

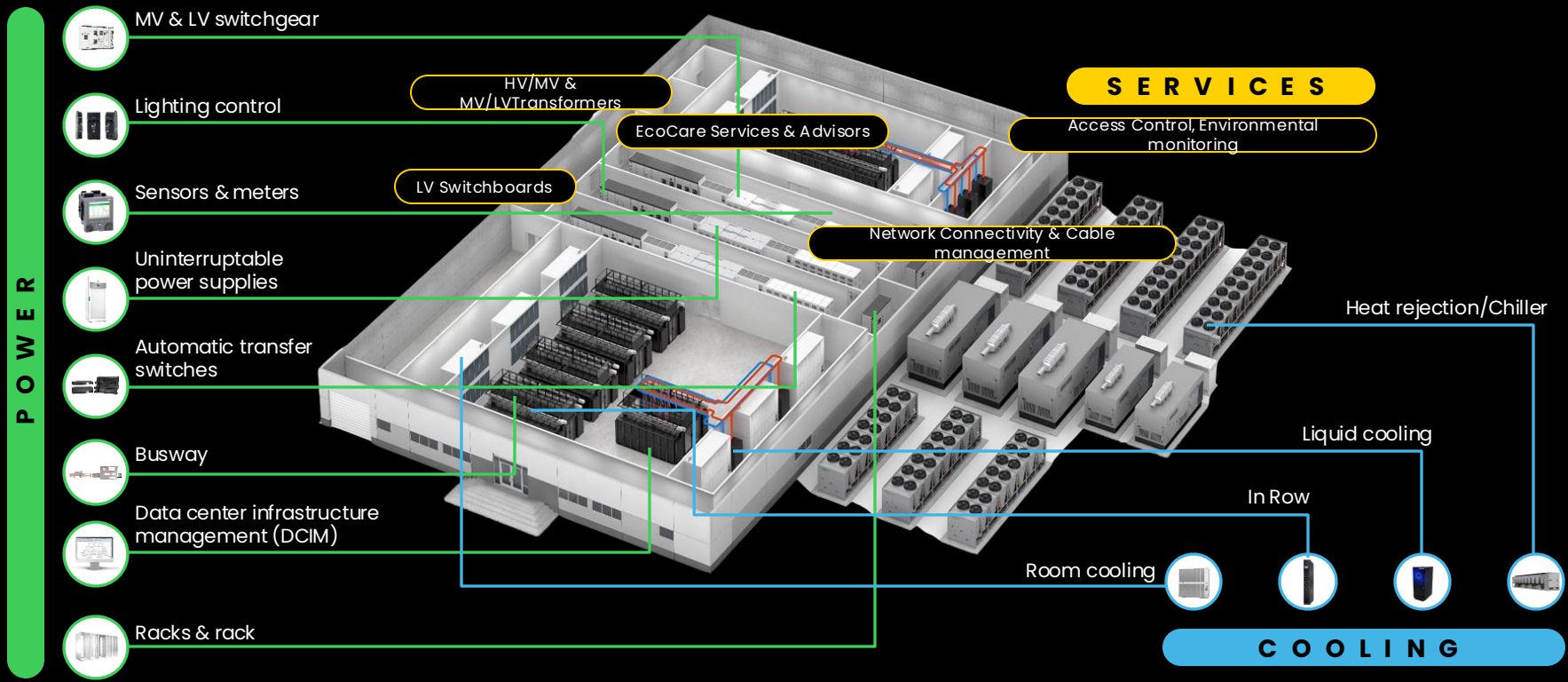


Winning the AI Factory Race: Next-Generation Cooling Solutions for AI Workloads

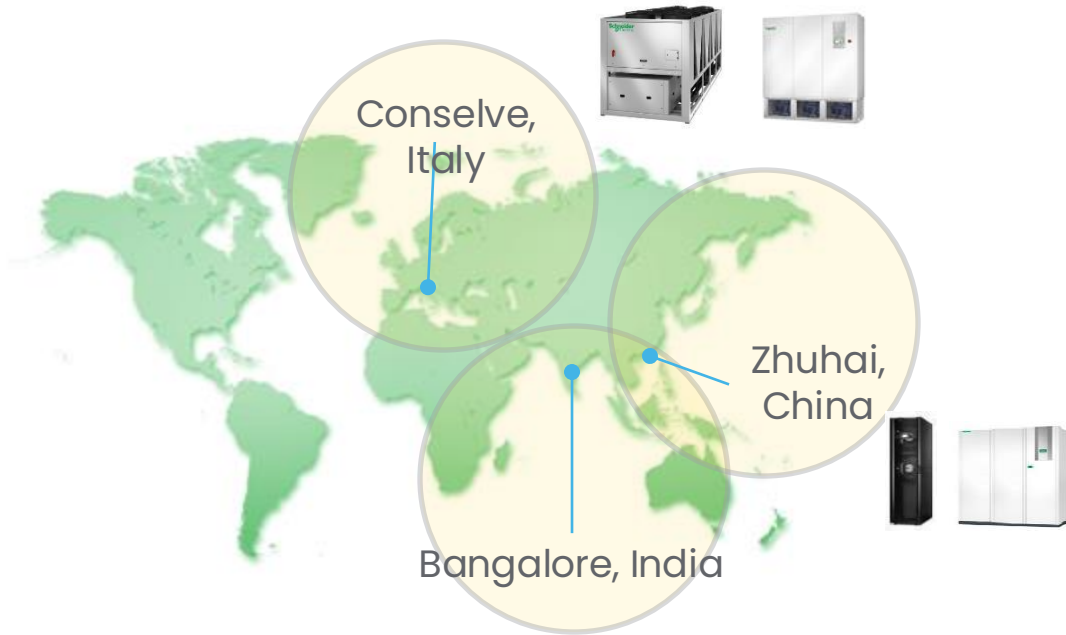
Göksu Akman

Schneider Electric Secure Power Business

Schneider Electric is the only company with the portfolio and experience to deliver every part of the solution including the IT infrastructure



Schneider Electric Cooling Plants in the World



Schneider Electric Cooling R&D in the World



Uniflair: the broadest portfolio and choice of architectures



Eco²truxure™
Innovation At Every Level

Flexible design for new and existing infrastructures

Uniflair Chillers



BENEFITS

- ENERGY SAVING
- PACKAGED DESIGN
- QUIET OPERATION
- QUICK RESTART

CONFIGURATIONS

-  AIR COOLED
-  WATER COOLED
-  FREE COOLING & ADIABATIC OPTION



Uniflair Chillers Video

UNIFLAIR CHILLERS



Chillers Portfolio overview

Uniflair Chillers Portfolio

A complete solution from 25 kW to 2400 kW

** Data declared at Data Center conditions: 30/20°C water inlet/outlet temperatures, 35°C outdoor temperature (air-cooled and free-cooling) – 30/35°C condenser water inlet/outlet temperatures*



Uniflair X-Large Chillers

XRA, BCE, BCWC, DSAF

Uniflair **XRA** range

- 300 – 1400 kW cooling capacity
- Above 2 MW with IT temperatures
- Air-cooled / Free-cooling
- Outdoor installation
- Screw compressors (fixed speed and inverter driven)
- EC fans
- Multiple refrigerants

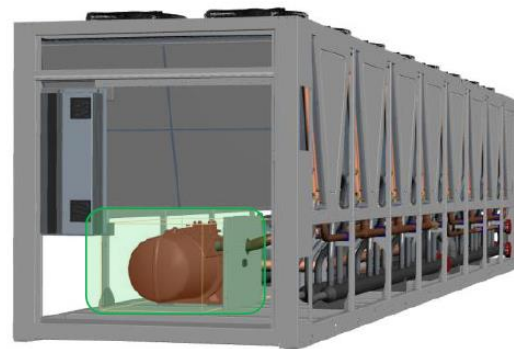
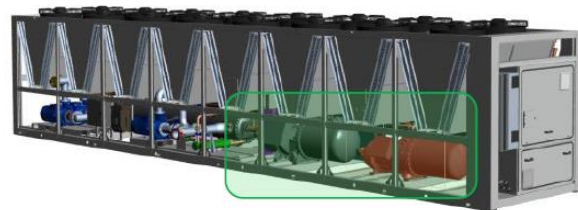


Product video

Compressors and refrigerant circuit

Main features

- XRA units are equipped with two double compact screw compressors operating on two independent refrigerant circuits.
- They are equipped with a temperature sensor in the overcurrent protection windings and a non-return valve on the delivery line for preventing reverse rotation of the screw and to allow equalization of the pressure values inside the compressor for pressure-free starting.
- Three compressors versions are available:
 - **Stepless Version:** two compressors stepless
 - **Hybrid Version:** 1 stepless compressor + 1 compressor inverter driven (external inverter)
 - **Full VSD Version:** 2 compressors inverter driven (external inverter)
- Each compressor is placed on rubber, anti-vibration supports to reduce the transmission of vibrations and reduce noise levels and possible faults.



High temperature Chillers: water setpoint up to 25°C!

