# The Future of Room-Based Cooling Systems in AI and High-Density Data Centers

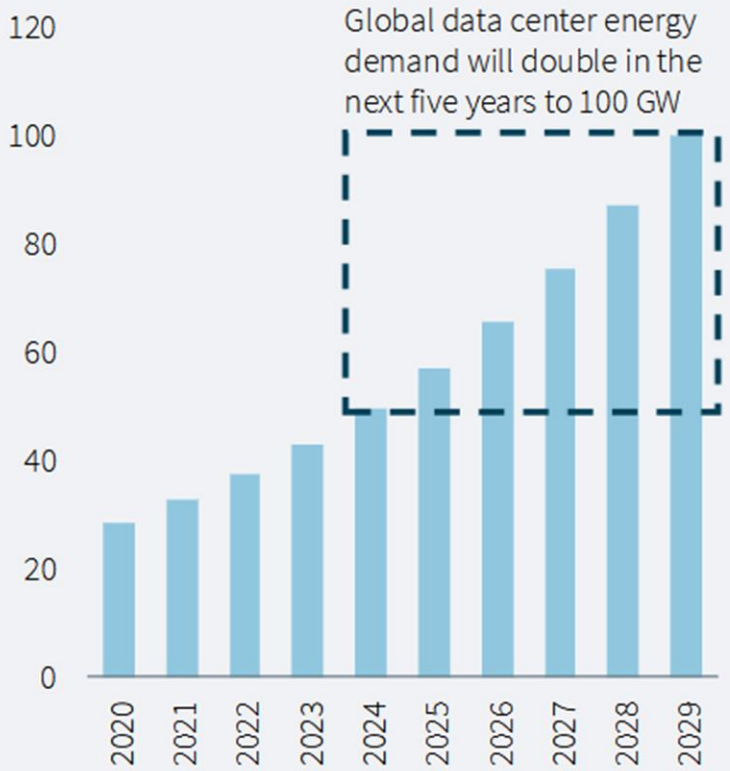
Datacenter Forum, Oslo

1. High-density trend & liquid cooling demand
2. Current significance of air cooling
3. Future outlook for air-assisted liquid cooling

# AI is accelerating DC capacity expansion

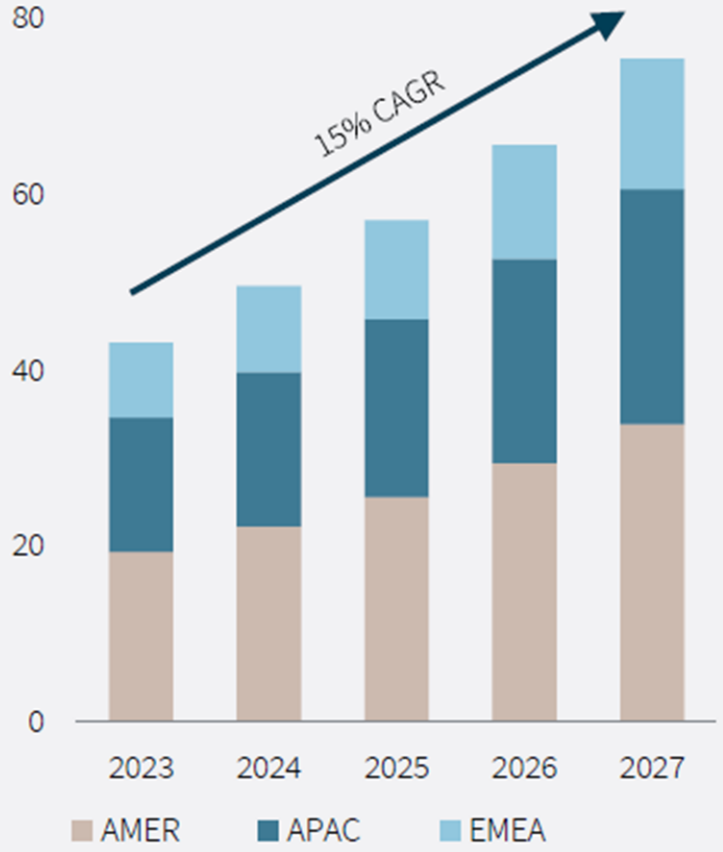
## High-density trend & liquid cooling demand

### Global data center energy demand (GW)




Sources: JLL Research, Structure Research
Note: Capacity includes hyperscale and colocation.

