High
Efficiency
Solutions.

CAREL

Energy saving solutions for data centers

Data center air-conditioning

Data center air-conditioning is essential for the correct operation of Information Technology equipment: processing and storage devices produce heat that needs to be removed in order to maintain optimum operating conditions, while at the same time ensuring minimum energy consumption

Energy saving through evaporative cooling and adiabatic humidification: integration and versatility

Worldwide data center power consumption is estimated to be 400 TWh annually, accounting for around 2-3% of the earth's total electricity usage: as a result of this astonishing level of energy consumption, energy saving solutions ned to be increasingly adopted
Currently the most widely implemented technological solution involves the use of Computer Room Air Conditioners (CRAC) or Close Control Units (CCU), which cool and where necessary humidify the air in the data center.

Continuous technological development in the sector and a constant focus on energy saving are reflected in the evolution of the air-conditioning solutions adopted: from controlling air distribution to installing air-conditioners near the heat sources, as well as using high efficiency equipment. Moreover, air handling units can be used to deliver outside air in free cooling mode, and where possible lowering temperatures even further using adiabatic humidifiers (evaporative cooling).

Energy saving

global energy saving:
68 kW for every 100 l/h of evaporated water, with very low energy consumption and pressure drop (30 Pa).

Mission critical

Reliable solutions for applications where continuous service and redundancy are essential.

Flexibility

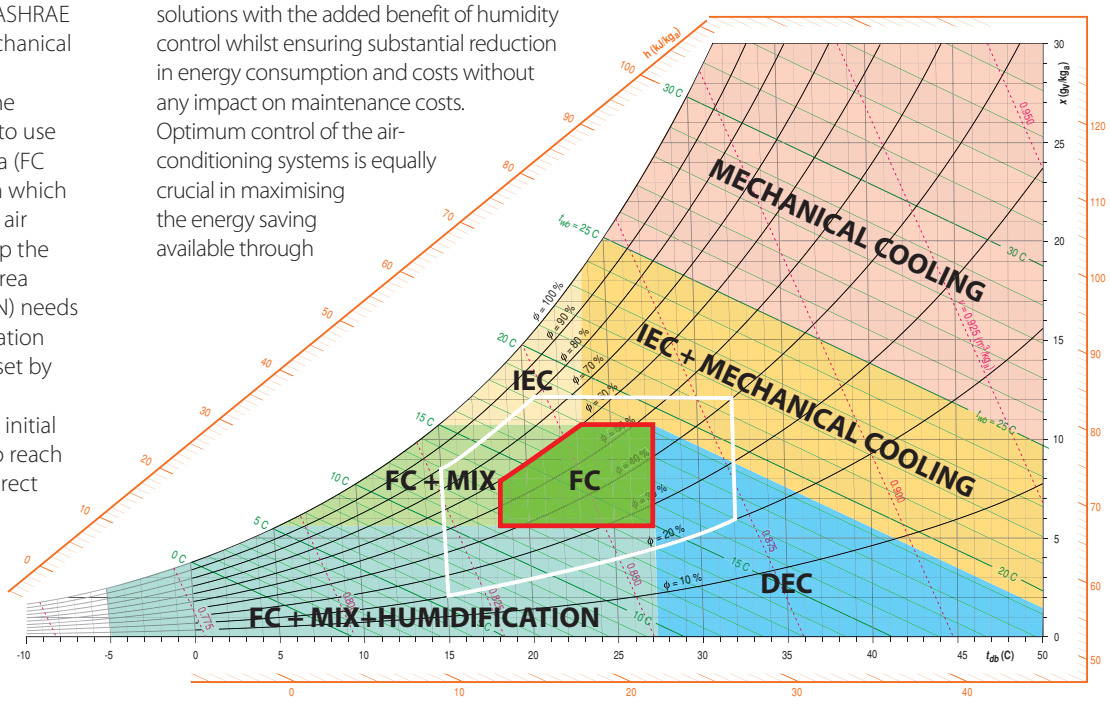
The energy saving proposals can be used in all applications, including retrofits for improving the PUI of existing data centers.