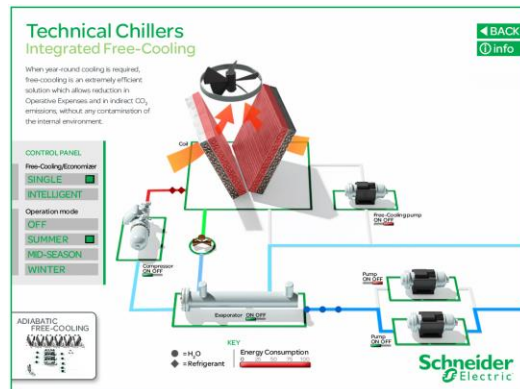


Uniflair Chillers with Scroll, Screw and Turbocor compressors are **specifically** design to work with high water temperature setpoint and wide delta T, even in **extreme outdoor conditions**

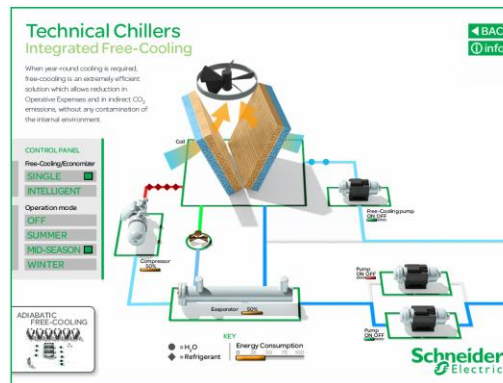
Operating modes with Free-cooling units

How it works

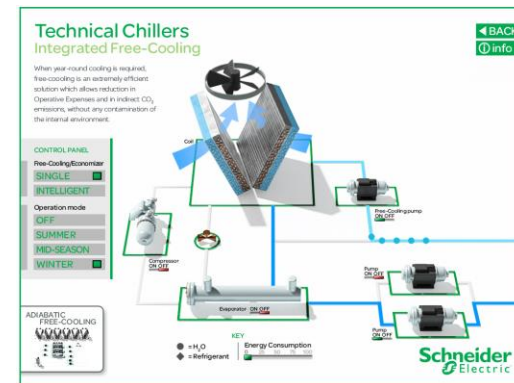
Mechanical mode



Mixed mode



Total free-cooling mode



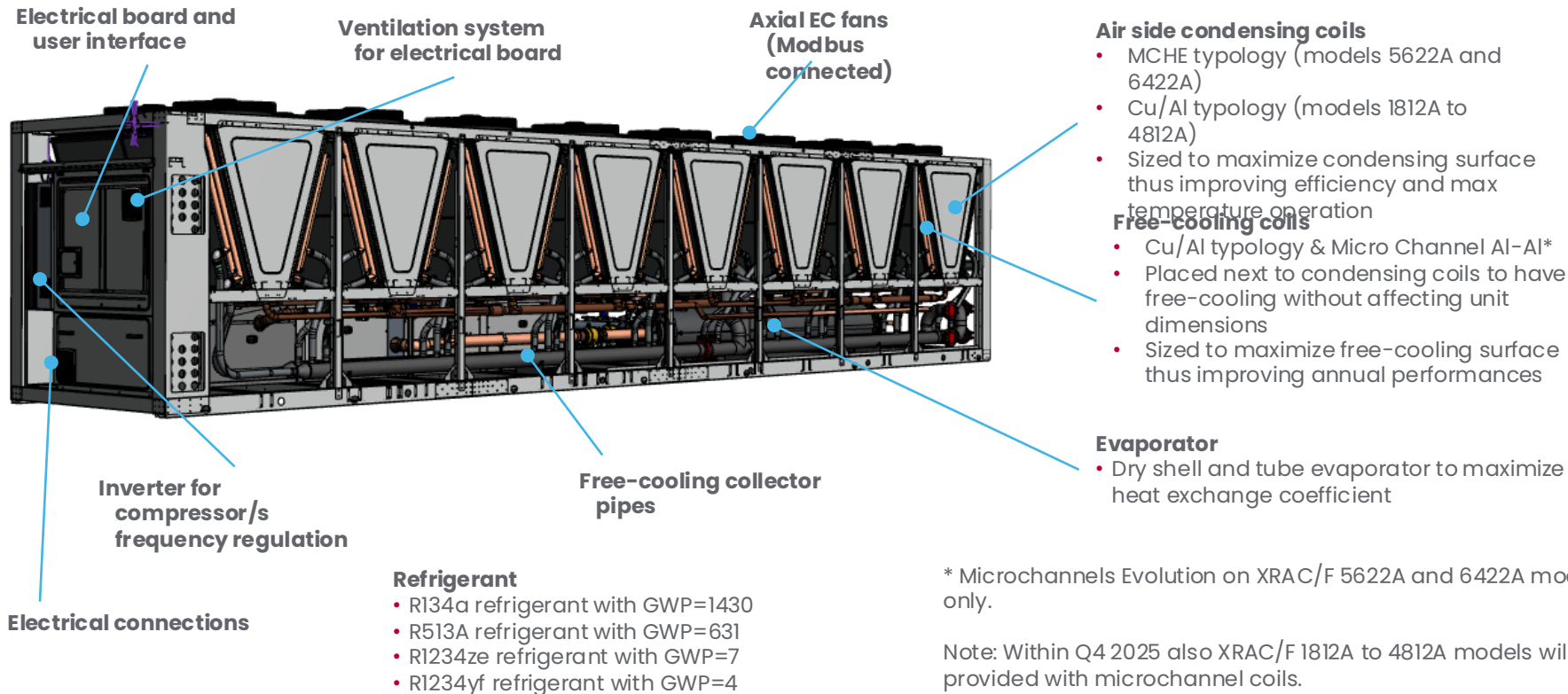
DX mode	Mechanical cooling (compressors) dissipates the thermal load
Mixed mode	The thermal load is dissipated by external air and compressors
Total free-cooling mode	The thermal load is dissipated by external air (compressors off)

https://uninet-it.schneider-electric.com/coolingfordatacenter/technical_chillers_freecooling.html

How it's made

XRAF5622A Hybrid version

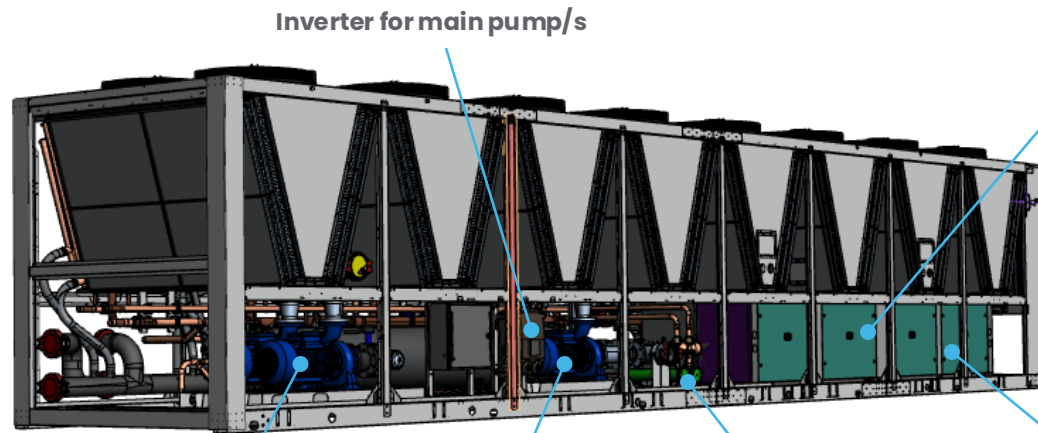
<https://sketchfab.com/3d-models/uniflair-inverter-screw-chillers-for-large-dc-71675c669ca349629cfc135ea8372946>



How it's made

XRAF5622A Hybrid version

<https://sketchfab.com/3d-models/uniflair-inverter-screw-chillers-for-large-dc-71675c669ca349629cfc135ea8372946>



Inverter for main pump/s

Main pump group

- 1 fixed speed
- 2 (1+1) fixed speed
- 1 VSD (with 1 inverter)
- 2 (1+1) VSD (with 1 inverter)

Free-cooling dedicated pump

Dehydrator filters

Subcooling economizer (option)

- Plate heat exchanger used to improve cooling capacity of the unit without changing unit frame

Compressors

- 2 double-screw compressors in different technology versions:
 - Stepless
 - Hybrid (1 stepless + 1 inverter driven)
 - Full VSD
- Two independent refrigerant circuits

Noise version:

- Basic without casing
- Quiet with soundproofed casing for compressors
- Quiet with soundproofed casing for compressors + noise reduction diffusers on fans
- Ultraquiet with soundproofed casing for compressors and fan speed limitation
- Ultra-Quiet with soundproofed casing for compressors and fan speed limitation + noise reduction diffusers on fans

Uniflair **XCA** range

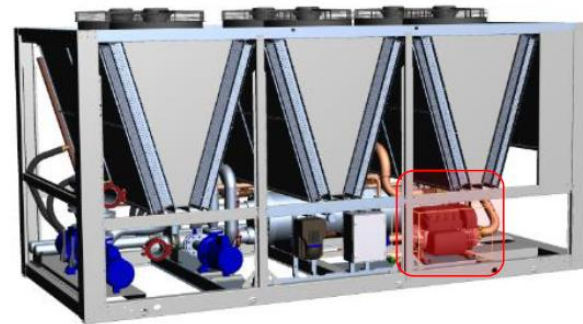
- 300 – 1700 kW cooling capacity
- Up to 2.2 MW with IT temperatures
- Air-cooled / Free-cooling
- Outdoor installation
- Oil-free centrifugal compressor/s (Turbocor)
- EC fans
- Multiple refrigerants



Oil-free centrifugal compressors

Main technical features

- XRA are equipped with oil-free centrifugal compressor(s) with magnetic bearings with an integrated inverter to enable high rotational speeds (up to 40,000 rpm) and to guarantee, at the same time, efficient control at different loads.
- XRA are equipped with 1, 2, 3 or 4 Turbocor compressors and according to the refrigerant selected, with TT or TG model
- Each compressor is cooled thanks to a cooling circuit that recirculate the liquid refrigerant in the compressor to cool down the inverter. A filter and a sight glass are integrated in the compressor cooling circuit.
 - The compressor/s are equipped with two stage centrifugal compression, variable speed permanent magnet motor and intelligent electronic controls, internal thermal protection, protection and control of the rotation axis position, soft start start-up, phase sequence control, pre-rotation valve, temperature and pressure sensors, anti-vibration supports



Green Refrigerants on Uniflair Chillers

Refrigerant choices on chillers

Considerations when selecting refrigerants

High pressure	R410A	R454B
Flammability	A1	A2L
Toxicity	Lower (A)	Lower (A)
GWP	2088	466
Athmosferic life	17 years	3.6 years

