EUROVENT

# DATA CENTRE COOLING
# GUIDEBOOK



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# CONTENTS


**1. WHAT DATA CENTRE COOLING IS AND WHY IT MATTERS 04**

1.1. What data centre cooling is 04

1.2. Why it matters in the modern economy 04

1.3. Why it matters for the environment 04

**2. TECHNOLOGIES 05**

2.1. Fundamentals 05

2.2. Air cooling 06

2.3. Liquid cooling 10

2.4. Chilled water production 13

2.5. Heat rejection 13

2.6. Waste heat recovery 14

2.7. Free cooling 16

2.8. Indoor air quality 18

2.9. Smart controls 18

2.10. Refrigerants 18

**3. SYSTEM PERFORMANCE 19**

3.1. Data centre performance metrics 19

3.2. Climate—performance link 20

**4. PRODUCT PERFORMANCE, WITNESS TESTING AND CERTIFICATION 21**

**5. STANDARDS 22**

**6. LEGISLATION 23**

6.1. Energy Efficiency Directive and data centre sustainability 23

6.2. Ecodesign for data centre cooling equipment 24

6.3. F-Gas Regulation 24

**7. THE EUROPEAN DATA CENTRE COOLING INDUSTRY 25**

7.1. Companies that contributed to this Guidebook 25

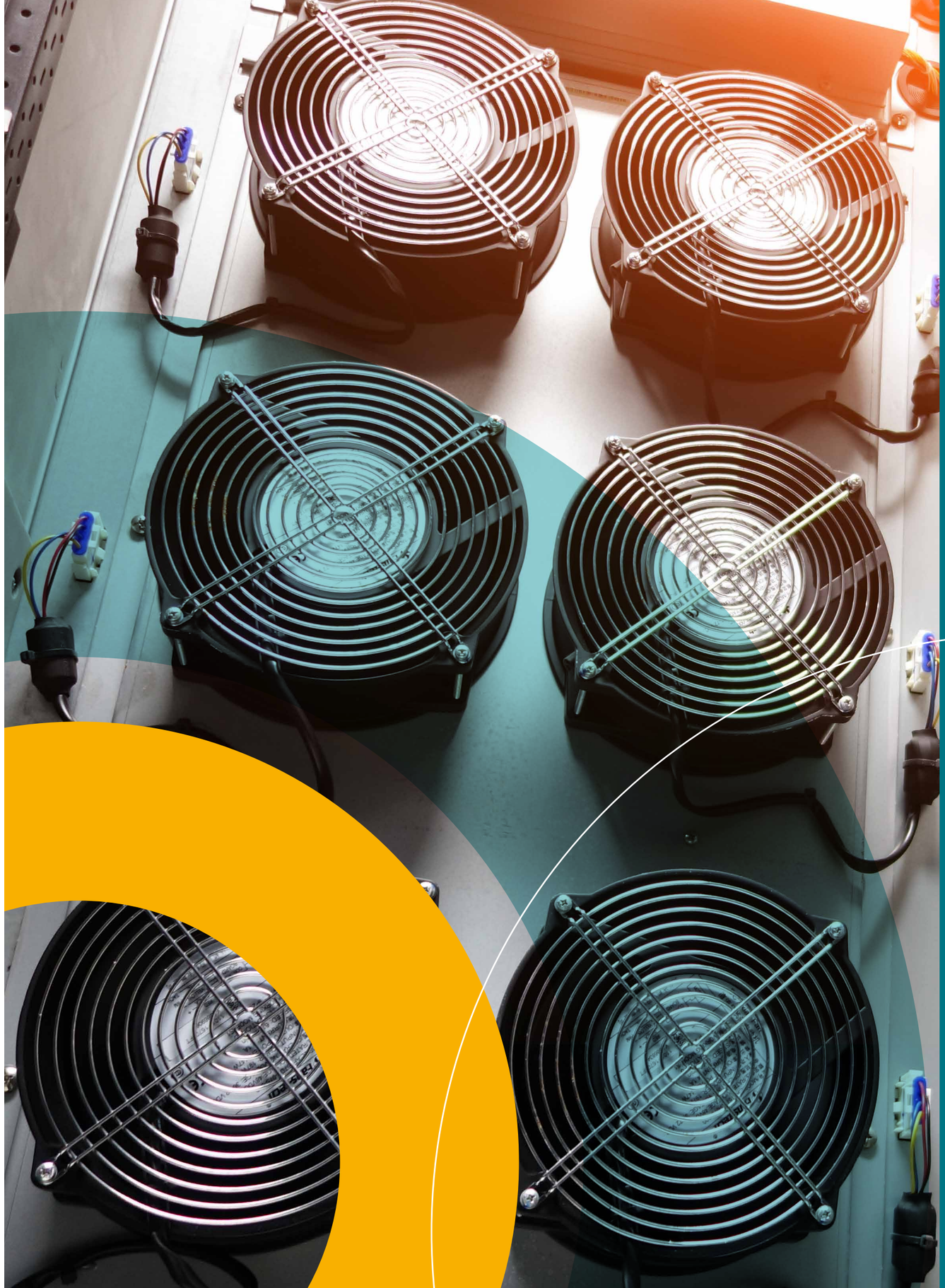
7.2. Manufacturing sites 25

7.3. Turnover 25

7.4. Direct and indirect employment 25

7.5. R&D 25

**8. ABOUT EUROVENT 27**

# 01 WHAT DATA CENTRE COOLING IS AND WHY IT MATTERS

This guidebook explains, in clear and technology-neutral terms, what data centre cooling is, how it works, and why it matters. It builds a shared technical vocabulary for informed policy-making, to align data centre performance requirements with environmental goals without compromising reliability in this mission-critical application.

## 1.1. What data centre cooling is

When a processor performs calculations, the electrical energy it consumes is converted into heat. If that heat is not removed, performance declines and equipment fails. Data centre cooling exists to transfer heat away from IT equipment to keep it within safe operating limits, so it delivers continuous service.

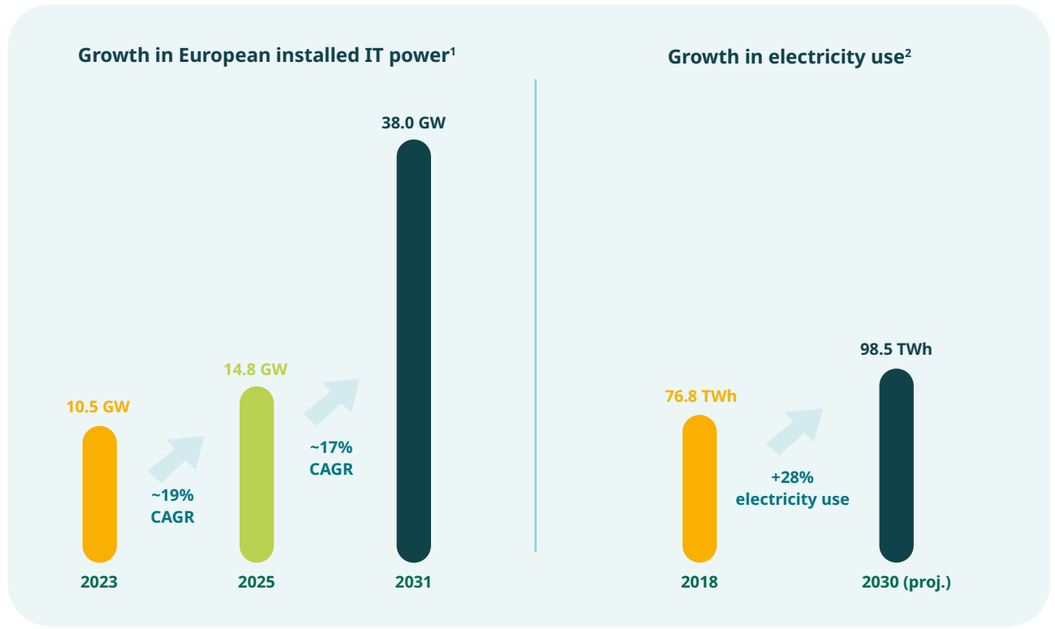
## 1.2. Why it matters in the modern economy

Every time you stream a film, store photos in the cloud, join a video call or use AI, your request is processed in a data centre. These facilities are the backbone of the digital economy and are increasingly treated as critical infrastructure, since outages can disrupt payments, communications, logistics or emergency services.

## 1.3. Why it matters for the environment

As demand for digital services continues to rise sharply, new data centre capacity (measured in installed IT power) and its associated electricity use are growing to match. Cooling can account for up to 40% of a data centre's electricity use.

In short, data centres are critical infrastructure, and cooling is essential to keep them running. If cooling fails, digital services are interrupted. It is therefore essential that rules allow for the tailoring of cooling solutions to local conditions such as climate, space and energy and water availability, ensuring reliability and optimising utility use.



