

DATACENTER COOLING

» RELIABLE, EFFICIENT AND SUSTAINABLE WITH DENCO® SOLUTIONS



Stable and precise air conditioning under every condition

We set standards in heat exchange. Our promise: perfect fit, reliable and sustainable solutions as a sign of the times. With highly efficient air conditioning equipment supplemented with powerful auxiliary systems, we cover a comprehensive spectrum that has grown into the largest portfolio in the world.

The back-up of the future: climate control of data centers.

We deliver first-class innovative solutions for sensitive requirements, such as particularly demanded by information technology. A reliable data center cooling systems demands a great deal of attention, since it is associated with considerable challenges: constant operational reliability, dynamic room conditions and a reduction of the operating costs are the most important parameters for efficient and reliable air conditioning of small to large data centers. This is where we invest our expertise, in touch with state-of-the-art technology and with an exceptionally keen awareness of innovations and influential trends. We are orient our work on the recommendations of the US professional association ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers).

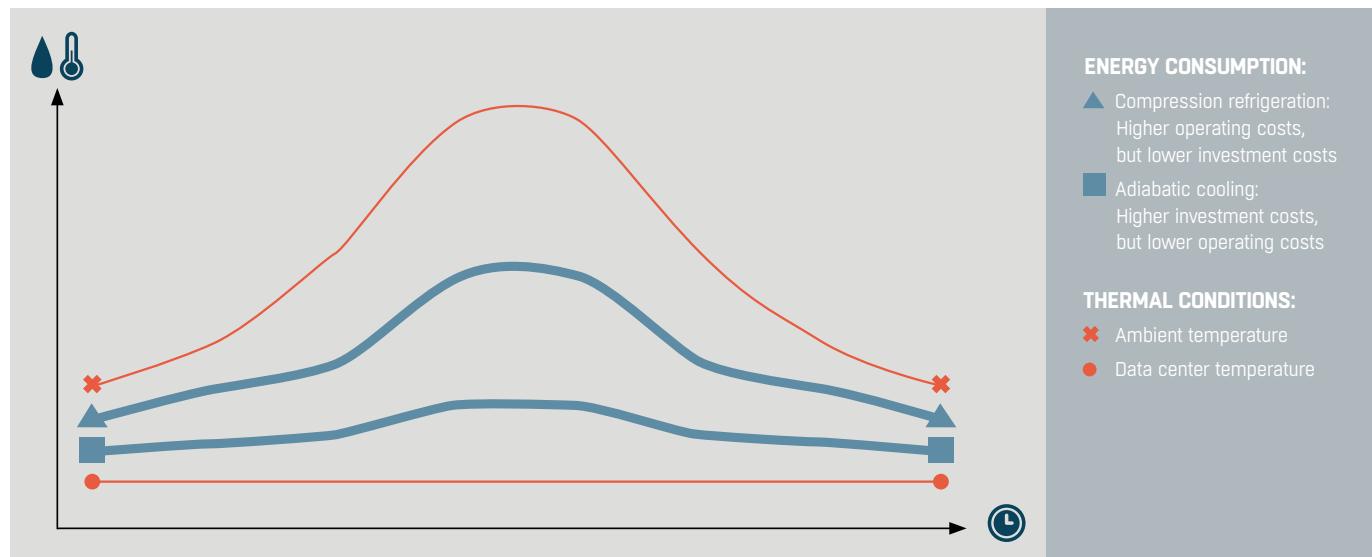
The chart demonstrates that independent of the outdoor air conditions, we ensure the comfort zone of your IT with our reliable cooling systems.





PROMISE

Close control units are much more than just words for us; they are also a promise. A promise, which we can keep due to our long-lasting expertise. All units of the DENCO product series are bywords for cooling accurate to the degree, exact control of humidity and absolutely reliable, space-saving and at the same time energy-efficient air conditioning solutions.