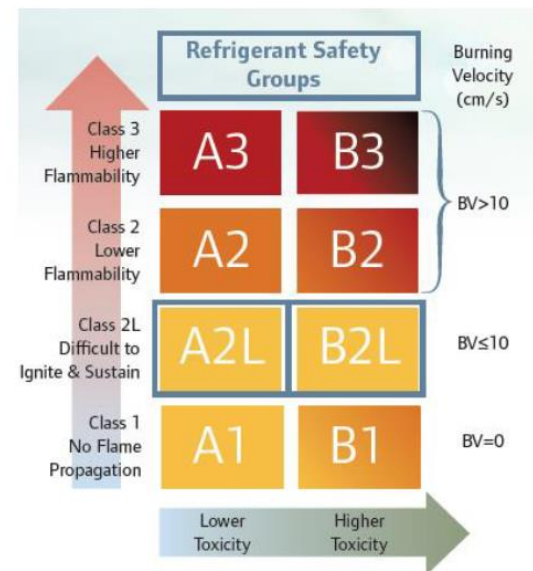
Refrigerants available for Uniflair scroll units

Mid-pressure	R134a	R513A	R1234ze	R1234yf
Flammability	A1	A1	A2L	A2L
Toxicity	Lower (A)	Lower (A)	Lower (A)	Lower (A)
GWP	1430	631	7	4
Athmosferic life	13.4 years	5.9 years	16 days	11 days

Refrigerants available for Uniflair screw units

Refrigerants available for Uniflair Turbocor units

Deep dive on flammability classes from ASHRAE

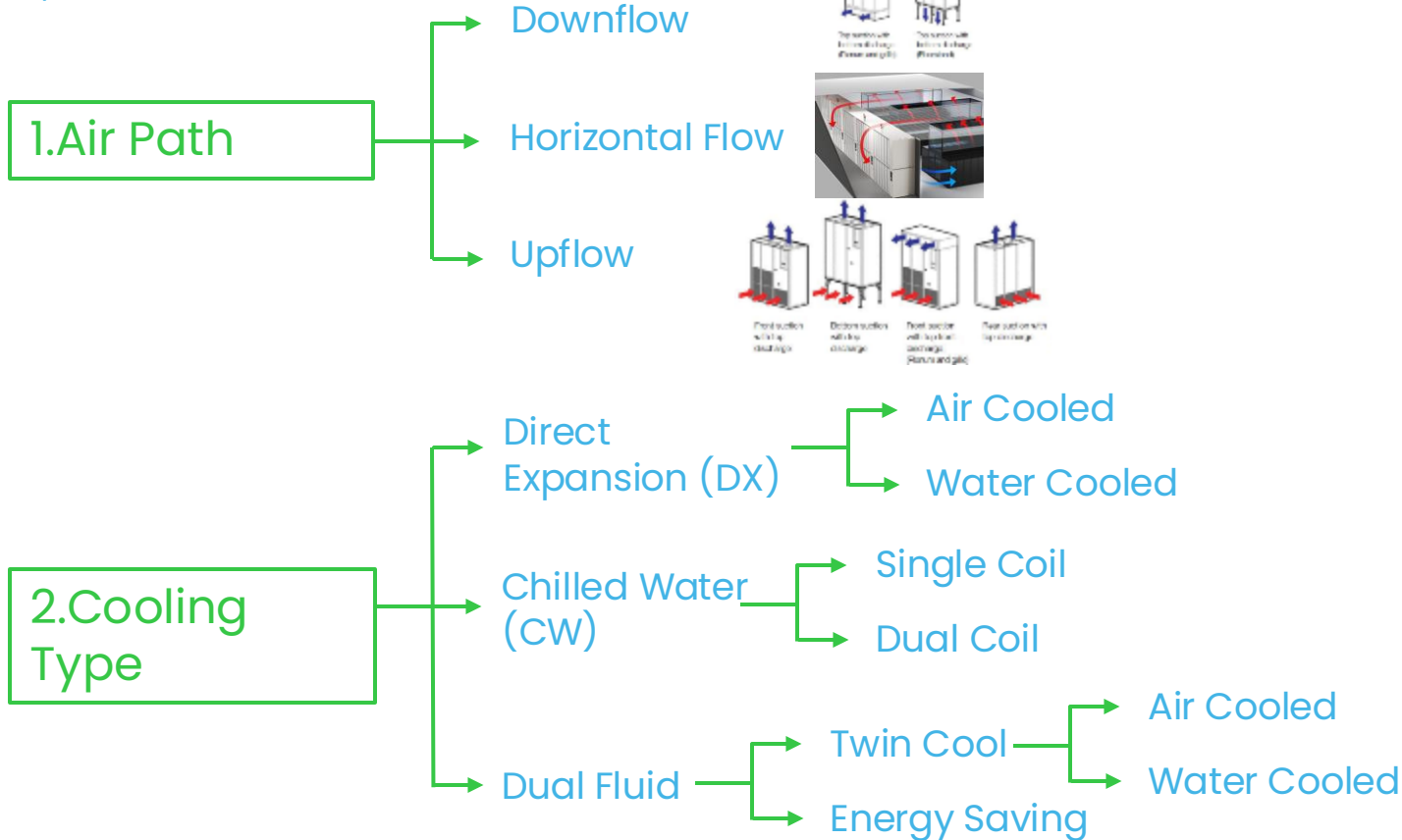


Uniflair Room Cooling

2024

Uniflair Room Cooling Classification

A complete solution from 5 to 500 kW

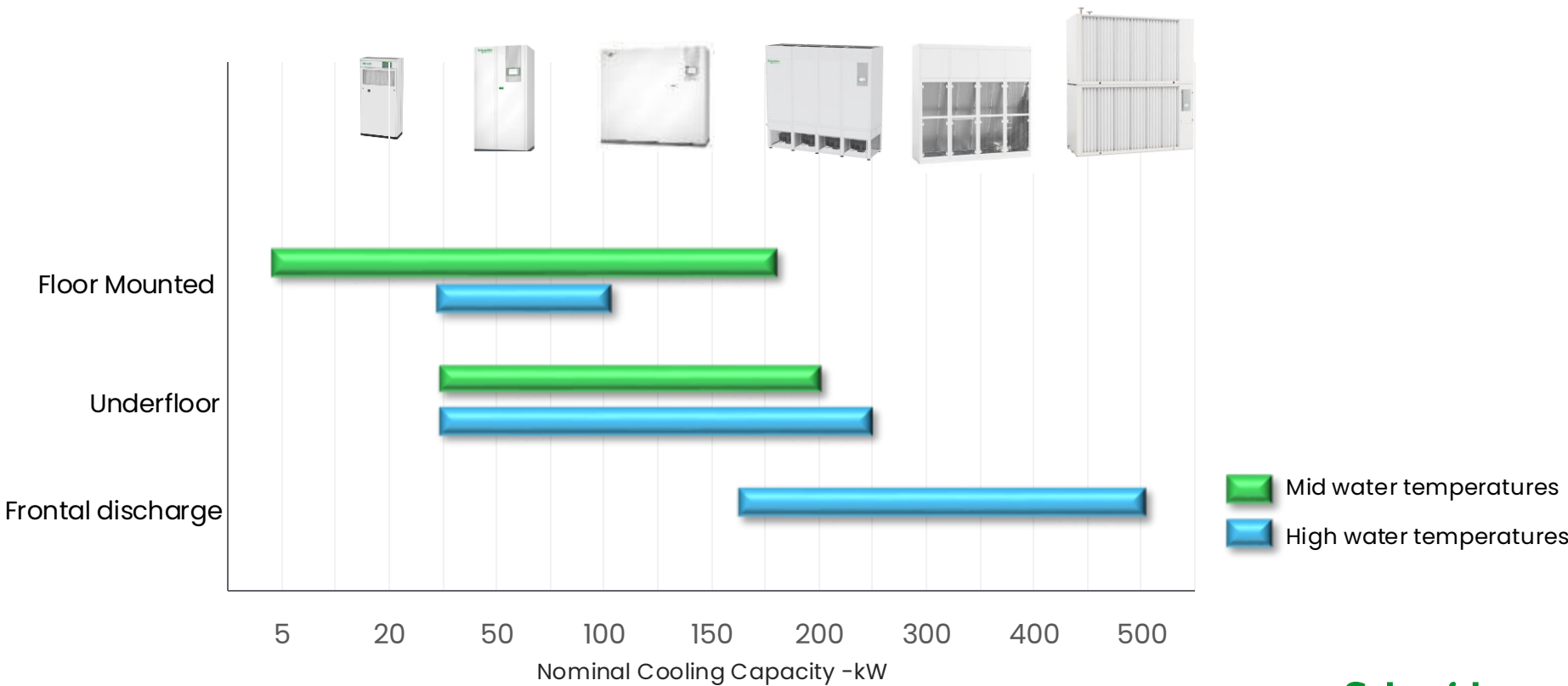




Uniflair Room Cooling Chilled Water

Uniflair Room Cooling Chilled Water

A complete solution from 5 to 500 kW





Chilled Water for High temperature applications

Complete range, 30 to 500kW Cooling Capacity

Design on optimum temperatures

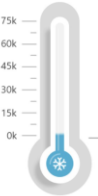
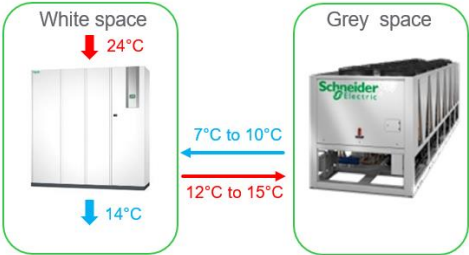
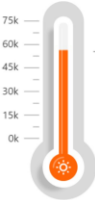
How to design next generation datacenters



The **estimated saving is 4%*** in **energy cost** for every degree of upward change in the set point.



