NORDIC KNOW-HOW 2021

NCSH
Nordic Center for Sustainable Healthcare

BEST PRACTICES OF
SUSTAINABLE HEALTHCARE
IN THE NORDICS

REPORT SERIES BY
NORDIC CENTER FOR SUSTAINABLE HEALTHCARE

#5 RENEWABLE ENERGY PRODUCTION

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).

Nordic sustainable healthcare is considered to be in the forefront in a global context (Eriksson & Turnstedt, 2019). Sustainability within healthcare has a long tradition in the Nordics and there are many good examples of best practices.

The aim of this Nordic Know-How report series is to spread knowledge and examples of Norbest practices to international actors in the field of sustainable healthcare.

The theme of this fifth chapter in the series is **renewable energy production** with focus on two of the main sources - **solar and wind**. These energy sources can be used by hospitals or other healthcare providers to provide renewable energy for their operations. This report provides good examples from Swedish municipal regions and hospitals on the topic of renewable energy production.

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#5 Renewable Energy Production

Report series by

NORDIC CENTER FOR SUSTAINABLE HEALTHCARE

2021

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ABOUT RENEWABLE ENERGY PRODUCTION

In this Nordic Know-How chapter, we look deeper into the production of renewable energy and specifically solar- and wind energy, as these two are the most common types in the examples presented in this report.

Both solar cells, solar collectors and wind power turbines can be used by regions or other healthcare providers to produce energy directly for their operations. Such a solution can significantly lower energy costs while also contribute to a lower environmental impact. Solar cells- and collectors can also be installed in close proximity to the hospital buildings. Depending on the size and position of the building, there can be good possibilities for installing solar- and/or wind power.

Renewable energy can be especially suitable for hospitals, as they have a high energy use around the clock and today, most Swedish regions use some type of renewable energy for their hospitals.

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ENVIRONMENTAL IMPACTS

SOLAR CELLS

The environmental impact from solar cells stems largely from the manufacturing process and this impact differs depending on the materials being used. Factors that affect the production chain are the choice of technology, basic materials, toxic metals, and greenhouse gas emissions.

The various manufacturing processes also require a lot of energy, and where the importance of a sustainable energy system becomes a fundamental aspect regarding the degree of environmental impact. When calculating the environmental impact from solar cells, the production and the energy system used in the production are therefore of great importance (The Swedish Energy Agency, 2018).

The placement of solar cells can often be in direct connection to where the electricity is being used, which contributes to a reduction in transmission losses. Due to a location on for example, roofs or facades, no land use is required. When producing electricity, the environmental impact is small, operation is quiet and does not normally give rise to any emissions.

The recycling of solar cells is also an energy-intensive process and shortcomings in recycling can give rise to environmentally harmful emissions (Naturskyddsföreningen, 2019b). In summary, a sustainable production chain contributes to a more environmental friendly solar cell and a smaller environmental impact.

ABOUT
RENEWABLE ENERGY PRODUCTION

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SOLAR COLLECTORS

The production of solar collectors is very similar to the production of solar cells. Common materials used for solar collectors are glass, aluminum and plastic.

An antifreeze liquid is necessary when the solar collector is used in cold climates, and there is a minor risk during the operating phase in the event of leakage. In order to utilize heat at low temperatures, a heat pump can be connected to the system. Dismantling and recycling of the solar collector is relatively easy as there is already infrastructure for handling and recycling the materials. But as with solar cells, the recycling is an energy-intensive process and shortcomings in recycling can give rise to environmentally harmful emissions (Naturvårdsverket, 2010).

WIND POWER

During the 2000's the expansion of renewable energy in Sweden has increased and in particular wind power.

Globally, wind power is today one of the fastest growing sources of energy in the world, as it is considered cheap and has a low climate impact. It can play a major role in minimizing greenhouse gas emissions and other air pollutants if it is used to replace an energy source that has a more significant impact on the environment.

Energy production through wind power turbines is strongly dependent on the right weather conditions, as the effect is proportional to the wind speed. Under the right conditions, a wind power turbine can be an effective source of energy (The Swedish Energy Agency, 2018).

