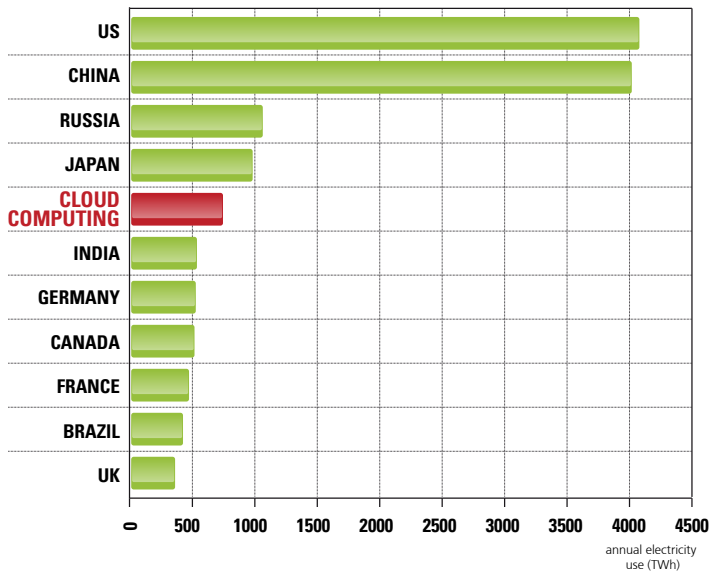# BlueBox

IT COOLING SOLUTIONS

Efficiency on Datacenters

Speaking of energy consumed by data centers as a problem of urgent relevance is necessary because, unlike what one might expect, the share of world energy demand for the operation of the digital world is significant. It is often said that "if the data center were a country, would be equivalent to ..." and the graph is a clear example.

Simultaneously, all forecasts give significant increases in data traffic and the development of new infrastructure in the coming years, and therefore not surprisingly the issue of the reduction of energy expended by the data center is, and probably will continue to be, a key factor for the development of related industry.

US
CHINA
RUSSIA
JAPAN
CLOUD COMPUTING
INDIA
GERMANY
CANADA
FRANCE
BRAZIL
UK

0 500 1000 1500 2000 2500 3000 3500 4000 4500

annual electricity use (TWh)

Source: Greenpeace International, How clean is your cloud, April 2012
Note: Cloud consumption here includes telecomunication infrastructure, but not the entire ICT ecosystem

140

70

Exabytes per month

2012 2013 2014 2015 2016 2017
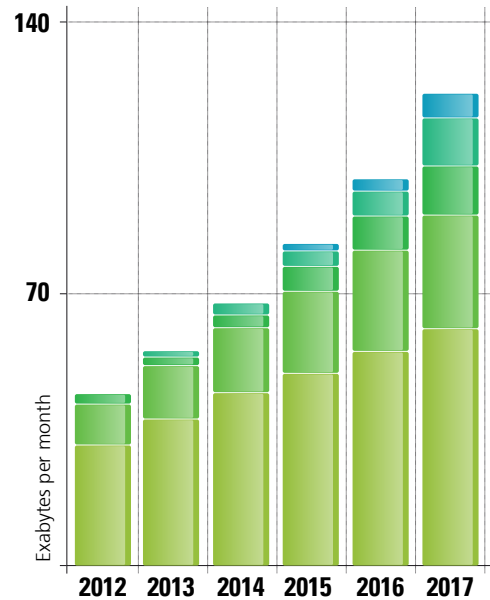
>PC
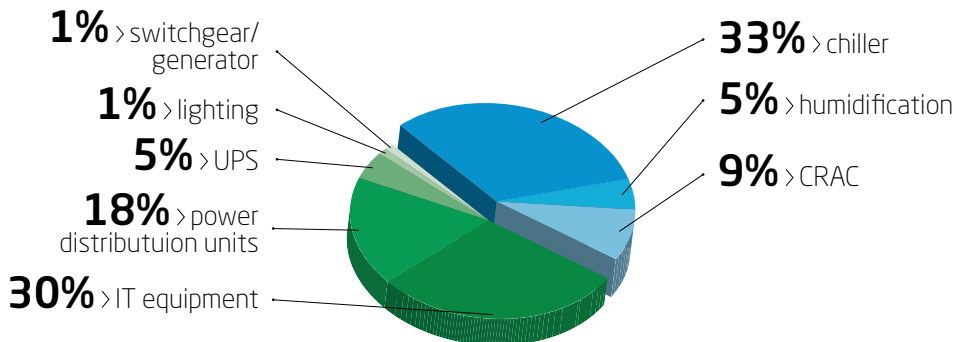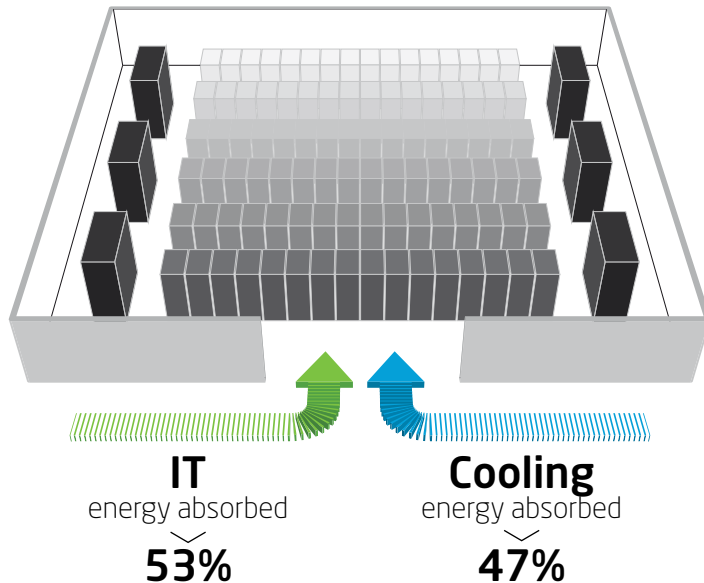>TV
>SMARTPHONE
>TABLET
>MACHINES

Data Source: Cysco, The Zetatbyte Era
Note: At 80 Zettabyte monthly, the world enters the zettabyte per year era

High precision cooling

It is fundamentally wrong to assume that the electric power expenditure in a data center is only that required to operate IT equipment. In contrast, only a fraction of the total power input is eventually used to feed the server and storage unit.