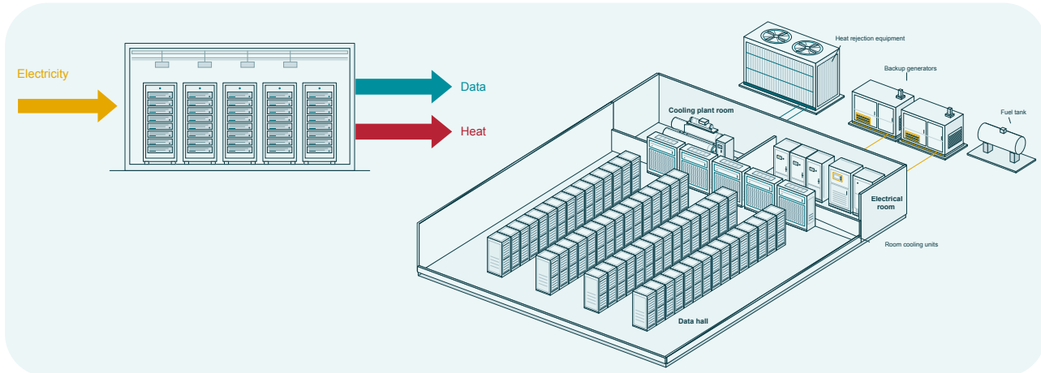

[1]EUDCA, State of European Data Centres 2026, pp. 6, 9. 2031 figure extrapolated.
[2]Directive (EU) 2023/1791 on energy efficiency, recital 85.



# 02 TECHNOLOGIES

## 2.1. Fundamentals

A data centre is an engineered environment designed to host information technology equipment and ensure its reliable operation. It typically consists of a dedicated room or building containing one or more server enclosures with a total IT load over 2 kW (and scalling up to several hundred MW). Within this space, servers, storage and networking equipment operate continuously, converting electrical power into computing work and heat that must be managed to avoid performance loss or downtime.




### The cooling chain

Cooling in a data centre can be understood as a chain that begins at the microprocessor and ends with heat rejection to the outdoor environment (or heat recovery). Heat generated at chip level must be transferred through successive stages, with overall performance depending on how well the system functions end to end. Because data centres are mission-critical, each stage must be designed with redundancy and resilience to perform reliably under peak loads and adverse conditions.

Heat rejection / recovery

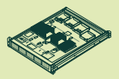
**Microprocessor**

At the core of each server is the **microprocessor**, which executes instructions and generates concentrated heat that must stay within safe temperature limits.



**Server**

**Servers** combine processors with memory, storage, power supply units, and network interfaces in standardised chassis that fit into racks.



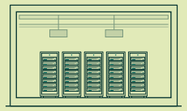
**Rack**

**Racks** organise and power multiple servers in a compact footprint, creating high power density and structured connections for cooling and networking.



**Data Hall**

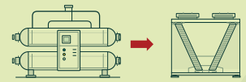
These racks are installed in the **data hall**, or white space of the data centre, where cooling is managed at room level through airflow or liquid distribution.



**Cooling Plant**

**Outdoors**

Beyond the data hall, the surrounding facility includes power systems, backup generation, safety systems and the cooling plant. Heat is transferred from the data hall to the cooling plant, where it is ultimately rejected to the outdoor environment, and/or partially recovered.

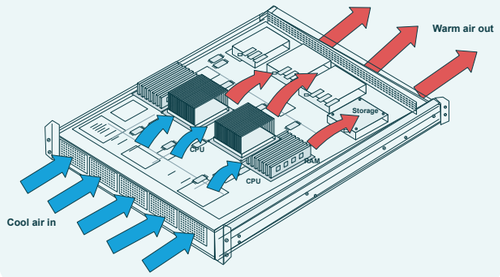


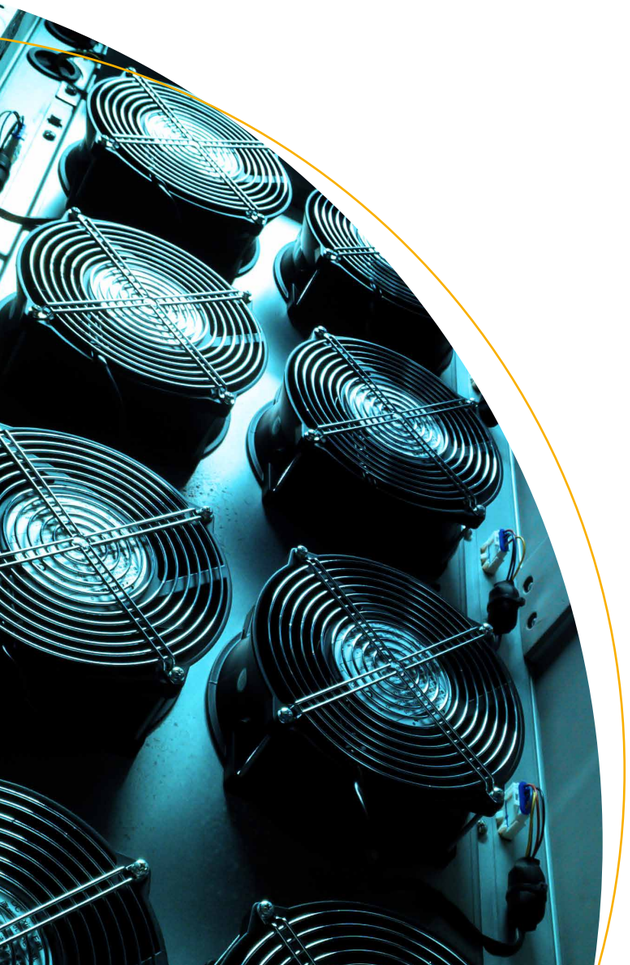
## 2.2. Air cooling

In air-cooled data centres, air absorbs heat from IT equipment before transferring it to cooling systems that ultimately reject or recover the heat.

### 2.2.1 Air-cooled servers

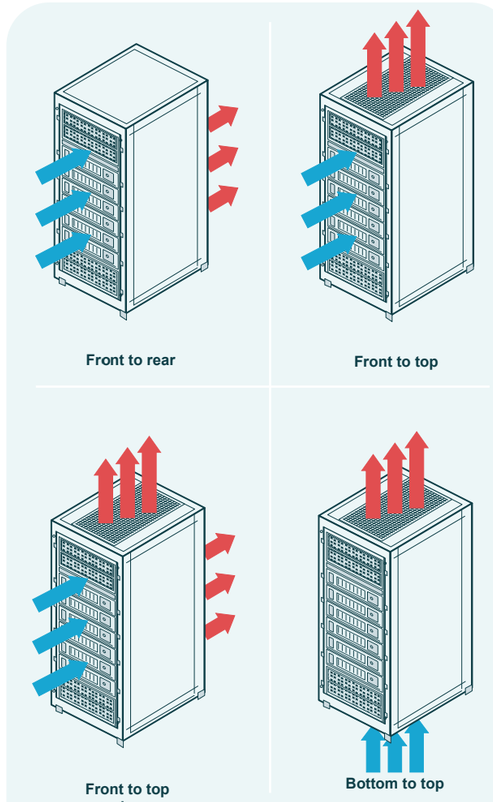
Air-cooled servers typically use front-to-back airflow. Fans draw cool air across heat generating components, including processors, accelerators and memory, before expelling warm exhaust air at the rear.



### 2.2.2 Racks for air-cooled environments

Racks typically align server intakes towards cold aisles and exhausts towards hot aisles. Blanking panels and containment systems limit air mixing and recirculation, improving temperature control.




### 2.2.3 Air-cooling architectures

Several architectures can deliver conditioned air to IT equipment. They can be combined or adapted to site conditions, power densities and operational requirements.

#### 2.2.3.1 Room-level cooling

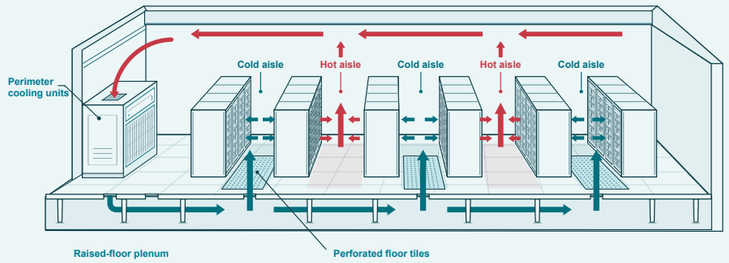
In room-level cooling, perimeter CRAC or CRAH units condition air, which is distributed across the data hall. The main configurations differ in how cooled air reaches the servers.

In raised-floor systems, cooling units supply air through an underfloor plenum and perforated tiles into the cold aisles. Thermal wall systems discharge cooled air directly into the aisles from cooling units aligned along a wall or at the end of rack rows.

