Press release

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Self-Cooling Supercomputer

A Fahrenheit adsorption cooling system is supporting sustainable energy efficiency at the Leibniz Supercomputer Centre

Data centres guzzle electricity. Globally they consume over two percent of the generated electrical energy and make a corresponding contribution to CO_2 emissions. Forecasts predict that the number of data centres, and therefore electricity consumption, will continue to grow in the coming years. For that reason, alternative solutions are being sought to significantly reduce electricity consumption and CO_2 emissions. The SuperMUC-NG supercomputer shows that these reductions can already be achieved today. The supercomputer from Intel-Lenovo installed at the Leibniz Supercomputer Centre (LRZ) at the Bavarian Academy of Sciences and Humanities in Garching uses complex models and simulations to improve our understanding of topics including the universe, climate change and the effect of medicines. To do so, it requires up to four megawatts of electricity. As a result of the huge, heat-generating computing performance, it needs effective and where possible energy-saving cooling.

An adsorption cooling system is making an important contribution to that effect. It converts the heat produced in processors into cooling energy for the cooling system. As a result of this heat recovery, the computer's cooling infrastructure optimises efficiency, which saves energy and significantly reduces CO_2 emissions. In the field of high performance computing (HPC), the SuperMUC-NG has become a model in terms of sustainability. The Fahrenheit adsorption cooling system with a performance of 600 kilowatts is currently one of the biggest in Europe.

Climate protection and energy prices have put an emphasis on increasing energy efficiency for all modern IT applications. Large data centres can be "green IT" pioneers by being cooled in a cost-effective and simultaneously resource-saving manner. According to the network of energy-efficient data centres (NeRZ), more than 13 billion kilowatt hours of energy are being converted to heat and then released into the environment without being used each year in German data centres. At the same time, the rising high power density in the data centres is increasing the demands on cooling systems. According to a study by the Borderstep Institute, the energy consumption of German data centres has increased by over 40 percent in comparison to 2010. Modern technical solutions, like the adsorption cooling system, may smooth the way toward more resource efficiency.

Andreas Thomasch, Director HPC & AI at Lenovo also confirms, "The warm water cooling solution implemented in collaboration with Fahrenheit and the Leibniz Supercomputer Centre shows how even very energy-hungry supercomputers using several megawatts can be operated by using waste heat to generate cooling capacity. This cooperative innovation combines the Fahrenheit adsorption technology with the Lenovo Neptune technology. It improves the climate balance and at the same time, reduces operation costs. For me it is a great example of joint innovation with our customers,

fully in accordance with the Lenovo strategy 'From Exascale to Everyscale™'." He says that he is also confident that this combination of technology could also be made deployable for customers using less than one megawatt in order to design high performance computing so that it is permanently more sustainable.

Cooling saves electricity

The warm water cooling system with a cooling performance of up to four megawatts of heat, cools the approximately 311,000 cores and memories of the SuperMUC-NG. The temperature of the warm water cooling system increases to up to 55 °C. This waste heat from the IT system can in turn be used to heat buildings during the colder months. Furthermore, the adsorption system uses the heat from the warm water to produce cooling energy. Thus, it cools the heated air from the remaining air-cooled components using water-cooled rear doors, which function as air-water heat exchangers. To do so, water at a temperature of approx. 20°C and a maximum cooling capacity of approx. 0.6 megawatts is required. This heat recovery system saves up to 80 percent electricity during cooling compared to conventional cooling systems. Thus, the computer cools itself because the heat available from the processes enables the production of cold water.

Prof. Dr. Dieter Kranzlmüller, Head of the Leibniz Supercomputer Centre, emphasises the advantages of the cooling concept, "Computers do not use electricity. They simply convert electrical energy into heat energy and they do that very efficiently. At the LRZ, we have already been working for a long time with warm water cooling for our supercomputer and are interested in subsequently using the heat that is generated in the process. In this way we can operate our supercomputer centre as efficiently as possible. The deployment of the adsorption chillers is a very promising approach in this regard."

Clearly reduced CO_2 emissions

It all has an extremely positive impact on energy efficiency: only a very small proportion of electricity is used to cool the computer. SuperMUC-NG achieved the very low PUE (power usage efficiency) value of 1.08. Only eight-percent of the energy consumption of the total computer infrastructure require periphery systems, the rest is simply using energy from the computer. The special cooling infrastructure of the supercomputer thus also drastically reduces the CO_2 emissions associated with the computer. Comparatively, the SuperMUC-NG is very good: the sector average PUE value is 1.67.

Hybrid system for re-cooling

The re-cooling of the adsorption system is performed by two separate hybrid re-coolers that can be operated in both wet and dry mode. The wet cooling ensures that the re-cooling temperature is lower than the outside temperature by way of evaporative cooling. This hybrid system saves energy and in the case of higher outside temperatures, it allows the deployment of a smaller cooling system. When operated dry, the re-coolers do not require any water, which lowers the water consumption of the system.

The technology from Fahrenheit is prize-winning: in 2018, its concept for adsorption cooling won the German Data Centre Prize in the air-conditioning and cooling category.

Adsorption cooling works like this:
The Fahrenheit adsorption cooling units work according to the principle of solid matter sorption, known as adsorption (from the Latin to suck (in)). Adsorption describes the enrichment of materials (gases or liquids) on the surface of a solid, the adsorber. In the adsorption process, water vapour from sorption material (silica gel or zeolite) is “sucked in” and adsorbed causing the water to vaporise and cooling energy to be generated. If the material is saturated, it is regenerated by applying heat. For the refrigerant, Fahrenheit uses pure water without synthetic refrigerants. The units allow a GWP (global warming potential) of zero to be achieved. The EU regulations on the fluorinated greenhouse gases (F-Gas regulation) are met without any problem.

Find more information on how adsorption works in this video.

An adsorption chiller cools water that is then used to air-condition rooms or to cool, e.g., machines, servers or other processes. The unique quality of adsorption cooling is that it uses heat, e.g., central heating or waste heat from machines, instead of electricity as the main input energy. Therefore, the adsorption chiller saves approximately 80 percent of electricity costs that would normally occur for an air-conditioning system or chiller.

Photos:

A Fahrenheit adsorption chiller converts the heat generated by the processors of the SuperMUC-NG supercomputer into cooling energy so that the computer uses it to cool itself.

Huge, heat-generating computing performance: the SuperMUC-NG supercomputer at the Leibniz Supercomputer Centre in Garching uses up to four megawatt of electricity. The Fahrenheit adsorption cooling system ensures effective cooling that saves as much energy as possible. Photos: FAHRENHEIT GmbH

About Fahrenheit GmbH

Fahrenheit products can make a considerable contribution to reducing the greatly increasing electricity requirement to generate cooling energy in the future. The units use adsorption technology. They use readily available or waste heat and reduce the electricity requirement to generate cooling energy by up to 90 percent in comparison to competitors' systems. The refrigerant consists exclusively of water and no environmentally hazardous materials are used. The low maintenance chillers provide a performance spectrum of 10 to 100 kW cooling capacity. Cascading the units makes even higher performances possible.

The green-tech company employs 35 highly-qualified employees at its sites in Munich and Halle (Saale). Its own research department and production facility are located in Halle. Fahrenheit GmbH was established in 2002 under the name Sortech AG as a spin-off of the Fraunhofer Institute for Solar Energy Systems (ISE) and aimed to help adsorption technology to make a break-through. Over 30 issued patents and nearly 800 product installations have been proven in practice.

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