



IT Cooling Solutions

STULZ Dynamic Free Cooling

Up to 60 % more energy efficiency
in the data centre – worldwide



DFC – up to 60 % more energy-efficient thanks to innovative STULZ Free Cooling strategy

The STULZ CyberAir 2 with DFC is the first precision air-conditioning system in the world that automatically switches to the best operating mode depending on the heat load in the data centre and seasonal variations in ambient temperature. DFC (= Dynamic Free Cooling) was developed exclusively for the STULZ CyberAir 2 with Indirect Free Cooling.

Full hybrid with Indirect Free Cooling

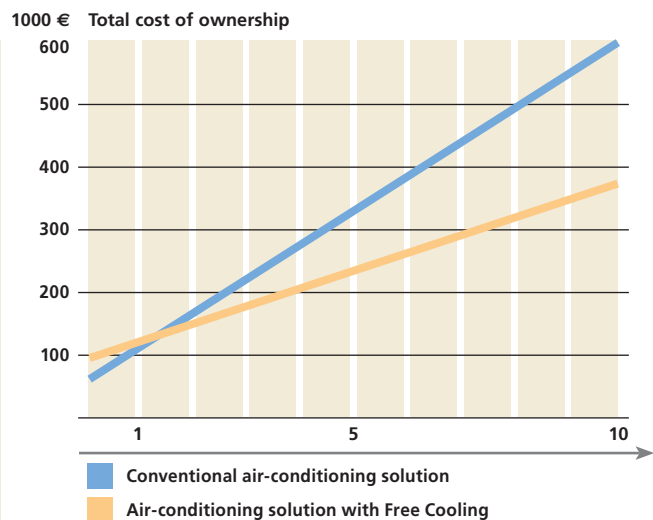
DFC combines compressor cooling and Free Cooling in four stages in all, and automatically searches for the most economical operating mode. In cool weather, DFC makes use of economical Indirect Free Cooling, which extracts all its cooling power from the ambient air. Energy-intensive compressor cooling (DX) is only switched on when absolutely necessary.

DFC for fully electronic savings

With utmost sensitivity and precision, DFC selects the most energy-saving mode, controls the speed of the EC fans in the A/C unit and those of the dry coolers, regulates the position of the control valves, reduces the electricity consumption of the pumps and ensures precise interior climate control. By incorporating standby units as well, DFC keeps all units, pumps and dry coolers in perfect balance in energy-saving partial load mode.

Energy savings with DFC

- Up to 60 % energy savings
- The world's first system with automatic efficiency optimisation
- Automatic switch between compressor cooling and Indirect Free Cooling
- Networking of all active components: A/C and standby units, control valves, compressors, EC fans, pumps and dry coolers



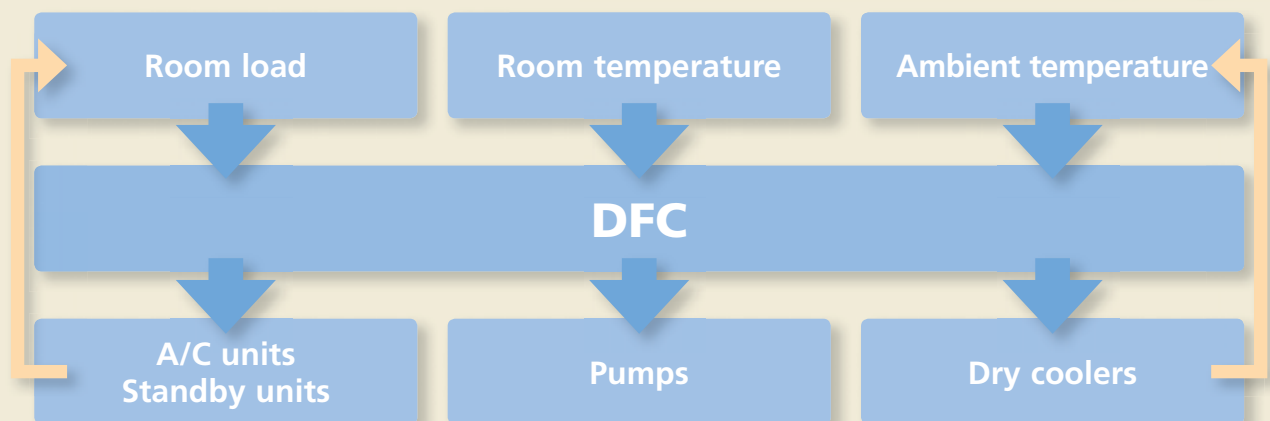
The higher capital investment in a STULZ CyberAir 2 with DFC compared with a conventional air-conditioning system is offset after just a few years.

