



Flanders
State of the Art



THE ENERGY SECTOR IN SWEDEN

FLANDERS INVESTMENT & TRADE MARKET SURVEY

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THE ENERGY SECTOR IN SWEDEN

Introduction to the market

March 2020

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1. INTRODUCTION

Sweden's energy sector is known to be very green. It is one of the only countries in the world that has a high energy consumption, but also low carbon emissions. Already 54% of all the energy produced comes from renewable energy sources. The country mainly depends on hydropower and bioenergy to maintain its reputation of being climate friendly.

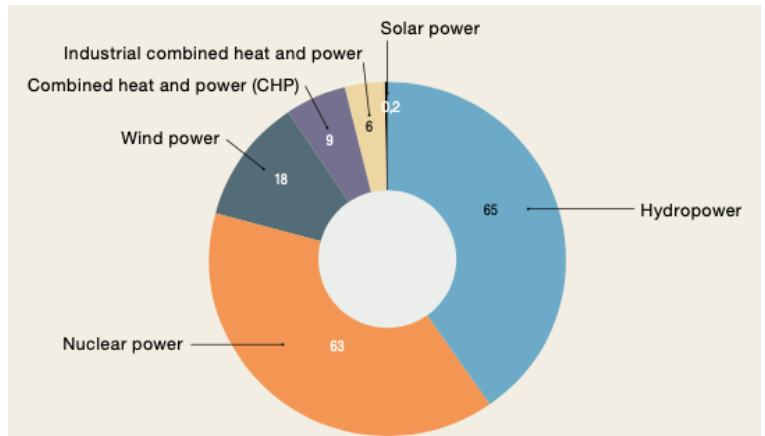
The progress of Sweden is partly thanks to the support of the government that is helping with the search for alternatives by investing huge amounts of money.

Sweden is already an example for the world, and it is heading towards an even greener future (Sweden.se, 2019).



2. THE SWEDISH ENERGY MARKET

Sweden gets 80% of its electricity from nuclear, hydroelectric power and a growing share of wind power. This last option is due to its massive supply of moving water. Nuclear power was chosen due to its relatively low carbon emission, although the political opinions are divided about the future use of nuclear power. At this moment Sweden is phasing out the use of nuclear power. From 2020, Sweden will have 3 nuclear plants with 6 operating nuclear reactors providing 40% of the country's electricity (World Nuclear Association, 2019).



Hydropower and bioenergy are currently the dominating renewable sources that the country is relying on. Sweden can therefore count on its rich supply of fast-moving water and biomass to provide the renewable energy. Hydropower is especially used to generate electricity and bioenergy is primarily used for heating (Sweden.se, 2019).

54% of its total energy consumption is currently coming from renewable sources. In 2012, they already had met the 2020 goal by surpassing 50% energy use from renewable sources. A great example of how Sweden is running ahead in the energy sector.

Sweden has one of the highest energy per capita consumptions in the world according to the International Energy Agency (IEA). In 2017, Sweden's average was remarkably higher than that of the world and Europe. On the other hand, it has also one of the lowest carbon emissions of the world. This can be explained by looking at the sources of electricity. 80% is coming from nuclear and hydroelectric power, 11% from wind power and 9% from combined heat and power plants which are powered by biofuels (Sweden.se, 2019).

The final energy use in Sweden can be divided in three main consumers. The main consumer is the residential and the service sector, being households that consume electricity and heating. The second largest consumer is the industrial sector by using huge amounts of electricity and biofuels. The third largest consumer is the transportation sector. They mainly use petroleum product such as gasoline and diesel, although the use of biofuels is increasing (The Swedish Energy Agency, 2019).

Supplied energy
incl. net export of electricity

Energy use

Electricity generation

Heat generation

Refineries etc.

Net export of electricity 12 TWh

Transformation- and transmission losses 145 TWh

Industry 142 TWh

Residential- and service 146 TWh

Domestic transport 87 TWh

Non-energy use 39 TWh

Foreign transport 34 TWh

Bunkering for foreign transport 34 TWh

Other 17 TWh

Fossil fuels 159 TWh

Biofuels 139 TWh

Heat pumps 4 TWh

Wind power 15 TWh

Hydropower 62 TWh

Nuclear power 178 TWh

125 TWh

50 TWh

87 TWh

6 TWh

107 TWh

3. DIFFERENT TYPES OF RENEWABLE SOURCES

One of the reasons of Sweden's advancements is the use of a lot of different kinds of renewable resources. The country is therefore primarily counting on its widely spread nature. The following is a list of the different resources Sweden is relying on.

