NL Agency
Ministry of Economic Affairs, Agriculture and Innovation

Sustainable cooling for data centres

The knife cuts both ways

>> Focus on energy and climate change

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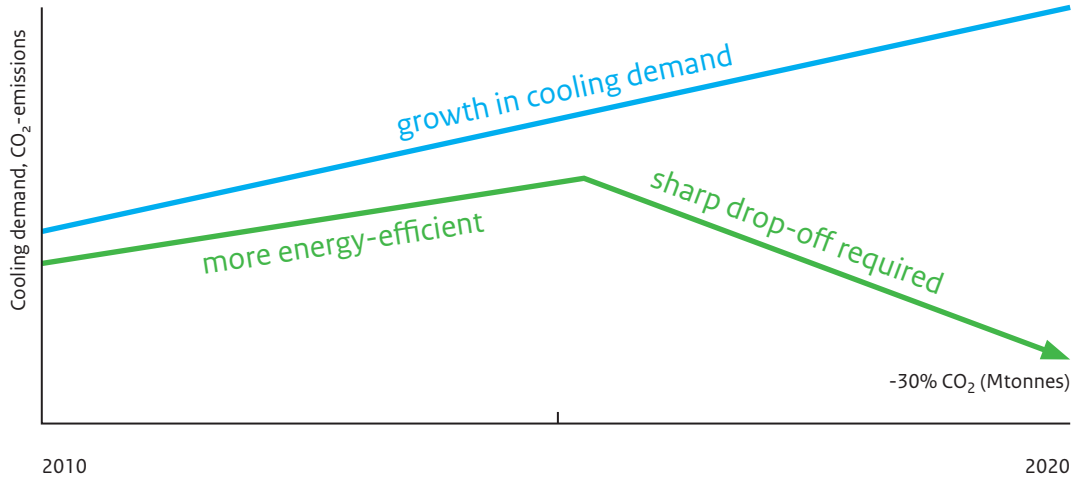
Sustainable cooling for data centres

The knife cuts both ways

The growth in the number of data centres will also lead to increased energy usage and CO_2 emissions in future years. Consequently, it is high time for a switch to sustainable cooling. After all, this is exactly the area where the sector can make significant advances in cost control, as cooling accounts for as much as 30 to 50% of total energy consumption. Did you know, for example, that you can save up to 80% or more on your energy costs for cooling? Meaning that you can reduce your EUE to less than 1.1. The solutions are already commercially available. Furthermore, a solution like this is highly profitable. Are you a manager or administrator at a data centre? And do you want to investigate using sustainable cooling? If so, the knife will cut both ways for you. Agentschap NL will be delighted to help you initiate your project.

As ICT takes on an ever more omnipresent role in our society, the sector's demand for electricity will also increase strongly in the future. This will not only create shortages in the mains network at local level, it will also place even greater pressure on our Dutch energy supply system. This is expected to occur in spite of the fact that the ICT sector has agreed to reduce its energy consumption annually by an average of 2% in the period up to 2020 (MJA-ICT sector agreement).
Cooling demand must be made to drop off sharply in the view of innovative market leaders. This view is shared by Agentschap NL, which offers all kinds of support to the ICT sector on behalf of the Dutch Ministry of Economic Affairs, Agriculture and Innovation in order to favour the introduction of **sustainable and profitable solutions**. And thereby face up to the challenges of the future: **green growth in the Netherlands.**

Graph: Cooling demand grows, sharp drop-off required in CO_2 emissions.

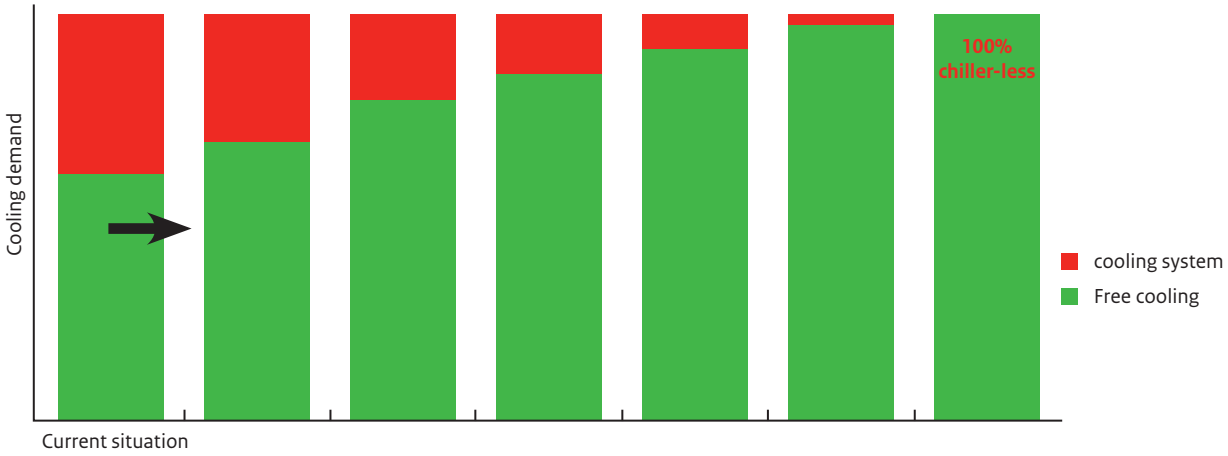


Our data centres do not have to be towed to an iceberg off Iceland for this. The Netherlands is a cold country with an abundance of cold air, soil and water in spite of its small size. This is something that the ICT sector discovered long ago (number of free cooling systems in use). We can exploit new solutions even more effectively, meaning that the conventional cooling systems can be scrapped (chiller-less operation). That is not only good for our environment, it also makes a data centre much more energy-efficient.

Did you know for example that you can **save up to 80% or more** on your energy costs for cooling? Not only is that good for the environment, it is also very attractive economically. An investment that pays for itself in next to no time because data centres operate 24 hours a day and conventional cooling systems are no longer required. So you no longer have to reserve capacity for this redundant electrical power consumption, which creates extra opportunities for growth. Sustainability is increasingly claiming a high place on the agenda of public organisations and private sector companies. This means that they apply the rules for **sustainable purchasing** increasingly often in their choice of data centre. To sum up, the tendency towards more sustainable data centres is a significant trend.

Availability is obviously the main priority for data centres. They must be able to offer their services day and night. Conventional cooling systems (back-up), which, in addition to high energy bills, also generate high CO_2 emissions, are no longer required for fulfilment of this task. We can intelligently combine a number of sustainable solutions in this cold little country. We can vaporise water in order to cool the flow of air in our data centres. And, even on the few hot summer days when the temperature outside exceeds that inside, we do not have to resort to conventional cooling because we can draw cold energy from the soil or from deep bodies of water nearby (such as the Eesermeer). New data centres with higher admissible temperatures in the server rooms benefit even more from these innovative cooling technologies.

The different sustainable cooling solutions with a favourable EUE value that are now commercially available



Sustainable and profitable cooling technologies are already available in many different forms. Producers have developed these solutions partly thanks to the subsidy schemes offered by Agentschap NL. A number of parties within the ICT sector are now using them and enjoying all the associated advantages. This brochure presents the results and explains why these parties chose the solutions they currently operate. Obviously you will also read more about the technologies themselves so that you can gain a good understanding of possible solutions for your own data centre.
The brochure is no more than a snapshot and does not pretend to offer a complete picture of the sustainable solutions that are currently available on the market.

The government supports sustainable purchases. Would you like to know more about the possibilities of sustainable cooling technology after reading this brochure? Are you curious about how Agentschap NL can help you? The Dutch government offers generic support for purchasing these sustainable cooling systems. For example, entrepreneurs can make use of the tax-deductible allowance for investments in energy-saving equipment (Energie Investeringsaftrek or EIA), which not only leads to **reduced energy costs** following the investment, but also reduces the level of income or company tax. The same applies for the schemes for tax-deductible investments that favour the environment (Milieu Investeringsaftrek or MIA) and arbitrary amortisation of environmental investments (Willekeurige Afschrijving Milieu-investeringen or Vamil), which generate tax advantages for you when you invest in climate-friendly equipment.
Furthermore, companies or entrepreneurs who save energy within buildings may be able to benefit from funding at a lower rate of interest under the terms of the 'Green' finance scheme (Groenregeling) via Agentschap NL. Please feel free to contact us.
We will be delighted to look at your situation.