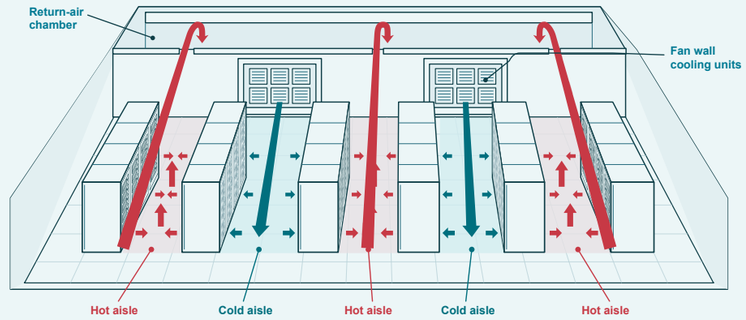
Hot- and cold-aisle containment can be used in these configurations to limit air mixing and maintain stable server inlet temperatures.



**Raised-floor configuration:**



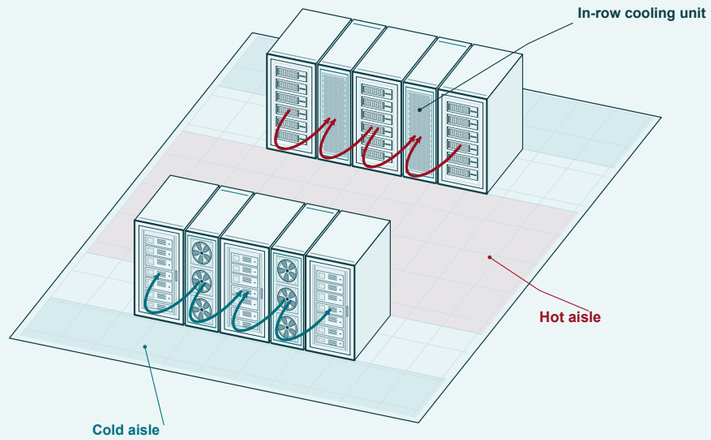

**Thermal wall configuration:**




#### 2.2.3.2 In-row cooling

In-row cooling units are installed between server racks. They draw warm air from the hot aisle, cool it locally and discharge conditioned air into the adjacent cold aisle.

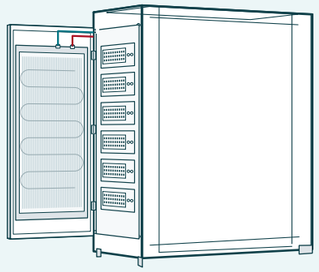
Short airflow paths improve temperature control and support higher rack densities. Cooling capacity can be added modularly, although the units require space and maintenance access within the rack layout.

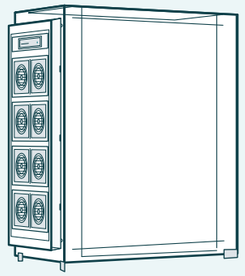


### 2.2.3.3 Rear-door heat exchanger

A Rear-Door Heat Exchanger (RDHx) uses a liquid-cooled coil integrated into the rear door of a server rack. Warm exhaust air passes through the coil, transferring much of its heat to the circulating liquid before returning to the room.

The servers remain air-cooled, but less heat is released into the data hall, reducing the demand on room-level cooling without changing the air supply arrangement.





### 2.2.3.4. Dedicated data-centre Air Handling Units

Dedicated data-centre Air Handling Units (AHUs) centrally condition and circulate large volumes of air, typically from outside the data hall. Warm return air is collected through ducts or plenums, cooled in the AHU and supplied back to the cold aisles.

These systems can integrate direct or indirect free cooling, evaporative enhancement and supplementary mechanical cooling (see section 2.7). They are particularly suited to facilities requiring large cooling capacities and centralised airflow management.





## 2.2.4 Cold air supply

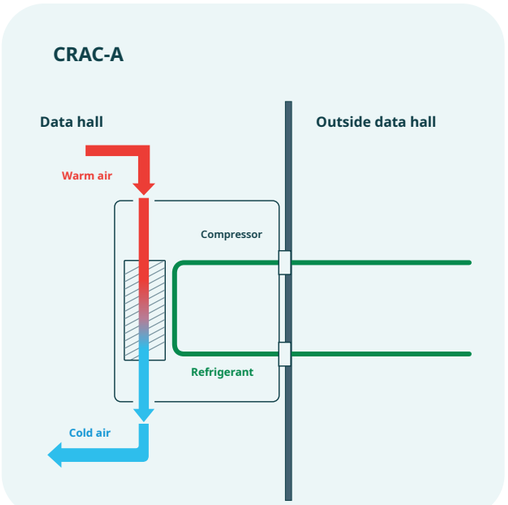
Air-cooling units can use either direct expansion (DX) refrigeration or chilled water coils to condition data hall air.

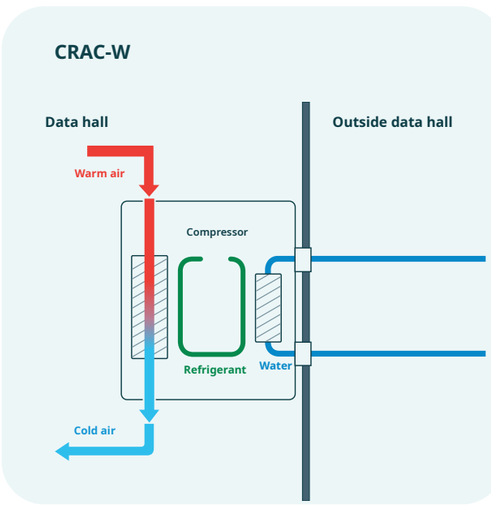
### 2.2.4.1 Computer Room Air Conditioner

A Computer Room Air Conditioner (CRAC) uses a direct expansion (DX) refrigeration circuit to cool data hall air.

In an air-cooled CRAC (CRAC-A), refrigerant absorbs heat from the air and rejects it directly to outdoor air through a remote condenser.

In a water-cooled CRAC (CRAC-W), the refrigerant transfers heat to a water loop, which carries it to outdoor heat rejection equipment. Both configurations use DX cooling, differing in how the heat is ultimately rejected.

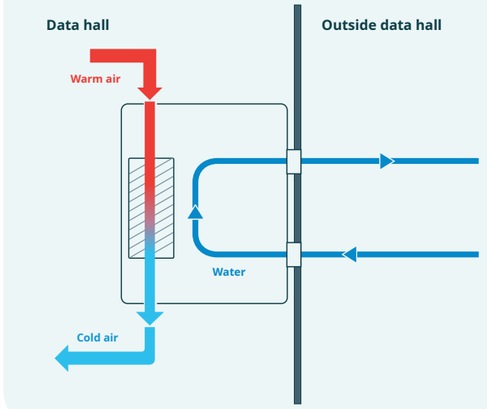



### 2.2.4.2 Computer Room Air Handler

A Computer Room Air Handler (CRAH) cools data hall air using a chilled water coil supplied by a central cooling plant, rather than its own refrigeration circuit. Fans circulate conditioned air back into the IT space.

Thermal wall units operate on the same principle but differ in installation and air distribution (see section 2.2.3.1). Higher chilled water temperatures can improve plant efficiency and facilitate free cooling or heat recovery.




CRAH units and so-called thermal wall systems belong to the same functional category: both are air handlers using chilled water as the cooling medium. The difference lies mainly in airflow distribution and installation. CRAH systems are commonly associated with raised-floor applications, while thermal wall configurations are typically used in slab-floor layouts. Because cooling generation is centralised, CRAH-based architectures can scale efficiently and enable higher chilled-water temperatures, which may improve overall plant efficiency and facilitate economisation or heat reuse, provided airflow management and IT operating conditions are aligned.

### 2.2.4.3 In-row cooling units

In-row cooling units (see section 2.2.3.2) can use either DX refrigeration, like CRAC units, or chilled-water coils connected to a central cooling plant, like CRAH units.

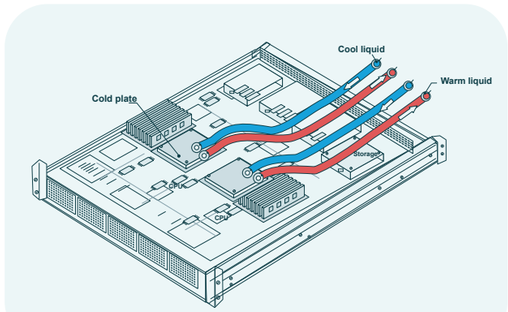
## 2.3. Liquid cooling

As power densities increase, removing heat using air alone becomes more challenging. Liquid cooling addresses this by using a fluid with a much higher heat capacity than air to absorb and transport heat. The main approaches include **cold plate (or direct-to-chip) cooling**, where cold plates remove heat from processors, and **immersion cooling**, where servers are submerged in a dielectric fluid.

