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DATA CENTER EVOLUTION

EXPLOITING NEW TECHNOLOGIES FOR HIGH EFFICIENCY SOLUTIONS


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SOLUTIONS FOR DATA CENTERS

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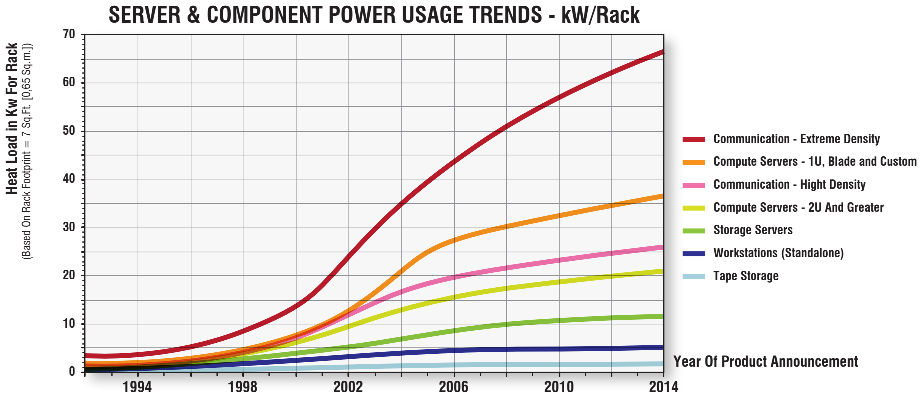
INTRODUCTION

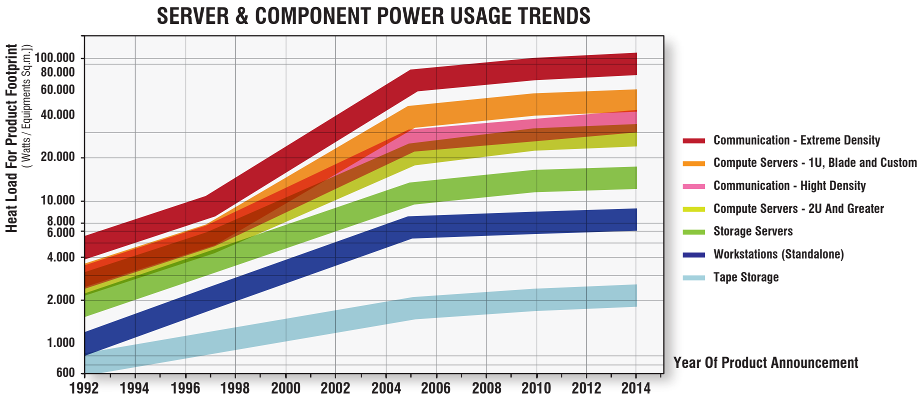
Data Centers are currently undergoing a great period of change. Developments in business and personal data transfer together with new technologies such as virtualisation and cloud computing are transforming Data centers into dynamic environments with greater power demands in a way that none could have predicted a few years ago. The cooling requirements of the Data Center infrastructure form a large part of the overall power requirements and it is therefore critical to ensure correct optimisation to achieve the desired energy efficiency levels. In Planning datacenter's for the future it is imperative that the design match's the infrastructure with greater scalability and integration enabling Data Centrers to evolve to cope with less power demands and lower running costs. This document highlights solutions available to deliver the highest energy efficient solutions to ensure Data Centers can cope with all future demands.

HOW DATA CENTERS CHANGED THROUGH THE YEARS

Heat loads rejected by electronic devices and telecommunication shelters keep increasing: in 2000 the Thermal Management Consortium showed that the IT power density has increased 300% from 1992 to 2002.



ASHRAE 20 year data for density per rack and per square meter to 2005 with a forecast to 2014.



Fonte: ASHRAE. 2005. Datacom Equipment Power Trends and Cooling Applications.
Atlanta, GA: American Society of Heating, Refrigerating and Air Conditioning Engineers.

In 2007 EPA (U.S. Environmental Protection Agency) wrote in the “Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431” that the energy demand of Data Centers would be 100 million kWh in 2011.
Worldwide web, tablets, online services offered by companies, cloud computing: this “big world” increases data traffic massively and the need for arranging reliable facilities to process, store and transmit these data. This large growth has then increased the energy consumption of Data Centers: half of the energy is normally consumed by servers while the other half is for electrical power supply and for the cooling system.
IT devices need a close controlled temperature and humidity environment in Data Centers in order to work properly and to provide a reliable and efficient service. Suppliers of servers advise Data Center owners to keep computing rooms within recommended hygrothermal limits throughout their whole working life.

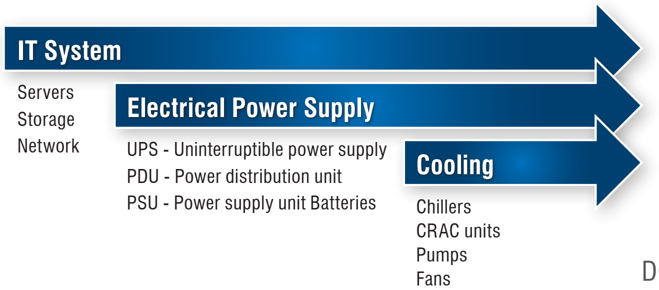
ASHRAE committee TC9.9 defined the hygrothermal conditions for Data Centers in order to provide standard guidelines. These directives aim to standardise the management of computing rooms to achieve high performances and reliability for ther servers, services whilst reducing the energy consumption.
The conditions are referred to air entering into servers.

DATA CENTER EFFICIENCY: PUE and DCiE

Data Center efficiency is measured by DCiE (Data Center infrastructure efficiency) and PUE (Power Usage Effectiveness), as defined by The Green Grid, a global consortium of IT professionals aiming to increasing the energy efficiency of Data Centers.

The biggest challenge for IT organizations to manage Data Centers is the reduction of energy for cooling and for power supply: that's the only way to let Data Centers grow. Efficient Data Centers let IT providers better manage the increasing demands on the network, computing and storage requirements with lower energy costs, thus with lower running costs (operating expense). A higher efficiency in the end leads to more competitiveness and readiness in answering to the market demands. The Green Grid consortium invented these two parameters PUE (Power Usage Effectiveness) and DCiE (Data Center Infrastructure efficiency) to rapidly evaluate a Data Center efficiency, compare different ones and find further improvements:
IT organizations and suppliers are always looking for new ways to optimise the energy performances of a Data Center.

Power Usage Effectiveness (PUE) is a measure of how efficiently a Data Center uses the input energy. Particularly it shows how much energy is used for the IT System compared to that used for Cooling and Power Supply.

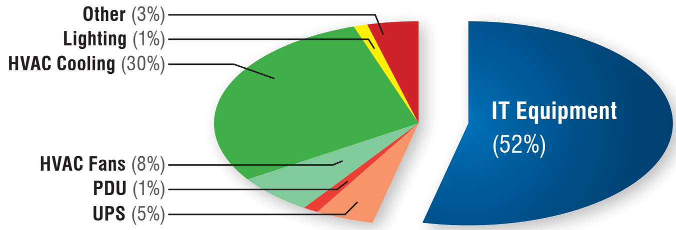


$$\text{PUE} = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}}$$

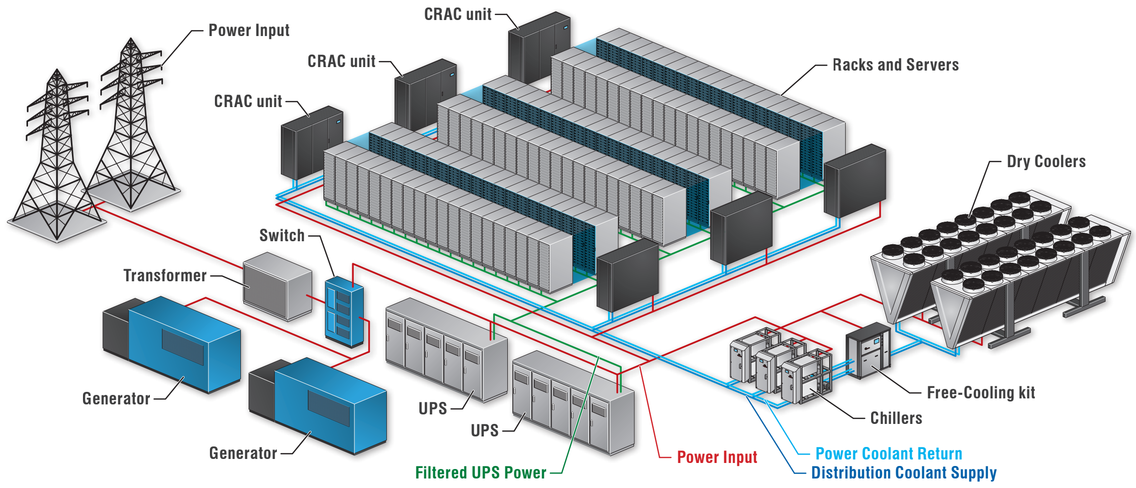
$$\text{DCiE} = 1 / \text{PUE}$$

DCiE is defined as reciprocal of PUE

1.9 PUE Data Center: common energy consumption splitting 1.9
(source: ASHRAE)



PUE target: from 2.0 down to 1.1
(source: ASHRAE)



AVERAGE PUE FOR LARGEST DATA CENTERS

2.5 or greater	9%
2.4 to 2.49	2%
2.3 to 2.39	2%
2.2 to 2.29	4%
2.1 to 2.19	6%
2.0 to 2.09	11%
1.9 to 1.99	9%
1.8 to 1.89	13%
1.7 to 1.79	11%
1.6 to 1.69	11%
1.5 to 1.59	7%
1.4 to 1.49	5%
1.3 to 1.39	4%
1.2 to 1.29	1%
1.1 to 1.19	2%
1.09 or less	3%

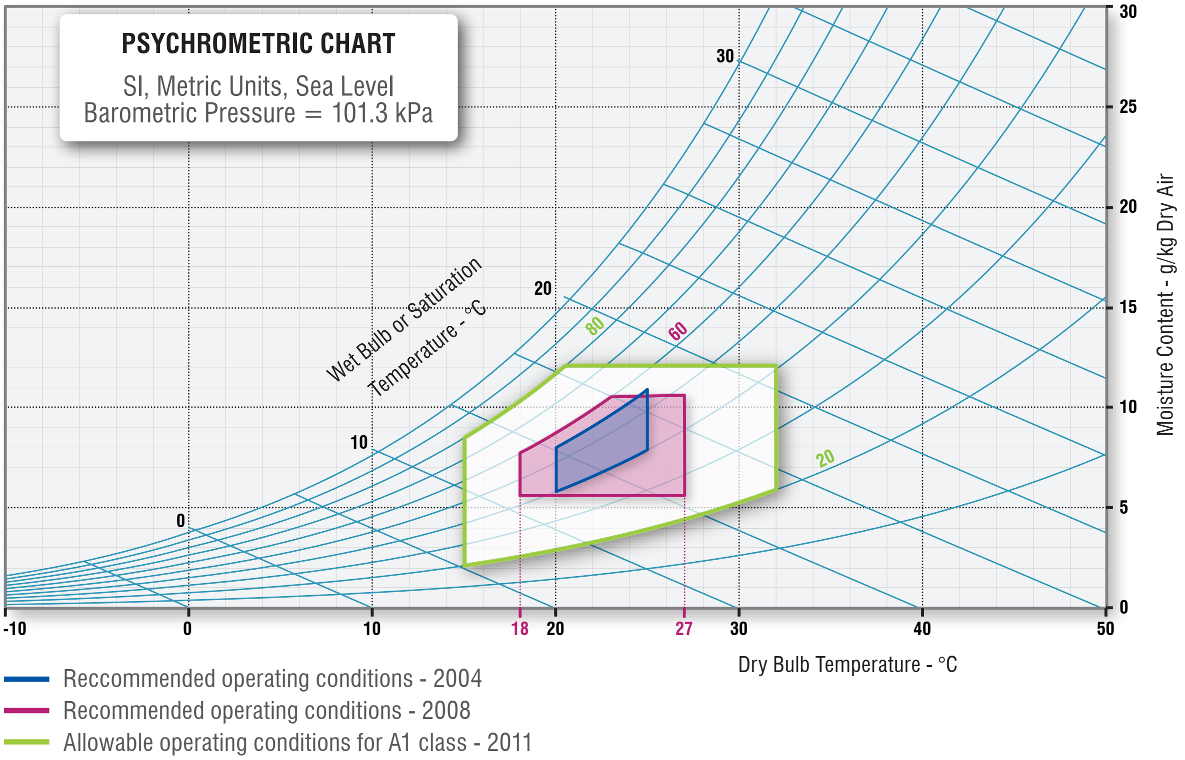
AVERAGE PUE 1.8 - 1.89

(source: Uptime Institute, 2012)

The lowest PUE Data Center is the one of «Yahoo!», close to the Niagara Falls: PUE = 1.08

TEMPERATURES AND HUMIDITY IN THE COMPUTER ROOM

Recent IT devices can operate at higher ambient temperatures: being less restrictive with the hygrothermal conditions in the computer room, the efficiency of the Data Center can increase substantially.



Temperature and humidity limits should be respected aiming for energy saving. In 2001, 2004 and later on in 2008 the Technical Committee TC9.9 of ASHRAE (consisting in the largest producers of IT devices) extended temperature and humidity recommended and allowable limits. As a result the cooling capacity can provide higher efficiency, CRAC units have higher capacity and the Free-Cooling availability has increased.

	ASHRAE TC 9.9 Year 2004	ASHRAE TC 9.9 Year 2011
MIN temperature	20°C (68°F)	18°C (64,4°F)
MAX temperature	25°C (77°F)	27°C (80,6°F)
MIN humidity	40% R.H.	5,5°C (41,9°F) DewPoint
MAX humidity	55% R.H.	60% R.H.-15°C (59°F) DewPoint

DATA CENTER EFFICIENCY: FREE-COOLING

As temperature limits inside computer rooms have increased in the last years, many more places around the world can achieve the needed cooling capacity for the servers as Free-Cooling capacity, using (directly or indirectly) fresh air from outside. The number of hours to run in Free-Cooling mode has increased and the map of countries with Free-Cooling availability has become wider.

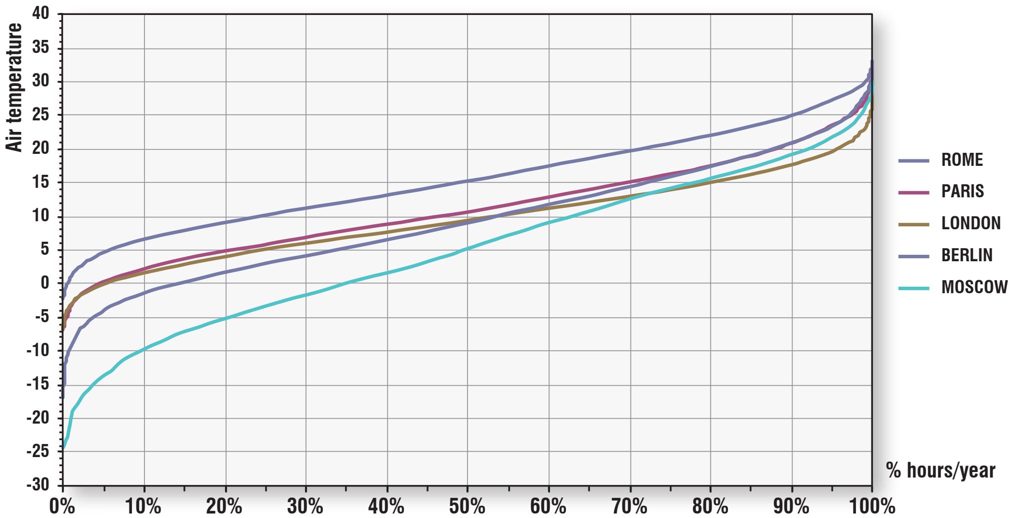
The cooling system can work in Free-Cooling operation when the outdoor temperature is below that o fthe computer room . The required cooling can be achieved by letting the outdoor air directly into the racks (direct Free-Cooling), or exchanging heat between outside and inside air (indirect Free-Cooling) or between the outside air and the A/C water circuit (indirect water Free-Cooling).