1 The rotary exchange wheel from KyotoCooling

Reinventing the wheel is not always a waste of money and effort. As KyotoCooling, a company based in Amsterdam, has successfully demonstrated. The company took the operating principle of the thermal wheel, which has been used for decades to heat buildings, and literally reversed it for use in data centres. The 'cold wheel', which has been patented by KyotoCooling, is the basis for a very efficient air-to-air heat exchanger. The system can save up to 80% of the energy used to cool data centres.

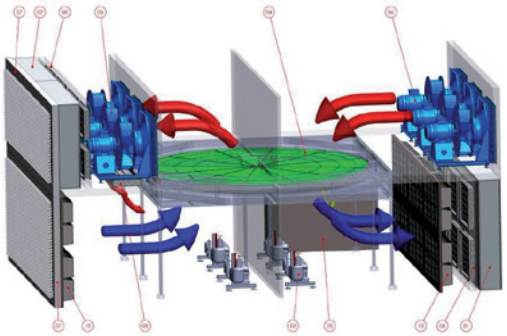
KyotoCooling's cold wheel is a slowly revolving wheel built up from an aluminium plate matrix. Half of the wheel rotates in the cool outside air and the other half in the warm air in the server room. The heat energy is absorbed and stored in the aluminium before being released to the outside air when the wheel has turned through 180°. The cold energy, which is absorbed and stored by the outside heat exchanger plates, is then released in the server room.

In the Netherlands, the outside air is cold enough (below 22°C) to allow sustainable data centre cooling via this method for 97% of the year. For the remaining 3% of the year, i.e. hot summer days, the KyotoCooling system features a conventional cooling system for back-up cooling power.

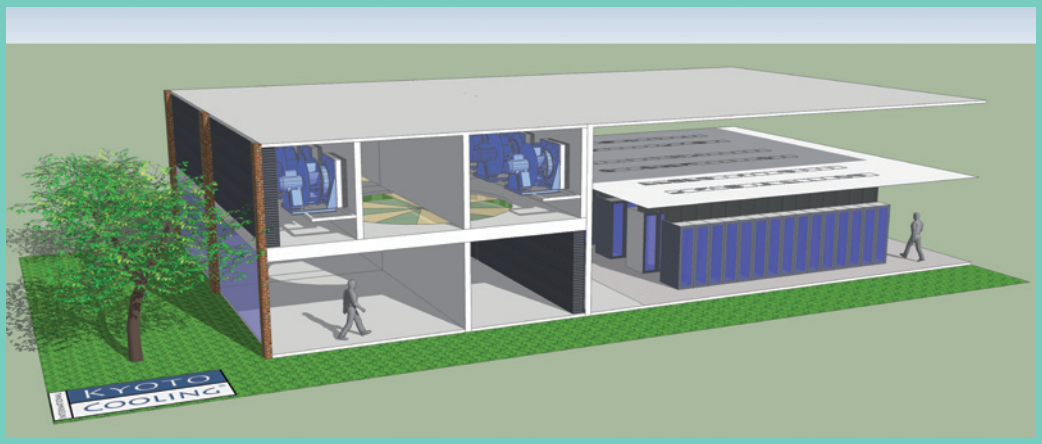
Separate spaces

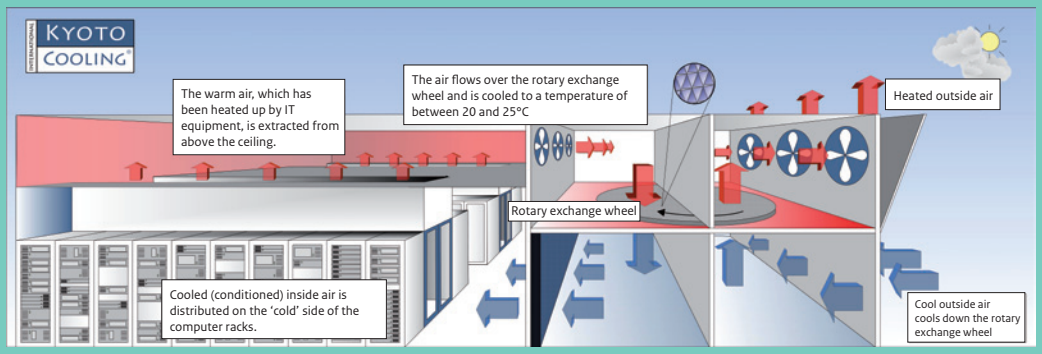
The amount of electricity used by the cold wheel for cooling is a fraction of the energy consumed by compression cooling systems and also lower than most free cooling systems. The reduction in energy consumption can primarily be explained by the physical separation between the warm return air and the cool supply air, which is fed to the server room. This separation is achieved by completely sealing the cold air corridor. The air from the hot air corridor is extracted above the ceiling and then passed through the cold wheel where the heat exchange process takes place. Consequently, the inside air never comes into contact with the outside air. This prevents the cool air from mixing with the return air. As a result, the quality of the cool air can be maintained at the desired level.

An additional advantage of using separate spaces is that the relative humidity in the computer room can be maintained at a constant level. The technology used by KyotoCooling was tested and practically demonstrated some years ago in a system in Amersfoort, which was built with subsidies provided by Agentschap NL. The system is now used by many companies in most parts of the world (from 180 kW up to 8 MW). KyotoCooling is primarily suitable for new data centres with a cooling capacity ranging from 100 kW up to 100 MW.



Example: Rotterdam internet exchange





'Pleasant working conditions and hugely energy-efficient'

Reliable, user-friendly and above all green. Those were the requirements that Rotterdam Internet eXchange (R-iX) set for the cooling system for its data centre. The 700 m² data room in the 'Spaanse Kubus' in the city of Rotterdam was put into operation two years ago.
Since then, a 'cold wheel' has operated continuously in order to provide cooling for the data centre. According to Hans den Aantrekker, the team leader at R-iX's data centre, the KyotoCooling system has satisfied expectations in every way.

'It is hugely energy-efficient', says Den Aantrekker. A quick look at a screen tells him that the PUE factor is currently 1.19. This number indicates the relationship between total energy consumption relative to IT-related consumption. Den Aantrekker: 'An excellent result, particularly when you take into consideration that this factor often exceeds 2 when a conventional cooling system is used.'

In addition to energy efficiency, Den Aantrekker extols the user convenience offered by the system. 'It is much quieter here than in most other data centres. That makes it a pleasant environment to work in, both for customers and employees. The constant temperature and the lack of annoying drafts also improve working conditions.' It is a little warmer in the heat corridor though. 'But that's hardly noticeable.'

No breakdowns worthy of mention have occurred during the two years that the cold wheel has been in operation at R-iX. 'It's actually a very simple system and there's not much that can go wrong', Den Aantrekker explains. 'Furthermore, a remote system closely monitors the health of the KyotoCooling equipment. I generally only discover that the cooling system requires work when the maintenance technician arrives at the door.'

2 The DataCenterCooling™ cooling concept from Datacenter Infra Solutions

Cold air descends, warm air rises, and evaporating water has a cooling effect. Taken together, these laws of nature form the basis for a completely sustainable solution for cooling data centres: DataCenterCooling™. The patented cooling concept reduces energy consumption by at least 80% compared to traditional cooling systems and consists of the ActiveCoolingRoof™ and an air conditioning unit which incorporates the sustainable StatiqCooling evaporative cooling technology.