### 2.3.1 Cold plate cooling

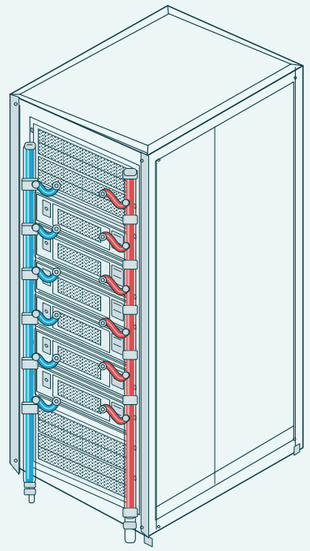
#### 2.3.1.1 Liquid-cooled servers

Cold plate cooling, also known as direct-to-chip cooling, removes heat directly from processors and accelerators using liquid-cooled metal plates. Coolant circulates through channels in the plates, absorbing heat and carrying it through hoses to the rack-level manifold. Other server components may remain air-cooled.




#### 2.3.1.2 Racks for cold plate cooling

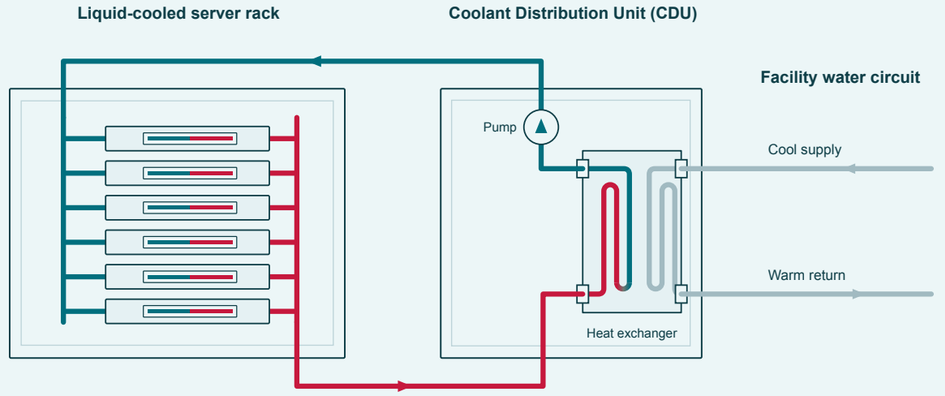
In cold plate liquid cooling, racks integrate supply and return manifolds that distribute coolant to each server through quick-connect fittings.

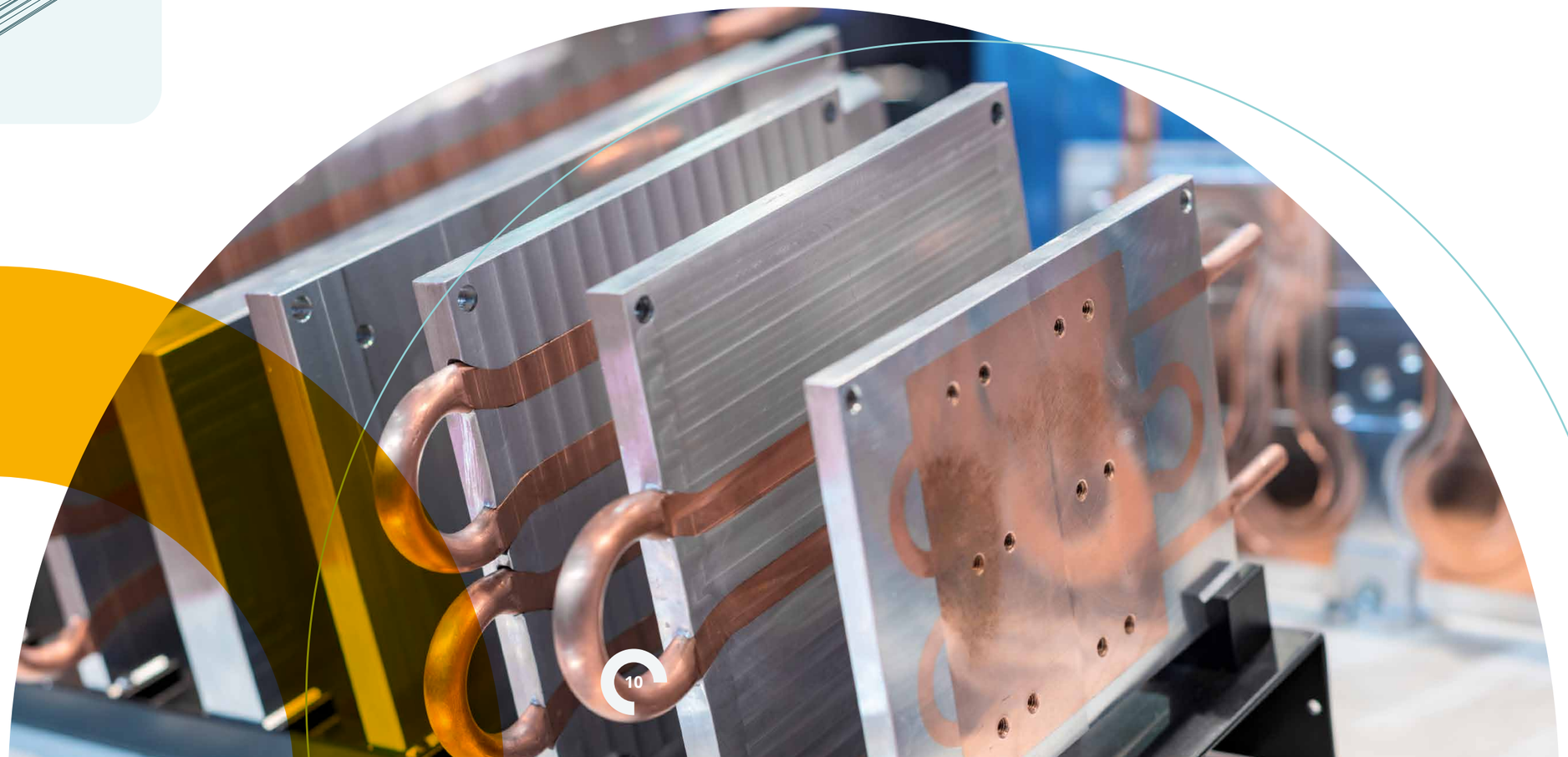


#### 2.3.1.3 Cooling architecture for cold plate cooling

Most direct-to-chip systems use two separate hydraulic loops. The IT loop circulates coolant between servers and a Coolant Distribution Unit (CDU), which controls flow, pressure and temperature while transferring heat through a heat exchanger. The facility loop carries this heat to the cooling plant, heat rejection equipment or a heat reuse system. This separation protects IT equipment from fluctuations in the facility water system.

Liquid cooling can operate at higher supply temperatures than traditional air-cooling systems, reducing compressor use, enabling free cooling and facilitating heat reuse. It can supplement or replace air cooling at server or rack level.



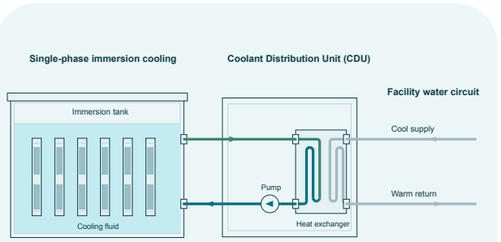



### 2.3.2 Immersion cooling

In immersion cooling, the server is placed directly into a tank filled with a specially designed dielectric fluid, which does not conduct electricity. Instead of using air or cold plates attached to individual chips, the entire server is submerged in this fluid. As electronic components operate, heat is transferred directly from their surfaces into the surrounding liquid. Immersion cooling systems apply specially designed enclosures rather than conventional open racks.

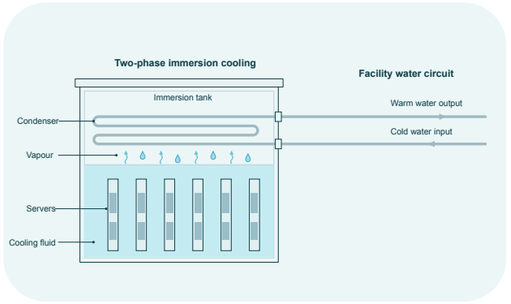
#### 2.3.2.1 Single-phase immersion

In single-phase immersion, the dielectric fluid remains liquid while absorbing heat from server components. Pumps circulate the warmed fluid through a heat exchanger, often integrated into a Coolant Distribution Unit (CDU), which transfers heat to a separate facility cooling loop. The heat is then rejected through cooling equipment or recovered for reuse. Flow rates and supply temperatures regulate cooling.




