

## **An overview of the Swedish heating market with comments**

*Sweden has come far in the work of transforming energy supply and consumption into long-term sustainability. In this work, Sweden has got unique conditions through large forests, hydro power, wind power as well as good conditions to produce biogas.*

*The Swedish climate, in combination with the number of urban areas in the southern part of the country, create good conditions for efficient and climate friendly district heating. With cold winter periods, Sweden has got plenty of heat sinks, suitable for CHP production. Through carbon dioxide free electricity production in hydro-, nuclear- and wind power, as well as biofuel CHP, the fast evolution of heat pumps contributes to a climate smart heating of dwellings and non-residential premises. This is of special interest when district heating is not an alternative. Moreover, the big assets of solid biofuels allow an increased use of wood and wooden pellets for heating. From a view of national preparedness, and, considering the risk for power and/or capacity shortage in the electricity system, solid biofuels as well as local production of biogas will probably have an increasing role in the future Swedish heating market.*

*The current mix of different energy carriers and heating forms in Sweden is a big advantage. The competition in the market is a driving force for new technologies and contributes in keeping prices down to end consumers. In this document, which is mainly based on information from the Swedish Energy Agency, we give an overview of the Swedish heating market and its different elements.*

### **Total energy supply and consumption 2017**

In 2017, the total energy supply in Sweden amounted to 565 TWh with a total energy consumption of 378 TWh. The single largest part of the total energy supply consists of nuclear fuel, which is also a big part of the explanation of the difference between supply and consumption; the difference mainly consists of losses from nuclear power. The second biggest source in the Swedish energy supply 2017 was biofuels, followed by crude oil and petroleum products.

The energy consumption in the Swedish industry sector amounted to 143 TWh. The energy consumption for heating in dwellings and non-residential premises amounted to almost the same; 146 TWh. The remaining part was used in the transportation sector.

Approximately 40 % of the total Swedish energy supply in 2017 was renewable energy:

- Biofuels: 143 TWh
- Hydro power: 65 TWh
- Wind power: 18 TWh

The production of renewable biogas is increasing, but still small; around 2 TWh.

### **Heating of dwellings and non-residential premises – in general (2016)**

In 2016, the total energy consumption for heating and hot water in Swedish dwellings and non-residential premises amounted to 80,5 TWh. The largest amount, approximately 40 %, was used in single-family dwellings (from now defined as “small houses”), followed by apartment buildings 33 % and non-residential premises 27 %.

During the period 2002-2016, district heating was the most common way of heating in Sweden. With 46,3 TWh corresponding to 57 % of the heating market, district heating accounted for the largest proportion within in the sector. District heating is mainly used in apartment buildings and non-residential premises, while small houses normally use other ways of heating. In small houses, approximately 17 % of the energy consumption for heating and hot water came from district heating during 2016, compared to 77% in non-residential buildings and approximately 90 % in apartment buildings.

During the same year, electricity was the second most used form of energy for heating and hot water production, with a consumption of 20,8 TWh. Electricity is still the most common energy carrier for heating and hot water production in small houses, where the consumption for these purposes amounted to 15,3 TWh. This means that electric based heating accounted for 48 % of the total energy consumption in small houses during the year. In comparison, electricity based heating accounted for 16 % of the total energy consumption in non-residential buildings, and only 8 % in apartment buildings.

Solid biofuels (district heating excluded) were the third most used energy carriers in 2016 within the heating sector, with a total energy consumption of 11,4 TWh, corresponding to 14 % of the total energy consumption for heating and hot water. In general, solid biofuels is used in small houses – almost 92 %. Only 8 % of the solid biofuels were used for heating and hot water in apartment buildings and non-residential buildings.

Historically, oil was the most common way of heating during the 1950:s until the late 1980:s. Between 2002 and 2016 the consumption of oil in this sector decreased from 14,8 TWh to 1 TWh.

### **District heating and CHP**

The Swedish market for district heating consists of several local, and natural, monopolies. Competition in network business is not allowed, whether it is district heating, electricity or gas. The markets for electricity and gas in Sweden are parts of the internal market within EU. Even if it is possible with third party access to district heating networks in Sweden (negotiated or regulated), the end user in a district heating network is (normally) not able to choose supplier. On the other hand, there is of course competition between district heating and other products and services in the heating market. Because of this, the pricing of district heating normally considers the prices of the alternatives. It is a free market, which means that the end user is free to cancel the agreement in accordance with the current terms.

No one is forced to connect to district heating. However, the number and size of the end users connected are important in order to achieve efficiency and profitability. In order to take advantage of the benefits of CHP, it is necessary with marketing of both heat and power. Of course, this is considered while setting the price for the heat. According to the organization Swedenergy, CHP accounts for approximately 9 % of the electricity production in Sweden today.

## Electricity and heat pumps

In 2016, the number of heat pumps in dwellings and non-residential buildings amounted to approximately 1 342 000. The most common type (533 000) was air/air heat pumps, followed by geothermal heat pumps (485 000). The remaining part consists of air/water- as well as exhaust air heat pumps.