Evaporative cooling and adiabatic humidification

The data center air-conditioning solution with the highest energy efficiency and lowest environmental impact

The graph illustrates the climatic conditions in which the evaporative cooling, in case combined with a heat recovery unit, gives the opportunity to reach the temperature and humidity conditions as recommended by ASHRAE and reduces significantly the mechanical cooling energy consumption.
The green area (FC) represents the conditions in which it is possible to use the free cooling, the adjacent area (FC +MIX) describes the conditions in which it is necessary to mix the external air with the return air in order to keep the temperature under control. The area below (FC+MIX+HUMIDIFICATION) needs an additional adiabatic humidification to reach the minimum humidity set by ASHRAE.
The blue area (DEC) identifies the initial external air conditions, suitable to reach the temperature set point with direct evaporative cooling DEC only!
The yellow area (IEC) represents indirect evaporative cooling IEC using a heat exchanger between the external air and the recirculated internal air; the area (IEC+MECHANICAL COOLING) needs a further mechanical cooling contribution.
When the introduction of external air in the data center is not allowed, the IEC contribution will cover the previous DEC scenario.

The outside air condition where mechanical cooling only is required is represented by the red area.
Evaporative coolers, such as water spray atomizers, provide highly efficient cooling solutions with the added benefit of humidity control whilst ensuring substantial reduction in energy consumption and costs without any impact on maintenance costs.
Optimum control of the air-conditioning systems is equally crucial in maximising the energy saving available through evaporative cooling and eliminating inefficiencies.



"Evaporative cooling" - the essential book on this cooling technique: an environmentally-friendly way to reduce the power consumption of cooling systems

No dust

The water spray humidifiers used for evaporative cooling do not introduce dust into the data center.

Connectivity

All the programmable controllers feature numerous plug in options for communicating with the most commonly-used BMS.

Temperature & humidity control

One rational and efficient solution can be used to cool the air through evaporative cooling while controlling humidity.

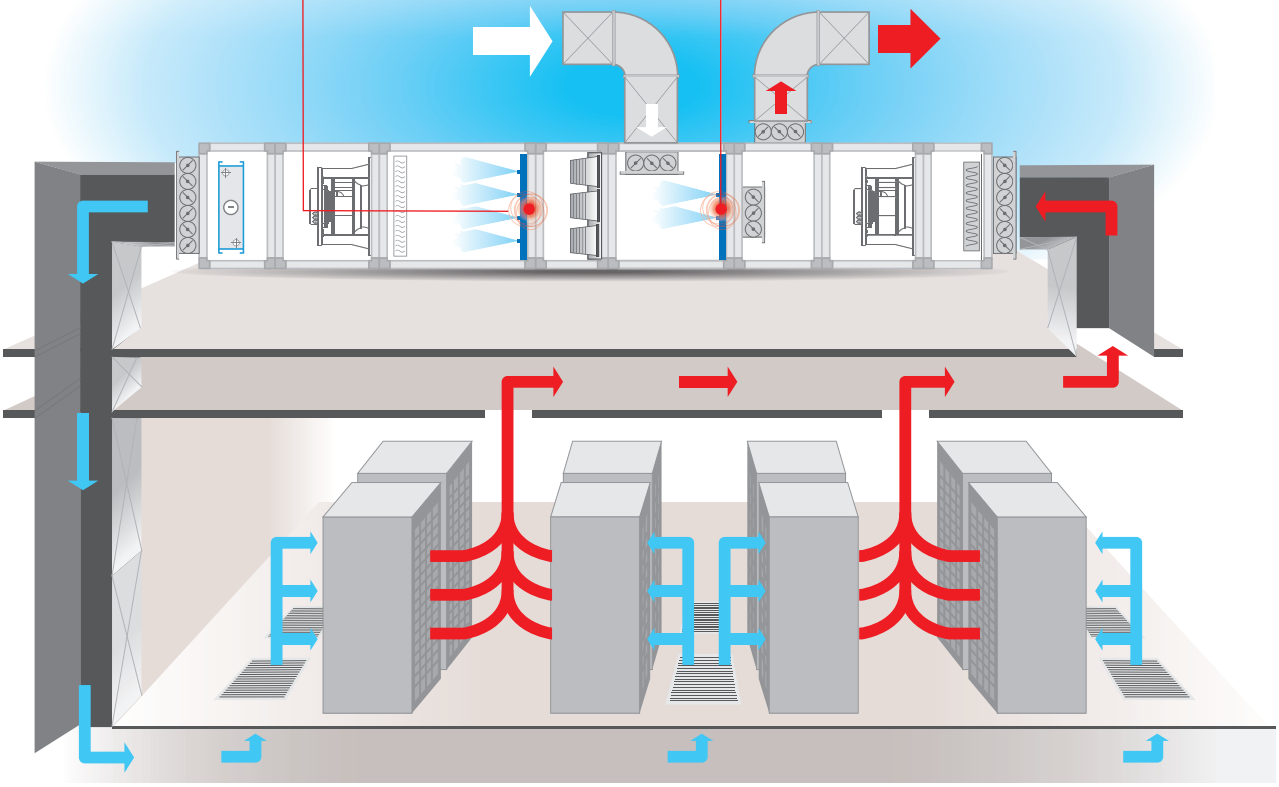
Direct free cooling + DEC and adiabatic humidification

