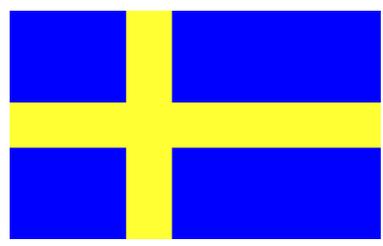


Development and promotion of a transparent European Pellets Market
Creation of a European real-time Pellets Atlas

Preliminary pellet market country report SWEDEN



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1. Introduction

The Swedish wood pellet market is one of the worlds largest and especially in relation to the number of inhabitants the consumption of wood pellets is significant.

Strong drivers provide for wood pellets being used in all sizes of combustion plants from small boilers in single family houses and small heating centrals for residential houses, public service buildings and industry over medium sized district heating plants up to large power plants producing power and heat for large district heating systems.

In 2008 the total wood pellet consumption in Sweden was around 1.85 million tonnes.

Pellet production has been running in Sweden since 1982 and is to a large extent based on residues from the numerous wood processing industries. Even though some producers are experiencing decreasing production due to changes in the feedstock availability the capacity is expected to increase in the years to come.

2. History of market development

In Sweden district heating is very common and is used in most cities and towns. The utilisation of wood pellets started in the district heating sector in the 1980'es where fossil fuel (mainly oil) fired heating plants were converted to solid biofuels. During ten years the annual biofuel consumption in the sector developed from 1.1 PJ to 57 PJ. In 2008 around 200 district heating plants used biofuels for heat production, for many of them the main fuel is pellets.

The development in the district heating sector provided for a pellet market with surplus pellets which could be used in individual boilers for space heating in private dwellings, public institutions and other large buildings. The main driver would be a taxation system that is favourable to biofuels (biofuel tax exemption in combination with high taxes on fossil fuels for heating purposes). From the mid 1990'es the development in the residential sector gained speed and during 10 years wood pellet heating grew from next to nothing to 80,000 households. In the following years the growth has continued - in 2008 around 120,000 households had pellet boilers. Another 20,000 had pellet stoves. On top of this around 4,000 medium sized boilers were in operation in Sweden.

Large scale consumption of pellets takes place in large district heating plants and CHP plants. These plants have gradually reduced their consumption of fossil fuels during the 1970-90'es due to energy taxes on fossil fuels. Many district heating plants switched from combustion of oil to coal, and after the introduction of the CO₂ emission tax in 1991, they are now switching from coal to biofuels, such as pellets. Another important factor to this development is the introduction of the electricity certificate system in 2003 in order to make the use of renewable energy more competitive. The system has made production of electricity from renewable energy sources more profitable in the large-scale segment where the majority of plants use biomass.

Wood pellet production in Sweden started in 1982 in Mora in order to accommodate the demand from the district heating plants. The production stayed at a low level for some time as the government was in favour of electricity from nuclear facilities and the attractive price relation based on fossil fuel taxes had not yet been built. When this happened in 1991 the demand and production increased steeply.

The production is to a large extent based on residues from the numerous sawmills and wood processing industries and the production facilities situated at or close to the feed stock generating industries. Pellets are produced at almost 100 sites, however the vast majority is produced by one third of these.

3. Pellet production

As mentioned above the Swedish wood pellet manufacturing companies vary in size and comprise small, locally based pelletising plants as well as large dedicated pellet plants operating close to all available hours.

Currently around 94 companies/plants produce pellets in Sweden. The total production capacity is shown in Figure 1. The capacity is currently increasing as large market actors - energy companies and paper companies - are commissioning facilities each with capacities over 100,000 t/y.