96 % of the heat pumps were installed in small houses during 2016, and the number of small houses with, at least, one heat pump installed, increased with nearly 50 % between 2009 and 2016. There are several reasons for the increase; the heat pumps are getting more and more efficient, they are normally easy to get installed and the electricity prices in Sweden have been reasonable during a longer period. However, the conditions might change quickly.

An arising problem in the Swedish electricity market is the risk of lack of power and/or capacity in the electricity system. This is an issue, not only for the national electricity transmission system, but also for the regional and local network systems. There are several reasons for this. The hydro power stations (producing approximately 50 % of electricity in the market) are to a large extent situated in the very northern part of Sweden, while most of the end users are found in the southern part of the country. As Sweden is a long country, roughly 1600 km from north to south, the transmission network is a crucial, and of course, limiting part of the system.

The Swedish nuclear power plants are all situated in the south, which of course is an advantage from a power- and capacity perspective. Today, there are three remaining nuclear powerplants in Sweden (Forsmark, Oskarshamn and Ringhals, Barsebäck near the Danish border is closed) with eight reactors in total. On January 1 2020, one of the four reactors (R2) in Ringhals will shut down and one year later another reactor (R1) is planned to shut down. Today, the four reactors in Ringhals produce approximately 50 % of the nuclear power electricity in Sweden.

There is a fast electrification of Sweden. In combination with a decreased electricity production in the remaining nuclear powerplants, it is important to achieve more capacity in the electricity networks and to use electricity in applications only where it is necessary. For this reason, biofuels and gas will, probably, become even more important in the Swedish heating market.

## Solid biofuels

As mentioned above, the energy consumption from biofuel amounted to 11,4 TWh in the heating of dwellings and non-residential premises. Even though solid biofuels is a common form of heating in Swedish small houses (as well as combinations of solid biofuels and heat pumps), the number of solid fuel furnaces have successively decreased during the last 20 years. A reason for this is the rapid development of heat pumps resulting in easily installed, high efficiency heating solutions.

According to the Swedish Environmental Protection Agency, there were about 173 300 wood logs boilers installed in Sweden in 2017 and roughly 82 200 wooden pellets boilers. Among the wood boilers, the main part (97 350) consists of old, conventional boilers.

While the number of solid fuel boilers (connected to the heating system of the house) is decreasing, there is an increase in the number of solid fuel space heaters in Sweden. According to the National Board of housing, planning and building, the number of solid fuel space heaters has increased from 966 000 in 1998 to 1,8 million in 2016.

## Gas

Compared to the rest of the EU, the Swedish consumption of gas is to be considered as very low. Gas has historically been a politically sensitive issue in Sweden. For example, through a parliament decision in the end of the 1980:s, the Swedish state is not allowed to own any network for the transmission or distribution of gas.

As one of the first countries in the world to introduce the carbon dioxide tax (1991), and with high ambitions for the transformation of the energy system into long-term sustainability, the introduction of natural gas on a big scale in Sweden is not considered as an alternative. Furthermore, there is a clear aim not to become dependent of Russian gas supplies. As known, Sweden chose not to connect when Nordstream was built.

The downside of this is that gas infrastructure is a necessary component in order to achieve a big scale production and use of renewable biogas. Compared to the Swedish electricity market where the Swedish state through Svenska kraftnät owns the transmission network, the development of the Swedish gas market (and the local networks) has been relatively slow and limited, financed by municipalities and private investors.

According to the Swedish Gas Association "Energigas Sverige", the total supply of natural gas in Sweden amounted to 12,1 TWh in 2017, and it was mainly used within the industry. In the same year, the domestic production of biogas amounted to 2,1 TWh, with a total consumption of 2,9 TWh, import included.

Natural gas and biogas consist of the same molecules, methane, and the two gases are normally mixed in the transmission and distribution networks. The largest gas network in Sweden "Västsvenska gasnätet" is connected to Denmark and extends from Trelleborg in south up to Stenungsund in the southwestern part of Sweden. The network and the gas market related to it, is a part of the internal market for gas within the EU. However, beside this network, there are 28 additional local gas networks in Sweden which mainly are used for the distribution of biogas.

According to the Swedish Gas Association "Energigas Sverige", the biogas amount of the gas for heating is approximately 60 % in average. In the largest local gas networks, Stockholm and Linköping, the biogas amount is as high as 70 % and 99,7 % respectively. In those networks, natural gas mainly used as backup.

In 2016, the total consumption of gas for heating of dwellings and non-residential premises amounted to 0,8 TWh which corresponds to approximately 1 % of the energy consumption within the segment. The consumption in small houses and apartment buildings amounted to roughly 0,3 TWh respectively during 2016, with the rest used in non-residential buildings.

With respect to the ongoing shut down of nuclear power in combination with the fast electrification, local produced biogas will most probably be a more important component in the future Swedish heating market, together with solid biofuels and biofuel CHP.

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Interview with *Energiföretagen Sverige*

Interview with *Energigas Sverige*