3.1 HYDROPOWER

Hydropower is making use of the power of flowing water to generate energy, usually electricity. The energy can come from falling water because of the difference in height – by using a dam – or from the power of fast-running water (Muisse, sd).



The main application – electricity – is the top renewable resource Sweden is using. For this, the country can count on the rich supply of moving water. Nuclear power and hydropower are together responsible for around 80% of the electricity generated in Sweden where hydropower has a share of 45%. The main advantage is the fact that hydropower is nearly inexhaustible. Flowing water in rivers and lakes will keep

flowing, making this a source that's been used for decades already and will be used for upcoming centuries. Electricity generation depends on the weather conditions during that year, especially the amount of rain or snow. Altogether, it still gives Sweden security on their electricity supply for the upcoming years.

3.2 BIOENERGY

Bioenergy is a type of energy that is extracted from materials that come from biological sources, called biomass. Most biomass is coming from wood, followed by agricultural biomass, and the top three is closed by biowaste. It is commonly used – in order of importance – for heating, electricity, and transport fuel (Bioenergy Europe).

Sweden can count on its 63% of land that is covered in forests to get biomass, the main resource to generate bioenergy. It is together with hydropower the top renewable resource in Sweden. The bioenergy is primarily used for heating, to provide households as well for industrial purposes. 56% of the final energy use in the industrial sector comes from biofuels. In the transport sector

this percentage accounts for 19%. Yet, this is a remarkable increase compared to previous years. The residential and services sector has 14% of its final energy use coming from biofuels.

3.3 NUCLEAR POWER

Nuclear energy is the process of generating electricity by splitting atoms. During this process, water is heated into steam. This steam activates a turbine, resulting in generating electricity. Using uranium instead of fossil fuels makes nuclear power an energy source that has a low carbon footprint as during the whole process, a small amount of carbon emissions are emitted (Nuclear Energy Institute, sd).

Yet, nuclear power is a topic that is subject to divided opinions in Sweden. On one hand it is an environmentally friendly option because of the low carbon footprint. This is an important advantage to some Swedish political parties. On the other hand, managing uranium is a very delicate process that involves a lot of risks. One accident can have disastrous consequences. This argument is causing opposition from other political parties.

Sweden is phasing out the use of nuclear power. To accomplish this, Sweden once implemented a tax against nuclear energy to discourage the use of nuclear power. However, this tax was withdrawn in 2019 (World Nuclear Association, 2019). The phasing out of nuclear power brings uncertainty to some as there needs to maintain stability in electricity supply while new renewable sources are replacing the nuclear power. From 2020, Sweden will have 3 nuclear power plants with 6 operating nuclear reactors. Most of these plants are located near the sea to use the sea water for cooling.

3.4 SOLAR POWER

Solar power is using the sun to generate electric or thermal energy. The most common application is the use of solar panels to generate electricity. It can be used for industrial or residential purposes (Solar, sd).

The Swedish government is doing a lot of efforts on the development and improvement of solar power. They're doing this by means of funding, investment support, and investments in innovation and research regarding solar power (Sweden.se, 2019).