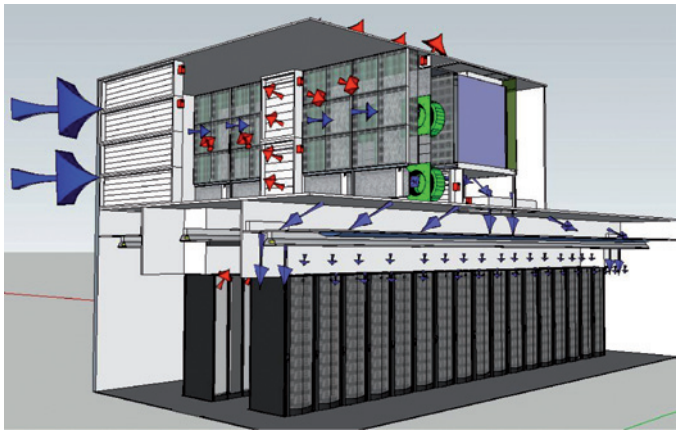
Many traditional cooling systems blow too much cold air too quickly into the 'cold' corridor in the data centre. Datacenter Infra Solutions felt that it could be done better and more effectively. The company therefore started to work on a technology which provides a room with no more cold air than it really needs. The result is the ActiveCoolingRoof™.

This solution distributes the cold air very evenly across a data centre's 'cold' corridor at a slight overpressure. This means that the fans in the equipment to be cooled can easily draw in the required variable quantity of cooling air, which is always precisely the amount needed, and no more than that. As a result, much less energy is required for cooling compared to a conventional cooling system. That is good for the environment, and also very interesting from a financial perspective.

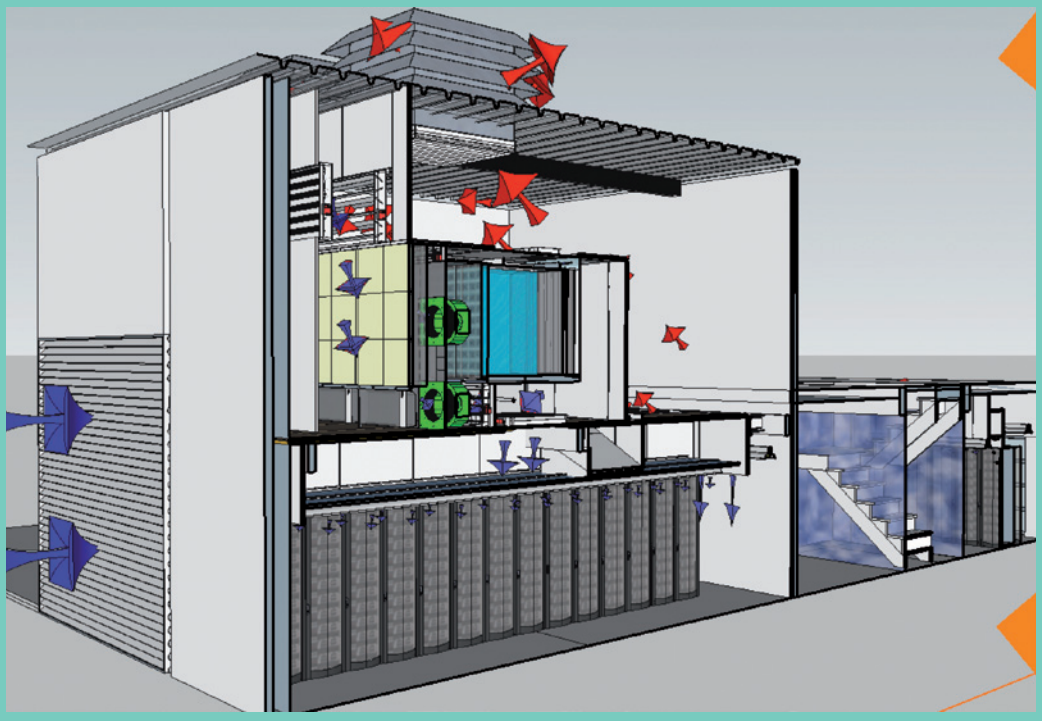
Conditioning air for cooling

The modular stainless steel air conditioning unit features very high quality fine particle air filtration, and always has two energy-efficient oversized EC fans. This means that the fans constantly run at low revs, which means that they consume little power and have a great deal of surplus capacity for emergencies. The heat from the data centre is reused and mixed with air drawn directly from outside to achieve the desired cooling temperature.

In the Netherlands the climate is cold enough to be able to provide the data centre with the necessary cooling on most days of the year. During the average 350 hours a year - out of an annual total of 8760 hours - when it is too warm to do this, that outside air is given additional cooling. This is done using the StatiqCooling heat exchanger which cools the air by evaporating water, and the water vapour which is thereby released is fed outside immediately so that the data centre does not become too humid. In the winter we used that processed air to humidify the cold air. This concept from Datacenter Infra Solutions offers a solution which is sustainable, available and highly lucrative throughout the year in accordance with the ARSHRAE standard.



Example: ColoCenter data centre in Zoetermeer



‘DataCenterCooling is environmentally friendly and energy-efficient’

There is increasing focus on data centres’ energy consumption as a result of their rapidly expanding size. “Energy saving for and by ICT” is the direction in which we are heading. This is driven not only by the desire to create a better environment, but also because the substantial rise in energy costs and the approaching shortage of fossil fuels require targeted measures. Great benefits can particularly be achieved in the area of cooling. Data centre cooling currently still consumes around 40% of the total power consumption on average.

The conscious choice to lower operating costs and the social goal of making data centres more environmentally-friendly and energy-efficient have prompted DataCenter Infra Solutions to develop a patented cooling concept in-house. This cuts the power costs for cooling by more than 80%.

Three data centre owners have already chosen to use the sustainable DataCenterCooling™ cooling concept. SmartDC in Rotterdam was the launch customer and also hosts the demo location. Following a thorough pilot trial, the cooling concept was launched onto the market in the 2nd half of 2011. e-Quest in Helmond decided straightaway to use it and thereby also wanted to contribute to thinking about the new modular air conditioning unit. At the end of 2011 ColoCenter also chose DataCenterCooling™ for their new data centre in Zoetermeer, featuring those new stainless steel air conditioning units. DataCenterCooling™ will perform in line with the latest ASHRAE standards and will also comfortably meet all stipulated criteria for the Milieukeur environmental quality market for ‘climate control in data centres’ as specified for the Dutch market by SMK at the end of June 2012.

3 Air@Work: total concept for sustainably cooling data centres

Just let the air do its job. In all ways possible, with maximum benefit as a result. This is the basic philosophy behind Air@Work. The concept unites StatiqCooling technology with the products of Holland Ventilatie Groep within the envelope of the DataCenterCooling™ cooling concept. The result: a strong innovation and technology alliance that ensures that users can optimally cool their data centres.

Air@Work focuses on air treatment within data centres. Heating and humidification, but also cooling. The system is fully set up as a total, turn-key concept, which users can apply immediately. Air@Work is suitable for cooling in a capacity range from 4kW to 10MW and applicable in practically all data centres, from Tier 1 to Tier 4 classification.

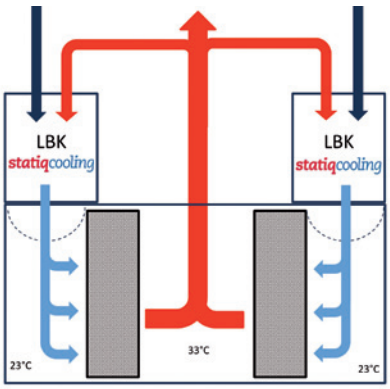
Air@Work's system consists of multiple units. Both Holland Ventilatie Groep technology and StatiqCooling technology play a prominent role. In the latter case, the heart of the engineering concept is a heat exchanger to which a fan supplies outside air.

The heat exchanger is made up of plastic plates that feature a membrane on the outside, which is continuously moistened with water. Outside air passing over that membrane through the small ducts in the plates causes evaporation, which cools the air. Ultimately, two thirds of the cooled air reaches the data centre. The rest of the air is used to transport the evaporated water to the outside.