Lighting, services, ventilation, UPS, etc but especially cooling are the voices that contribute to an increase in power consumption compared to the mere absorption of IT equipment.

And it is clear that, given the preponderance of consumption for removal of the heat generated in the "data halls", the efficiency (ie the amount of energy consumption divided by the cooling output) of cooling systems plays a determining role in the composition of the "pie chart".

IT
energy absorbed
53%

Cooling
energy absorbed
47%

1% › switchgear/ generator
1% › lighting
5% › UPS
18% › power distributuion units
30% › IT equipment

33% › chiller
5% › humidification
9% › CRAC

PUE
power usage effectiveness

Total power consumption
Power consumption by **IT equipment**

PUE, an acronym for "Power Usage Effectiveness", is one of the most successful metrics in the Data Center industry , as (with all necessary precautions) it can summarize in one simple and manageable figure the state of "health" of the data center in terms of efficient use of its electrical power sources.

Maintaining, or obtaining, a low PUE, as close as possible to "1", allows to dedicate most of the electrical energy expenditure to the supply of IT equipment.
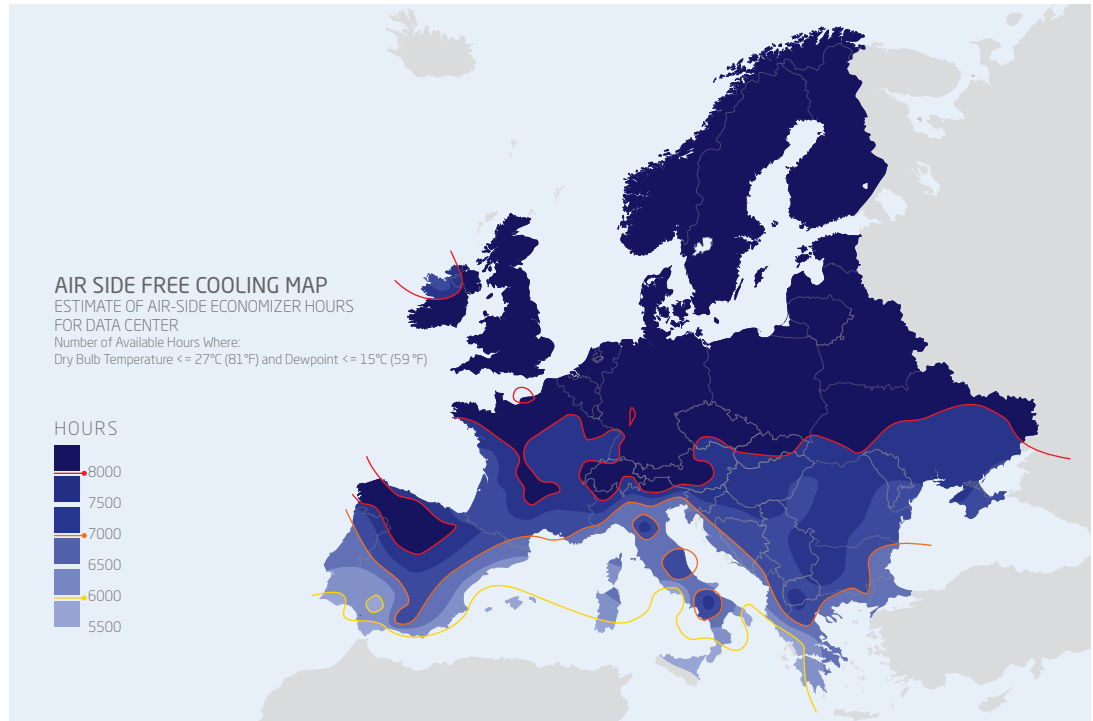
pPUE

pPUE is basically PUE restricted to a physical or logical boundary. It allows calculation of PUE "restricted" to specific subsystems such as, for example, IT+cooling, or IT+power.

FC
FREE COOLING

Assuming that nothing is ever completely free, it remains a key concept the idea of using sources of cooling as much as possible cheap and available in abundance.
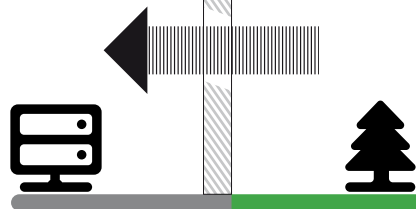
The concept of "free cooling" takes its start from the consideration that the outside air is, in "classic" cooling systems that use a refrigerant cycle (otherwise called "mechanical cooling"), only used to dissipate the condensation heat of refrigerators.

But, above all because of the geographical location of the data center and the relatively high temperatures of newly designed facilities, direct or indirect use of outside air - when at lower temperatures than Data Center design - involves a considerable energy advantage.

AIR SIDE FREE COOLING MAP
ESTIMATE OF AIR-SIDE ECONOMIZER HOURS FOR DATA CENTER
Number of Available Hours Where:
Dry Bulb Temperature <= 27°C (81°F) and Dewpoint <= 15°C (59°F)

HOURS

- 8000
- 7500
- 7000
- 6500
- 6000
- 5500

Directfreecooling

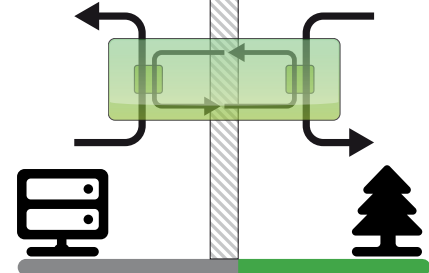**in**door: **14°C**   **out**door: **14°C**

Direct means that ambient air is used directly to remove heat load gnerated by IT equipment
Pros: More efficient
Cons: air quality issues, humidity control.