The solution that optimises the use of outside air, lowering temperatures in summer through direct evaporative cooling (DEC) and controlling humidity in winter, using the same unit

- Maximum free cooling and DEC efficiency
- Extension of the period in which free cooling can be used
- Precise humidity control

The system comprises an AHU that introduces outside air in summer for free cooling, plus DEC when the outside conditions allow. The air is humidified and cooled providing approx. 680W/L cooling with a power consumption from just 4W/L. This process is the most efficient method of cooling since it does not involve intermediate heat exchange stages.
The air is delivered into the cold aisles and distributed through grills or diffusers. The return fan then draws in air from the hot aisles.
A mixing damper controls the minimum supply temperature by modulating recirculation.
In winter, the system ensures precise supply humidity control, with a power consumption of only 4W per litre in comparison to 750W per litre for steam humidifiers.

HumiFog represents the ideal solution for these types of systems; high-pressure atomisation combined with inverter control guarantees extremely high absorption efficiency and accurate temperature and humidity control. The solution with master and slave racks and a single pumping unit allows the flow-rates to be suitably sized for evaporative cooling in summer and humidification in winter, with the flexibility of having differentiated systems based on installation limits, in particular the recirculation configuration



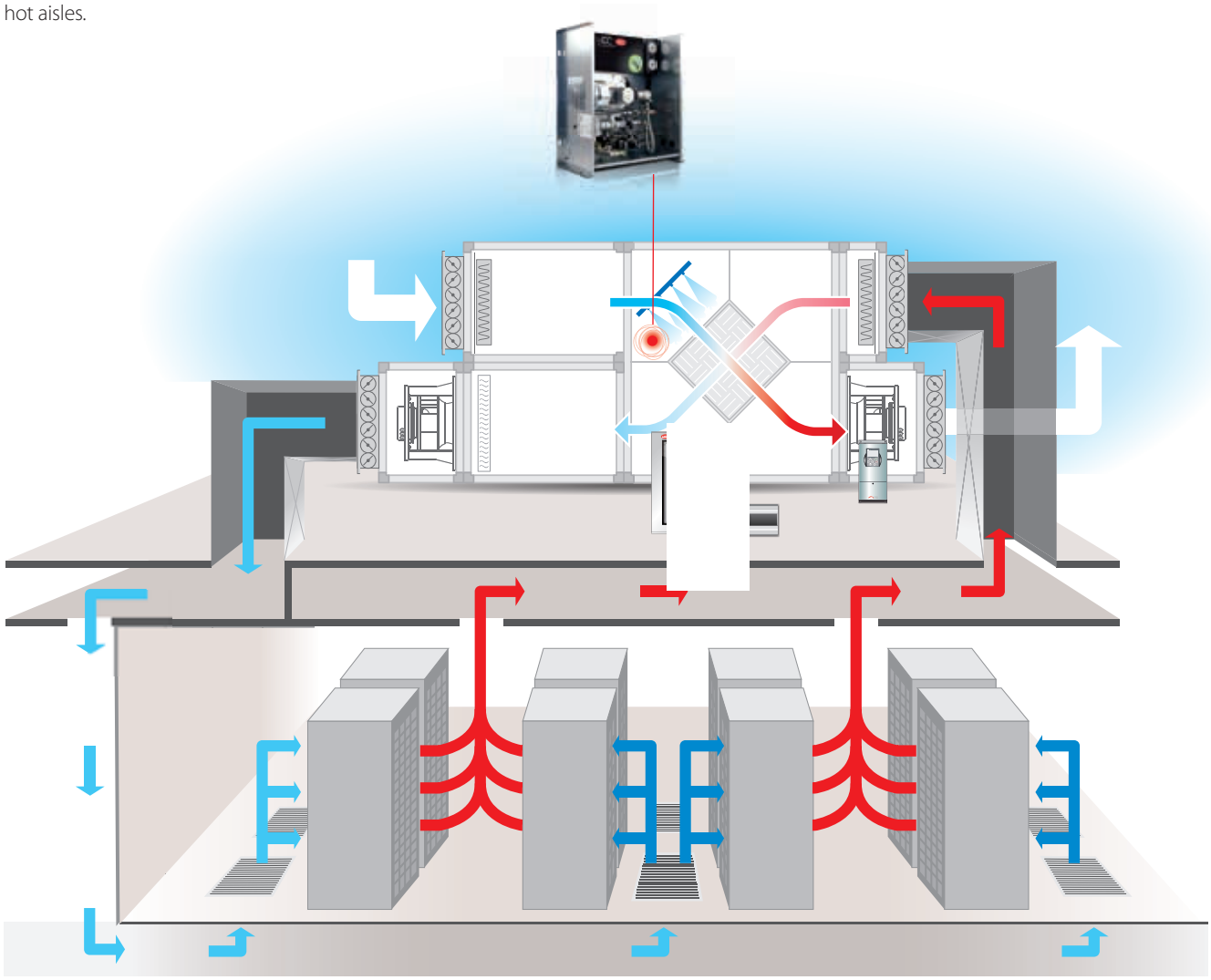
Indirect air-side free cooling + IEC

The solution that maximises free cooling, implementing indirect evaporative cooling without introducing outside air into the data center due to problems such as pollutants, or when humidity levels mean DEC is not feasible

The system comprises an AHU that recirculates the air, cooling it via a heat recovery unit that exchanges heat with the outside air. This "secondary" air stream flows through the heat recovery unit without entering the data center.
The evaporative cooler reduces the "secondary" air temperature, while at the same time increasing its humidity up to 95%, guaranteeing maximum cooling of the recirculated air.
A cooling coil can deliver supplementary cooling capacity if needed, as well as guaranteeing redundancy.
The air is delivered into the cold aisles and distributed through grills or diffusers.
The return fan then draws in air from the hot aisles.

KEC represents the ideal system for these types of unit, as its modularity and flexibility mean installation can be adapted to suit the manufacturer's layout. Modulation of production guarantees supply temperature control, by adapting to variations in temperature and auxiliary air flow-rate. The flow meter can be used to monitor water consumption and minimise usage, thus improving WUE.

- Extension of the conditions in which evaporative cooling can be used
- Air recirculation to avoid introducing contaminants
- Minimum water consumption