#### 2.3.2.2 Two-phase immersion

In two-phase immersion, heat from server components vaporises a low-boiling-point dielectric fluid. The vapour rises and condenses on a cooled surface above the fluid bath, returning as liquid by gravity. This cycle typically requires no pumps for the dielectric fluid. A separate facility cooling loop removes heat through the condenser for external rejection or reuse.



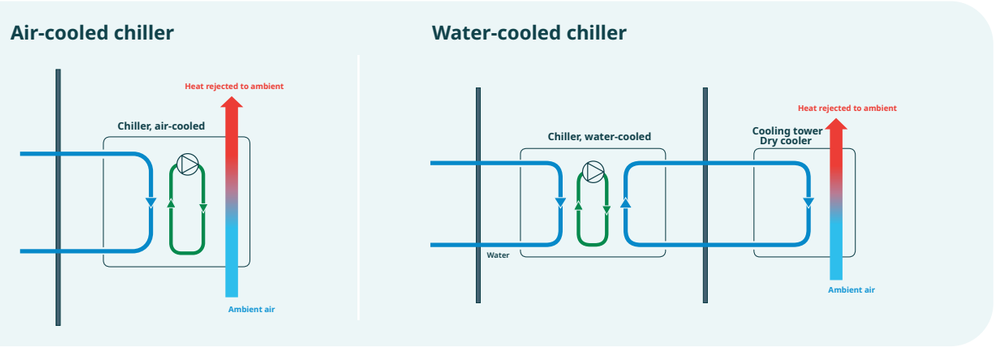





## 2.4. Chilled water production

In architectures that use chilled water, such as CRAH systems, thermal wall units and many water-based in-row modules, a central plant is required to produce that chilled water. Chillers are the most common means of doing so. They remove heat from a water circuit and transfer it to an external sink, typically outdoor air or a condenser-water loop. Their efficiency and environmental impact are closely linked to the method of heat rejection and the operating temperatures of the system.

The most common type is the vapour-compression chiller, which uses electrically driven compressors and may be air-cooled or water-cooled. Air-cooled chillers reject heat directly to outdoor air through condenser coils and fans. They are simpler to install and do not require a condenser-water loop, but their efficiency depends strongly on ambient air temperature. Water-cooled chillers transfer heat to a condenser-water loop, which then rejects heat via dry, adiabatic, hybrid or evaporative heat rejection equipment. They typically achieve higher efficiency in large facilities but require additional infrastructure and, in some cases, water use and treatment.

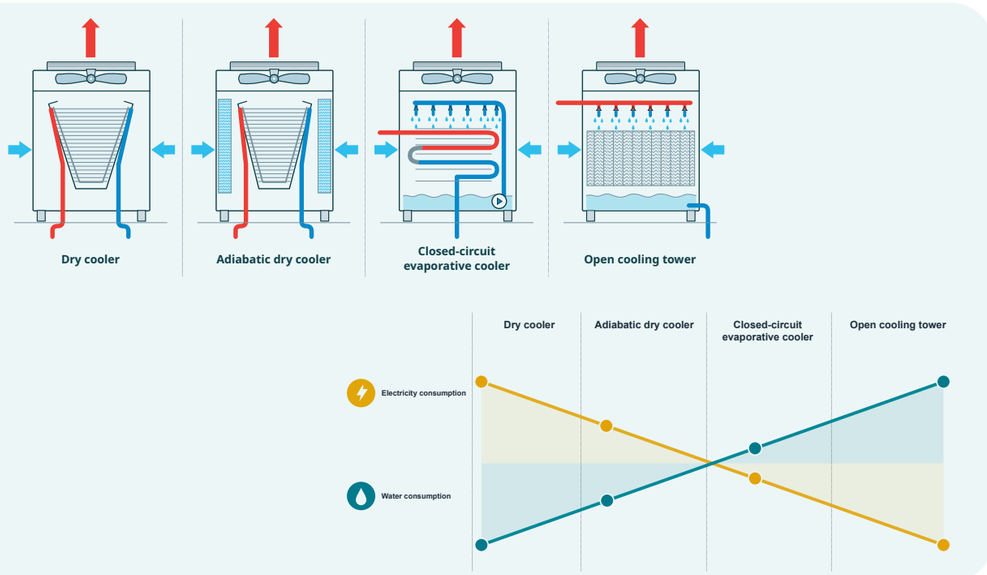



## 2.5. Heat rejection

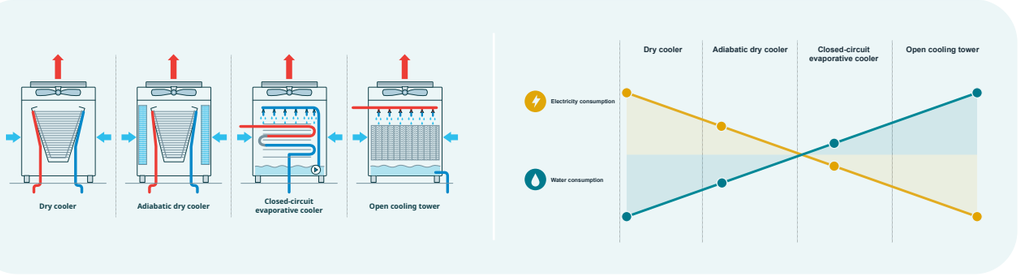
Heat rejection transfers heat from data centre cooling systems to the outdoor environment, unless it is recovered for reuse. Four main technologies are available, offering different balances between electricity and water consumption.

Dry coolers reject heat directly to outdoor air without consuming water. Adiabatic dry coolers use water to pre-cool incoming air, improving efficiency under warm conditions. Closed-circuit evaporative coolers spray water over a heat exchanger, keeping the process fluid in a separate circuit. Open cooling towers bring circulating water into direct contact with air, rejecting heat through evaporation.

Evaporative technologies generally consume less electricity but more water than dry cooling. The optimal solution depends on climate, operating conditions and local water availability.

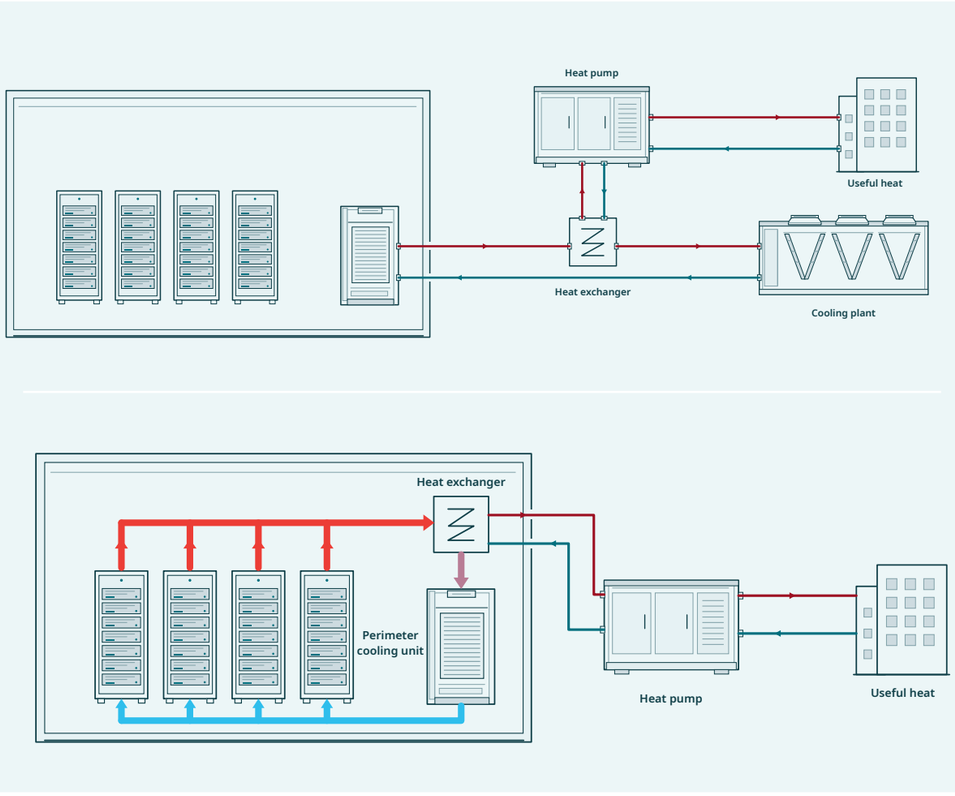


To provide data centres with optimised solutions tailored to their specific requirements, **intermediate technologies** such as hybrid and adiabatic systems are available. Adiabatic units use a small portion of water to pre-cool the air before it's used to cool the medium in the heat exchanger, whereas hybrid units use somewhat more water whilst it is evaporated on the heat exchanger during the high load design conditions. All of these, combined with smart operating controls provide flexible solutions that allow operators to optimise the balance between water and energy consumption as per their requirements.