Indirectfreecooling

**in**door: **14°C**   **out**door: **4°C**

Indirect means that a heat transfer media is used between ambient air and the Data Center
**Pros**: physical separation between ambient air and Data Center, no concern for air quality, humidity, security
Cons: less efficient because of two temperature difference gaps.

Indirectfreecooling - chilled water system

racks
chilled water coil
CRAC
freecooling chiller
compressor
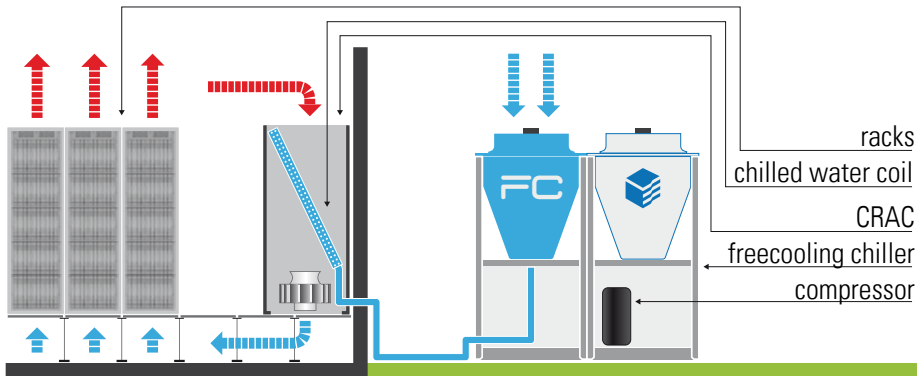
A chilled water system, with external chillers operating in "free cooling" mode is an extremely versatile and efficient solution for large data centers. Depending on the location and internal design conditions of the data center, it is possible to reduce energy consumption by 30-40% on an annual basis, thus maximizing the total cost of the system (TCO). The possibility of using electronically commuted (EC) fan motors on both internal and external units also guarantees the maximization of energy efficiency even at partial load.

Indirectfreecooling - direct expansion system water condensed

racks
freecooling
chilled water coil
CRAC
dry cooler
compressor
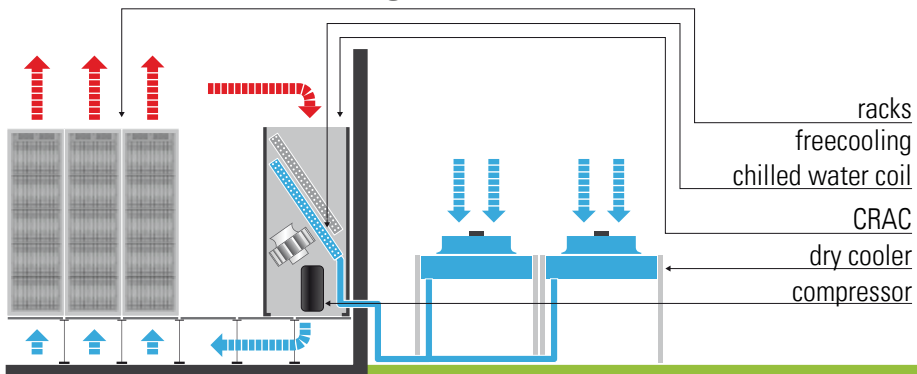
Direct expansion systems equipped with free cooling coils, to be connect with external dry coolers, are an effective and efficient solution for small to medium data rooms, where the installation of large external chiller is problematic and when it is anyway take advantage of favorable climate conditions.
Strengths of this solution is the integrated management of mechanical and free cooling and free, allowing throughout the course of the year the minimization of compressor operation and consequent operating costs.

Directfreecooling - direct expansion system air condensed

racks
freecooling
chilled water coil
CRAC
dry cooler - off
compressor
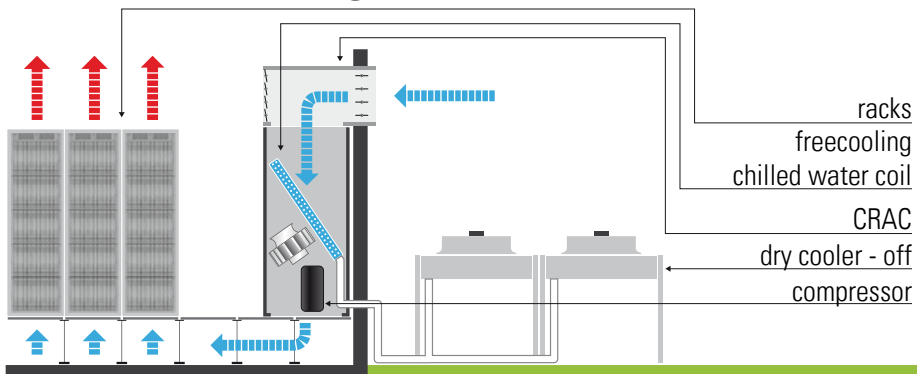
A direct expansion system with direct air free cooling is definitely the most efficient solution as it profits from the most favorable conditions of outside air that may occur during the year. Ideal for rooms with high turnover equipment , where outside air immission is not considered problematic and humidity control inside is not too stringent.