INTELLIGENT COMPLETE SYSTEMS FOR EVERY DATA CENTER

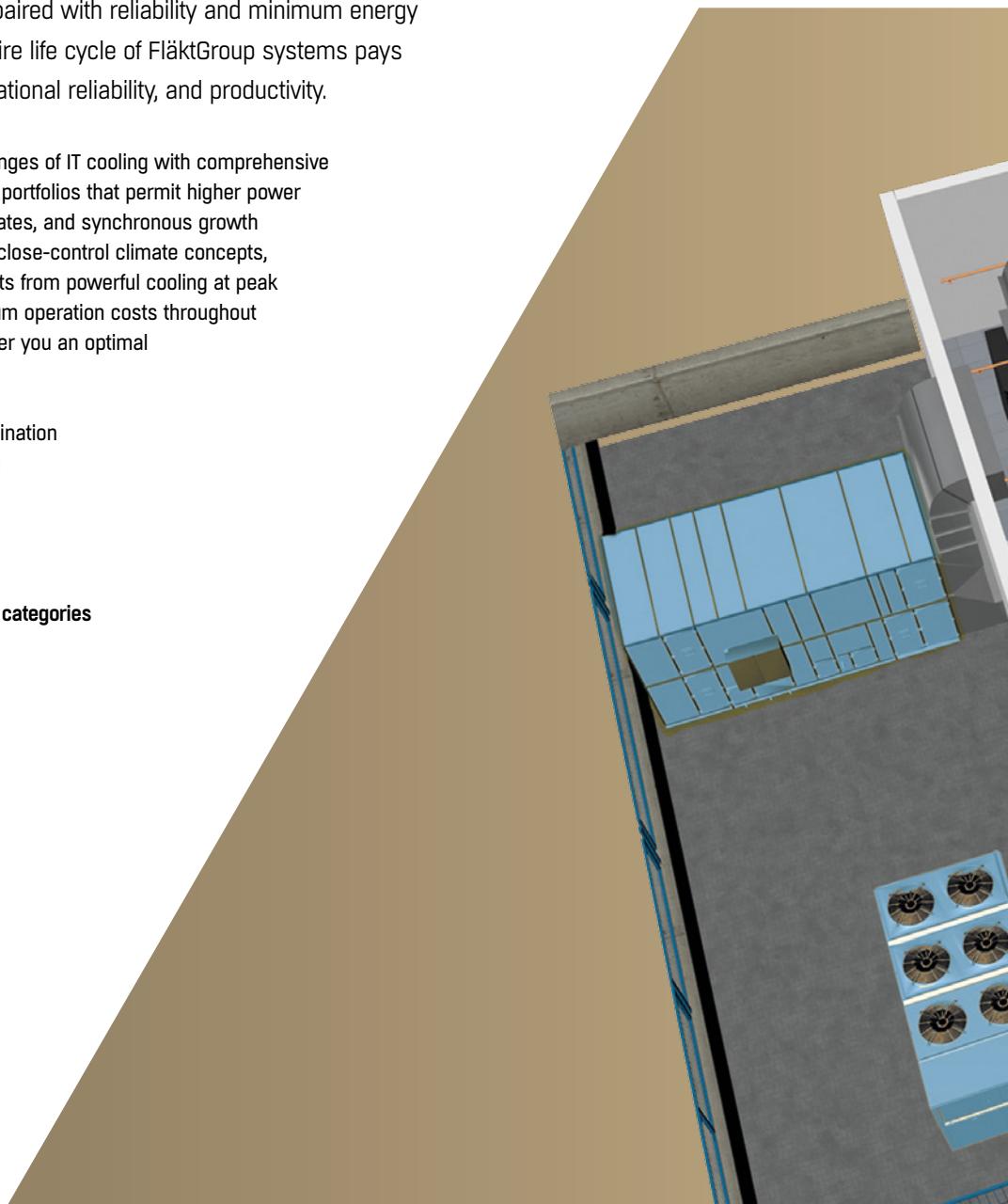
Commercial data centers, all kinds of companies, and especially telecommunication systems depend on the maximum availability of information technology. Perfect data back-up, a redundant energy supply and fail-safe hardware are a matter of course – and reliable, precise and efficient hardware cooling is a must. With regard to cooling, humidifying and cleaning air streams, as experts for air treatment we can make a decisive contribution to the efficiency of buildings and their functional rooms. The combination of customized climatisation technology paired with reliability and minimum energy consumption over the entire life cycle of FläktGroup systems pays off in cash, systems operational reliability, and productivity.

We face the future and challenges of IT cooling with comprehensive and sustainable performance portfolios that permit higher power density, dynamic operating states, and synchronous growth processes. With our efficient close-control climate concepts, we can satisfy all requirements from powerful cooling at peak summer conditions to minimum operation costs throughout the course of the year and offer you an optimal price/performance ratio:

- Indirect free cooling in combination with adiabatic humidification
- Direct free cooling
- Compression cooling
- Cold-water based systems

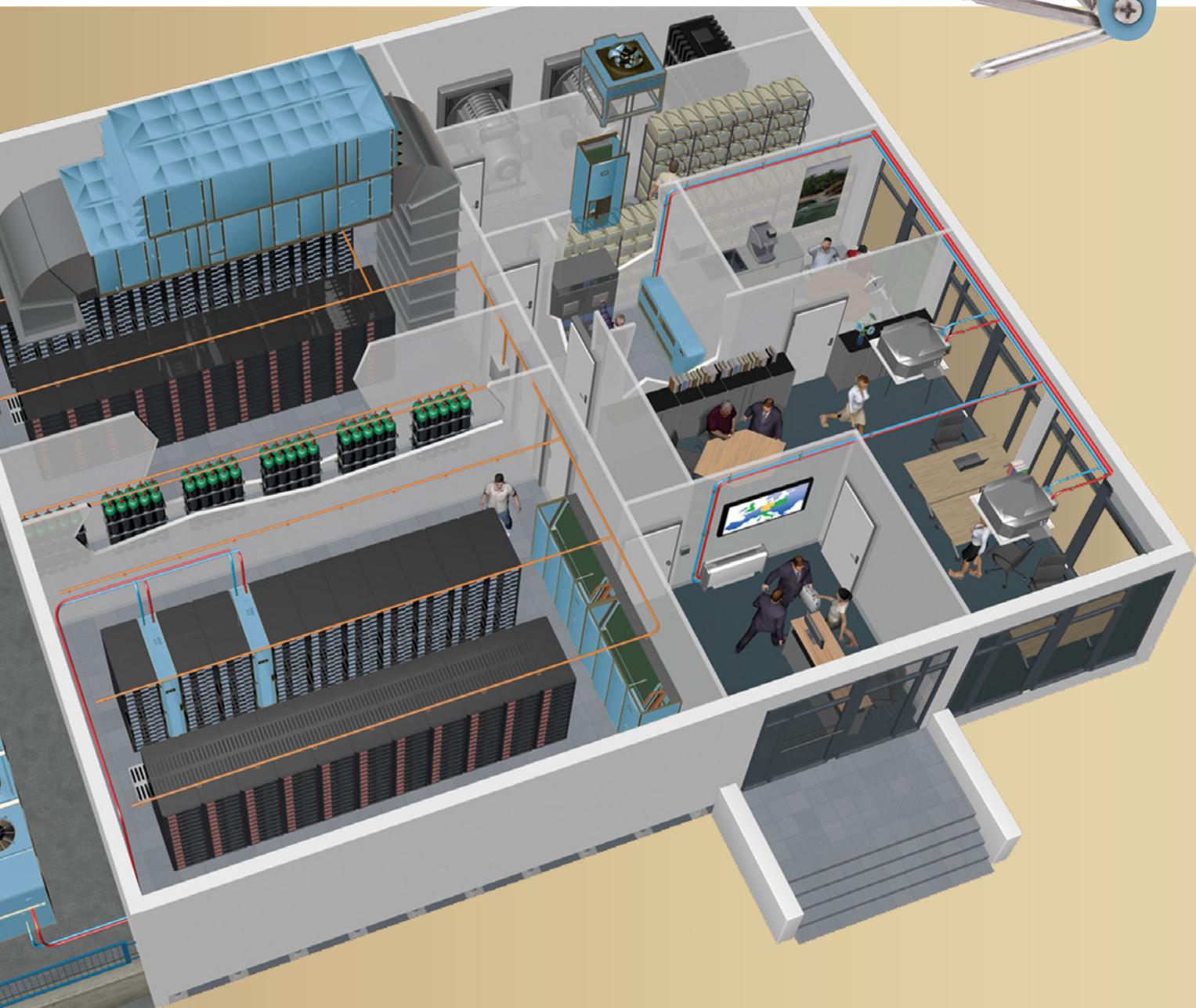
Convince yourself of the three categories of our diverse product range:

- Innovative Air2Air solutions
- Interior systems
- Outdoor facilities



First rate efficiency. Our promise for your data center: the reliable reduction of so-called Power Usage Effectiveness (PUE). The PUE formula determines the efficiency of energy consumption within a data center. Efficient precision air conditioning is a major factor for the successful reduction of PUE. Our systems achieve a partial PUE (pPUE) as far as 1.03.

Intelligent and customized product solutions for your individual requirements.



» Cooling is essential, **efficiency is the key**

Optimise conditions and maximise your savings

The Uptime Institute

- Unbiased, third-party data centre research organisation
- Founded in 1993
- www.uptimeinstitute.com

ASHRAE

- American Society of Heating, Refrigerating and Air-Conditioning Engineers
- Mission statement: To advance the arts and sciences of heating, ventilation, air-conditioning and refrigeration to serve humanity and promote a sustainable world.
- Founded as ASHAE in 1894
- Modern format due to merger of ASHAE and ASRE in 1959
- www.ashrae.org

With energy costs increasing pressure on data centres and more than two-thirds describing that reducing energy consumption is “very important”¹, control of room temperature is no longer our industry’s only priority. Buying more efficient equipment can be a good start, but you can maximise savings by evaluating your operating conditions, enabling cost reduction to be made year-on-year.

ASHRAE Thermal Guidelines²

Class	Dry-Bulb Temperature (°C)	Humidity Range (Non Condensing)	Maximum Rate of Change (°C/hr)
A1	15 – 32	20% to 80% RH	5 / 20
A2	10 – 35		
A3	5 – 40		
A4	5 – 45		

Class B and C do not apply to data centres.

For the classes above, the guidelines have a recommended dry bulb temperature range of 18°C to 27°C. DENCO products recognise the developments in IT equipment and are designed to capitalise on these capabilities. The higher temperatures allow for better efficiency throughout our range. Alongside this opportunity, we also have knowledge and experience of other methods to save energy:

- A sensible heat ratio (SHR) of 1 is best for performance. All the energy used is going directly into cooling the dry-bulb temperature of the air. Any other value than 1 shows that energy is being wasted.
- EC fans or inverter compressors enable great energy savings. These technologies combined and networking strategies, such as running redundancy, enable greater savings than the sum of the individual parts.
- Use hot and/or cold aisle configuration: higher air inlet temperatures increase freecooling potential.
- Humidifiers can be a source of energy waste: a sealed room can reduce or remove humidification needs or only require installation of humidifiers on some units.
- Air tightness expresses how well sealed the room is. It helps the stability and control of an environment.

¹ Uptime Institute 2013 Data Centre Industry Survey – Matt Stansberry & Julian Kudritzki

² Allowable boundaries are expansive values based on assessment of specification and adhering to ASHRAE assessment methodology. Values: “2011 Thermal Guidelines for Data Processing Environments – Expanded Data Center Classes and Usage Guidance”

THE FORMULAS FOR ECONOMISING

Increase your profits on the bottom line

SHR: Sensible Heat Ratio

An SHR of 1 is ideal. It demonstrates that all the energy is being used to cool the air; whereas a lower value shows that the moisture content in the air is being changed during the cooling process, i.e. condensation is being made. Other methods of calculating SHR include looking at inlet or outlet temperatures and moisture.

$$\text{Sensible Heat Ratio} = \frac{\text{Gross Sensible Capacity}}{\text{Gross Total Capacity}}$$

SEER: Seasonal Energy Efficiency Ratio

As EER values would vary when comparing the same system in different locations with different climates, the SEER is a useful annualised comparison. The use of total is to signify a time period relating to interest.

$$\text{Seasonal Energy Efficiency Ratio} = \frac{\text{Total Effective Cooling}}{\text{Total Power Input}}$$

EER: Energy Efficiency Ratio

The EER expresses a comparison of the how much useful cooling has been made relative to the amount of power that has been used by the unit. It is a sample of a specific condition at a particular moment and would be affected by conditions indoors as well as outside of the building.