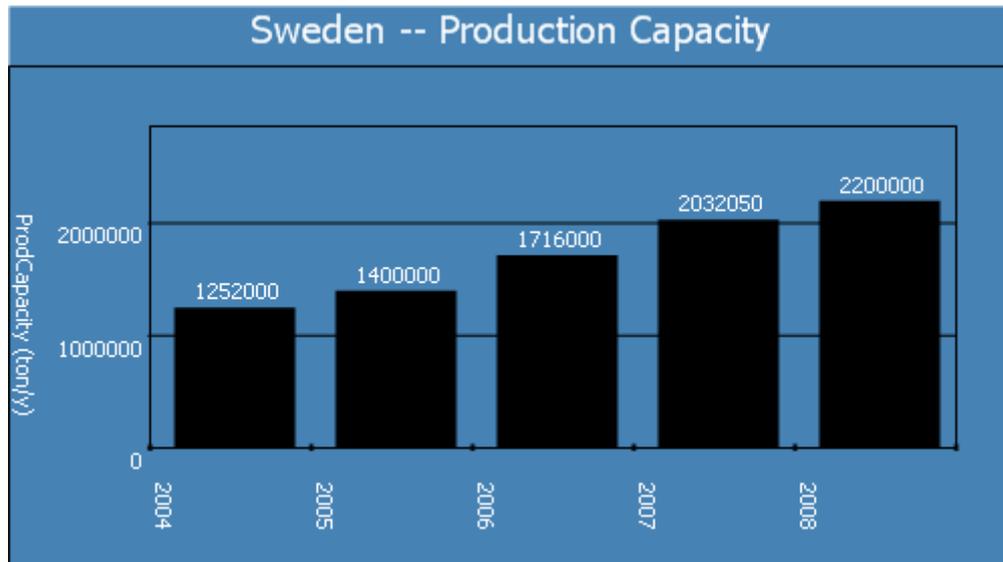


Figure 1: Wood pellet production capacity in Sweden. Source: PELLETS@LAS.

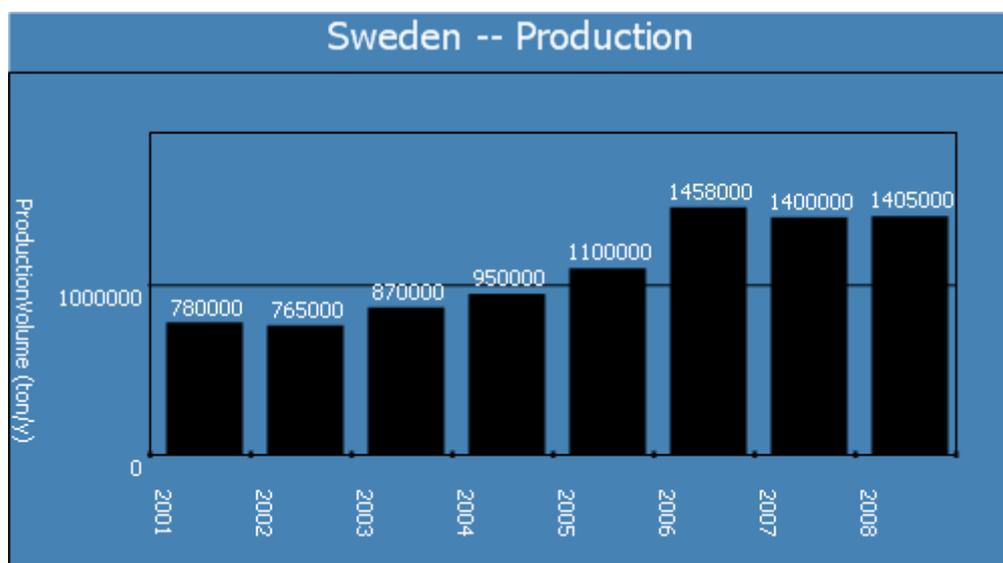


Figure 2: Wood pellet production in Sweden. Source: PELLETS@LAS.

In Sweden a wide range of raw materials are used in wood pellet production; sawdust, shavings, wood chips and other forestry by-products. While some actors increase capacity other manufacturers struggle with the access to raw material as

sawmills have been reducing activity. The raw material issue seems to be visible in the actual production development as can be seen in Figure 2.

In Sweden the Swedish Pellet Standard - SS 18 71 20 - was established in 1999. The standard classifies the fuel into three groups. The first (Group 1) is designed to fit the high quality needs of the small-scale segment for use in one or two family houses. Group 2 and 3 are designed to fit the needs of large-scale industrial users that do not need the highest quality. Three fourths of the pellets produced in Sweden meet the Swedish standard. Mainly small manufacturers do not follow any formalised standard.