The establishment and design of wind turbines is a fundamental part of minimizing any negative environmental and social impact and protect humans, animals and ecosystems that may be affected.

Indirect factors such as manufacturing, transport, installation, operation and decommissioning have indirect negative effects on the environment. But in relation to fossil energy production, the net profit is ultimately considered better (IPCC, 2011).

Seen from a life cycle perspective, approximately 12 g of CO2 is produced for every kWh of wind power that is produced. The lifespan of a wind turbine plant is on average about 20 to 25 years, and constant development in technology is made to extend the service life and thus also minimize the environmental impact (Naturskyddsföreningen, 2019a).

TECHNOLOGY FOR RENEWABLE ENERGY PRODUCTION

SOLAR CELLS

The main components of most solar cells are glass, an aluminum frame and silicon. The silicon is a thin semiconductor material that enables the capture of the sun's rays. An electrical voltage arises between the front and back when the sun's rays reach the solar cell, and with the help of an electric cable, electrons begins to move from one side to the other and thus is created and electric current (Naturskyddsföreningen, 2019b).

The research and development of solar cells is constantly ongoing and leads to an increased efficiency, both when it comes to the manufacturing process and the degree of production. There are a variety of technologies that convert sunlight into usable energy and the these are developed to suit for different conditions (The Swedish Energy Agency, 2019).

The different models differ in terms of appearance, flexibility, price and efficiency, which can also be decisive factors in a balance of suitability. The choice of solar cells should be based on the needs and conditions of the installation site. The most common types on the market today are monocrystalline solar cells, polycrystalline solar cells and thin-film solar cells. The first two account for about 95% of the total world market.

MONOCRYSTALLINE SOLAR CELLS

Efficiency: 15–22%
Material: Silica, glass, aluminum frame
Appearance: Rectangular with rounded edges and blackish tone/colour.

As the cells only consist of one crystal, it enables the electrons in the solar cell to move more freely than other types, which also contributes to a higher efficiency. Monocrystalline solar cells dominate the market and rapid technological development has also resulted in higher efficiency. The solar cell type produces a good amount of solar electricity at even low amounts of sunlight, which means that it fits well in a colder climate with limited sunlight.

POLYCRYSTALLINE SOLAR CELLS

Efficiency: 15-17%
Material: Silica, glass, aluminium frame
Appearance: Rectangular and bluish tone/colour.

As polycrystalline solar cells consist of several crystals, the electrons do not move as freely as in monocrystalline, which in turn results in a slightly lower efficiency and the price is cheaper. Generally suitable for facilities where there is plenty of space.

THIN FILM SOLAR CELLS

Efficiency: 10-16%
Material: Varying subject structure from model to model
Appearance: Flexible and adjustable, black in tone.

Thin film solar cells often require a low material consumption and different types of materials can be used during manufacture. The bendable property makes it possible to place on surfaces where the two above-mentioned types are not suitable. Common areas of use are for roofs and facade integration.

TECHNOLOGY FOR RENEWABLE ENERGY PRODUCTION

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SOLAR COLLECTORS

In a solar heating system, the solar collector collects and absorbs sunlight, in comparison to a solar cell that convert solar energy into electric current. Solar collectors are used to take advantage of the heat directly from the sun and can be used for example, to heat up water or air inside hospital buildings. There is often carrier fluid (e.g., water, air) that absorbs the heat from the sun (Naturskyddsföreningen, 2019b).

In general, the carrier fluid is primarily transferred to a storage tank through a heat exchanger that disposes the heat to the building's radiators etc. The solar collector's carrier fluid works in a circular process where it is pumped into the heat exchanger, and then pumped back to the solar collector to be reheated. Solar collectors are often used as a complement to other heating systems in buildings, as it mainly provides heat and hot water during the summer (IPCC, 2011a).

WIND POWER

A wind turbine takes advantage of the air's kinetic energy through the force that occurs when the blades in the wind turbine begins to rotate. The energy that occurs in the rotation of the wind turbine is then passed on to the generator, which eventually converts the generated energy into electricity.

