**Note**

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# Energy-efficient data centre cooling solution requirements needed in the EU

*The amount of energy consumed by digital solutions is growing, and data centres are sprouting up in many places. Unfortunately, these data centres are not energy-optimized. Therefore, as the adoption of the Green Deal by the EU requires a revision of the EU's Energy Efficiency Directive, it makes sense to include specific requirements for data centres so as to cut data centres' energy consumption at no cost.*

**Data centres' energy use is rocketing**

Digital solutions are advancing rapidly. High-quality streaming services are one factor driving the expansion of data centres all over the world, including the EU. But the IOT (Internet of Things), video conferencing, gaming etc. are also growing rapidly. This already today consumes more than 8 % of the total electricity production in EU and causes carbon emissions of 4 % of the EU total emissions. An exponential increase is expected up to 2030[1].

**The EU Commission and Germany are already focusing on data centres**

When the EU commission presented its long-term Green Deal strategy in February, a key point was that data centres were to be carbon-neutral by 2030.

This is also underlined by the German environment ministry, which includes data centres in its action list for the tech sector. This means that data centres are to be regulated to make them efficient, using power from sustainable sources but also reusing waste heat, for example in the form of hot coolant that can be used for district heating.

That the Germans are focusing on this is significant, both because Germany is a large, important EU state and also because Germany will take over the EU presidency on 1 July 2020.

**Data centres use energy for two main purposes**

A data centre's energy consumption is in two parts. On the one hand, electricity is used to run the servers; on the other, power is used to cool the servers in the data centre. It is important to realize that the energy that goes on cooling the servers is significant: globally, it is about the same as that used to power the servers. At the same time, waste heat is generated that, measured in watts, is equal to the total energy consumed by the data centres. In other words, all the electricity that goes into the data centre is converted into heat.

[1] [1] Sources: https://www.opencompute.org/documents/the-current-state-of-data-center-energy-efficiency-in-europe-ocp-white-paper
https://datacenter.com/news_and_insight/datacenter_com-signs-eu-code-of-conduct-for-efficiency-in-data-centers-as-participlant/

**Current cooling technologies**

In practice, the very largest data centres in the EU, also known as hyperscale data centres, are concentrated around a handful of providers such as Google, Apple, Facebook, Amazon, Microsoft etc., who use servers developed in-house. Then there are a raft of enterprise data centres and supercomputer data centres where the servers are typically from big manufacturers such as HP, Dell, Lenovo etc. What they all have in common is that the servers are mainly based on technologies used in the USA that are spreading throughout the world, regardless of the situation in the countries where the servers are installed.

As far as running the servers is concerned, only electricity can be used. Server development therefore focuses on developing maximally energy-efficient servers with the greatest possible data capacity and least possible electricity consumption. Besides this efficiency improvement, the data centres concentrate on using electricity from sustainable sources such as solar and wind.

When it comes to cooling, this is more or less always done by means of traditional air cooling, where the surplus heat within the servers is removed by small, extremely power-hungry fans in each individual server, and this heat is again removed from the building by means of air cooling.

The universal retention of traditional air cooling is probably also partly due to the fact that the very big players in the server market are mostly based in the USA and other countries whose energy systems are not as advanced as those in the EU, and where more attention is paid to uniformity and simplicity of concept than to delivering energy-efficient server centres tailored to the local energy situation.

**Cooling technologies: efficient alternative possibilities**

Technologies already exist that use water cooling instead of air cooling. These technologies[2] have been on the market for around two decades, so they are tried and tested, but only in a small number of data centres and rarely with a view to connecting them to district heating – largely because these installations are in hot climates where the focus has been on saving electricity used for cooling.

Using water cooling instead of air cooling costs only a few percent more in the installation phase; if the operating phase is taken into account, water cooling is actually cheaper than air cooling in the long run, as both the electricity saved and the sale of residual heat generate income. Typically, therefore, the extra investment in water cooling will pay for itself in a few months.

This is because water cooling has more advantages, energy-wise, than air cooling:

1. Water cooling reduces the energy consumption of the totality of servers in the data centre by 10-30% as compared with air cooling, with the greatest reduction in geographical areas where the outdoor temperature is high.
2. Water cooling delivers waste heat from the cooling process at 60 degrees Celsius, whereas air cooling can only deliver about 25 degrees Celsius.
3. Waste heat at 60 degrees Celsius from water cooling of data centres can be used directly for heating via Europe's district heating systems, or for district cooling driven by the 60-degree hot water.
4. The use of waste heat at 25 degrees Celsius from air cooling of data centres requires the added expense and electricity consumption of a heat pump to attain a temperature high enough for reuse in heating or cooling.

