NORDIC KNOW-HOW 2022

NCSH
Nordic Center for Sustainable Healthcare

BEST PRACTICES OF
SUSTAINABLE HEALTHCARE
IN THE NORDICS

REPORT SERIES BY
NORDIC CENTER FOR SUSTAINABLE HEALTHCARE

#6 DISTRICT HEATING & COOLING

INTRODUCTION

Climate change is one of the greatest environmental challenges faced by societies today and action must be taken from a wide range of sectors – healthcare being no exception. A study from 2019 estimates that the climate footprint of the healthcare sector is equivalent to 4.4% of global net emissions (HCWH, 2019).

Healthcare accounts for approximately 10% of Sweden's gross domestic product, making it a significant part of the economy which can contribute to a reduction in society's climate impact through, among other things, sustainable procurement (Statistics Sweden, 2019). Hospitals in the Nordics have been working with sustainability in healthcare for many years and are considered to be in the forefront in a global context (Eriksson & Turnstedt, 2019).

The Nordic Know-How report series produce and share knowledge and examples of Nordic best practices to an international audience in the field of sustainable healthcare. The focus in this sixth chapter is on **district heating and cooling**. The report aims to give a better understanding of the opportunities, its application and how hospitals can take a leading role in the development and implementation of these systems, improving the environmental impact of the health sector.

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#6 DISTRICT HEATING & COOLING
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ABOUT
DISTRICT HEATING & COOLING

The district heating and cooling (DHC) in simple terms is the infrastructure that connects local heat sources with local heat demand. As an energy source for hospitals, is a technology that can lower the energy costs while also contribute to a lower environmental impact. The technology is also a reliable energy source that can improve the robustness of the hospitals heating and cooling systems, fundamental for the working of these strategic facilities.

District heating

The technology works in such a way that hot water from the thermal power plant is pumped out under high pressure in the underground pipeline network. When the hot water reaches the receiver (hospital), there is a district heating central with a heat exchanger functioning to transfer heat energy from one medium to another (Energiföretagen, 2016).

When energy from the hot water is transferred into the facility, the water cools off again. When the water is at a sufficiently low temperature it is led back to the heating plant, where the process starts over. The hot and cold water in the systems never interact with one another, but the heat is effectively transferred from one system to the other. On its way back to the heating plant, the water continues to heat for example sidewalks, streets and football fields (Energiföretagen, 2016).

District cooling

District cooling works much the same as district heating, the major difference is that the water temperature in the pipes is cold and cools the connected properties instead of heating them. In the Nordic region, district cooling is mainly used by large facilities, for example hospitals (Stockholm Exergi, 2019).

The (DHC) has many advantages, being one of the most important to diversify energy sources. Potential sources include combustion of waste or bio fuel, geo thermal heatpumps, waste heat from industries, the use of the waste heat from industries, data centres, waste incineration or residues from the forest industry, that would otherwise go to landfill (E.ON, 2021). The heat and cold is then distributed through a under ground pipe network (The Swedish Energy Agency, 2017).

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ENVIRONMENTAL IMPACT

According to the UNEP (2019), heating, cooling and hot water represent sixty per cent of the energy demand in buildings and its environmental impact mainly depends on the process related with the energy generation. For example, what fuels are burned, how the fuel is transported and how the residues are utilised.

Over the decades, distribution techniques have been replaced with increasingly sustainable technologies. A common situation is that waste incineration plants are converted into combined heat and power plants, which means opportunities for the generation of electricity, while at the same time recycling the heat for the district heating system (Werner, 2017).

Although district heating in Sweden today usually does not come from fossil sources, negative effects on the environment can still occur. For example: if the biofuel is extracted from high forests with high biodiversity levels, or if people and animals are displaced as a consequence of the extraction of biofuel. In order to avoid this environmental impact, it is therefore important to ensure that the district heating purchased is eco-labelled (Naturskyddsföreningen, n.d).

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Demand for district cooling has increased, even in geographically colder areas such as in the Nordic region. Instead of using several small on site refrigeration systems and air conditioning units, district cooling can be seen as a more environmentally friendly alternative (Stockholm Exergi, 2019; Energiföretagen, 2016).

The strong drivers in this development are the advantages with local management of resources, extensive heat distribution networks and low energy impact (compared to other heating systems). In this context, there is a clear trend of an increasing number of hospitals connected to district cooling networks (MSB, 2021).

RESILIENT AND RELIABLE ENERGY SYSTEMS

Disruptions in hospital buildings, such as a loss of cooling capacity during a heat wave or loss of heating in cold winter month can be devastating for patient safety. Having the hospital connected to a district heating/cooling network can be a more redundant source of heating and cooling than on-site solutions covering the peak demand.