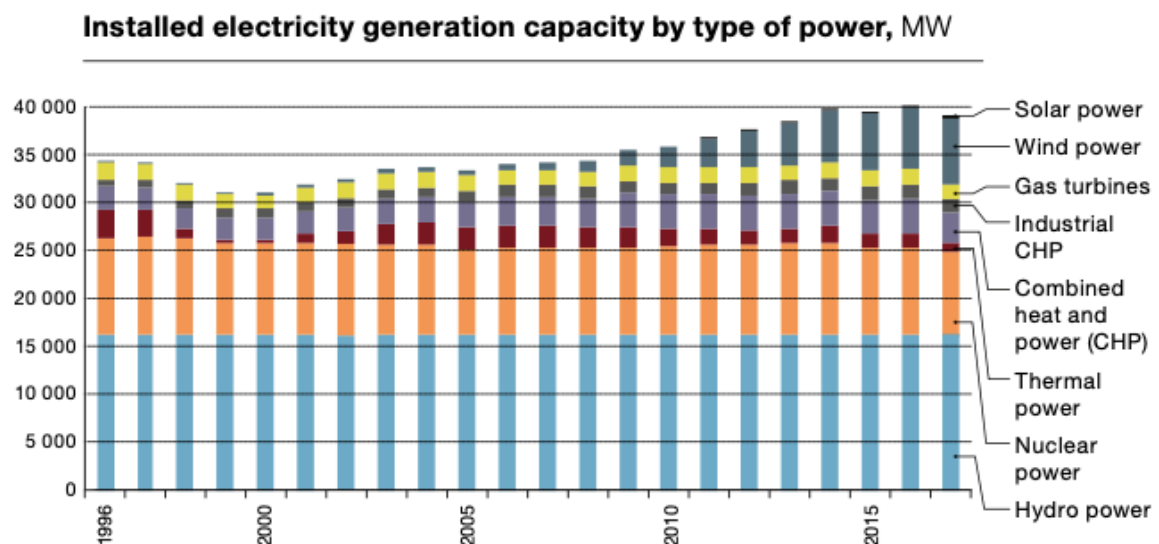
Solar power use in Sweden is increasing each year, but it's still only providing a very small portion of the yearly generated electricity. Sweden has 2 advantages for its use of solar panels. The first is its more extensive rainfall to clean the solar panels so that no dirt and dust can cover the panels. The second is the fact that solar panels produce more electricity at lower temperatures, which turns out better for Sweden (Byman, 2016).

3.5 WIND POWER

Wind power uses, as stated in the name, wind as primary source to drive turbines which generate electricity or perform other tasks like milling for example (Wikipedia, 2020). It is also a renewable source without carbon emissions, at least when operative. The installation on the other hand requires heavy, polluting machinery and the use of land and other resources. When in operation, windmills also cause disturbance to humans, animals, and the environment that are in close proximity of the turbines.

Sweden has a yearly increasing share of wind power. This is mainly caused by Sweden's goal to have a 100% renewable electricity production by 2040. The conditions in Sweden are ideal to generate electricity from wind power with their long coastline and high annual average wind speeds. Although, potential for wind power in the north is high, the cold weather opposes new challenges with ice and snow being the most important ones. Sweden has around 3,600 wind turbines producing 18 TWh, or 11% of the nation's electricity (The Swedish Energy Agency, 2019).

Below is a chart that shows the electricity generation. It is clear to see how the share of wind power is rapidly increasing.



4. ROLE OF THE GOVERNMENT

"In its energy market policy, the government aims to promote efficient and competitive markets that ensure a reliable energy supply at internationally competitive prices (Sweden, 2020)."

Being a world leader in using renewable resources is achieved with the help of the government who has offered a lot of help, such as investments and funding, in this domain (as mentioned in previous topics). Sweden is one of the countries that shows that it's possible to have environmental taxes and still achieving economic growth and welfare. The picture below shows an increase in GDP from 1990 until 2016 while also having a decrease in CO₂ emissions.