In order to optimize the uptake of wind, the rotor blades should be set at the best possible angle and the use of longer rotational blades will allow a greater wind capacity to be absorbed (Västra Götaland, 2017).

Wind turbines are completely dependent on the wind and generates electricity between a wind speed of 3-25 m/s, a wind turbine generates most energy when the wind reaches a speed of 12-15 m/s. At a higher wind speed over 25 m/s, the control system in general limits the power in order to prevent an overload in the turbine (IPCC, 2011b).

The challenge with wind turbines and its electricity production is that it is not constant or has an even flow since it is dependent of the wind. During the winter months, energy consumption increases, and a colder climate can be an advantage for wind turbines as it often contributes to more wind. The location of wind turbines can both be on land and offshore. It is more technically complex at sea as the foundations must be attached to the seabed. One advantage with an offshore placement is that there is a higher wind speed and when larger turbines are used, it enables greater energy production (Västra Götaland, 2017; IPCC, 2011b).

EXAMPLES FROM SWEDEN

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REGION VÄSTRA GÖTALAND

In 2014, region Västra Götaland adopted a solar power plan which says that by the year 2030, the region will install solar cells with a capacity of 3000 MWh per year. This corresponds to 420 trips around the world in an electric car. The region's own properties account for a large part of the total energy consumption and one goal is to halve the consumption from year 1995 by 2030. That include energy efficiency measures in existing buildings during renovation and refurbishment, higher requirements for new and old buildings, and reducing the energy use in healthcare (Västra Götalandregionen, 2020a).

Solar cells are a part of that goal and the region has planned to build solar cell panels on several hospital buildings. Two examples of hospitals in Västra Götaland that have installed solar energy are Skaraborgs Hospital and Norra Älvsborgs County Hospital (Västra Götalandregionen, 2020b).

SKARABORG HOSPITAL

Skaraborg Hospital in Skövde, Region Västra Götaland has one of Sweden's largest solar cell plants with two different types of installations, one on the rooftops and one with so-called canopies in the hospital's parking lot. The roof-mounted solar cell system consists of 1,328 solar cell panels with a total installed power of 0.332 MWh (expected to produce 300 MWh of solar electricity per year).

The canopies consist of approximately 7,000 square meters of solar cell panels in the hospital's parking area (Västra Götalandregionen, 2020b). The hospital has also installed energy efficient windows, walls and ceilings, and heating and cooling of the building is adapted to the needs of the business. The building uses a quarter as much energy as an average hospital building (Västra Götalandregionen, 2020a).

NORRA ÄLVSBORG COUNTY HOSPITAL

Norra Älvsborg County Hospital in Trollhättan has the largest solar cell plant in the region, with 4,500 solar cell panels. The plant has recently been commissioned but has an expected annual production of 1.35 MWh/year (Västra Götalandregionen, 2020c). Normally, solar cells are placed facing south for the best effect, but here they have chosen to place the solar cells facing east-west to get a more even electricity production throughout the day.

The solar cell plant is built on the ground on a bed of gravel to prevent vegetation, as weeds has been a recurring problem in the past (Solkompaniet, 2020). The type of solar cells that are used at Norra Älvsborg county Hospital are monocrystalline solar cells and they are combined with electricity from Trollhättans energy network (G. Ljungberg, personal communication, 29 April 2021).

EXAMPLES FROM SWEDEN

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REGION SKÅNE

During the 2000's, Region Skåne has increased its environmental performance in many areas and the region's first environmental programme was established in 2001. Since 2009, region Skåne has only purchased the eco-labelled electricity *"good environmental choice",* a label that among other things, guarantees that all electricity comes from renewable sources (Naturskyddsföreningen, n.d; Region Skåne, 2017).