If the hospital is connected to a district heating network, the resources are shared among the buildings within the municipality. In a worst case scenario, heating and cooling can be prioritised and redirected to the hospital. Some hospitals also have a combination of on-site heating and cooling production in combination with district heating/cooling for optimized performance and redundancy.

An established collaboration between the hospital and the supplier of district heating and cooling creates better conditions for a reliable system. Collaboration creates a deeper understanding of both parties' ability to see and identify needs that can contribute to the prevention of unwanted events and disturbances (MSB, 2021).

Benefits with district heating

- Simple and predictable.
- Benefits across the sustainable development agenda— improving human health by cutting air pollution, increasing access to affordable and clean energy, and creating green and decent jobs.
- District heating can reduce environmental impact by 50 – 80%.

United Nations Environment Programme (UNEP). District Energy in Cities Initiative. http://www.districtenergyinitiative.org/

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DISTRICT HEATING AND COOLING IN SWEDEN

Sweden has a long history of district heating. Today, almost all major cities have these systems installed. There are around a hundred heating plants in Sweden that produce district heating, each plant unique in its size and function.

The greenhouse gas emissions from the Swedish electricity and district heating sector are low compared to many other countries. Focusing on a combination of heat recovery and renewable fuels, Sweden has to a large extent replaced fossil fuels in the district heating sector. This is mainly because the energy production is often based on hydropower, nuclear power, wind power and biofuels in heat and power plants (Naturvårdsverket, 2020).

The Swedish district heating systems are generally reliable and in good condition, but there are variations where, for example, newer district heating lines are of better quality and thus more robust than older management systems. In the event of disruption, the district heating network of hospitals is often a high priority for the supplier. This means that district heating suppliers take a great responsibility and hospitals are given the highest priority in the network, compared to other properties (MSB, 2021).

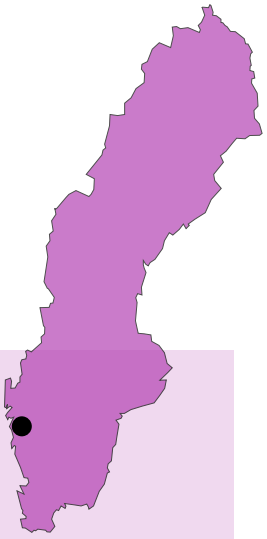
This report includes examples of Swedish initiatives in regions such as Region Halland, and Region Skåne.

REGION HALLAND

District heating has been used since the hospitals were built around the 1960–1970s and is the primary heating system for all of region's hospitals (Halmstad, Varberg and Kungsbacka). It comes from renewable sources, where the largest part is the burning of biofuel. The region's goal is to reduce energy consumption and continuously develop energy efficient solutions and work towards a transition to renewable energy sources.

The need for district cooling has also increased in the region in recent years. This is mainly due to an increased need for comfort cooling in buildings, but also to enable performing medical care safely even during the summer months. Currently, district cooling is only used in one hospital, Halmstad Hospital, where the system has been providing the hospital with cooling since 2013. Discussions are taking place at Varberg Hospital regarding future installations.

71.5% of the region's energy is consumed by medical buildings. The measures planned and implemented are of great importance when it comes to streamlining hospital buildings and installations. It is also of great importance for how supervision and management are carried out, as well as how energy efficiency improvements and optimizations are carried out in the real estate business (F. Christensson & R. Mellberg, personal communication, 11 November 2021; Region Halland, 2020).



Population: 282 885
Area: 17 519 km2
Municipalities: 16

REGION SKÅNE

In 2014, Region Skåne set up a plan to become fossil free by 2020. As part of the plan, they invited the energy companies in the region to a dialogue on how to get access to fossil free energy for the hospitals. On a local level, Helsingborg Hospital invited their local energy provider Öresundskraft to a discussion on the possibilities of receiving fossil free energy for their hospital complex. Öresundskraft is a municipality owned energy provider that is producing district heating/cooling and electricity. The two parties signed an agreement and initiated a plan for phasing out fossil-based fuels until 2020. Since then, the production has incrementally moved towards a 100% renewable sources of energy. The last challenge was to replace the starting fuel with high burning temperatures. The cooperation between Helsingborg Hospital and Öresundskraft is still an ongoing process working on improving the overall energy performance of the hospital.

The results from this collaboration have not only provided the hospital with a clean source of energy, Öresundskraft has also transformed their whole production. All their customers now have access to a fossil free energy source thanks to the collaboration with the hospital.

