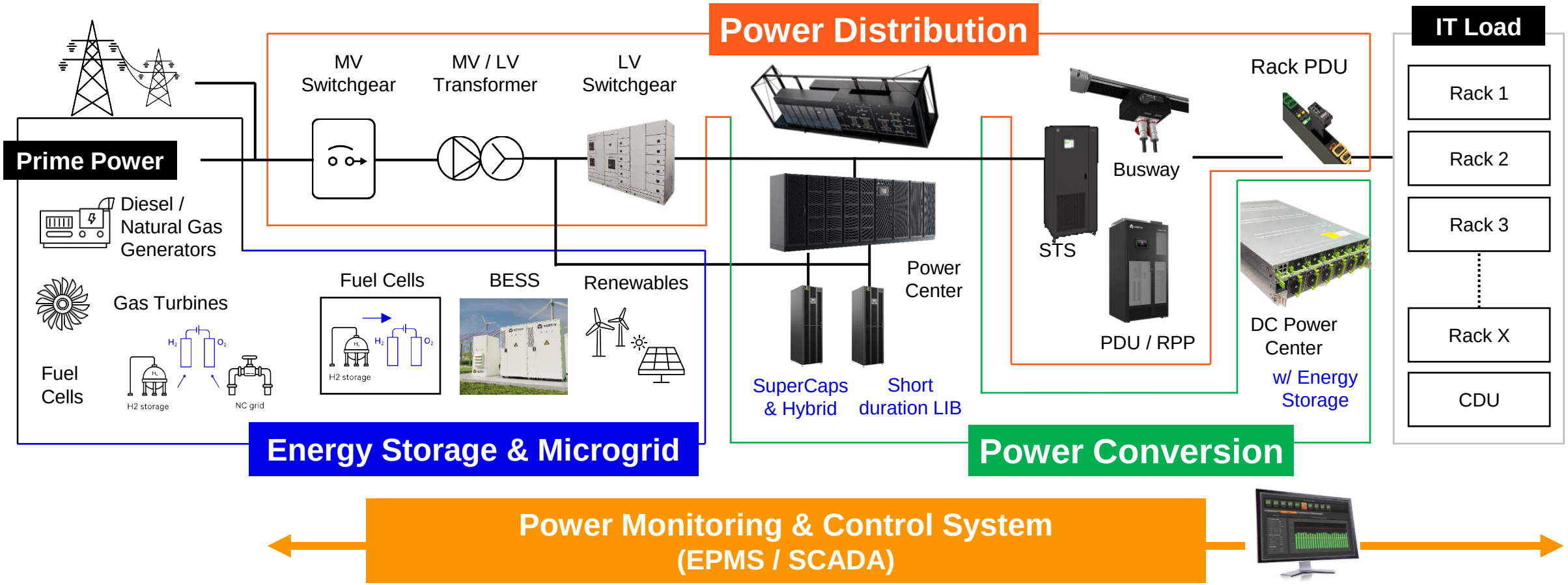


Operations and Deployment Speed and Flexibility

- Prefabricate Power Infrastructure design considerations
- Modular build outs, standardize work

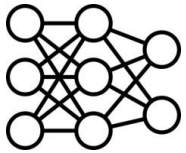
Full System Approach is Required to Solve these Challenges!

Vertiv's Power Train Portfolio



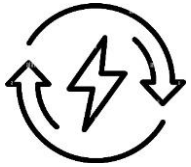
Expanding our portfolio and capability across the power train

Power Management: Evolving Critical Power Needs



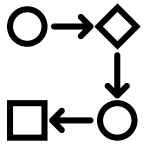
AI Densification & Load Management

- Dynamic AI workload management
- Impact on Data Center Powertrain



Power Availability & Sustainability

- Enable BYOP and Microgrid strategies to complement grid
- Coordination with on-site generation
- Implement sustainable and cycling energy storage solutions



Operations and Deployment Speed and Flexibility

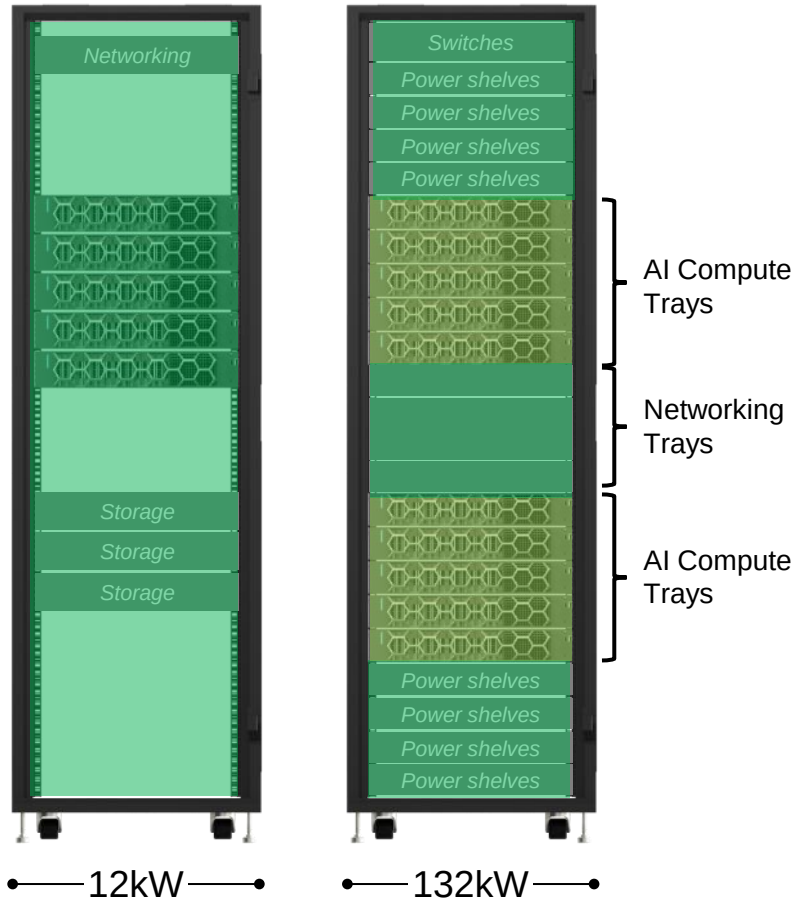
- Prefabricate Power Infrastructure design considerations
- Modular build outs, standardize work

Full System Approach is Required to Solve these Challenges!

Load Cycle at UPS Output: Base and Maximum Load

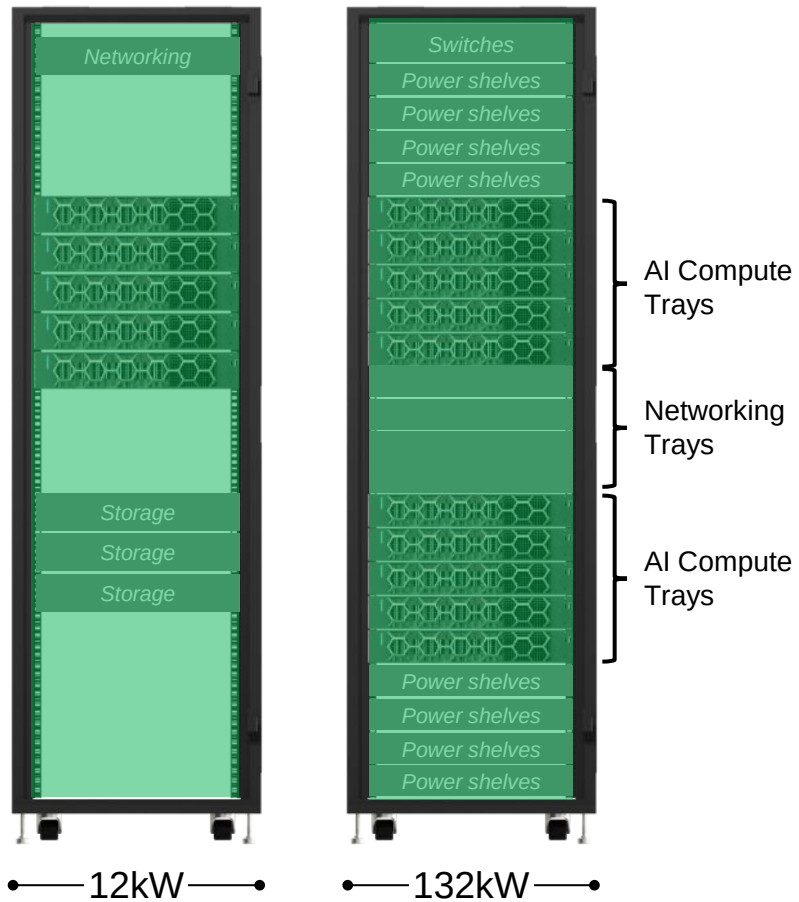
Base Load:

Network racks + Not GPU portion of HDC racks + AI compute idle

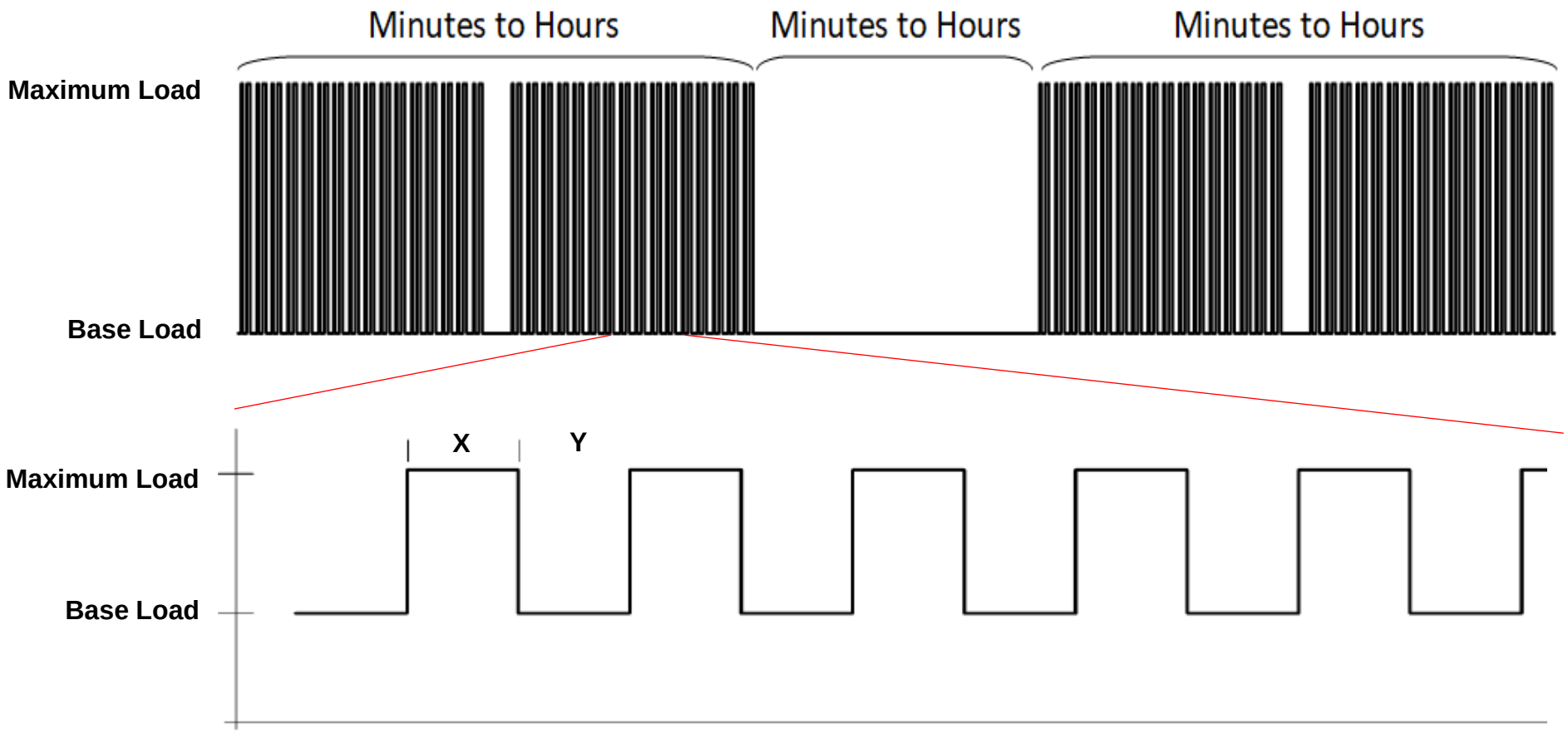


Maximum Load:

Network racks + HDC racks



Load Cycle at UPS Output



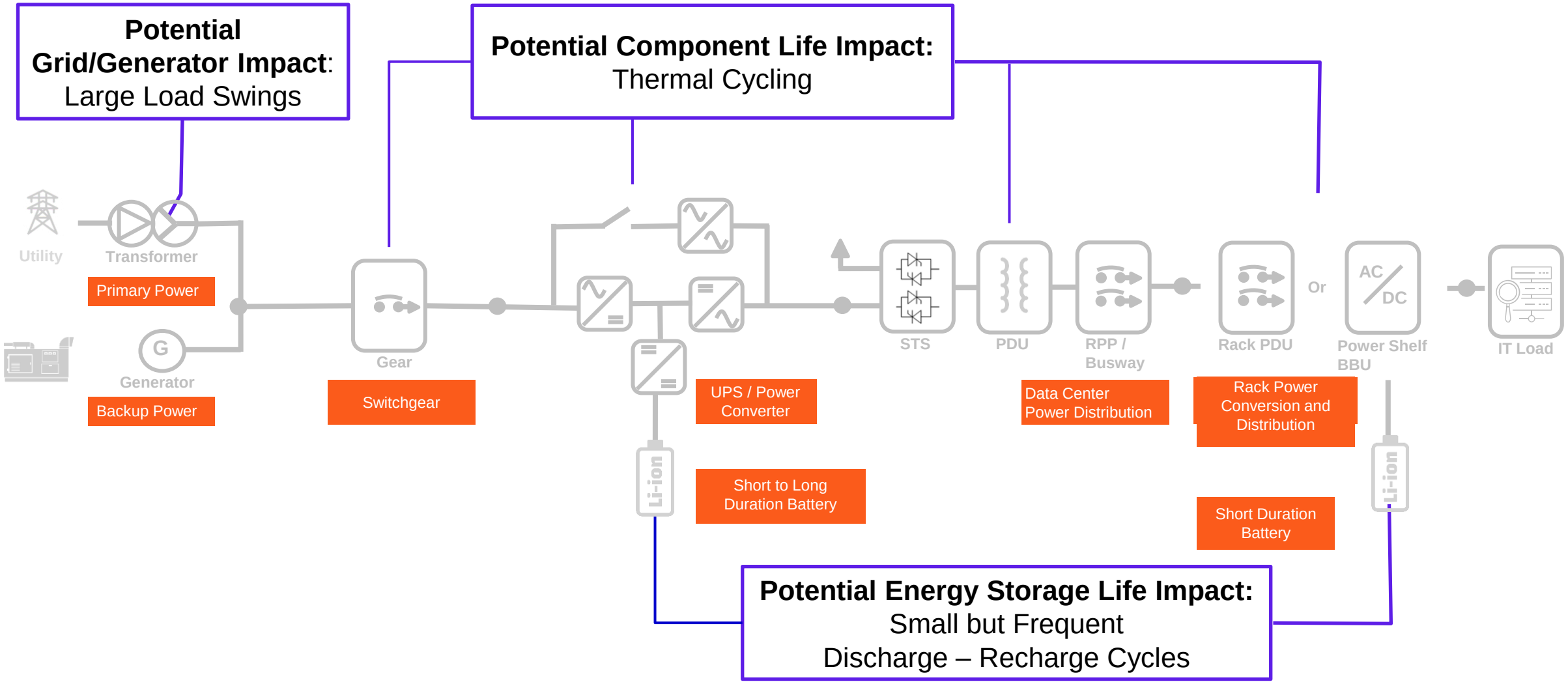
Note:
Peak demand not shown

Base Load: Network racks + Not GPU portion of HDC racks + AI idle load

Maximum Load: Network racks + HDC racks

Duty Cycle X-Y: May vary between 1-1 to 2-1 ratio. Typical processing time is 0.5-2s

AI workload effects on data center power train



Vertiv™ Trinergy workloads management

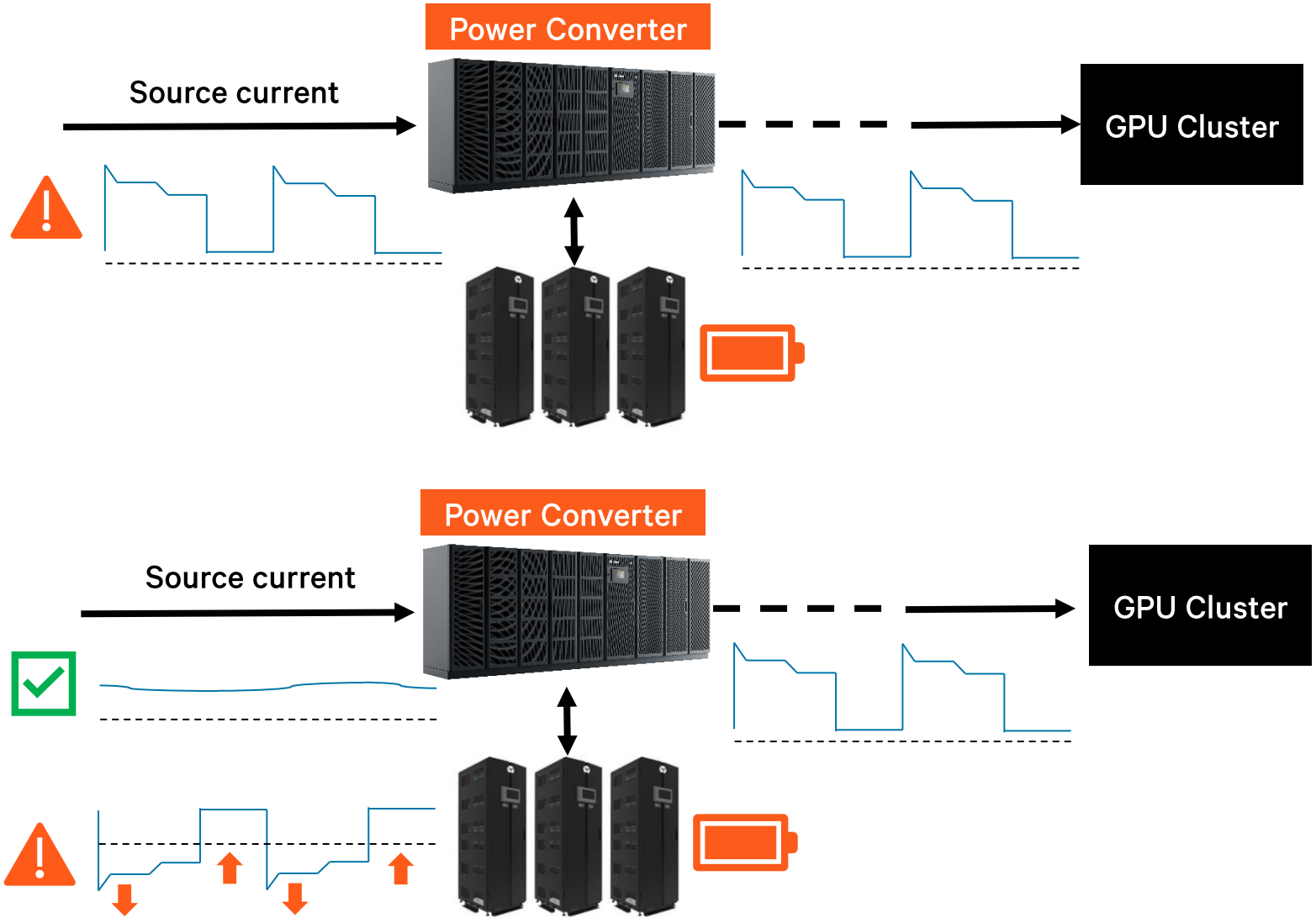
Minimize impact on batteries

UPS is modified to handle load steps >100%

Minimize impact on grid/generators

UPS is modified to use Batteries for Power Smoothing (Input Load Averaging)

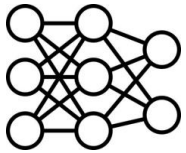
At UPS level, two scenarios should be considered:



VERTIV.