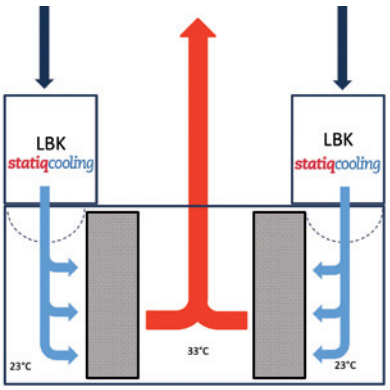
Negligible maintenance costs

Fans and valves are the only moving parts in this system. As a result, the Air@Work concept is characterised by negligible maintenance costs. Furthermore, TNO tests have shown that the evaporative technology does not lead to risks of Legionella growth.

The system works without compressors, water pumps or chemical refrigerants. This ensures that the system is not only sustainable and environmentally friendly, but also very energy-efficient: the Power Usage Efficiency (PUE) factor for data centre cooling remains under a value of 1.15 in by far the majority of cases. Finally, the system can be equipped with emergency cooling, which ensures 100% air recirculation.



Outside temperature < 23 °C: Air from the outside (dark blue) is mixed with air from the heat corridor (red) and blown into the cold corridor (light blue). The warm air (red) is partially discharged to the atmosphere and partially recirculated. The StatiqCooler does not operate in this situation.



Outside temperature > 23 °C: Air from the outside (dark blue) is cooled down by the StatiqCooler and blown into the cold corridor (light blue) The warm air (red) is discharged to the atmosphere.

Example: SmartDC in Rotterdam

‘Always available, and sustainable and energy-efficient to boot’

Data centres deliver their services day and night, which means that the cooling technology used must be available at all times. However, as a provider that attaches great importance to sustainability, SmartDC wanted to achieve more. The Air@Work cooling system design, which is based on the DataCenterKoeling™ cooling concept was a perfect fit with that objective, says Richard Boogaard, SmartDC’s managing director. “We are very happy with the performance of this cooling concept. Not only because the cooling system is always available, but also because the solution is both very energy-efficient and sustainable. Air@Work offers us substantial advantages in several areas.”

The Air@Work cooling system has operated since September 2011 in one of the units at the data centre, which is located in the former Van Nelle factory in Rotterdam. It already provides a cooling capacity of 200kW, with the likelihood of more to come in the future. “We want to apply this technology more widely”, says Boogaard. “Evaporative cooling offers us huge opportunities. The air quality in the server room is better because the StatiqCooling evaporative technology ensures 100% free cooling. Furthermore, this solution is very well engineered. The concept is always available and therefore offers greater continuity than our conventional DX cooling systems.”

SmartDC is already well aware of the advantages of the system. As a result, it seems likely that the cooling solution will prove its added value in the marketplace. Boogaard: “Our experiences with this cooling concept are positive. So good in fact, that we want to apply it more extensively.”

4 External air cooling with evaporative technology

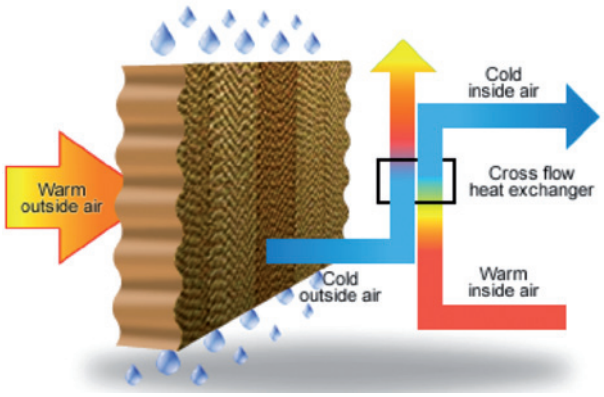
The Datacenter Group's cooling is based on the innovative use of a centuries-old principle. Long before the introduction of electric air-conditioning people used wet cloths which were hung in door and window openings to cool the air as it entered. This approach was the starting point for the cooling of The Datacenter Group's data centre in Amsterdam.

The Datacenter Group attaches great importance to sustainability. From a technical perspective the organisation is constantly looking at ways of integrating sustainability into its organisation, processes and activities. One of the innovations which The Datacenter Group has developed and which now gives the company a PUE score of 1.16 is a new type of cooling system. A cooling system which is very energy-efficient and is also not harmful to the climate, since it makes no use of chemical coolants. No cooling device has been installed.

The new cooling system was brought on-stream in 2010 and has now been operational for two years. The system works on the basis of air/air cooling. This means that warm air from the data centre's server rooms is cooled indirectly by colder outside air using a cross-flow heat exchanger. The 'free air cooling' works up to 22 degrees Celsius; if the outside temperature rises above 22 degrees Celsius, the evaporation cooling system comes into operation. The system draws in outside air through moistened cardboard packs, which reduces the temperature of the outside air by around 10 degrees Celsius through the evaporation of the water.

One of the benefits of the cooling system at The Datacenter Group is that harmful substances cannot reach the servers, since it uses indirect air cooling. It is also the Netherlands' most energy- efficient way of cooling, and has resulted in a massive drop in the EUE. The EUE is the annual average of the PUE. A traditional data centre has an EUE of around 1.8. The Datacenter Group has an EUE of 1.16, which means that Amsterdam is home to the Netherlands' most energy-efficient data centre.

The Datacenter Group is currently building a next generation data centre in Delft which will open in September 2012. The same technical principles will be applied in this data centre. Because Delft is a 'greenfield' data centre - a building specially designed for the management, protection and cooling of server parks - the installation of the cooling system here will achieve maximum efficiency. The EUE expected to be achieved in Delft is 1.13.



The Netherlands' most efficient data centre

The Datacenter Group has created a data centre in Amsterdam with a PUE score of just 1.16 for the whole of 2011.

"Our company facilitates the external storage of data by providing server space in our centres. It is vital for both the private and public sector that this is done in a secure and sustainable way. We help them by offering the data centre facility with the highest quality and reliability at the lowest price," explains Joscha Niemann, managing director of TDCG. "Traditionally the PUE score for a data centre is 2, but nowadays most data centres in the Netherlands achieve a PUE of between 1.4 and 1.8. We wanted to reduce that score even more - both in order to save energy and in order to offer our services at a competitive price. Our new system has enabled us to achieve a PUE score of 1.16."
"What makes our data centre special is the efficient way in which the energy system works. We thereby make use of outside air and an evaporative technology," he continues.

"However, the techniques that we are using are not new. Heat exchangers and evaporative technology are familiar elements for achieving energy savings. What is innovative is the combination of technologies that we have used. That has not been done before."
But TDCG did not develop the system for commercial use. "We developed the system from a technical perspective, and in that regard two aspects are vital: the reliability and the sustainability. Reliability is the most important reason for the market to choose our services. Sustainability only comes second. But since customers are seeing that sustainability also repays them in the form of lower energy costs, they are also becoming increasingly interested in it."

5 Aquifer Thermal Energy Storage (ATES) for data centres as applied by Installect companies

Aquifer Thermal Energy Storage (ATES) is increasingly common in functional architecture. Installect Advies, GeoComfort and Insted, which are all subsidiaries of Installect, have already engineered and now manage more than 200 systems. ATES technology is an excellent way of cooling data centres. However it does require an approach that matches the specific characteristics and requirements in this sector.

