CAREL

Climate solutions

evaporative cooling, adiabatic humidification and programmable controllers

energy saving solutions for data centers

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Data center air-conditioning

Data center air-conditioning is essential for the correct operation of Information Technology equipment: processing and storage devices produce considerable heat that needs to be removed in order to maintain optimum operating conditions.

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

Worldwide data center power consumption is estimated to be 30 GW, accounting for around 1.5% of the earth's total electricity usage: as a result of this astonishing level of energy consumption, energy saving solutions are 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

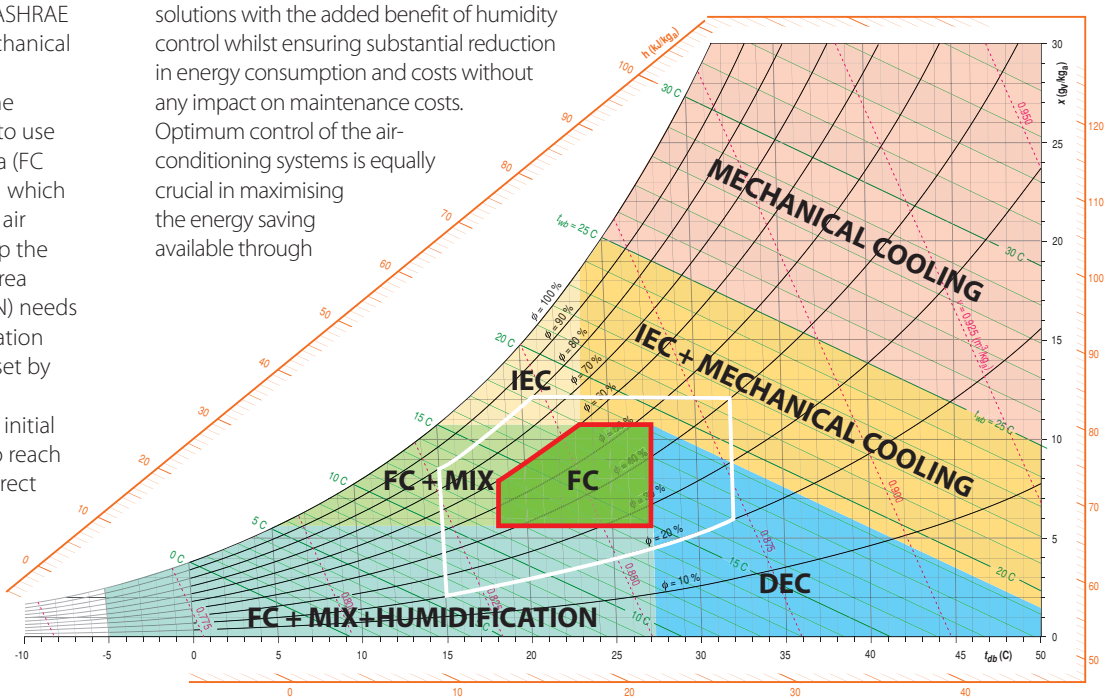
The energy saving proposals can be used in all applications, including retrofits for improving the PUI of existing data centers.