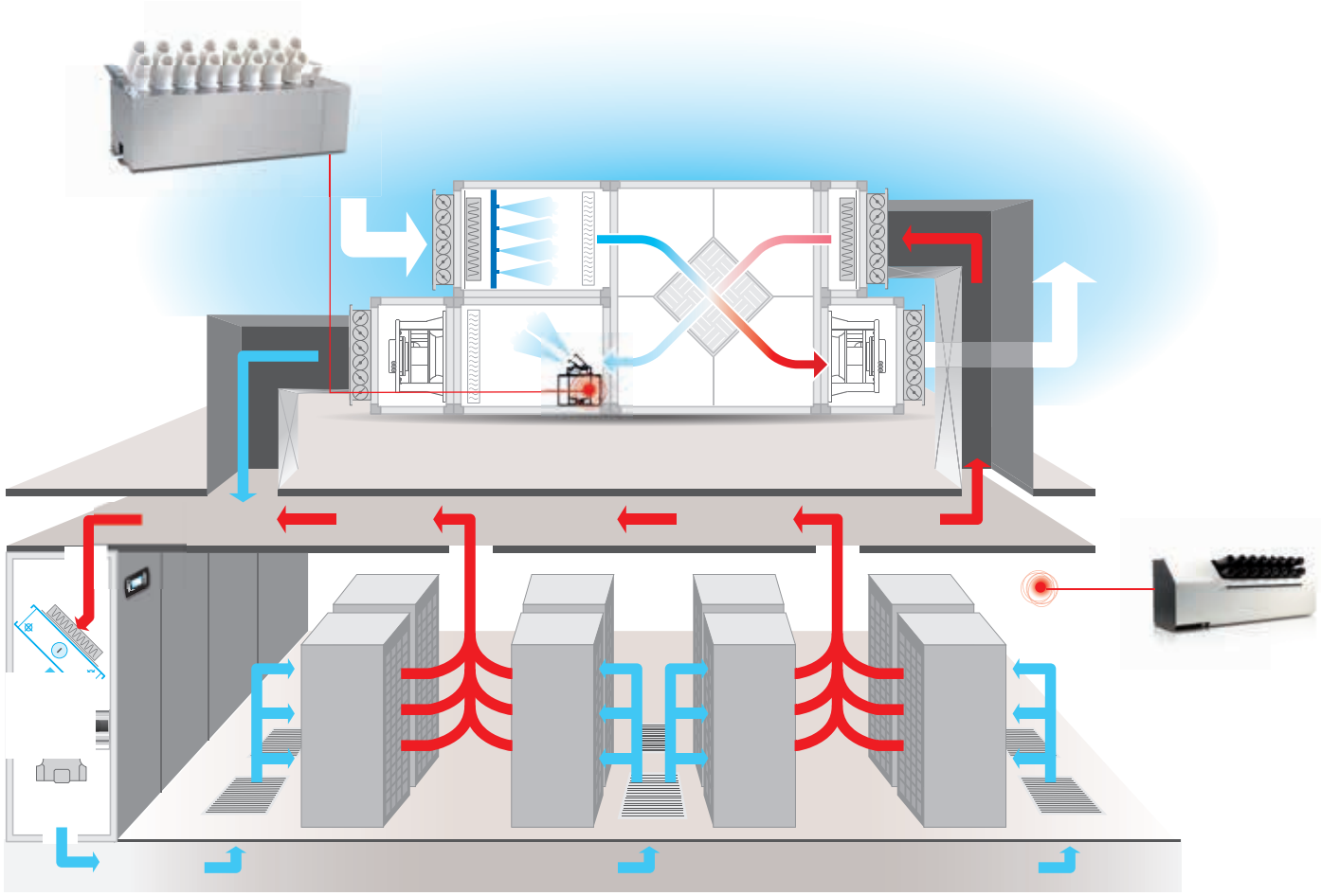


Adiabatic humidification for air recirculation systems

The solution for humidity control in both traditional systems, such as perimeter air-conditioners, and IEC or combined systems

- Air recirculation to avoid introducing contaminants
- Infiltration of outside air and dehumidification by the CRAC reduce humidity
- Compact and energy saving solution, also ideal for retrofits

The system can comprise either traditional perimeter CRACs or IEC units that recirculate the air, or a combination of both technologies, so as to feature redundancy or reduce energy consumption in specific periods of the year.
These systems do not introduce fresh outside air and therefore are often chosen for installations in areas in where outdoor air quality may cause problems due to potentially corrosive pollutants.
In traditional installations, dehumidification is provided by the cooling coils; nonetheless, newer data center layouts, for example hot aisles and cold aisles, have led to the adoption of higher air supply temperatures, with a consequent reduction in dehumidification.
Relative humidity is therefore lowered due to infiltration of outside air or dehumidification phenomena during transients in operation; humidification requirements are therefore lower, also as a result of new acceptability limits for the equipment. HumiSonic represents the ideal solution for these types of systems: compact, modulating and with low energy consumption, the appliance controls humidity while saving energy. Versions are available for duct installation, ideal for AHUs or IECs, and stand-alone installation, complete with fans that directly deliver the atomised water into the room (HumiSonic Direct).
The microscopic size of the water droplets guarantees extremely fast absorption, generally in the space of 2-3 metres; installation in a free space, for example near a door, thus allows diffusion of the moisture for optimum and precise humidity control.