The biggest players in the data center industry are raising the thermostats in their data centers saving in energy costs in the process.



Typical Chilled Water systems operate with low water temperature and the operating temperature of the Data Center is very low

Uniflair HXCV designed to extended high temperatures



Uniflair HXCV HT

Single coil version
from 140 to 250kW cooling
capacity
Chilled water coil specifically
designed to work efficiently with
high temperatures and **wide
water DT (10°C)**



Uniflair HXCV HTE

Single coil version
from 140 to 250kW cooling
capacity
Chilled water coil specifically
designed to work efficiently with
high temperatures and **extended
water DT (12°C)**

Specific design for high water
temperatures to **leverage on
Free Cooling operation** with
external free cooling trim chillers

Average **25% less
power consumption**
delivering the same airflow
of traditional units

Average **30%
more
capacity** on
the same
perimeter

A large glacier with a green horizontal band across the middle containing text.

Chilled Water Solution for No-Raised Floor Applications

Complete range, 150 to 500kW Cooling Capacity

Front Flow Chilled water

Fan Wall Solutions :FWCV



Uniflair FWCV Range

High-efficiency hyper front flow air conditioners, 150 to 500kW, designed for Hyperscale Data Center

Uniflair FWCV frontal flow chilled water unit combines the extremely precise environmental parameter control to the highest level of efficiency, granting the best kW/footprint.

- Multiple sizes and capacities to match with most of the customer cooling requirements
- Reliable Cooling thanks to **in-built redundancy** (dual power supply)
- Full frontal access for easy maintenance and reduced shutdown time
- Easy to use with a user friendly 7-inch touchscreen display
- Smart airflow management through many different control logics
- Precise control of the supply air temperature
- Zero white space occupancy: complete segregation of the white space and no mechanical and electrical service staff in Data Hall

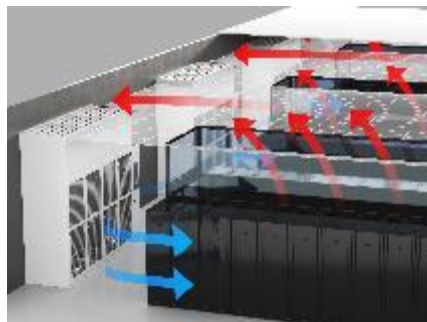
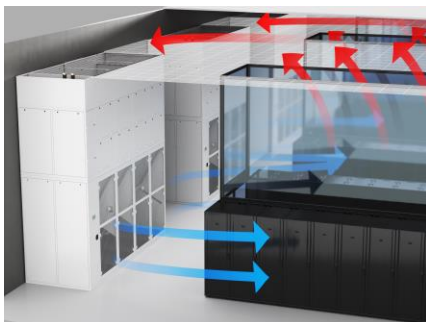
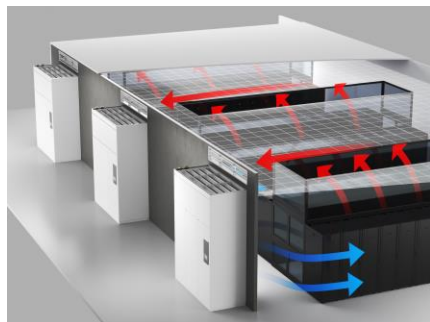


Front Flow chilled water for Data Centers without raised floor

Reshape the concept of cooling to win the challenges in modern DC

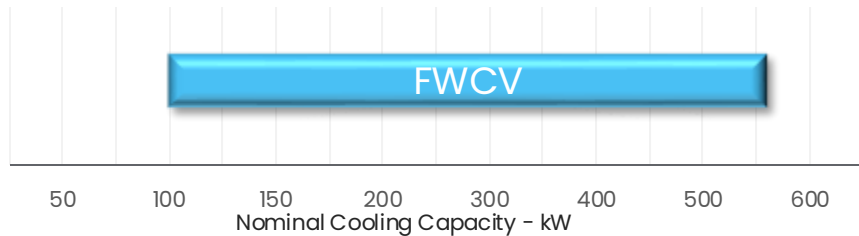
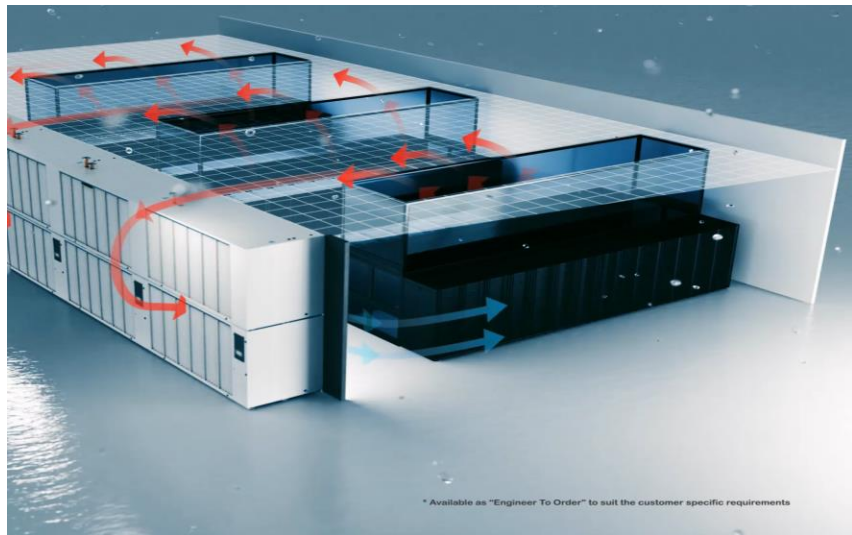
The even more increasing sizes of Data Center force the cooling systems to overcome their limits and reshape the concept of cooling.

Front Flow chilled water offers the right solution to win the challenges in modern and future DC where the design is **moving away from raised floor** preferring frontal flow solutions distributing the cold air directly the data hall with the minimum power consumption



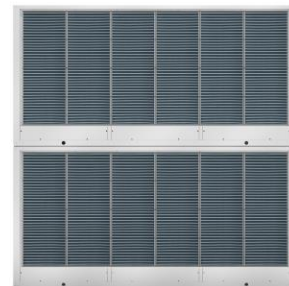
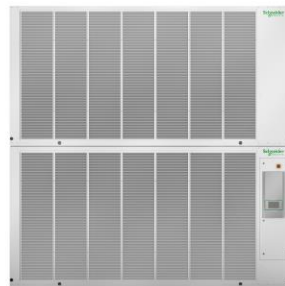
Hyper Front Flow Chilled Water – Frontal Discharge Solution

FWCV – Front Discharge Chilled Water Units



Uniflair Hyper Front Flow Chilled Water FWCV is the Schneider Electric fan wall solution for HyperScale DC designed to be installed outside the Data Hall in the technical corridor.

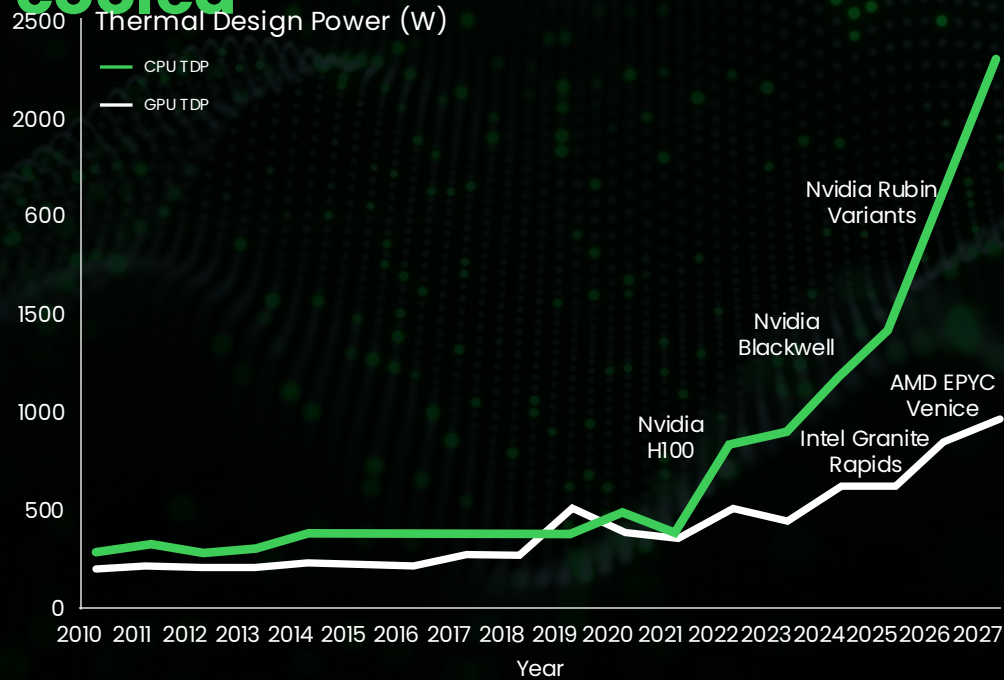
FWCV units don't require the raised floor and create a **cooling wall** on the white space distributing the cold air in the entire room with the minimum power consumption. The hot isle containment ensures the separation of cold and hot air avoiding hot spot and ensuring a reliable cooling to all the IT equipment.



A photograph of a server room with rows of server racks. The room is dimly lit with blue and green ambient lighting. The racks are filled with server units, some of which have glowing green lights. The perspective is from a low angle, looking down the length of the server aisle.

Cooling Technologies for AI Infrastructure

The GPU disrupted the way data centers are built & cooled



From:
IT Rack
(White Space)
Dominant



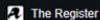
To:
Facility
(Gray Space)
Dominant

TDP **4X**
In two years

700W (H100)
2700W (GB200)

Source: Data based on Schneider internal sources and market analysis.