$$\text{Energy Efficiency Ratio} = \frac{\text{Effective Cooling}}{\text{Power Input}}$$

PUE: Power Usage Effectiveness

This metric has received rapid adoption by the industry as a simple method to give a ratio as to the power requirements to maintain operation of your IT equipment. This is discussed in greater depth on the next page.

$$\text{Power Usage Effectiveness} = \frac{\text{Total Power Consumption}}{\text{Power Consumption by IT Equipment}}$$

Four categories classify the accuracy of a PUE measurement:

PUE Category 0

- IT load measured at UPS output(s)
- Total data centre power measured at the utility meters
- Peak utilisation/demand in a single snapshot measurement

PUE Category 1

- IT load measured at UPS output(s)
- Total data centre power measured at the utility meters
- 12 month cumulative readings

PUE Category 2

- IT load measured at PDUs supporting IT loads
- Total data centre power measured at the utility meters
- Peak utilisation/demand in a single snapshot measurement

PUE Category 3

- IT load measured at the point of connection of IT devices to electrical system
- Total data centre power measured at utility meters
- 12 month cumulative readings

MINIMISING USE, MINIMISING COSTS

Power usage effectiveness (PUE) is a ratio to assess how much energy has been used to service or cool the IT equipment in the data centre relative to the amount of energy used by the IT equipment. It has a simple equation:

$$\text{Power Usage Effectiveness} = \frac{\text{Total Power Consumption}}{\text{Power Consumption by IT Equipment}}$$

The ideal value is 1, where all energy used within the data centre has only been used on the IT equipment and therefore no cooling, lighting, uninterrupted power supply (UPS) losses or mechanical services have been required to keep the IT equipment running.

The Uptime Institute survey estimates that an average PUE amongst data centres is 1.651, but also advises that with companies investing in better energy efficient equipment and adopting industry best practice, this number could be reduced considerably. Some companies have been noted to perform exceptionally, achieving PUE scores of 1.10 or less, the implication that for every 1 kW of energy they use on IT equipment, it only requires 0.1 kW of energy to cool, light and maintain the data centre.

When using PUE, caution is required: the figure can easily be manipulated. As the IT equipment's energy is the denominator of the equation, then if you had two quotes, both with the same mechanical equipment, but one has less efficient IT equipment, the less efficient quote would have a better PUE value, even though, in the real world, it would be the wrong option.

We would recommend, where possible, using the highest category as the measurement technique for sampling your PUE. The lower the category the less accurate your sample of PUE will be. It could be affected by hot or cold days as well as by underutilised IT equipment. Using a lower category will also mean it is difficult to know if you are making effective improvements to your energy saving..

¹ Based on self-reported figures in the Uptime Institute 2013 Data Centre Industry Survey – Matt Stansberry & Julian Kudritzki



Green thinking, reliable focus **Little affect, little effect**

Green IT

Green IT can mean different things to different individuals or organisations. For instance: "Green IT is a collection of strategic and tactical initiatives that directly reduces the carbon footprint of an organisation's computing operation" is a part of how BCS, The Chartered Institute for IT, outline the subject.

Alternatively, Greenpeace equate 'Green IT = Energy Efficiency + Renewable Energy' with an emphasis and focus on the source of the energy, rather than just the efficiency of the consuming device.

Others may combine these ideologies, but the objective is the same: reduce and minimise our industry's impact of the environment that we inhabit. All our products have efficiency as a central focus, reducing our consumption, and some products can utilise their environment conditions to provide freecooling for your systems.

We believe by having a green approach and technical expertise, combined with our customers desires and applications, we can together make our environment a better place for all.

Tier Classification

The Uptime Institute devised a set of tier classifications to be able to consistently describe and compare data centres and their infrastructure in terms of projected reliability and uptime availability.

The standard is designed in a manner so that any site is limited to its weakest subsystem. It helps individuals to understand and assess complex infrastructure when comparing across sites and can allow for a common comparable aspect on what might be vastly differing designs.

DENCO products are designed in awareness of this standard and its growing popularity and use within the industry and therefore have several options to help align with your tier requirements. Whether that is N+1 networking capabilities for seamless maintenance or dual power supply inputs.

We secure and conserve resources – in the long-term

Technological progress. We contribute to global stability with a high degree of innovation and efficiency. The results of our intensive development work are ecological and economic system solutions that promise future-oriented close-control air conditioning of data centers.

Information and communication technology shows us the future, opens new possibilities, but also requires a considerable share of our electricity. In numbers: the data centers in Germany alone require annually more than ten terawatt hours of electricity, which corresponds to the power of two nuclear power plants. And the numbers are on the rise. For this reason, we are increasingly focusing on the topic of "Green IT", with the objective of protecting the environment and promoting the environmentally sound use of communication and information technology.

With an exceptional sense of responsibility for our environment and the future, our special attention is directed towards the development of an innovative and sustainable product range that guarantees low CO₂ emmission, a high level of energy efficiency, and low operating costs.

Production Wurzen: Europe's largest production factory for air-handling units.

Maximum capacity with highest claim to sustainability: for a production area of 25,000 m², more than 300 staff in three shifts on 22 assembly lines produce over 7,000 CAIRplus units per year. The output: unique quality in the sign of "Green IT".





“ Our innovative Air2Air systems conform to all requirements of Green IT.