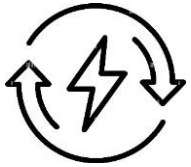
Powering AI innovation, Vertiv™ Trinergy™

Power Management: Evolving Critical Power Needs



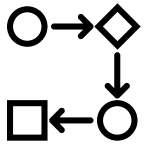
AI Densification & Load Management

- Dynamic AI workload management
- Impact on Data Center Powertrain



Power Availability & Sustainability

- Enable BYOP and Microgrid strategies to complement grid
- Coordination with on-site generation
- Implement sustainable and cycling energy storage solutions



Operations and Deployment Speed and Flexibility

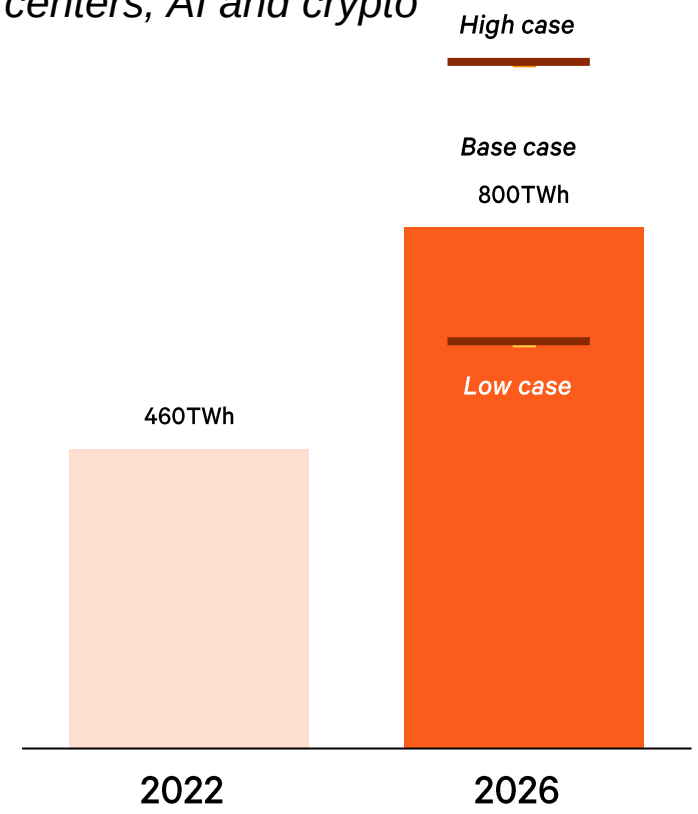
- Prefabricate Power Infrastructure design considerations
- Modular build outs, standardize work

Full System Approach is Required to Solve these Challenges!

Data center power demand is expected to grow at a rapid pace with AI.

International Energy Agency

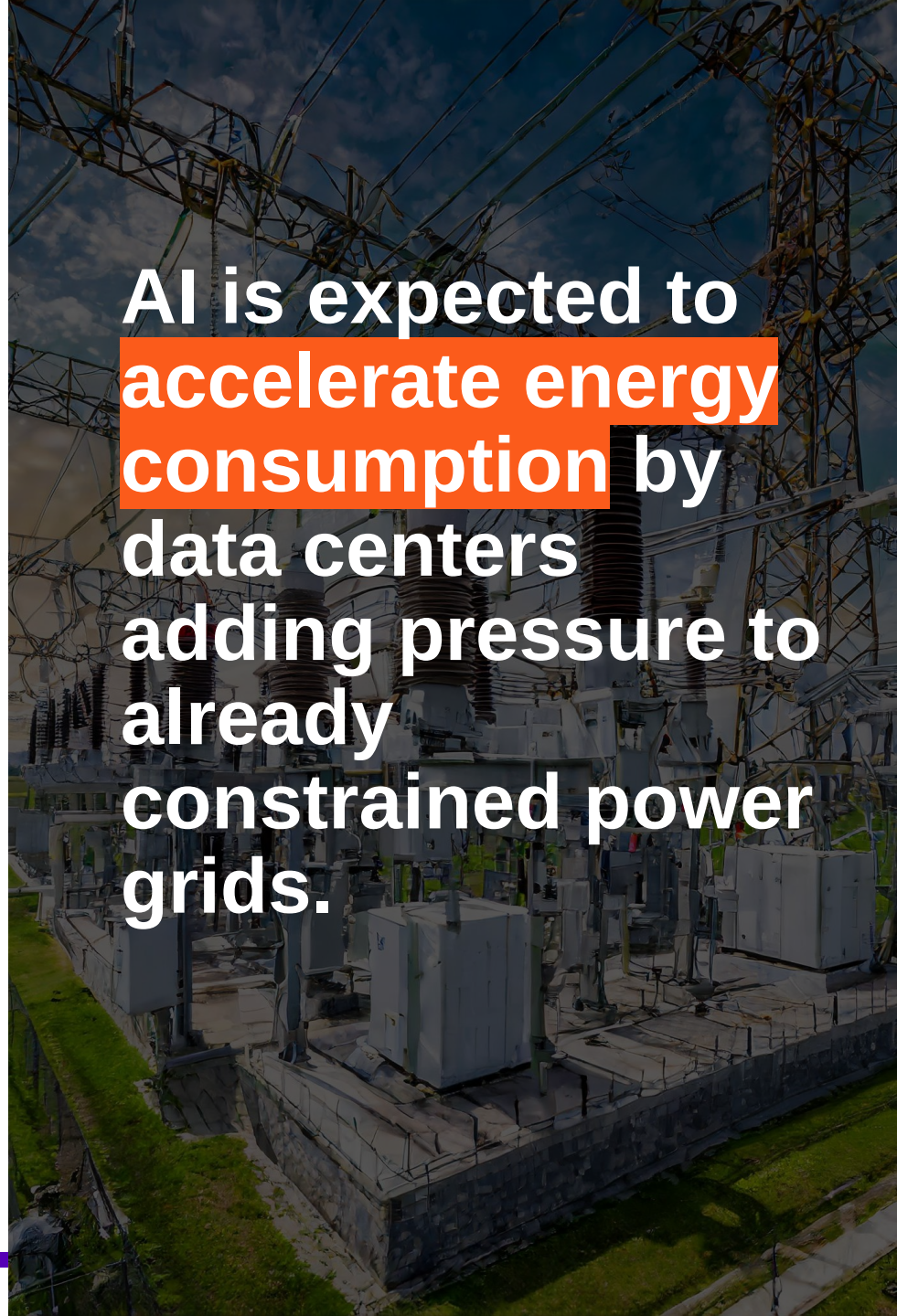
Global electricity demand from data centers, AI and crypto



Authorities imposing limitation on data center expansion.

- Connection **restrictions** in place since 2021.
  Top colocators had permits rejected by Irish authorities 2023.
- New data centers banned for three years.
  Aimed to minimize impact on Singaporean grid and carbon footprint commitments, measure was lifted with introduction of stricter rules.
- Restrictions on new data centers in Virginia.
  New rules impacting construction along route 7 in Loudoun county, where power infrastructure is limited.

Source: IEA Electricity, 2024- kpmg.ie/strategy, 2022 - Data Center Frontiers, 2022



AI is expected to accelerate energy consumption by data centers adding pressure to already constrained power grids.

Meta

Our Path to Net Zero

We commit to reaching net zero emissions across our value chain in 2030.

amazon

We're the world's largest corporate purchaser of renewable energy and we're on the path to powering our operations with 100% renewable energy by 2025—five years ahead of our original 2030 target.

Google

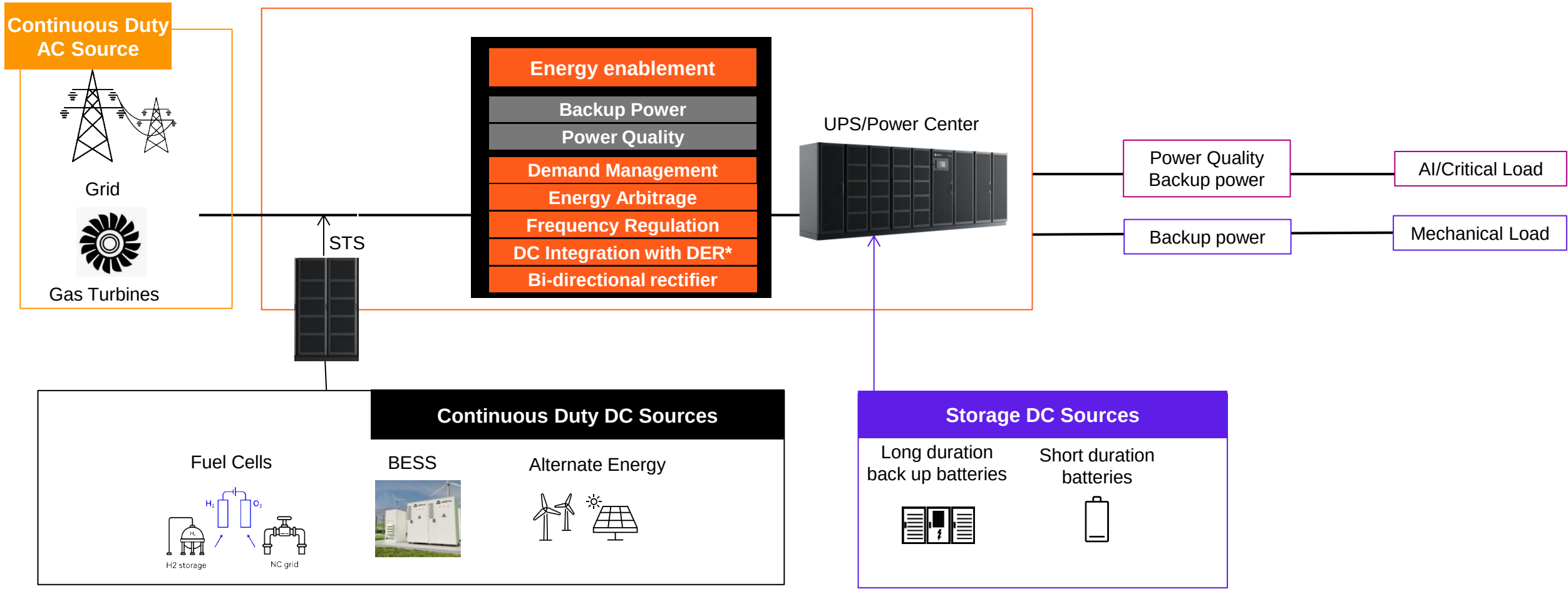
Operating on 24/7 Carbon-Free Energy by 2030.

Source: Meta, Amazon, Google, Microsoft

Largest data center operators are committing to net zero targets, increasing demand of renewable energy.

BYOP: from power protection to energy enablement

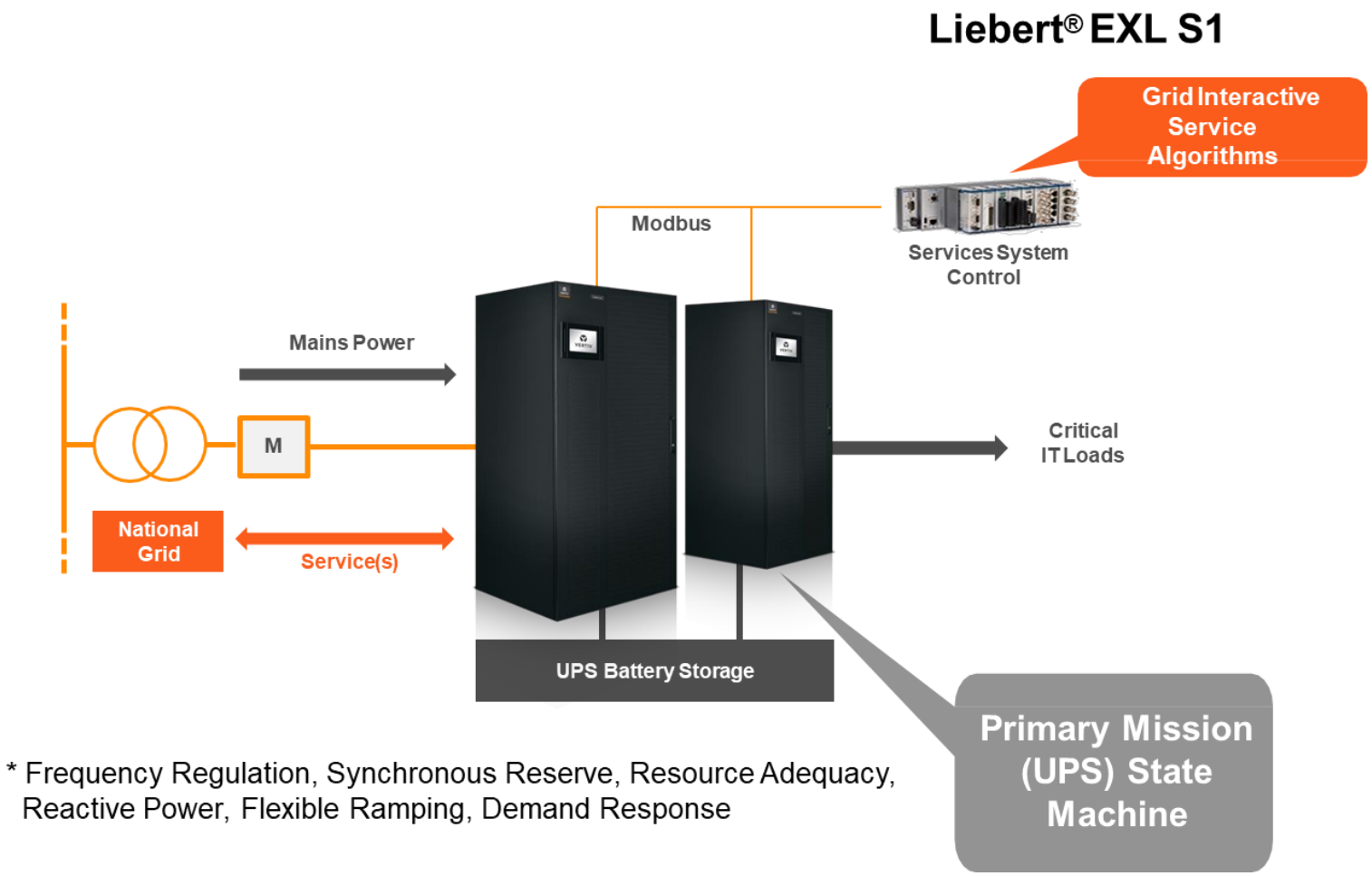
An evolving UPS function and new converters enable new AI driven demands and a changing energy environment



To enable decarbonization and transition to green energy

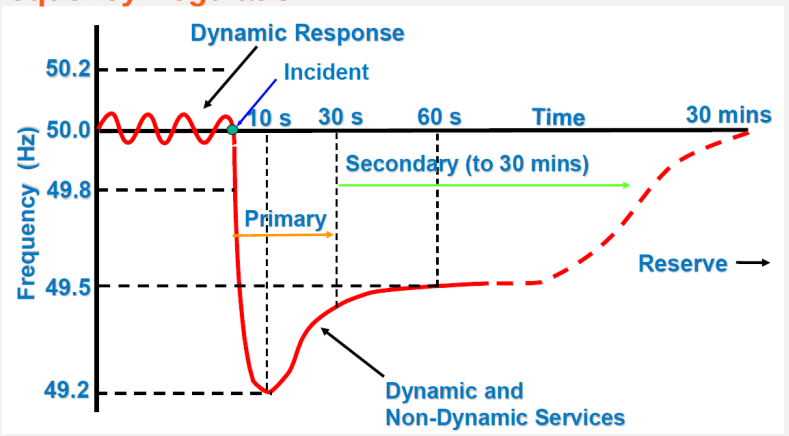
BYOP Use Case: Grid Interactive UPS

Vertiv™ Liebert® EXL S1 as advanced power solution able to manage frequencies

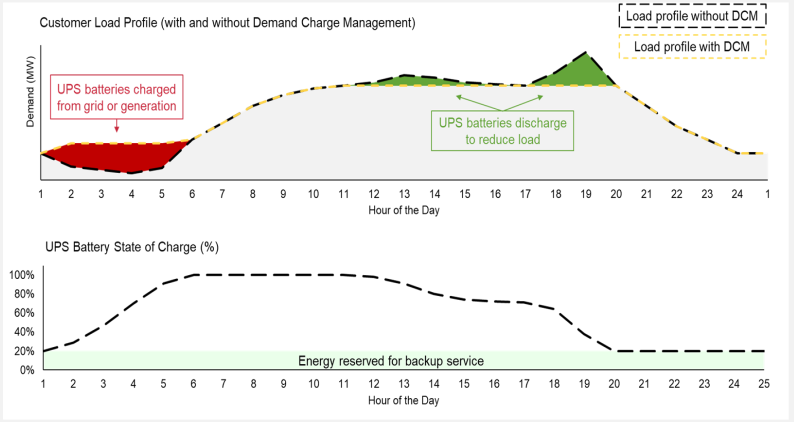


* Frequency Regulation, Synchronous Reserve, Resource Adequacy, Reactive Power, Flexible Ramping, Demand Response

Frequency Regulation



Demand Management (Peak Shaving)



Vertiv enabled the UPS systems to balancing services at Conapto:

Conapto: Sweden's first certified climate-neutral colocation service provider

CONAPTO
COLOCATION MADE IN SWEDEN

Public case study available on vertiv.com

Grid Services Opportunities

Demand & Response Services can be broadly categorized to target Frequency Management and Demand Management

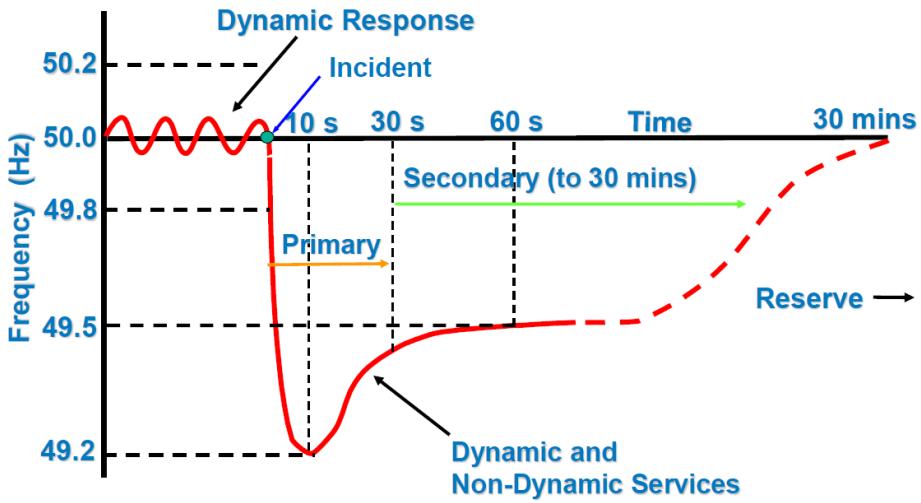
Frequency Management

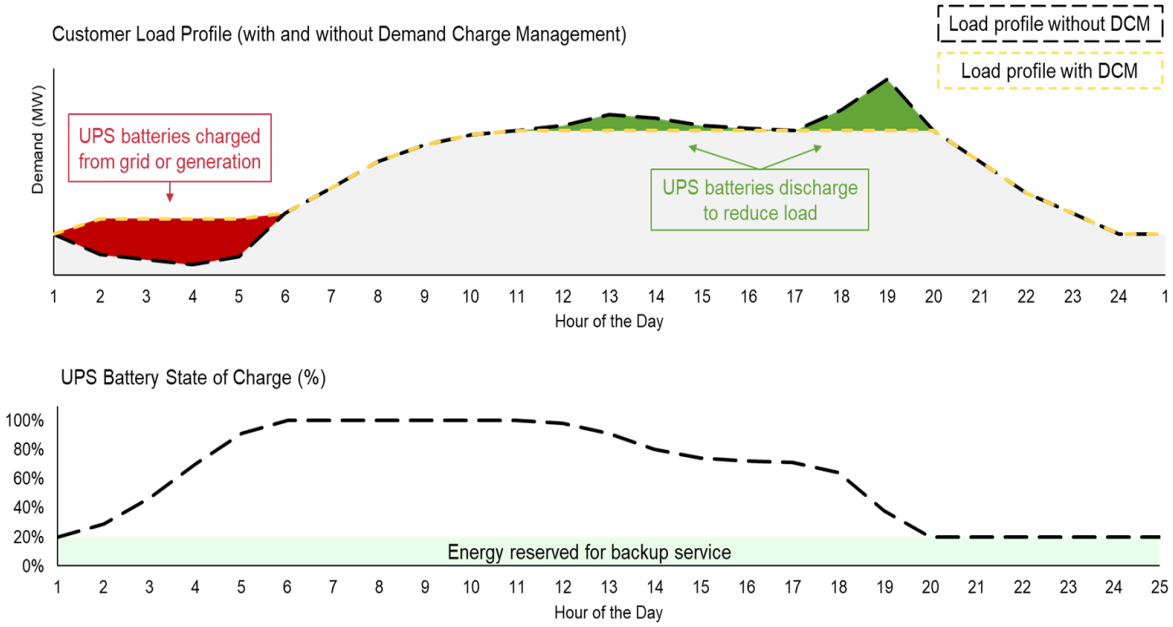
A **fast-acting balancing system** is needed to provide a quick response to sudden frequency variations and increase or reduce the electricity demand within a few Seconds (**fast frequency response** and primary reserves) or minutes (secondary reserve).