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

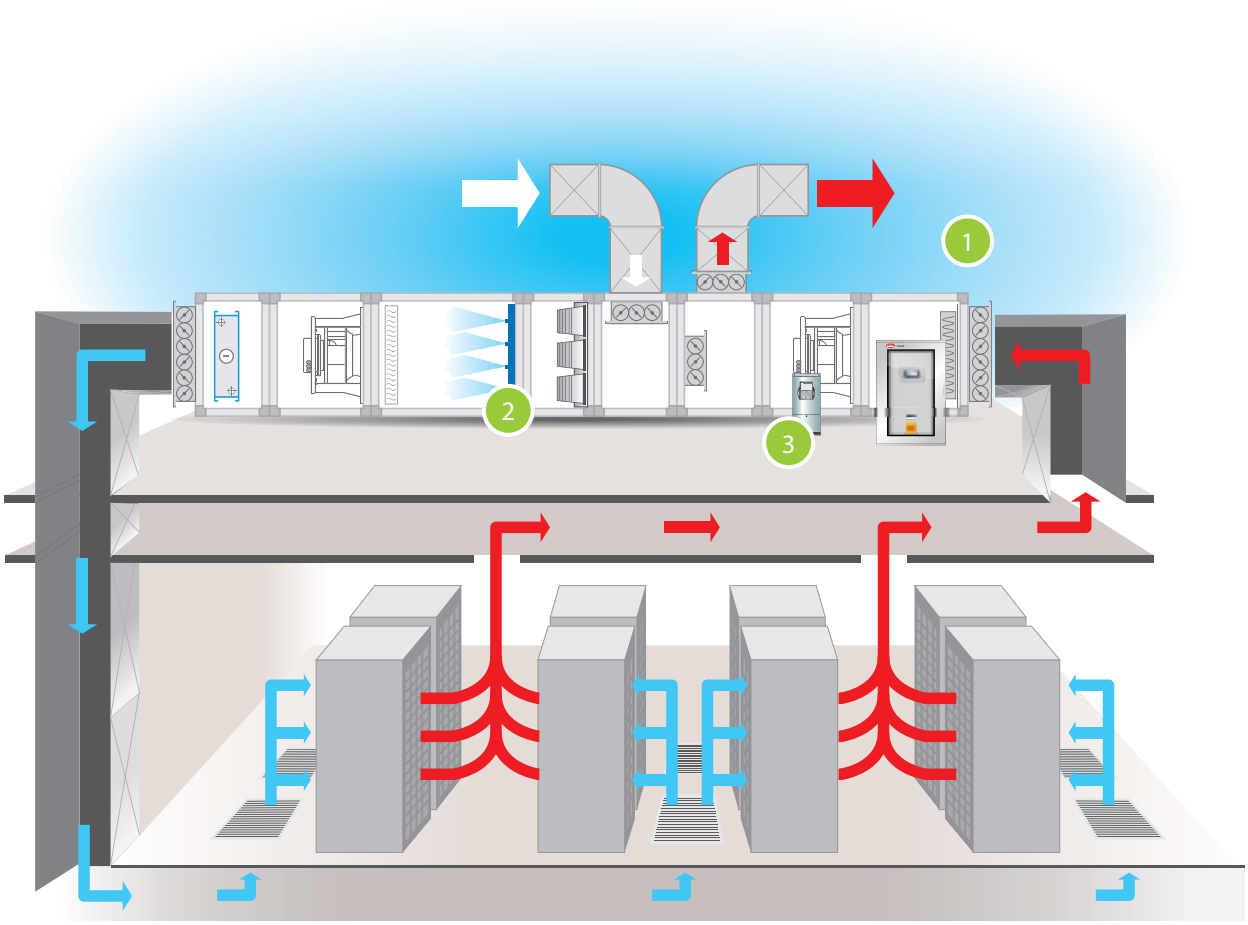
Maximum free cooling and DEC efficiency

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.

1. *pCO: management of the AHU components and supply temperature and humidity control*
2. *humiFog: guarantees precision and maximum efficiency in DEC and humidification (supply humidification requires more precise control)*
3. *VFD inverter to modulate the air volume, minimising total energy consumption*