### Global data center capacity (GW)

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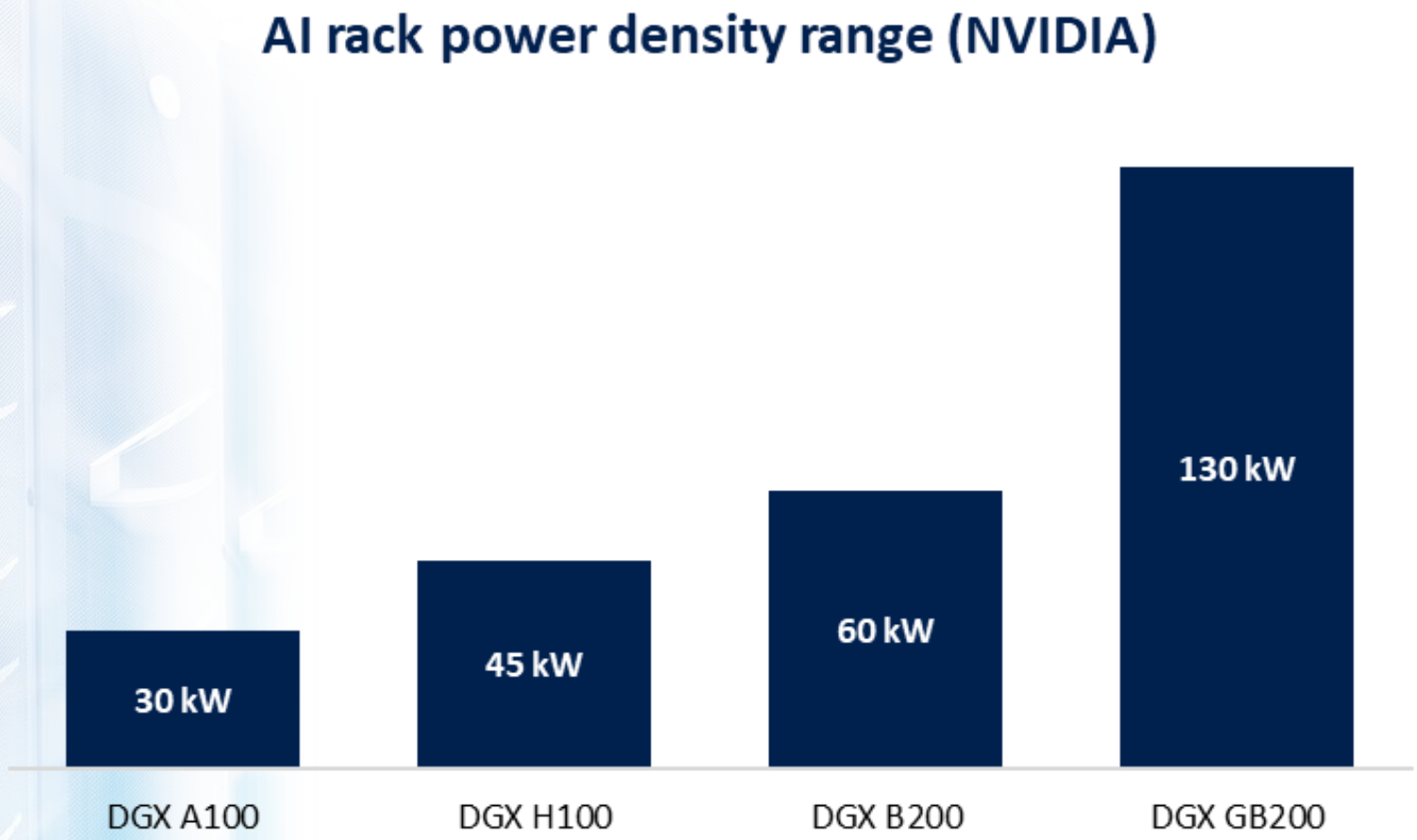
Note: Capacity includes hyperscale and colocation.