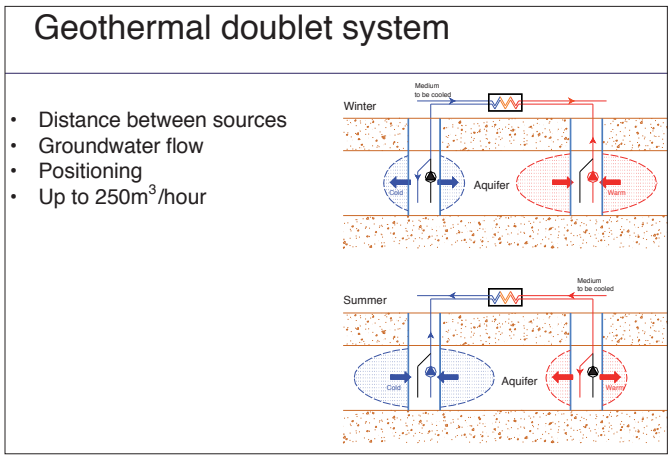
Data centres have high cooling demand throughout the year. Consequently, ensuring cooling continuity is their primary priority. By optimising the temperature in the data room, a very substantial part of the total cooling demand can be satisfied via free cooling, which basically boils down to direct cooling using outside air. Additional cooling capacity is only required during a very small part of the year. This can be achieved with an energy storage system, which accumulates the surplus of free cooling in the winter in an underground storage facility so that it can be delivered when high temperatures occur in the summer. This concept makes it possible to achieve an Energy Usage Efficiency (EUE) value of between 1.1 and 1.2.

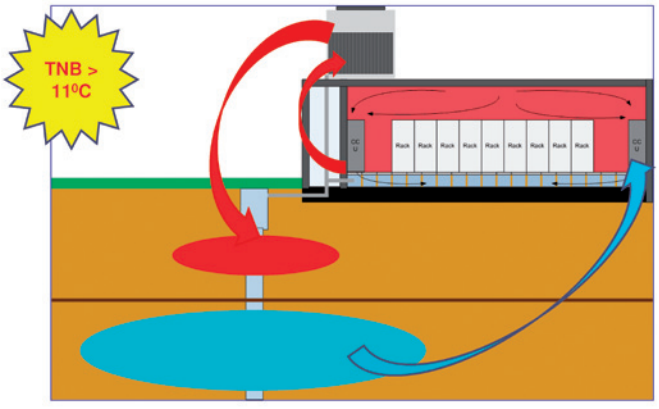
Emergency cooling as well

The main advantage of an ATES system is that it can also act as a preferential emergency cooling system at any time of the year. This is because cooling can always take place based on the natural temperature in the underground storage facility. Furthermore, this type of emergency cooling also requires significantly less emergency power than traditional chillers. Start-up is also much faster. There are various different types of ATES system. For example, users can choose for a geothermal doublet system or single source system. Each of the systems has its own advantages depending on the size of the data centre and the specific characteristics of the location.

Remote ATES management and optimisation

In addition to the areas of focus outlined above, adequate ATES system management is also crucially important in a data centre context. Both performance and the thermal balance in the underground storage facility must be monitored effectively. In addition, the system must be capable of reacting rapidly if the basic cooling arrangement fails unexpectedly. Obviously, the customer's operational process takes precedence at all times. If there is a good fit with the customer's specific requirements, the use of ATES has enormous potential in the field of sustainable cooling systems for data centres.





ATES in the data centre – Single source system

Example: Equinix AM3 in Amsterdam

‘Equinix uses ATES in a number of ways’

Equinix likes to adopt a sustainable approach in its operations. The extent to which this supplier of global data centre services does so is demonstrated by the construction of AM3. The data centre, which is the third Equinix location in Amsterdam, will be built in the Science Park. Various parties are involved in this construction project. Royal Haskoning as the main designer and Dura Vermeer and Unica as contractors.

As one of the most sustainable data centres in the world, AM3 will be highly energy-efficient. Not least because of the sustainable cooling system, an ATES doublet system from GeoComfort, which provides a cooling capacity of 12MW. This is the first time that Equinix has used this system, says Michiel Eielts, the company’s managing director in the Netherlands. “Exciting, although we are confident that this proven cooling technology will deliver the expected results. Our other two data centres in Amsterdam are also extremely energy-efficient. We wanted to maintain and optimise that sustainable character. Aquifer thermal energy storage (ATES) fits in perfectly with that strategy in our opinion.”

Equinix does not have to use mechanical cooling to cool the data centres on hot summer days. The cooling demand is satisfied by the underground aquifer thermal energy storage system. And that is not the only benefit, says Eielts. “The heat energy from the data centre, which we cool down using the underground storage system, is put to good use and channelled to the nearby faculty building of the University of Amsterdam. This illustrates how we use ATES technology in a number of ways, which of course makes the data centre solution even more sustainable.”

The ATES doublet system is designed to give Equinix the double benefit of sustainability and substantial savings. Eielts: “At this capacity level, I expect that our investment will have paid for itself within 10 to 15 years. That period applies for the complete data centre, including the design work and preconstruction studies. If you take the ATES system in isolation, the payback period is approximately 5 to 7 years. We are happy to invest now and enjoy the benefits in the future.”

6 Climate technology from Menerga for data centres

Data centres must be cooled 24 hours a day. Given that fact, it is easy to understand how a cost-efficient solution can pay back itself in a relatively short time period. Menerga's system (see the figure below) is an excellent example of a cost-efficient solution. The technology uses both direct free cooling with outside air and indirect cooling of the recirculated air via water evaporation. No expensive water treatment systems are necessary, just ordinary tap water.

If required, Menerga's system uses outside air to provide direct free cooling in the room.
For the indirect cooling system the unit use two air flows. The first one is outside air, the second one is the recirculating air from the server room. When outside temperatures are high, this recirculation air can be cooled by indirect adiabatic cooling, otherwise known as evaporative cooling.
By using this technology a data centre is capable to achieve an average Power Usage Effectiveness (PUE) of 1.05 for its cooling needs!

Water evaporation takes place in a heat exchanger. This humidifies the flow of the outside air, and cools it down significantly. Next, the heat exchanger transfers the cold energy to the recirculation air flowing towards the data centre, without transferring moisture. The unused water during the adiabatic cooling period will be used again.

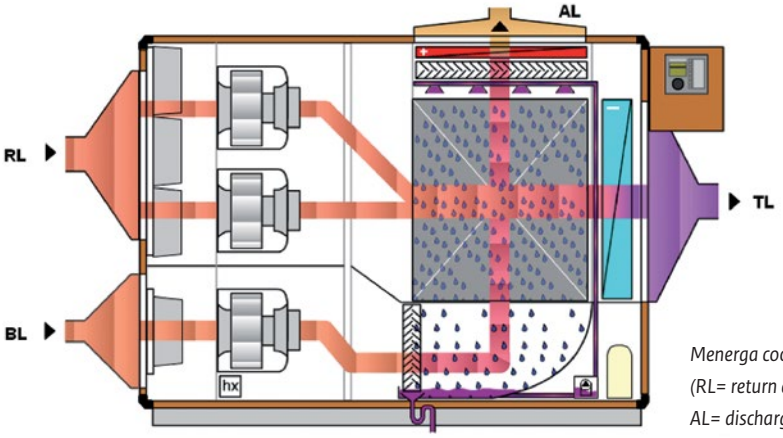
This technology is characterized by low maintenance costs. Due to the low electrical power usage a relatively small main connection is required. Consequently, the emergency power supply does not have to be particularly large.

Separate flows of air

What Menerga's technology makes so special is that the outside air and recirculation air remain completely separated from each other. This keeps the oxygen content in the room to a minimum. In addition, extra and therefore more expensive humidification is not required during the winter. If the temperature in the data centre needs to be lower than 24°C, a small refrigerant cooling circuit or a cold water heat exchanger can be build in the unit to complete the required capacity.

Obviously this principle also applies when outside temperatures are high. Depending on the local situation or demands Menerga offers this technology with two possible systems: the Adsolair and the Adcoolair. Both have energy efficient DC motors and provide a cooling capacity range from 20kW up to 450kW per unit.

Multiple units can be connected to each other if a room requires more cooling capacity. Cooling a data centre with this technology quickly generates a huge saving in energy consumption.



Menerga cooling system (RL= return air; BL= outside air; AL= discharge air; TL= supply air)

Example: EvoSwitch in Haarlem

‘The Menerga system is an ideal cooling solution for EvoSwitch and is already starting to prove its worth’

EvoSwitch strives to limit its CO_2 emissions as far as possible. So when the data centre in Haarlem doubled its 5000 m² floor area last year, installing a sustainable cooling system was an obvious move. Cooling technology from Menerga was soon identified as the best choice. And with good reason, says JanWiersma, the technical manager at EvoSwitch.