Cooperation

One part of the challenge was to provide a sustainable production of cooling for the hospital. The hospital had previously looked into different solutions on-site. Through the discussions with Öresundskraft, they decided to go for district cooling which at that time was not developed in the area. Thanks to the hospital's size as a customer and being dedicated with long term commitment to fulfilling their environmental goals, they could sign up for a long term contract. This allowed Öresundskraft to invest in the infrastructure and production that can also be used by other customers such as industries etc.

The cooling comes from different sources depending on season to optimize the production and sustainability aspects. During summer months, absorption cooling is used. This method is optimal during summer when there is an excess of district heating which can be used to run the absorption coolers. During fall, when the excess of heating becomes less accessible, absorption coolers are complemented by electric heat pumps during peak demand. During the winter and early spring, free cooling is accessible from the ocean. In the spring, electric heat pumps are again used during peaks. This way the optimal source is continuously used in the production.

System approach for reusing energy

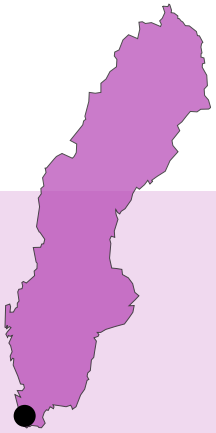
Large scale energy systems, such as district heating and cooling, provides a sustainable and robust source of energy. In case of an emergency, heating and cooling can be allocated to the most critical functions in the city, like the hospital.

Öresundskraft has connected their district heating network with networks in neighboring municipalities and so the heating is produced in several plants that can support each other.

Industries connected to the network can also provide heat to the system. One of the more energy intensive industries within the district heating network contributes with as much as 1/3 of the total energy consumption of the network. This is a great way of reusing heat that otherwise would have gone to waste.

(D.Olerup, November 2021)

Population: 1 389 336
Area: 10 968 km2
Municipalities: 33



Innovation in district heating and cooling systems

A breakthrough in the development for new systems and possibilities for district heating and cooling is in Region Skåne, specifically in Lund. The innovation is the world's largest low-temperature district heating grid.

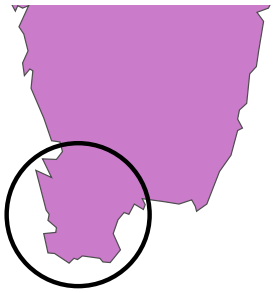
This cutting edge development is the result of an innovation ecosystem which began in 2009 with the decision to build two large research facilities in Lund: the European Spallation Source (ESS) and the MAX IV Laboratory. In this context, an exponential growth of the Brunnshög district was envisioned, meaning that in 40 years it will reach 40,000 people living and working within its limits.

Apropos of this development, Kraftringen Energi AB, the energy company owned by the municipalities of Lund, Eslöv, Hörby and Lomma, has committed to building a next generation low temperature district heating grid. This has implications for the near future of the technologies and the hospitals connected to this grid.

The system temperature of 65 degrees Celsius eliminates the need for extra equipment to handle growth of legionella bacteria and includes the possibility to use plastic pipes. As the MAX IV energy central is connected to the grid, there is a redundant heat supply with extremely low primary energy usage in periods when there is no production at the Max IV Laboratory.

The implications for the hospitals and the healtcare facilities in the region will be major and could mean a new push for expanding the possibilities to share and learn from the Swedish experience.

(Celsius City, 2022; UNEP, 2022)



Grønnköpingkið. Visit the world's greenest hospital at: https://worldsgreenesthospital.org/

Image: LINK Arkitektur

CONCLUSIONS

WHY CHOOSE DISTRICT HEATING & COOLING FOR HOSPITALS?

- District heating is a good way to use a local, or similar heat resource, that otherwise would go to waste or landfill in order to satisfy the local heating demand. The energy sources can be waste heat from industries, data centres, waste incineration and residues from the forest industry etc.
- In line with climate change and higher temperatures in the summer months, the demand for district cooling has increased even in geographically colder areas. Instead of having several small cooling systems and air conditioning units, district cooling can be seen as a more environmentally friendly and a robust alternative for reliable energy to the hospitals.
- District heating and cooling is considered a reliable system for heating and cooling. Robustness is an important aspect of an energy system. Being a part of a larger network with several energy production units makes the network a redundant source of heating and cooling.
- As a large stakeholder in the City, the hospital has great potential to drive the development towards fossil free energy for the whole City.