# AI workloads are increasing rack density

## High-density trend & liquid cooling demand

**The AI data center market is moving towards greater rack densities**

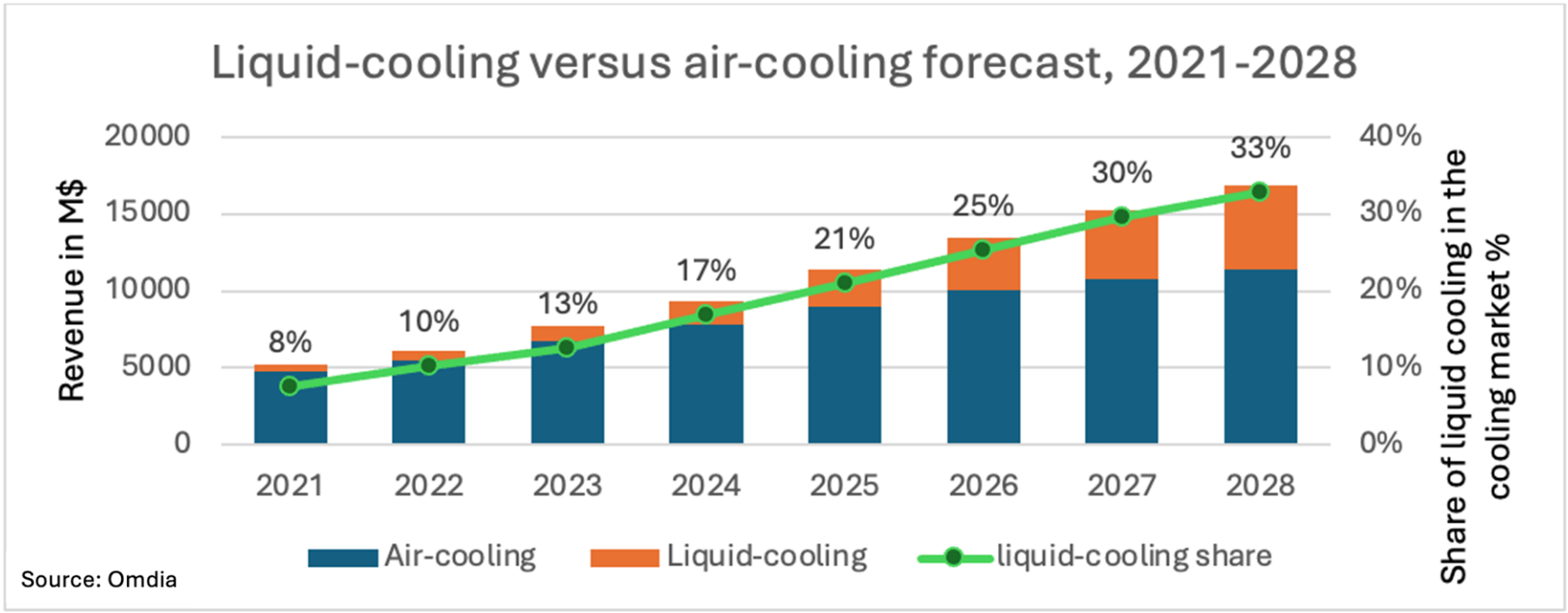


# AI is surging demand for liquid cooling

## High-density trend & liquid cooling demand

**Air Cooling: For many decades the only choice**

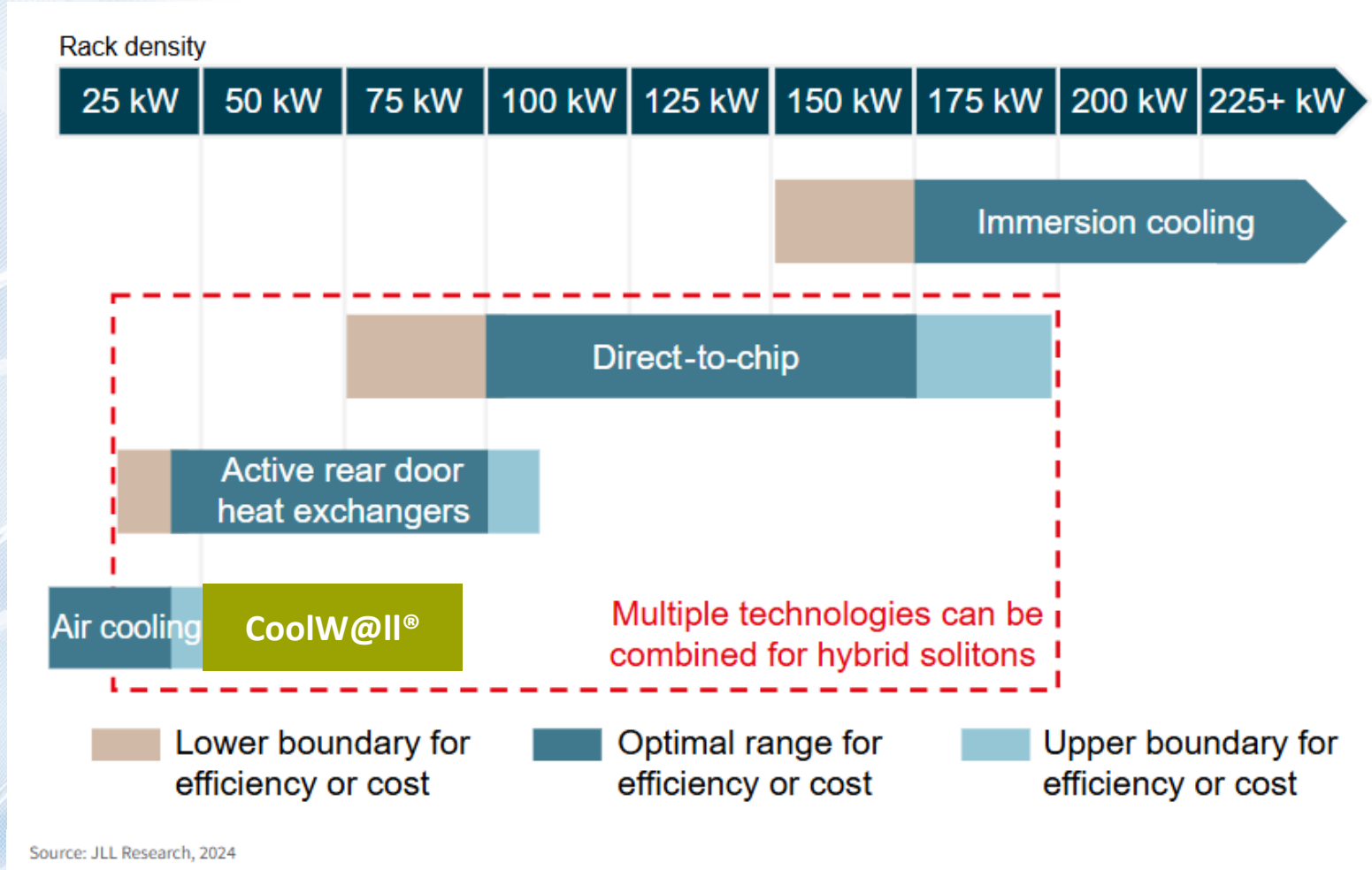
**Cheap, simple, well established**



# Applicable cooling technologies by rack density

## Current significance of air cooling

**Ranges are approximations that vary by manufacturer**




Source: JLL Research, 2024

# AI workloads are increasing rack density

## Current significance of air cooling

## NVIDIA DGX H100 – The popular standard for AI infrastructure.

| Feature | Specification |
|---|---|
| Operating Temperature | 5° C to 30° C (41° F to 86° F) |
| Relative Humidity | 20% to 80% non-condensing |
| Airflow | 1105 CFM Front-to-Back @ 80% fan PWM |
| Heat Output | 38,557 BTU/hr |