[2] Manufacturers include Asetek, CoolIt Systems and DCX, Motivair and Nortek.

**The need to set energy efficiency requirements for data centres**

Now that it can be demonstrated that it is actually cheaper to operate a data centre using water cooling, why is a switch from traditional, inefficient air cooling to water cooling not happening automatically?

There are probably three reasons for this.

1. The above-mentioned impact of ownership in countries that do not have district heating or district cooling and which, instead of focusing solely on maximizing energy efficiency overall, prioritise uniformity and the purchase of power from sustainable energy sources.
2. Data centres and their energy consumption get a lot of political attention. Unfortunately, the usual way of measuring a data centre's energy efficiency does not include the circular approach, i.e. measurement by resource reuse, although measurement methods do exist for assessing a data centre's overall energy balance. Such methods should therefore be adopted.
3. Individual servers should be equipped from the outset with water cooling instead of air cooling. Server manufacture is all about delivering a large quantity of identical products, so there is also a reluctance here to offer servers with different cooling technologies. This makes it difficult to source servers with built-in water cooling, as only a few suppliers provide it at present.

There is therefore a need to set requirements for the energy efficiency of data centres, especially so as to phase in energy-efficient water-cooling technologies with lower overall electricity consumption and more opportunity to use waste heat for heating and cooling.

Remarkably enough, setting requirements to promote the use of water cooling instead of traditional air cooling will actually yield an overall financial saving on data centre operation as a whole.

**EU data centre energy efficiency requirements must be included when the EU directive is revised**

With the adoption of the EU's Green Deal and the expected associated increase in the EU's greenhouse gas emission reduction target from the current minimum of 40% by 2030 to 55% by 2030, the EU Commission has announced that this will mean a partial revision of the Energy Efficiency Directive, with stricter EE requirements.

The EU's approach continues to see enhanced action on energy efficiency as absolutely crucial to the cost-effective implementation of a 55% cut in climate-impacting gas emissions by 2030 as compared with 2005.

The Energy Efficiency Directive already includes a requirement to consider district heating etc. when EU states carry out changes or make new investments in national energy systems.

Data centre energy efficiency requirements should also be written into the EE Directive, given that these data centres' energy demands are rising steeply and are, as mentioned above, expected to account for as much as 20% of the EU's total electricity consumption in 2030.

Moreover, rules should be included requiring sector integration between data centre electricity consumption and the use of waste heat for necessary heating or cooling through the widespread presence in the EU of district heating systems and, to an extent, district cooling systems.

**Concrete proposals for EU data centre requirements for incorporation into the Energy Efficiency Directive**

1. New data centres located in the EU must use the most energy-efficient cooling technology; at present, this is water cooling.
2. In existing data centres, when entire server 'racks' are replaced, the most energy-efficient system must be used to cool both servers and building. During a transitional phase, existing air cooling can coexist perfectly well with new water cooling.
3. Water cooling must be designed so that the surplus heat is water-borne and at a minimum temperature of 60 degrees Celsius.
4. Water cooling systems must be designed so that a minimum of 65% of the electricity consumed can be used as hot water at a minimum temperature of 60 degrees.
5. To enable the 60-degree surplus heat to be made use of, there must be national rules requiring data centres to be located appropriately close to either heating or cooling demands.
6. When the possibility of using excess heat for heating or cooling is exploited, this must be done via energy-efficient sector coupling between the data centre and heating or cooling demands, e.g. by establishing a district heating or cooling network.
7. General energy efficiency requirements should be set for the combined power consumed by the running and cooling of servers, as well as the possible use of the 60-degree (minimum) cooling water.
8. The energy efficiency and sector coupling requirements are to be differentiated by EU climate zone.
9. The efficiency requirements must reflect the fact that the southern climate zone, with its high air temperatures, generally has greater potential for energy efficiency improvement of direct electricity consumption when moving from air to water cooling. In this climate zone, the requirement to exploit surplus heat must chiefly mean a requirement to use 60-degree (minimum) hot water for cooling purposes.
10. In the northern climate zone, the direct efficiency gain obtained by moving from air to water cooling is smaller because of the lower outdoor temperature and the possibility of direct cooling, such as by night air. This calls for a lower efficiency improvement requirement. On the other hand, it is more important here to require data centres to be located where the 60-degree (minimum) hot water can be used for heating, either in existing district heating systems or in new ones.

*This note is also published as a blog in Danish on https://concito.dk/concito-bloggen/eu-boer-stille-krav-om-energieffektive-koeleloesninger-datacentre*