Demand Management (Peak Shaving)

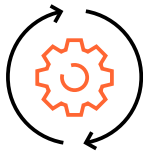
In times of low demand or high supply, energy is fed into storage, from which it is released at times of high demand or low supply. Alternatively, consumers adjust their energy consumption according to the changes in electricity market price or management of different auxiliary power sources.

The faster the response, the higher the revenue opportunity.



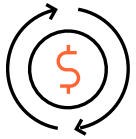


Micro-Grid / BESS for the Data Center



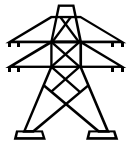
Performance & Sustainability

- Additional back-up time options
- Step load management
- Continuous operation of on-site generation: Transition and ride through
- Reduced generator starts



Financial

- Energy cost reduction: bill and tariff optimization
- Revenue generation: grid service participation



Grid Capacity

- Faster interconnection of new facilities
- Increasing capacity of existing grid interconnection for expansion

Increasing use-cases and role of Micro-Grids / BESS in the Data Center

Microgrid enablement

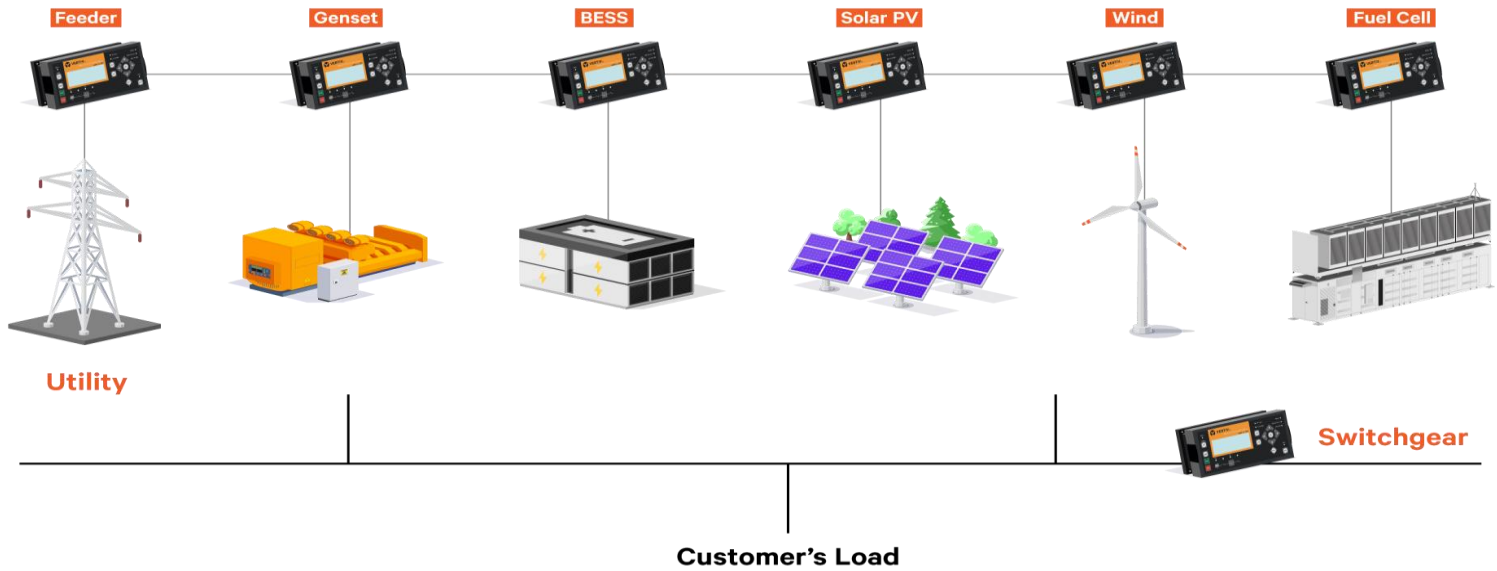
Foundation of a Microgrid

BESS is “always on”

- Leverages best in class energy output
- Seamless operations

Controls optimize energy management

- Coordinated output for Grid Services



Vertiv Differentiators

- Fully scalable solution → Added runtime while complementing UPS backup
- High resilience setup → BESS+ UPS provides extended runtime with high resiliency
- Fast and safe functionality → Integrates with Vertiv Unify Platform

Enabling BYOP (Bring Your Own Power) and Mission Critical Microgrids

In Delaware, Ohio, Vertiv has operational BESS and fuel cell proofs of concept (PoC).

Fuel Cell Integration

- 400kW fuel cell solution packaged in a Vertiv™ SmartMod™
- Initial scope to support Vertiv™ Liebert® EXL S1; Expansion to other Vertiv UPS models in future
- HPL batteries to provide transient ride-through
- H_2 stored on-site in tube containers

Battery Energy Storage System plus Solar

- 1.0MW AC Solar PV
- 1.5MW/1.5MWh Battery Energy Storage System (BESS)
- Integrated Energy Management System (EMS)
- Setup for Future Microgrid
- Virtual controls demonstration available

Back-up Power: Vertiv™ Power Module H2

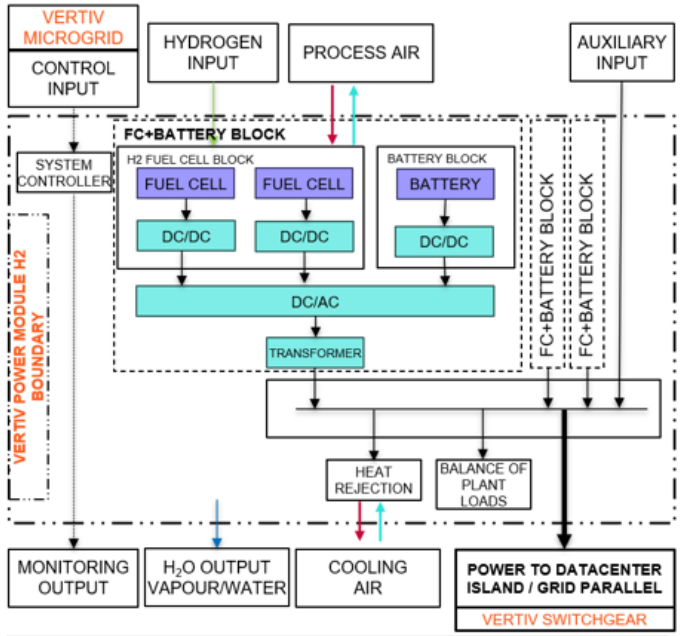
System Design:

- PEM FC
- Drop-in replacement for diesel generators
- 350kW – 1MW in single Block
- MW block systems in paralell

Value proposition (Datacenter market focus):

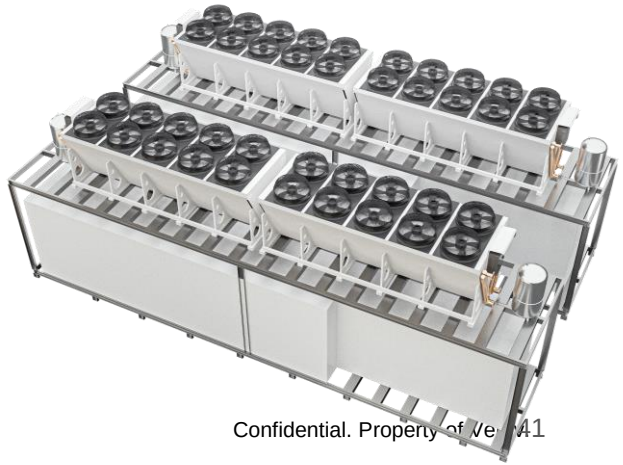
- Zero emission (SOx, NOx, PM) backup
- Grid support capability
- Peak shaving, Capacity enablement

PM H2 500 – 350kW

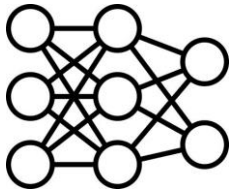


PM H2 1500

PM H2 4000

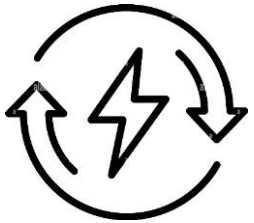


Power Management: Evolving Critical Power Needs



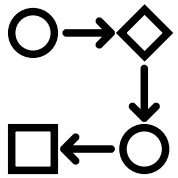
AI Densification & Load Management

- Dynamic AI workload management
- Impact on Data Center Powertrain



Power Availability & Sustainability

- Enable BYOP and Microgrid strategies to complement grid
- Coordination with on-site generation
- Implement sustainable and cycling energy storage solutions



Operations and Deployment Speed and Flexibility

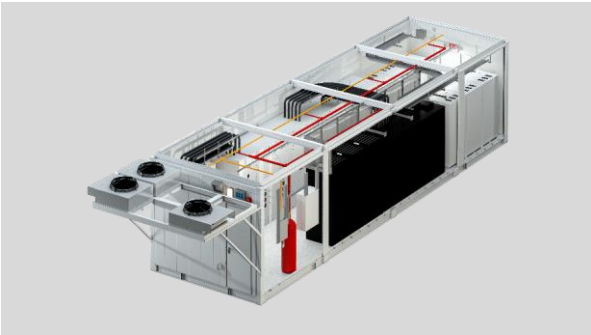
- Prefabricate Power Infrastructure design considerations
- Modular build outs, standardize work

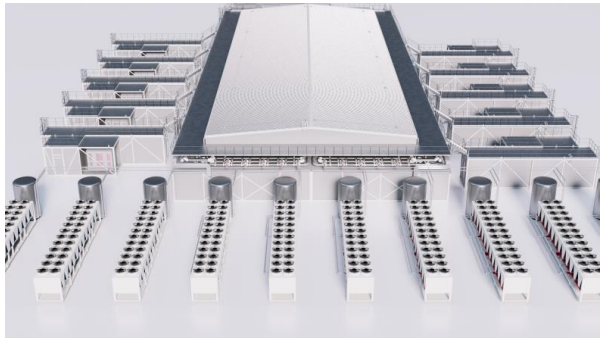
Full System Approach is Required to Solve these Challenges!

Designing Power Infrastructure considerations

Row Capacity Design → **Power Block** → **Core Block**

SmartRun | Power Module & Skid | OneCore





- 2N
- 4 to make 3
- Future Proofing

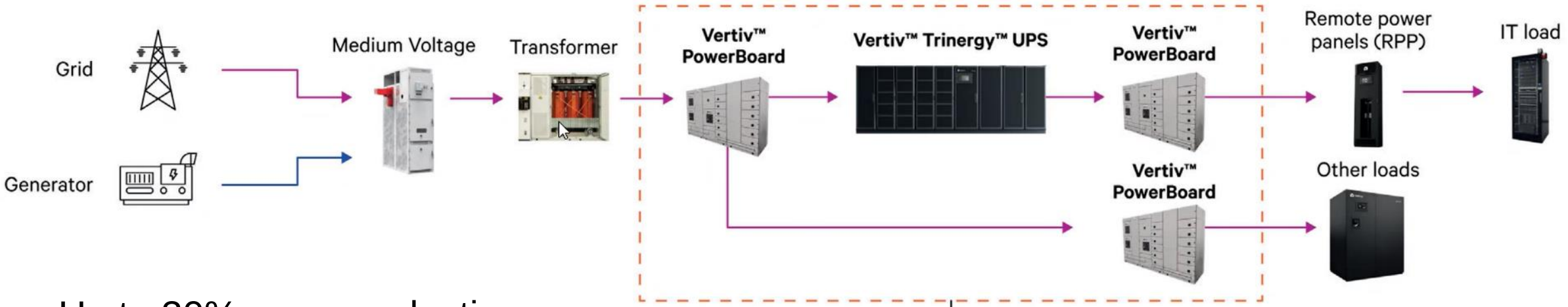
- UPS
- LV SWRG
- TX
- RMU

- Generator
- 2N/N+1

- Redundancy Topology:
  - Distributed vs. Block
- Multi-MW repeatable block

Future Proofing → AI Factory Re-tooling

Integrated Power Solution: Vertiv™ PowerNexus



- Up to 30% space reduction
- Up to 25% lower TCO due to reduced installation, maintenance, and operational expenses over the system's lifecycle
- Up to 50% faster deployment, less human error

Fully Integrated Vertiv™ PowerBoard Switchgear and Vertiv™ Trinergy UPS, and Vertiv™ Unify

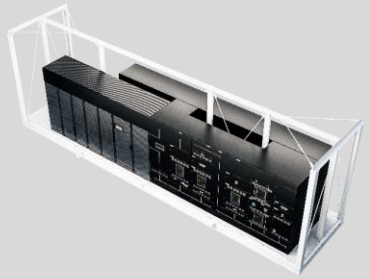
Vertiv™ PowerNexus - Integrated Offering Suite & Content

Build Options

Integrated Product

- *Products designed for interconnection; electrically, mechanically and digitally connected.*

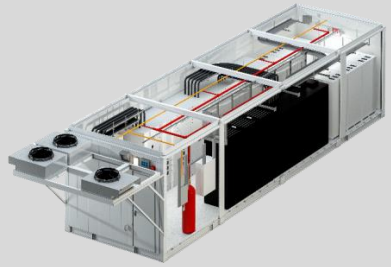
Includes (minimum):
- *Common switchgear, distribution, UPS, controls & monitoring.*
- *Can include battery and cooling.*



Integrated Systems on Skid

- *Products optimally arranged on a skid; electrically, mechanically and digitally connected.*

Includes (minimum):
- *Common switchgear, distribution, UPS, controls & monitoring and skid.*
- *Can include battery and cooling.*



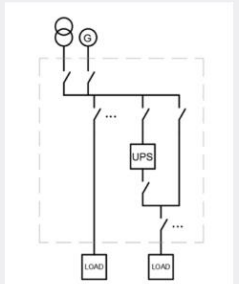
Integrated Systems in Encl.

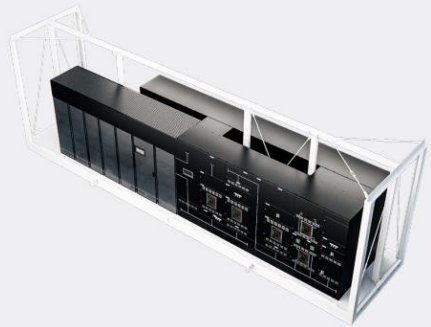
- *Products pre-integrated in an enclosure, electrically, mechanically and digitally connected.*

Includes:
- *Common switchgear, distribution, UPS, controls & monitoring, battery, cooling and enclosure.*
- *Can include Fire system & access control*

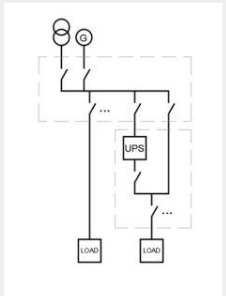
Arrangements

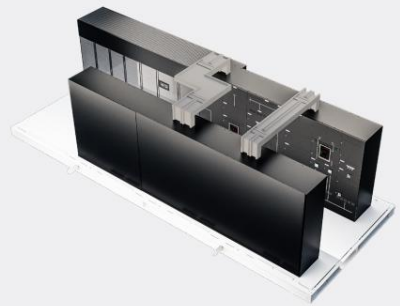
Back-To-Back





Front-To-Front





Vertiv™ Prefabricated Power Infrastructure

Design:

- **Single-supplied complex power infrastructure solution**
  - *MV,SWB, UPS, Battery & Cooling integrated into single system*
  - *Auxiliary systems as per customer requirements (FSS, Access, CCTV)*
- **Reduced Footprint compared to traditional builds(10 - 30%):**
  - *Single unit UPS vs. Parallel configurations of smaller UPS blocks*
  - *Skid-ed Back-to-Back design*
- **Reduced number of complex dependencies**

Quality:

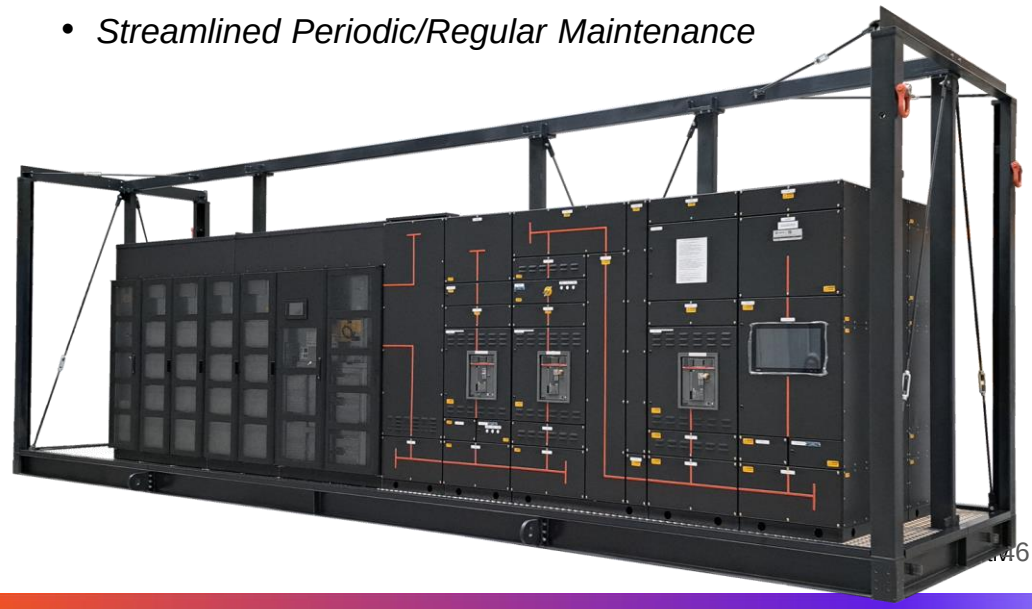
- **Factory assembled quality standards**
  - *Controlled environment & streamlined production process*
- **Reduction of on – site testing**
  - *Level 2/3 factory acceptance tested as part of build process*
  - *Up to L5 upon request*
- **Reduced potential of on-site equipment damage from other trades**

Deployment / On-Site:

- **Reduced Lead Times**
  - *Factory assembly in parallel to site construction of building*
- **Faster Onsite Deployment**
  - *Reduction of on-site man hours during installation phase*

Maintenance

- **EPMS: Vertiv Unify**
  - *Single point diagnostics & maintenance*
  - *Streamlined Periodic/Regular Maintenance*



VERTIV.