Source: NVIDIA

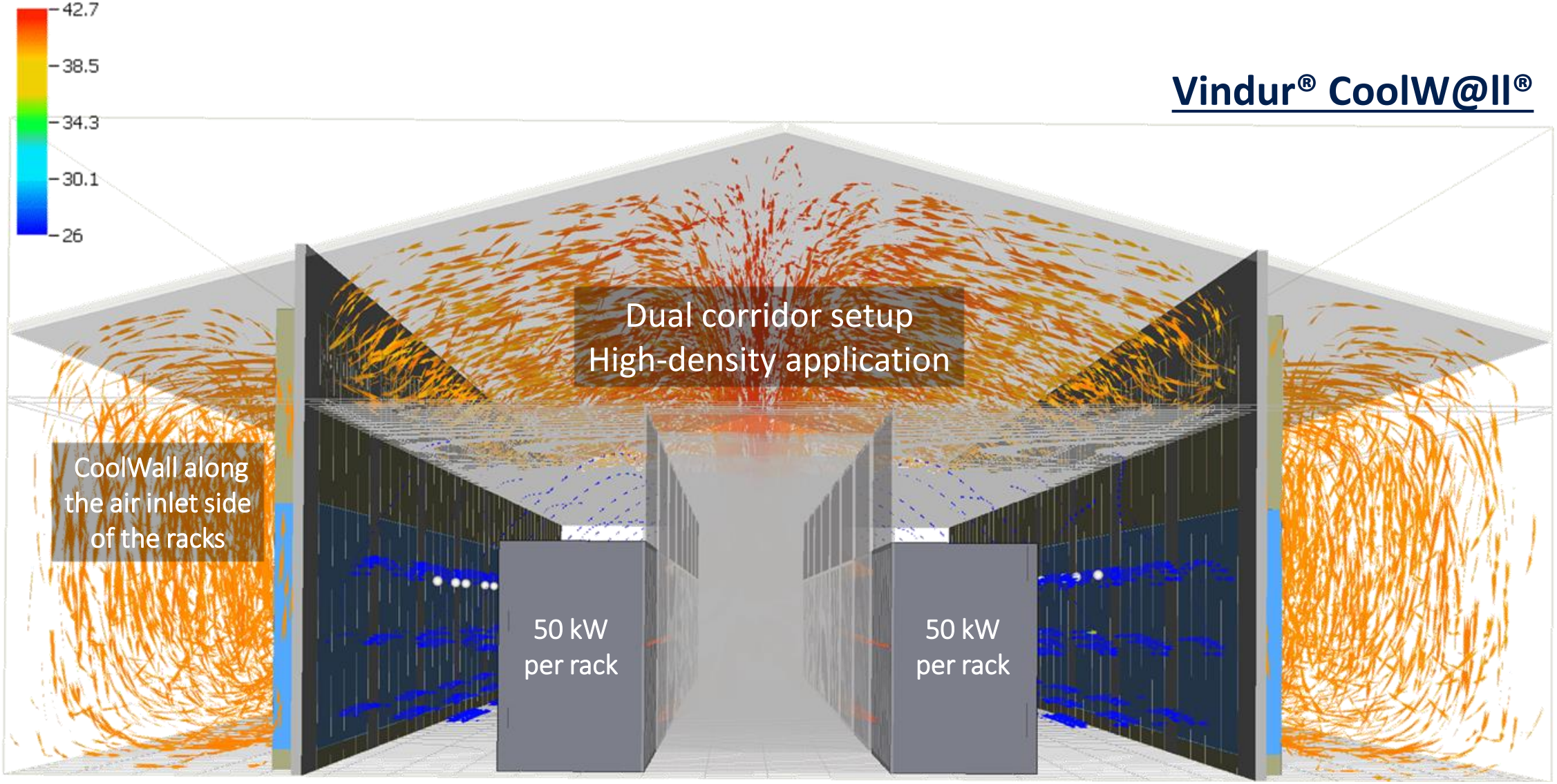
- 8 x H100 Tensor Core GPUs per DGX
- 4 x DGX systems per rack
- Airflow: 7.510 m³/h
- Heat load: 45,2 kW

dT: 18 K

# Pushing the boundaries of air cooling to the limits

## Current significance of air cooling

**Vindur® CoolW@ll®**



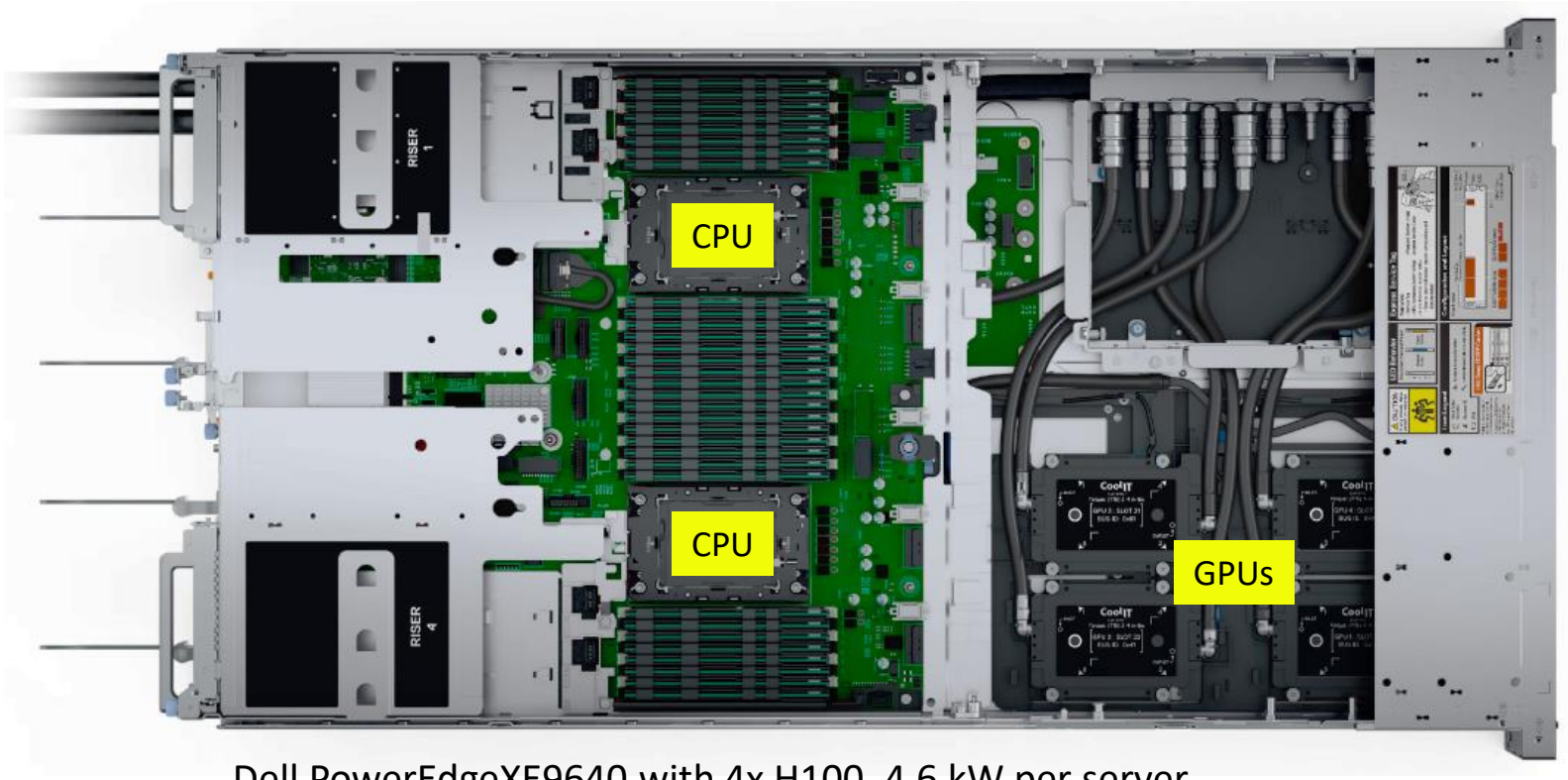
# Liquid-cooled servers still rely on air cooling

