

ENGINEERING
TOMORROW



Case story

The world's largest solar hot water system - **reduces annual CO₂ emissions by 15,700 tonnes**



30%

cost reduction in
1st year compared
with traditional drive
systems

The world's largest solar hot water system is helping the municipality of Silkeborg reach its ambitious target of CO₂ neutral heat production in 2030. The Silkeborg plant is designed to produce 80,000 MWh of heat annually, and at the same time reduce annual CO₂ emissions by 15,700 tonnes.

The solar hot water system harnesses energy to heat the homes and workplaces of 40,000 citizens. It runs on VLT® drives and supplies 18-20% of the annual heat consumption in Silkeborg municipality, which has an ambitious target of CO₂-neutral heat production by the year 2030.

The government in Denmark is furthermore reducing subsidies to traditional power sources to motivate utilities to transfer to green energy sources. Silkeborg District Heating plant has installed the new solar heating plant in advance of just such a reduction in subsidies, from January 2019.

Solar water heating was chosen since it allows storage of solar energy harvested in daylight for use at nighttime or in a different time of year. This extends the added value of the sun and makes solar solutions even more profitable.



With a focus on reducing the CO₂ emissions as much as possible, it was decided to make solar cells a part of the building.

The reason we chose Danfoss Drives is because of its wellknown brand. They have a reputation for being serviceminded and available 24/7.

Per Hvilshøj Christiansen
Project Manager
Silkeborg Heating Plant



The endless fields of solar panels cover a total area of 156,694 square meters.



This model has been successfully utilized in several applications in the field of solar heating due to the height of the plate. This application gives us a high Theta value and a low LMTD.

Henrik Jørgensen
Key Account Manager &
Sales Engineer, SONDEX

Successful transfer of energy

In 2016, Danfoss acquired full ownership of Sondex. By joining forces we are able to offer our customers a broader, even more competitive and innovative product and service portfolio within heat transfer.

A total of four heat exchangers delivered by SONDEX® are connected to the solar heating plant – each of them measure 4.10 meters in height and 5.20 meters in width. The model is named S221 and has between 884 and 936 plates.

At the utility in Silkeborg, the buildings are adapted to the size of the heat exchangers. They are specifically designed for the customer due to the effect and the height difference of the landscape.

Silkeborg could have had a smaller vendor size, but then they would not have achieved the same close temperature on the primary and secondary sides as in the four major ones, which are chosen by the solar panel supplier Arcon Sunmark.

Silkeborg District Heating Utility decided to create a PN10 system, and consequently, the heat exchangers were calculated according to the pressure drop in the solar panels. S221 is currently the tallest model with connection size DN200 at Sondex.

By having a high delta T, you can operate at a lower flow which means that you do not need to invest in larger pumps. At the same time, a small LMTD (Logarithmic mean temperature difference) can get the temperature on the district heating side as close to the temperature of the solar heat side thereby enabling you to transfer as much of the energy as possible.



During a guided tour, Per Hvilshøj Christiansen gave an introduction to the heat transfer solution by SONDEX®.

Reduced pump energy consumption

Four large pumps run continually to distribute the hot water to consumers. In addition, four more are available on standby as backup. All eight water pumps are controlled by VLT® AQUA drives to maintain their energy consumption at an absolute minimum.

Alarm reduces leakage

Leakage in water pipes is a known source of energy losses. Therefore, the Silkeborg plant has installed a system which raises an alarm, when a leak is detected. The system detects leaks by a change in resistance. In addition, annual leakage checks are performed.



VLT® AQUA Drive FC 202 controls all eight pumps at Silkeborg water heating plant.

The VLT® AQUA Drive

The VLT® AQUA Drive has proven a successful solution for this application. Project Manager, Per Hvilshøj Christiansen, explains:

"What we have experienced with Danfoss Drives is that the drives are very energy-efficient with minimal operating costs. Add to this, the life expectancy and the level of technical support you are able to get anytime, this has proven a great success for all parties involved".



Key Account Manager at Danfoss Drives, Asbjørn Jonassen and Project Manager, Per Hvilshøj Christiansen talking about the efficiency and features of the drives.

Facts:

- The Silkeborg solar water heating plant contains 22 km of piping which links together 12,436 solar heating panels, equivalent to the area of 20 soccer fields. The panels are installed over an area of 50 hectares, comparable to 60 soccer fields.
- The park is built in four independent sections, to ensure maximum operating reliability. If an operating problem arises in one field, the operators isolate it and then run on the other three.
- The plant is designed for a lifetime of 25 years. It is a highly efficient plant, which is 4-6 times more effective than residential solar water heating systems installed typically on rooftops of private homes.
- The plant runs on well-known technology which is also used in completely different industrial purposes. For example, in Chile a solar water heating system supplies the copper extraction process at the internationally-renowned Chilean copper mines.

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