“Our second data centre covers an area of 5,000 m² and is configured as a complex of multiple modular units. Within those design constraints, Menerga’s technology looked to be an excellent cooling solution and is already starting to prove its worth. We were expected to achieve a PUE of 1.2, but the actual value is likely to be even lower. That’s quite a difference in comparison with the PUE value of nearly 1.4 in our other data centre section where we are still using conventional cooling equipment. Once the new data centre has been fully set up, EvoSwitch will have a total capacity of 20 megawatts. So we’re talking about a short-term saving of several millions.”

While many Dutch residents complained about the poor weather this summer, Wiersma welcomed the relatively low temperatures. After all, lower temperatures lead to more cool outside air. And that leads to more free cooling in turn, which is primarily what the Menerga system uses. “It’ll be interesting to see what happens if we get a warm summer”, says Wiersma. “Even though the savings we make may be slightly less, that deficit will be negligible compared to the benefits that this cooling technology has already delivered for us.”

7 Compressor-less cooling for data centres with equipment from Jaeggi and Rittal

Cooling all year round without having to use energy-guzzling chillers. That is the unique attraction of the hybrid dry cooling technology that Swiss company Jaeggi has developed. For most of the year, the system cools using nothing but outside air (dry cooling). In addition, an efficient and safe wet cooling system guarantees low cooling water temperatures during spells of warmer weather. The system can achieve a water consumption saving of 70% to 90% compared to a conventional open cooling tower.

Compressor-less cooling for data centres is possible because modern computers can withstand much more heat and higher temperatures than previous designs. The latest international guidelines (ASHRAE) recommend an air entry temperature of 27 °C. In fact, the temperature may even increase to as much as 32°C (this is the challenge!). In Jaeggi's hybrid dry cooling system, the temperature of the cooling water supply lies between 24°C and 28°C and the air entry temperature with the Rittal CoolWall in the cold corridor lies between 27°C and 31°C under these circumstances.

When the outside temperature becomes too hot (between approximately 20°C and 25°C), the system can switch from dry operation to (partially) wet cooling. This means that the system allows water to flow over two heat exchangers, which are set up in a V configuration. A thin layer of water on the outside of the exchanger provides extra cooling and evaporates partially. The water that does not evaporate is analysed and, if the quality is good enough, passed back over the exchanger.

Less chemicals and Legionella-safe

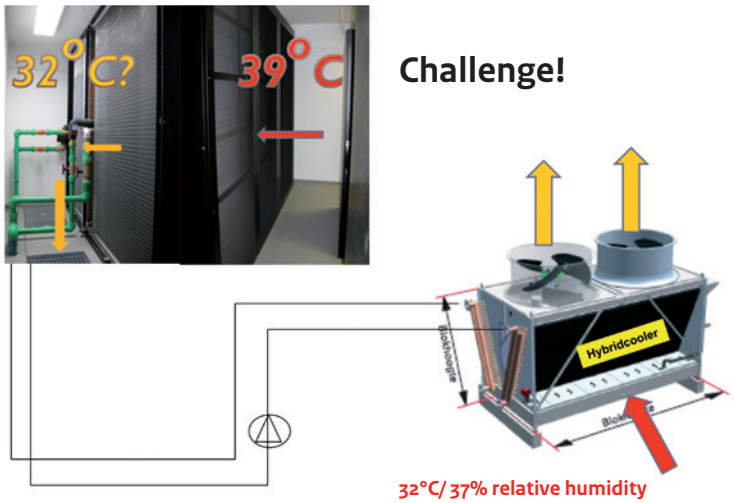
Because the system uses so little water, correspondingly smaller quantities of chemicals have to be added. The chemicals are required in order to treat the water for the wet section. In Jaeggi's hybrid dry cooling system, the use of chemicals is approximately 10 times less than that of conventional open cooling towers.

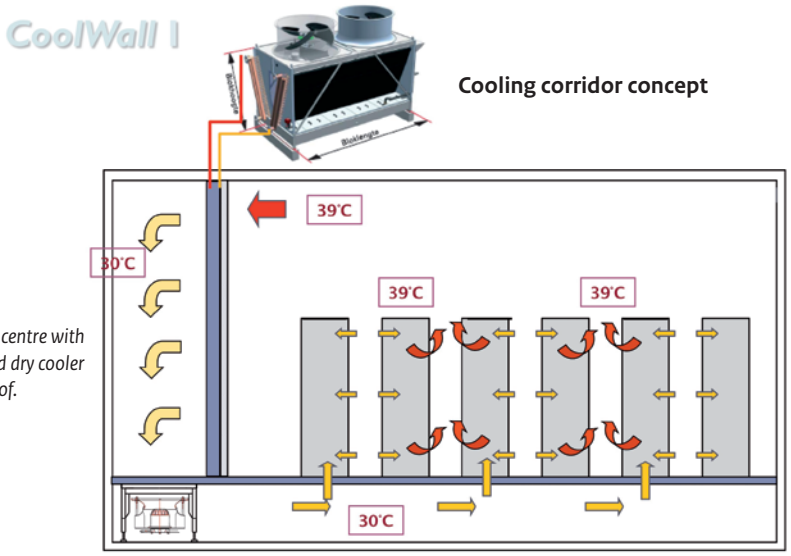
Another significant difference compared to cooling towers is that Jaeggi's hybrid cooler does not emit potentially dangerous water aerosols. These aerosols can spread Legionella bacteria. After completing an extensive test in March this year, TNO declared the hybrid coolers to be 'Legionella-safe'. In terms of the Legionella hazard, the system from Jaeggi may be classed as a dry cooling system.

Jaeggi is currently installing one of its largest cooling systems (20 MW) at a new data centre in Amsterdam. The hybrid dry cooling technology from Jaeggi is suitable for both existing and new data centres and starts to show a return from a cooling capacity of approximately 400 to 500 kW.

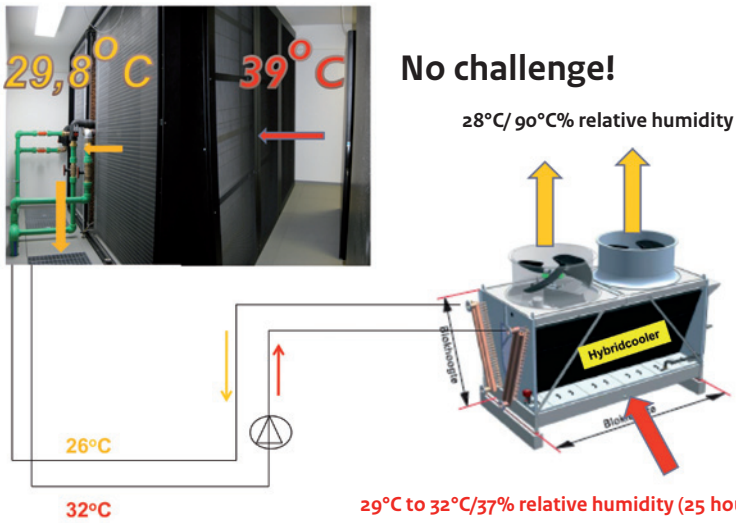
Cooling in the server room

The challenge = ICT capable of withstanding 32 degrees Celsius according to ASHRAE.





The data centre with the hybrid dry cooler on the roof.



8 Low Speed Ventilation: low PUE and EUE through the effective usage of laws of nature

Optimal air circulation and low energy use can be achieved in data centres through a holistic approach to the building and the technology. Low Speed Ventilation, which has been developed by Boersema Installatie Adviseurs, aims for a PUE and EUE score of 1.08 - five percent electrical and three percent cooling - at an indoor temperature of 25 degrees.