## Future outlook for air-assisted liquid cooling

### Direct-to-chip liquid cooling

- CPUs and GPUs are equipped with copper cold plates
- Cold water supply and hot water return circulate and remove the heat load from the CPUs and GPUs.
- Fans are required to collect the heat from non-liquid-cooled parts

**15-30 % of the heat load is still dissipated into the room!**




Dell PowerEdgeXE9640 with 4x H100, 4,6 kW per server

# The future will be HYBRID

## Future outlook for air-assisted liquid cooling


Source: NVIDIA

### NVIDIA GB200 NVL72 – The next chapter in generative AI.

- 36 Grace Blackwell Superchips in one rack
- Heat load: 132 kW

- Rule of thumb is 70/30:

  130 x 70 % = 91 kW of heat removed by DLC

  130 x 30 % = 39 kW of heat removed by air

- **Liquid cooling is becoming vital for AI DCs.**
- **Air Cooling will still play an important role.**
- **The future will be HYBRID!**

# Rear door heat exchangers as one option for the remaining heat load

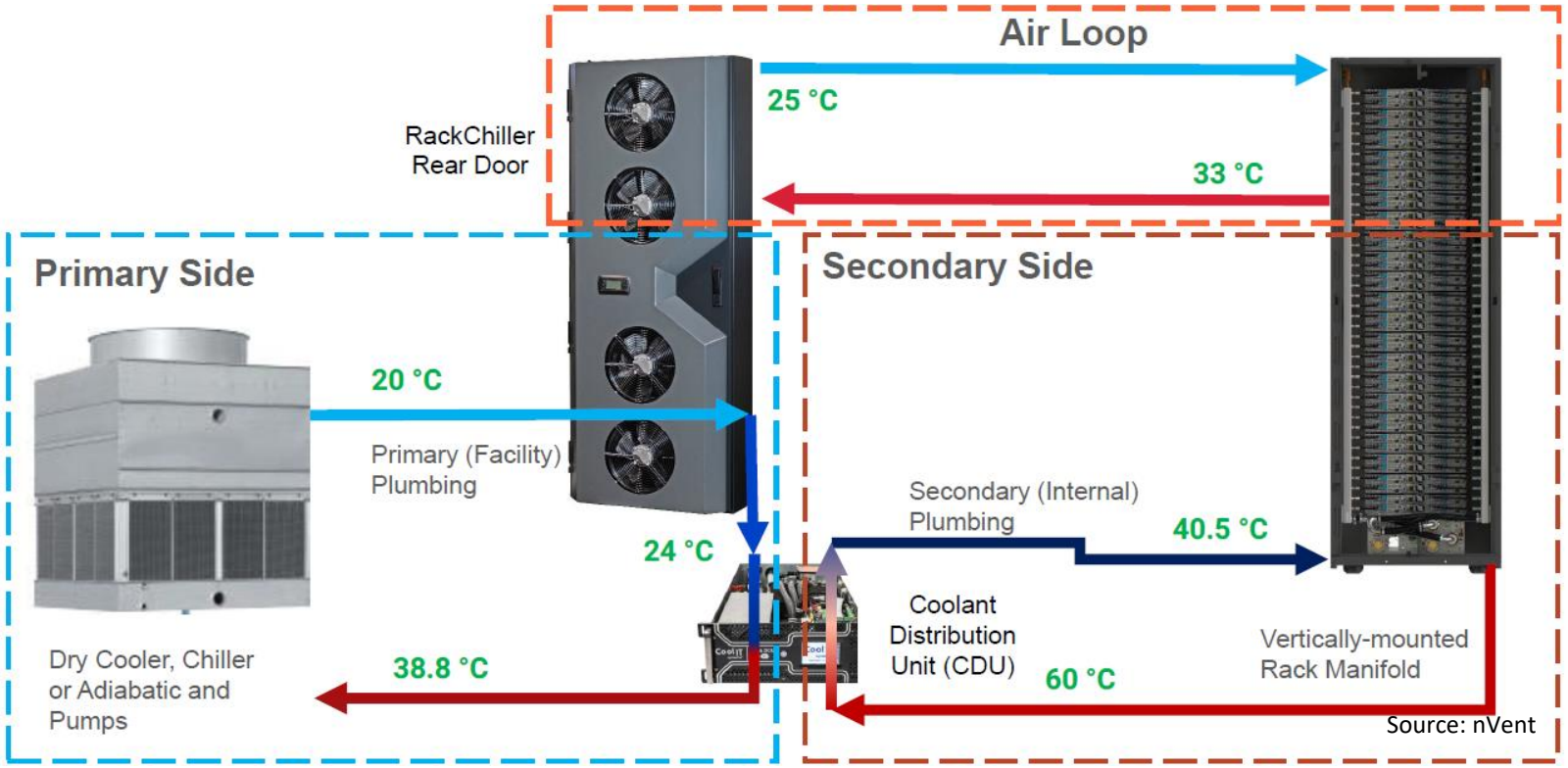
## Future outlook for air-assisted liquid cooling