Table 1: Classification of fuel pellets according to SS 18 71 20

Property	Test Method	Unit	Group 1	Group 2	Group 3
Dimensions: diameter and length in producer's store	By measuring at least 10 randomly selected fuel pellets	mm	To be stated as max 4 times Ø	To be stated as max 5 times Ø	To be stated as max 5 times Ø
Bulk density	SS 18 71 78	kg/m ³	≥ 600	≥ 500	≥ 500
Durability in producer's store	SS 18 71 80	Weight of fines < 3 mm, %	≤ 0.8	≤ 1.5	> 1.5
Net calorific value (as delivered)	SS-ISO 1928	MJ/kg	≥ 16.9	≥ 16.9	≥ 15.1
		kWh/kg	≥ 4.7	≥ 4.7	≥ 4.2
Ash content	SS 18 71 71	% w/w of DM	≤ 0.7	≤ 1.5	> 1.5
Total moisture content (as delivered)	SS 18 71 70	% w/w	≤ 10	≤ 10	≤ 12
Total sulphur content	SS 18 71 77	% w/w of DM	≤ 0.08	≤ 0.08	To be stated.
Content of additives		% w/w of DM	Content and type to be stated.		
Chlorides	SS 18 71 85	% w/w of DM	≤ 0.03	≤ 0.03	To be stated.
Ash dissolution	SS 18 71 65 / ISO 540	°C	Initial temperature (IT) to be stated.		

4. Pellet trade and logistics

Apart from being a large manufacturing country, Sweden also is a large wood pellet importing country. For the last five years, Sweden has imported between 300,000 and 400,000 t/y. The pellets are imported from Canada, Poland, Finland and the Baltic Countries.

Some Swedish manufacturers also export pellets. Up to 150,000 t/y have been exported during the last years - the majority being shipped to Denmark and to the United Kingdom. The total amount of pellets imported, exported and delivered to the Swedish market during the period 1997-2008 is shown in Figure 3.