A larger operation field in terms of indoor hygrothermal conditions lead to:

- A larger number of hours for Free-Cooling
- A larger number of countries where Free-Cooling is achievable
- Higher chilled water temperatures for CRAC units, thus more indirect Free-Cooling hours

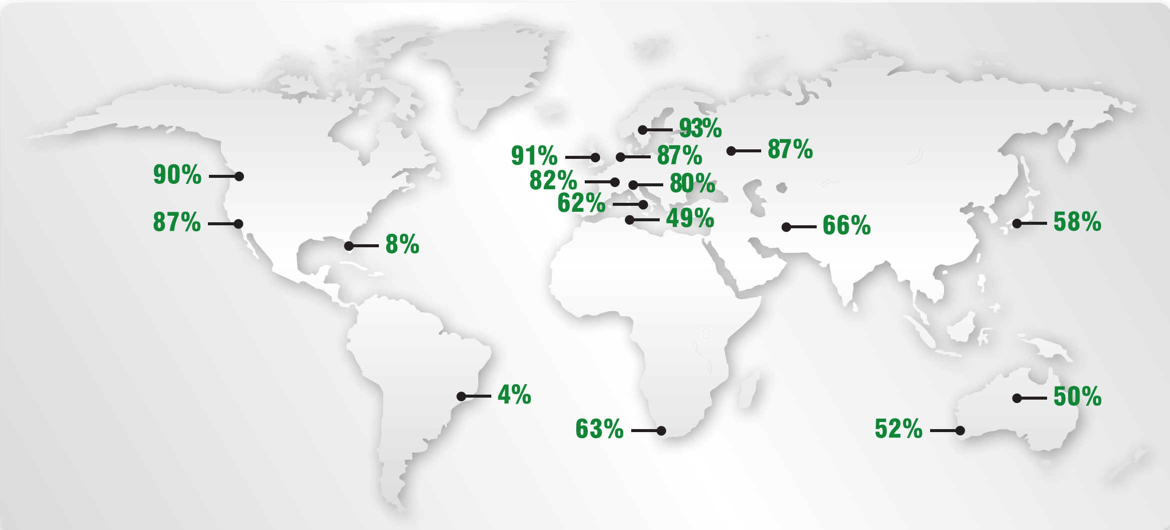
These have enabled new Data Centers to reduce the energy consumption for cooling, making them more efficient.

ANNUAL DRY TEMPERATURE DISTRIBUTION



INDIRECT FREE-COOLING:

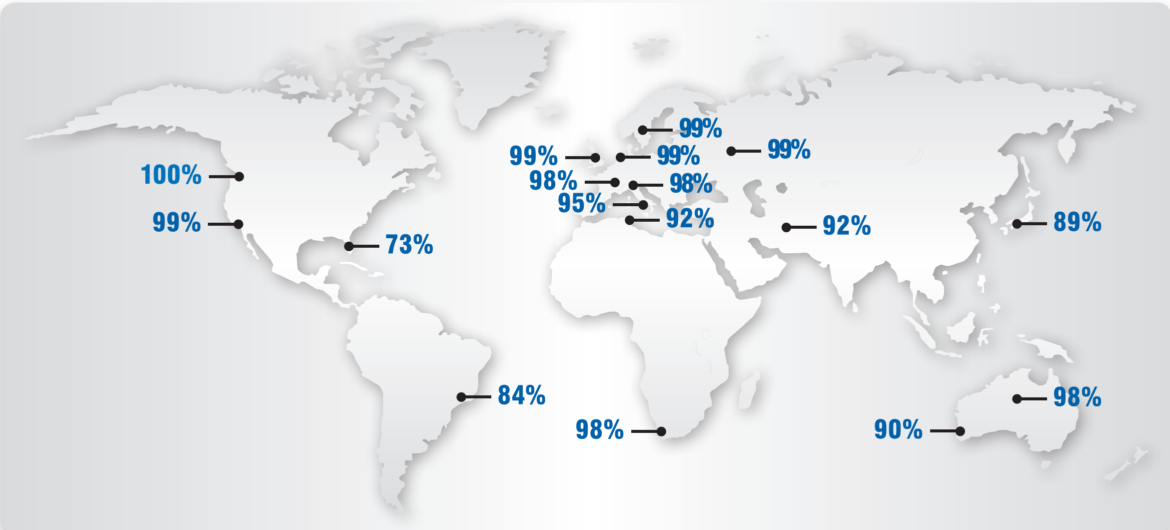
% OF YEARLY HOURS WHEN THE OUTDOOR TEMPERATURE IS BELOW 18°C



Free-Cooling is a big advantage in cold and mild climates.

DIRECT FREE-COOLING:

% OF YEARLY HOURS WHEN THE OUTDOOR TEMPERATURE IS BELOW 27°C



For a total direct Free-Cooling operation with no dehumidification the dew point must be below 15°C, being the allowable humidity limits those reported by ASHRAE.

When in direct Free-Cooling operation a Data Center uses outside fresh air which is blown into the server room. Its quality strongly affects the IT devices performances and behaviour.

ASHRAE recommends, besides hygrothermal values, particulate contamination limits and gaseous contamination limits. The reference norm for particulate contamination is ISO 14644-1: the quality of the air is defined by nine different classes (1 to 9 ISO class) as the number of particles in each cubic meter of air. Each particle is considered with its size. ASHRAE claims that air filters used must achieve ISO 8 class cleanliness.

According to ANSI/ASHRAE Standard 127-2007 the indoor air must have filtration class MERV8, while the air entering the Data Center must have filtration class MERV11/MERV13 depending on the outdoor air quality and specific computer room conditions.

	Maximum Number of Particles in Air					
	Particle size					
ISO CLASS	D > 0.1 μm	D > 0.2 μm	D > 0.3 μm	D > 0.5 μm	D > 1 μm	D > 5 μm
Class 1	10	2				
Class 2	100	24	10	4		
Class 3	1000	237	102	35	8	
Class 4	10000	2370	1020	352	83	
Class 5	100000	23700	10200	3520	832	29
Class 6	1000000	237000	102000	35200	8320	293
Class 7				352000	83200	2930
Class 8				3520000	832000	29300
Class 9				35200000	8320000	293000

When dedicated measurements show that outdoor air can not be directly used for cooling purposes (ISO class greater than class 8) then specific filters with a high efficiency must be used.

The reference norm for gaseous contamination is ANSI/ISA S71.04-1985: different corrosivity levels (from G1 to Gx) define each gas reactivity level according to concentration. ASHRAE's book "Particulate and Gaseous Contamination in Datacom Environments" of 2009 recommends level G1 for Data Centers.

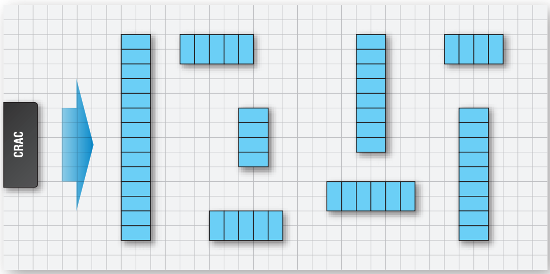
SEVERITY LEVEL	G1	G2	G3	Gx
Reactivity Level	< 300 Angstrom	< 1000 Angstrom	< 2000 Angstrom	≥ 2000 Angstrom
Gas	Gas Concentration			
H_2S - Hydrogen sulfide	< 3 ppb	< 10	< 50	≥ 50
SO_2 - Sulphur dioxide	< 10	< 100	< 300	≥ 300
Cl_2 - Chlorine	< 1	< 2	< 10	≥ 10
NOx - Oxides of nitrogen	< 50	< 125	< 1250	≥ 1250
O_3 - Ozone	< 2	< 25	< 100	≥ 100
NH_3 - Ammonia	< 500	< 10000	< 25000	≥ 25000

In the end direct Free-Cooling is the best solution thermodynamically, but it must take into consideration:

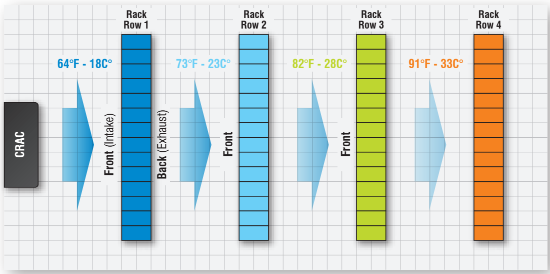
- high efficiency filtration causes high air pressure drops, therefore the fans' energy consumption may reduce the global efficiency of the system.
- the replacement of old filters may be expensive
- a strict control of gaseous contamination with chemical filters is necessary
- the upper humidity limit must be controlled (dehumidification may be needed)
- the lower humidity limit must be controlled (humidification may be needed)

DATA CENTER EFFICIENCY: AIR FLOW CONTROL

In the original computer rooms the racks had no particular orientation and the cooling capacity was delivered to the whole ambient. Cold air was blown at a very low temperature and mixed with hot air out of servers. The whole room was kept at constant temperature, normally between 18°C and 24°C.



Maldistribution of racks and how the room was at the same temperature



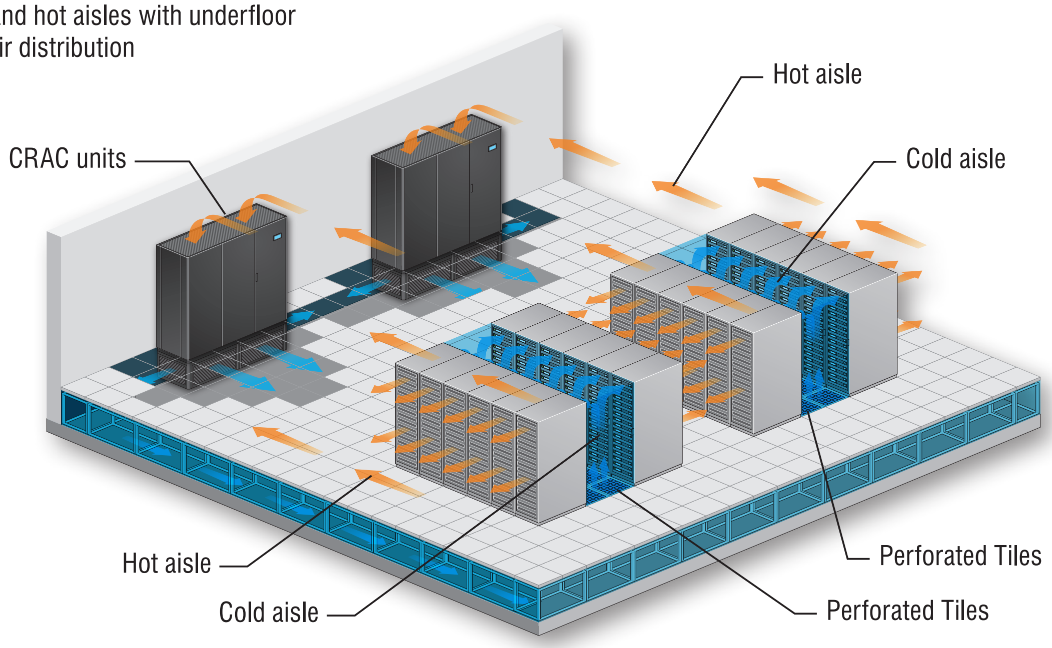
Maldistribution of racks and aisles

When CRAC units are not correctly oriented, hot spots may lead to malfunctions and failures

Fundamentals of Data Center power and cooling efficiency zones (White Paper #21). The Green Grid

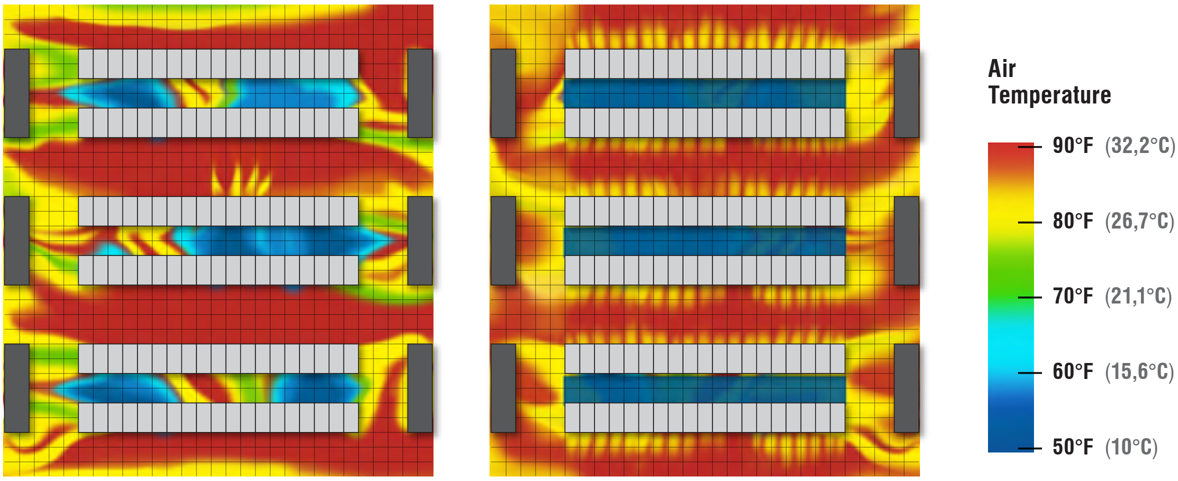
Since the heat load density of servers has increased in recent years, computing rooms' layout have changed. Racks are now arranged in rows, creating hot aisles for hot air discharge and cold ones for the conditioned air distribution: the so called "cold aisle and hot aisle compartment".

Cold and hot aisles with underfloor cold air distribution



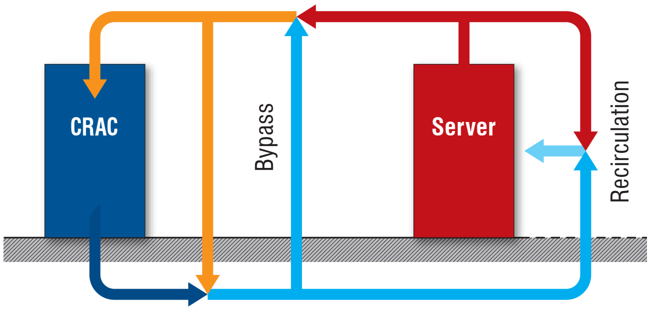
This layout gives no more mixing of cold and hot air, providing cooling directly on the suction side of servers, where it is needed.

An efficient air conditioning of a Data Center needs a competent analysis and a precise management of the air flows. Compartmentalisation is the key point to let chilled water temperature rise up: by separating the computer room into cold and hot aisle there's no more mixing of air flows at different temperatures, thus no energy losses.



Compartment-less

With compartment



How air flows with different temperatures mix without containment.

Data Centers need optimization for the air distribution to prevent flows at different temperatures from mixing and avoiding dangerous hot spots and unnecessary cold spots. This is achieved by using raised floors as plenums to distribute cold air and deliver it to servers. The effectiveness of such a system is guaranteed by controlling the static pressure under the raised floor; with no control of the pressure energy is wasted, colder supply air is needed and more cooling capacity is requested.

The underfloor static pressure depends on CRAC units, leakages, losses: in this way modulating fans can be controlled to keep the static pressure constant below the floor. When heat loads are low or when many redundant CRAC units are working all together, then this type of regulation ensures energy saving. The best configuration is the one which allows a constant static pressure at every point under the floor: high raised floors, plug modulating fans and obstacle free.