FOR MORE INFORMATION ABOUT HOW TO TRANSFORM SUSTAINABILITY CHALLENGES INTO INNOVATIVE SOLUTIONS FOR THE HEALTH SECTOR, PLEASE CONTACT NCSH:

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REFERENCES

Aalborg Forsyning: Erhverv
URL: https://www.aalborgforsyning.dk/erhverv/Koling [Retrieved: 2022-01-11].

Celsius City. (2022). *Brunnshög: where science heats the city*. URL: https://celsiuscity.eu/brunnshog-where-science-heats-the-city/?utm_source=rss&utm_medium=rss&utm_campaign=brunnshog-where-science-heats-the-city [Retrieved: 2022-01-12].

E.ON. (2021). *Fjärrvärme - ett bra miljöval*. URL: https://www.eon.se/fjarrvarme/miljopaverkan [Retrieved: 2021-07-01].

Energiföretagen. (2021). *Fjärrkyla*. URL: https://www.energiforetagen.se/energifakta/fjarrkyla/ [Retrieved: 2021-09-01].

Energiföretagen. (2016). *Fjärrvärme på djupet. Ta vara på energin*. URL: https://www.energiforetagen.se/globalassets/energiforetagen/det-erbjuder-vi/kompetensforsorjning-dokument/fjarrvarme-pa-djupet_broschyr-for-utskrift.pdf [Retrieved: 2021-09-01].

Eriksson, D. & Turnstedt, L. 2019. Nordic Sustainable Healthcare: A Nordic Whitepaper About Sustainable Healthcare. Nordic Innovation. URL: http://norden.divaportal.org/smash/get/diva2:1346242/FULLTEXT01.pdf. [Retrieved: 2021-09-20].

MSB (Myndigheten för samhällsskydd och beredskap). (2021). *Den robusta sjukhusbyggnaden. En vägledning för driftsäkra sjukhusbyggnader*. URL: https://www.msb.se/sv/publikationer/den-robusta-sjukhusbyggnaden---2021--en-vagledning-for-driftsakra-sjukhusbyggnader/

Naturskyddsföreningen. (n.d). *Fjärrvärme*. URL: https://www.bramiljoval.se/omraden/fjarrvarme/ [Retrieved: 2021-09-15].

Naturvårdsverket. (n.d). *El och fjärrvärme, utsläpp av växthusgaser*. URL: https://www.naturvardsverket.se/data-och-statistik/klimat/vaxthusgaser-utslapp-fran-el-och-fjarrvarme/ [Retrieved: 2021-09-15]. portal.org/

Puttige, A, R. (2021). Utilization of a GSHP System in a DHC Network. Modeling and Optimization. ISBN: 978-91-7855-649-6 (pdf). Electronic version available at: http://umu.diva-portal.org/

Region Fakta. (2021). *Statistik från län och regioner i Sverige*. URL: https://www.regionfakta.com/ [Retrieved: 2021-11-17].

Region Halland. (2020). *Miljöredovisning Region Hallands fastigheter 2020*. [Retrieved: 2021-11-09].

SCB. (2019). Hälso- och sjukvårdens andel av BNP var 10,9 procent 2019. URL: https://www.scb.se/hitta-statistik/statistik-efter-amne/nationalrakenskaper/nationalrakenskaper/halsorakenskaper/pong/statistiknyhet/halsorakenskaper-2019/ [Retrieved: 2021-11-08].

Stockholm Exergi. (2019). *Års- och hållbarhetsredovisning 2018*. URL: https://www.stockholmexergi.se/content/uploads/2019/03/Stockholm-Exergi-2018_pages_print-_links-v4.pdf [Retrieved: 2021-10-10].

The Swedish Energy Agency. (2017). *Fjärrvärme*. URL: https://www.energimyndigheten.se/snabblankar/lattlast/hur-varmer-du-upp-ditt-hus/fjarrvarme/ [Retrieved: 2021-07-01].

Tekniska Verken. (2020). Installation. URL: https://www.tekniskaverkenikiruna.se/fjarrvarme/installation [Retrieved: 2021-09-25].

Tidningen Energi. (2020). *Framtidens fjärrvärme tar form*. URL: https://www.energi.se/artiklar/framtidens-fjarrvarme-tar-form/ [Retrieved: 2021-10-03].

United Nations Environment Programme (UNEP). District Energy in Cities Initiative. http://www.districtenergyinitiative.org/ [Retrieved: 2022-01-12]

Werner, S. (2017). District heating and cooling in Sweden. *Engineering and Science. 126*(1), 419-429. https://doi.org/10.1016/j.energy.2017.03.052

Olerup, D. Head of Key Accounts at Öresundskraft AB, Interview, November 2021