Compressors
driven by inverter brushless dc

on Crac

In addition to being extremely efficient at part load and allow a more precise adjustment of temperature and humidity, the use of variable speed compressors allows to use the reserve units (which normally are on standby, ready to replace the unit which may be malfunctioning) in a very smart way. In fact, by simultaneously operate also reserve units, the cooling system will operate at partial load with an overall lower energy consumption.
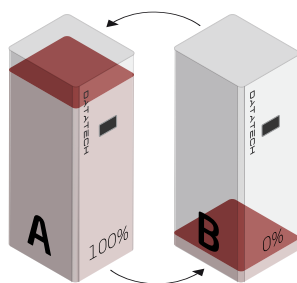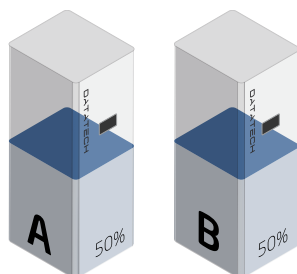
DATALINK

primary with secondary unit used only as a backup

EER **3***

A-main unit

B-backup unit

SMART DUET

both units used at partial load

EER **4***

A-main unit
B-main unit

🔴 ON/OFF   🔵 BLDC Inverter

*thermal load 23 kW at 24°C/50% rh internal conditions and 35° outdoor conditions

on Chiller

The global effort to increase energy efficiency in buildings and systems is spearheading the development of all those technologies capable of chipping in.

The field of Air Conditioning has developed technologies which achieve the maximum energy saving in partial load conditions.

The technology which more than any other meets the objective of Efficiency Improvement with partial loads is that of the Inverter applied to compressors.
Our units use rotary or brushless scroll compressors, driven by a DC inverter, for residential or light commercial applications.
For higher power applications, our solution is to use dual screw compressors with built-in AC inverter.

For multi-compressor units you can choose between hybrid units, namely a single inverter-operated compressor alongside traditional compressors, or full inverters, having all the compressors driven by an inverter. This allows the customer to find the best compromise between energy efficiency and the cost of the unit.
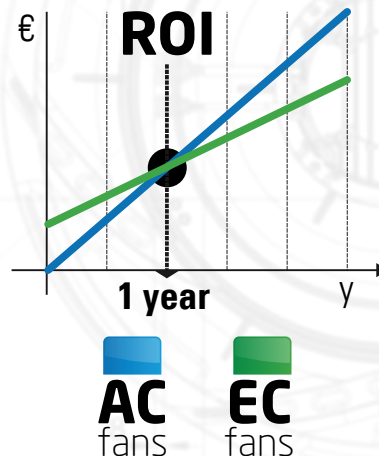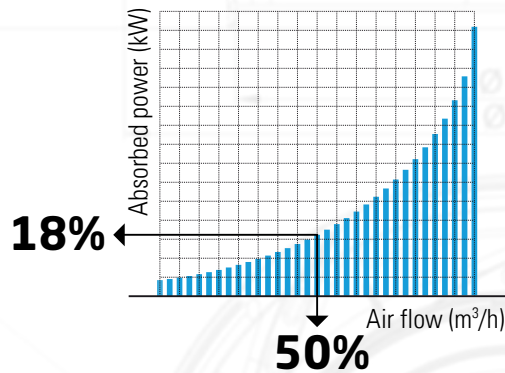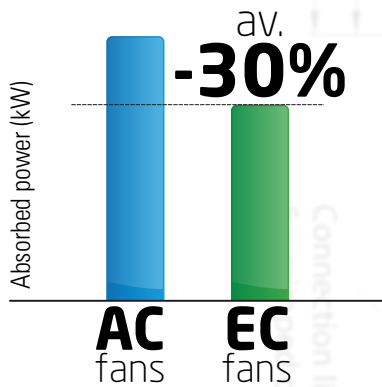
The use of inverters combined with scroll and screw compressors also achieves the utmost efficiency while maintaining the same operating limits as traditional units.

Bar chart — ESEER

|	Unit with standard screw compressors	Hybrid unit	Unit full inverter
		+27%	+40%

efficiency
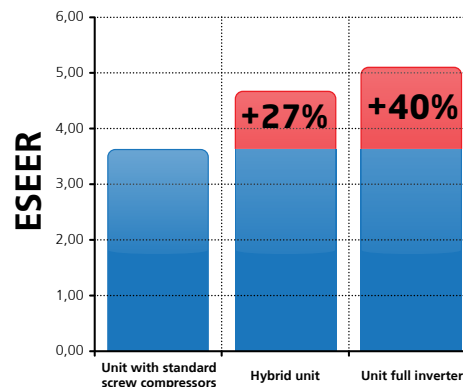
EC Fans
electronically commutated brushless motor

EC fans are "state of the art" with regard to ventilation within the Data Center. EC - Electronically commuted, in addition to the latest technology of three-dimensional shaping of fan blades in composite material mean reduced energy consumption and noise, self-adaptation to changes in heat load, air volume or static pressure.

av. **-30%**

Absorbed power (kW)

AC fans **EC** fans

Absorbed power (kW)

18% ←

Air flow (m³/h)

50%

€

ROI

1 year   y

AC fans   **EC** fans

Automatic
control
of fan
pressure

The automatic control of the fan discharge pressure optimizes the performance of the fans and provides IT equipment only the amount of air it actually needs. Even in the case of partial filling of the Data Room, it will be sufficient to place perforated tiles where necessary, and the air flow rate will be guaranteed.