Design, deploy, and maintain liquid cooling infrastructure

VERTIV.

Designing Cooling Infrastructure for AI

Piergiorgio Tagliapietra

Director EMEA Application Engineering Thermal Management

Marin Pajic

Lead Engineer

Which solution

A cooler with high leaving water temperature from up to 40°C.

Global solution working from -20°C to +52°C external ambient temperature with multiple power supply for worldwide applications

A cooler to support any current and future increase or decrease of the water temperature regimes, ready now for next generation of chip

Very low-GWP R1234ze refrigerant, compliant with regulations worldwide for years to come granting maximum seasonal efficiency

AI workload proliferation

A cooler solution to support AI proliferation and high density increases

Flexibile product

A cooler able to work with any different water temperature regimes, across multiple sites and diverse climate conditions

Future proof solution

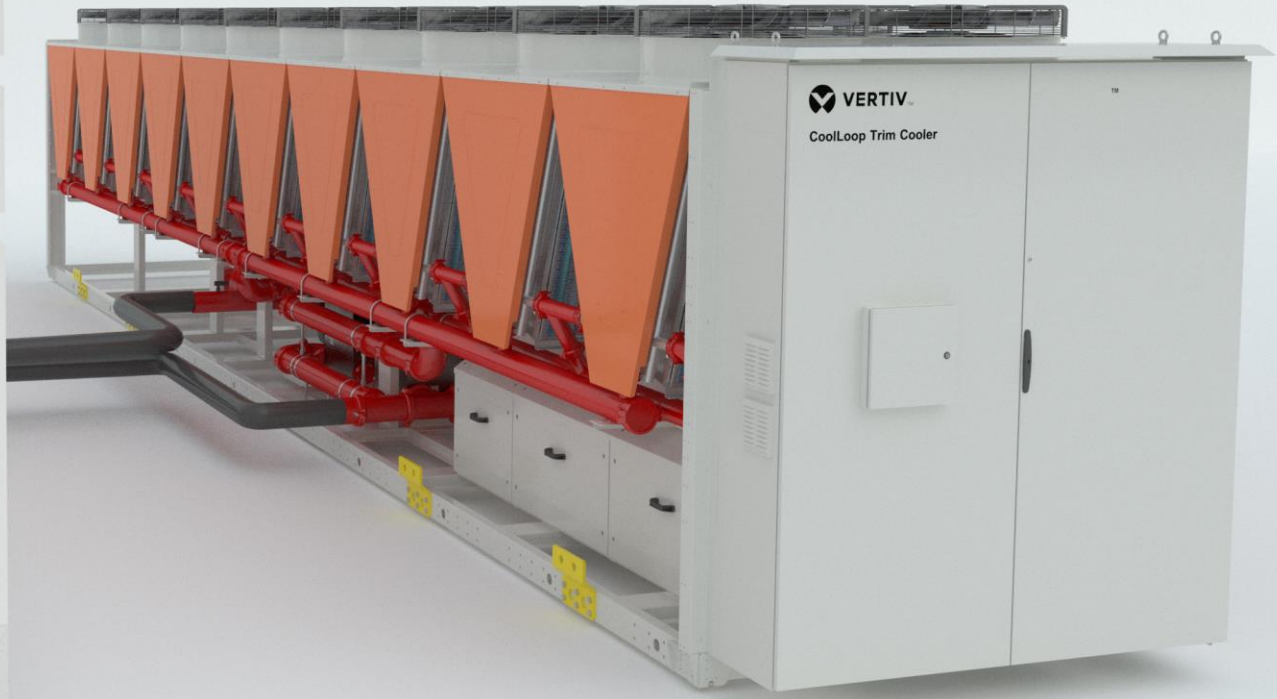
A future-ready solution with a future oriented mentality able to work with any different water temperature regimes

Sustainability goals

An environmentally friendly, future-focused solution compliant with F-gas regulations and allowing the maximum seasonal efficiency

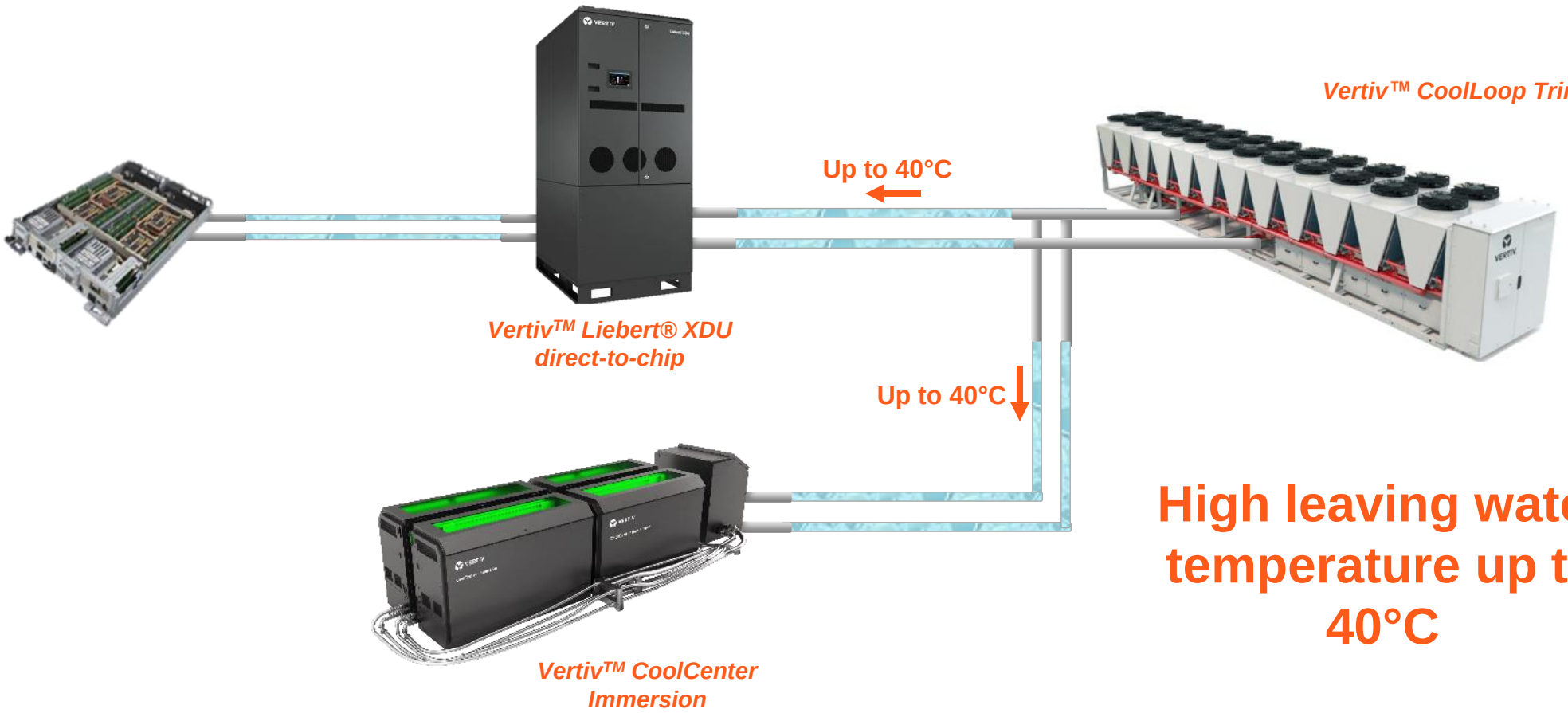
Vertiv™ CoolLoop Trim Cooler

The combination of Drycooler efficiency with mechanical cooling density and worldwide operation



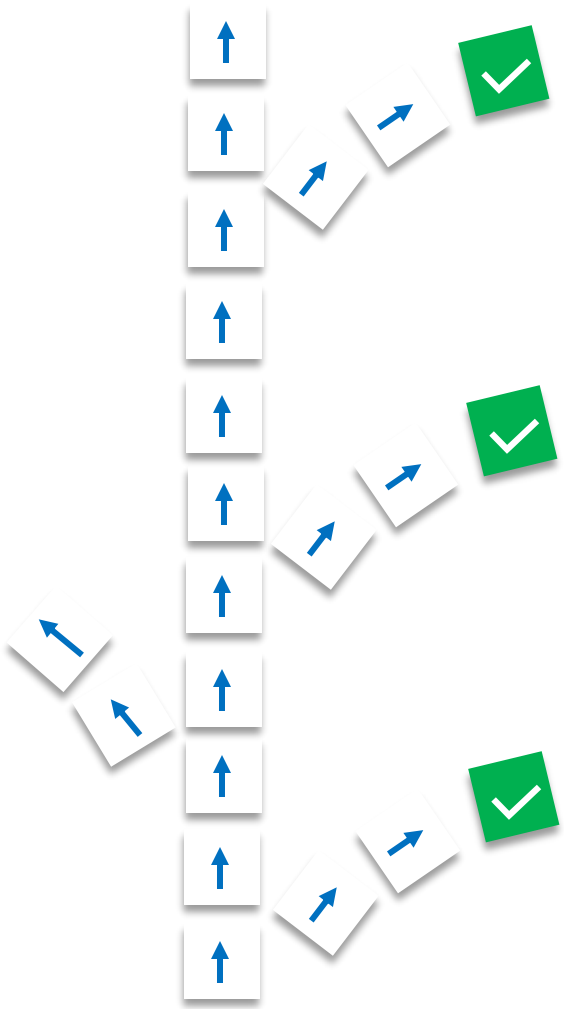
AI workload proliferation

Easy coupling **Vertiv™ CoolLoop Trim Cooler** with **Vertiv™ Liebert® XDU direct-to-chip** unit or **Vertiv™ CoolCenter Immersion.**

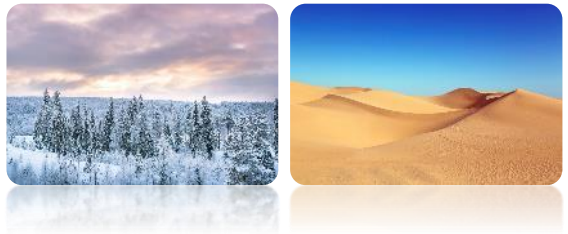


High leaving water temperature up to 40°C

Flexible product designed for global applications



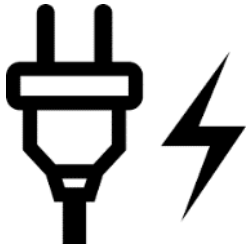
Different ambient temperatures: extended operative range **from -25°C up to 52°C**



Wider operative water temperature range: **up to 40°C** for next gen of chip cooling.

Easy implement configurations for every datacenter set-up: total liquid cooled, hybrid air and liquid cooled or air cooled.

Multiple power supply: 400(50Hz), 380(60Hz), 460(60Hz)



Future-ready – AI-ready – Densifiction-ready solution

Vertiv™ CoolLoop Trim Cooler can successfully manage the uncertainty of the future of the data center sector. It is a densification-ready solution able to flex from lower to higher water temperature regimes.

Today → **Future**

Use the same cooler

Leaving water temperature: **30°C**

Leaving water temperature: **20°C**

Today → **Future**

Use the same cooler

Leaving water temperature: **22°C**

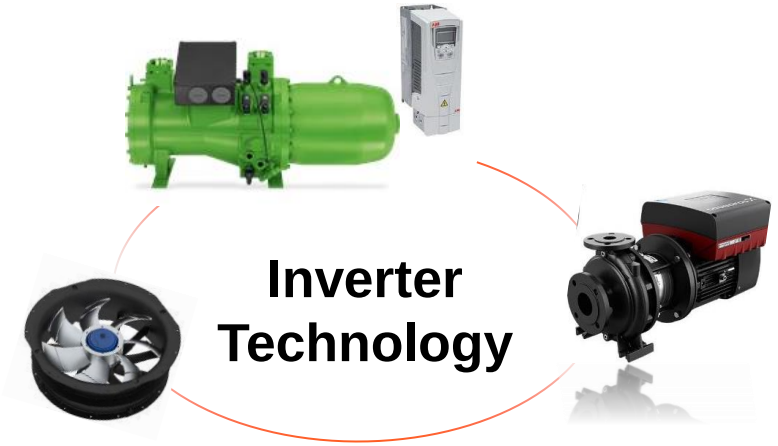
Leaving water temperature: **35°C**

New set-up of the facility

- **No additional CAPEX**
- **No addititonal installation costs**
- **No additional roof space occupancy**

Sustainability goals

Vertiv™ CoolLoop Trim Cooler with very low-GWP R1234ze refrigerant guarantees compliance with major bans and regulations worldwide for years to come granting at the same time maximum seasonal efficiency especially at partial load



Free Cooling Optimized

- Extended free cooling coils are optimized for high ambient temperature, using Microchannel heat exchanger.
- Better heat exchange improves the efficiency

Inverter driven technology

- The inverter driven technology is widely used for compressors, EC fans and user pumps.
- It allows to maximize both energy efficiency and minimize the energy consumption especially at part load operation.

Indirect Effect	Enhancing efficiency leads to lower electricity consumption. Reduced electricity usage results in lower CO_2e emissions.

Other key features

High capacity

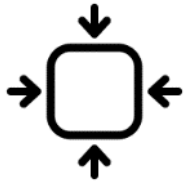
Supply water temperature up to 40°C reaching up to almost 3 MW of cooling in a single, compact frame

Footprint

More space available for IT load

No extra roof space occupancy to reach almost 3 MW (only 38 m^2)

No additional space inside the building



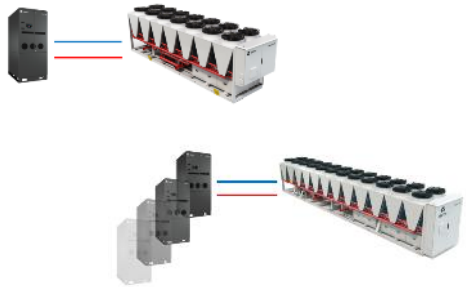
Mechanical backup

Mechanical cooling for backup or to handle peak demands in high ambient temperatures.

Liquid cooling ready

Easy coupling with direct-to-chip and immersion cooling

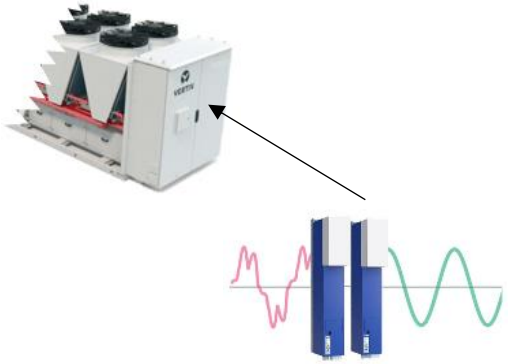
1to1, 1to2 or 1toN configurations



Harmonic Filters

No additional roof space occupancy

Active harmonic filters in the electrical panel.



Cooling capacity range

Liebert® AFC with low GWP refrigerant

630 kW *

2000 kW *

*LWT: Leaving water temperature
Conditions: LWT:20°C, A:42°C

850 kW**

2650 kW**

Vertiv™ CoolLoop Trim Cooler

Up to almost 3MW in a single frame !!! (LWT 40°C)

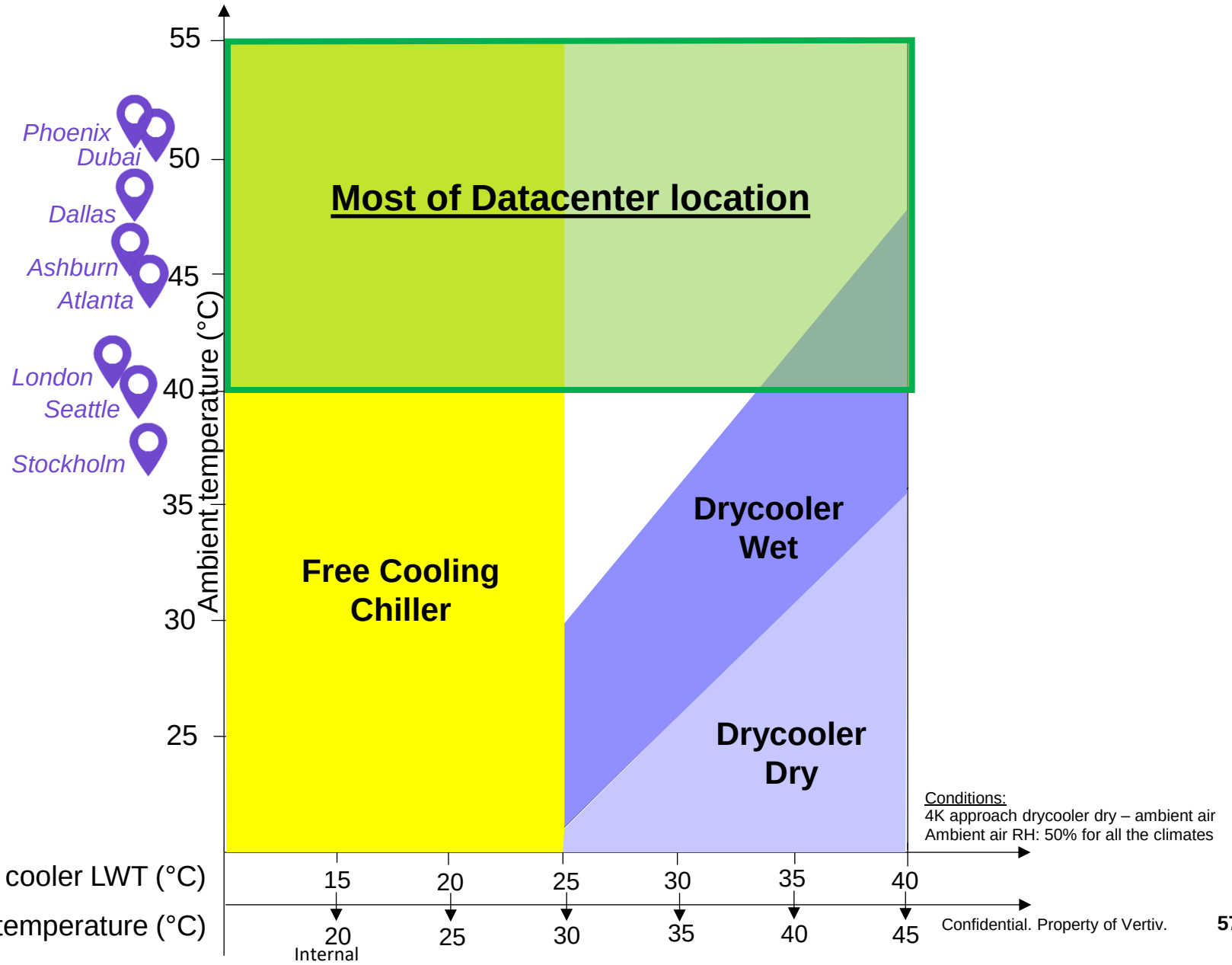
**LWT: Leaving water temperature
Conditions: LWT:28°C, A:42°C

**LWT=28°C is the design condition
LWT=20÷40°C is the leaving water temperature range possible**

Vertiv™ CoolLoop Trim Cooler – Drycooler

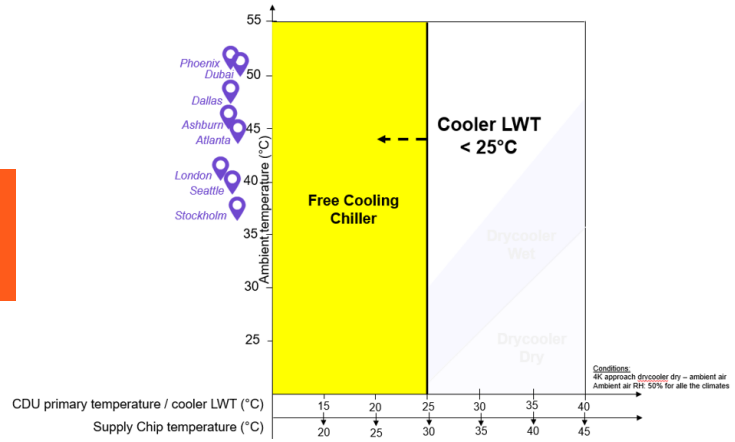
At present, there is a significant operational area that remains unaddressed by existing technologies:

