



From left: Gert Nielsen, Terje Klyve, Håkon Selvnæs and Helene Møller Rørvik. Photo: Martin Håndlykken.

EXHIBITOR

Phase-change storage keeps hot water circulating at Solstrand

At Solstrand Hotel & Bad in Os, outside Bergen, a Cartesian Thermal Box is connected to the hotel's new CO₂ heat pump. The storage unit charges while the heat pump produces domestic hot water and keeps the recirculation water hot when the heat pump is off.

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Terje Klyve has been technical manager at Solstrand since 2012. When he took over, he did not have a complete overview of the building.

“No, not at first. But it was very exciting. I came from the trades, so it was exciting to come here and be given the freedom I have actually had,” says Klyve.



Terje Klyve was given considerable freedom when he joined as technical manager and has used it to substantially upgrade the hotel's technical systems. Photo: Martin Håndlykken.

The hotel has its own spa department, and that is reflected in its energy use.

“We have a spa with a great deal of water and high energy demand. We serve an industry where guests expect comfort, so it is important that we work to find the most sensible energy solutions possible,” he says.

The heat pump that kept losing compressors

Multiconsult was brought in to investigate a heat pump that repeatedly suffered compressor failures. The Multiconsult team, including Gert Nielsen, Senior Thermal Energy Nerd at Multiconsult, found that the domestic hot water system was forcing the entire installation to operate at a higher temperature than it had been designed for - something Terje already knew.

“One of the reasons the compressors keep failing is that they run at insanely high temperatures compared with what they were designed for and what the systems actually need,” says Nielsen.

According to Nielsen, the heat pump installation as a whole lost at least one compressor every year. Multiconsult proposed separating the systems, but they turned out to be more closely interconnected than the consultants had expected. The hotel was built in the 1890s and has expanded in stages.

“The approach has been: ‘Now we are adding something here, so we will have to connect it to this.’ No one has sat down and thought through how it should all work. That is what we are trying to do now,” says Nielsen.

There were also no drawings that could help Klyve when he started. Nielsen points out that the documentation is also about the day when Klyve eventually leaves.



Håkon Selvnes of Cartesian and Gert Nielsen have worked closely together to make the solution work. Photo: Martin Håndlykken.

“If our documentation is not good enough for a new person to step straight in, we will have to hire them a couple of years before Terje leaves so there can be a proper handover.”

Gert Nielsen, Multiconsult

Seawater, ammonia and CO₂

Solstrand has installed a new seawater line to provide more stable temperatures throughout the year. It is intended in particular to meet cooling demand in late summer. At the same time, the old heat pumps are being phased out in favor of systems using ammonia and CO₂ as refrigerants. The CO₂ heat pump now in operation supplies all of the hotel's domestic hot water.

The recirculation challenge

A domestic hot water system with recirculation needs heat even when no one is drawing water. This is a known challenge for CO₂ heat pumps: they need a low return temperature to operate efficiently, while water returning from the recirculation loop is much warmer. Håkon Selvnes, CPO and co-founder of Cartesian, describes it as a problem that has frustrated engineers for a long time.

The Solstrand solution is to charge a Thermal Box to 65°C at the same time as the heat pump produces domestic hot water in the conventional tanks.

“When you switch off the heat pump, you route the recirculation water through our Thermal Box and heat it there. That means you avoid using an electric boiler or gas-fired boiler.”

Håkon Selvnes, Cartesian

Klyve explains that the storage unit takes over the recirculation load when the heat pump is not running, for example at night.

“It appears to work very well,” he says.

Selvnes believes this is the first installation of its kind in Norway, and possibly in the world, although he stresses that this has not been confirmed.



The Cartesian Thermal Box beside the CO₂ heat pump in the plant room. A thermal water tank would have been about eight times larger. Photo: Martin Håndlykken.

A large amount of energy in a small volume

The Thermal Box uses phase-change materials (PCMs), mainly bio-based materials, which store energy when they melt and release it when they solidify. Nielsen compares the process with ice.

“Ice absorbs energy when it melts and releases it again when it freezes, and that happens at a defined temperature. So you can store a great deal of energy in a small volume,” he says.

The Solstrand storage unit holds 75 kWh. If the hotel stored the same amount of energy in water with a five-degree temperature difference, Nielsen says the tank would be around eight times larger.

Among its product configurations, Cartesian offers a fully assembled Thermal Box Standard with a circulation pump, energy meter, valves and a controller that connects to the building management system via BACnet or Modbus. Each module stores between 60 and 125 kWh, and the units are built and assembled in Trondheim.

Nielsen first raised the idea with Selvnes at the annual meeting of the Norwegian Refrigeration Association in Bergen a couple of years ago. He had been working for some time on different ways to solve this challenge. Finding a customer took time.

“The idea is not difficult. The hard part is finding someone brave enough to say: ‘We think this is a good idea, and we are going to do it.’ Not because we make money from it, but because we believe it is the right thing to do.”

Gert Nielsen, Multiconsult

For Klyve, the point is to stay slightly ahead without jumping at everything.

“If you want to be part of it, you have to stay a little ahead. You have to want something, and you also have to be willing to take some risks to succeed. You should not jump at every possible idea, but when something makes sense, it is great fun to try it,” he says.



*Nielsen has worked with phase-change materials before, but this is the first time a Norwegian supplier has been able to provide the solution.
Photo: Martin Håndlykken.*

The same technology in Amazon facilities

Cartesian also supplies cooling storage to Amazon logistics centers in Europe. At a fulfillment center in the United Kingdom, ten Thermal Box modules connected to the central cooling system are expected to increase effective cooling capacity during peaks by 38 percent, without upgrading the chillers. Cartesian's calculations indicate a five-year payback period and a reduction of 137 tonnes of CO₂ emissions. At a similar center in Germany, 16 modules are expected to provide 21 percent more cooling capacity, while four heat-storage units connected to a heat pump installation at a distribution center in Italy are expected to provide 28 percent more heating capacity.

“Cartesian had a fantastic thermal-storage solution. We see it as one of the critical pieces in achieving our net-zero goal by 2040.”

Brad Swartz, Principal Program Manager for Sustainability, Amazon EU Operations, in a customer film on Cartesian's website

Presentation at VVS-Dagene

Cartesian will exhibit at VVS-Dagene at Nova Spektrum in Lillestrøm from 14 to 16 October and give presentations on all three days. The company will cover the Solstrand solution as well as capacity challenges in refrigeration systems.

“We will look at the recirculation water and how we solve the challenge at Solstrand. We will also show how Cartesian's technology can be used in other applications,” says Selvnes.

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