## Pros:

- Physical proximity to the heat source => high ratio of real heat transfer to maximal heat transfer

## Cons:

- Higher fan power (multiple small fans are less efficient than one large fan)
- Higher CAPEX (multiple units compared to central units)



# CoolWalls (Fan Walls) as one option for the remaining heat load

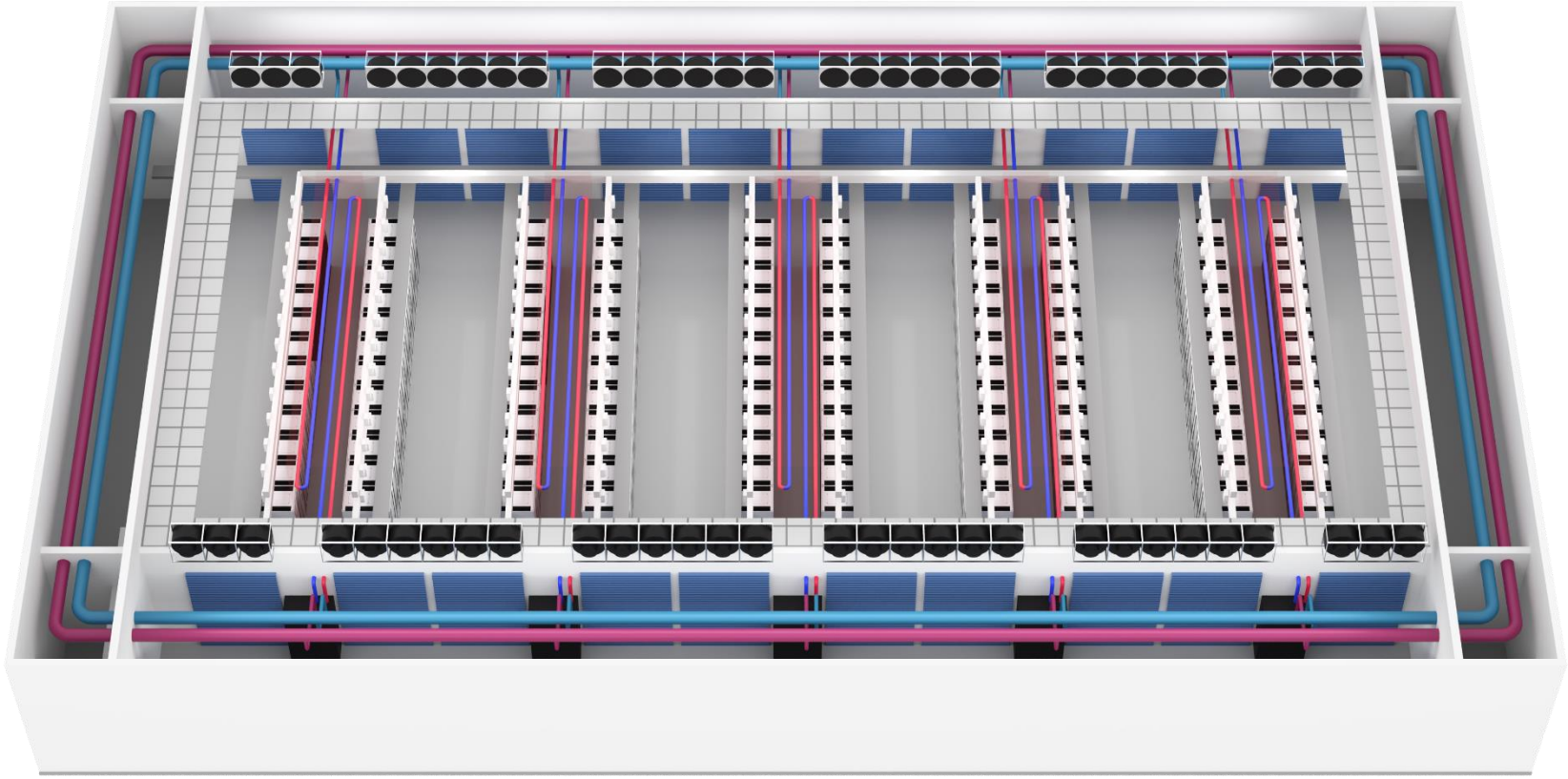
## Future outlook for air-assisted liquid cooling

### Pros:

- Lower CAPEX with fan walls than with multiple RDHx (including plumbing)
- Clear separation and easier Maintenance as the units are located outside the data hall
- Lower energy consumption

### Cons:

- More space is needed as one or two technical corridors are required
- Airtightness must be ensured