REDUNDANCY

To guarantee the IT devices have enough reliability and ensure the service has no interruption, the designing of a Data Center must take into account a certain redundancy.
The Uptime Institute defined four levels of redundancy: Tier I, Tier II, Tier III, Tier IV.

TIER I: single distribution paths for power supply and cooling; no redundancy of components.

TIER II: single distribution paths for power supply and cooling; “n+1” redundancy for gen-sets and UPS.

TIER III: multiple distribution paths for power supply and cooling, one of which active only; redundancy of components on one power supply line with “n+1” redundancy for gen-sets and UPS.

TIER IV: multiple distribution paths for power supply and cooling, all active; redundancy of components on one power supply line with “n+1” redundancy for gen-sets and UPS. All cooling devices (CRAC units, chillers, dry coolers, etc.) with dual power supply.

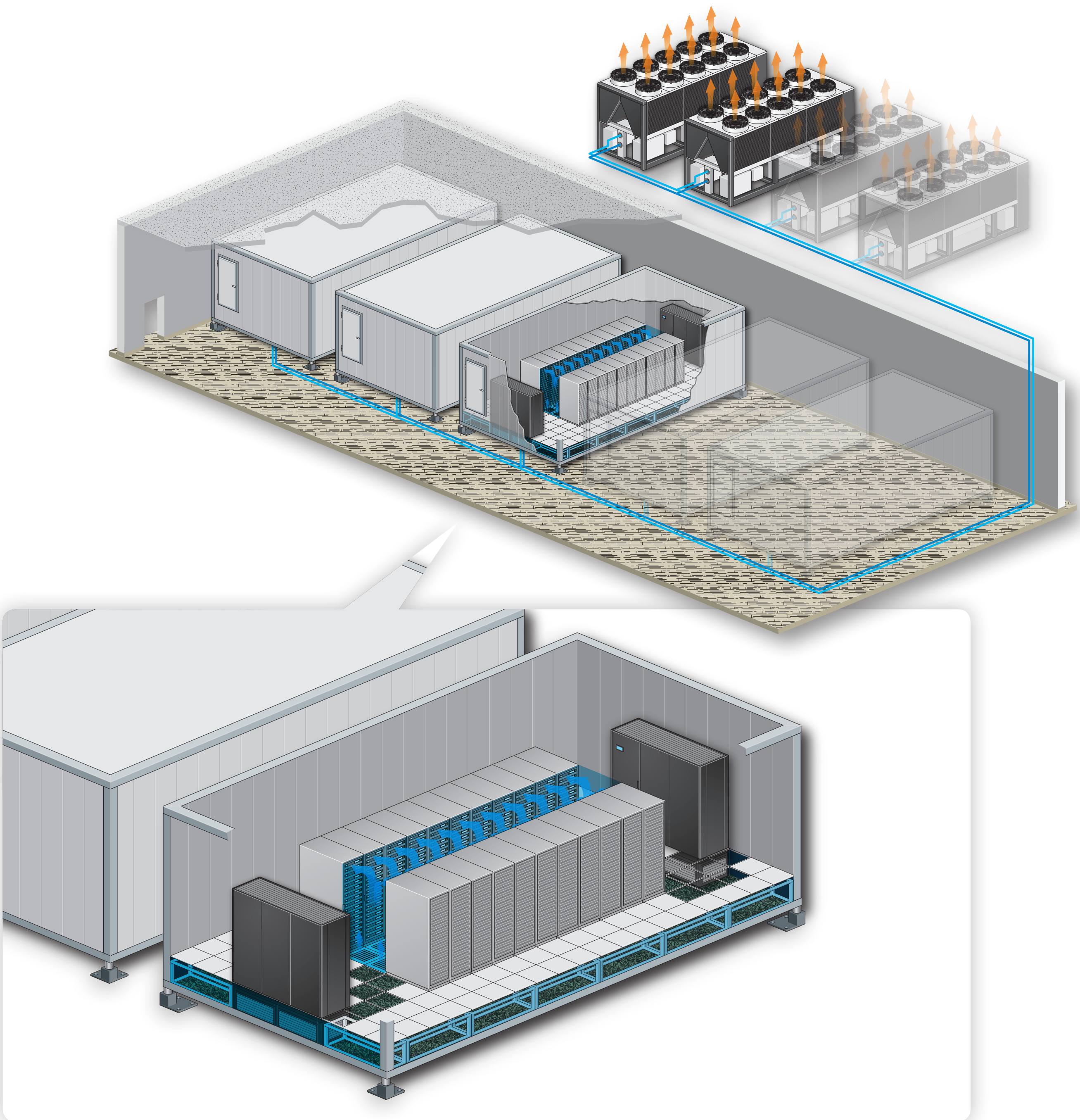
REDUNDANCY CRITERIA

	TIER I	TIER II	TIER III	TIER IV
Number of Delivery Paths (power and cooling)	1	1	1 active and 1 passive	2 active
Utility Entrance	Single Feed	Single Feed	Dual Feed	Dual Feed from different utility substations
Single fault tolerance	NO	NO	NO	NO
System allows concurrent maintenance	NO	NO	YES	YES
Downtime	28.82 hrs (0.329%)	28.69 hrs (0.259%)	1.58 hrs (0.018%)	0.44 hrs (0.005%)
Uptime	8731.18 hrs (99.671%)	8731.31 hrs (99.741%)	8758.42 hrs (99.982%)	8759.56 hrs (99.995%)
Redundancy of the cooling units and power *	N (No redundant unit)	N+1 (One redundant unit)	N+1 (One redundant unit)	2N (Redundancy sufficient to maintain critical area during loss of one source of electrical power)

*UPS, CRAC, Chillers air and water cooled, remote condensers, dry cooler, AHUs…
N= number of active units strictly needed.

SCALABILITY AND MODULARITY

The modularity of a Data Center consists of adding or removing components of a system (IT, power supply and cooling) according to the actual needs. To design a modular and scalable Data Center is a more economically sustainable and efficient solution.



MONITORING AND CONTROL OF A DATA CENTER

Each device in the cooling system for a Data Center is equipped with sophisticated sensors to ensure the server room hygrothermal conditions and the air quality are strictly controlled. Each onboard microprocessor is provided with a dedicated software to control and monitor all the air conditioning variables.

The highest efficiency for a Data Center is achieved when all CRAC units and chillers are controlled as a single system, in order to get:

- **INTEGRATION**: a single control board manages all the units for air conditioning of the Data Center. Real integration comes when all the heat loads, even of opposite signs, are used.
- **ENERGY SAVING**: Distributing the load on many refrigerating units, modulating the speed of compressors, pumps and fans and the use of Free-Cooling lead to real energy saving.
- **REDUNDANCY**: The needed redundancy of the system comes from the complete management of all the air conditioning units.
- **LIFETIME**: The cooling demand of the Data Center is distributed on all the refrigerating units installed. This lets them work for a uniform number of hours.

LIGHTING

Part of the energy consumption of a Data Center comes from lighting in the rooms, from the server room to the offices, from UPS rooms to technical rooms. The reduction of the energy absorbed from lights is another step toward achieving a low PUE value, then towards energy, economic and environmental sustainability of the system.

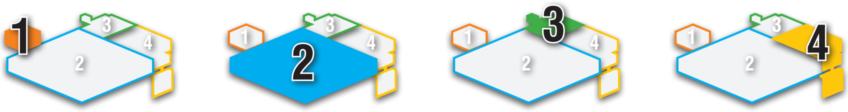
LED technology is the state of the art in lighting and gives many advantages when used in a Data Center:

- lower energy consumption compared to traditional solutions (up to 70%)
- no additional heat load in the rooms, thus no additional energy consumption for air conditioning
- no maintenance required
- long life (50,000 minimum hours of work)
- easy to assemble
- unlimited number of starts and stops
- quick strt-ups and shut-downson and off the immediate
- easy management with integration in automatic control systems, with light modulation as a function of the actual needs

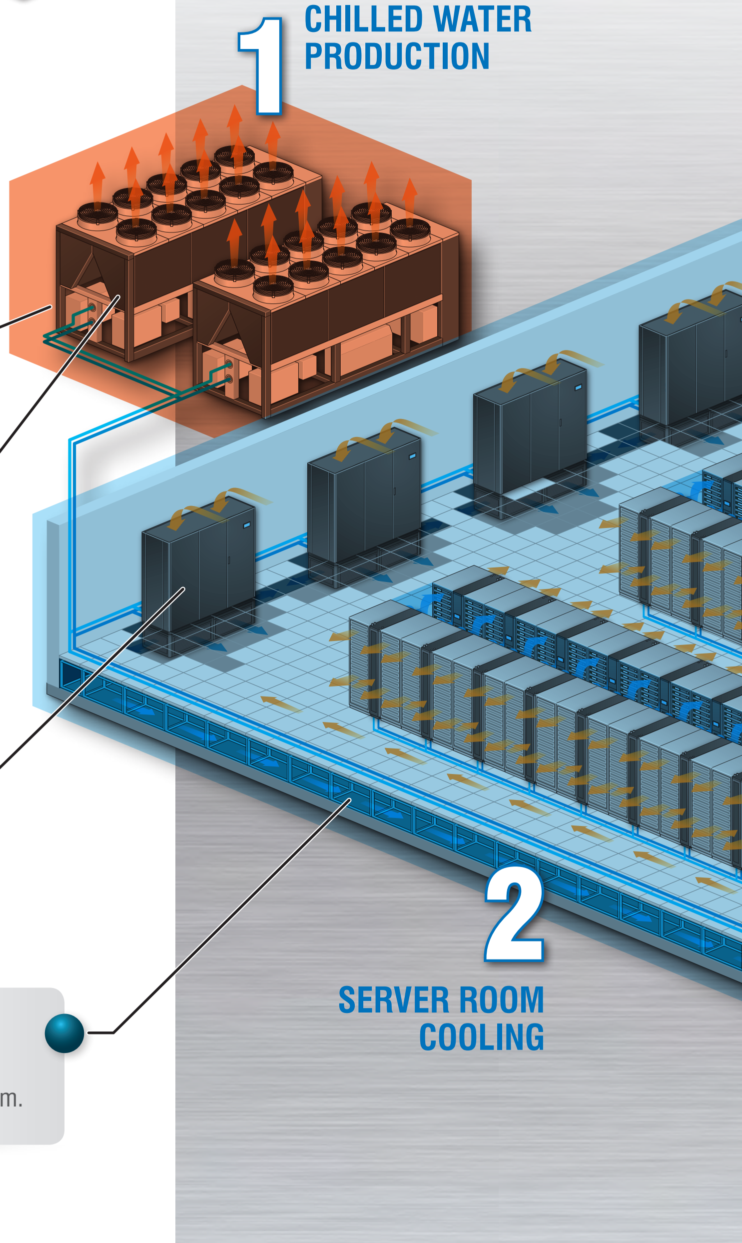



DATA CENTER: TYPICAL LAYOUTS

A Data Center can be divided into four main macro-areas, each of which offers real opportunities for the exploitation of available technologies. In order to maximize the energy efficiency of the whole system it is important that all sections are integrated with each other, either in terms of infrastructure or control and management of the plants with the aim of optimising running costs.



1 - **CHILLED WATER PRODUCTION**
2 - **SERVER ROOM COOLING**
3 - **SMALLER SERVER ROOMS OR UPS/BATTERY ROOMS**
4 - **INTEGRATION AND HEAT RECOVERY**



The chilled water is most efficiently produced when the cooling capacity is provided using all the compressors available. Their insertion on different chillers is managed considering all the units as a single one.

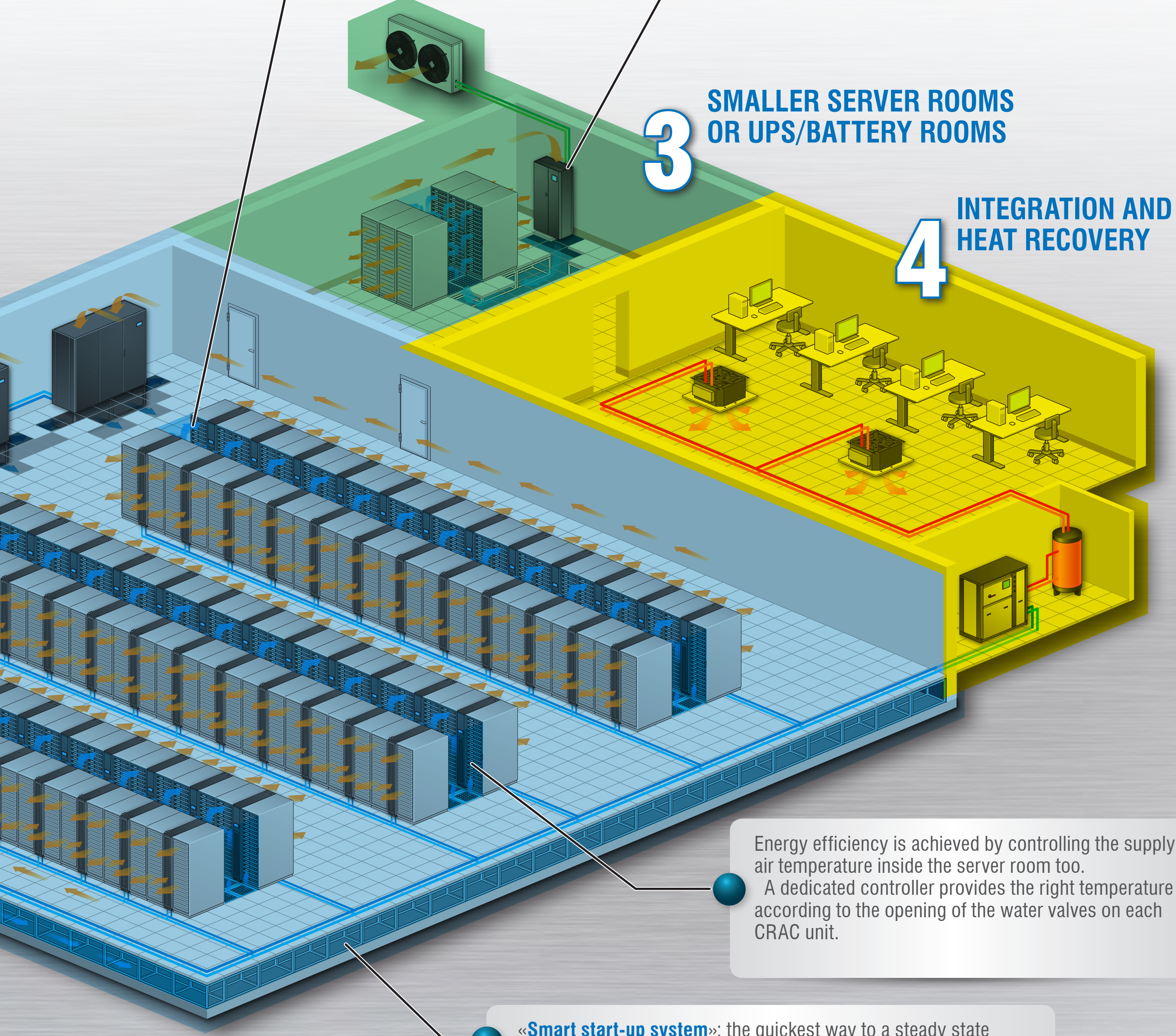
When using a Free-Cooling system for the chilled water production, the charge of antifreeze mixtures can be reduced with benefits in terms of installation costs, running costs and maintenance costs.
The «**Glycol-Free**» execution for Free-Cooling chillers makes Data Centers greener.

«**Floating set point**»: the importance of linking the supply water temperature to the actual cooling demand. It makes no sense to run the chiller system at low water set points when the server room is at partial load.

If the Data Center is developed with a raised floor, the «**Δp control**» can manage the underfloor air overpressure to provide the necessary air flow and an equal distribution of the cooling capacity through the room.