CAIRplus®

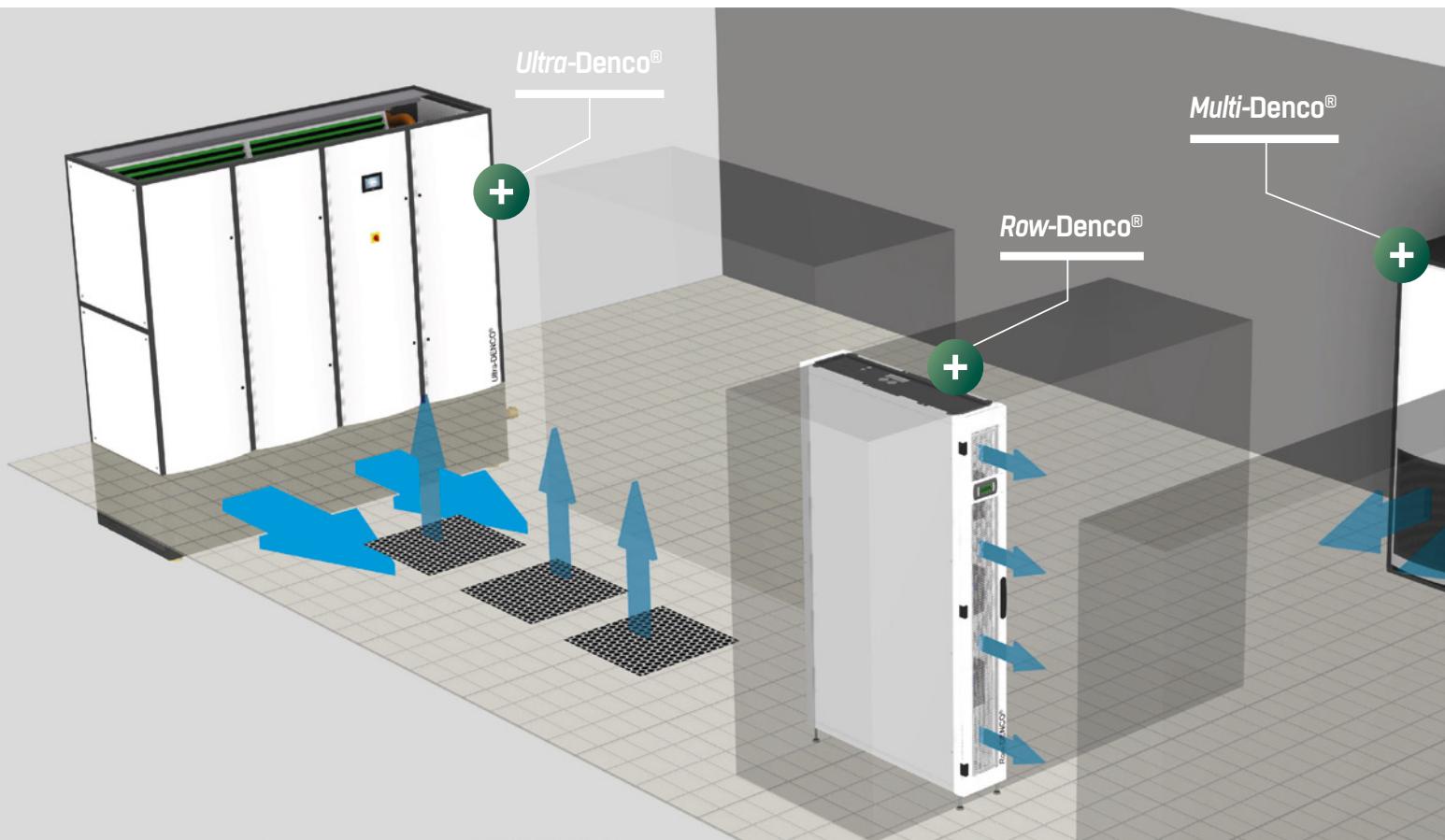
Close-control air conditioning by direct free cooling – with CAIRplus we offer a well-proven technology for climate control of data centers using outdoor air, which ensures considerable energy savings. CAIRplus is Eurovent certified.



Adia-DENCO®

Indirect adiabatic cooling lowers the energy and operating costs by up to 70% – The innovative Adia-DENCO works according to the principle of indirect free cooling in combination with adiabatic humidification for removing heat. Therefore it features an extremely low energy consumption.

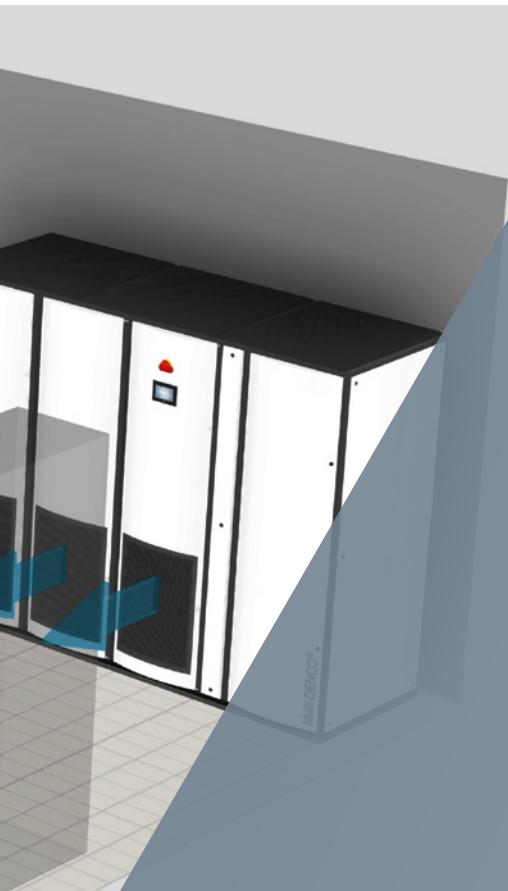




ELEGANT SOLUTIONS FOR ANY CLAIM

Our CRAC – Computer Room Air Conditioning units of the DENCO product series specify the most modern state of technology for close-control air conditioning in a data center.