- Drycooler operate only if ambient temperature is 3-5K below CDU primary entering temperature
- Most of the chillers are limited by maximum Leaving Water Temperature (<25°C)
- There is an unmatched area for ambient temperature and high leaving water temperature



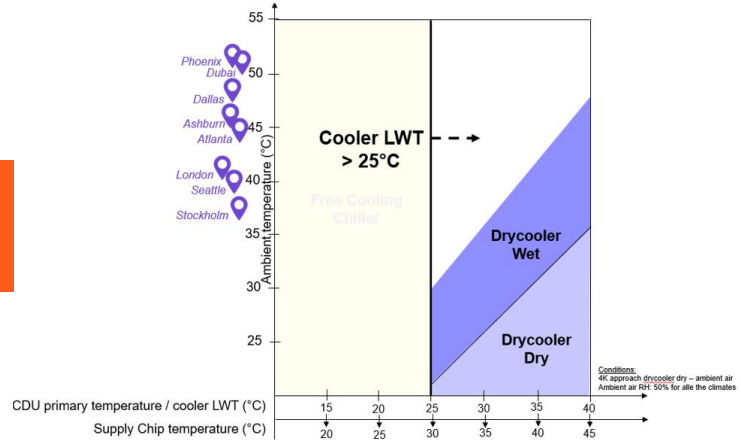
Vertiv™ CoolLoop Trim Cooler – Drycooler operating range

Cooler LWT < 25°C

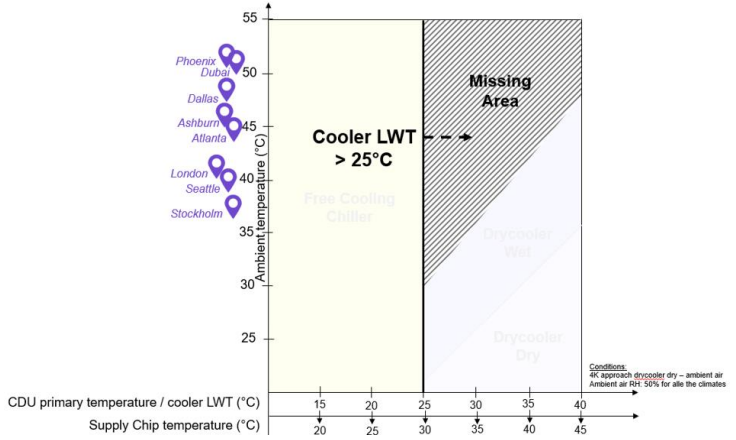


Most of the chillers are limited by maximum Leaving Water Temperature (<25°C)

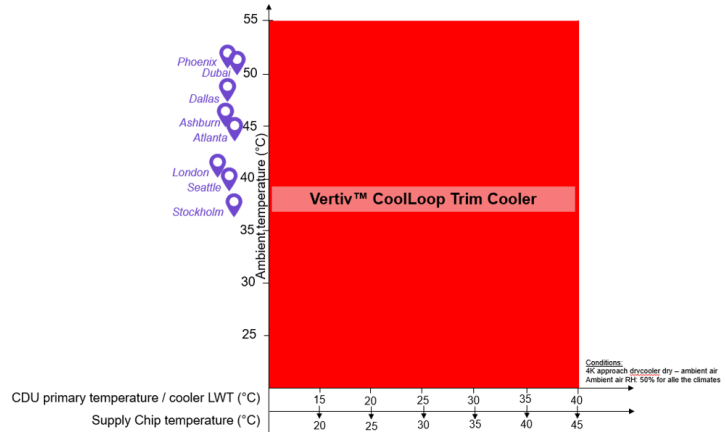
Cooler LWT > 25°C



Drycooler operate only if ambient temperature is 3-5K below CDU primary entering temperature, using water in wet mode



There is an unmatched area for ambient temperature and high leaving water temperature



Vertiv™ CoolLoop Trim Cooler can manage the entire working range without using water

Cooling density comparison: Freecooling chiller - Trim Cooler

Example

18 MW Datacenter with four data halls (4,5 MW each)

N+1 configuration – **1500 kW** for each unit

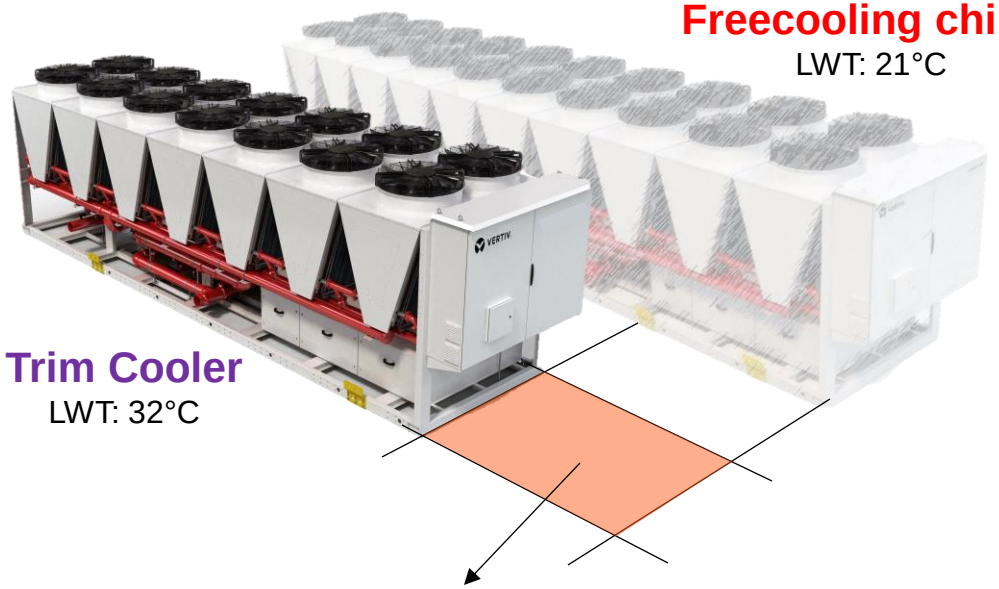
n.15 Freecooling chiller or Trim Cooler

Design external ambient temperature: 42°C - London

Water Temperature – Freecooling chiller: **31 - 21°C**

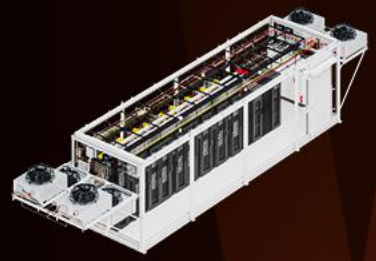
Water Temperature – Trim Cooler: **42 - 32°C**

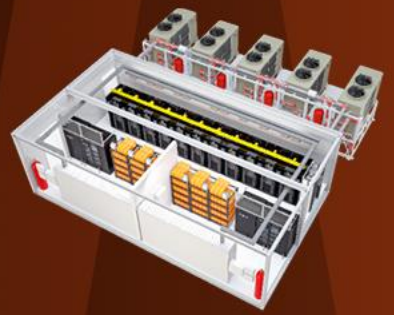
Reach the capacity with different water temperature regime !!!



25%
Saving Space

	LOW DENSITY & MEDIUM DENSITY	HIGH DENSITY	EXTREME DENSITY
POWER PER RACK	<20 kW	<50 kW	100+ kW
COOLING TYPE	In Row Cooling Perimeter Cooling	AIR COOLED PORTION In Row Cooling Rear-Door Heat Exchanger Cooling Island	Perimeter Cooling In Row Cooling Rear-Door Heat Exchanger Cooling Island Direct-to-Chip Liquid Cooling
TECHNOLOGY	AIR COOLED	AIR COOLED	AIR & LIQUID COOLED
INFRASTRUCTURE SOLUTIONS	SmartMod™ SmartMod™ Max SmartMod™ Combo	MegaMod™	SmartMod™ HDX	MegaMod™ CoolChip



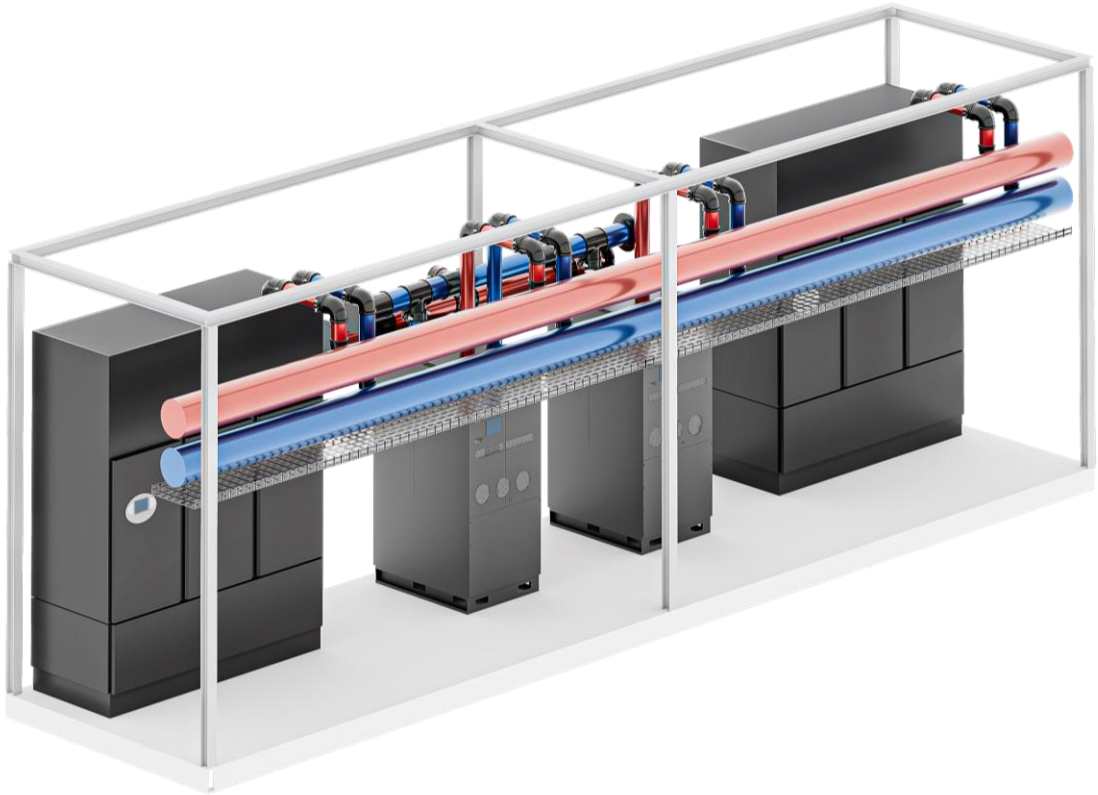


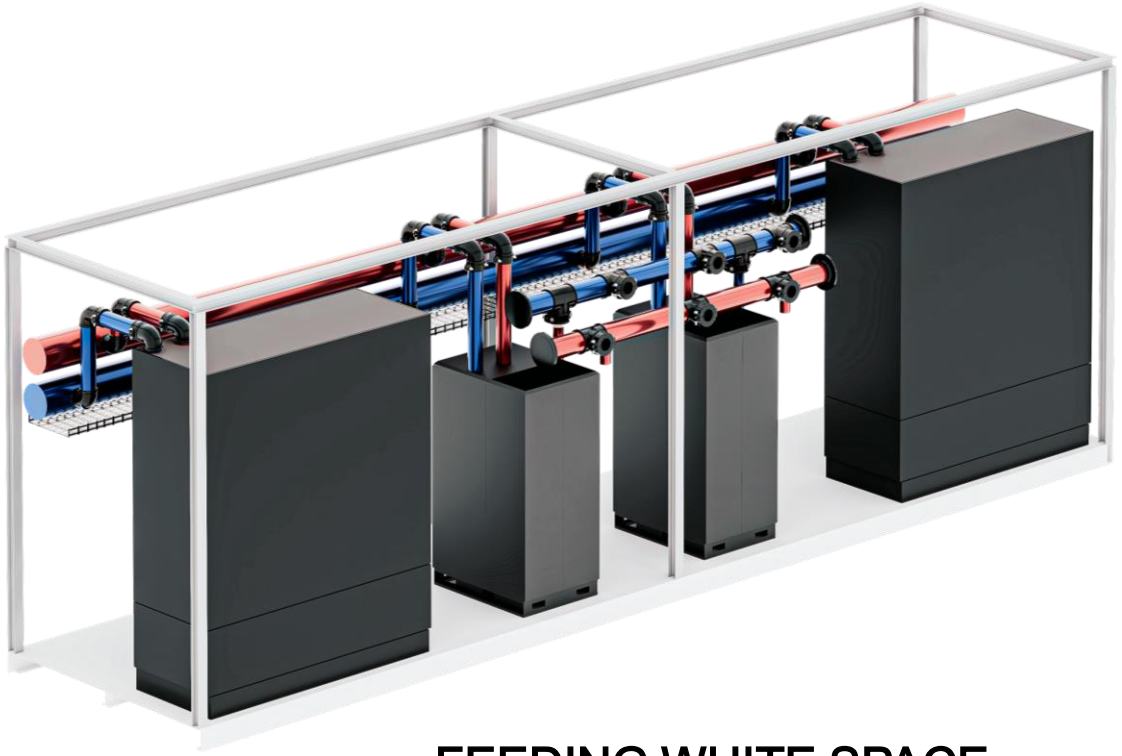
VERTIV.

COOLING SKIDS – AI Ready Prefabricated Infrastructure

MECHANICAL CORRIDOR

- Common primary loop feeding CRAHs' and CDU's
- Full service and accessibility space

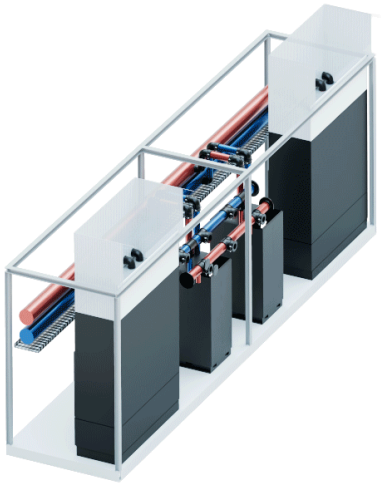


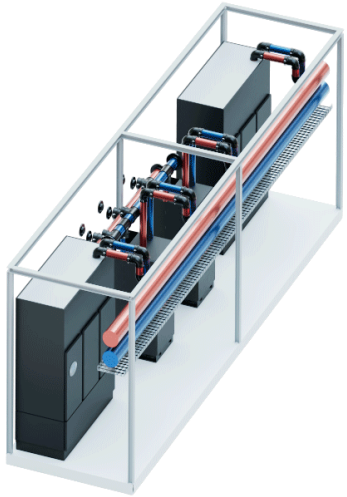


FEEDING WHITE SPACE

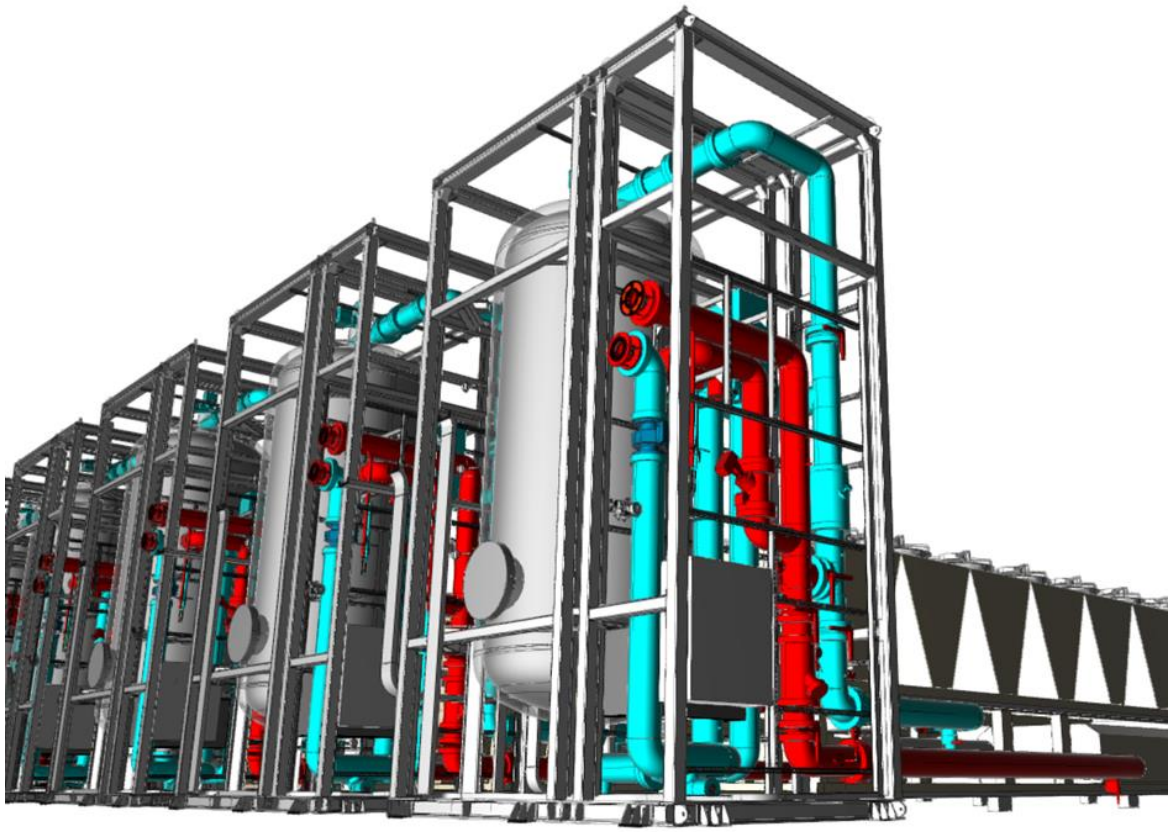
- Rear Discharge CRAH
- CDU's onto common secondary loop to feed IT row