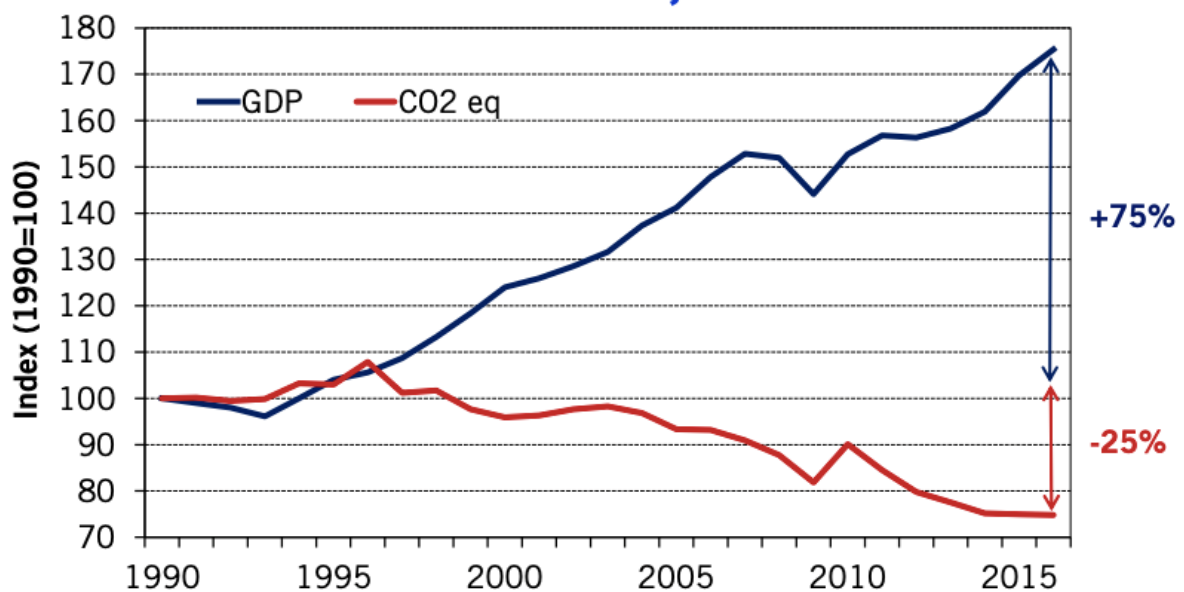
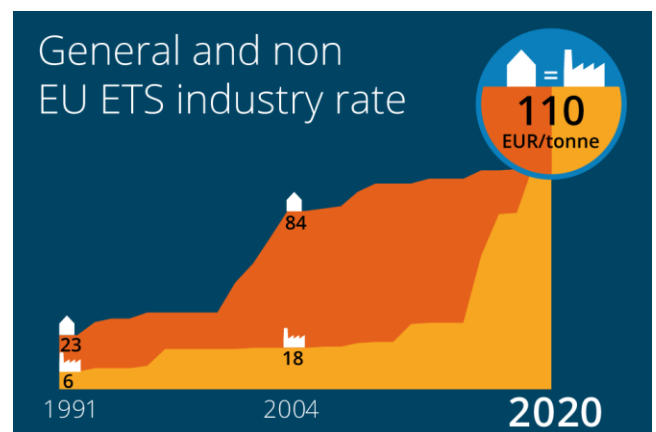


Figure 1 Real GDP and Domestic CO₂eq emissions in Sweden, 1990–2016

Below is a list of government initiatives that promote the use of renewable sources.

4.1 CARBON TAXATION

Sweden was one of the first countries to implement the carbon tax in 1991 and has the highest rate in the world. This measure contributes to the energy transition Sweden is working on to meet its ambitious long-term targets as well as the Paris agreements conditions. Levying a carbon tax results in extra revenues for the government to spend on climate enhancing measures. The tax money can for example be used to grant subsidies to companies



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5. LONG TERM GOALS

Sweden has set ambitious climate goals to achieve in the next decades. The ultimate goal and ideology to pursue is to reduce emissions in the most effective, cost-efficient way. The country's electricity generation is already largely decarbonized due the access and use of nuclear power, hydropower, and many other renewable energy sources. Also heating has a low carbon footprint by using bioenergy and heat pumps. There are three important goals they want to achieve in the long run. The first is having a zero-carbon economy by 2045. The second goal is achieving the target of using 100% renewable energy sources for the generation of its electricity. The last goal is reducing the emissions in the transport sector by 75% between 2010 and 2030.

Other goals set by Sweden include reducing greenhouse gas emissions and a more efficient energy use. The EU has set goals as well for its member states. These are roughly in line with the goals Sweden has set for itself.

6. LIST OF ENERGY-RELATED COMPANIES

Company name	Description	Specialization
Vattenfall AB https://www.vattenfall.se/english/	Swedish state-owned energy producer, leader in Scandinavia	Electricity Heating
Fortum www.fortum.se	Finnish energy supplier with major presence in Sweden	Electricity from hydropower
E.ON www.eon.se	Energy supplier	Electricity
AB Vindkraft http://www.vindkraft.com/	Contractor for wind power plant construction	Wind power
InnoVentum https://www.innoventum.se/	Company focused on the installation of renewable energy solution	Wind power Solar power
S-Solar AB http://www.ssolar.com/	Swedish company specialized in solar power applications	Solar power
Soltech Energy https://soltechenergy.com/	Supplier of energy and solar solutions	Solar power
Svebio https://www.svebio.se/en/	Swedish bioenergy association	Bioenergy
Swedenergy https://www.energiforetagen.se/	Swedish energy organisation	Energy

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