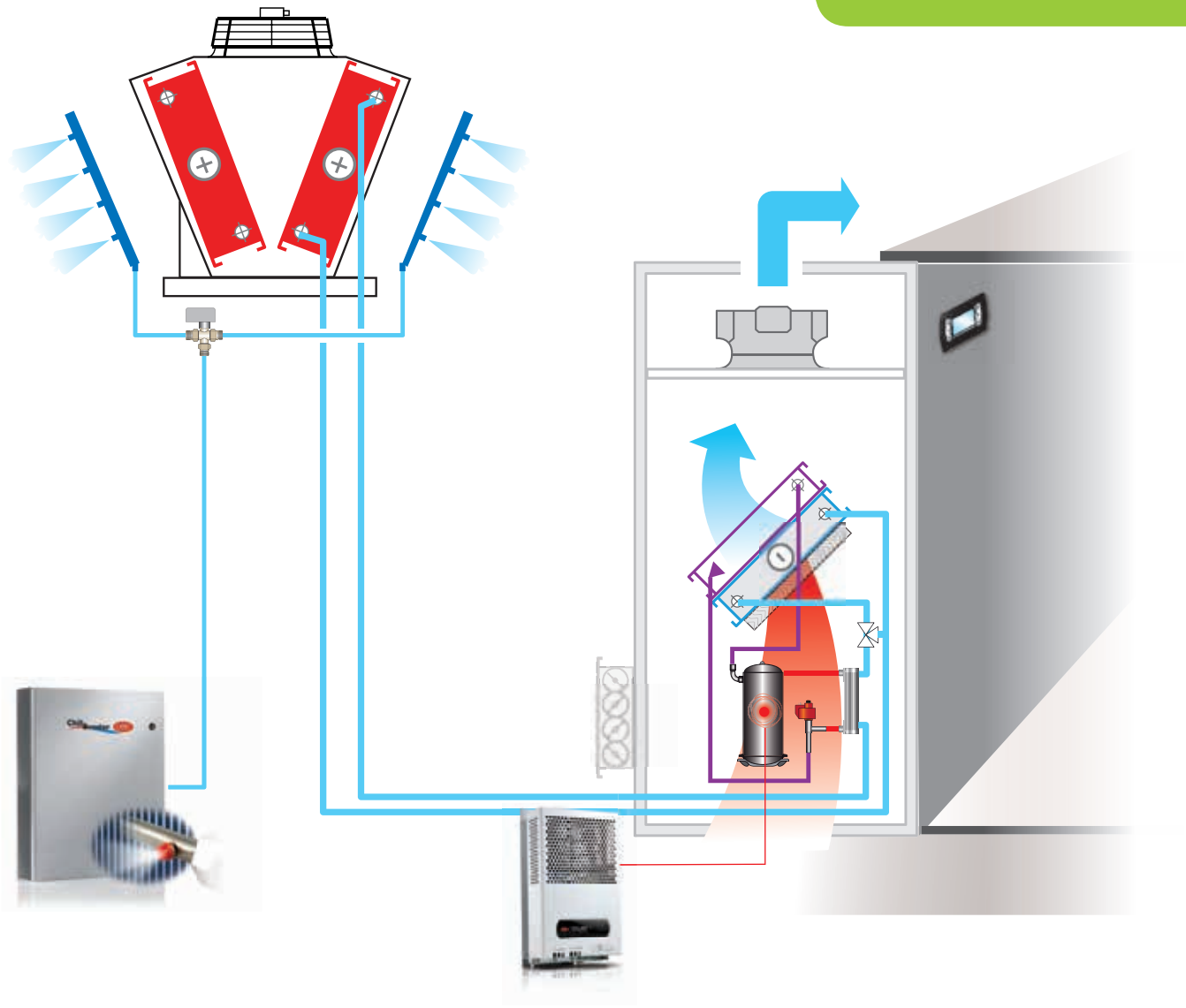


Indirect "water-side" or air free cooling + IEC

The solution for saving energy through evaporative cooling, however without modifying the air flows inside the data center, using traditional air-conditioning technology, maximising the benefits by using BLDC compressors.

The system comprises perimeter CRAC units that control supply or server room temperature and humidity.
chillBooster, installed on the dry cooler or the condenser, evaporatively cools the air intake and guarantees considerable energy saving by lowering the average refrigerant circuit condensing temperature.
In CRAC systems with water-side economizers, i.e. fitted with a water coil that can be combined with an outdoor drycooler, chillBooster extends the period in which free cooling can be exploited, therefore considerably reducing the use of mechanical cooling.
The use of variable-speed compressors based on BLDC technology maximises energy savings, as modulation of cooling capacity allows "partial free cooling" to be exploited, i.e. free cooling can be activated even outside conditions mean it cannot provide 100% of required cooling capacity. Modulating compressors thus provide the remaining work at part load; the period in which free cooling can be exploited is therefore much longer, even when adopting direct free cooling with fresh air damper and continuing to control supply temperature by operating the compressor at low speed, generally a much more efficient solution.