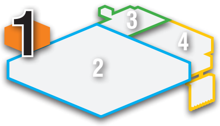
The **cold- and hot-aisle compartment** has nowadays become essential to get high PUE values. This is how avoid exergetic losses due to mixing of air flows at different temperatures and to increase the global efficiency of the Data Cente

Most of the devices of an air conditioning system are **modulating**.
The real advantage comes with a proper control strategy: there can be higher efficiency or very fast reactions to cooling demands.

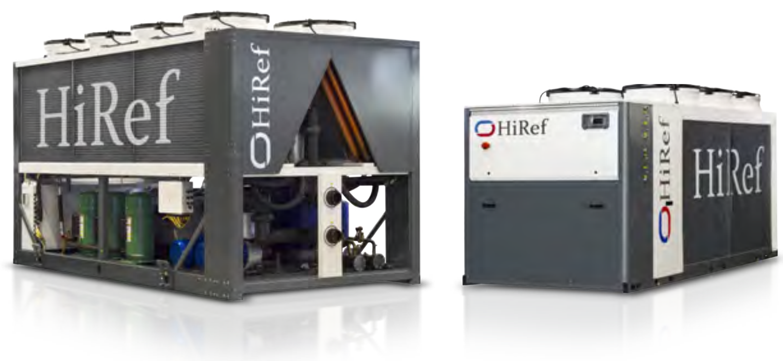


Energy efficiency is achieved by controlling the supply air temperature inside the server room too.
A dedicated controller provides the right temperature according to the opening of the water valves on each CRAC unit.

«**Smart start-up system**»: the quickest way to a steady state after a power supply interruption. It saves money and gives the cooling system the required stability.



CHILLED WATER PRODUCTION



TSX

- Glycol-Free execution
- Multi-scroll solution
- Three noise level configurations
- EC fans available
- Hydronic kit onboard

MHW

- Extreme low-noise with Hi-Box
- Continuous capacity modulation with BLDC compressors
- Easy accessibility with Hi-Rail

XSW

- Refrigerating circuit and number of compressors customizable
- Multi-scroll solution
- Small footprint

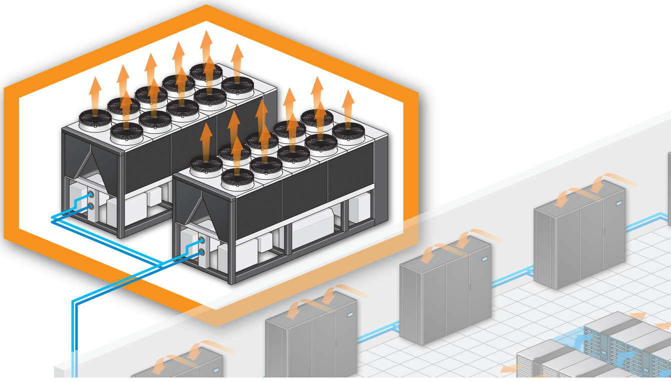
XVW

- Up to 1.5 MW cooling capacity
- Screw compressors optimized for the application
- Shell and Tube exchangers selected according to application

COOLING ONLY AIR-TO-WATER CHILLERS WORKING IN PARALLEL

TSX-C

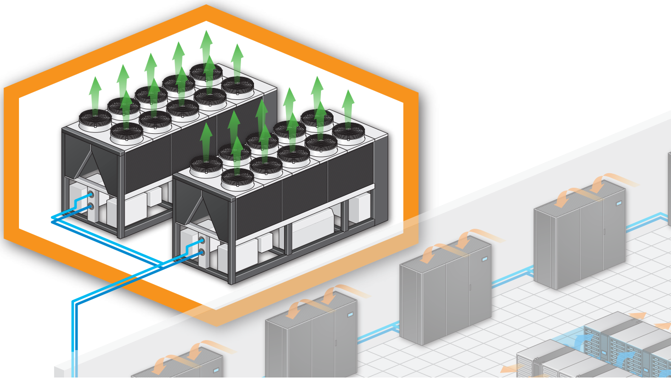
- Simple and easy to install solution
- Low installation costs
- Outdoor units: no room is needed inside the builiding
- Small footprint



PACKAGED FREE-COOLING AIR-TO-WATER CHILLERS WORKING IN PARALLEL

TSX-F

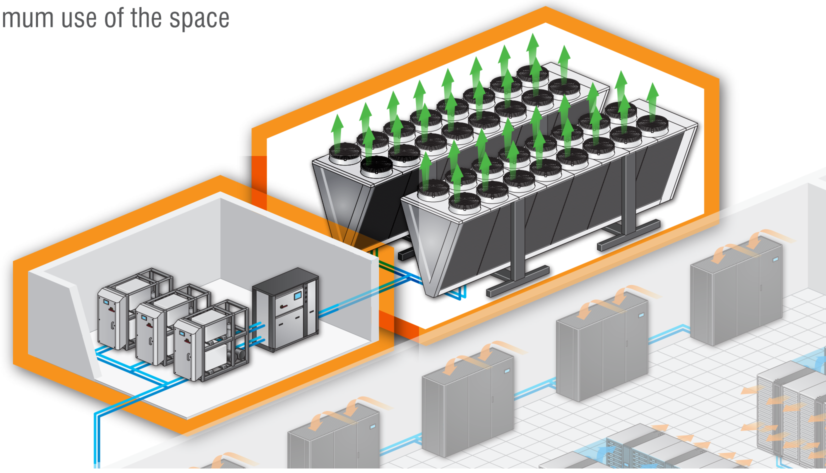
- Simple and easy to install solution
- Low installation costs
- Outdoor units: no room is needed inside the builiding
- Small footprint
- Lower running costs thanks to the Free-Cooling technology

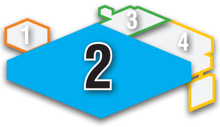


WATER-TO-WATER CHILLERS WORKING IN PARALLEL WITH A FREE-COOLING KIT AND DRY COOLERS

XSW / XVW / MHW + PLM-F

- Lower running costs thanks to the Free-Cooling technology
- The Free-Cooling exchangers can be sized making maximum use of the space
- Further Free-Cooling exchangers can be added later on when the Data Center expands
- Chillers are installed indoor and not exposed to weather
- Lower outdoor noise emission compared to packaged chillers

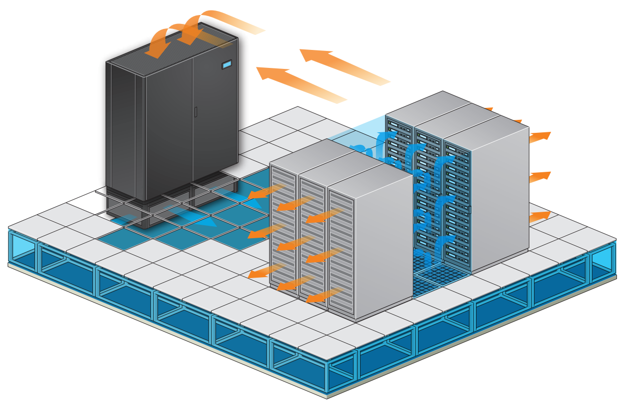


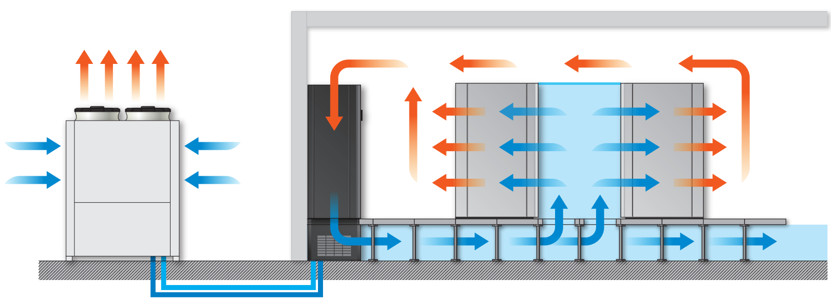


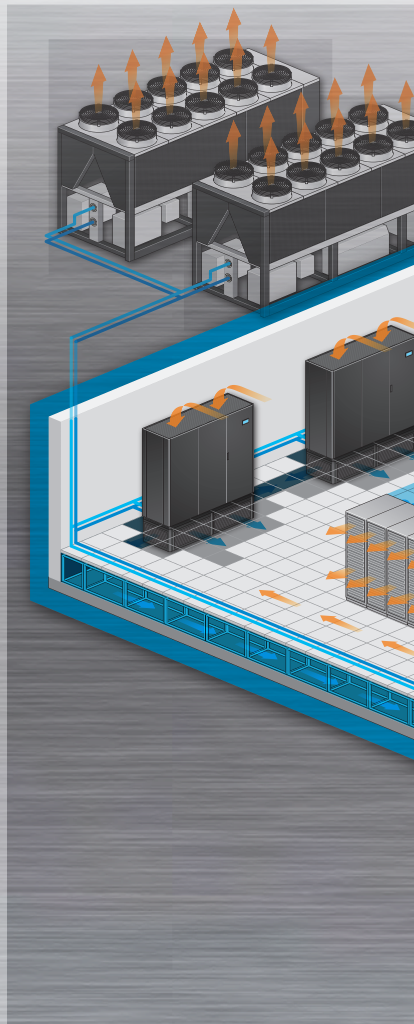
CHILLED WATER UNITS WITH UNDERFLOOR FANS

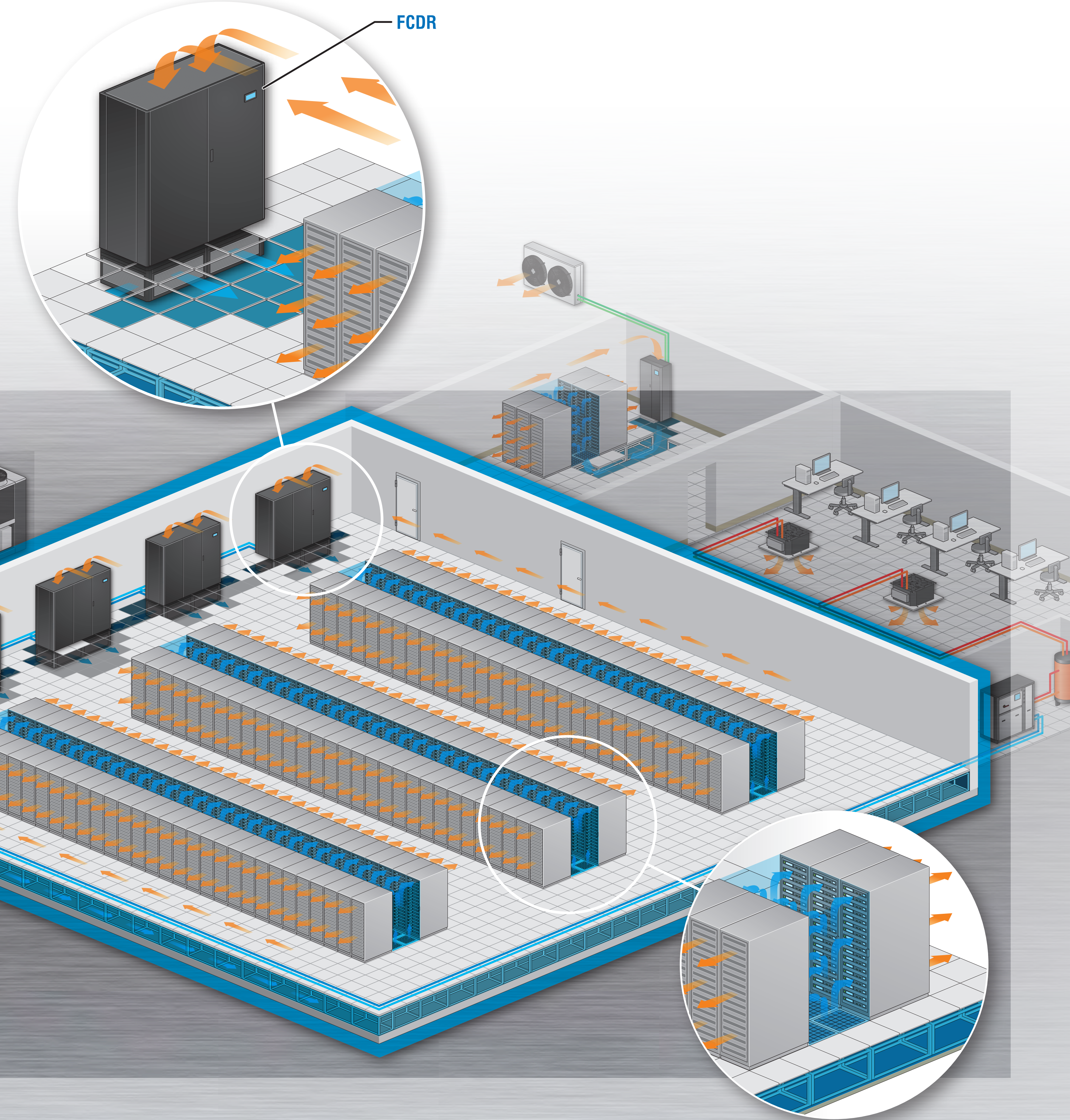
The computer room is cooled down by chilled water units.
The fans are installed in an underfloor module in order to make more room for the CW coils in the main frame and to enhance the aerodynamic efficiency. An air-flow and pressure control provides an homogeneous distribution of the cooling capacity through the room.
This is the most common configuration for medium/high-density Data Centers.

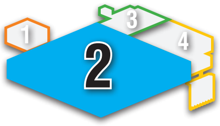
TREF FF; JREF CW; TREF CW








FCDR



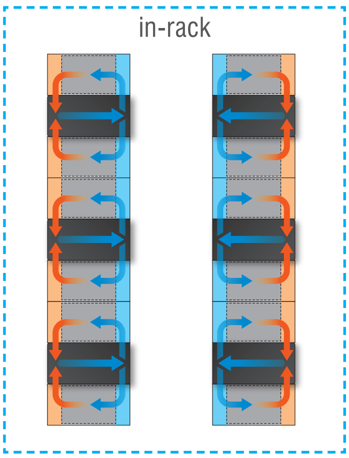
CHILLED WATER UNITS WITH UNDERFLOOR FANS AND CHILLED WATER RACK COOLERS

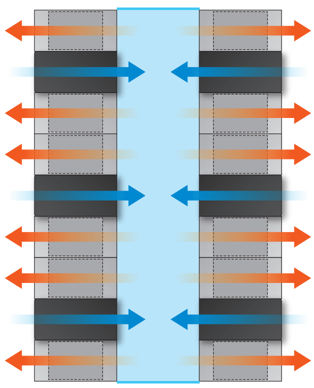
Data Center cooling with a combination of chilled water CRAC units and chilled water in-row rack coolers.

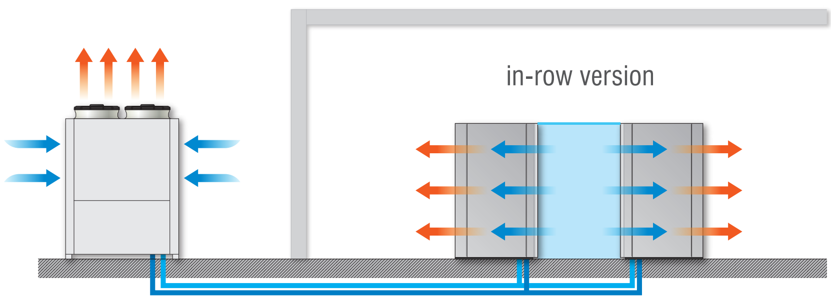
This “hybrid” configuration provides redundancy or the possibility of achieving spot cooling wherever and whenever it is needed. The rack coolers are switched on only in case there’s a high-density zone inside room with the highest efficiency, thanks to the room compartment in cold/hot aisles.