## 2.6. Waste heat recovery

All of the above-mentioned technologies enable data centres to manage and remove heat as efficiently as possible. Waste heat recovery builds on this by allowing the heat generated by IT equipment to be used for beneficial purposes rather than rejected to the atmosphere. Heat can be captured at different points in the cooling chain and transferred to district heating networks, nearby buildings or industrial users. The potential is significant, but its practical realisation depends on temperature levels, proximity to demand, system integration and the alignment of heat supply with demand.






### 2.6.1. Barriers to waste heat recovery

The EUDCA State of European Data Centres 2026 highlights several recurring barriers to large-scale deployment. These include a

- mismatch between data centre heat availability and local heat demand profiles,
- limited or absent district heating infrastructure near sites,
- regulatory and contractual complexity, and
- uncertainty around long-term demand that makes investment decisions difficult.

Moreover, power availability and grid access remain the primary drivers for site selection, and some operators may have low tolerance for operational risk or dependency on external networks.

That said, when appropriately designed, waste heat recovery systems can be implemented without introducing operational risk. In such configurations, heat recovery represents an opportunity to improve overall energy efficiency, support local decarbonisation efforts, and enhance integration with surrounding communities. Early consideration of heat recovery can unlock additional long-term value.

### 2.6.2. Technologies that support waste heat recovery

From a technical perspective, liquid-cooled architectures generally facilitate heat recovery more effectively than traditional air-cooled systems. Direct-to-chip and immersion cooling often operate at higher and more stable coolant temperatures, which can increase the usability of recovered heat. In contrast, air-based systems typically deliver lower-temperature heat.

In many cases, the recovered heat must be upgraded using heat pumps to reach the temperature levels required. The integration of large-scale heat pumps can improve the economic and technical feasibility of reuse, but introduces additional energy demand and infrastructure requirements.



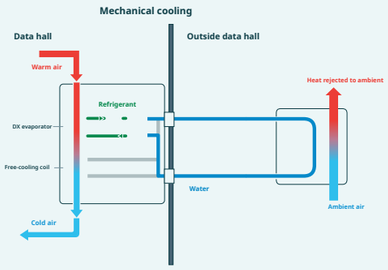
## 2.7. Free cooling

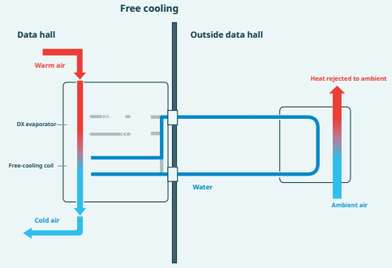
Free cooling, also known as economisation, reduces or avoids compressor operation by using favourable outdoor conditions to remove heat from data centres. It can be integrated into various air- and liquid-cooling architectures.

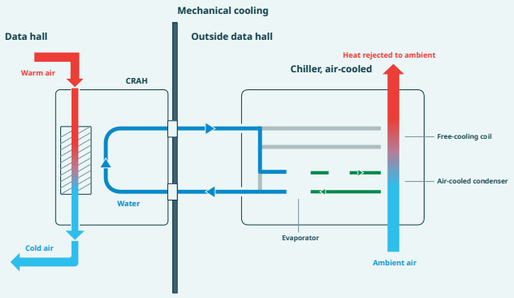
Direct free cooling introduces filtered outdoor air into the data hall, requiring careful control of air quality and humidity. Indirect free cooling transfers heat to the outdoor environment through heat exchangers or intermediate fluid circuits, keeping indoor and outdoor air separate.

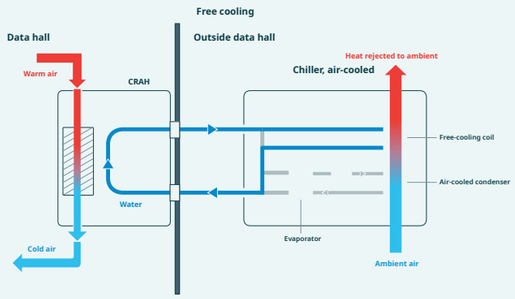
Indirect free cooling can use air, water or refrigerant circuits, depending on the system architecture. Mechanical cooling provides supplementary capacity when outdoor conditions are insufficient.

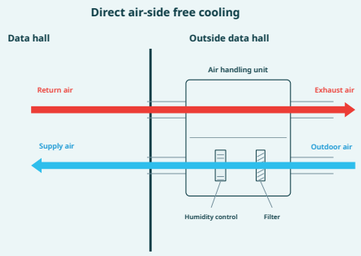
Its effectiveness depends on local climate, operating temperatures and control strategies. Annual system performance is therefore more meaningful than efficiency measured at a single operating point.

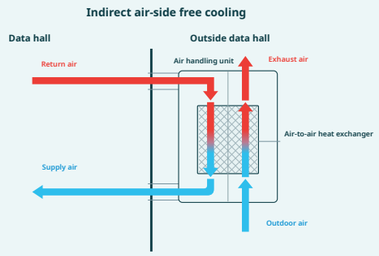


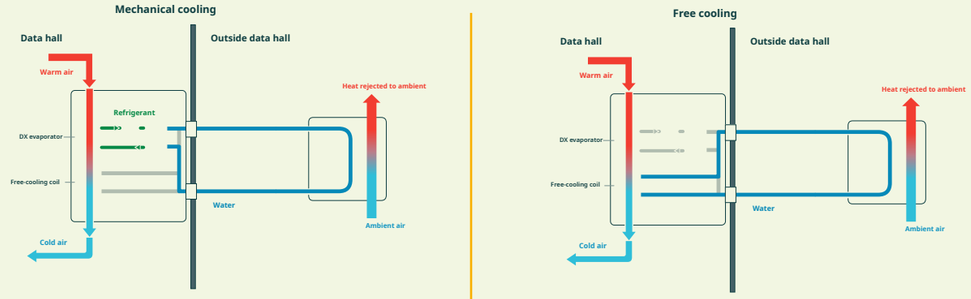





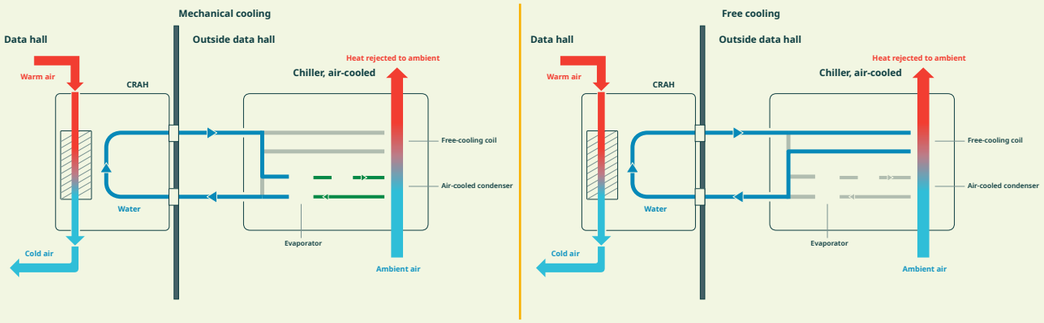

### Figure 2.7-1 — CRAC with water-side free cooling

An outdoor-cooled water loop supplies an additional cooling coil, reducing or eliminating compressor operation.




### Figure 2.7-2 — CRAH/thermal wall system with water-side free cooling

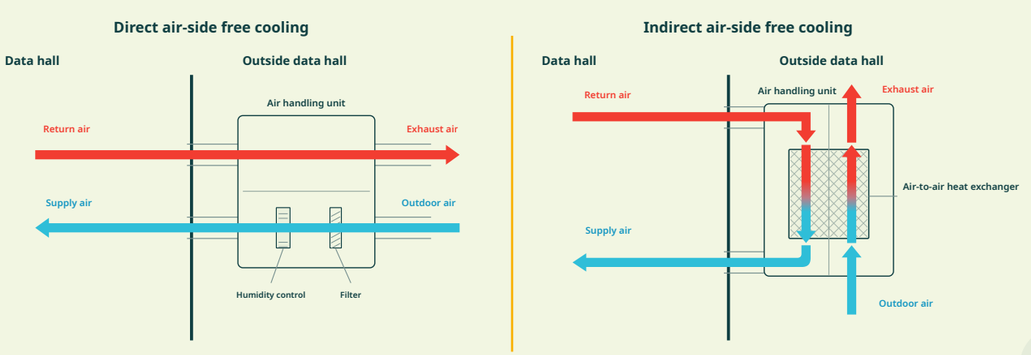
Free cooling can be provided either by a chiller equipped with an additional free cooling coil or by a separate dry cooler. When outdoor conditions permit, these systems cool the water without operating the compressor.




### Figure 2.7-3 — Dedicated data centre AHU with direct or indirect free cooling

**Concept:**

Direct free cooling supplies filtered and humidity-conditioned outdoor air to the data hall while exhausting warm return air. Indirect free cooling transfers heat from the data hall airstream to a separate outdoor air stream through an air-to-air heat exchanger. Both reduce mechanical cooling demand when conditions permit.