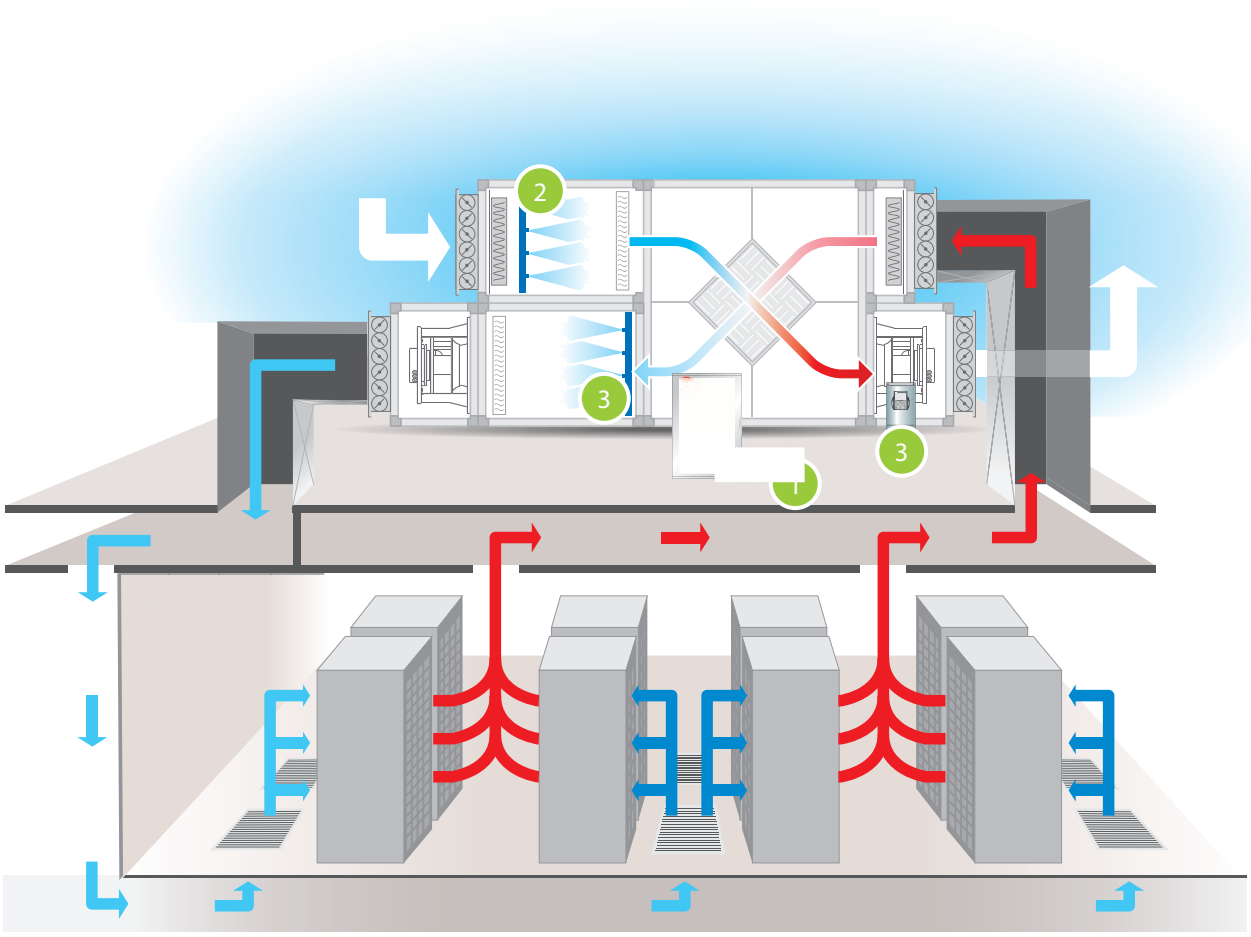
Indirect air-side free cooling + IEC

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 (2) 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.
In winter, a second water spray humidifier (3) ensures precise supply humidity control, with a power consumption of just 4 W per litre of atomised water.
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.

1. *pCO: management of the AHU components and supply temperature and humidity control*
2. *optiMist: guarantees humidity control and a considerable energy savings through IEC*
3. *optiMist: guarantees humidity control and a considerable energy savings through IEC*
4. *VFD inverter to adjust the secondary air flow-rate based on requirements*

Extension of the conditions in which evaporative cooling can be used
Air recirculation to avoid introducing contaminants
Precise humidity control



Indirect free cooling + IEC combined with CRAC

The solution involving IEC combined with traditional air-conditioning technology using perimeter Computer Room Air Conditioners