Many years of expertise justify the unique product line with absolutely precise cooling solutions, exact observance of air humidity and absolutely reliability, space-saving and simultaneously energy-efficient air conditioning. The DENCO close-control units do justice to the highest requirements in data centers and telecommunication installations, and provide a valuable contribution to reliable operation and continuous availability of indispensable information technology.



Innovative features of your individual DENCO® equipment:

- EC fans
- Inverter-compressor technology
- Upflow/Downflow
- DX/chilled water option with sensitive heat ratio (SHR) = 1
- Racks can be used with a waste heat of up to 30 kW

DENCO®: perfect form inside

The DENCO product series offers highest precision for various application scenarios and individual requirements: from *Ultra-DENCO* for use in data centers with high IT power to our *Multi-DENCO*, a diversified product for many usages, up to the *Row-DENCO*, which is required for racks with high power density.

Variety of implementation:

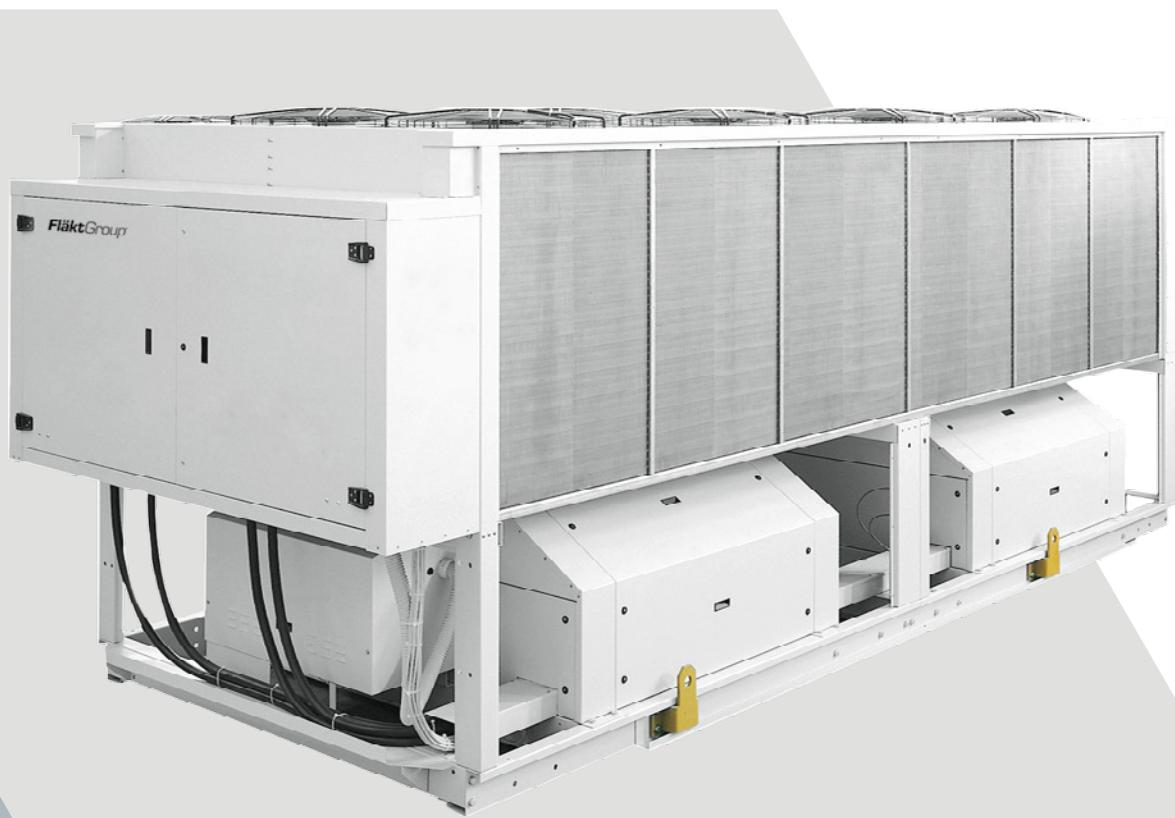
- Hyper-scale datacenters
- HPC datacenters
- Edge datacenters
- Retrofitting