## 2.8. Indoor air quality

Indoor Air Quality (IAQ) is a critical aspect of data centre cooling. Airborne particles and corrosive gases can damage IT equipment, impair cooling performance and increase the risk of data errors or unplanned shutdowns. Dust may accumulate on components and restrict heat transfer, while gases such as sulphur compounds or ammonia can accelerate corrosion of sensitive materials. Site conditions and surrounding activities should therefore be assessed during planning, and appropriate particle and, where necessary, gas-phase filtration should be integrated into the cooling design. Even in largely recirculated systems, high airflow rates distribute contaminants throughout the data hall, making effective filtration and monitoring essential.

Air filters influence energy performance. As filters load with dust, pressure drop increases, raising fan energy consumption and affecting overall PUE. Regular maintenance, airflow and pressure monitoring are therefore required to ensure consistent operation. Eurovent Recommendation 4/21 provides a structured methodology to assess and compare the energy performance of air filters under defined operating conditions, enabling objective evaluation of lifecycle energy impact.

## 2.9. Smart controls

As power densities increase and cooling systems become more complex, intelligent control systems are essential to ensure both efficiency and reliability. Modern frameworks integrate real-time sensing with coordinated unit-level and system-level control across CRACs, CRAHs, in-row units, CDUs and chillers. Rather than relying on a single central controller, resilient designs combine local unit intelligence with higher-level Building Management Systems, avoiding single points of failure while enabling optimisation of the entire cooling chain.

Smart controls continuously regulate temperature, airflow, pressure and, where relevant, humidity or coolant parameters to maintain safe operating conditions within recognised IT environmental envelopes. Variable-speed fans, pumps, valves and compressors adjust output to actual load, reducing energy use and mechanical stress. In mission-critical environments, redundancy strategies such as N+1 or 2N are actively managed so that standby units rotate, backup components engage automatically and failures are isolated without service interruption. At system level, control logic coordinates alarms, safe modes and load redistribution, while optimisation algorithms select the most efficient operating configuration based on climate and demand. Increasingly, advanced analytics and machine learning are applied to enhance resilience, improve efficiency and support preventive maintenance.

## 2.10. Refrigerants

Refrigerants are working fluids used in vapour-compression systems such as DX units and chillers to absorb and release heat. Because many refrigerants are greenhouse gases, leaks can have significant climate impact, making them relevant for sustainability and regulatory compliance in data centres. Refrigerant choice affects direct emissions, energy efficiency and system design, and in Europe is governed by the F-Gas Regulation (see section 5.3 below). Current trends include a shift toward lower-GWP refrigerants (e.g. R1234ze for chillers, R454C for CRAC units), improved leak detection and tighter containment practices to reduce direct emissions while maintaining performance and reliability.



# 03 SYSTEM PERFORMANCE

Technology choices alone do not determine outcomes. Actual performance depends on design, climate conditions, control strategies, load profiles, and many other factors. The same equipment can deliver very different results depending on where and how it is configured and operated. This chapter introduces the key metrics and indicators used to evaluate system performance.

## 3.1. Data centre performance metrics

Data centres consume energy and other resources to deliver computing services. To assess how efficiently these resources are used, a number of key performance indicators are commonly applied.

$$\text{TUE} = \frac{\text{Total DC facility energy}}{\text{Compute energy}}$$

$$\text{PUE} = \frac{\text{Total DC facility energy}}{\text{IT equipment energy}}$$

$$\text{WUE} = \frac{\text{Annual water usage}}{\text{IT equipment power}}$$

$$\text{REF} = \frac{\text{Energy from renewables}}{\text{Total DC facility energy}}$$

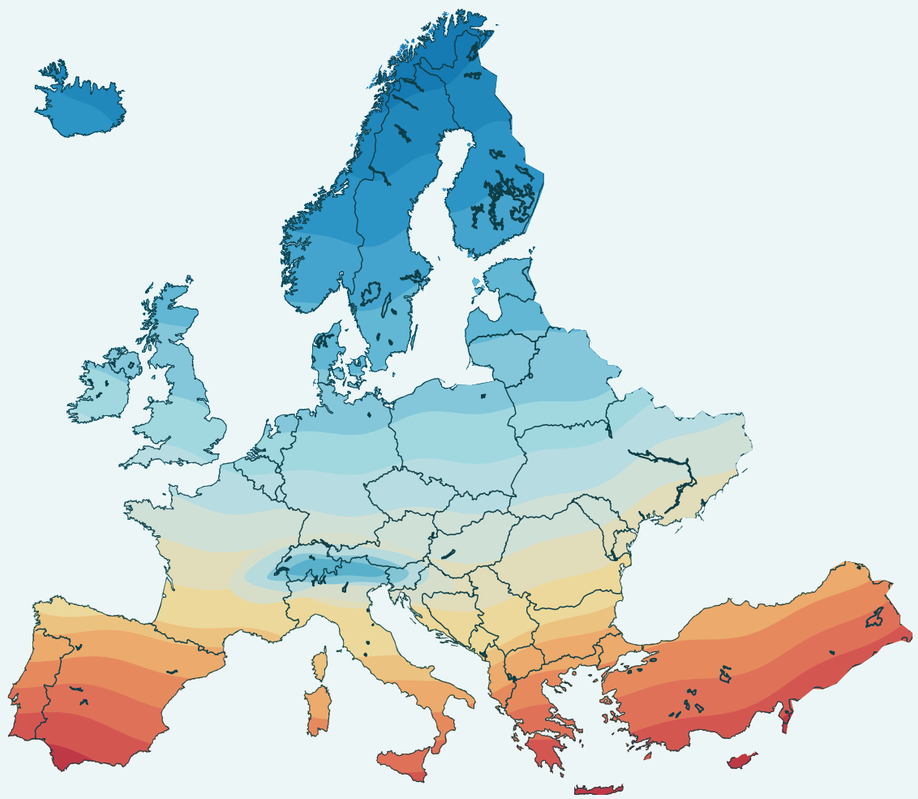
$$\text{ERF} = \frac{\text{Energy reused}}{\text{Total DC facility energy}}$$



### 3.2. Climate—performance link

System performance is closely linked to local climate and resource conditions, which may vary over the year. Facilities in colder regions, such as the Nordics, often achieve lower PUE values than those in warmer Southern Europe because milder ambient temperatures allow for greater mechanical refrigeration cycle efficiency, more frequent use of economisation, and can reduce mechanical cooling demand.  At the same time, technologies such as evaporative cooling can improve electrical efficiency, particularly in warm and dry climates, but may increase water consumption and be less appropriate in regions facing water scarcity or high humidity. These differences illustrate that system performance depends not only on equipment efficiency, but on how cooling strategies are matched to local climate, resource availability and policy objectives.

**Climatic potential for free cooling**



Fewer favourable hours — More favourable hours

Using the available technologies, as described above, in a proper way for specific regional requirements, allow data centre operators to design and operate their installation in an optimised way and stay within the shown PUE and WUE recommendations that can be reached when using high performing equipment



# 04 PRODUCT PERFORMANCE, WITNESS TESTING AND CERTIFICATION

Data centre cooling equipment as described above must perform reliably under a wide range of operating conditions, as they protect mission-critical digital infrastructure. Key parameters including cooling capacity, energy efficiency at full and partial load, water use, pressure drops, acoustics, refrigerant charge and stability under extreme climates must therefore be measured using repeatable and transparent test methods. Reliable and comparable performance data are essential not only for designers and operators, but also for policymakers seeking fair and technology-neutral sustainability requirements.

Independent third-party certification provides this assurance. Programmes such as those operated by Eurovent Certita Certification verify declared performance against recognised standards and harmonised rules, enabling unbiased comparison across technologies and manufacturers. Certified performance data support system design, energy modelling and regulatory compliance, while ensuring equal evaluation conditions for air- and water-based, free-cooling and compressor-driven solutions alike. Where project-specific validation is required, witness testing allows customers to observe factory performance tests before delivery. Together, certification and witness testing strengthen confidence in data centre cooling technologies and support more resilient and sustainable data centre development.