Air recirculation to avoid introducing contaminants

Ideal solution for retrofits in existing data centres

Humidity control with adiabatic humidification

Redundancy with two separate systems

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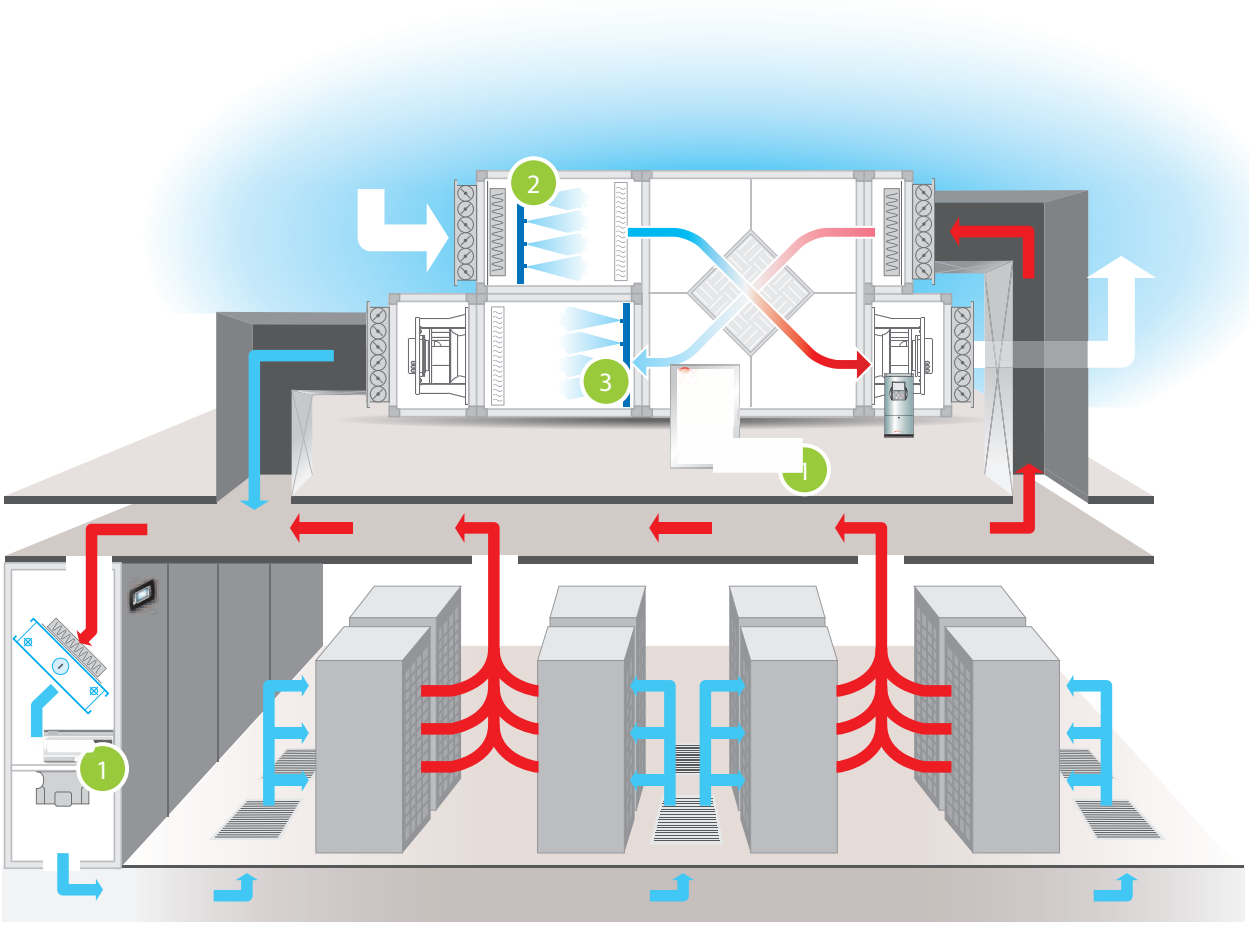
The evaporative cooler (2) reduces the "secondary" air temperature, while at the same time increasing its humidity up to 95%, guaranteeing maximum cooling of the recirculated air.
The cooled air is delivered to the CRAC intake, thus significantly reducing air-conditioner energy consumption.
In this example, the AHU can handle a variable percentage of recirculated air, adapting the requirements of the application and the spaces available: all the air delivered to the CRAC can be pre-cooled, or just a portion of it, meaning more compact units and ducting.