IT HALL – AI Ready Prefabricated Infrastructure





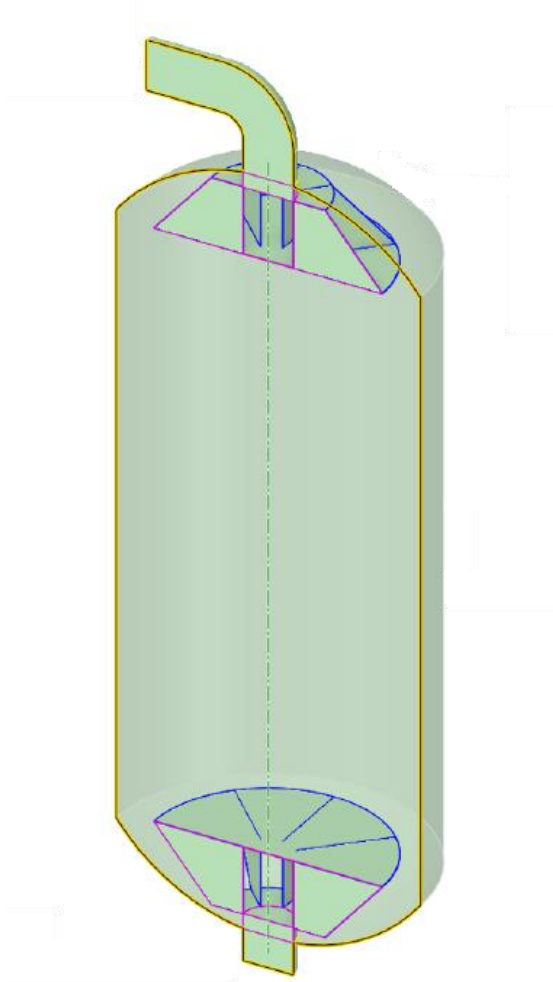
Chiller skids



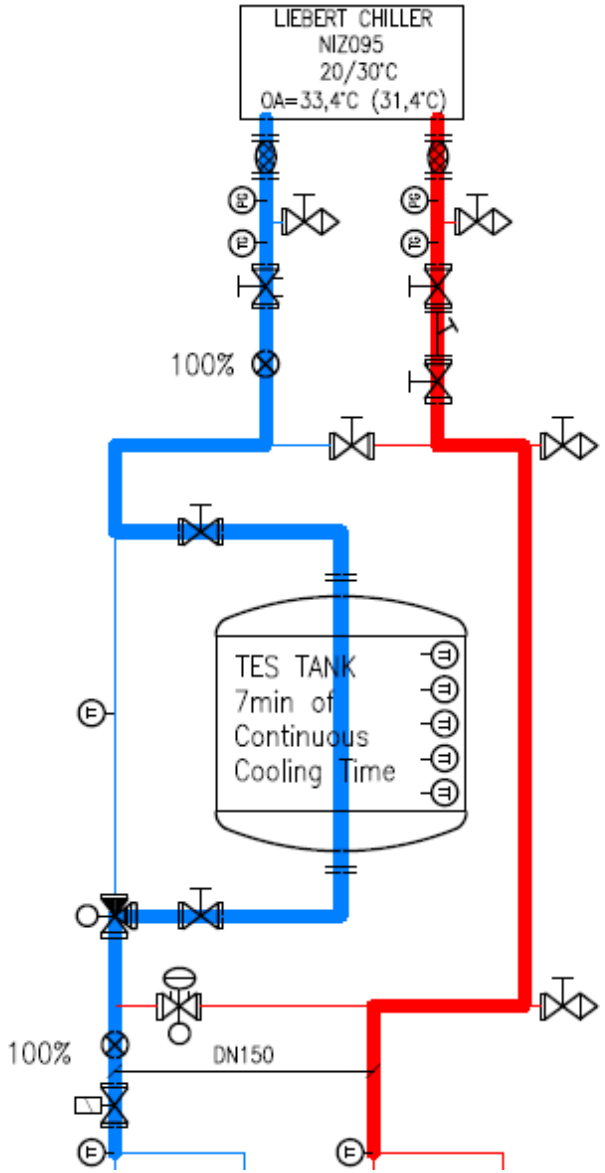
- Factory integrated
- 7 min of stored Thermal energy
- Concurently maintainable chilled water topology
- Motorized valves controlled by chiller with 8 preprogrammed modes of operation

Thermal Energy Storage tank operation modes

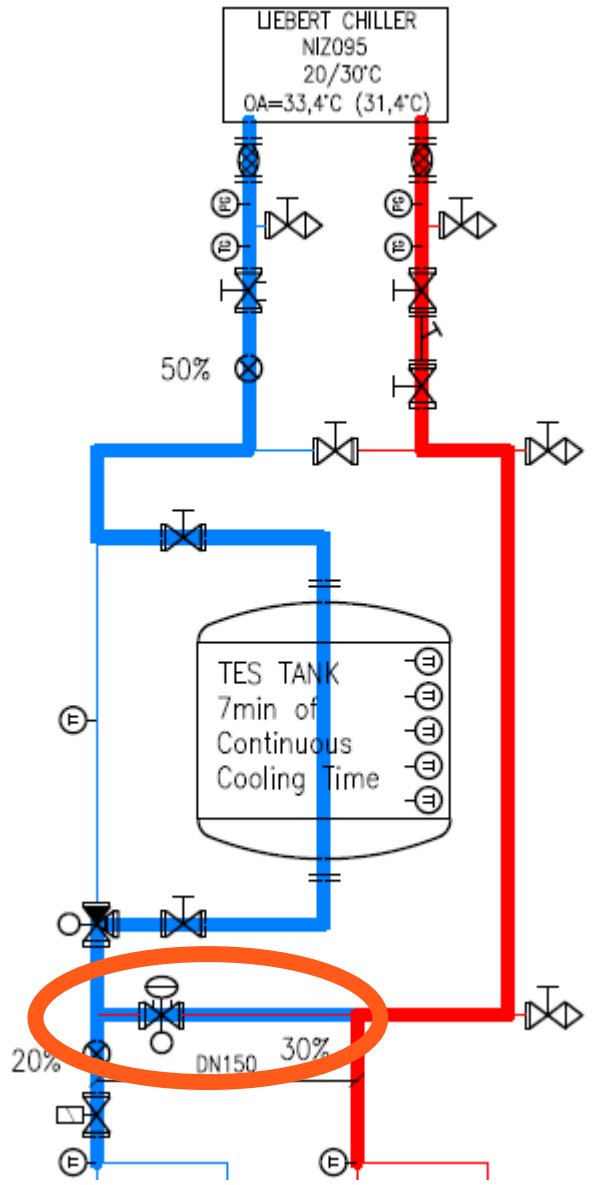
1. Normal operation
2. Minimum flow bypass
3. Transfer from standby to operation
4. Standby tank cooling
5. TES tank maintenance
6. TES tank discharging
7. TES tank charging
8. TES tank heating in winter



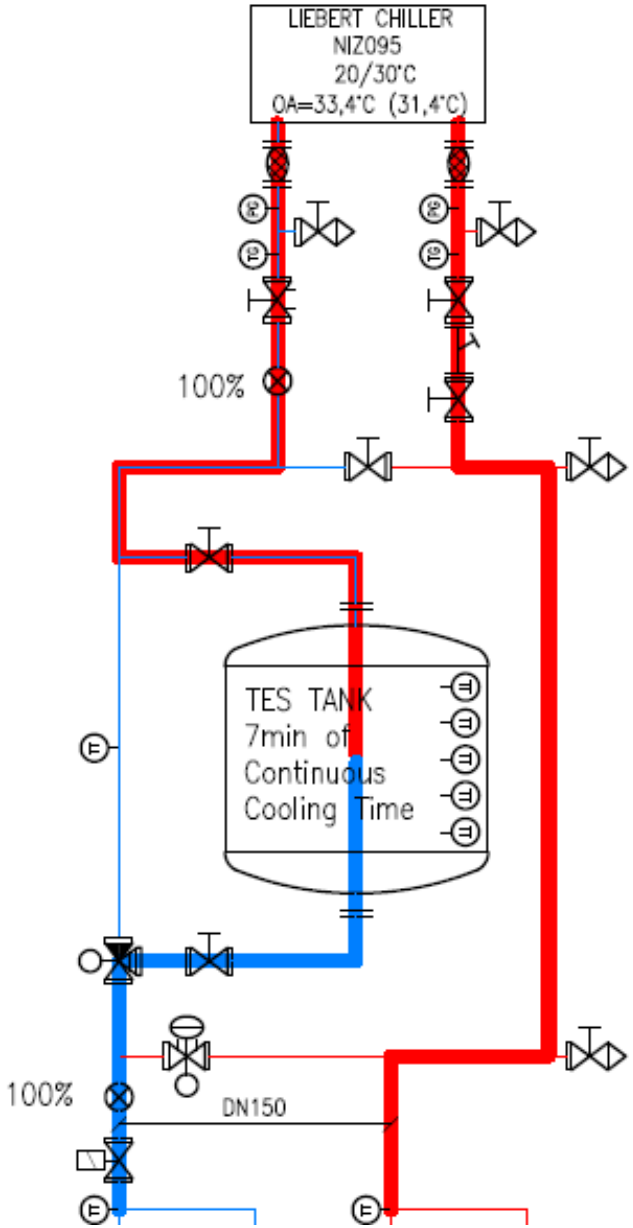
Normal operation



Minimum flow bypass



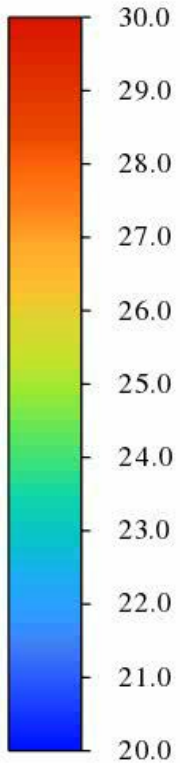
TES discharging



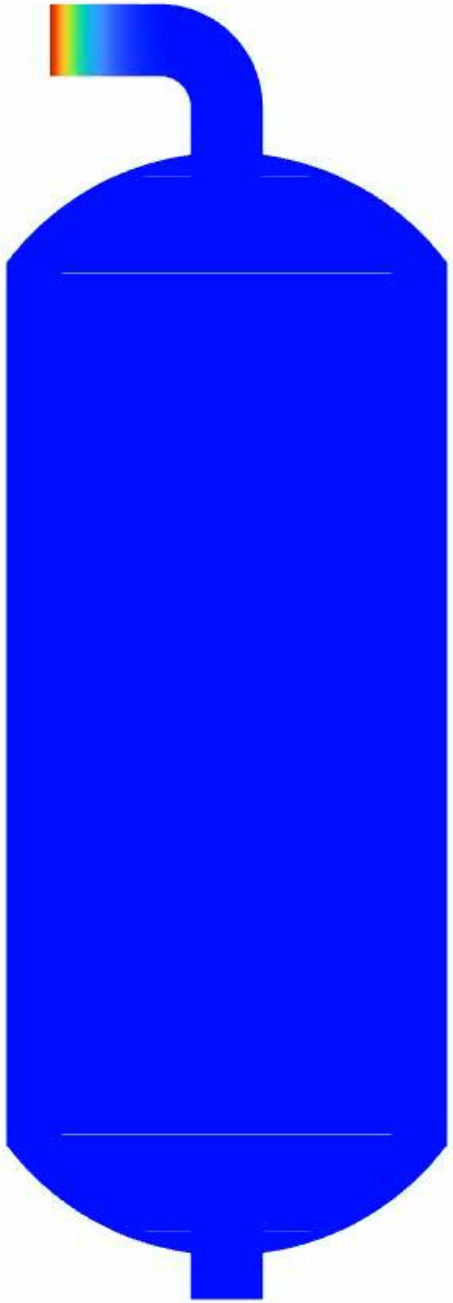
Flow time: 0 s

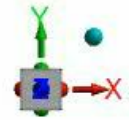
Ansys 2022 R2

contour-1
Static Temperature

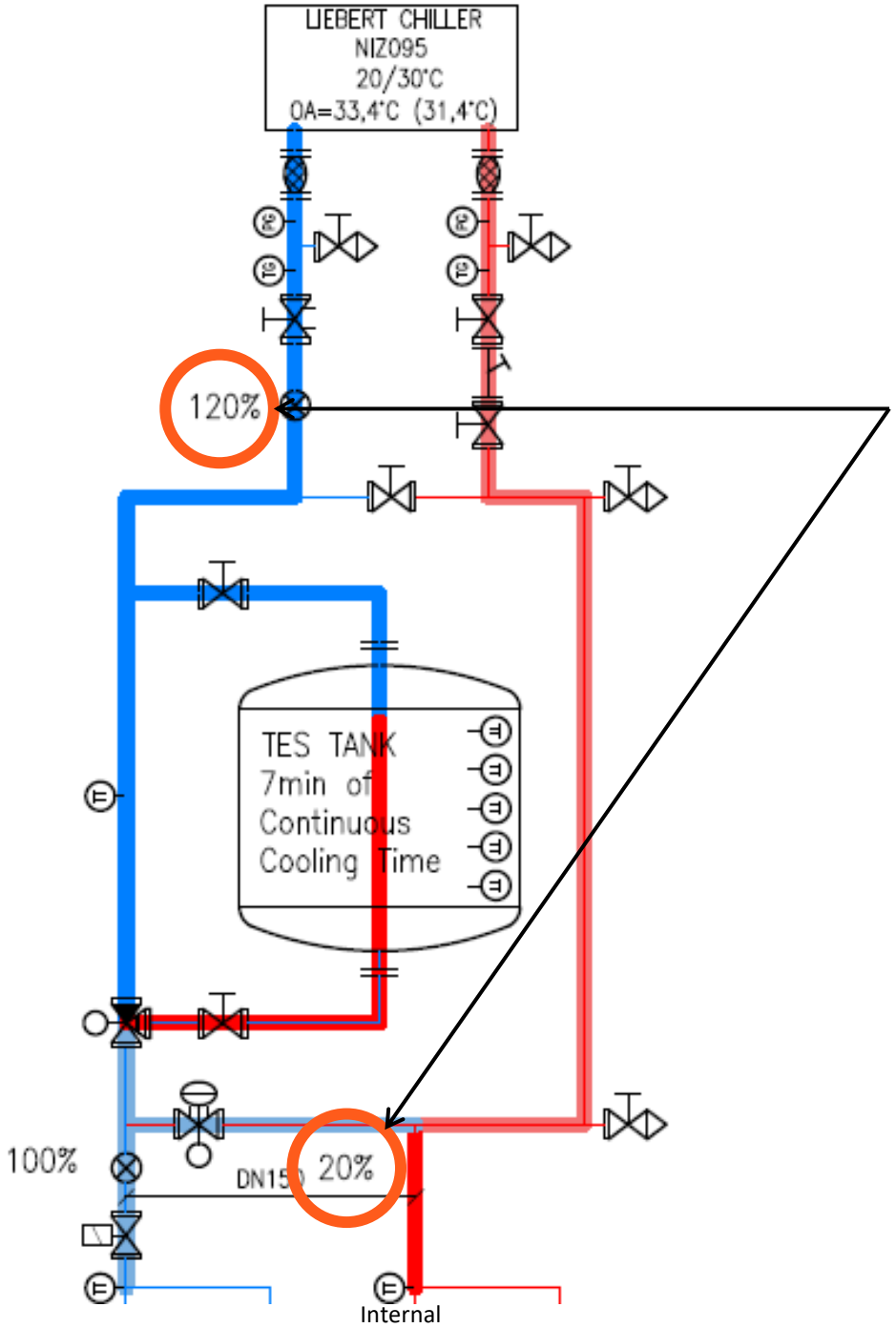


[C]





TES charging

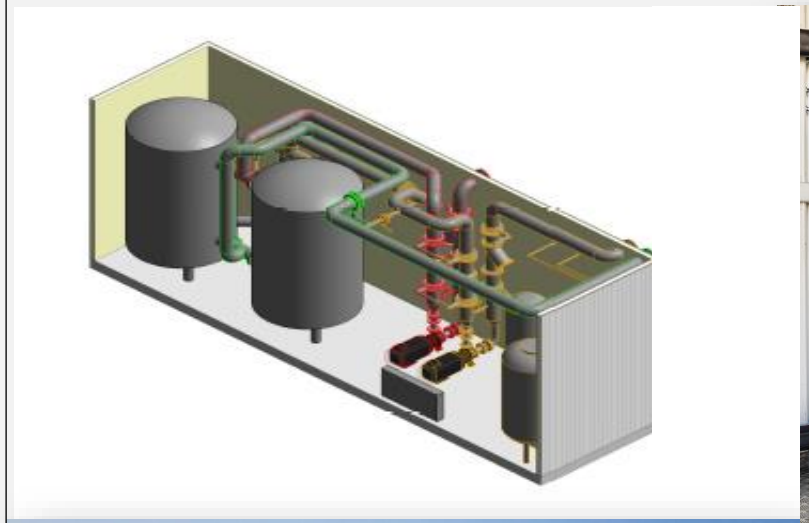


- Flow increase
- Setpoint decrease

Hydro Modules

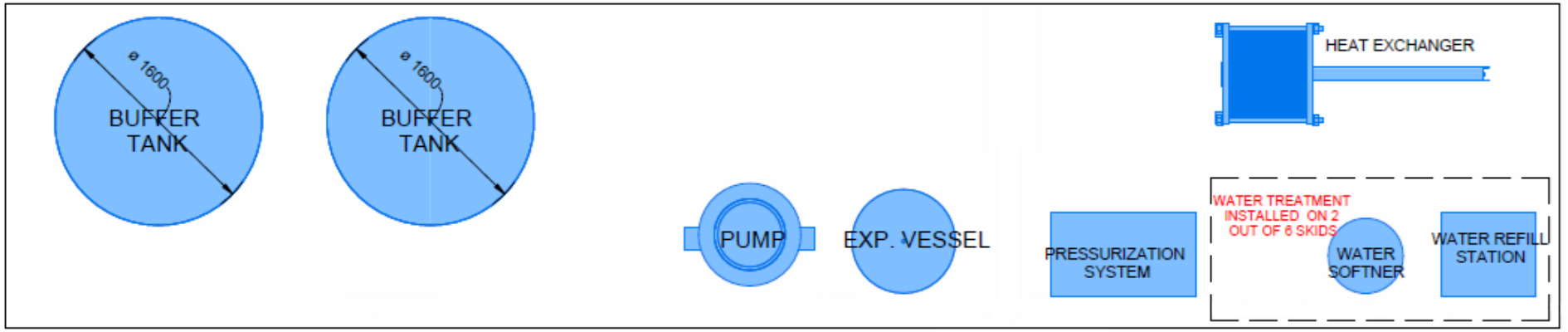
COMPONENTS INCLUDED IN HYDRO MODULES:

- Continuous cooling tanks (2x 6m3)
- Hydraulic decoupler
- Safety valves
- Expansion tanks
- Primary / secondary pumps
- Automatic pressurization
- unit with 2x glycol storage tanks
- Integrated control system

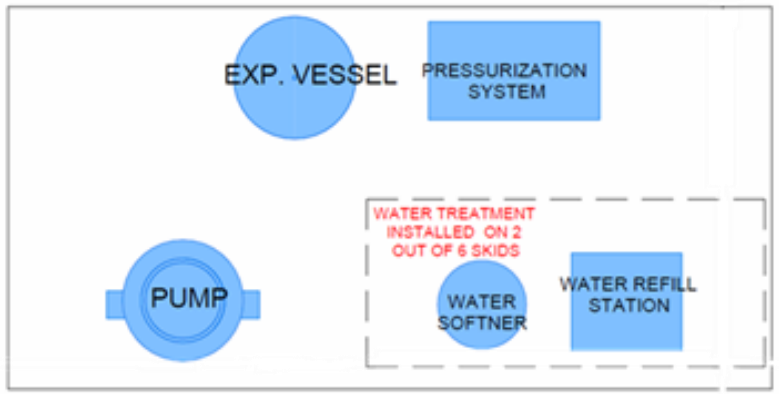


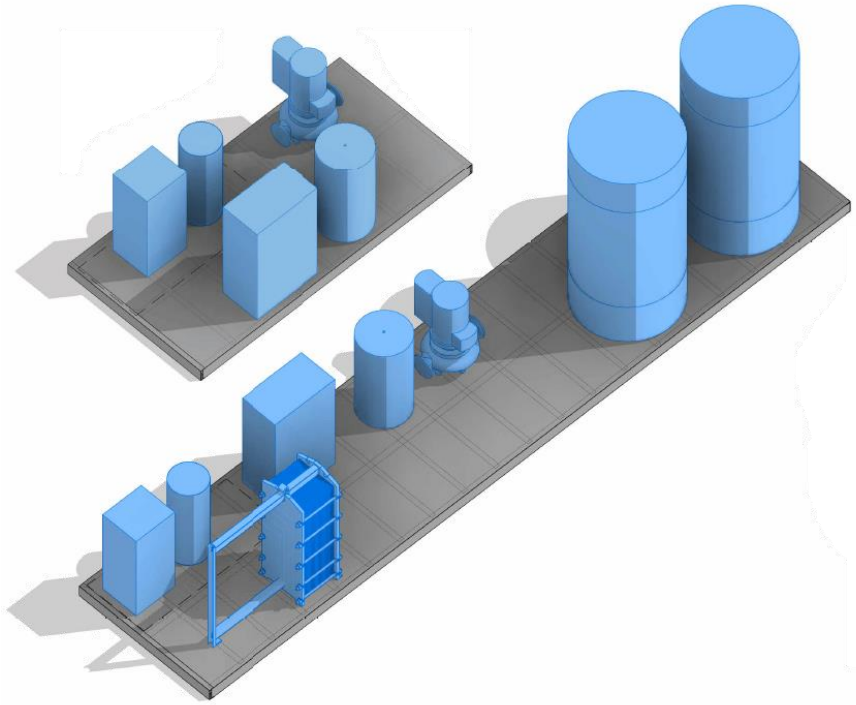
Hydro Skids

Secondary skid



Primary skid





VERTIV.