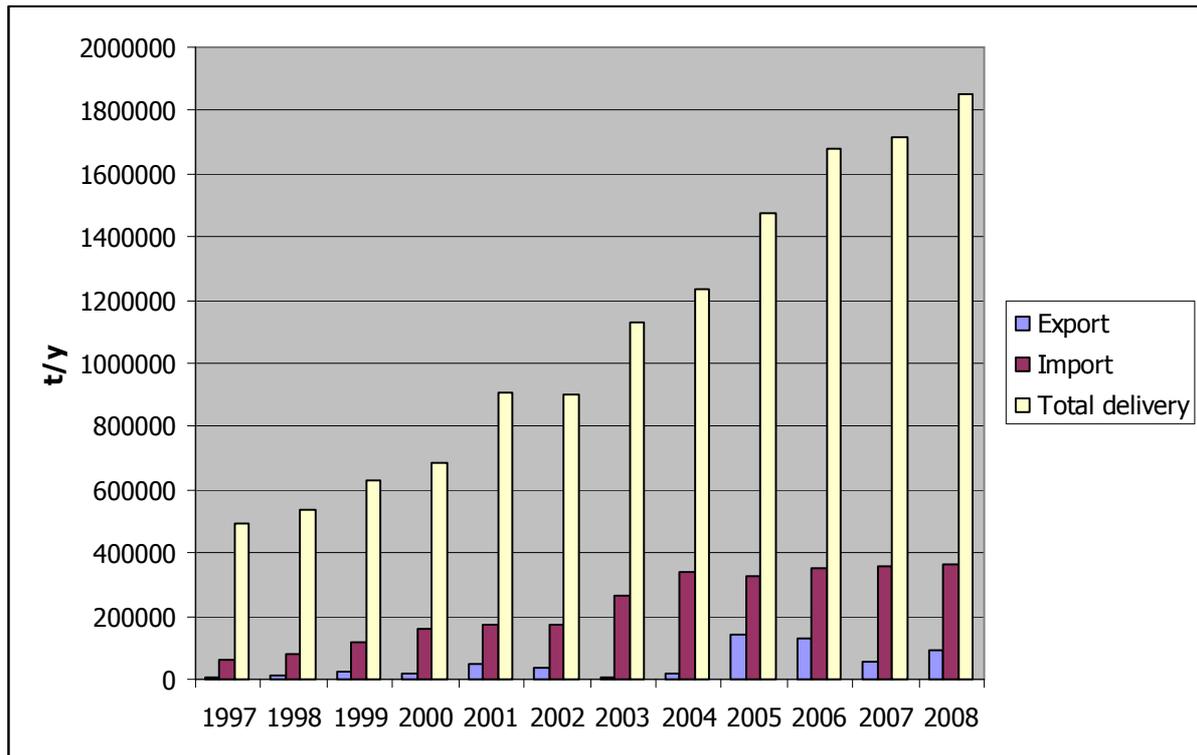


Figure 3: Amount of wood pellets imported, exported and delivered to the Swedish market 1997-2008. Source: PIR

Being a very well developed pellet market, all types of transportation modes and delivery types are in place.

Transportation for the domestic market is done by trucks, rail and sea. Most of the pellet importation to Sweden is by cargo ships. In the European market area ship loads are typically 4,000 - 6,000 tonnes, with the overseas shipments being in large volumes of usually 20,000 - 30,000 tonnes.

For retailers selling to residential consumers pellets are delivered in bags of 16 or 25 kg, typically packed on pallets. Delivery to the consumer may also take place by blower lorries or tipping lorries, especially for medium sized consumers.

Some manufacturers are selling pellets in bulk straight from the plant and deliver pellets by lorry, train or cargo ship. Around 180,000 t/y pellets are delivered by ship to southern Sweden mainly to large heat and power plants close to Stockholm and Helsingborg. Deliveries have some synergy effect since the ships transport pellets to the South and transport round wood on the return trips.

5. Pellet consumption

Efficient drivers provide for wood pellets being used in all sizes of combustion plants from small boilers in single family houses and small heating centrals over medium sized district heating plants up to large power plants producing power and heat for large district heating systems.

In 2008 the total consumption was around 1.85 million tonnes. Please refer to Figure 3 for an overview of the development over the years of the total wood pellet consumption.

Around 60 percent of the Swedish wood pellet consumption takes place in small and medium sized pellet boilers for heating purposes and district heating plants (2008). Large district heating plants and CHP plants together account for the remaining 40 percent of the present consumption.

Pellet prices in Sweden have remained constant at a high level for a long period and have not been sensitive to the changing crude oil prices during 2008. From the end of 2008 the pellet industry has seen increasing prices of around 13 percent. The development is visible on Figure 4 which shows the index price for bulk delivery of 3 tonnes of pellets for a residential consumer. Index 100 is around 255 €/t incl. VAT.