EUROVENT CERTIFIED PERFORMANCE
www.eurovent-certification.com



# 05 STANDARDS

- EN 50600 series – Data centre facilities and infrastructures, notably:
  - EN 50600-1 – General concepts
  - EN 50600-2-3 – Environmental control
  - EN 50600-4-1 to EN 50600-4-9 – Data centre KPIs, including PUE, ERF, CER, and WUE
- EN 14511 series – Performance testing of air conditioners, chillers and heat pumps
- EN 14825 – Seasonal and part-load performance of cooling equipment
- EN 1397 – Performance testing of hydronic fan-coil units
- ANSI/ASHRAE Standard 127 – Testing and rating of cooling equipment serving data centres and other ITE spaces
- EN 1886 – Mechanical performance of air-handling units
- EN 13053 – Rating and performance of air-handling units
- EN 308 – Performance testing of air-to-air heat-recovery equipment
- EN 1216 – Performance testing of heating and cooling coils
- ISO 5801 – Fan performance testing
- ISO 12759 series – Fan efficiency classification
- EN 1048 – Performance testing of dry coolers
- EN 327 – Performance testing of air-cooled condensers and gas coolers
- EN 1117 – Performance testing of liquid-cooled refrigerant condensers
- EN 1118 – Performance testing of refrigerant-cooled liquid coolers
- EN 13741 – Thermal performance testing of series wet cooling towers
- EN 14705 – Thermal performance testing of large cooling towers
- ISO 16890 series – Particulate air filters for general ventilation
- ISO 10121 series – Gas-phase air-cleaning media and devices
- EN 378 series – Safety and environmental requirements for refrigerating systems and heat pumps
- ISO 817 – Refrigerant designation and safety classification
- ASHRAE Thermal Guidelines for Data Processing Environments – IT equipment environmental conditions
- EU Code of Conduct for Data Centre Energy Efficiency – Data centre energy-efficiency practices
- Eurovent Recommendation 11/1 – Rating points for air-to-air process and IT cooling
- Eurovent Recommendation 18/2 – SEPR for very-high-temperature process chillers
- Eurovent Recommendation 9/12 – Performance efficiency of evaporative cooling equipment
- Eurovent Recommendation 9/13 – Water consumption of evaporative cooling equipment
- Eurovent Recommendation 4/21 – Energy-efficiency evaluation of air filters
- Eurovent Recommendation 4/26 – Selection of molecular filters



# 06 LEGISLATION

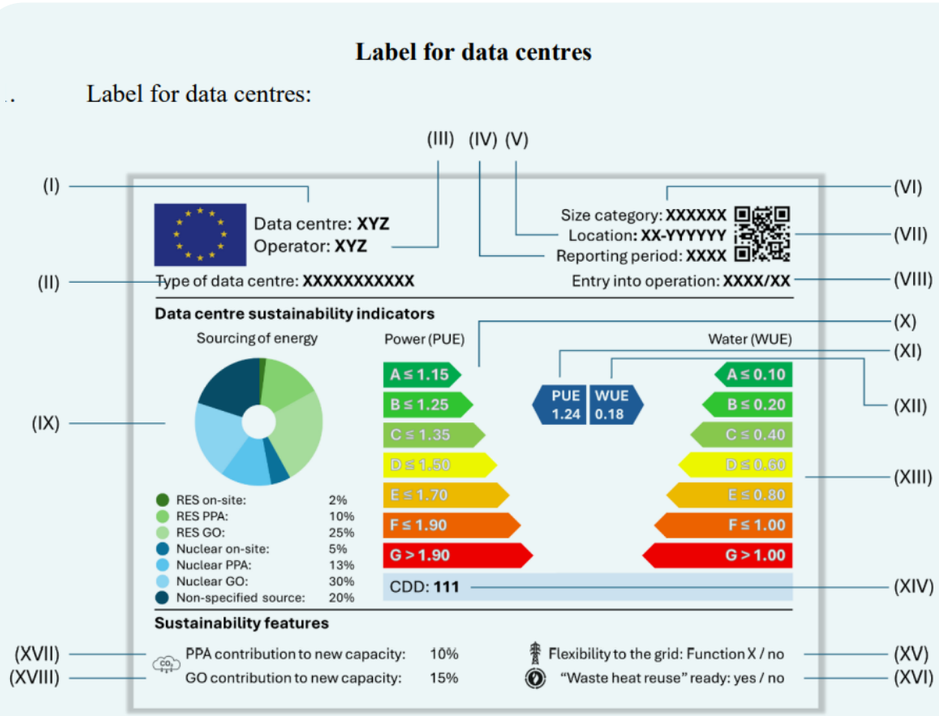
## 6.1. Energy Efficiency Directive and data centre sustainability

The recast Energy Efficiency Directive (EED) requires data centres with an installed IT power demand of at least 500 kW to report annually on energy performance, water consumption, waste heat reuse and other indicators. Delegated Regulation (EU) 2024/1364 establishes harmonised reporting requirements and a European database.

On 21 September 2026, the European Commission adopted a Delegated Regulation establishing a common EU sustainability rating scheme for data centres. Starting on 15 August 2027, annual electronic labels will classify data centres from A to G for Power Usage Effectiveness (PUE) and Water Usage Effectiveness (WUE), alongside information on energy sources, waste heat reuse and grid flexibility.

The Commission is also preparing potential Minimum Energy Performance Standards (MEPS) for data centres.

Separately, the EED requires data centres with a total rated energy input exceeding 1 MW to utilise waste heat unless this is technically or economically infeasible, as demonstrated through a cost-benefit assessment.





## 6.2. Ecodesign for data centre cooling equipment

Data centre cooling equipment is not yet specifically regulated by Ecodesign, but some products may fall within existing regulatory frameworks. Ecodesign regulations exist for air conditioners and chillers (Regulation (EU) 2016/2281), air conditioners with a capacity of less than 12 kW (Regulation (EU) 206/2012), and air handling units (Regulation (EU 1253/2014). Data centre cooling applications are generally excluded because their primary purpose is the cooling of industrial applications, and the prescribed conditions do not reflect the operations of data centre.

The Regulations for chillers and air conditioners are under revision. It is expected that data centre cooling products, including data centre chillers and CRAC units, will be included in the scope with appropriate definitions and performance metrics, based on Eurovent Recommendations 11/1 'Rating points for A/A process and IT Cooling' and 18/2 'SEPR for Very High Temperature Process Chillers'.

## 6.3. F-Gas Regulation

The 2024 F-Gas Regulation (EU) 2024/573 directly affects data centre cooling, which relies on HFC and HFO refrigerants. It introduces stricter leak-check obligations, accelerates the HFC phase-down with major quota cuts in 2027 and 2030, and imposes product bans based on refrigerant GWP, equipment type and capacity. The exact impact depends on how a product is classified under Annex IV, making correct definitions critical for compliance timelines.

Low-GWP HFO refrigerants are largely exempt from quota reductions and many product bans, though small chillers and air-conditioning units ≤12 kW face restrictions from 2032–2035. However, HFOs fall under the broader PFAS category, currently under separate restriction discussions in the EU. A future PFAS ban could significantly affect data centre cooling refrigerant options beyond the F-Gas framework.



# 07 THE EUROPEAN DATA CENTRE COOLING INDUSTRY

## 7.1. Companies that contributed to this Guidebook

This Guidebook was published by Eurovent and prepared jointly by participants in the Task Force 'IT Cooling', bringing together manufacturers representing the vast majority of the data centre cooling equipment market in Europe.

Particularly important contributions were made by Enrico Boscaro, Jeremie Chang, Mustafa Dilsen, Massimiliano Ferrario, Christophe Fraysse, Kurt Geens, Dennis Kilimann, Isabella Patruno, Stijn Renneboog and Mario Scattolin.



### 7.2. Manufacturing sites

The European data centre cooling industry draws on an HVACR manufacturing base comprising more than

**350 manufacturing sites**

across Europe. Many of these sites produce IT cooling units, chillers, air handling units, heat rejection equipment, fans, filters, heat exchangers, controls and other cooling technologies used in data centres.



### 7.3. Turnover

The European data centre cooling industry is estimated to generate annual turnover of approximately

**EUR 2 billion**

from cooling equipment and related services.



### 7.4. Direct and indirect employment

The European data centre cooling industry is estimated to provide around

**10,000 direct jobs**

and support a further

**20,000 indirect jobs**

across the supply chain and in system design, installation, commissioning, maintenance and servicing.



### 7.5.R&D

The European data centre cooling industry represented by Eurovent is estimated to invest approximately

**EUR 75 million**

annually in research and development.



# 08 ABOUT EUROVENT

Eurovent is the voice of the European HVACR industry, representing over 100 companies directly and more than 1.000 indirectly through our 16 national associations. The majority are small and medium-sized companies that manufacture indoor climate, process cooling, and cold chain technologies across more than 350 manufacturing sites in Europe. They generate a combined annual turnover of more than 30 billion EUR and employ over 150.000 Europeans in good quality tech jobs.



**Vision**
Eurovent's vision is an innovative and competitive European HVACR industry that enables sustainable development in Europe and globally, which works for people, businesses, and the environment.

**Mission**
Eurovent's mission is to bring together HVACR technology providers to collaborate with policymakers and other stakeholders towards conditions that foster fair competition, innovation, and sustainable growth for the European HVACR industry.

For in-depth information and a list of all our members, visit www.eurovent.eu

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