All nine hospitals within the region are environmentally certified according to ISO 14001 (Region Skåne, 2017). An investment in self-produced renewable energy has been carried out where the region owns six wind turbines of its own and has solar cell plants in seven hospitals around the region. The solar cell plants produced 800 MWh of electricity in total in 2019. In the same year, the region's wind turbines produced 64000 MWh in total, which was 9000 MWh above the set annual target (Region Skåne, 2019).

Renewable electricity will contribute to a better environment and keep the costs of electricity use down within the region and its properties. Wind turbines cover approximately 40% of the total electricity demand in Region Skåne (Region Skåne, 2021).

In 2016, the Forensic Psychiatric Centre (RPC) was inaugurated in the city of Trelleborg

RPC achieves the highest level of a certification system based on Swedish building and government regulations, i.e., Environmental Building Level Gold. Below you can read more about RPC (Region Skåne, 2016).

FORENSIC PSYCHIATRIC CENTRE IN TRELLEBORG

The Forensic Psychiatric Centre in Trelleborg has been built as a so-called passive and plus energy house, which means that the building has the capacity to produce more energy than it consumes. Wind turbines on the site, solar cells and solar heat collectors on the roof produces electricity and hot water. The building covers an area of around 11900 square meters in total.

130 square meters of solar heat collectors and 1282 square meters of solar cell panels are mounted on the roof. The solar heat collectors cover the hot water demand between March and September. They produce approximately 30 MWh of hot water per year and any overproduction can be dumped into the geothermal wells for future use. The solar cells produce approximately 170 MWh of electricity per year. The wind turbine is 25 meters high with a wing diameter of 14 meters. It produces approximately 65 MWh of electricity per year and has a power of 0.025 MW. Overproduction of electricity from wind turbine and solar cells is sold to the grid (A. Vesterberg, personal communication, 2 mars 2021).

EXAMPLES FROM SWEDEN

REGION JÖNKÖPING

Region Jönköping has since 2019 installed more than 19000 square meters of solar panels on the roofs of the county's properties, which together will produce about 3000 MWh of electricity and corresponds to 7% of the county's total need (Region Jönköpings län, 2017).

An investment was made to achieve the climate goal set based on the region's programme for sustainable development. Prior to the installation, an inventory was carried out of which of the roofs were most suitable for the placement of solar cells within the county's properties, both from a strength point of view and profitability. The inventory of the roofs resulted in several different buildings within the county that were suitable for the purpose, including three hospital roofs and seven health centres (Smålands-tidningen, 2018; Region Jönköpings län, 2017).

The solar cells on the three hospitals and seven health centres are expected to produce approximately 2000 MWh of electricity. The region uses monocrystalline solar cells in combination with purchased electricity with the *"Good Environmental Choice"* label. The produced electricity is used for heating and cooling the properties, but also for the extensive technical equipment used in the healthcare operations, for example (C. Sjöberg, personal communication, 28 April 2021).

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CONCLUSION

- Renewable energy can contribute to minimizing greenhouse gas emissions and other air pollutants and play a significant role in the transition to a fossil-free energy production.
- Both solar cells, solar collectors and wind power turbines can be used by regions or other healthcare providers to produce energy directly for their operations. Such a solution can significantly lower energy costs while also contribute to a lower environmental impact.
- Using renewable energy can help the healthcare sector to increase its environmental performance and influence other regions/hospitals to adopt a sustainable approach.
- Continuous development of research and technology in solar and wind power, leads to increased efficiency, better materials, longer life span etc.

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ABOUT NORDIC KNOW-HOW

Nordic Know-How is a report series created by Nordic Center for Sustainable Healthcare (NCSH), within the project *Platform for Internationalisation: Energy and Climate Smart Healthcare*. The project is financed by the Swedish Energy Agency.

This series consists several reports which provide an overview of good examples and best practices of sustainable healthcare in the Nordics.

Each report has a certain theme relating to a sustainability challenge in the healthcare sector. The purpose of this series is to bring Nordic practices and knowledge to international actors, spreading Nordic expertise in this field to the world.

Nordic Know-How:
#1 Nitrous Oxide Destruction
#2 Geothermal Energy
#3 Lighting
#4 Ventilation

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