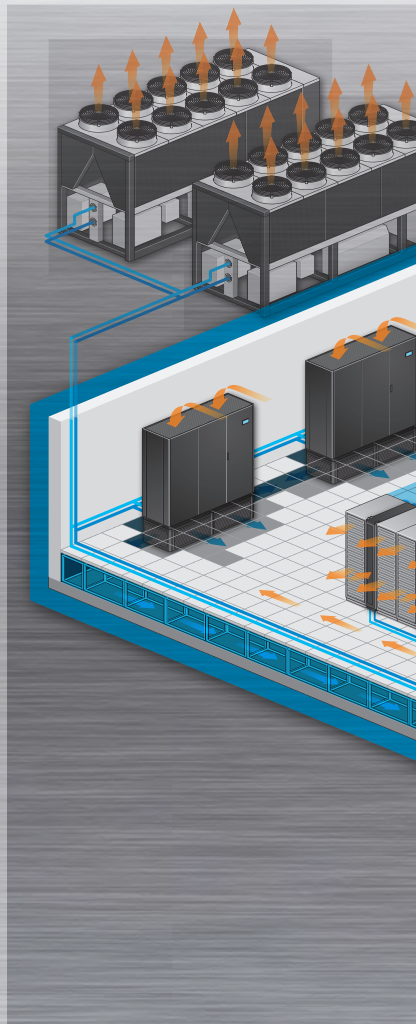
The solution is quite simple, as both CRAC units and rack coolers are connected to the same chilled water circuit.

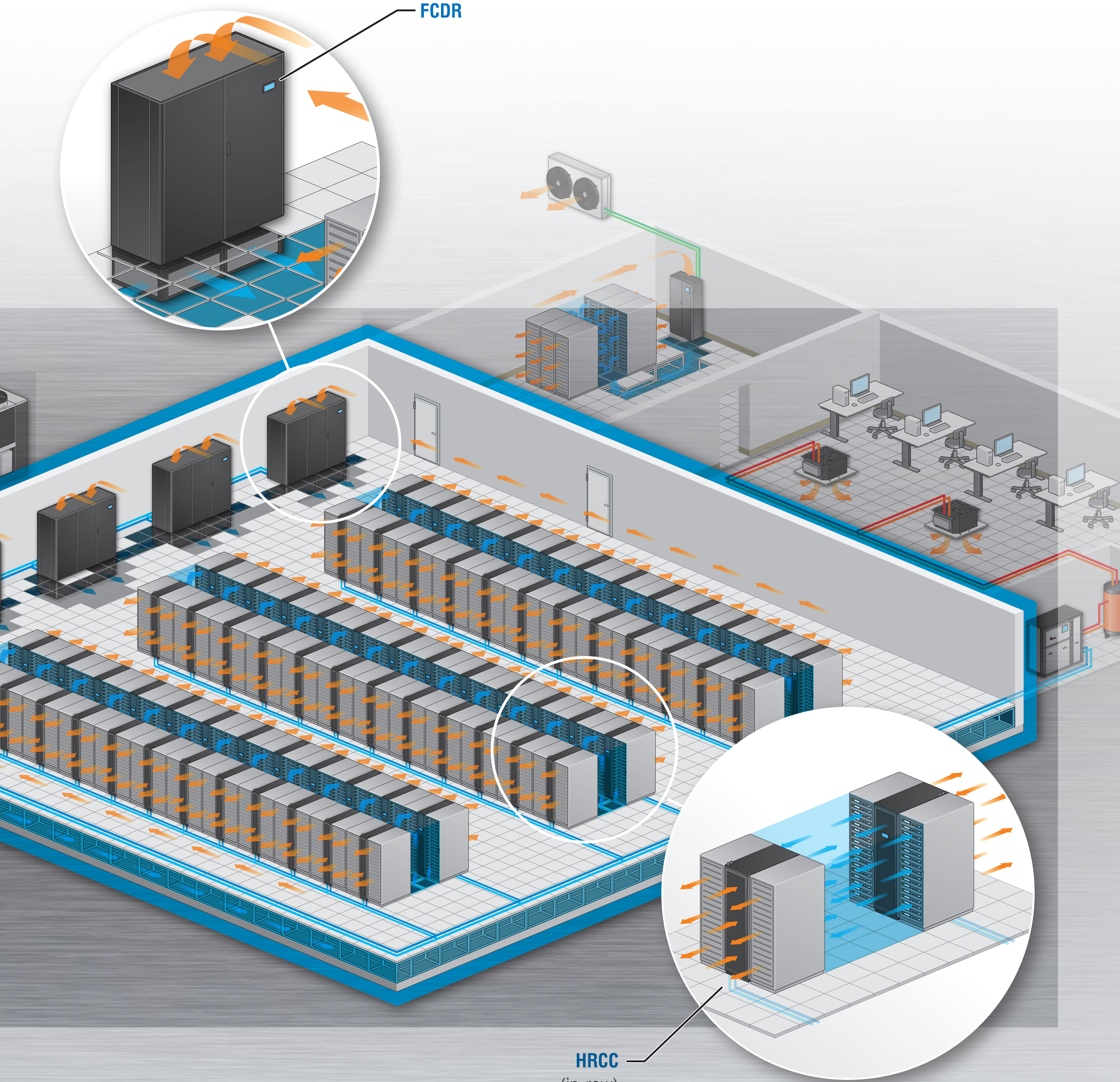
HRC CW





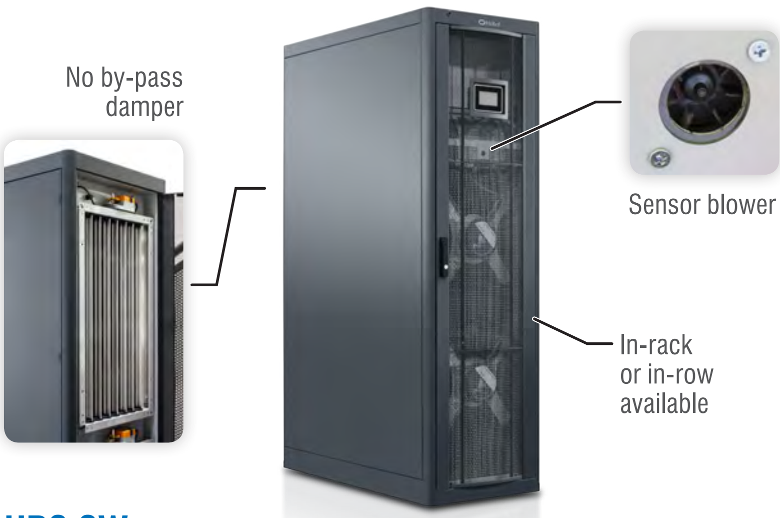




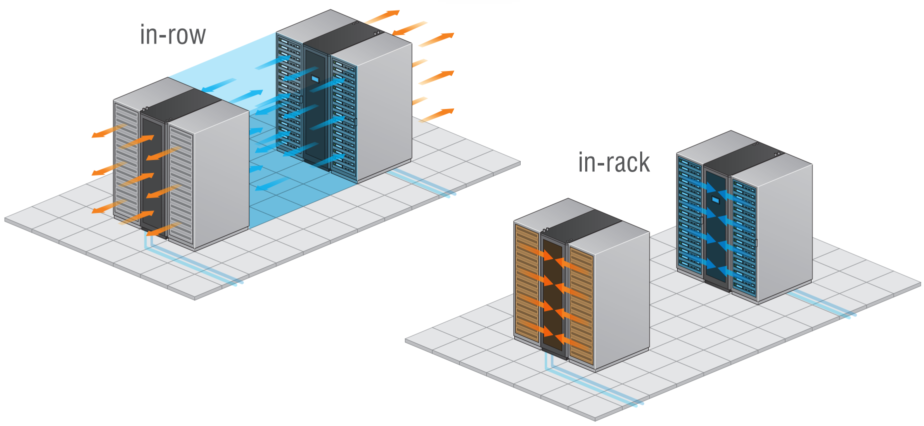

FCDR
HRCC
(in-row)

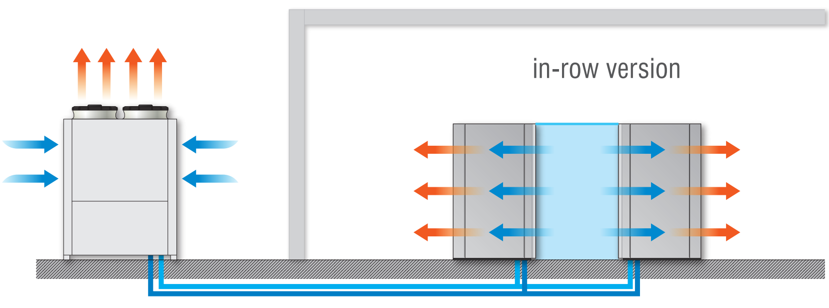
CHILLED WATER RACK COOLERS

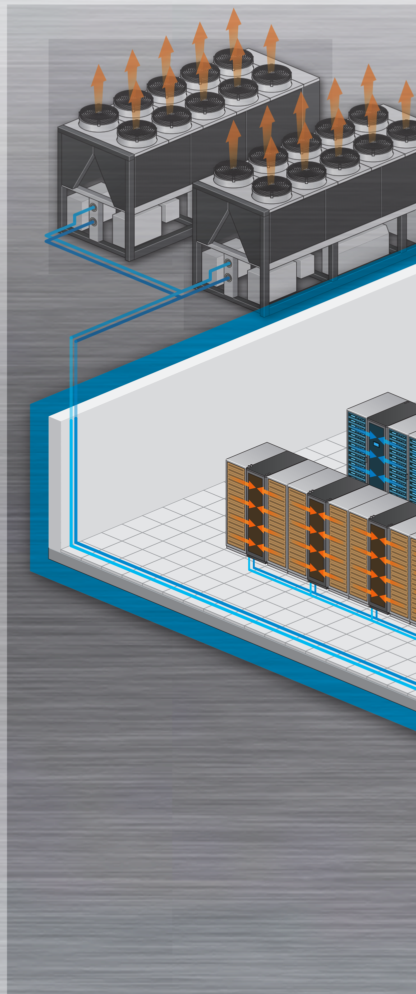
When the need for cooling the computer room is high density (> 10 kW/rack), then a spot cooling solution is required.
The rack coolers deliver the needed cooling capacity to the cold aisle, taking hot air from the hot aisle. They're installed close to each rack, providing an immediate and efficient reaction to any load variation.

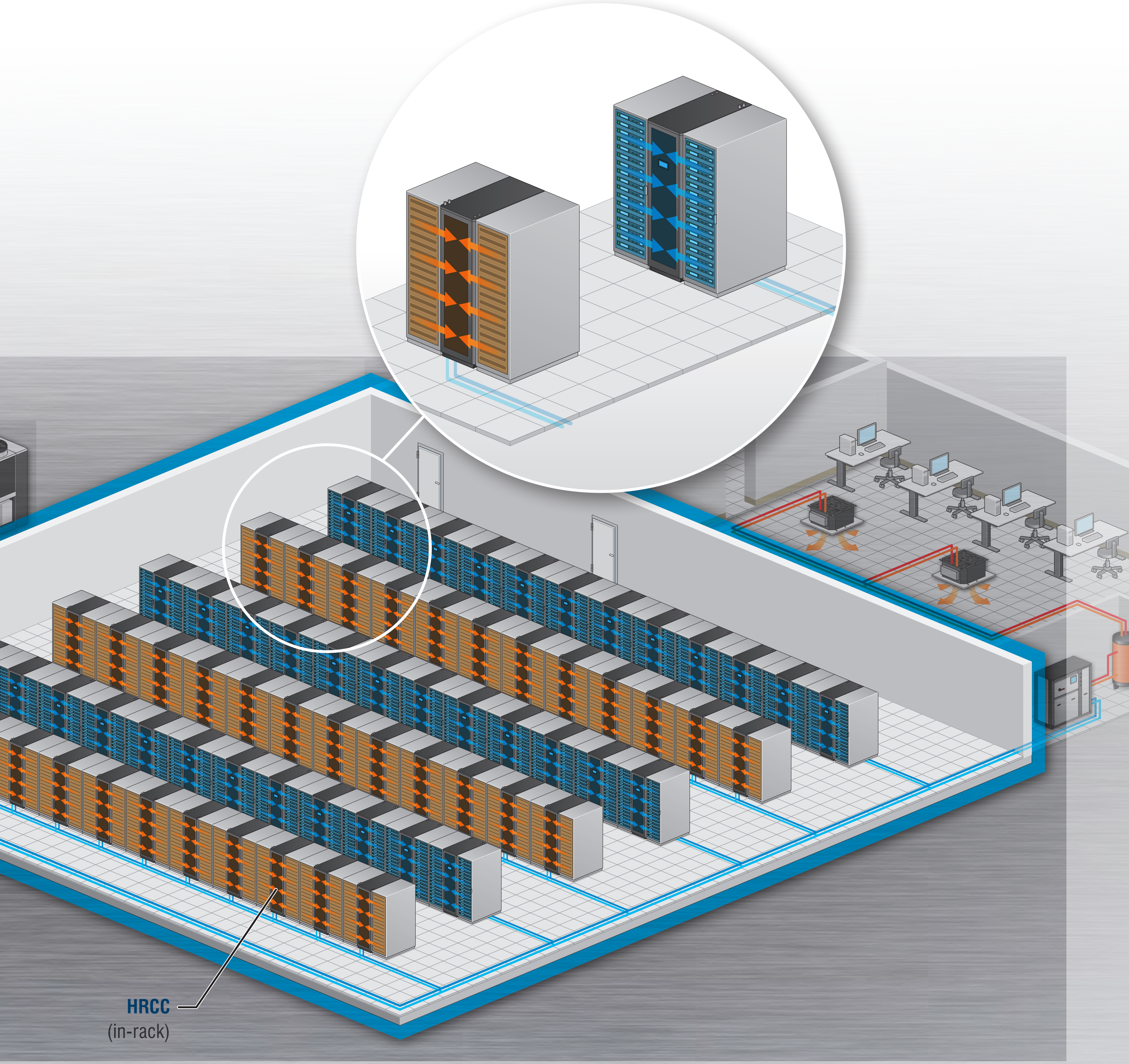


HRC CW





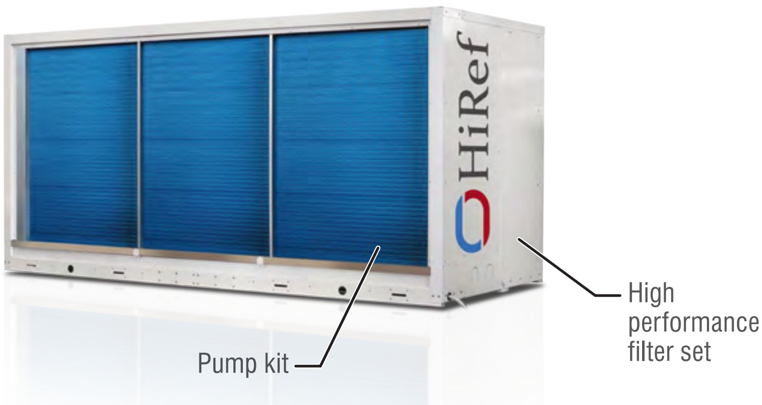



HRCC
(in-rack)

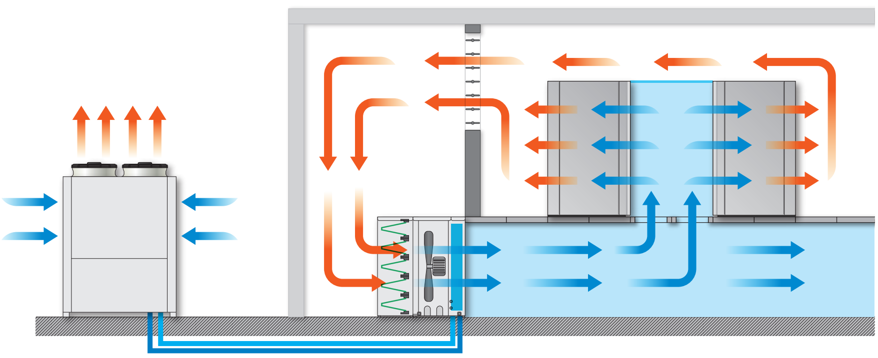
CHILLED WATER UNDERFLOOR UNITS

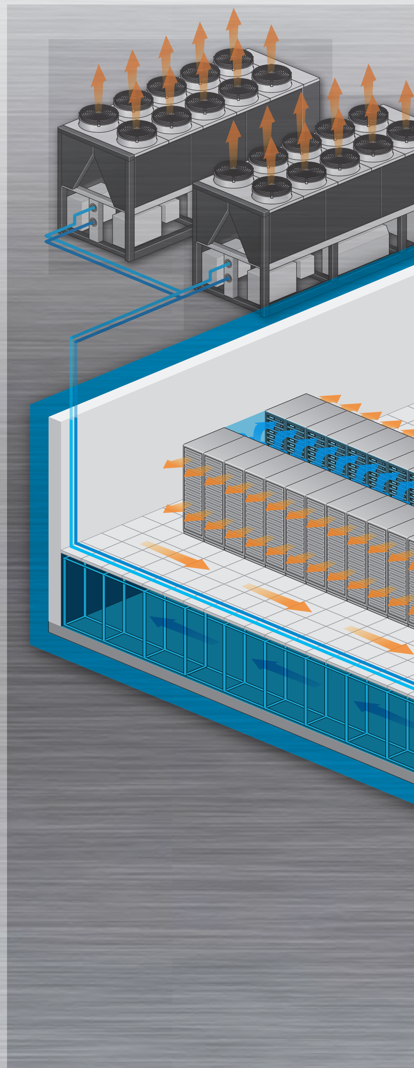
Great advantages come with completely underfloor chilled water CRAC units. As they're usually installed in a perimeter corridor, there's more room for racks in the main server room while the maintenance of them can be completely done outside the server room.