pressure
20 Pa
partial load

pressure
20 Pa
full load
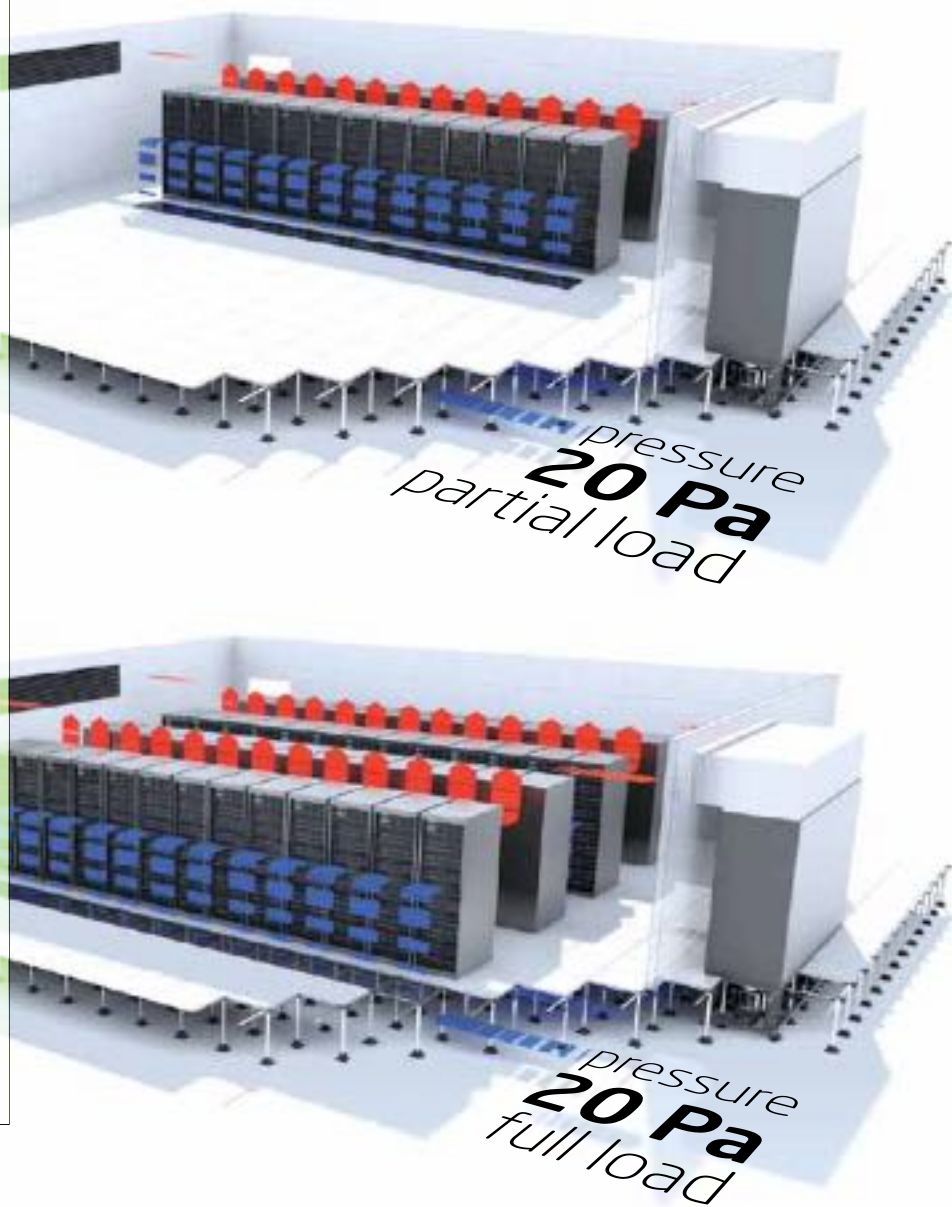
Reliability on datacenter

The ultimate goal of a data center is ultimately to provide a continuous service, 24/7. For this reason, the reliability of all the systems (power supply, UPS, cooling) must be ensured and, in addition to the quality of the components, it is necessary to provide a certain degree of "redundancy" to all systems, ensuring that the failure of a component does not cause an interruption of the service.

The Uptime Institute has developed the "Tier" classification to describe the reliability level of a data center.
Different levels of "Tier" provide ever increasing levels of redundancy and complexity, with the ultimate goal of drastically reducing the "downtime" of a data center, due to accident or human error.

TIER IV
- •> Multi-million dollars business
- •> 2 indipendent utility paths
- •> Fully redundant (2N + 1)
- •> Able to sustain 96 hours power outage

99.995% availability
25 minutes downtime

TIER III
- •> Large company
- •> Multiple power and cooling paths
- •> Fault tollerant (N + 1)
- •> Able to sustain 72 hours power outage

99.982% availability
1,6 hour downtime

TIER II
- •> Medium size business
- •> Single path of power and cooling
- •> Some redundancy in power and cooling

99.749% availability
22,7 hours downtime

TIER I
- •> Tipically small business
- •> Single path of power and cooling
- •> No redundant components

99.671% availability
28,8 hours downtime

Double circuit

Higher "Tier" levels must involve a cooling system that includes at least two routes of delivery. For this reason, it is essential to have cooling units equipped with dual cooling coils and rlevant independent hydraulic circuits.
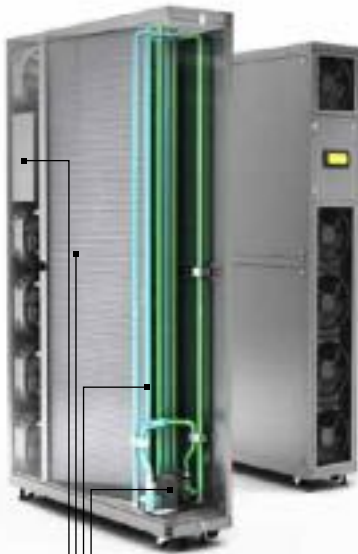
Double
- ·› electrical supply
- ·› heat exchanger
- ·› circuit
- ·› 2 way valve

Double power supply on chiller units with manual or automatic switching.

0

1
main
power supply

1
backup
power supply

Controls

Communication and interaction between the **system** components is essential to maximize the **performance** of the units and to ensure the best **efficiency** throughout the operation, continuity of service and optimal **control** of the thermal load across the **data center**.