The DFC system – individual A/C units work in perfect harmony with Indirect Free Cooling

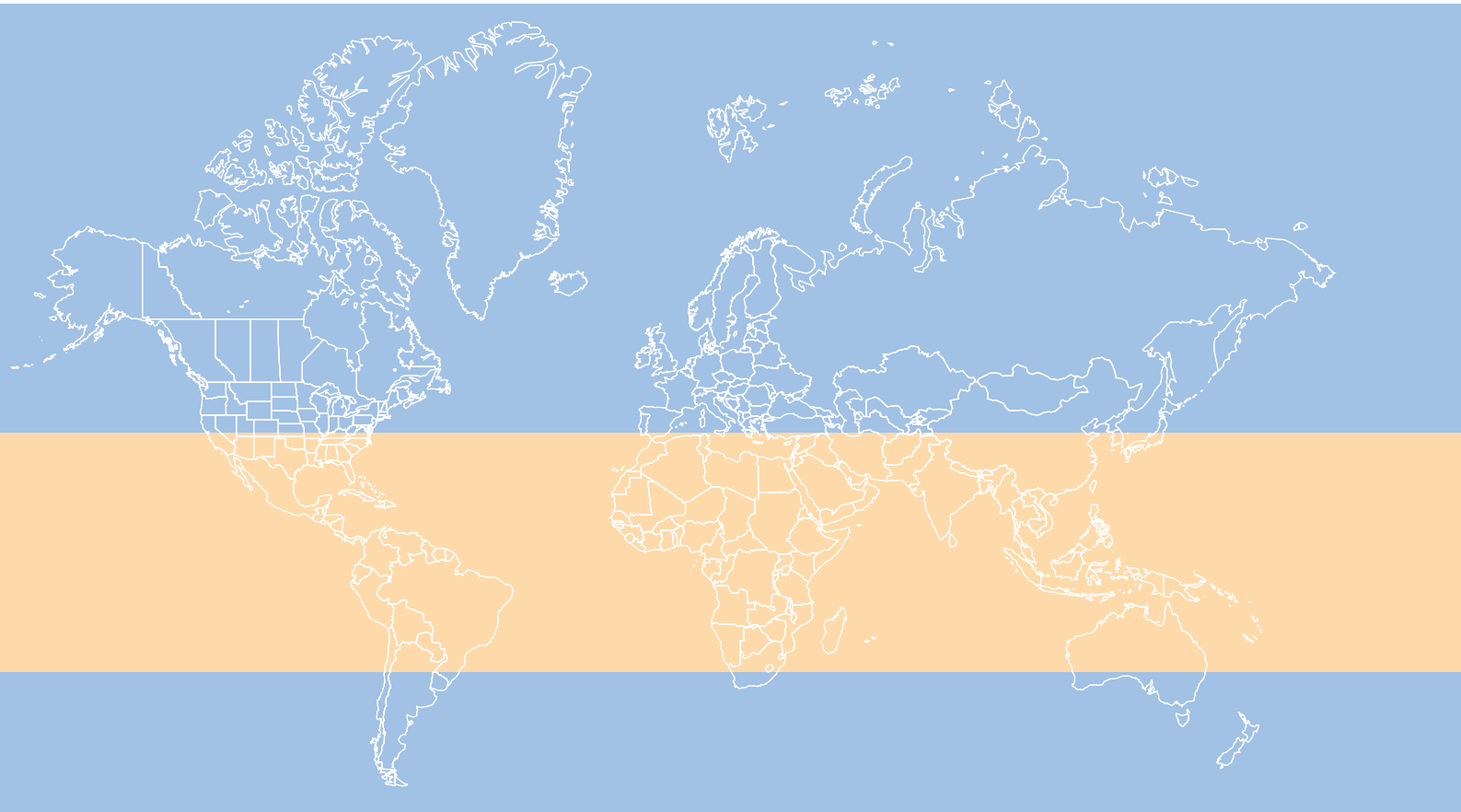
Each A/C unit works with a DX refrigerant circuit comprising an evaporator, electronic expansion valve (EEV), scroll compressor and brazed plate condenser – and a separate chilled water circuit for use of Indirect Free Cooling. The mechanical switchover from DX to Indirect Free Cooling mode is achieved steplessly by means of 2-way valves.