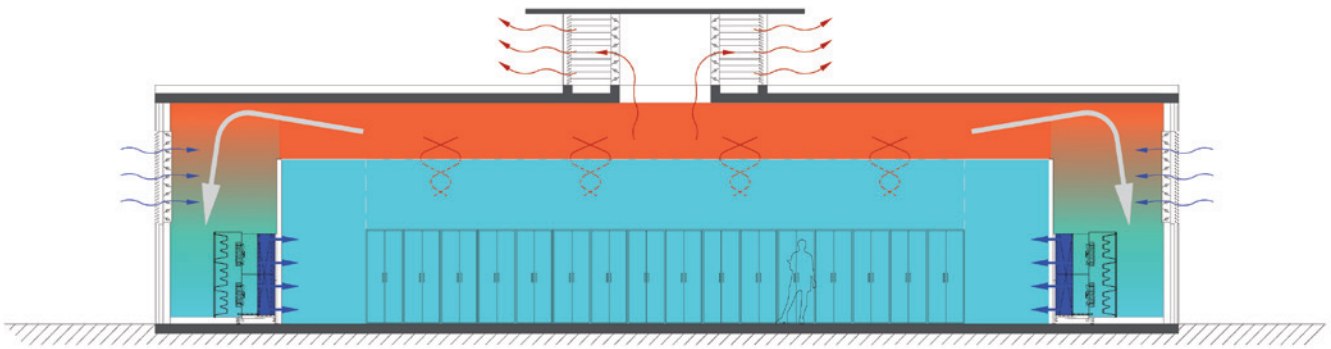
Servers produce a warm air flow which needs to be cooled in order to achieve the correct temperature. But why do current data centres use high air speeds? The laws of physics for achieving effective and energy-efficient cooling demand the opposite, namely Low Speed Ventilation. The pressure difference to be bridged in modern data centres can go up to a 1,000 Pa. By opting for the holistic approach of Low Speed Ventilation it is possible to achieve a pressure difference of just 60 Pa to 80 Pa. This approach results in low investments and low maintenance and energy costs and also guarantees the availability of air at every server position. No hotspots, in other words!

Low Speed Ventilation works with the laws of physics relating to thermodynamics and aerodynamics. Instead of transporting air through narrow channels, the air in the data centre is given plenty of space. Low Speed Ventilation makes use of a double wall around the computer room. This double wall acts as the transport channel for the air. If the choice is made to use outside air, it enters the building by this channel, thus creating a stable air flow in the computer rooms. This is independent of external variations in wind pressure. With Cold Containment the air is fed under the computer floor, and directly into the server space with Hot Containment. If the use of direct outside air is not desirable and a closed system is used, the benefits of Low Speed Ventilation will continue to apply.

The low PUE and EUE is achieved by the extremely low fan power, the excellent opportunities for outside air cooling and the high cooling water temperatures. The low air speeds also mean that filters of F9 quality can be used. Instead of mechanical cooling, it is also possible to use a simple thermal energy storage system as a back-up for the outdoor air cooling.
Low Speed Ventilation can be used in existing and new buildings and offers excellent opportunities for reusing residual heat.

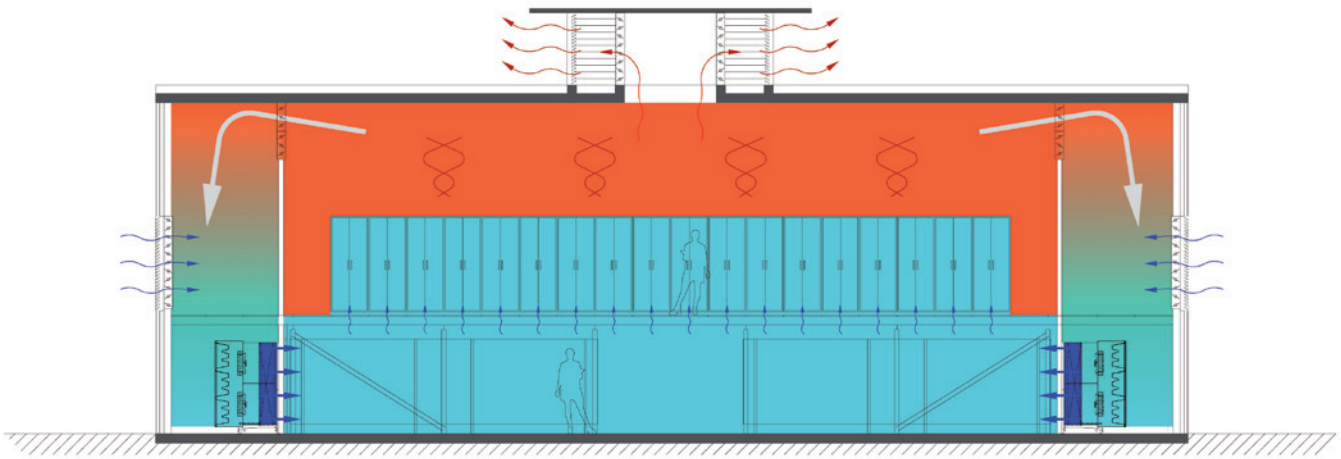
Back to basics

With Low Speed Ventilation the building, the systems and the IT equipment are all part of the process. The system also makes maximum use of proven technologies and laws of nature. “Simplification results in understanding, reduced costs and a better environment for the servers. In a good design all the elements fit together naturally,” explains Kees Boersema, managing director of Boersema Installatie Adviseurs in Amersfoort.



According to Boersema it is vital for a data centre that the examination covers not only the solutions offered by technology, but also the building which forms part of the cooling process. “For us, going back to basics meant identifying what criteria a building had to meet and developing a concept whereby the focus is on the server’s surroundings. A server must have ample access to sufficient cold air and therefore not be restricted by the structure of the building or the facilities in the building. In the Low Speed Ventilation concept that we have developed the flow of air is not impeded by obstructions and bottlenecks. There is always sufficient air available for the IT equipment.”

Alongside an easily understood technology and the energy efficiency, Low Speed Ventilation also offers other benefits. Boersema says: “Our primary aim is to provide data centres with a system based on high availability at low operating costs. We have managed to achieve that by working with proven technologies and an easily understood concept, which also keeps the overall management costs low. With Low Speed Ventilation we manage to achieve direct savings of up to 20% on CAPEX and OPEX.”



9 D2C technology from Optimair: energy-efficient cooling and drying

Evaporating water in a dew-point cooler is a sustainable way of cooling data centres. But what if the air humidity is high? Then the air has to be dried first. Which is exactly what Optimair's product does without consuming much energy. Dry to Cool technology, commonly abbreviated to D2C, provides the basis for an air dryer. Combining that technology with the process of dew-point cooling creates a product that can achieve an energy saving of up to 80%.

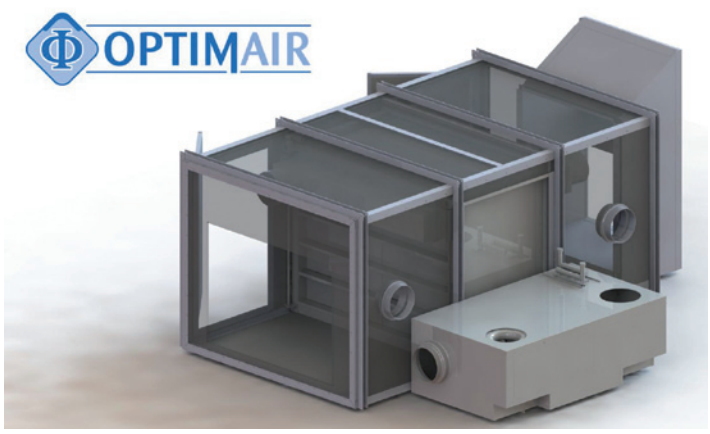
Water is a perfect cooling agent. Evaporating water cools the air. Many sustainable technologies are based on this process, however evaporation becomes difficult when the air itself is already very humid. So the air has to be dried first. Even though dryers exist for this specific purpose, they consume large amounts of energy. Which explains why Optimair felt that this was an area where major benefits could be achieved.