GPU based servers are driving rack densities towards 1MW – equivalent to 200 standard ovens



Google details plans for 1 MW IT racks exploiting electric vehicle supply chain

Google is planning for datacenter racks supporting 1 MW of IT hardware loads, plus the cooling infrastructure to cope, as AI processing...

1 day ago

AI servers of the future: 'rack density' of 1000kW+ with NVIDIA's next-gen Rubin Ultra AI GPUs

AI servers are projected to consume over 1000 kW of power due to NVIDIA's upcoming Rubin Ultra AI GPU and HBM4 memory.

Nov 24, 2024



Data Center Dynamics

<https://www.datacenterdynamics.com/news/hypersca...>

Hyperscalers prepare for 1MW racks at OCP EMEA

7 days ago — Google has joined Meta and Microsoft's collaboration project on a power rack the companies hope will help them reach rack densities of 1MW.

Nvidia DGX SuperPod's continue to increase rack power densities as their GPU's evolve ...

2022

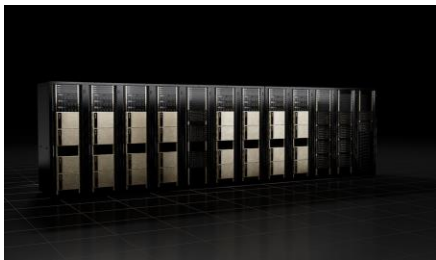


Hopper
Up to
40kW/Rack

Confidential Property of Schneider
Electric |

Page 36

2024



Blackwell
Up to
130kW/Rack

2026 H2



Rubin
Up to
200kW/Rack

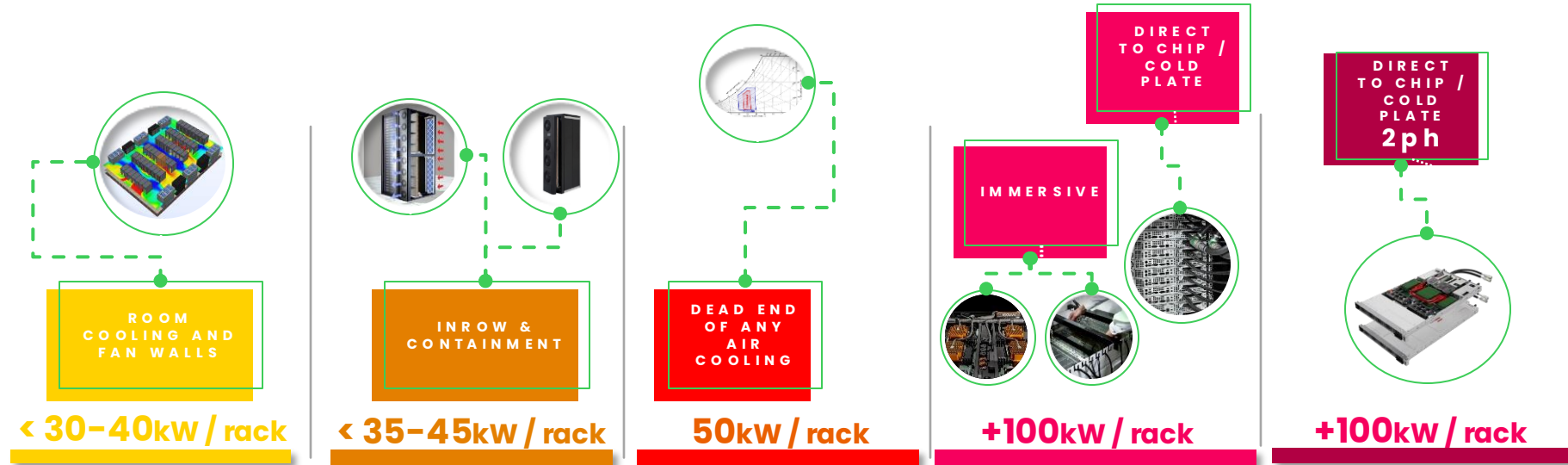
2027 H2



Rubin Ultra
Up to
600kW/Rack

Schneider
Electric

Removing the heat using air is reaching its limit, however densification won't happen overnight



MOVE COOLING CLOSER TO IT TO IMPROVE COSTS AND ADDRESS INCREASING DENSITIES

IT BENEFITS FROM LIQUID COOLING BUT
WITHIN CERTAIN CONDITIONS

NO OTHER WAYS
THAN LIQUID!

motivair™

by **Schneider** Electric

Schneider Electric Acquires Motivair

Coolant Distribution Units (CDUs),
Rear Door Heat Exchangers (RDHx),
Cold Plates and Heat Dissipation
Units (HDUs)



CDU



Schneider Electric a global leader in liquid cooling

A complete, end-to-end portfolio of liquid cooling solutions that can be deployed in new or retrofitted data centers anywhere in the world, at scale.

We are the only liquid cooling provider to have deep and proven expertise straight down to the silicon level.



The leaders in liquid cooling

More than a decade of experience



Field-proven at exascale

Integral to US-based supercomputers Frontier, Aurora and El Capitan



Tomorrow's AI density-ready

Solutions up to 2.3 MW, ready for the next leap in computing

Schneider Electric is aligned with all the main players in the AI ecosystem for solution design and deployments

Chips / GPUs



NVIDIA is the single most influential voice today

Most collaborated and partnered across the IT stack

System Integrators



Various partnerships with top AI players

Awarded by Nvidia and Intel in various categories of AI partnerships

Servers



Together make up 32% of server vendor unit shipments WW (44% of market is ODM direct)

Most partnered servers in alliance networks

Coverage by dedicated teams

Liquid cooling is challenging to design, deploy and operate:

1. Made up of 3 domains
 - Whitespace
 - System Backbone
 - Heat Rejection
2. Water going to the chip and facility's water line
3. Current AI IT designs necessitate both air and liquid be deployed in the same data center
4. Data centers are designed and simulated by digital tools but operation challenges still exist
5. Power is not "adjustable" or "controllable", cooling is
 - Temperatures
 - Pressures
 - Flow rates
6. Installation and operation ecosystem still being developed

High efficiency cooling supporting AI workloads

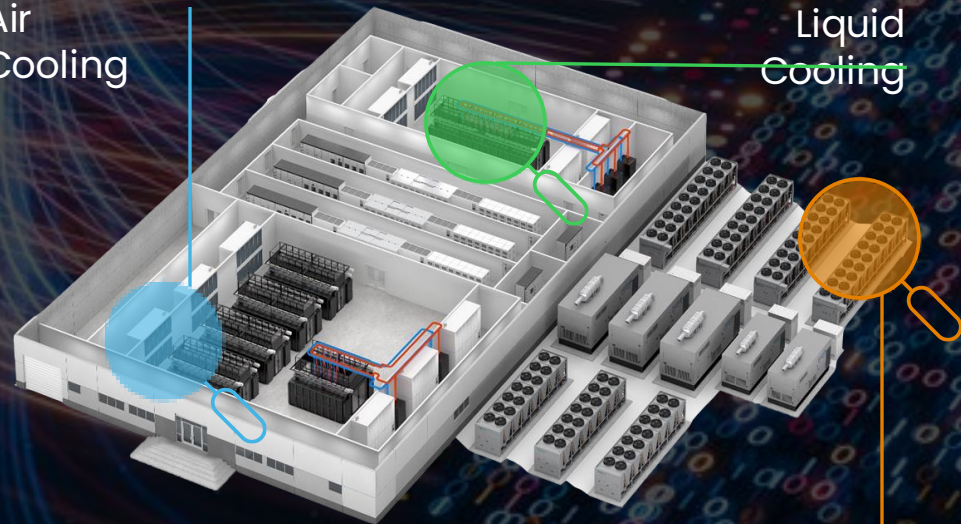


From Chip to Chiller: the fully-integrated liquid cooling ecosystem

More than just a collection of components, this is a **co-ordinated architecture**. One that is designed to scale with AI, adapt to hybrid environments, and deliver performance without compromise.

Air
Cooling

Liquid
Cooling



Heat
Rejection

From Chip To Chiller



White space

System
Backbone
Heat
rejection



How to cool servers

It's not liquid only -
Fluid distribution (TCS)
Complementary air



Coolant distribution
units



Chillers

Compressor-less solutions (dry-
coolers, Cooling towers)

From Chip To Chiller



White space

System
Backbone

Heat
rejection



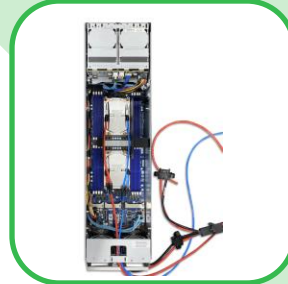
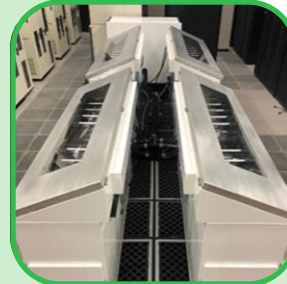
How to cool servers
Fluid distribution (TCS)
It's not liquid only



Liquid cooling technologies



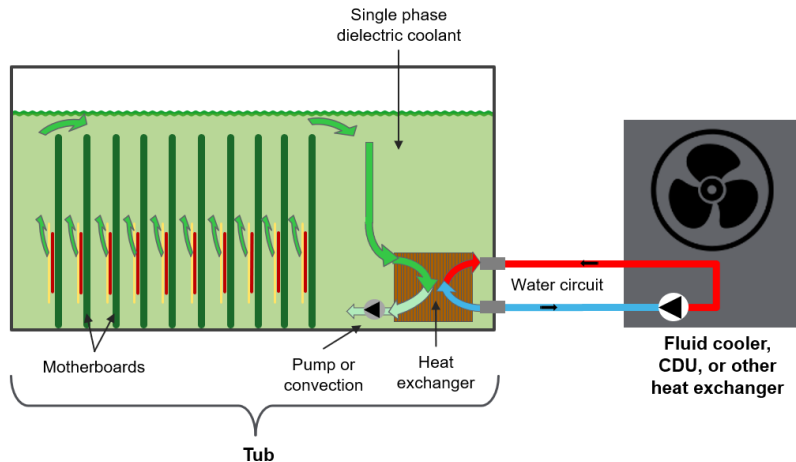
Direct to chip



immersion



Immersed – tank / tub / open bath – single phase



- Some HPC and crypto deployments
- Dielectric oil flows across servers to remove heat
- Leaks will not harm servers
- Fluid Brands: Engineered fluids, Shell, Exxon, BP, Cargill, Fuchs + many more
- Adopted by: Dell OEM, Supermicro
- Require major modifications for Server as well as DC – hard to integrate to existing infrastructure
- Horizontal installation – Space constraints
- Dielectric fluids and potential PFAS restrictions

Market is heading to Direct to Chip, single phase since densification and hybrid design



DIRECT TO CHIP TECHNOLOGY...