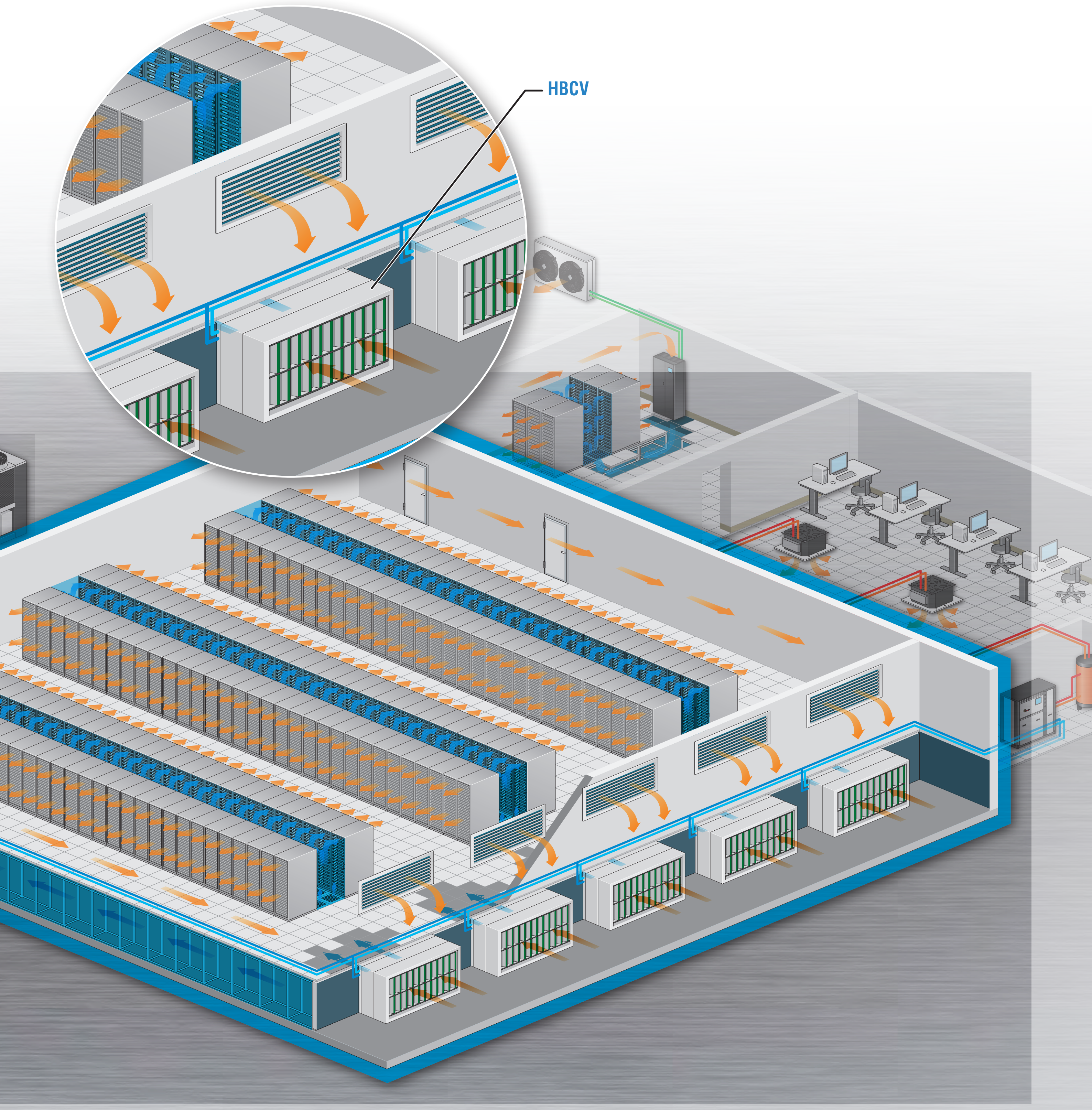
The air velocity is lower than "traditional" solutions, thus the ventilation power consumption is reduced, while there's a better air distribution through the false floor.



HBCV



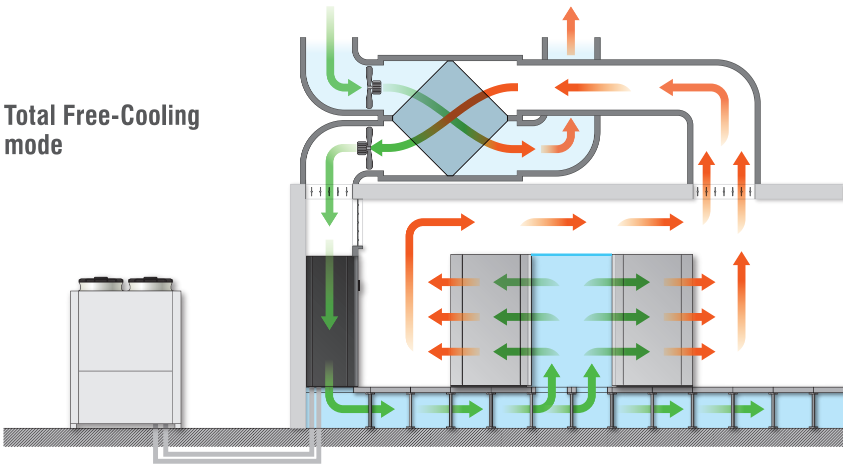



HBCV

CHILLED WATER UNITS WITH UNDERFLOOR FANS AND HIGH PERFORMANCE AIR-HANDLING UNITS
(INDIRECT FREE-COOLING)

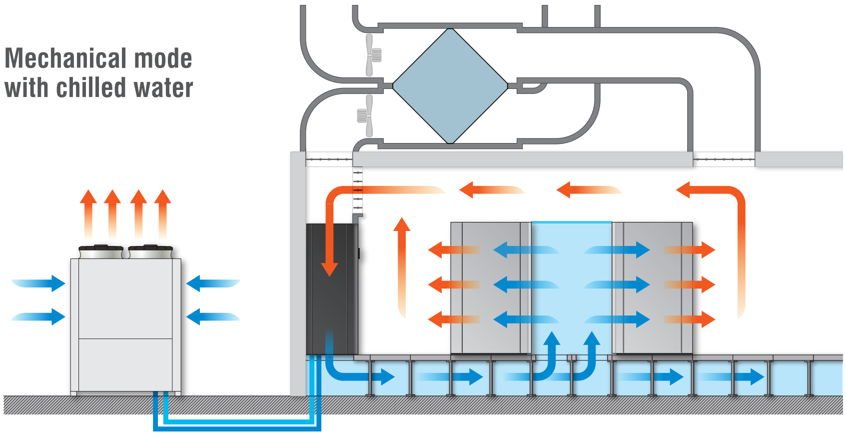
When the outdoor air temperature is below the computer room temperature for most of the year, then an indirect Free-Cooling solution should be considered. A heat recovery system (or air handling unit) is installed on top of the Data Center, providing Free-Cooling capacity to the racks.

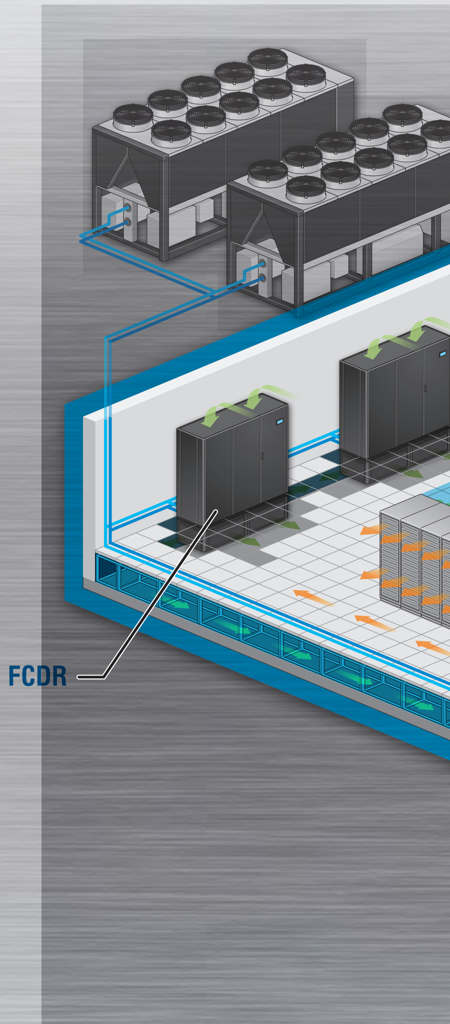
Total Free-Cooling mode

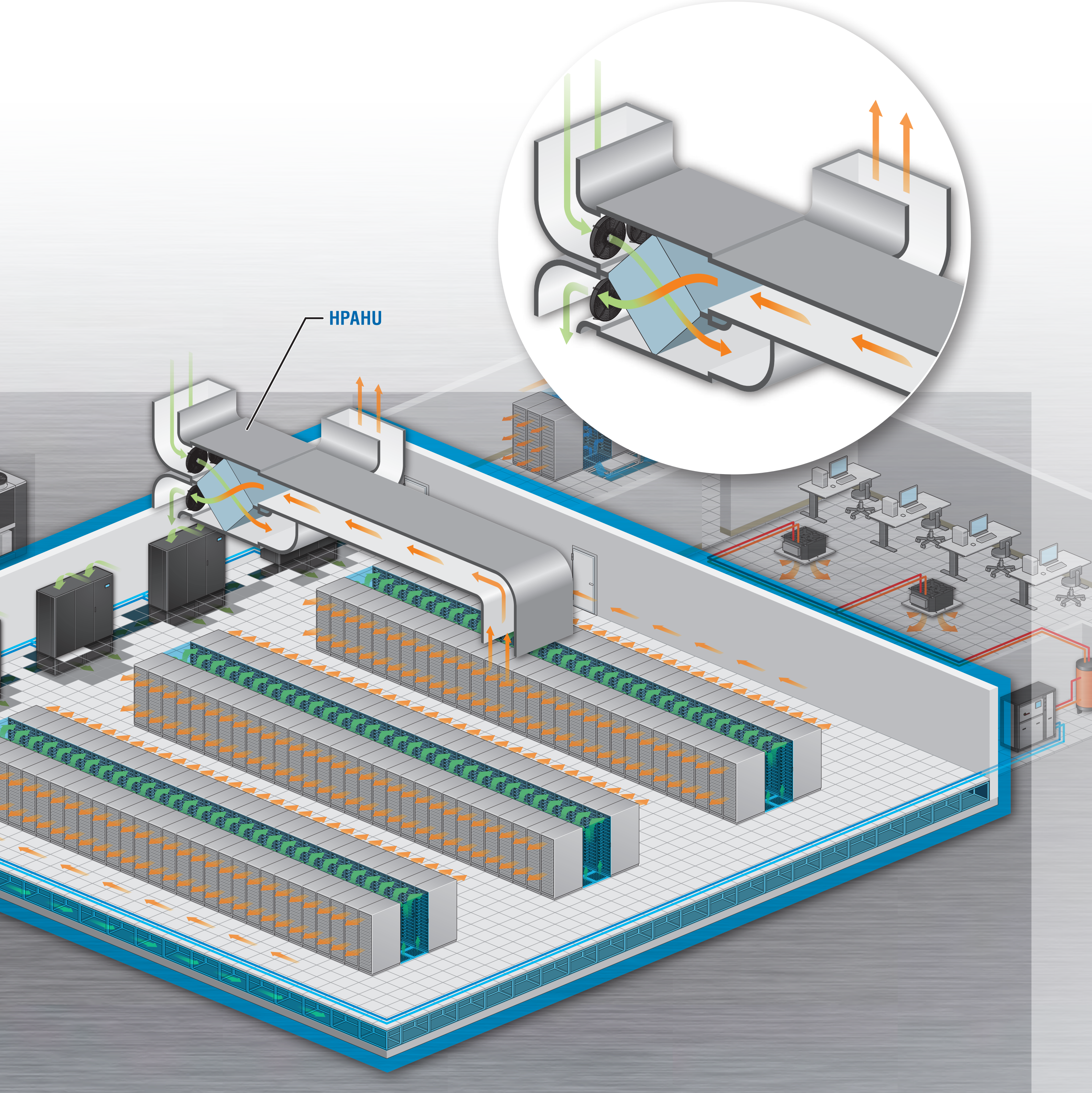


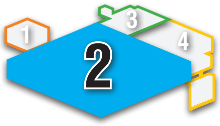
CRAC units work at partial load to reach the required capacity, or give 100% of it when the outside is too hot. Below the total Free-Cooling temperature the CRAC units can be switched off and the needed capacity is provided by modulating fans and dampers only. This indirect Free-Cooling system requires no deep filtration, which is a great advantage if compared to direct Free-Cooling ones.
The outside installed chiller can be in “cooling only” execution, thus simpler.
The whole system has a higher Free-Cooling efficiency, as it doesn’t use any additional thermal barrier (FC chillers have an additional heat exchange between air and water).