In winter, a second water spray humidifier (3) ensures precise supply humidity control, with a power consumption of just 4 W per litre of atomised water

1 ***pCO**: management of the AHU components, CRAC units and supply temperature and humidity control*

2 3 ***optiMist**: guarantees humidity control and a considerable energy savings through IEC*

4 ***VFD** inverter to adjust the secondary air flow-rate based on requirements*



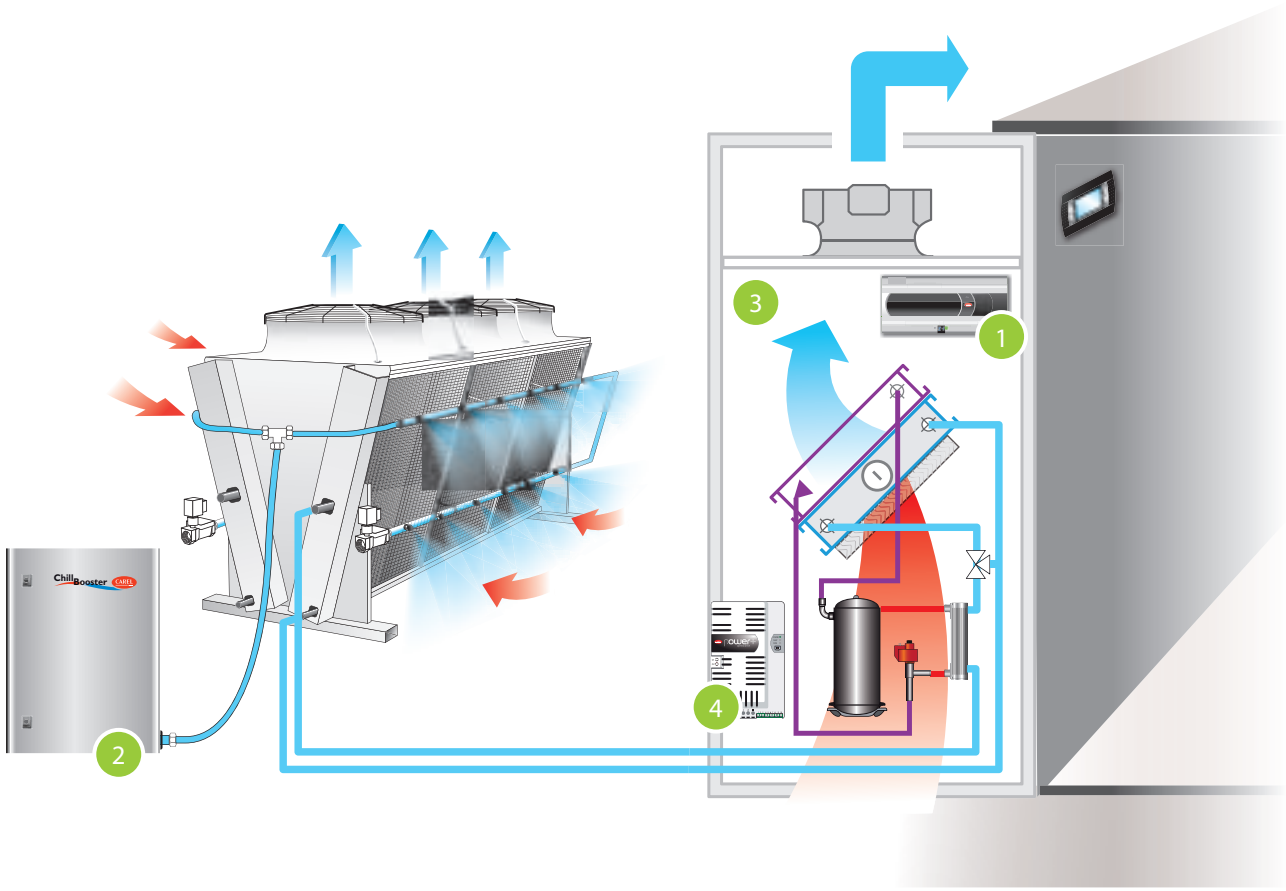
Indirect "water-side" free cooling + IEC

The solution for saving energy through evaporative cooling, however without modifying the air flows inside the data center, using traditional air-conditioning technology

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.