...Cools where and how is required – The cold plate cool exactly where the heat rejection is required, i.e. the chip. It matches perfectly with densification and AI servers



... does not force to decide now if to use liquid – Hybrid design, air and liquid is possible. Existing sites with air-cooler servers can be extended to liquid-cooler.



... is simple – it does not require server modification, the cold plate are available embedded in the servers



... allows flexibility – DtC technology keeps the same layout in datacenter. Users do not need to decide if and how much liquid-cooled servers will be used



... uses efficient air – DtC still needs air cooling, however it is more efficient than in traditional datacenters



... won't be impacted by next regulations – Single phase technology uses water (PG25) which won't be impacted by any restrictions. Incoming PFAS restrictions will likely impact Two-phases solutions

TCS main components, requirements and challenges

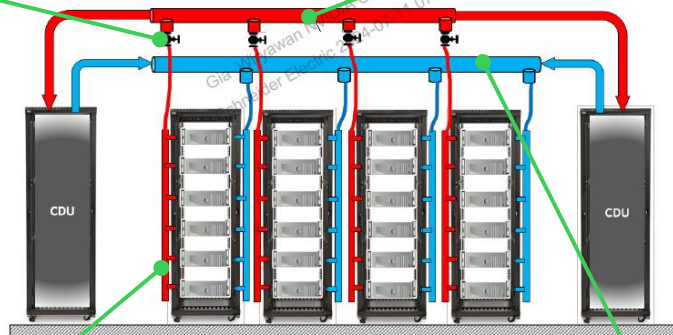
Architectur

e

Peak Flow control support rack evolution



TCS design takes care of **Flow balance** between rack



Above images are not illustrative of rack elevations or POD designs, but intended to show only the liquid-cooling fluid network

TCS measurement system **monitor operation** (temperatures, pressures and flow)

In-Rack Manifolds handle flow distribution through servers

Guidelines



ASHRAE TC 9.9 Committee recently released liquid cooling guidelines

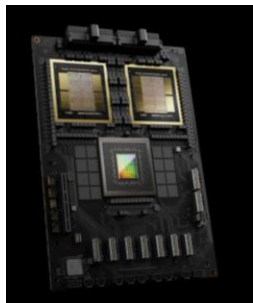
- TCS materials
- Corrosion prevention leveraging on PG25
- Bacteria contamination and growth both at factory and at site
- Proper filtering at CDU (between 1/2 - 1/10 of the smallest passage, i.e. 25µm)

Ongoing discussions at ASHRAE

- CDU approach
- Flow regulation
- Sea Salt Corrosion of Coastal DCs
- Erosion Study on (Piping & Components)
- Digital Twins
- CFD Modeling for Thermal Resistances
- Guidelines for Data Center External

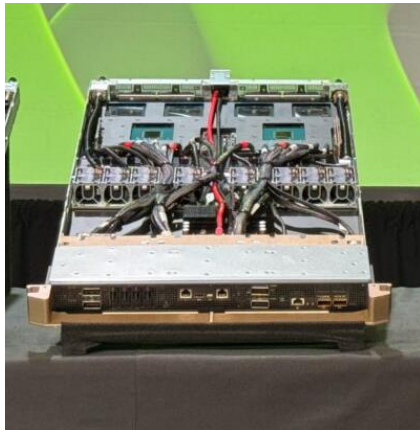
100kW+ racks, the future is already

here
NVIDIA GB200
2700W

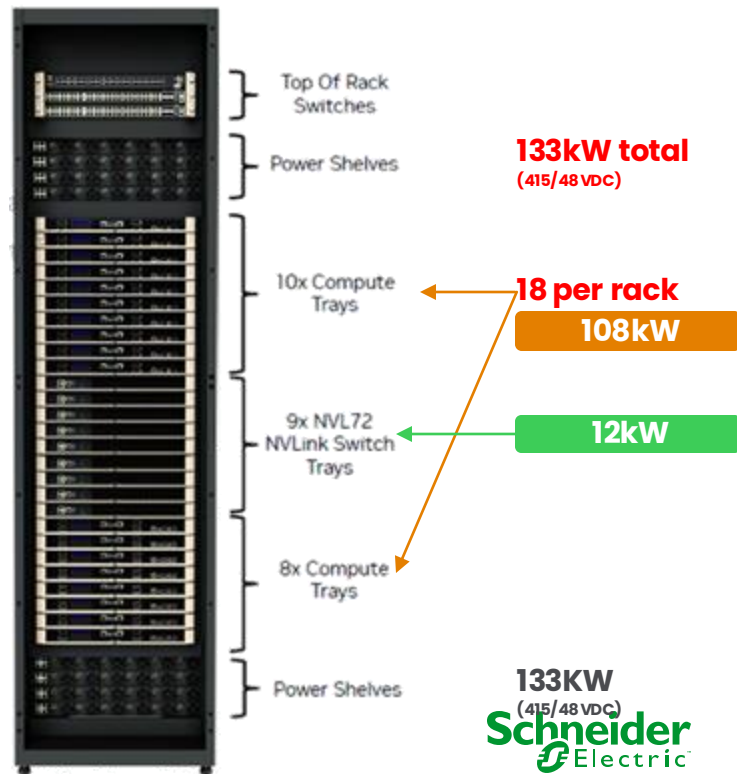


2x per
server

NVIDIA DGX
6500W

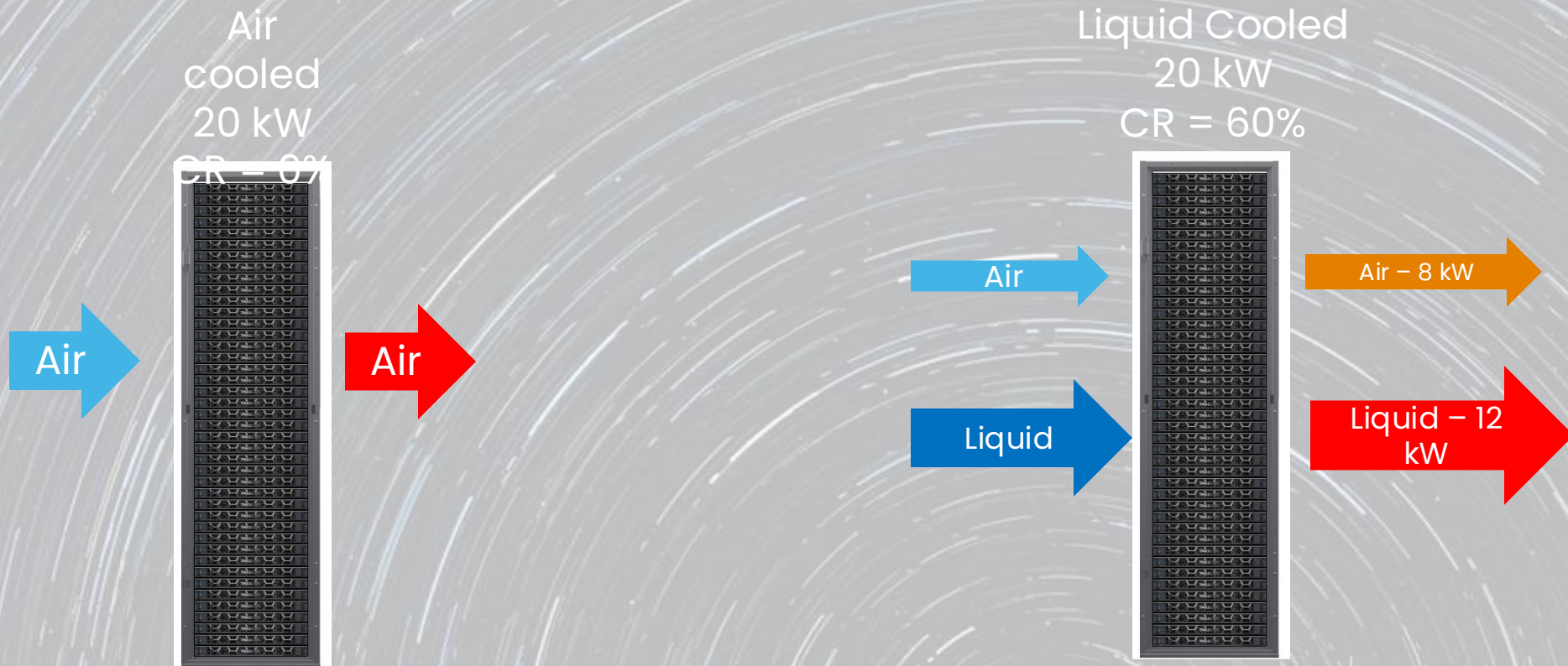


NVIDIA DGX GB200
120kW @liquid
13kW @air



The “capture ratio” – CR

It's the % of total load rejected through “liquid”.