controls
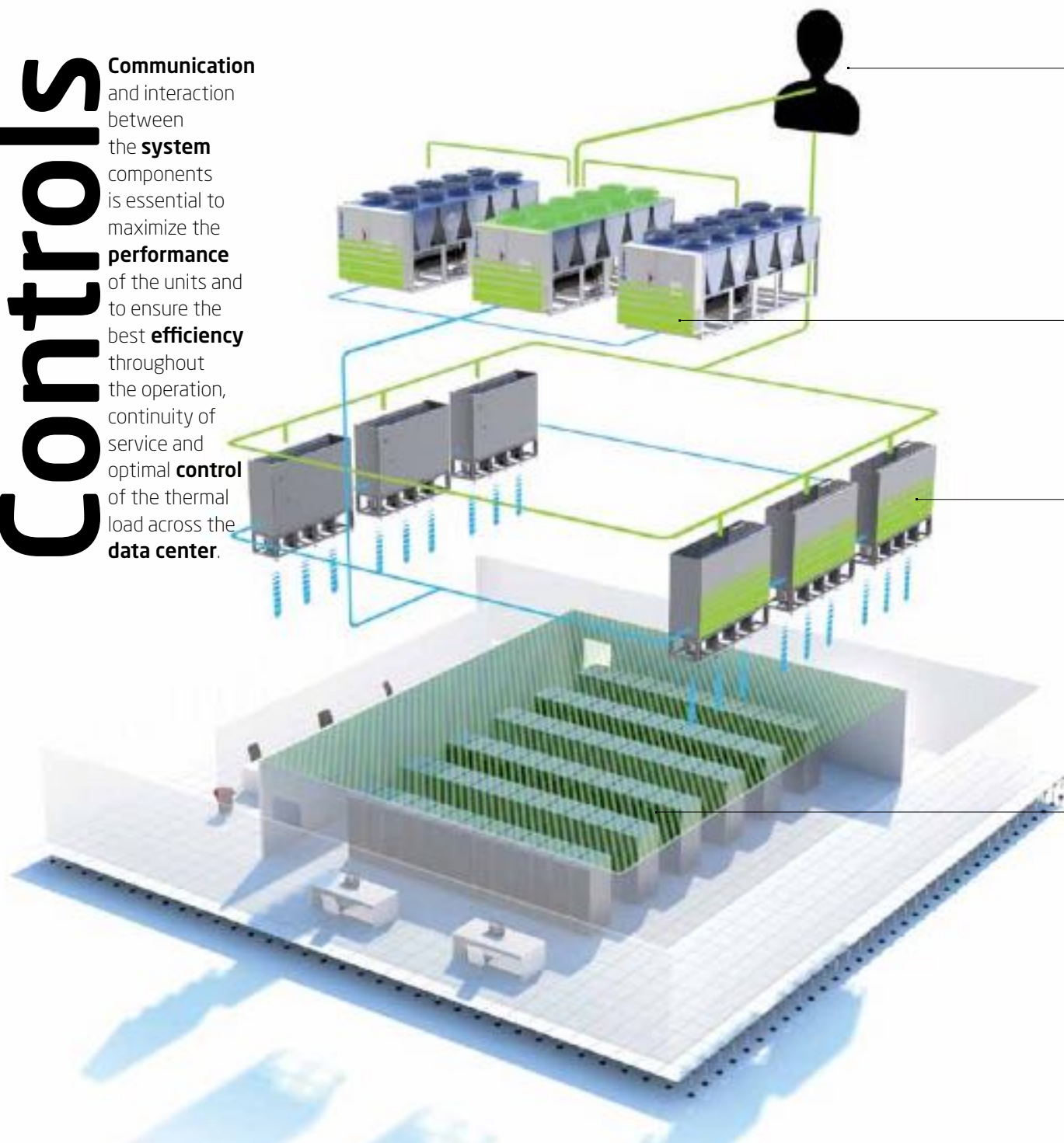
The user, or maintainer, or plant supervisor can easily check the status of individual units through for example simple but effective html pages that summarize the values of greatest interest and allow even with a simple tablet to modify the operating parameters of the individual units or system as a whole.

The local network comprising the external chiller is able to optimize energy consumption, in addition to providing advanced services for the management of redundancy, thermal load, sequencing priority and free cooling.
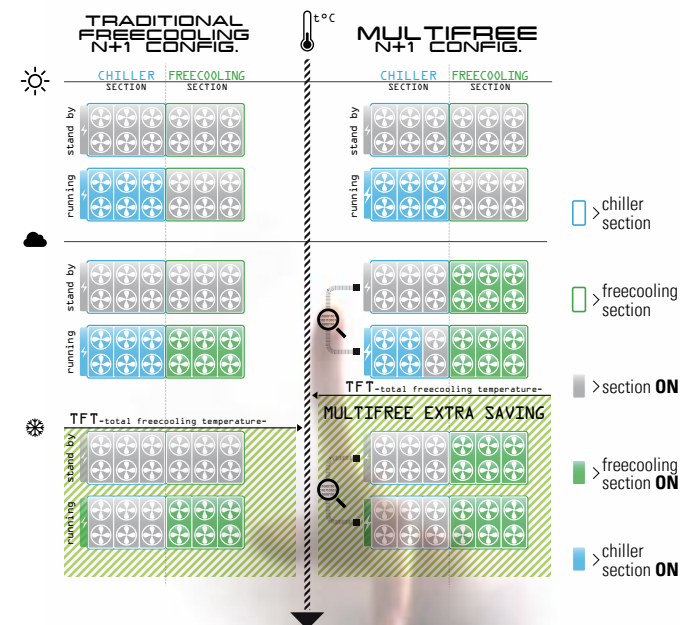
ADVANCED CONTROL FUNCTIONS

> Unit management by integrated web page
> Data logging of all units parameters one month long
> User friendly interface based on visual icons
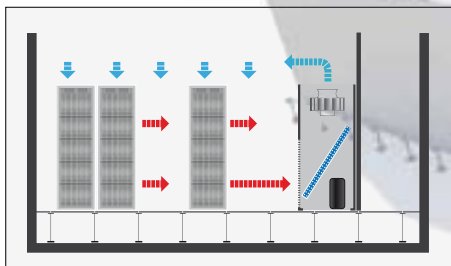> RS485 and Ethernet ports as standard

MULTILOGIC FUNCTION
> Up to 32 units (1 Master e 31 Slave) connected to the same hydronic circuit
> Management of units with different logics and priority levels

MULTIFREE FUNCTION
> Maximise the efficiency using the freecooling from stand-by unit in n+1 configuration