Platform for critical power and thermal infrastructure | Vertiv™ Unify

Vertiv Unify – BMS & EPMS solution

David Lam

EMS Business Development Director

Nikola Rosic

Director Design Engineering

What – Why - How

Vertiv BMS EPMS Solutions in Data Centers

Digital World

Almost everything we encounter in our day-to-day lives requires interaction with E-Commerce, cloud computing, data storage, AI...

Sustainability and Renewables

Increase in rack density and demand, renewables, creates strain on our grid infrastructure and impacts Power Quality and Cooling issues.

Continuous Uptime

Business operations are increasingly reliant on continuous availability of critical infrastructure.

Intelligence & Sensitivity

As technology advances devices and systems are becoming more intelligent and dependent on iner system connections

What is a BMS EPMS system?

A system that monitors and controls building critical infrastructure: HVAC, Cooling, Power, Security, and Environmental Conditions.

Importance in Data Centers

Ensures uptime, optimizes energy efficiency, maintaining optimal DC conditions and prevents critical infrastructure failures.

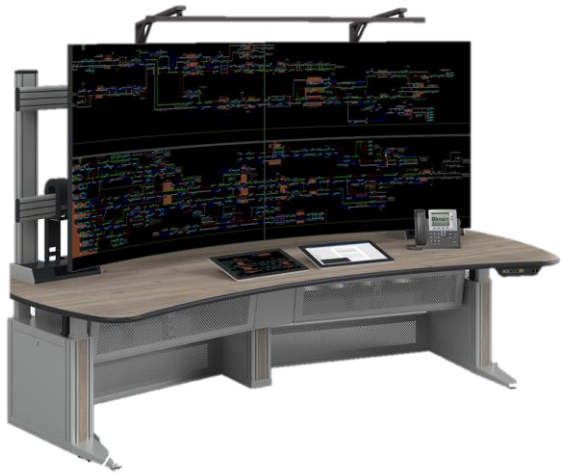
Challenges Without a BMS EPMS system

- Inefficient energy use
- Higher operational costs
- Lack of real-time visibility
- Lack of control capabilities
- Lack of reporting, optimising and connectivity
- PUE and enviromental condition issues

Vertiv Unify

Monitor and Control critical infrastructure in real time

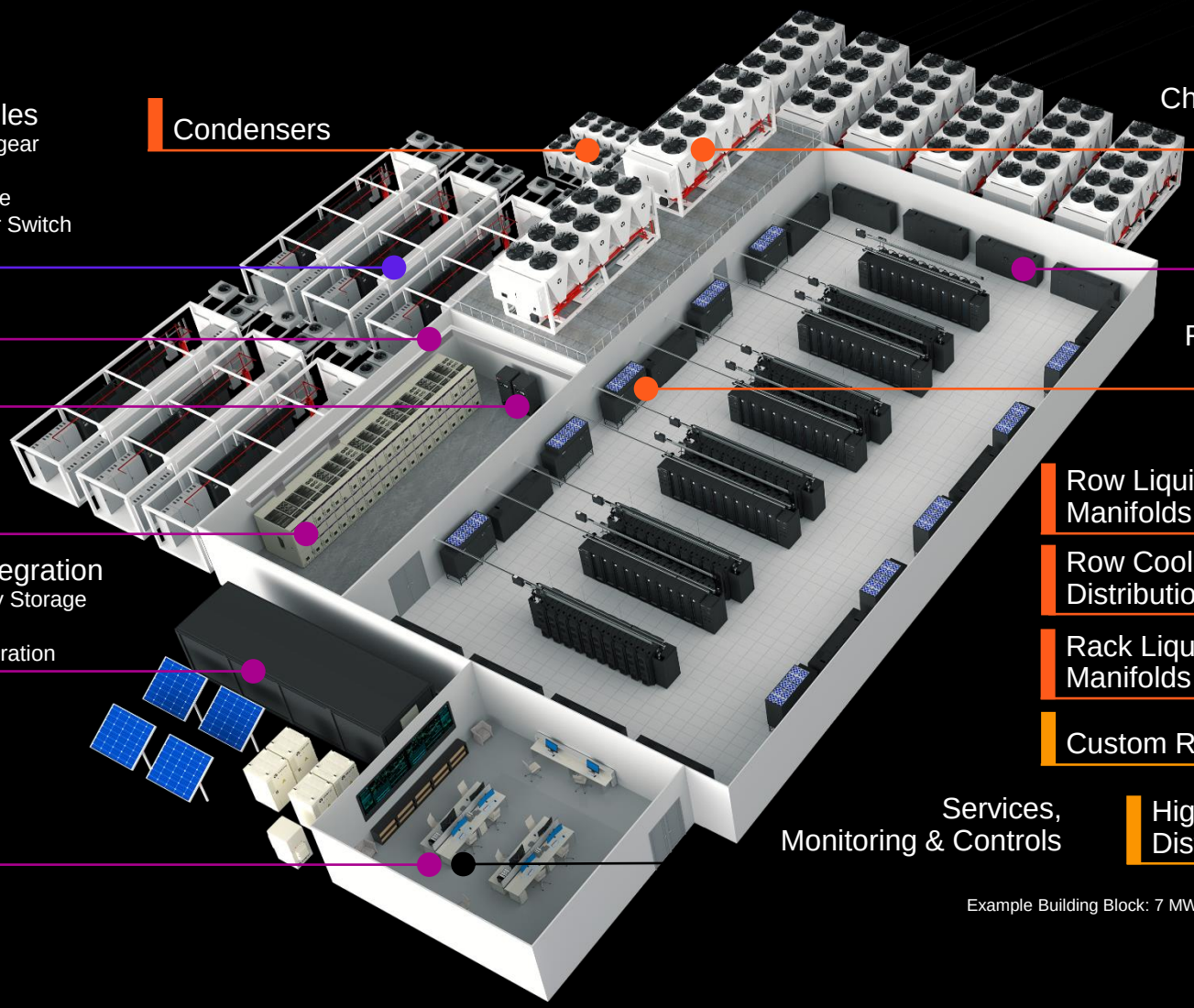
A software platform designed to monitor and control Data Center critical infrastructure, solve operational challenges, enable integration, enhance the value of Vertiv equipment portfolio and Data Center efficiency,



- **Simplifies Operations**: Streamlines user interaction with Vertiv's critical infrastructure portfolio
- **Optimisation Efficiency:** PUE and Energy improvements with reduced operational costs
- **Data at your Fingertips**: Aggregated data in a central location and format available to operations
- **Accelerates Deployment**: Minimizes risk, effort and time-to-operation with decentralization.
- **Service Ready**: Enables digital services and full lifecycle opportunities
- **Enhanced reliability:** Improved uptime and reliability

Where does Vertiv Unify Fit?

Overall solution for equipment integration



Power Modules
- MV/LV Switchgear
- 3-Phase UPS
- Energy Storage
- Static Transfer Switch
- Cooling Units

MV Busduct

DC Power

MV/LV Switchgear

Microgrid Integration
- Battery Energy Storage System
- Fuel Cell Integration

Vertiv Unify

Condensers

Chillers/Outdoor Heat Rejection

Transformer/ Distribution Units

Room Cooling Heat Collection

Services, Monitoring & Controls

Vertiv Portfolio Key

- Power Management
- Thermal Management
- IT Systems
- Services
- Infrastructure Solutions

High-Capacity Busway

Row Liquid Manifolds

Row Coolant Distribution

Rack Liquid Manifolds

Custom Racking

High-Capacity Rack Power Distribution

IT Management + Software

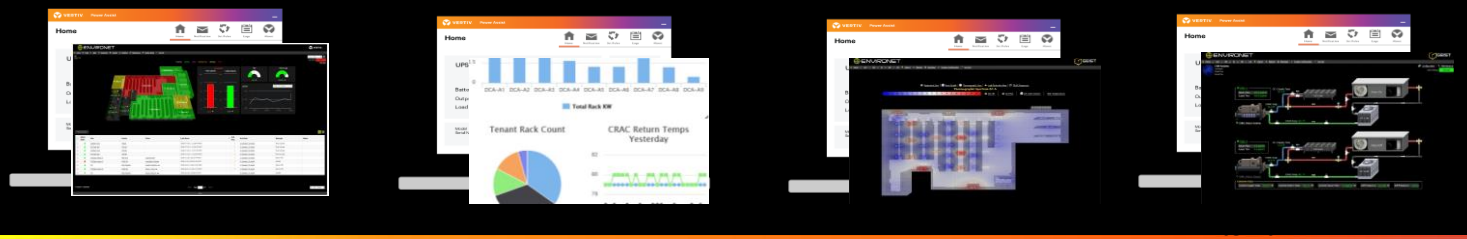
Example Building Block: 7 MW, 100 racks, ~70kw/rack,, 20% Air; 80% Liquid Cooling

Solution Features

BMS EPMS Solutions in Data Centers

- Cross-platform compatibility (Windows, Linux, macOS)
- HTML5-based web-deployed clients
- Real-time data handling
- Integration (MQTT, Snowflake, OPC-UA)
- Unlimited licensing model
- Built-in redundancy capabilities
- Scalable and flexible architecture
- Historical data logging with trending and reporting
- Built in redundancy and high availability options

Monitor | **Analyze** | **Visualize** | **Operate**

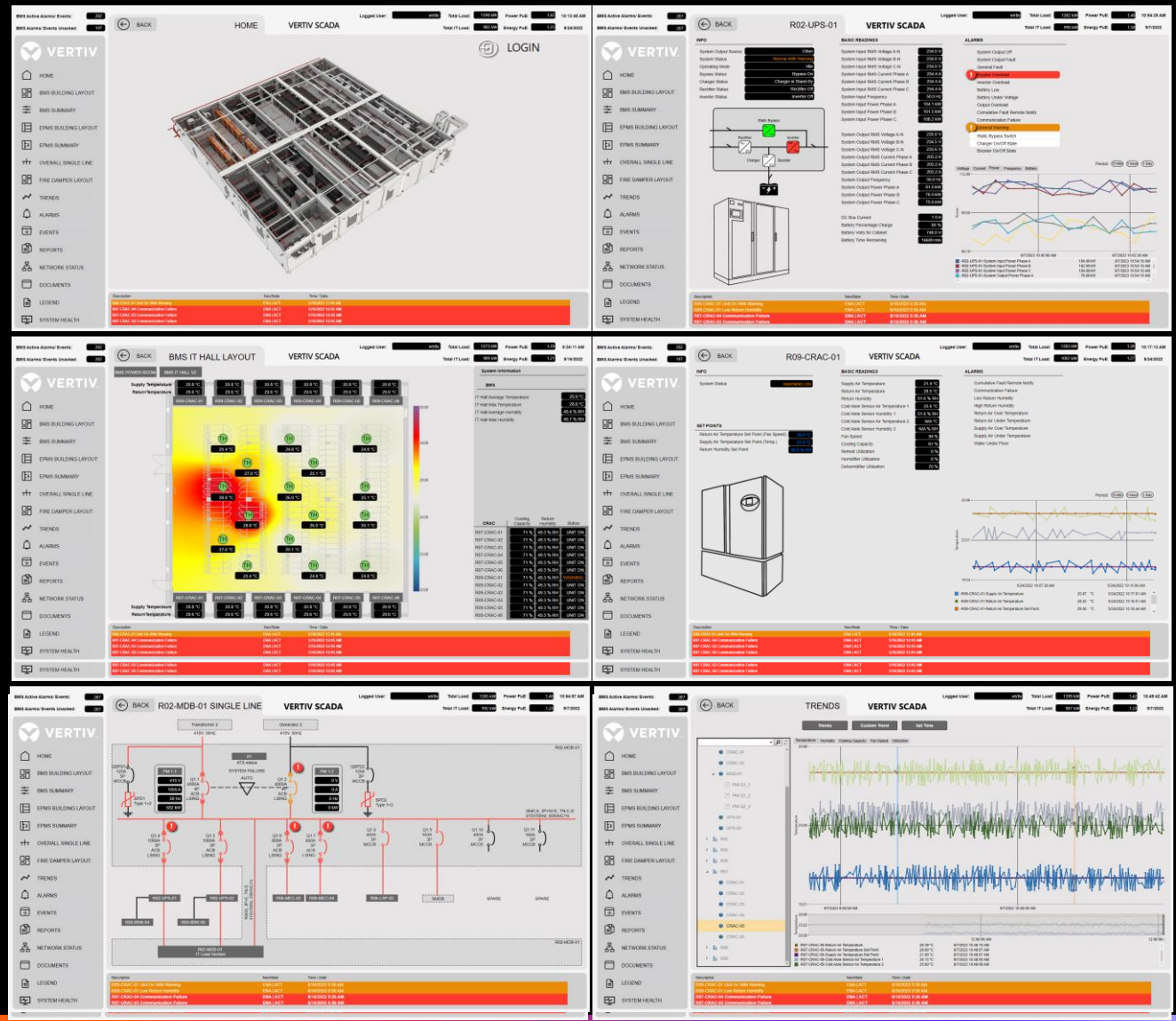


BMS EPMS Vertiv solution

Make it simple

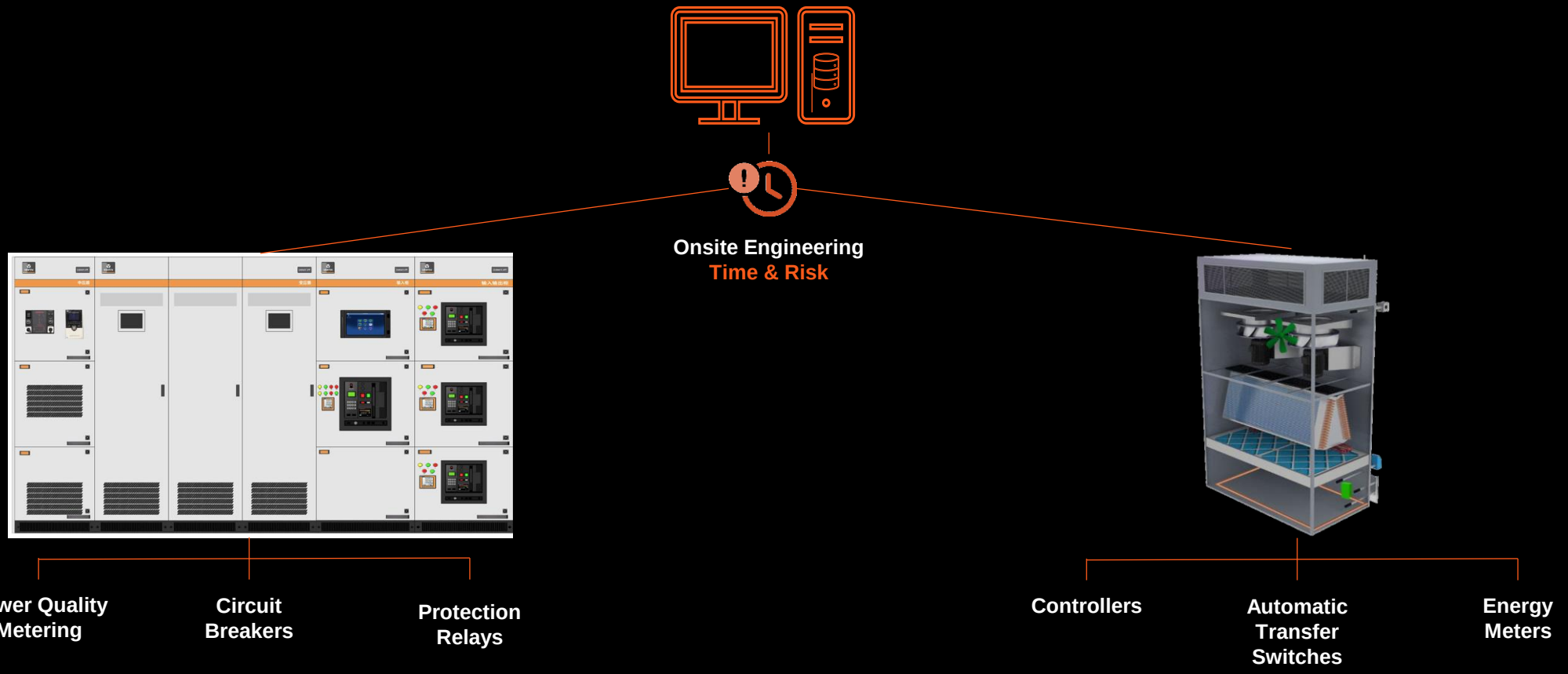
Vertiv BMS solutions

- **BMS solution** - centralized supervision, automation, and data-driven decision making
- **Real-time data acquisition** - from temperature, pressure, flow, and level sensors
- **Cooling Chain Visualization** – from the Chiller to the rack
- **Power Chain Visualization** – from Utility to the rack
- **Remote access & integration** – Databases and cloud lakes
- **Sensor-Based Control** – precise regulation and live data monitoring and capturing
- **Real time PUE and trending** – increase efficiency and decrease costs
- **Analysis and decision making** – Customizable KPI widgets for executive dashboards