Mechanical mode with chilled water





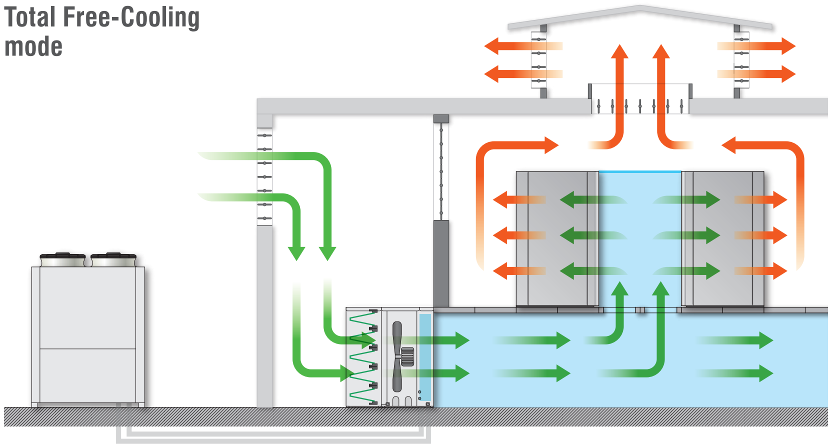

HPAHU



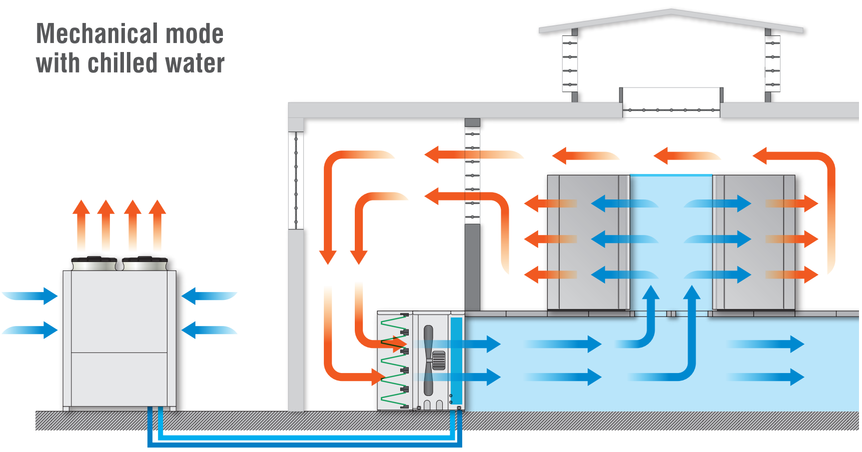
CHILLED WATER UNDERFLOOR UNITS AND DIRECT FREE-COOLING

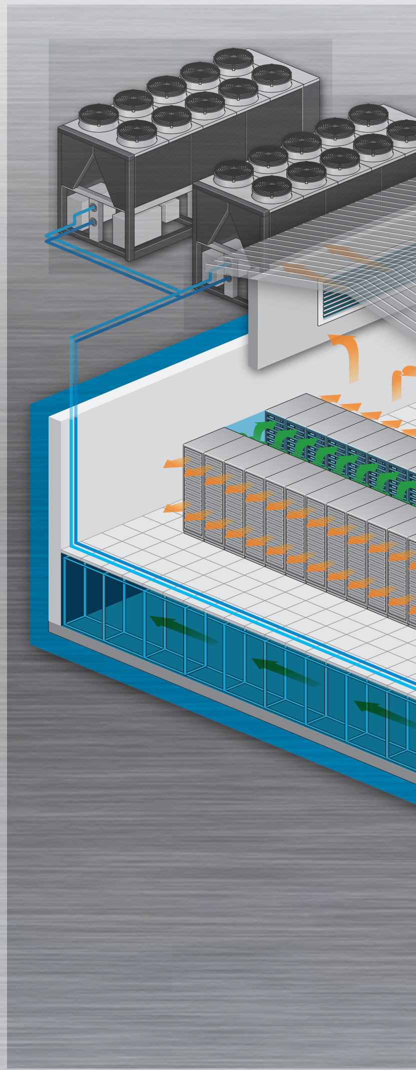
When the outdoor air temperature is below the computer room temperature for most of the year, then a Free-Cooling solution should be considered.
Direct Free-Cooling is the most energy efficient configuration as the cooling capacity is provided without any heat exchange, taking directly air from the outside. When it comes in combination with chilled water CRAC units, then the chiller has no Free-Cooling execution, thus it can be simpler and cheaper. The CRAC units work at partial load to reach the required capacity, or give 100% of it when the outside air temperature is higher than the computer room. Below the total Free-Cooling temperature the CRAC units can be completely switched off and the needed capacity is provided by modulating fans and dampers only.

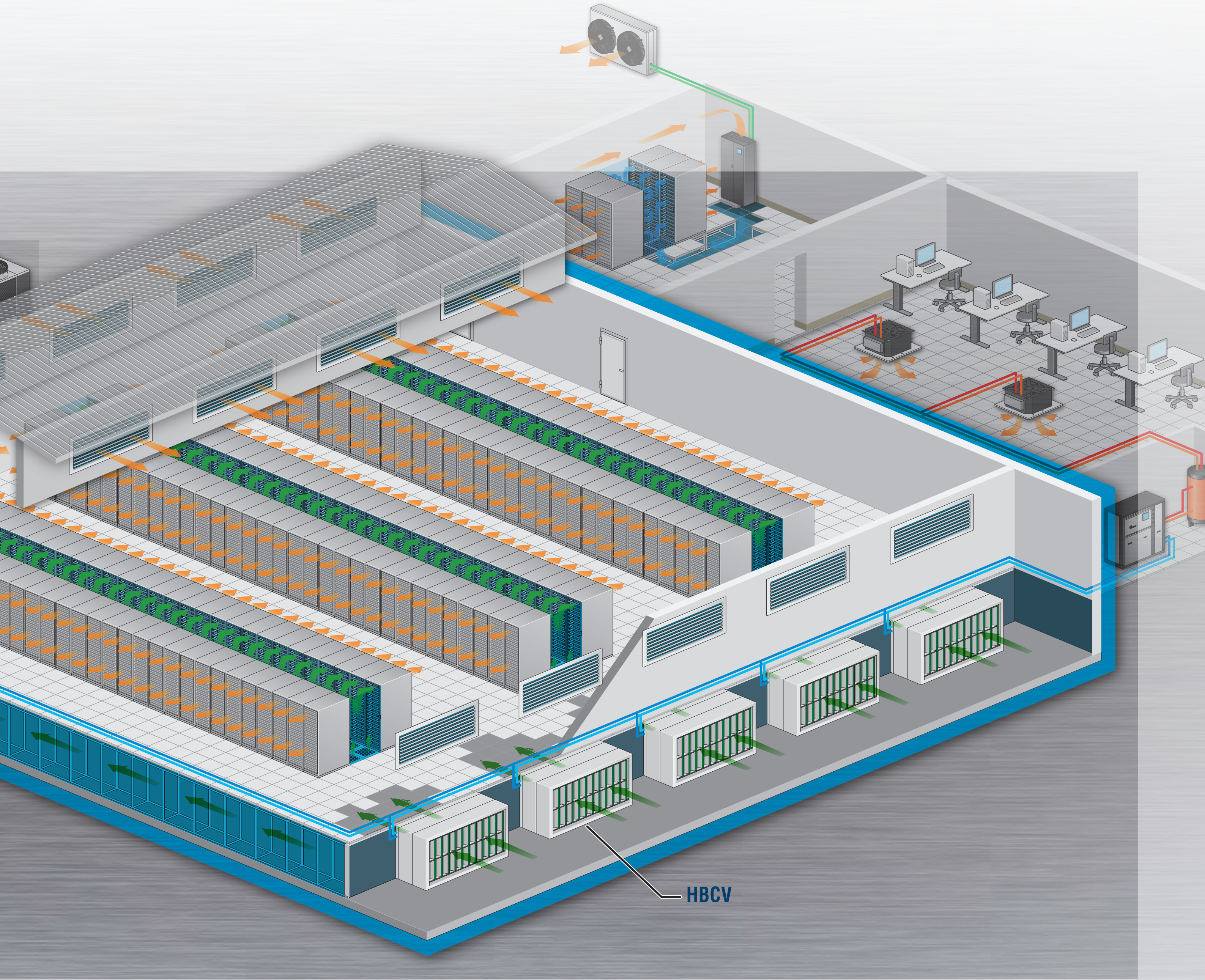
Total Free-Cooling mode

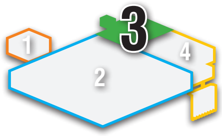


Mechanical mode with chilled water






HBCV

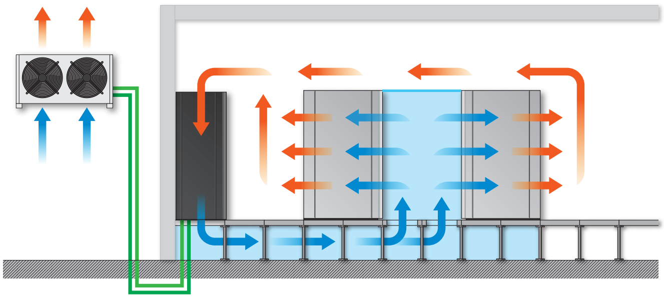


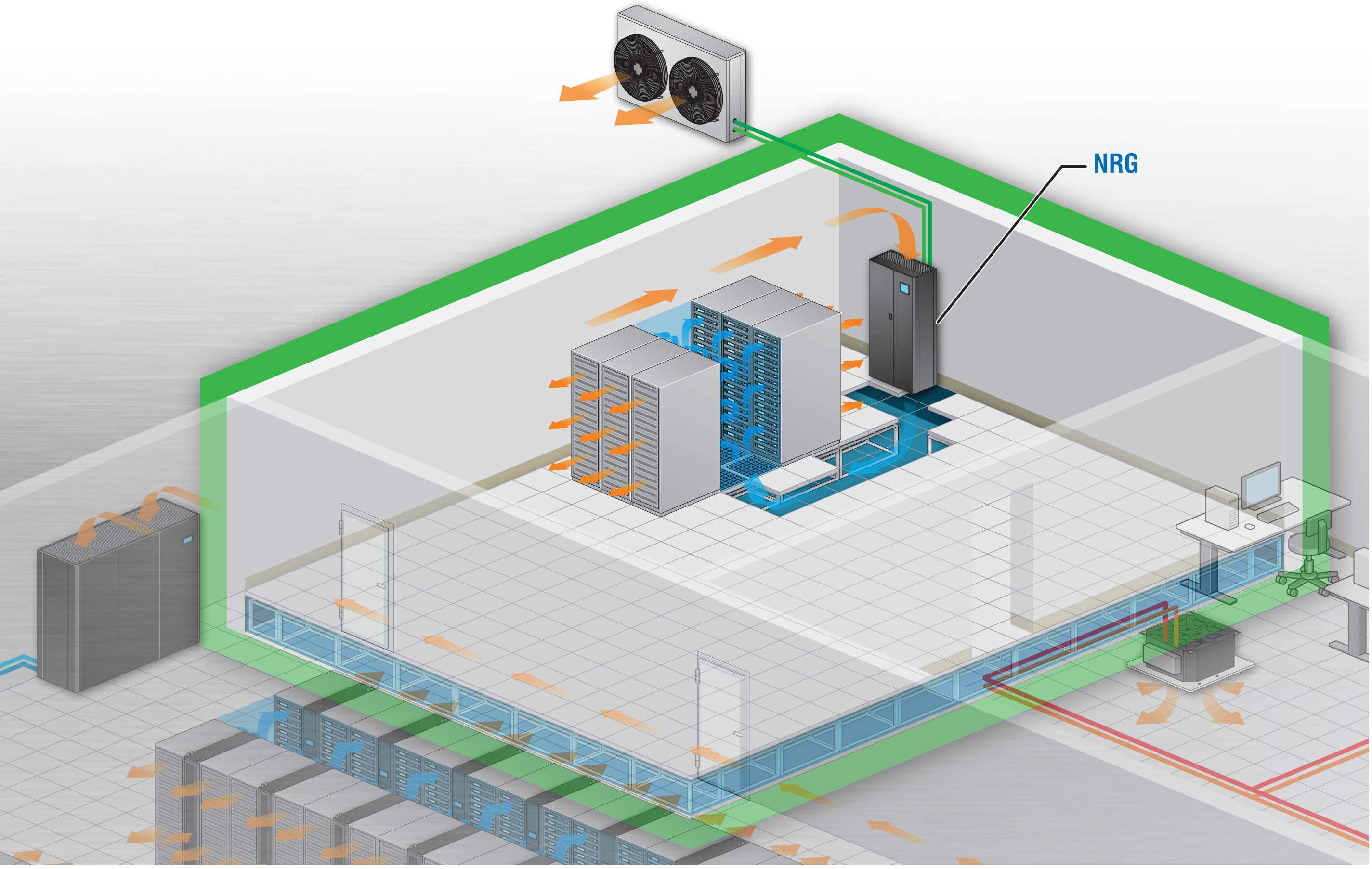
DX DOWNFLOW UNITS

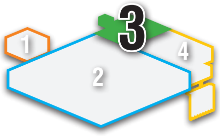
NRG

Small server rooms with double floor can be cooled using downflow DX CRAC units. Comparting the ambient in cold and hot aisles gives more efficiency thanks to no mixing of air flows at different temperatures.

A DX water cooled CRAC unit can be installed, which uses the chilled water ring in the server room as thermal source.



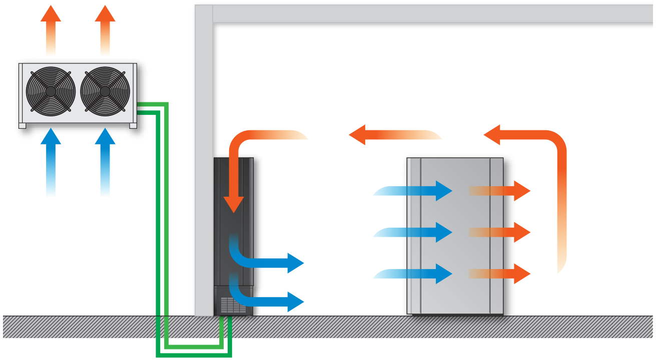


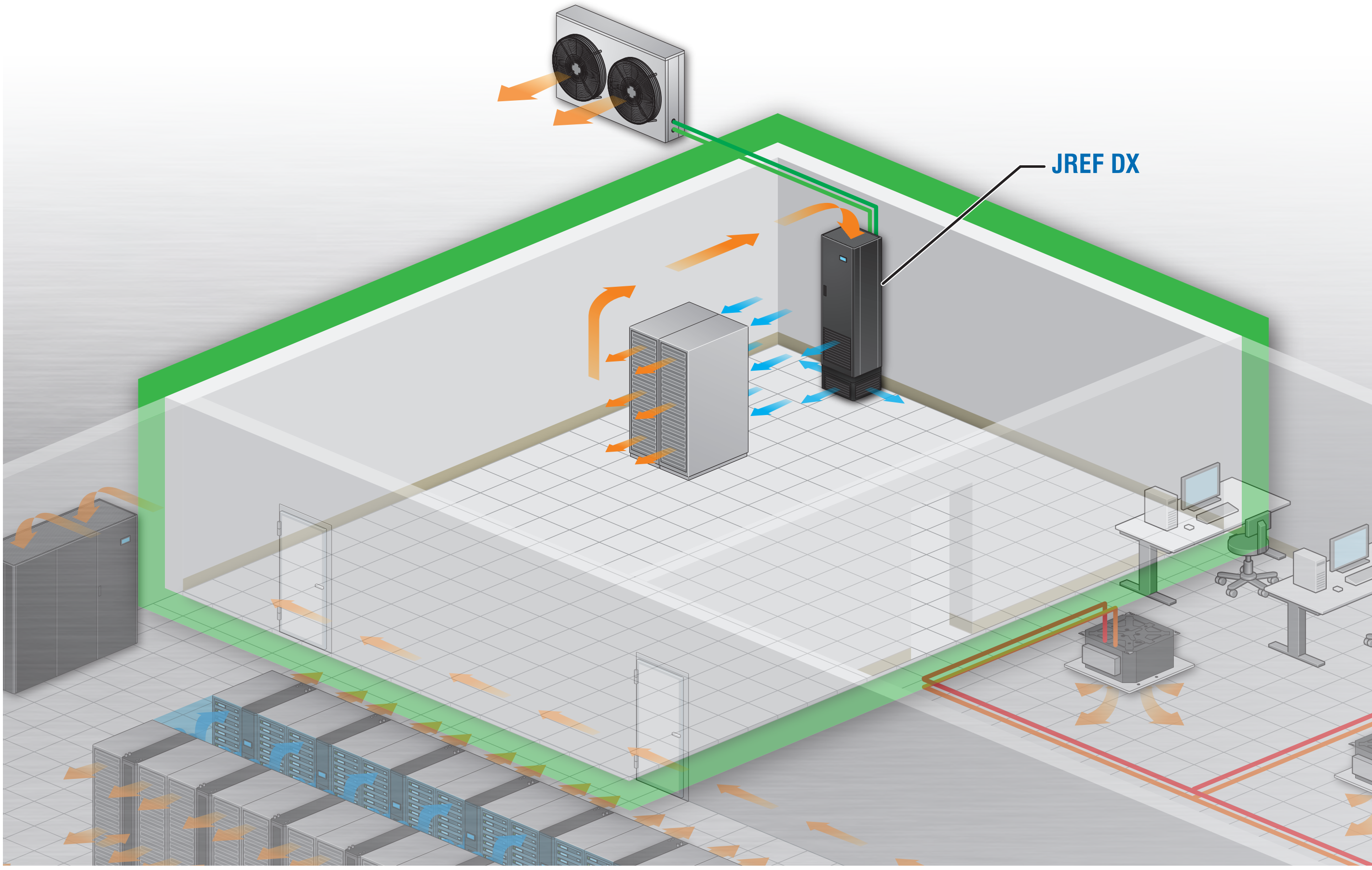


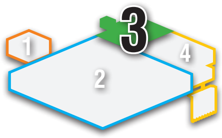
DX DISPLACEMENT UNITS WITH NO DOUBLE FLOOR

JREF DX

Small server rooms with no double floor can be cooled using displacement CRAC units with front/side cold air supply.