The local network comprising air conditioning units inside the Data Center allows to manage redundancy, to balance the operation, to avoid conflicts and to monitor the operation of all units from a remote display.
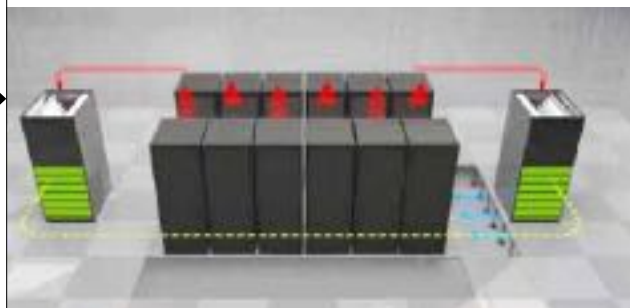
CWDS (Chilled Water Dynamic set)
This solution allows to adapt the the chilled water temperature supplied to
Datatech air conditioners to the actual thermal and hygrometric room load.
By increasing water temperature when maximum cooling capacity is not required, the process-dedicated chiller efficiency is increased. In case of "free cooling" chillers it is possible to achieve a greater number of running hours without compressors.
At the same time, in case it is necessary to lower the humidity rate, a lower water temperature makes the dehumidification process better and faster.

TRADITIONAL FREECOOLING N+1 CONFIG. | t°C | MULTIFREE N+1 CONFIG.

CHILLER SECTION   FREECOOLING SECTION

TFT-total freecooling temperature-

MULTIFREE EXTRA SAVING

> chiller section
> freecooling section
> section **ON**
> freecooling section **ON**
> chiller section **ON**

plug & play solution
water free version
direct freecooling module available
**indirect freecooling coil available**
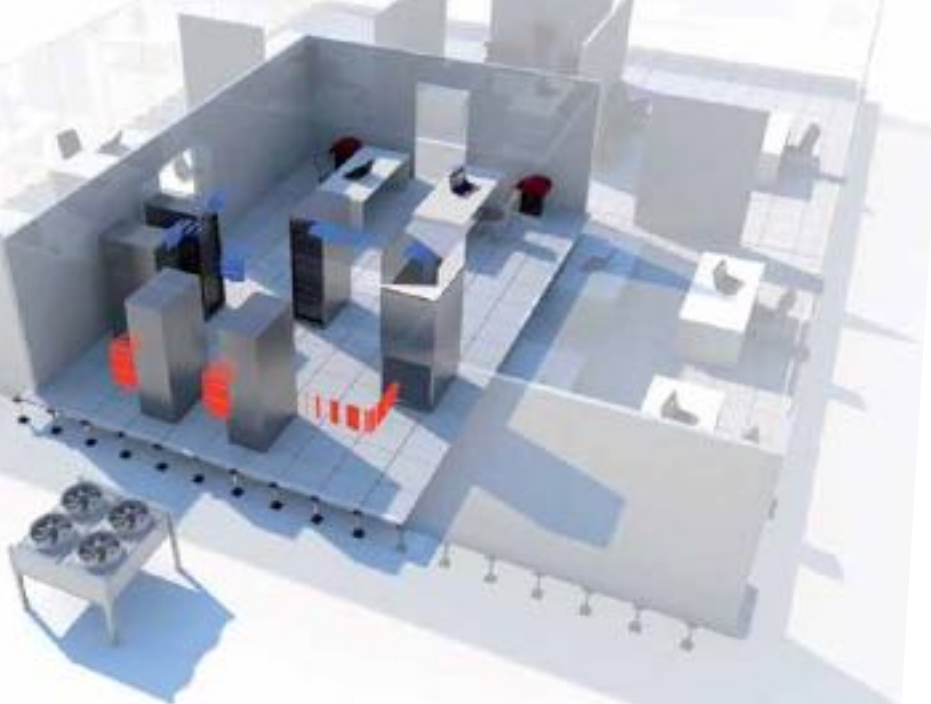
Characteristic of a server room is the need for a versatile and compact cooling system
. A Datatech direct expansion unit with remote condenser with vertical airflow
and air distribution directly in the room is the ideal solution, reliable and
efficient, to meet different installation requirements. The variety
of configurations and rich accessories allow to taylor the
best solution for each customer.