Traditional Approach

Without Unify Onboard



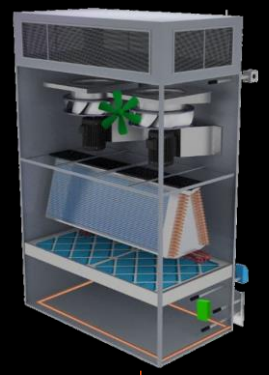
Accelerated Approach

With Unify Onboard

Power Quality Metering

Circuit Breakers

Protection Relays



Controllers

Automatic Transfer Switches

Energy Meters

Accelerated Approach

With Unify Onboard

Power Quality Metering

Circuit Breakers

Protection Relays

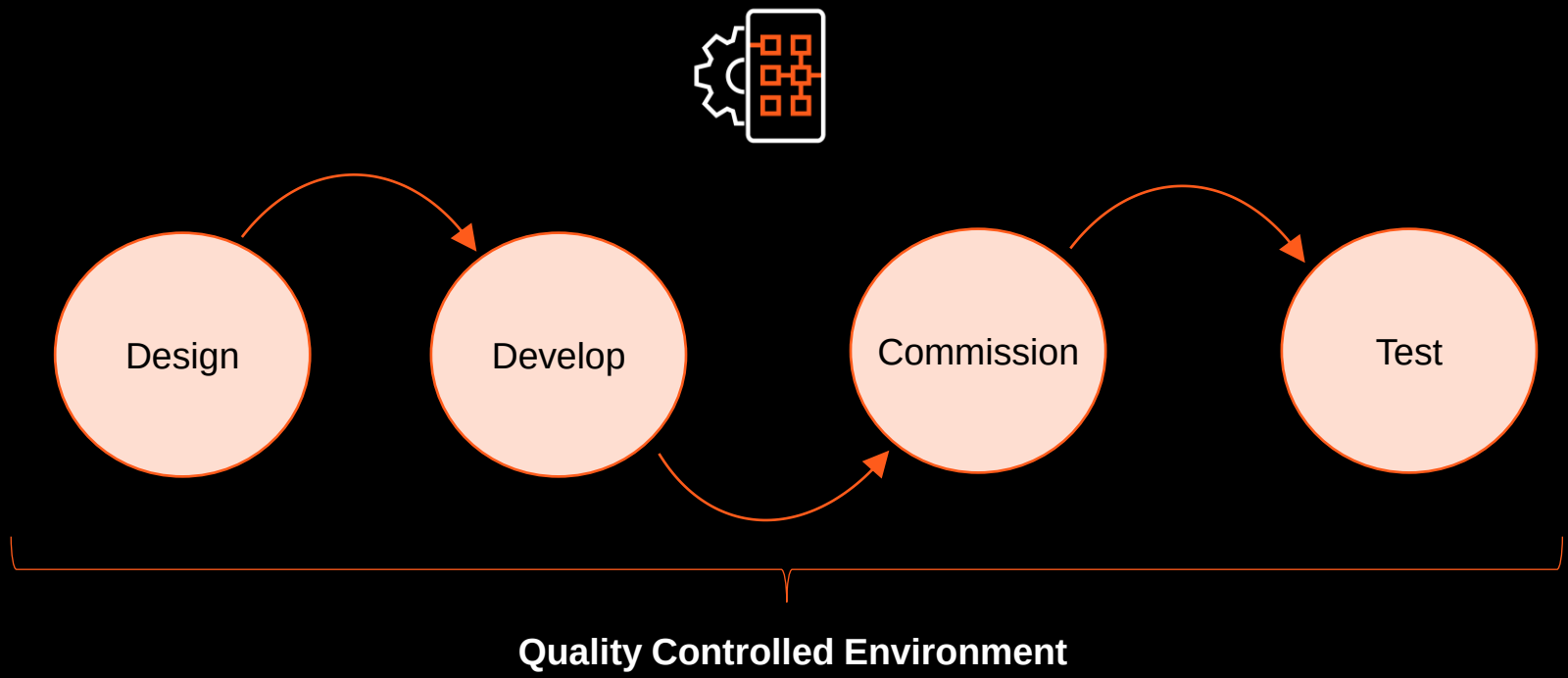
Controllers

Automatic Transfer Switches

Energy Meters

Accelerated Approach

With Unify Onboard



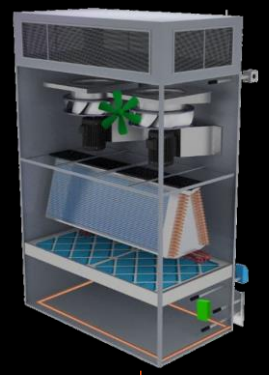
Accelerated Approach

With Unify Onboard

Power Train
LEVEL 4 READY

- Power Quality Metering
- Circuit Breakers
- Protection Relays

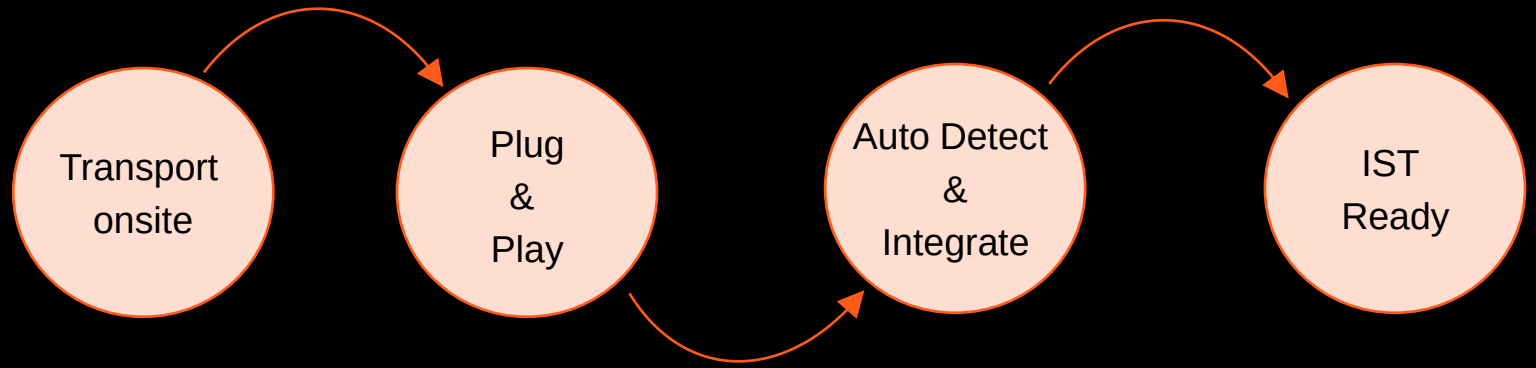
Thermal Chain
LEVEL 4 READY

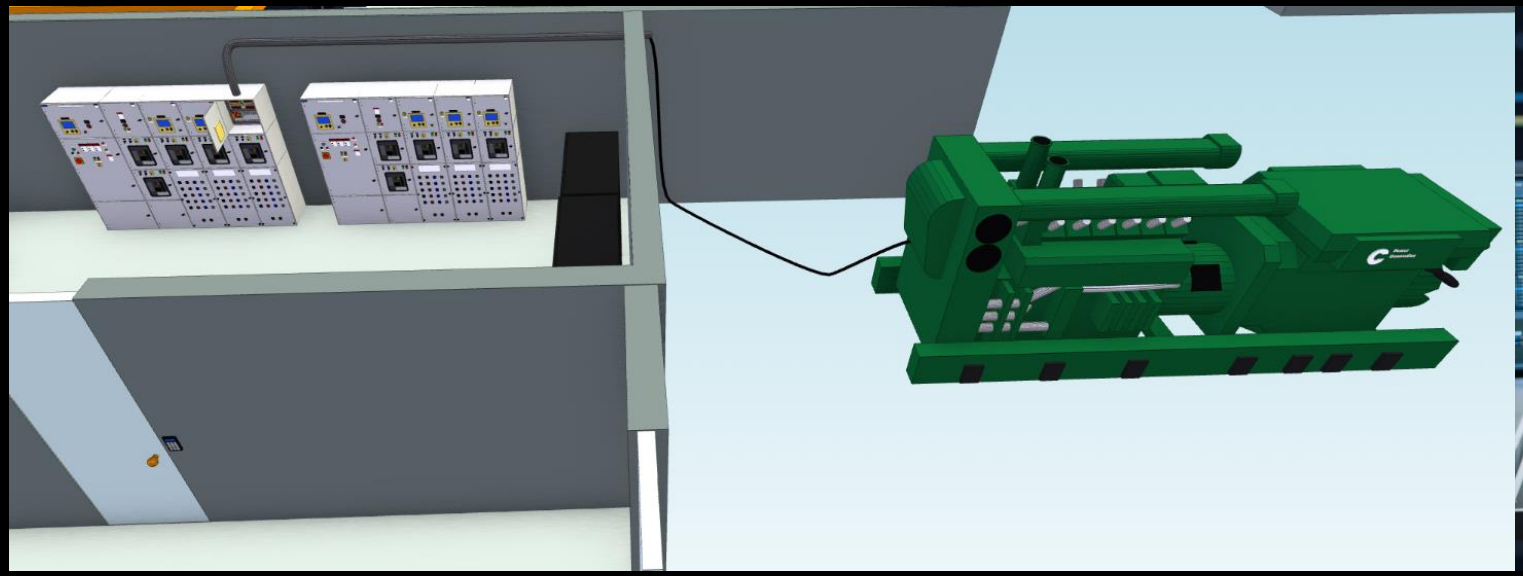


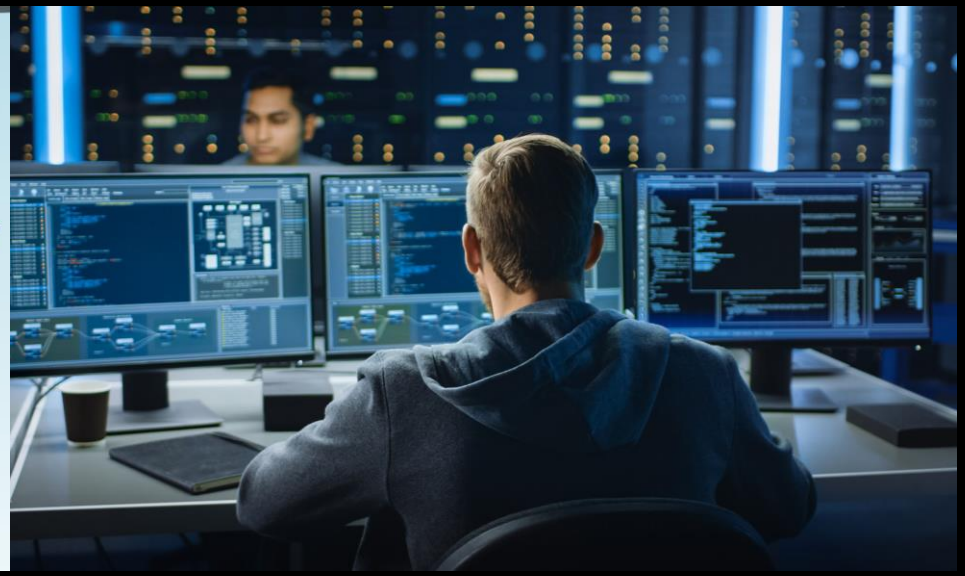
- Controllers
- Automatic Transfer Switches
- Energy Meters

Accelerated Approach

With Unify Onboard







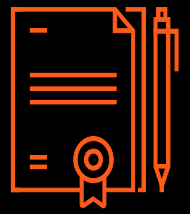
Vertiv Unify Differentiators

Plug & Play Equipment

Software onboard within the equipment, built and tested at Vertiv factory.

Unlimited Licensing

Unlimited clients, connections, tags and designers.

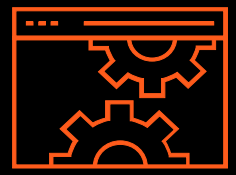


Scale Out Architecture

Multiple architecture possibilities allows robust or redundant design of any size system.

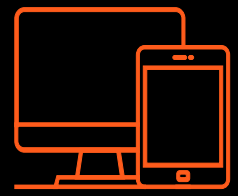
Cross Platform Compatibility

Installs on any major operating system including mobile IOS and Android.



View On Any Device

Graphics viewed on any device including desktops, industrial displays and mobile devices.



VERTIV.

keep it humming™

Connecting the pieces

Krešimir Krpan

Senior Director of Solution Architecture & Business Development

Tackling technology challenges for the future

Challenges

- *Growing power demands*
- *GPU load profiles*
- *Power availablity and permitting*
- *Cooling technologies to ensure silicon does not overheat*
- *Coolant quality and distribution*
- *Maximizing AI cluster proximity*
- *Retrofit of installed base*
- *Power, cooling and IT interoperability and complexities*
- *Unwavering continuity and uptime*
- *Operators' deployment speed*

Possible Future Technology

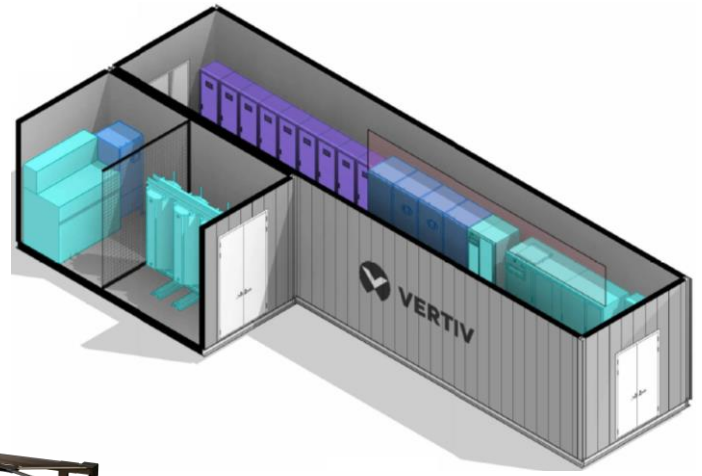
- **High-voltage** power conversion and power distribution
- **Liquid and Air-cooling flexibility** as loads mix changes over time: AI vs. non-AI loads, and increasing density of AI loads
- **Whitespace integration** between IT, Cooling, and Power
- Going **beyond heat rejection physical limits**: footprint, micro-climate, reuse
- Increasing focus on **speed and scale**
- Extreme continuity increases **importance of digitally enabled services**
- **Higher power** capacity blocks
- **Arbitration** across power sources and energy storage systems

Vertiv technology thought leadership is defining and enabling future-ready digital infrastructure

Prefabricated blocks for AI datacenters

Power infrastructure – Power modules / skids

- Widely adopted construction methodology
- N+1 distributed or block redundant topologies
- Including MV & Transformer
- Repeatable

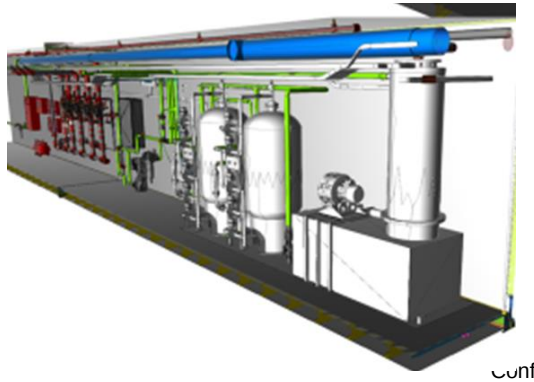


Whitespace – Overhead Superstructure

- SFN – final system must be clean
- Busbar quantity
- Fiber / cable tray quantity

Hydro blocks – key to efficiency

- Interface to heat reuse systems
- Managing dual circuits where applicable
- Heat pumps, etc.

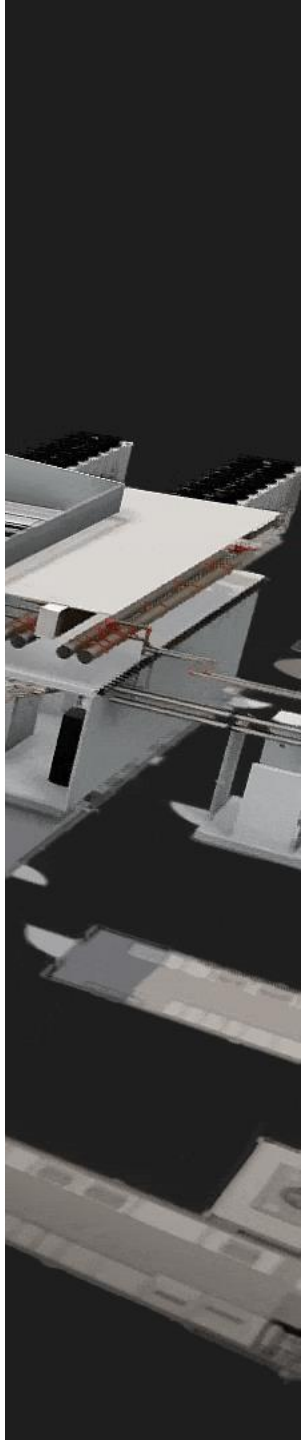


Need For Speed?

- Chip availability is primary client concern
- Site/Power availability is the main differentiation
- Off site manufacturing streamlines the construction process
- Quick On-site Assembly, Minimizing Disruptions and Risk

- **PO to Handover in 9-12 months for 10-50MW!**

OneCore - Prefabricated Hybrid Construction



CoolAisle™

Heat reuse

Denis Rančić

Director of Offering for Infrastructure Solutions

CoolAisle™ - Cooling island

*Patent pending

CoolAisle™ - Cooling island

In Aisle cooling unit / assembly

- Can be in hot aisle or in cold aisle
- 20-40kW/ rack air cooling
- Prefabricated units or skided assembly

Heat rejection

- Primary loop pipework
- Water coils + fans
- SFN

*Patent pending

CoolAisle™ example - 12MW block

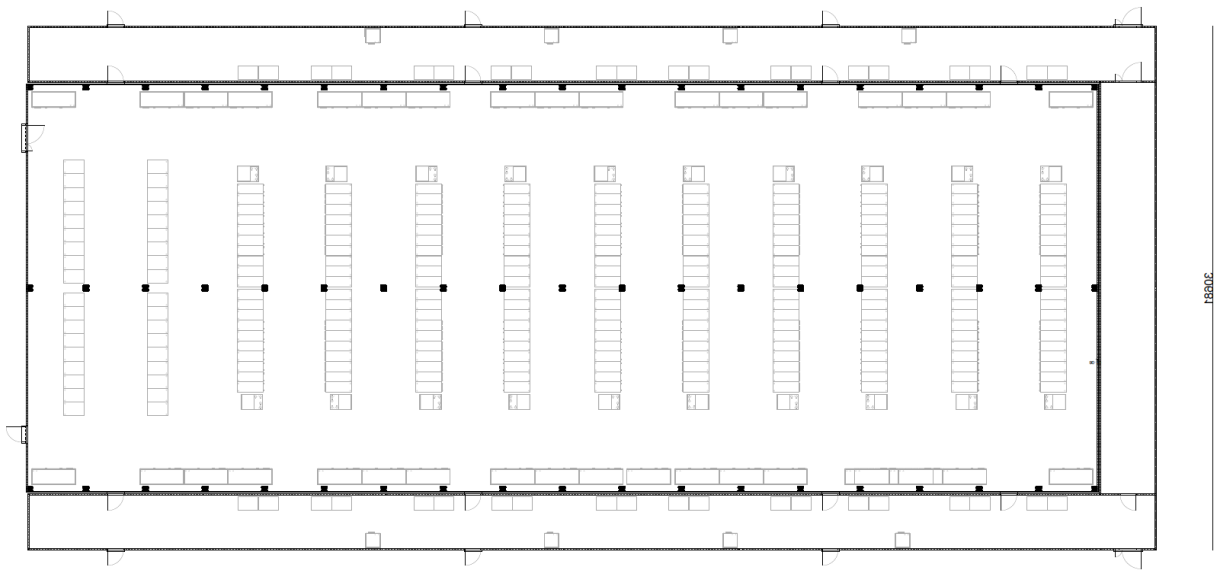
10 x Nvidia SuperPod; 900kW liquid cooling per pod; 300kW air cooling per pod

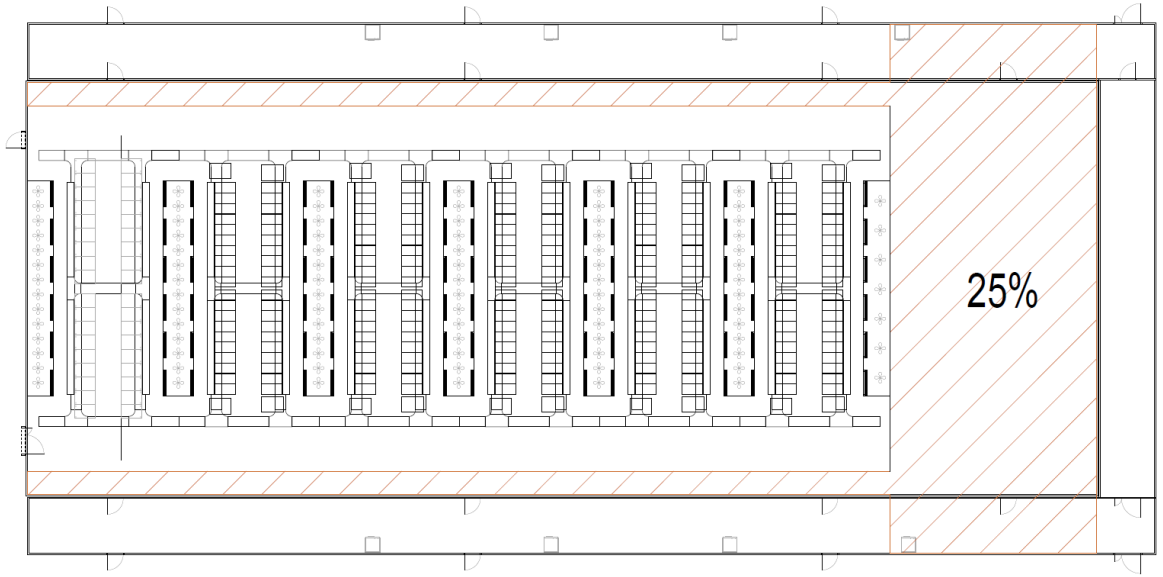
Current solution

- Perimeter air cooling with standard units
- Aisle with is defined by air flow and number of units required on perimeter
- Aisle length is limited

New solution

- In Aisle air cooling with CoolAisle
- Aisle width is defined by installation, maintenance and code requirements





Data center Heat reuse

Redused required cooling capacity by generating power

Power generation

Low temperature motor

-5MW

Cooling Module

5MW

Data center

100MW

Cooling distribution unit (CDU)

Liquid to Liquid

Scalable to Data Center

Direct to Chip (D2C)

Cooling module to support XDU if required (redundancy)