Production site in Liberec, Czech Republic

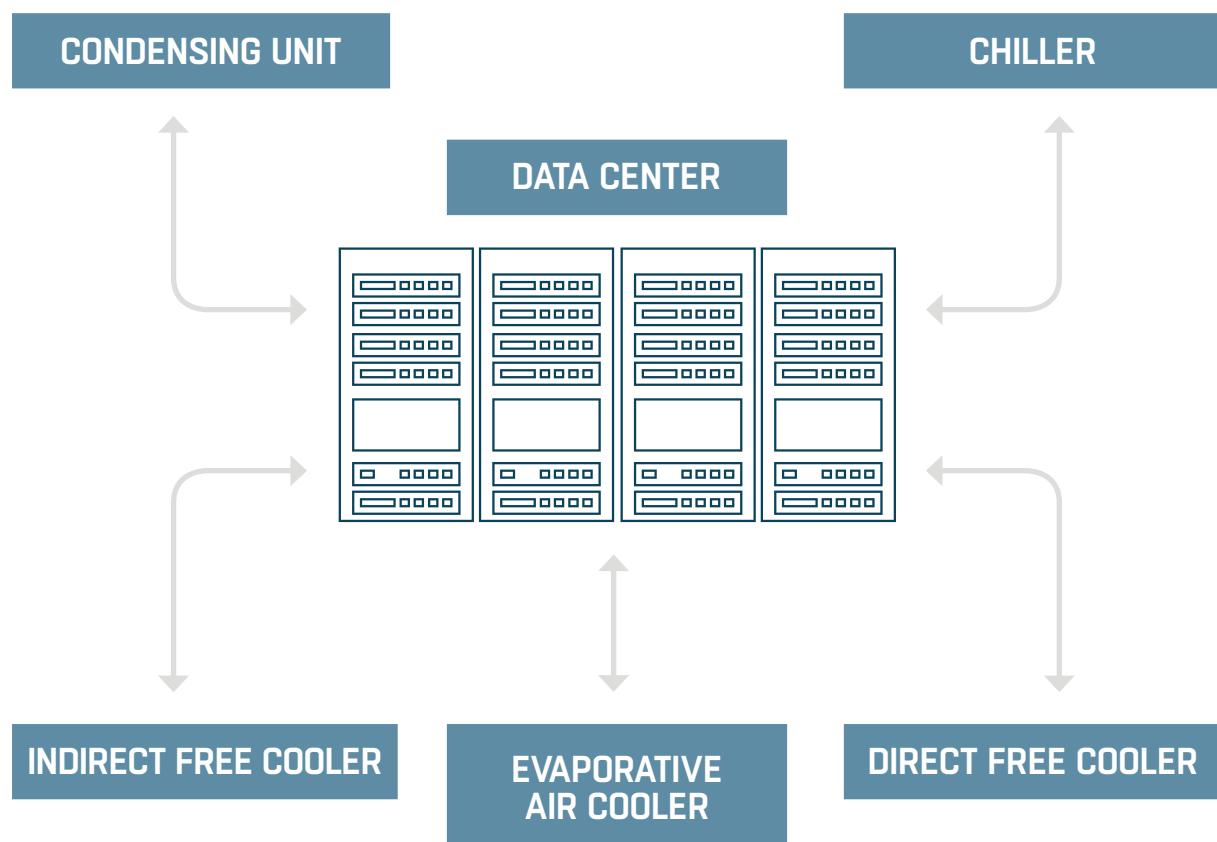
» Free air cooling **par excellence**

Ambient air becomes an energy source

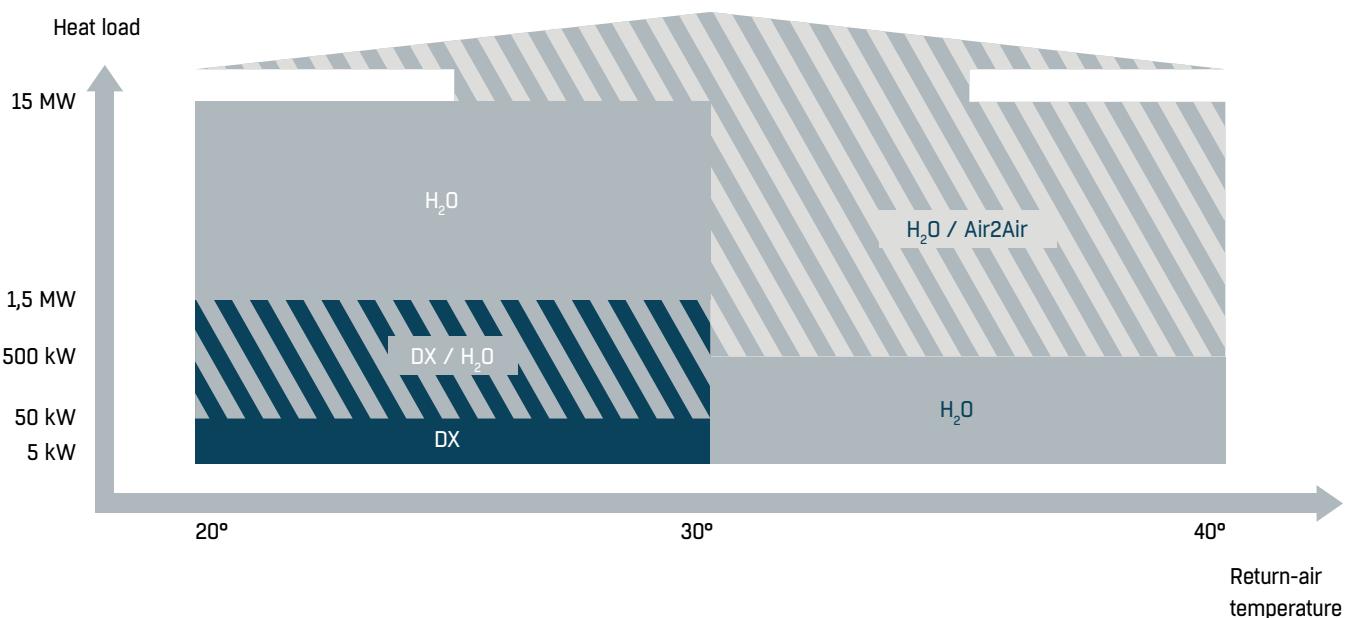


Both our compressor-based as well as our compressor-free systems offer highest quality and flexibility with quiet working. Our products reflect our philosophy of sustainability: with the smallest footprint our systems conserve the environment and valuable resources, and ensure low energy consumption as well as reduced operating costs.