- The use of IEC extends the period in which free cooling can be used.
- Energy saving as a result of lower condensing pressure
- Easy-to-install on existing systems: maximum efficiency achieved when used in combination with BLDC compressors



A complete range of energy saving solutions for data centers

both at a unit and system level

boss

ChillBooster

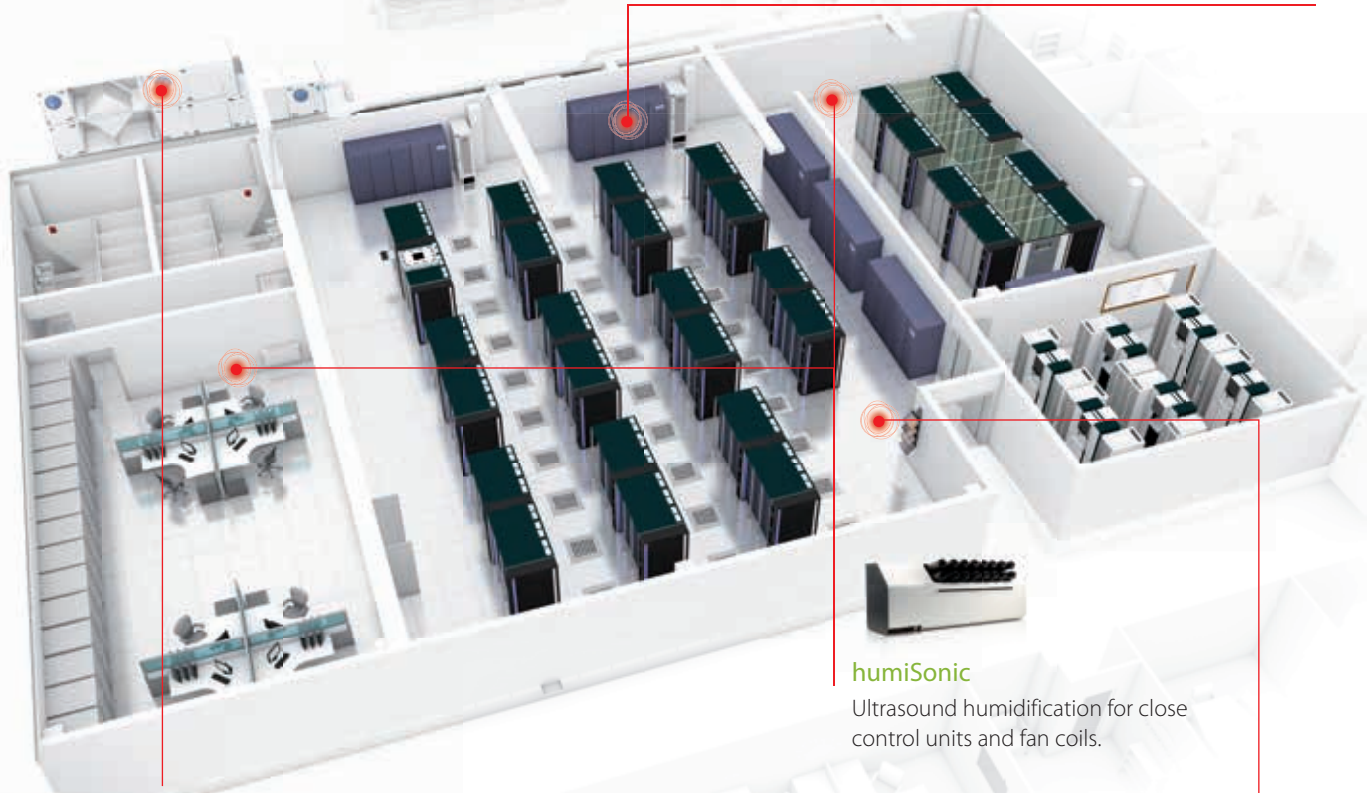
Evaporative cooler for condensing units.

KUE

Steam humidification kit for close control units.

power+

Controller for compressors with permanent magnet brushless motors (BLDC).



humiSonic

Ultrasound humidification for close control units and fan coils.

Optimist/KEC

Air can be effectively cooled by exploiting the evaporation of atomised water. 100 kg/h of water absorbs 69 kW of heat when evaporating, with power consumption of less than 1 kW.

c.pCO sistema

Flexibility, connectivity, integration, Ethernet embedded, energy saving.

humiFog

Adiabatic humidifiers offer significant advantages in terms of precise and efficient temperature and humidity management.

rTM

Wireless sensors Temeperature and humidity probes with Zigbee protocol are used to moniotr the server area and identify any hot spots.

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