When room air flows through the heat exchanger in DX mode, the heat is transferred to a refrigerant, and emitted into the ambient air via a pipe system leading to an external dry cooler. Both the A/C unit and the dry cooler are equipped with EC fans with stepless control. Speed-controlled pumps are used in Free Cooling mode to supply the water/glycol mixture.

DFC controls all the components of the air-conditioning system with precision and always selects the best possible operating point, ensuring an optimum supply of cold air in the data centre.



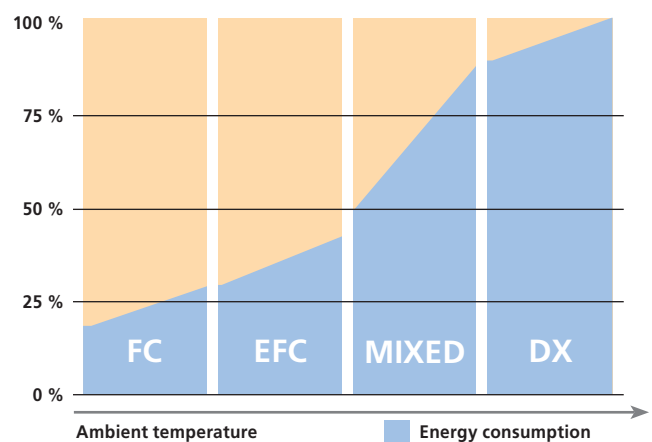
DFC – energy-saving advantages worldwide



In moderate climates north and south of the equatorial zone, the energy-saving advantages of the STULZ CyberAir 2 with DFC can be exploited to the full. Electricity consumption for data centre air-conditioning falls by up to 60 %.

STULZ Direct Free Cooling DFC

- Electronically controlled cooling system, combined compressor cooling and Free Cooling in four stages:
 - FC Free Cooling energy-saving mode
 - EFC Extended Free Cooling
 - MIXED Compressor and Free Cooling
 - DX Compressor cooling
- Electronic load distribution for partial load mode
- The efficiency of the compressor is increased in Mixed mode thanks to the electronic expansion valve

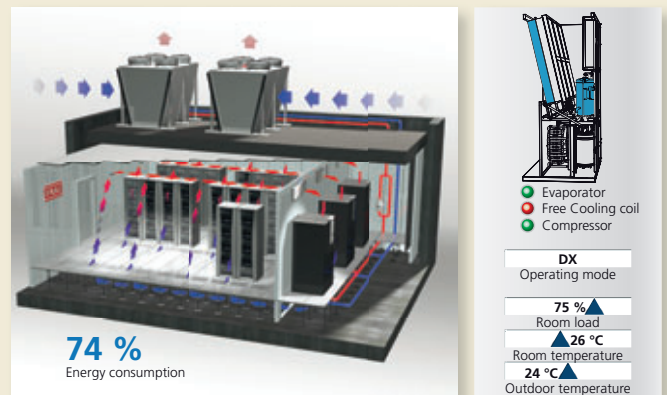


Indirect Free Cooling installation with CyberAir and DFC Direct Free Cooling

Here we present an example showing the 4 operating modes and the required energy for the air-conditioning at 75 % capacity and a room temperature of 26 °C in the data centre. Thanks to the scalability of the DFC, this example can be applied to data centres of almost any size.

DX (compressor cooling)

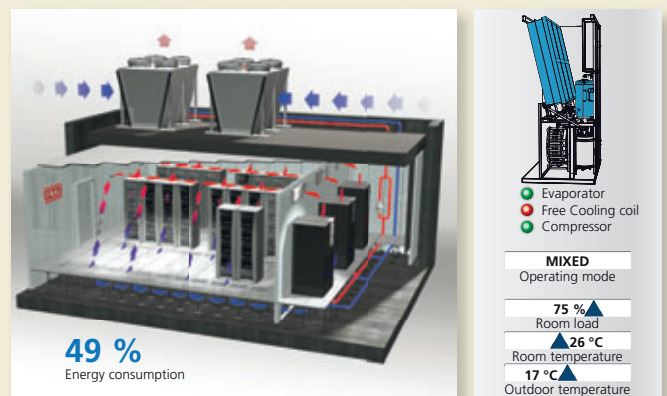
As shown in this example, when the ambient temperature rises above 24 °C, the DFC system automatically selects energy-intensive DX mode. But even in this mode, savings are achieved through the use of modern components (EEV). Allowing higher room temperatures can boost this savings effect even further, as the compressor is activated later on.