From Chip To Chiller



White space



System
Backbone



Coolant distribution
units

Heat
rejection



Coolant Distribution Units

Floor-Mounted

MCDU-60
2.3 MW



MCDU-50
1.7 MW



MCDU-40
1.2MW



MCDU-30
850KW



MCDU-25
625KW



Rack-Mounted

NEW MCDU-10
210KW



MCDU-4U
102KW



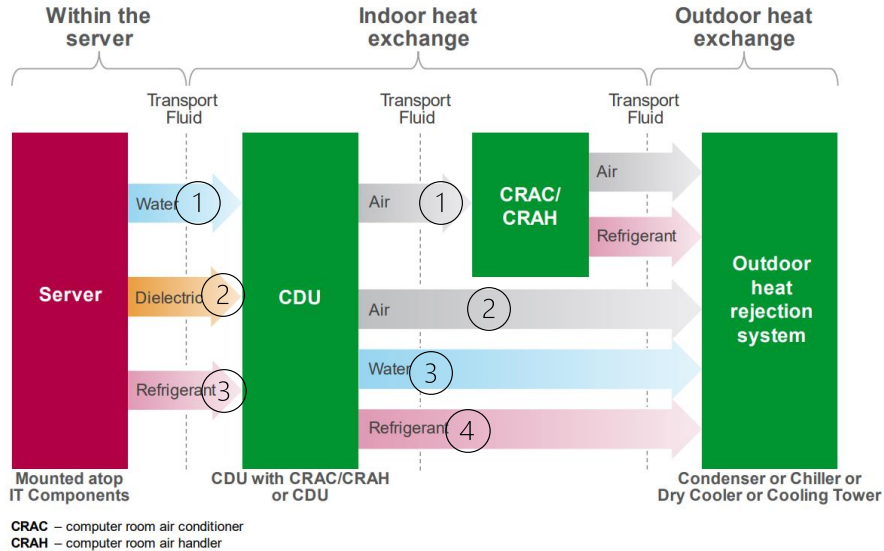
High Runners

- Seven Standard Models (Floor Mount & Rack)
- Built in redundancy and resiliency features
- Advanced PLC control and safety system
- Exascale Ready
- UL/CSA/CE certified

Life Is On

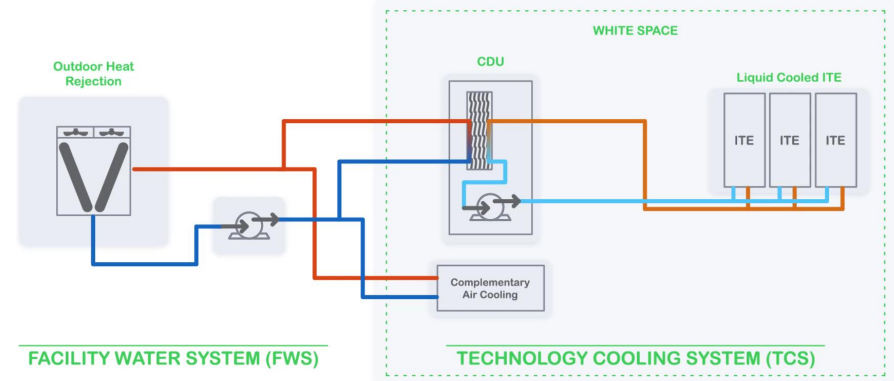
Schneider
Electric

Coolant Distribution Unit role in moving the heat



1. Liquid 2 Air w/ CRAC/H
2. Liquid 2 Air w/ outdoor AHU
3. Liquid to Liquid on CW systems
4. Liquid 2 liquid on DX compressor assisted CDU

Current predominant medium is water w/ glycol (25%) – PG25



InRack or floor standing CDU can be used, according to density

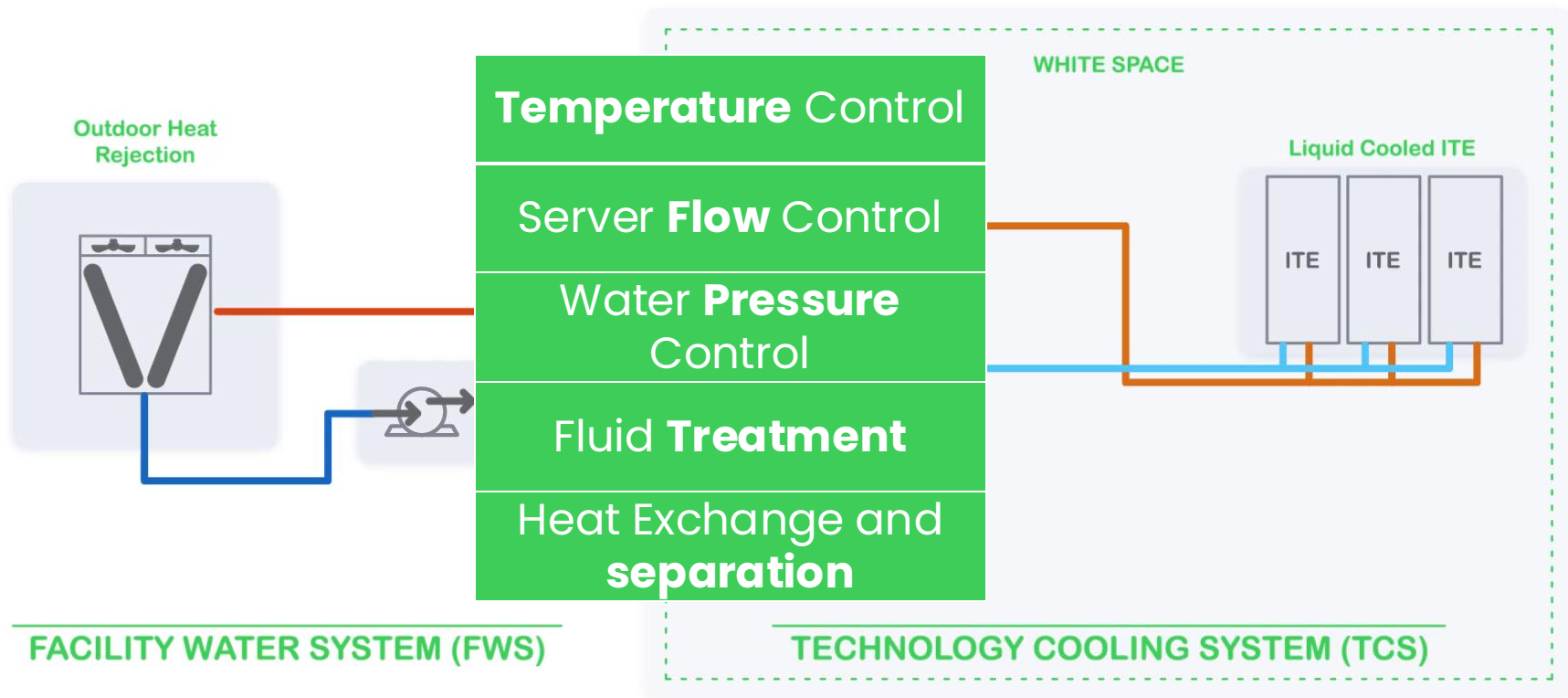


Inrack CDU

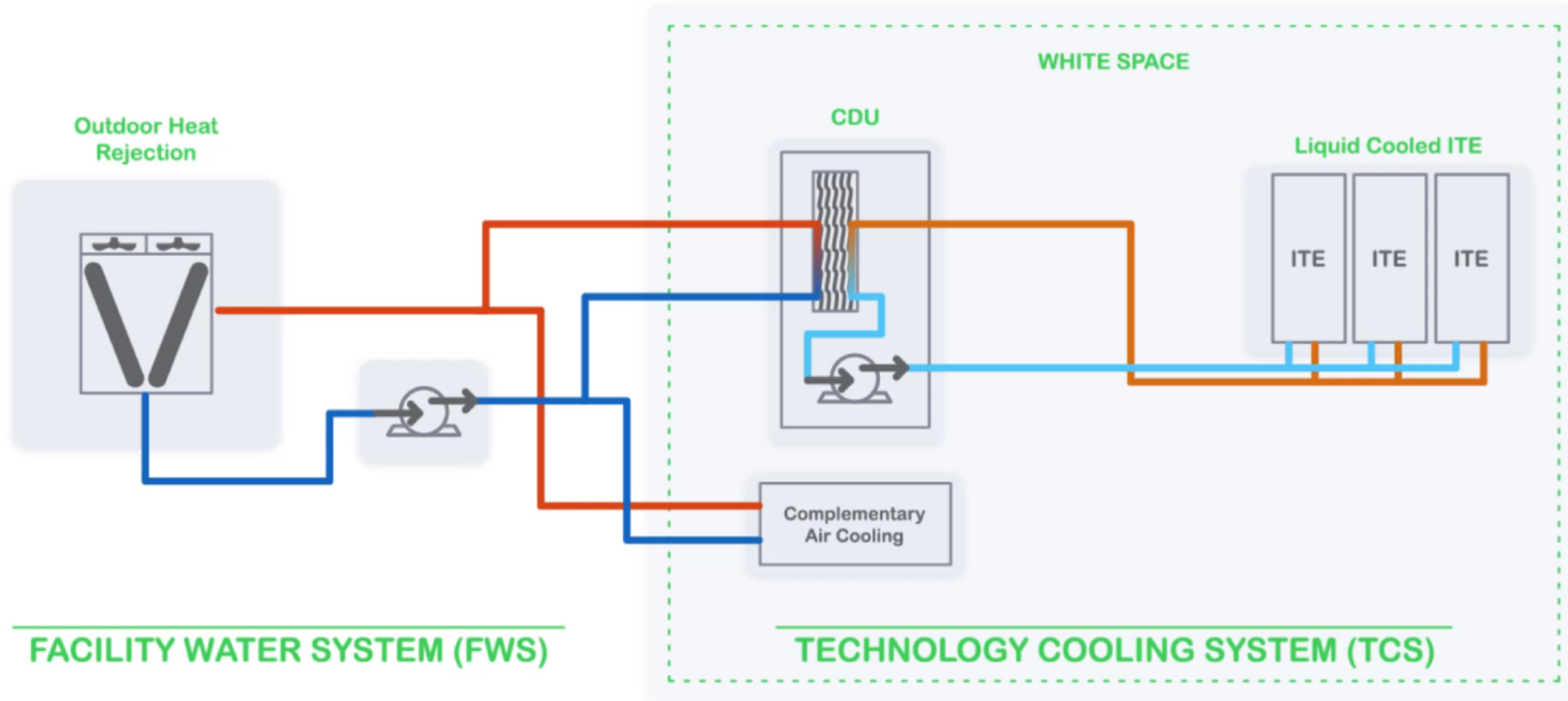


room, floor standing

CDUs are the backbone of liquid cooling architectures



Heat rejection is optimized as a SYSTEM of CDU and Chiller



A scenic mountain landscape with a calm lake reflecting the surrounding peaks and forests. The mountains are rugged and rocky, with patches of snow and dense evergreen forests. The sky is a mix of light blue and white clouds. The lake is very still, acting as a perfect mirror for the landscape above.