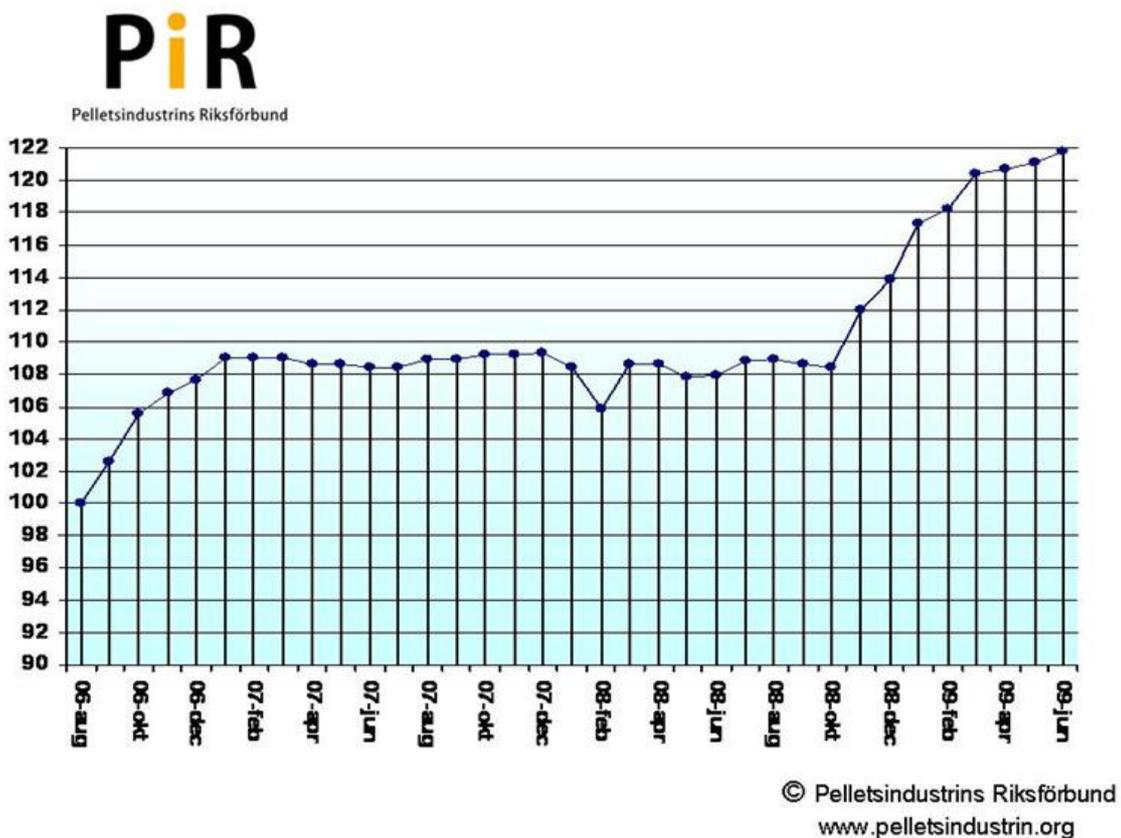


Figure 4: Swedish pellet price index. Average price per tonne of pellets delivered in bulk for residential customer. Source: PIR

6. Mixed biomass pellets

The straw potential in Sweden is presented in the table below. The residues mainly origin from wheat, barley, oats and mixed cereals. The total amount of agricultural residues is 5.2 million tonnes corresponding to an energy resource of approximately 21 TWh.

Table 2: Agricultural residues potential, Sweden, 2000.
(pelletcentre.info)

Agricultural residues potential	1000 t
Wheat	1731
Durum wheat	0
Rye	226
Barley	1703
Oats and mixed cereals	1402
Maize	0
Other cereals	207
Total	5269

The Swedish University of Agricultural Science in Umeå has analysed that the annual energy use of agricultural biomass in 2004 amounted to 1.1 TWh corresponding to approx. 1 % of the total biomass consumption for energy purposes.

Sweden has almost no production of MBPs for fuel purposes. Sweden is a wood industry country and has abundant wood residues that can be used for fuel purposes without the technical obstacles that MBPs may have. However, some development is visible.

At the Swedish University of Agricultural Science in Umeå a pilot-plant for pelletising reed canary grass has been tested. The capacity is 400 kg/h. The pellets were used in an internal heating plant for examining combustion properties. The main problems discovered were high ash content and low and varying ash melting temperatures.

In the ongoing EU-LIFE project "BIOAGRO" Swedish companies are aiming to promote the use of MBPs. The BIOAGRO project will "demonstrate an innovative method to reduce the discharges of greenhouse gases by using energy from grain, waste from grain, seed and grass to produce heat". In more concrete terms a MBP pelletising line is installed at the seed and grain producer, Skånefrö AB along with a combustion line producing heat. More info is available at www.bioagrolife.se.

7. Legal framework & Policy

Drivers

Large scale: The main driver for converting from fossil fuel combustion to combustion of solid biofuels in large scale facilities was the carbon dioxide tax that was introduced in 1991 and made fossil fuels more expensive. The current framework conditions for large scale electricity production based on renewables in Sweden are given by an electricity certificate system combined with renewable obligations (quotas) and exemption from CO₂-taxes.

The electricity certificate system intends to promote “green” electricity production in Sweden. For each MWh sustainable produced electricity the producer qualifies for one certificate. In order to create a demand for certificates the Swedish end-users have since 2003 been committed to buy a certain amount of certificated electricity. This share will increase every year until 2010.