MIXED (compressor and Free Cooling)

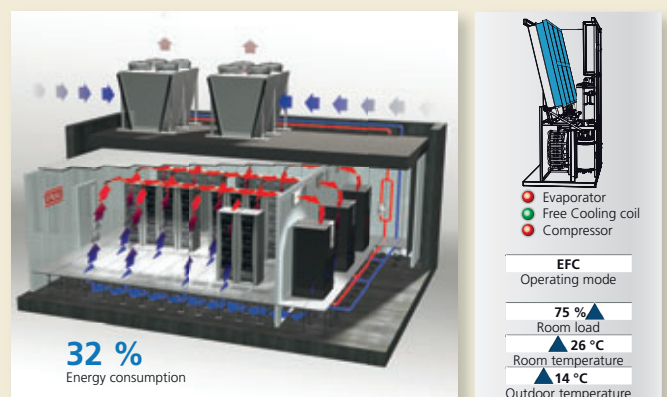
When the ambient temperature lies between 16 °C and 23 °C, the system activates Mixed mode. In other words, compressor cooling is joined by Free Cooling.

In this mode, too, the higher the permitted room temperature, the longer the period during which use of DX mode can be reduced and more cost-efficient Mixed mode can be used!



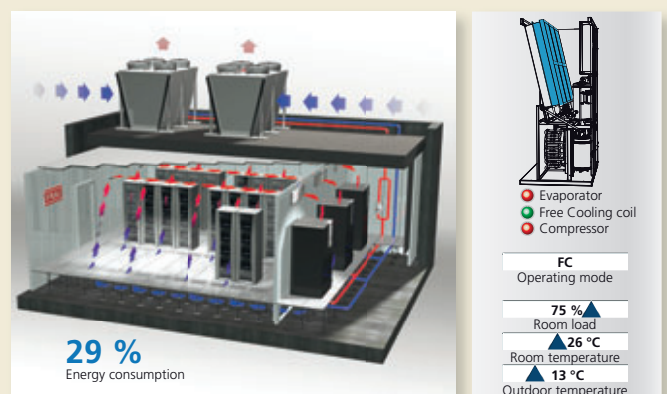
EFC (Extended Free Cooling)

When ambient temperatures lie between 14 °C and 15 °C, Extended Free Cooling is activated, and the compressor is switched off completely! The airflow increases in EFC mode, so that Free Cooling can also be used at higher temperatures.



FC (Free Cooling)

When ambient temperatures are below 13 °C, pure, cost-efficient Free Cooling mode is possible. There is no need for additional use of a compressor.



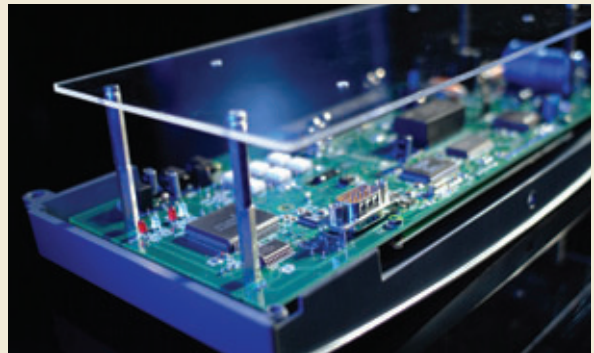
DFC with Indirect Free Cooling can be employed in most regions of the world, depending on the local temperature profile.

Example: In Hamburg, pure DX mode is required for only 21 % of the year!

DFC – the key to efficiency lies in a combination of good ideas

Automatic mode selection with C7000 microprocessor

The controller in the A/C unit ascertains the most favourable operating mode at any one time on the basis of the ambient temperature and the heat load in the data centre, and incorporates available standby units.