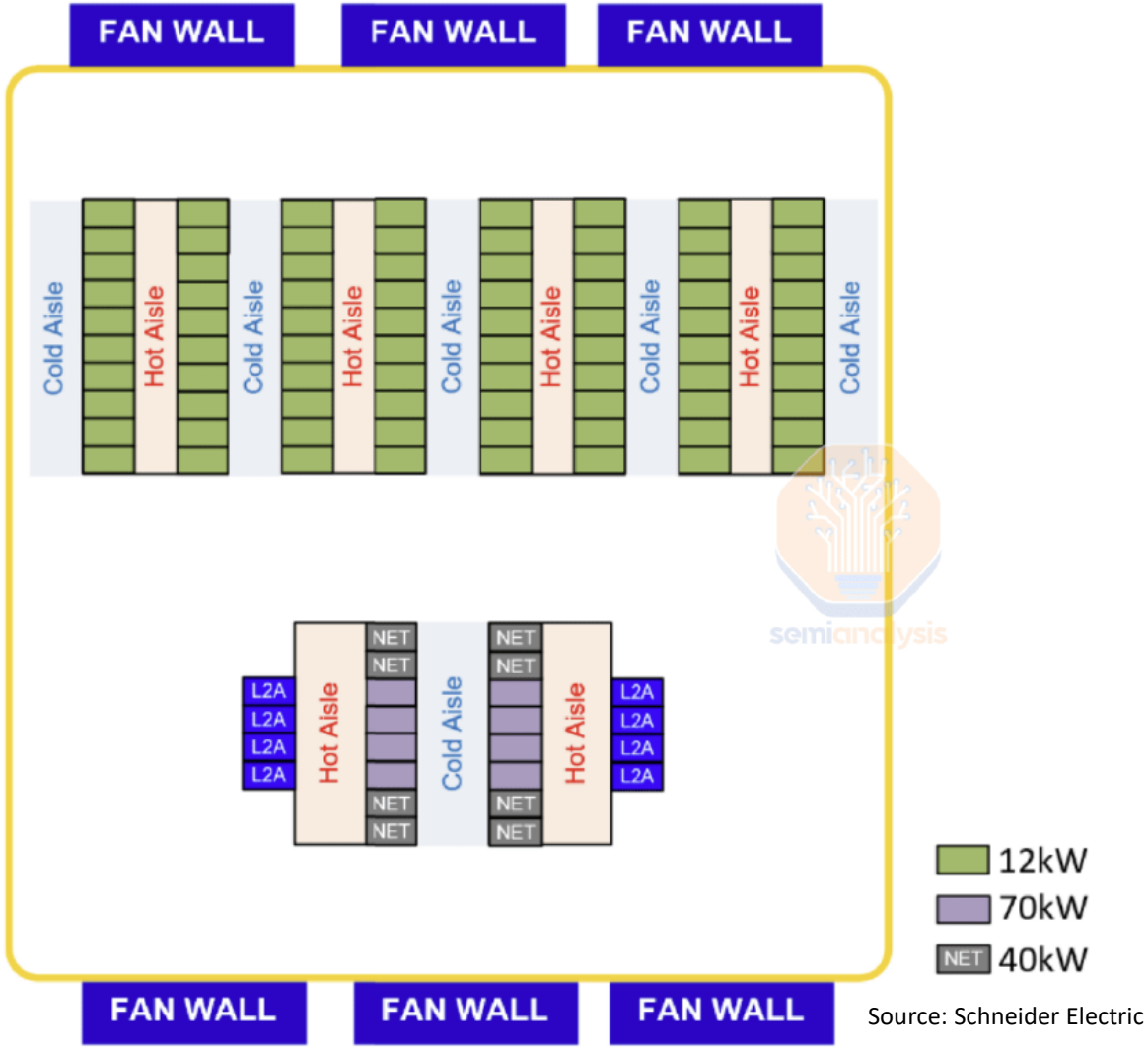
Source: Rittal

# CoolWalls (Fan Walls) as one option for the remaining heat load

## Future outlook for air-assisted liquid cooling

### In a typical data hall of the future:

- There will be still ordinary server racks with a lower heat load per rack which will be purely cooled by air
- There will be high-density clusters where the server racks will depend on a mix of direct liquid cooling plus air cooling