In 2006 the system had resulted in that 5.7 TWh out of a total electricity consumption of 146 TWh was produced on basis of renewables.

In addition to the certificate system the CO₂-tax for fuels emitting fossil carbon makes it more profitable to use biomass than fossil fuels. There is also financial stimulation in place for biomass co-firing, but due to a lack of coal-fired power plants in Sweden, co-firing is mainly used on gas- or oil-fired plants.

Medium scale: In the medium scale market a tax deduction scheme is in place. The scheme is effective for publicly owned buildings, allowing building owners to deduct 30% of the investment in taxable income. The scheme was still effective in 2008, after this the future of the scheme is uncertain.

There are no other grants available for investments in wood pellets fired boiler systems for industry, district heating or other medium scale installations. Regarding energy taxes and VAT, the same mechanisms apply as for small scale installations - please see below.

Small scale: In the small scale world, wood pellets for heating purposes are generally attractive due to the high energy tax on fossil fuels for heating. The previous income tax deduction scheme to support private households investments in renewable energy is no longer effective.

Fossil fuels are heavily taxed in Sweden, while biofuels, including pellet, are exempted from energy tax. The high taxes are the basic mechanism that supports the strong development of biomass markets in district heating and in individual households.

The Swedish VAT rate is the same - 25 percent - for all fuels, fossil or biological, so this is not an incentive.

Swedish emission thresholds for combustion of wood pellets

The emission thresholds that apply to combustion of wood pellets in Sweden are formulated locally by municipalities or regionally by the regional governments.

In a guide from 1987 regarding solid fuel fired plants from 500 kW to 10MW fuel input, the Swedish EPA has the threshold values for particulate matter that appear from table 7.1. However, the EPA states on their website that with all the current focus on particles, the values for new plants should be lower.

Table 3: Swedish guide for threshold values for particulate matter (mg/Nm³ at 7,6 % O₂), 1987.

	Plants 0,5 - 3 MW	Plants 3 - 10 MW
Within densely built-up areas	100	100
Outside densely built-up areas	350	350

For large scale applications with a nominal fuel input over 50 MW the governmental order NFS 2002:26 applies. The thresholds have been described thoroughly on pages 7-11 in Martti Parikka's country report described in paragraph 10 which can be found on <http://eubionet2.ohoi.net/ACFiles/Download.asp?recID=4094>.

For plants that annually generate 25 GWh useful energy, the emission of NO_x is regulated by a NO_x-taxation system. The current tax is 50 SEK/kg NO_x emitted.

8. Projections on future development

The Swedish wood pellet market will grow significantly in the years to come - both on the consumption side and the production side.

The demand in the residential sector can be expected to increase due to high fossil fuel prices and high fossil fuel energy taxes. The pellet industry predicts a 50,000 t/y increase for the next years. Thus, the demand is expected to reach around 900,000 t/y in 2012. Furthermore, a positive development is expected to take place in larger heating systems in the commercial and industrial sector that has only recently seen stronger interest for renewable energy fuels.

The present large scale consumption level of approx. 0.8 million tonnes is expected to decrease slowly in the coming years as some plants are looking for a higher degree of fuel flexibility. In total, the pellet industry predicts that the consumption in Sweden in 2012 will be 2.65million t/y.

On the production side the capacity is already larger than the domestic demand. Current plans of very large market actors provide for a further large production capacity increase. The logical conclusion is that Sweden is preparing to serve a part of the growing pellet market elsewhere in Europe. This will come true provided the raw material situation is handled well.

9. Summary and conclusions

With an annual wood pellet consumption of 1,850,000 tonnes and a population of 8 million, the per capita wood pellet consumption in 2008 exceeded 230 kg per person. Although this figure provides evidence for the mature character of the Swedish pellet market, there is still a high potential for the market to grow.

The growth will take place in the residential sector and in medium sized industrial heating appliances, while in the utility sector wood pellets seems to be replaced by other solid biofuels.

The growth in the Swedish wood pellet market is expected to mainly be supplied via domestically produced pellets. The sector is furthermore expected to grow to export for the increasing pellet demand elsewhere in Europe.

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