The C7000 microprocessor: a highly intelligent development by STULZ engineers

Indirect Free Cooling

In cool weather, DFC makes use of economical Indirect Free Cooling, which extracts all its cooling power from the ambient air. The water/glycol circuit separates the circulating air circuit in the ICT room from the ambient air circuit, so that in Indirect Free Cooling mode, ambient air is not conveyed directly into the data centre. Indirect Free Cooling does not depend on the quality of the ambient air. This means no dust, no pollen and no problems with excessively dry or moist air! Instead, the added benefits are longer maintenance intervals, fewer filter changes and lower operating costs.



Dynamic component control

With utmost sensitivity and precision, DFC selects the most energy-saving mode, controls the speed of the EC fans in the A/C unit and those of the dry coolers, regulates the position of the control valves, controls the speed of the pumps and ensures precise interior climate control. It doesn't matter whether your data centre has three A/C units, or twenty: DFC can be scaled to fit without problem and satisfies every individual requirement – even in the largest of data centres.



Free Cooling standby manager

Unlike with conventional unit sequencing, the STULZ standby manager always exploits existing reserve capacity for cooling, whenever possible. The advantages are reduced fan power input and lower noise emissions, with simultaneously improved air distribution in the data centre. The remaining units only run at full load in DX mode or when individual units fail or require maintenance.

The technology behind the standby manager:

- The enlarged heat exchanger surface means that water of a higher temperature can also be used for Indirect Free Cooling. Increasing the temperature of the water extends the period that Free Cooling can be used, because the chilled water is able to dissipate the heat load into the environment via the dry coolers, even at higher ambient temperatures.
- The airflow is reduced earlier on – achieving a considerable reduction in the energy consumption of the fan.

Dynamic water temperature

In conventional air-conditioning systems, Free Cooling begins at a certain preset water temperature. DFC, on the other hand, controls the mode in accordance with the current heat load in the data centre – which is frequently below this set value! Instead, the actual heat load can be dissipated when there is a smaller temperature difference between the chilled water and the room air. DFC exploits this fact and works dynamically, i.e. without a fixed starting value, which means that it can considerably increase the number of operating hours using Free Cooling.

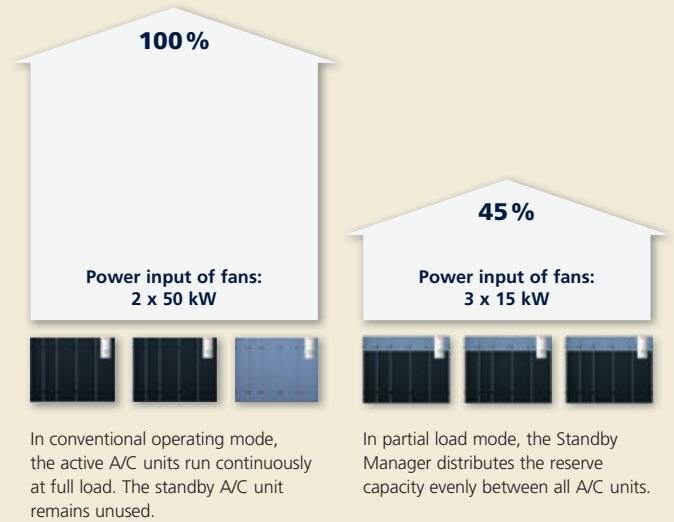
Optimised unit design

The enlarged surface produces an extended heat exchanger surface and improved air conduction with less resistance. The air can flow through the system better – with a positive effect on the fan power input. Another additional benefit of the optimised unit design is a reduction in operating noise.

Dual 2-way valve

Each A/C unit is equipped with two 2-way valves, and supplies the connected components (brazen plate condenser and Free Cooling coil) with exactly the right quantity of water for the current operating mode. This saves pump energy.

Energy savings with standby management



Load status	Actual heat load	Required water temp. °C*	Required ambient temp. °C*	FC & MIXED Annual operating hours in %**
Full load	500	10.4	7	43 %
80 % load	400	13.1	11	63 %
60 % load	300	15.8	14	79 %
40 % load	200	18.4	17	92 %

* Values refer to the selection of the system

** Values depend on the local weather profile. This example refers to Hamburg.



The enlarged surface ensures improved air conduction with less resistance.

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IT Cooling Solutions

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