“ *Outdoor solution makes the difference*



DECISION MATRIX FOR YOUR OPTIMAL SYSTEM



Find your perfect system!

Settle for the correct close-control air conditioning system with our flexible product combinations. The Figure shows the recommended systems which are categorized depending on server temperature and thermal load.

WATER-BASED SYSTEMS (H ₂ O)	DIRECT EXPANSION SYSTEM (DX)	AIR-BASED SYSTEMS (Air2Air)
<ul style="list-style-type: none">• Ultra-DENCO + evaporative cooler• Multi-DENCO + chiller + dry cooler• Row-DENCO + chiller	<ul style="list-style-type: none">• Row-DENCO + condenser unit• Multi-DENCO + condenser unit/condenser	<ul style="list-style-type: none">• Adia-DENCO• CAIRplus

Amazing hyper-scale data centre campus

Bulk N01 Data campus is located in the south of Norway in Vennesla, closed to the attractive city of Kristiansand. The N01 Campus has the capacity for over 300.000 m² of secure and flexible white IT buildings. Potential power capacity up to 1000 MW of 100% renewable hydroelectric energy making N01 Campus to the ultimate location for a new sustainable green data center.

The first building is equipped with Flaktgroup Adia-DENCO® especially designed for regions with high snow loads and cold ambient temperatures. 2400 m² of white space running with 4 Adia-DENCO's in an n+1 configuration. The wall units are able to provide up to 400 kW. The volume flow of the units are in peak operation up to 100.000 m³/h. A special exhaust air outlet and an additional roof heating prevents snow loads on the roof of the unit.

Thanks to our technology, BULKN01, could take the next step towards a sustainable world. Our Adia-DENCO unit can run purely on rain water harvested on the roof of the data centers. This means no secondary water source is needed.



Highlights for reliable cooling

For efficient air conditioning of its factory-side computer center, Daimler AG commissioned the climate manager in 2011. Our *Ultra-DENCO* range convinced the client with a unique price/performance ratio as well as a comprehensive liability including a long warranty period. The highest requirements of future server cooling withstood the test of especially comprehensive operational reliability. After a careful planning phase, Daimler AG equipped its computer center with six *Ultra-DENCO* 100 C and 100 CH systems. The installation phase took some time and was a special challenge, since the outfitting had to take place during ongoing production. However the subsequent success justified the new installation: our units now provided the 100 m² server room with climatic cabinets for the regulation of the automatization and the complete robot control. The new unit is integrated in the building management system of Mercedes-Benz, so that malfunctions can be immediately recognized and resolved at the PC. Apart from the room, the intake or discharge temperature as well as the current temperature in the raised floor, the position of the cold water valves in the *Ultra-DENCO* cabinets can also be monitored.

Even on hot high-summer days, the innovative close-control air conditioning solution has proven itself and ensured a cool "company head".



First Service Always at your side

Our services at a glance

- Own heat exchanger production
- Use of certified products and components from well-known manufacturers
- Short delivery times for spare parts
- Installation & commissioning of new facilities
- Refurbishing
- Periodic servicing & maintenance
- Factory witness test
- Upgrading and optimisation of old facilities
- Consulting and training
- Care package with extended warranty:
 - Bronze – all-around service incl. 24h reaction time
 - Silver – all-around service incl. 12h reaction time
 - Gold – all-around service incl. 4h reaction time





Economical from the beginning

The technical developments of FläktGroup represent state-of-the-art swimming pool climate control. Our systems support diverse applications that optimally conform to current criteria of cost effectiveness, safety and sustainability. Our products and services go far beyond pure technology. They are integrated into a comprehensive and in every respect customised service package. This programme includes not only conventional services such as spare part delivery, maintenance, and repair. It unites the consulting and engineering of a technology leader with customised after-sales service and rapid response times. And this not only for installing new equipment. This service also applies for upgrading and optimising old equipment and provides you with perfect support in all project phases. The functionality of the system is secured over its entire service life.

International service und support in experienced hands

Wherever you need us, we will be there for you in the shortest time. All over Europe, our own customer service ensures that you are able to make optimal use of our units' advantages at all times. Many technicians are ready on-call in Germany alone for rapid deployment. All services are designed for absolute safety and reliability. For example, an on-site function check is a part of our delivery service, conducted by an experienced FläktGroup technician together with the installer. This way we directly and personally pass on our functional know-how built up over many years. In this context we should also mention the training we offer in the technology of our climate control systems. Such training is a beneficial instrument for ensuring the lasting functionality and availability of the systems.

A decision for quality

A high quality standard is the basis and principle for all our services. All our service specialists are highly experienced and devote themselves to their work with great diligence. Technically and personally convincing: this is what you can expect from us.

EXCELLENCE IN SOLUTIONS

WWW.FLAKTGROUP.COM

VERSATILE COMPLETE SYSTEMS

FläktGroup is the European market leader for smart and energy efficient Indoor Air and Critical Air solutions to support every application area. We offer our customers innovative technologies, high quality and outstanding performance supported by more than a century of accumulated industry experience. The widest product range in the market, and strong market presence in 65 countries worldwide, guarantee that we are always by your side, ready to deliver Excellence in Solutions.

PRODUCT FUNCTIONS BY FLÄKTGROUP

Air Treatment | Air Movement | Air Diffusion | Air Distribution
Air Filtration | Air Management | Air Conditioning & Heating
Controls | Service

» Learn more on www.flaktgroup.com
or contact one of our offices