Source: Schneider Electric

# Minimization of the technical corridor

## Current significance of air cooling


# Best-in-class room-based air cooling

## Current significance of air cooling

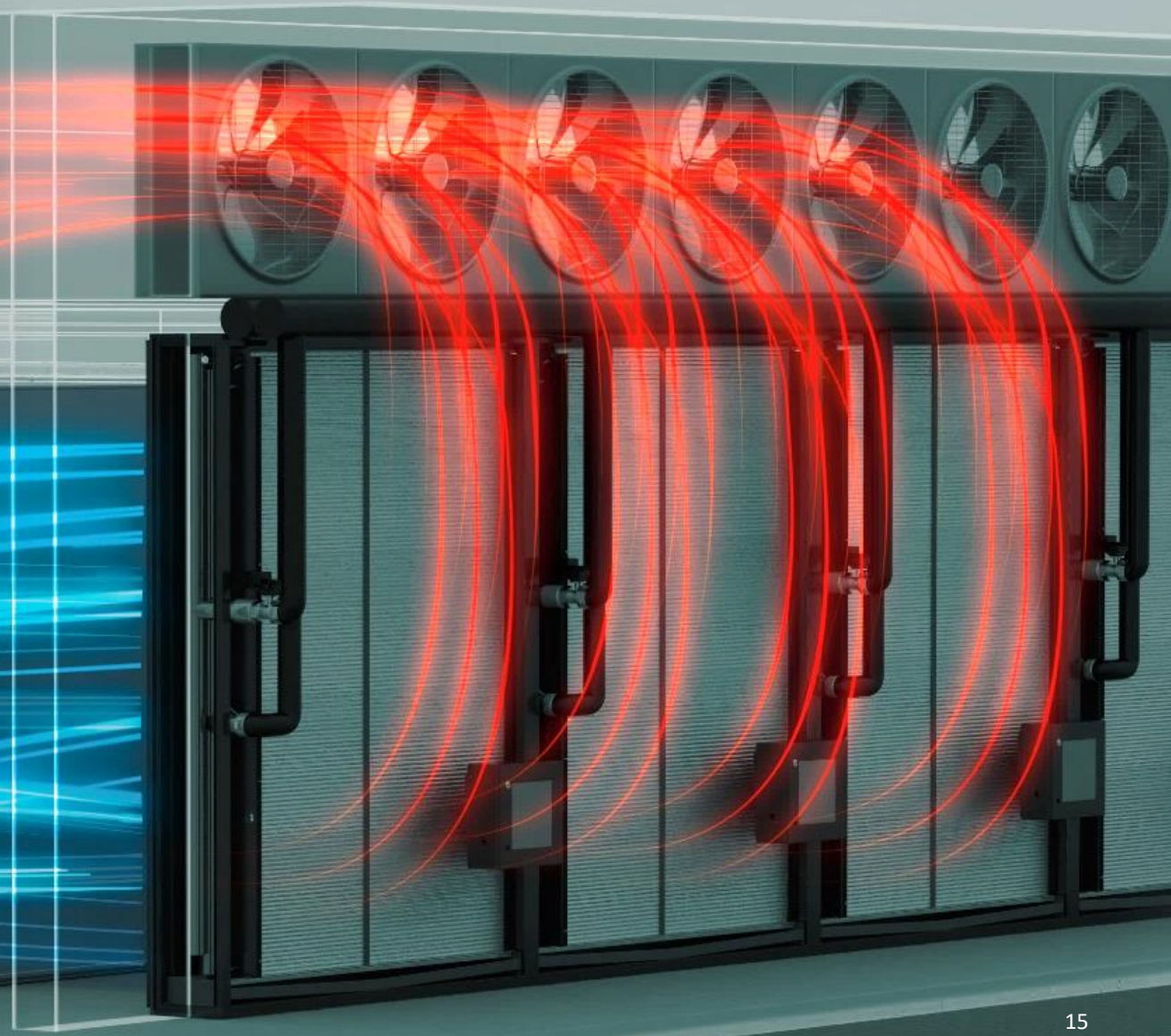
### Cooling wall system

**Built-in solution that maximizes cooling potential**

- ¬ Utilizing almost the entire room height/width
- ¬ Transforming service corridor into a walk-in cooling chamber

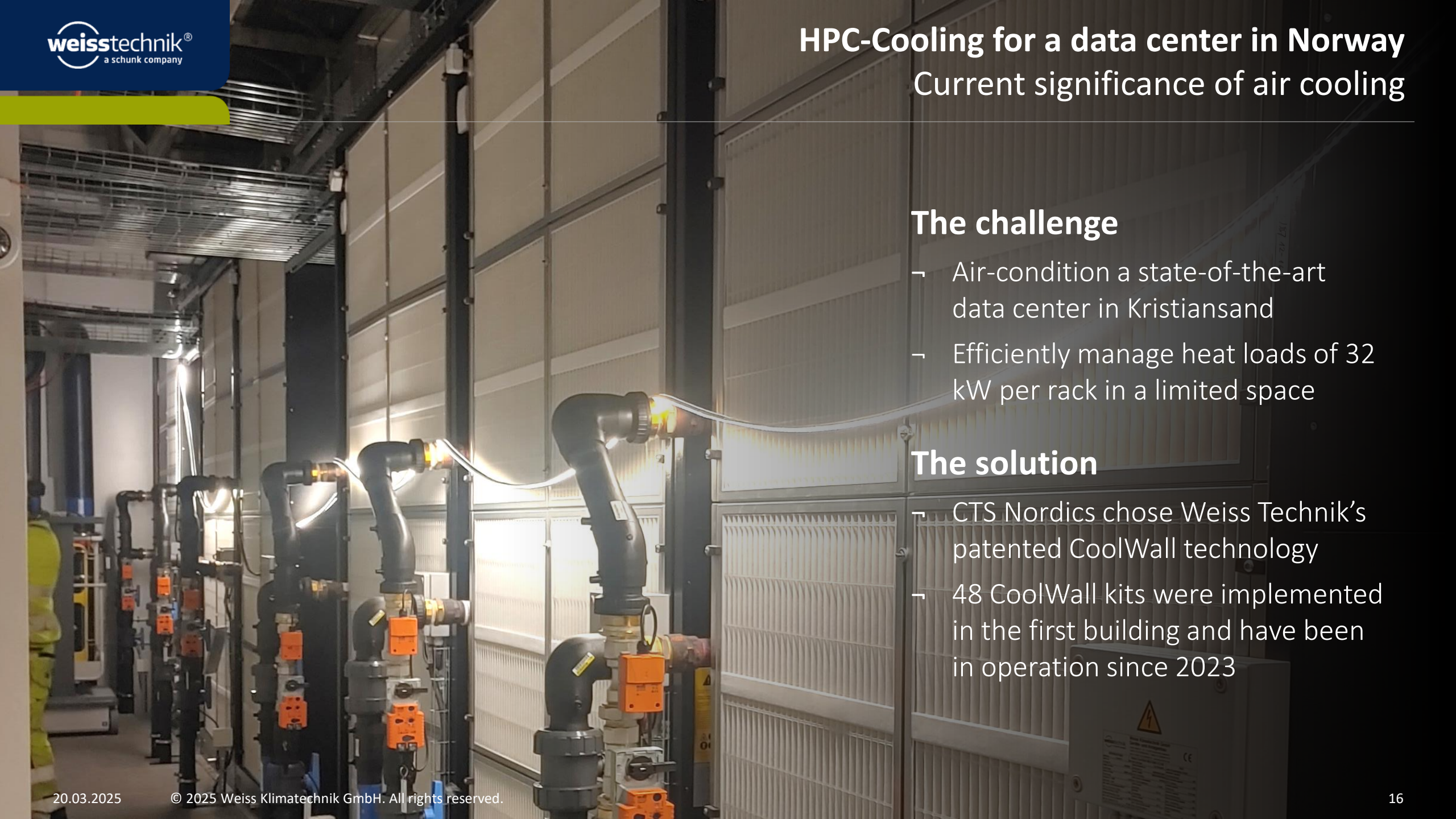
  - Enlarged coil and filter surfaces
  - Reduced internal pressure losses
  - Minimized floor space requirement

**Highest capacity per footprint and minimal power consumption!**



# HPC-Cooling for a data center in Norway

## Current significance of air cooling



### The challenge

- Air-condition a state-of-the-art data center in Kristiansand
- Efficiently manage heat loads of 32 kW per rack in a limited space

### The solution

- CTS Nordics chose Weiss Technik's patented CoolWall technology
- 48 CoolWall kits were implemented in the first building and have been in operation since 2023

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