Chilled Doors Introduction

Engineering Manager – Applications

Chilled Doors

Chilled Doors

MCD-M4
12kW

MCD-M8
30kW

MCD-M12
45kW

MCD-M12-F
55kW

MCD-M14
65kW

MCD-M14-6
70kW

MCD-M14-6
70kW

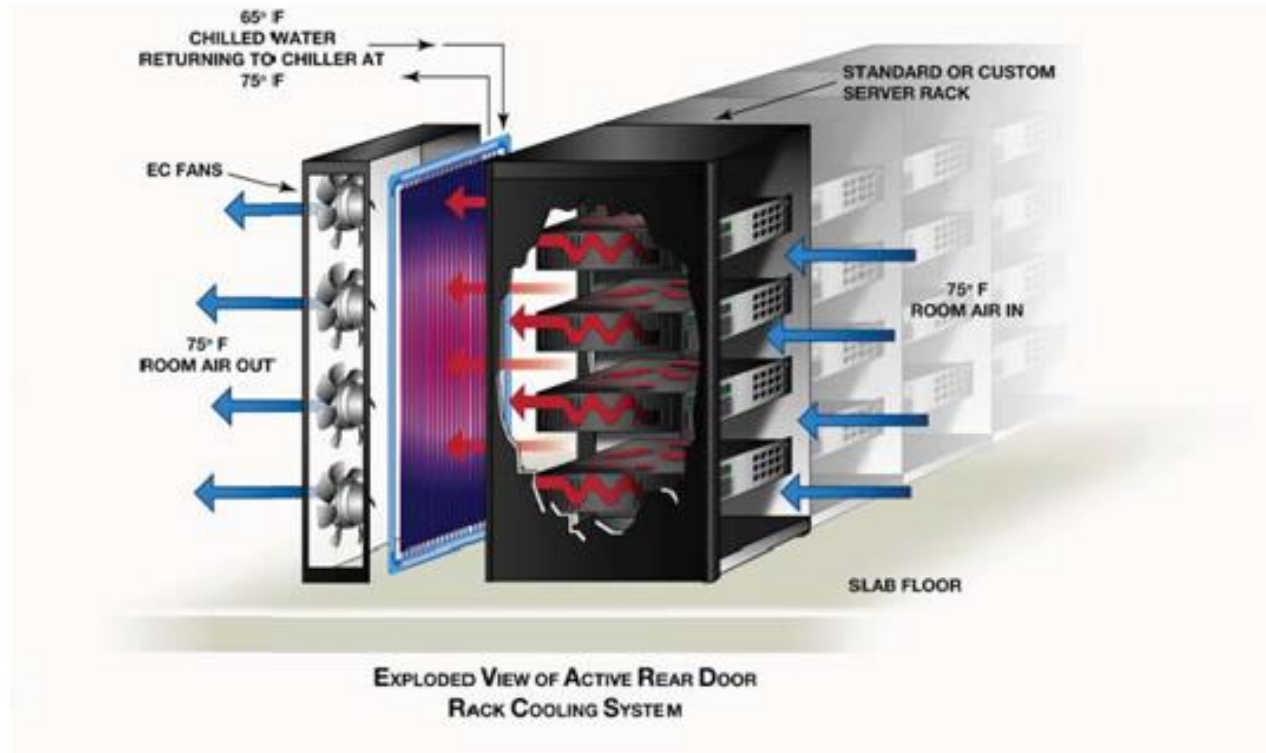
MCD-M15-E
70kW

MCD-M16
75kW



- Nine Standard Models
- Built in redundancy and resiliency features
- Advanced PLC control and safety system
- Exascale Ready
- UL/CSA/CE certified

Chilled Door – Operation



Chilled Door – Key components

- 1 0-75kW **100% Heat Removal**
- 2 **Hot Swappable** centrifugal fans
- 3 **Touch screen** display interface
- 4 High Efficiency **heat exchanger**
- 5 **Rack Agnostic** on Interface Frame



- 6 Regulation **2-way valve** on FWS
- 7 **TOP or BOTTOM** connection
- 8 **95° Door Swing**
- 9 **Quick-Disconnect connections** on FWS
- 10 **Leak Prevention System / Detection**

From Chip To Chiller



White space



System
Backbone



Heat
rejection



Chillers

Compressor-less solutions
(dry-coolers, Cooling towers)



XCAC / XCAF

Best in class Schneider Turbocor Chillers

2.4 MW cooling

capacity at IT conditions

+25% efficiency

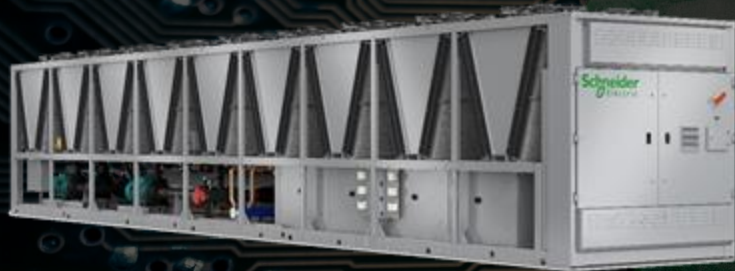
vs traditional technologies

30°C water setpoint

for air and liquid cooling application

7 GWP

200 times less than traditional refrigerants



XRAC / XRAF EHT

The best choice when it is not possible to get a choice

up to 40°C water

setpoint for low to high density chips

Flexibility

for a smooth transition from air-cooled to liquid-cooled servers

7 GWP

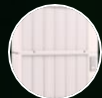
200 times less than traditional refrigerants

A broad cooling offer portfolio to support AI

PRECISION COOLING



Up to **250kW** Mid/Large air Cooling (CRAC/H)



Up to **500kW** Frontal discharge chilled water

INROW/RACK COOLING



Chilled water and Direct Expansion



RDHx



Micro DC



Air distribution

LIQUID COOLING



50-70kW Liquid to Air CDU, heat rejection unit



50kW to 2MW Liquid to Liquid Coolant Distribution Unit



Manifolds and Distribution

HEAT REJECTION UNITS FOR AIR AND LIQUID COOLED SERVERS



Up to **2MW** Air Cooled chillers



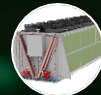
Up to **2MW** Free-cooling / economizers



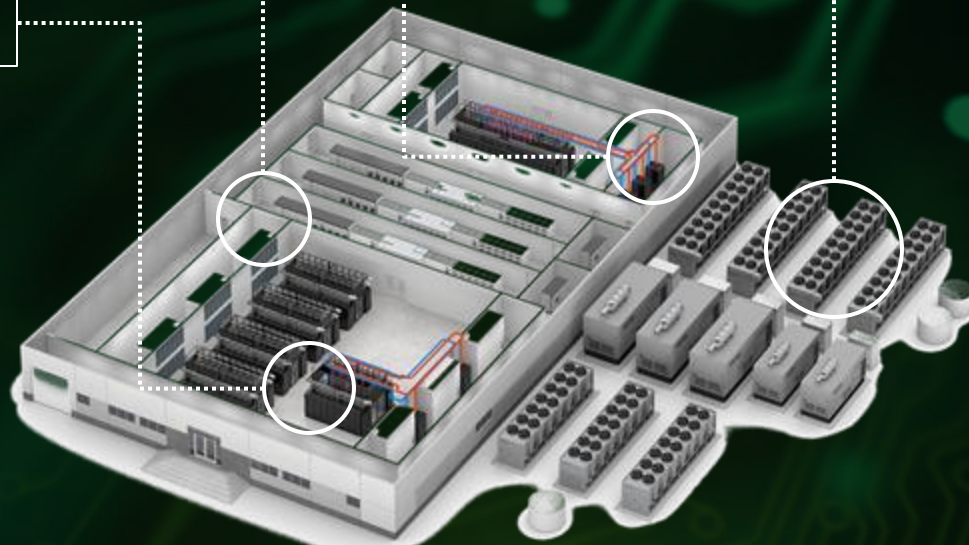
Up to **1.5MW** Free-cooler, compressor assisted



Up to **2.5MW** Water cooled chillers



Up to **1.5MW** Dry-cooler, Adiabatic coolers



While others talk about liquid cooling, Schneider Electric delivers it – globally, reliably, and at scale



Decades of unmatched leadership in advanced thermal management / high density cooling – pioneering innovation since the 1959.



A **global force** from design to deployment – Schneider Electric delivers, operates and maintains end-to-end.



Together with our **ecosystem of partners**, Schneider Electric delivers real solutions to cool and power Accelerated Compute & AI—meeting the needs of today and tomorrow.



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Gener
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