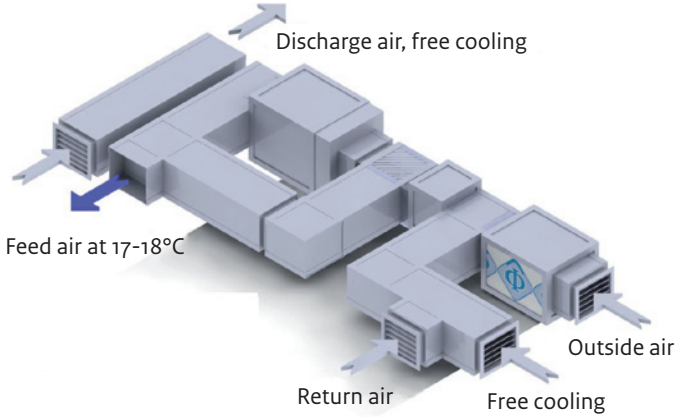
So the company started work on developing an energy-efficient air dryer at its base in Tuk in the Dutch province of Overijssel. The project has now been successfully completed and Optimair currently offers a product that combines both cooling and drying in a sustainable way. Without using greenhouse gases like the Freon in conventional chillers.

Solution for high air humidity

Optimair uses the outside air for cooling. In a data centre, this means that cooling the air is not required on a cold winter day. However, the true benefits of D2C technology come into play in situations where high temperatures are combined with high air humidity. It is precisely in locations where large amounts of heat are generated that D2C can improve on dew-point cooling to provide better cooling and achieve a lower temperature. In a data centre, where a great deal of heat is released, this technology offers extra added value over and above the energy savings that it achieves.

Optimair's D2C technology combines energy-efficient cooling and ventilation. The system ensures that users can achieve major savings by controlling the temperature and humidity in a room 24 hours a day. As a result, Optimair's product is a highly versatile solution. It can be used in an office environment, for example, or public buildings, but is also eminently suitable for cooling the air in a data centre.





Example: Van Dam Groep in Rijssen, Rosmalen

‘A perfect solution for sustainable climate control’

Thinking in terms of sustainability is one thing. But acting sustainably is the whole point of the exercise, in the opinion of the Van Dam Groep. This professional equipment installer with subsidiaries in Rijssen and Rosmalen focuses its intention on residential construction, functional architecture and industrial sites where it promotes innovation and sustainability. This approach has led to a close collaboration between Van Dam and Optimair in applying Dry to Cool technology. “This is true of our own building as well”, says Tino Broekhof, who is Van Dam’s commercial manager. “Our objective is to create a carbon-neutral working environment.”

Van Dam users Dry to Cool technology in its own building. “D2C is a perfect solution for sustainable climate control”, says Broekhof. “That applies in an office environment, although the technology can obviously be used just as effectively in a data centre. In fact, that is exactly the environment where this solution delivers the greatest benefits. Our office is used primarily during the day, whereas a data centre operates day and night. So the energy savings lead to an even faster payback in a data centre.”

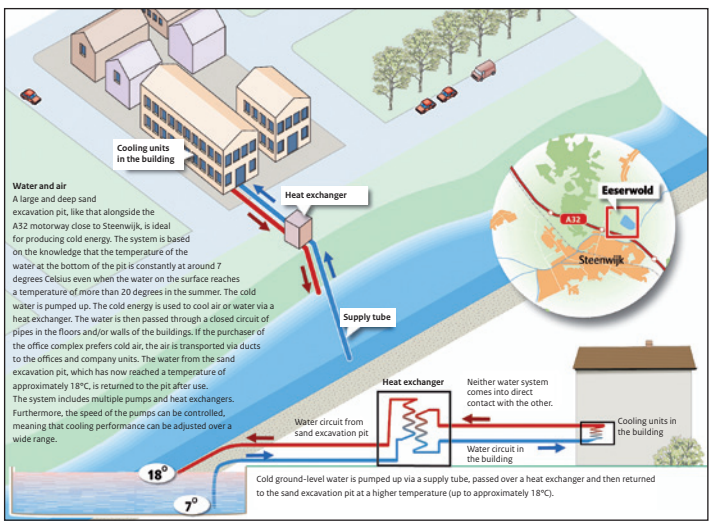
The Dry to Cool technology can be connected to the existing ‘cold corridor’ concept in data centres. Separate warm and cold aisles ensure that the temperature of the cooling air can be controlled precisely both at the bottom and top of a rack system. In this set-up, the conventional chiller is replaced by a D2C system, which allows users to achieve energy savings of up to 80% and eliminate the use of harmful refrigerants. Broekhof: “We have been using this technology since April/May this year in our office. The energy savings are already very significant.”

10 Recovering cold energy from the Eesermeer

Deep lakes are a natural source of readily available cold energy, which is replenished in a natural way each winter. The Eesermeer Lake Source Cooling project uses this cold energy in an innovative way in order to cool the buildings located on a nearby industrial estate. When developing the total system, allowance was made for the cooling capacity that would be required by a data centre.

Demand for sustainable, energy-efficient cooling is growing. Furthermore, the load on the electricity supply system, both in terms of generation and distribution, increases strongly each summer . Consequently there is every reason to look for more sustainable sources of cold energy, which are also more energy-efficient.

Lake Source Cooling (LSC) is an interesting concept in this respect. It uses the natural cold energy present in deep lakes, which is automatically replenished by the cold air during the winter. In the summer, temperature stratification ensures cold energy storage at the bottom of the lake. The equipment required for this consists of intake systems, heat exchangers, distribution pipes and stations, return pipes and controls. The system is capable of delivering large amounts of cold energy



Water and air
A large and deep sand excavation pit, like that alongside the A32 motorway close to Steenwijk, is ideal for producing cold energy. The system is based on the knowledge that the temperature of the water at the bottom of the pit is constantly at around 7 degrees Celsius even when the water on the surface reaches a temperature of more than 20 degrees in the summer. The cold water is pumped up. The cold energy is used to cool air or water via a heat exchanger. The water is then passed through a closed circuit of pipes in the floors and/or walls of the buildings. If the purchaser of the office complex prefers cold air, the air is transported via ducts to the offices and company units. The water from the sand excavation pit, which has now reached a temperature of approximately 18°C, is returned to the pit after use. The system includes multiple pumps and heat exchangers. Furthermore, the speed of the pumps can be controlled, meaning that cooling performance can be adjusted over a wide range.

efficiently and at low cost, even in the late summer period. The expected electricity saving is nearly 80%. In addition, this saving is made at a very favourable time of the year.

Roelofs Planontwikkeling and Unica Installatiegroep collaborated with UR Cool to construct an LSC system for this project on the banks of the Eesermeer lake in the Dutch municipality of Steenwijkerland. The plant delivers cold energy to buildings on the newly developed Eeserwold industrial estate. Two similar projects have also been initiated elsewhere in the Netherlands; one on the banks of the Nieuwe Meer (in Amsterdam Zuid) and one on the banks of the Ouderkerkerplas (Amstelveen). However, the new project differs fundamentally from its predecessors in a number of areas. Sustainability: the Eesermeer project does not use a back-up in the form of compression cooling. This was possible because the Eesermeer lake is substantially deeper than the Nieuwe Meer and therefore offers much greater supply reliability. Furthermore, the building cooling systems used on the industrial estate have been designed to accept the cold energy supply from the LSC system from the outset. Because of these differences, the Eesermeer project is potentially highly repeatable. The LSC system can be combined with a (micro) combined heat and power plant, bio-fuel plant or residual heat plant (for sustainable heating).

This is a publication of:

Agentschap NL
NL Energie en Klimaat
Croeselaan 15
PO Box 8242 | 3503 RE Utrecht
T +31 (0)88 602 92 00
www.agentschapnl.nl/duurzameenergie

Publication no. 2EOSA1201

Agentschap NL is an agency of the Dutch Ministry of Economic Affairs, Agriculture and Innovation. Agentschap NL implements policy for various ministries in the area of sustainability, innovation and international issues. Agentschap NL is the first point of contact for companies, knowledge institutes and governments. For information and advice, funding, networks, legislation and regulations.

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