1. ***pCO**: management of the CRAC units and supply temperature and humidity control*
2. ***ChillBooster**: uses evaporative cooling to increase air-conditioning system efficiency*
3. ***KUE**: controls air humidity inside the data centre*
4. ***power+**: maximises direct expansion refrigerant circuit efficiency*

The use of DEC 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

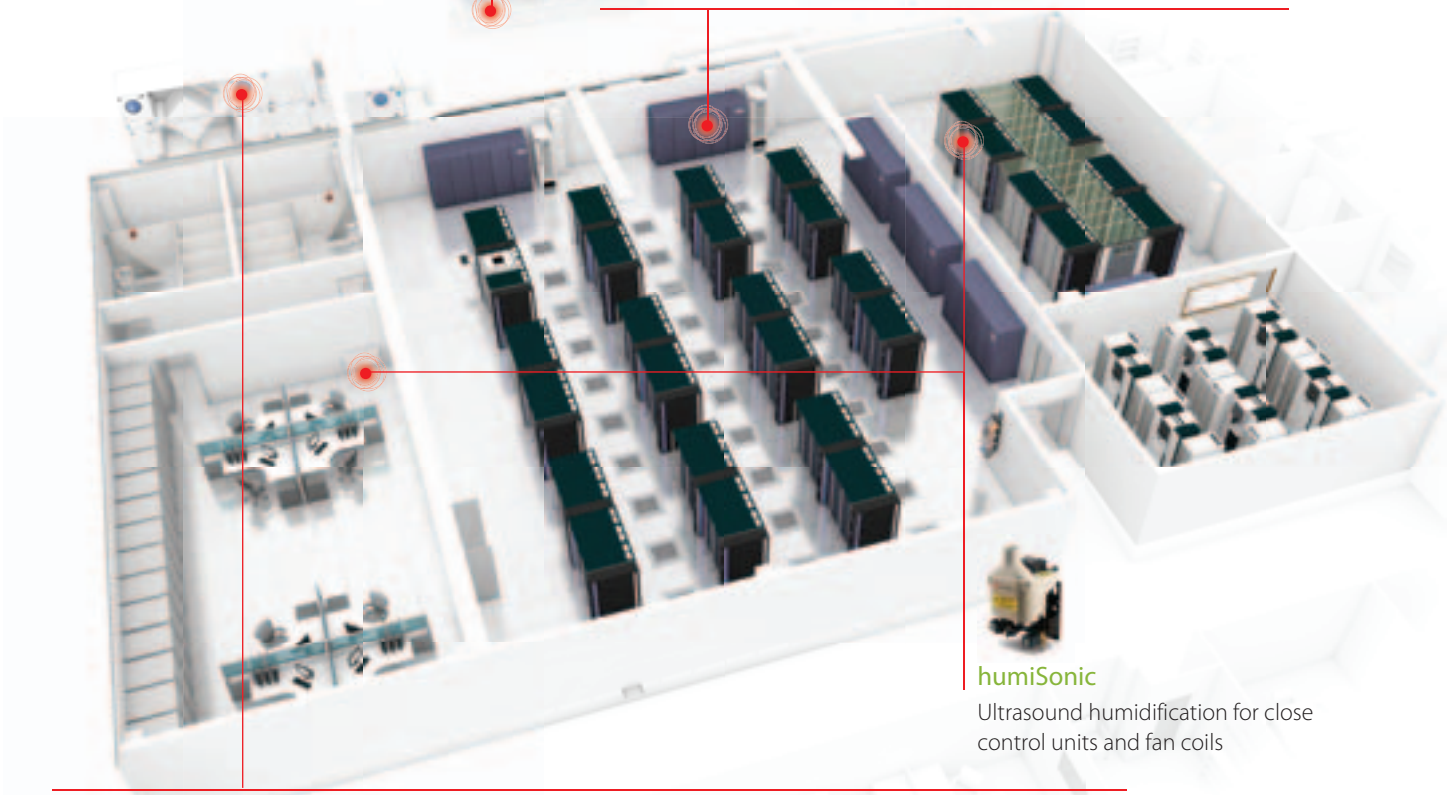


CAREL's 40 years' experience in data centers

ChillBooster
Evaporative cooler for condensing units

KUE
Steam humidification kit for close control units

power+
Controller for compressors with permanent magnet brushless motors (BLDC/BLAC).



humiSonic
Ultrasound humidification for close control units and fan coils

Optimist
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.

VFD
Inverters represent a cutting-edge solution for modulating fan speed.

pCO sistema+
Flexibility, connectivity, integration, energy saving.

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

+3000054EN - 1.0 - 09.11.2012

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