Datatech /ED
Datatech+

Precision
air conditioners for
technological
environments
6÷104 kW
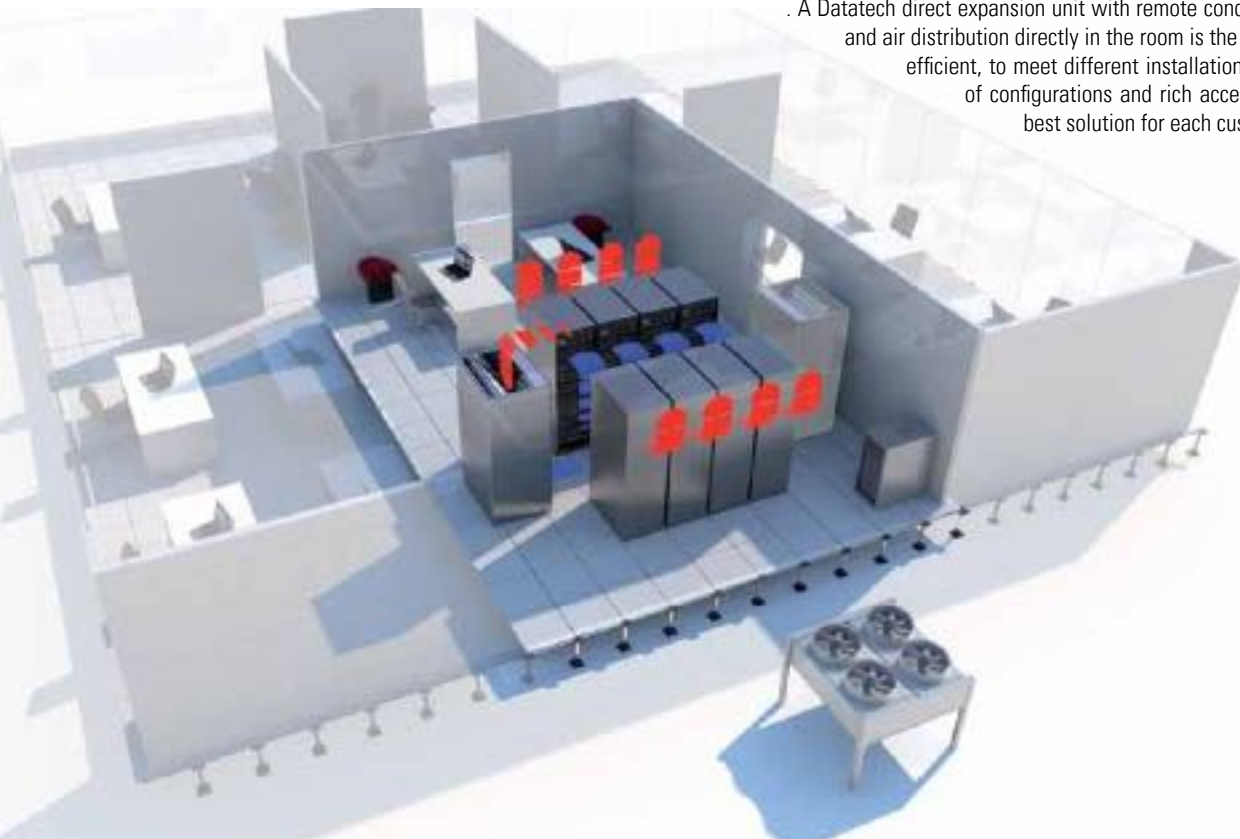
The medium-sized data center , specifically designed to shelter inside IT equipment and provide a safe and secure environment , able to operate continuously 365 days a year , finds in the combination of indoor chilled water Datatech units plus Tetris FC NG chiller the most energy- efficient and unique solution in the market. The pair of indoor units with airflow under the raised floor , with a typical layout of rows of racks in hot aisle / cold aisle arrangement, with water-cooled chillers and dry coolers can achieve maximum energy performance and the optimization of plant operation during the whole year.
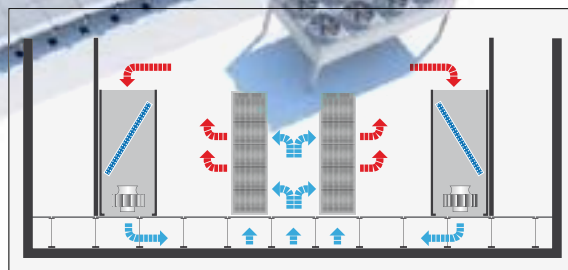
high kW/m^2 ratio
double water circuit available

Datatech /CW

Precision air conditioners for technological environments **6÷220 kW**

Tetris W FC NG

Water cooling freecooling chiller **39÷634 kW**

application

The large, modern data centers, typically large "Colocation Providers" or large institutions require dedicated cooling, high efficiency and high capacity cooling units . The Datatech units with separate fan section, installed below the raised floor, reach the top of the performance in terms of efficiency and cooling capacity per footprint . The coupling to the large Kappa Rev chillers can reach the cooling power needed to remove large amounts of heat that originate within the data center .

optimized for raised floor installation
strict underfloor pressure control

Datatech /PFW

Precision air conditioners for technological environments with plenum fan **70÷260 kW**

Kappa Rev HEi XEi

Air cooled modular chiller with inverter **286÷1451 kW**

Small data centers, despite the name, may require a high power density in the case the so-called "blade" servers are used. A solution based on Coolblade "in-row" cooling units allows to efficiently remove large amounts of heat. A non-negligible advantage of such a solution is the possibility to avoid the distribution of air through the raised floor, thus saving on the initial costs of installation.
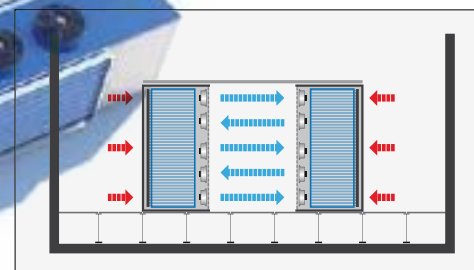
high kW/m² ratio
minimum footprint
designed for containment solutions

Zeta Echos FC

Air cooled freecooling chillers
45÷145 kW

Coolblade & Coolmate

High density cooling system for technological applications
16÷27 kW

application

ITcooling

Datatech + > 7÷100 kW
Precision direct expansion air-conditioners, air cooled or water cooled for technological environments. Features all brushless DC inverter driven components.

Datatech /ED > 6÷104 kW
Precision direct expansion air-conditioners, air cooled or water cooled for technological environments. Available also as DC/FC (Dual Cooling/Free Cooling) version.

Datatech /CW > 6÷220 kW
Precision chilled water air-conditioners for technological environments. Available also as DW (Dual Water) version.

Datatech /PFW > 70÷260 kW
Precision high capacity chilled water air-conditioners for technological environments with plenum fan.

Coolblade & Coolmate > 16÷27 kW
Chilled water in-row air conditioners & pumping set for high density IT aplications.

Technological chiller product range

Zeta Echos FC > 44÷143 kW
High efficiency air cooled freecooling chillers. Patented system.

Tetris 2 FC series > 97÷518 kW
High efficiency air cooled modular freecooling chillers.

Kappa Rev FC series > 320÷1300 kW
High efficiency air cooled modular freecooling chillers.

Kappa Rev HEi & XEi > 286÷1451 kW
Air cooled chillers and heat pumps with Inverter compressor.

Tetris W FC/NG > 39÷634 kW
High efficiency water cooled freecooling chillers with integrated hydronic module.

AIRCON DOO
ул. Дичо Петров бр.3
1000 Скопје, Македонија
Тел. 02 30 90 500
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contact@aircon.com.mk