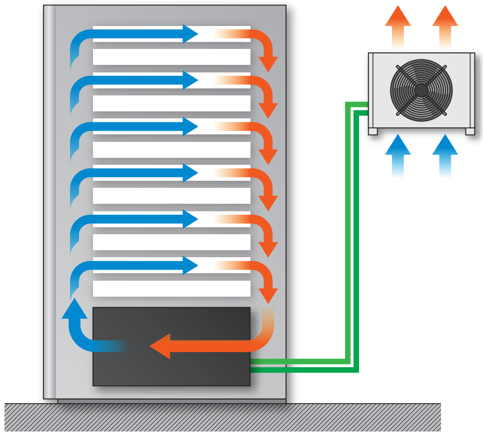




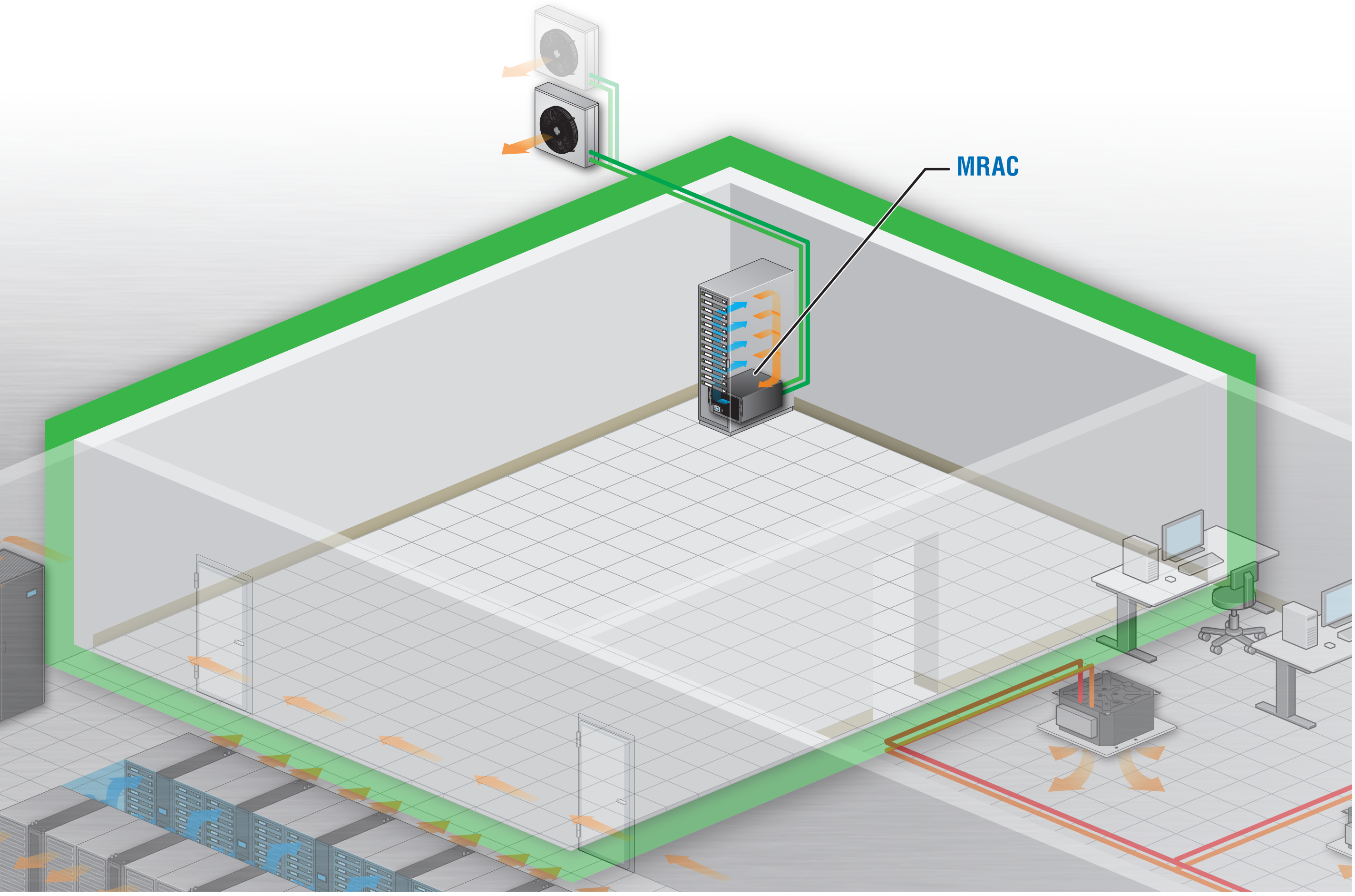


MINI RACK COOLER SOLUTION

For single racks or in the case of little server rooms a mini rack cooler can be used to provide cooling in a closed loop inside the rack.



MRAC

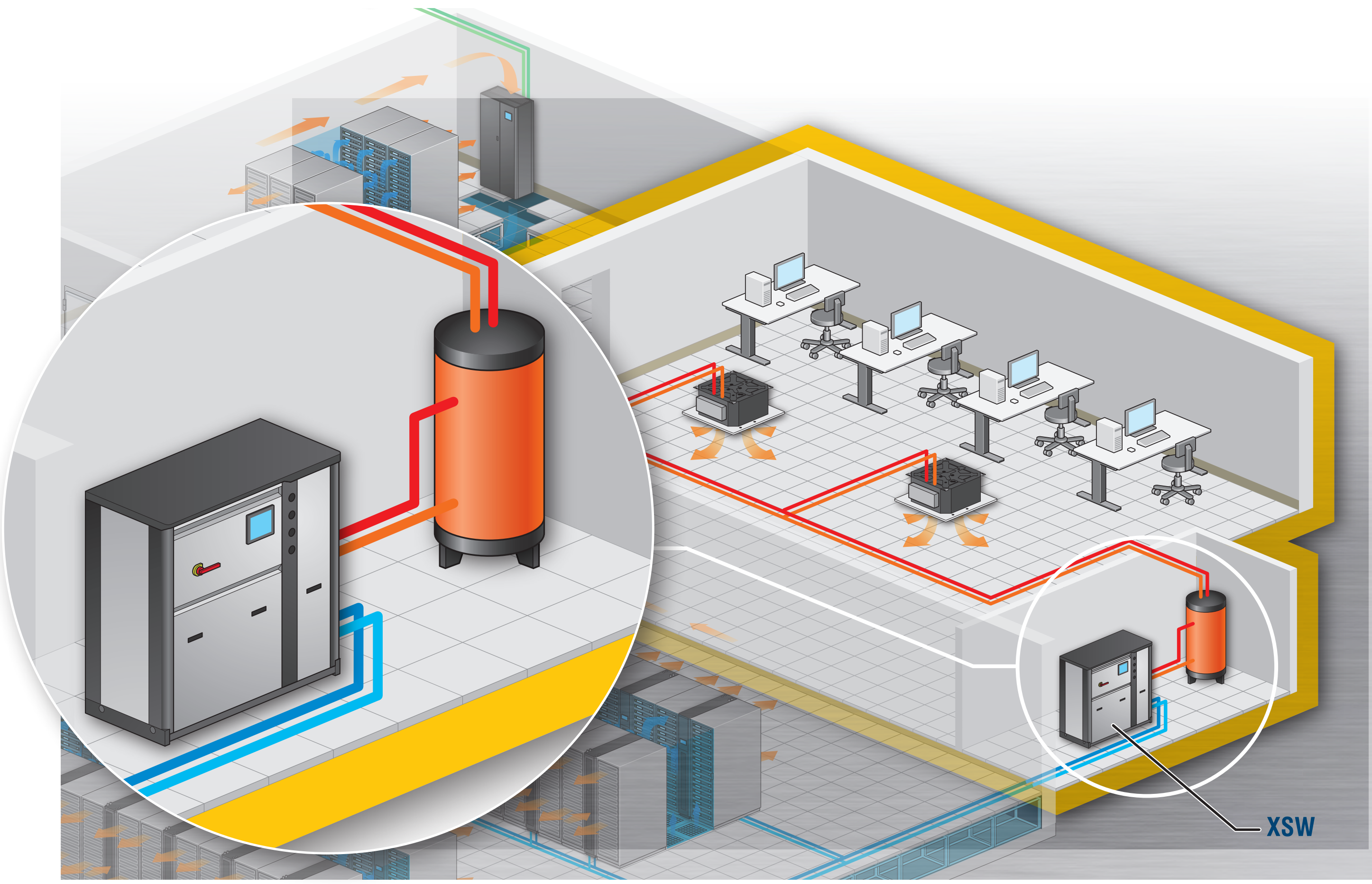


HEAT PUMP FOR HEAT RECOVERY OUT OF THE SERVER ROOM

XSW; XVW; MHW

Real energy efficiency comes with integration.
Data Centers are “one-way” cooling-demand-only systems and a lot of heat is rejected into outside air. The recovery of this heat load (totally or partially) can result in great advantages if used for further heating purposes.
What’s a heat pump got to do with a Data Center? The drawing shows how a heat pump recovers the energy rejected out of the server room to heat up some offices during wintertime. The heating demand can come from different users, such as nearby houses (district heating), industrial processes, offices, etc.

In this way integration means to take advantage of opposite heat flows at the same time, wasting no energy and guaranteeing a highest global efficiency for the whole system.



CRAC UNITS DX

JREF, TREF

- Air or water condensed
- Free-Cooling
- Dual-Cooling
  - Upflow,
  - Downflow,
  - Displacement
- -40°C external air execution

Power range: 8 - 126 kW

CRAC UNITS DX BLDC

NRG

- Air or water condensed
- Free-Cooling
- Dual-Cooling
  - Upflow,
  - Downflow,
  - Displacement
- -40°C external air execution

Power range: 8 - 110 kW

CRAC UNITS CW

JREF CW, TREF CW

- Single or double water circuit
  - Upflow,
  - Downflow,
  - Displacement

Range di potenza: 8 - 240 kW

CRAC UNITS CW FF

FCDR

- Single or double water circuit
- Underfloor fan module
- E-Wing
- Flow-Grid

Power range: 8 - 260 kW

UNDERFLOOR UNITS

HBCV

- High performance filter kit
- Onboard pump kit

Power range:
40 - 200 kW

HIGH DENSITY CRAC UNITS

HRC

- Air condensed DX execution
- In-row or in-rack versions
- BLDC compressors for DX execution
- Anti by-pass damper
- Sensor blower

Power range: DX: 3 - 45 kW
CW: 10 - 75 kW

HIGH DENSITY CRAC UNITS FOR SINGLE RACK

MRAC

- Double motocondensing unit available for MRAC
- Modulating compressor (BLDC) for size 7.3 kW

Power range:
3.6 - 7.3 kW

SPLIT TELECOM UNIT

HTS, NTS

ON/OFF compressor
or modulating (BLDC)

Direct Free-Cooling kit

Power range:
3 - 30 kW

INDOOR TELECOM UNIT

HTD/U/X, NTD/U/X

ON/OFF compressor
or modulating (BLDC)

- Upflow,
- Downflow,
- Displacement

Direct Free-Cooling kit

Power range: 4 - 28 kW

OUTDOOR TELECOM UNIT

HTW, HTWD, HTR

ON/OFF compressor
or modulating (BLDC)

- Upflow,
- Downflow,
- Displacement

Direct Free-Cooling kit

Power range: 4 - 32 kW

POLYMORPH MODULES

FOR WATER-TO-WATER COOLING ONLY CHILLERS

PLM-F/M/P/H/R

Executions:

- Free-Cooling
- Multifunction 2 pipes
- Multifunction 4 pipes
- Heat pump
- Total heat recovery

For any water-to-water
cooling only chiller

AIR-TO-WATER CHILLERS AND HEAT PUMPS

TSX, HWC, TSE, XVR

Executions:

- Cooling only
- Reversible heat pump
- Free-Cooling

Monobloc or split versions

Ductable indoor version

Glycol-Free kit for Free-Cooling executions

Power range: 40 - 1500 kW

WATER-TO-WATER CHILLERS AND HEAT PUMPS

XSW, XVW, MHW

Executions:

- Cooling only
- Reversible heat pump

High temperature hot water production version available

Power range: 40 - 1500 kW

HIREF: THE CUSTOMIZED DATA CENTER

HiRef was founded in 2001 as a company focused on the production of air conditioning units for technological environments (Data Centers and telecommunications shelters); today the brand is known all around the world as being strongly innovative, technological, and product customization-oriented.
With its own highly dynamic and specialized in-house research and development center, and internal mechanical, electrical and software development design department, along with its internal semi-finished product manufacturing departments, HiRef has, over time, acquired the necessary competences to not only offer products, but also complete solutions for the world of air conditioning and chilling. It is this very philosophy that has allowed HiRef to offer its customers truly valuable services, such as assistance in plant engineering planning and streamlining system performance, completing its line of highly customized products.

The objective of HiRef is to fulfil the requirements of its customers without compromising the thermo-hygrometric parameters of the air-conditioned rooms: extensive knowledge on plant engineering, combined with a remarkable know-how for innovative technologies make it possible to reach the energy efficiency levels required to achieve meaningful monetary savings and reduce the impact on the environment.

Over the years the company has experienced rapid growth, overcoming many challenges affecting the sector, thanks to a truly unique resource that has led its success: its people. By recognizing and using the talent of each individual human resource, HiRef is now one of the companies that can boast non-stop product innovation and high quality levels, combined with extreme flexibility.

THE CUSTOMIZED DATA CENTER

The efficient plant is not made of efficient components only.
The reliable plant is not made of reliable components only.

The Data Center efficiency is the result of a complex and detailed design, in which each component is selected with a global vision of the system itself. Just at this crucial stage HiRef is able to support the designer in choosing the solution that is best suited to the specific needs of the site; and it is in this context that HiRef manifests itself as a company that can offer not only high quality products for the data center, but also a number of services that allow you to achieve the levels of reliability, efficiency and sustainability desired.

The designer is assisted in choosing the ideal product so that it is added to a system solution that enhances its potential. With this end, HiRef is able to perform energy analysis for the calculation of the energy consumption of the plant in year type and customize the technical solution proposed for research PUE minimum. The department's internal software development creates the most appropriate control logic to all units, according to specific needs and requirements.
The customer is also welcome to visit the departments of production of their units and to be present in an active way and in collaboration with the staff HiRef, for any performance test or a FAT (Factory Acceptance Test) for validating the performance required , those refrigerating acoustic characteristics. Finally, the technical staff of HiRef is available to perform the start-up and testing of the plant in situ and to support the after-sales service during the maintenance of the units.

High Technology in Refrigeration Devices

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