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Contents

An overall picture of the energy situation in Sweden

The Swedish Energy Agency intends, with the publication Energy in Sweden and the collection of figures Energy in Sweden – Facts and Figures, to provide an overall picture of the current situation in and development of the energy sector in Sweden.

Energy in Sweden contains information about the final use and total supply of energy, energy prices, energy markets and fuel markets, as well as current energy and climate policy.

The figures in the energy balance, user sectors and district heating market are based on official statistics up to and including 2011. The figures concerning the electricity market, fuel markets and energy prices cover the period up to the end of 2012. Energy in Sweden 2013 also includes current events in the energy sector as of spring 2013.

More information about the Swedish Energy Agency's statistical responsibilities is available on our website.

Energy balance

The energy system is always in balance. This means that the amount of energy supplied is constantly the same as the amount of energy used, including losses. Demand for energy has increased in recent years, which means that the total amount of energy supplied has also increased.

The energy system in balance

We live in a society that is strongly dependent on energy. Energy is required in order to, for example, heat buildings when it is cold outside or coo buildings when it is hot. We need energy for lighting, equipment and transport, as well as for the production and distribution of goods and services.

The Swedish energy system is based partly on domestic sources of renewable energy such as water, wind and biofuels. In addition, a large proportion of the energy supplied is dependent on imports such as nuclear fuel for electricity production in nuclear reactors and fossil fuels like oil and natural gas for the transport system. Swedish electricity production is based to a large extent on hydro-power and nuclear power, but the use of biofuels for electricity production and heating is constantly rising.

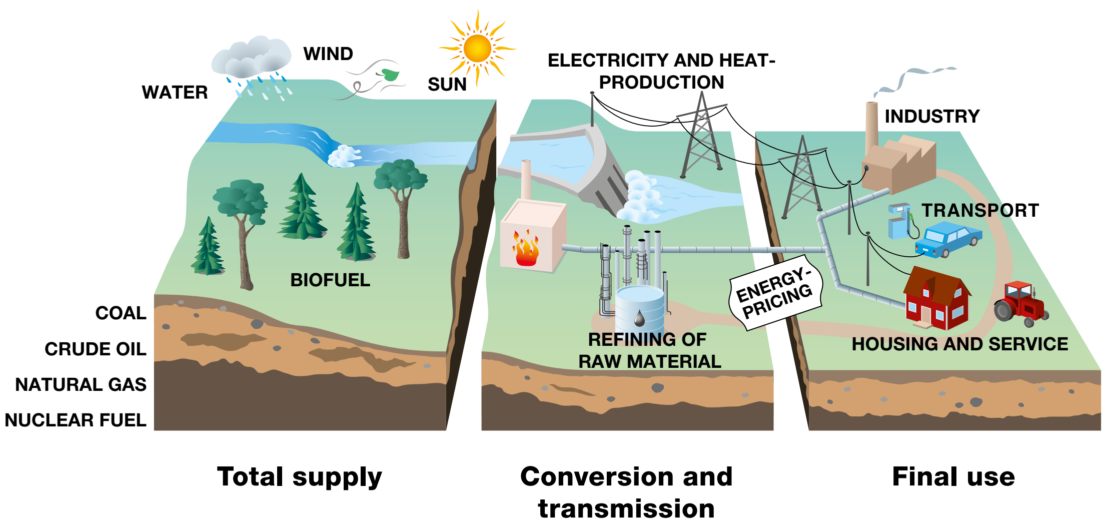
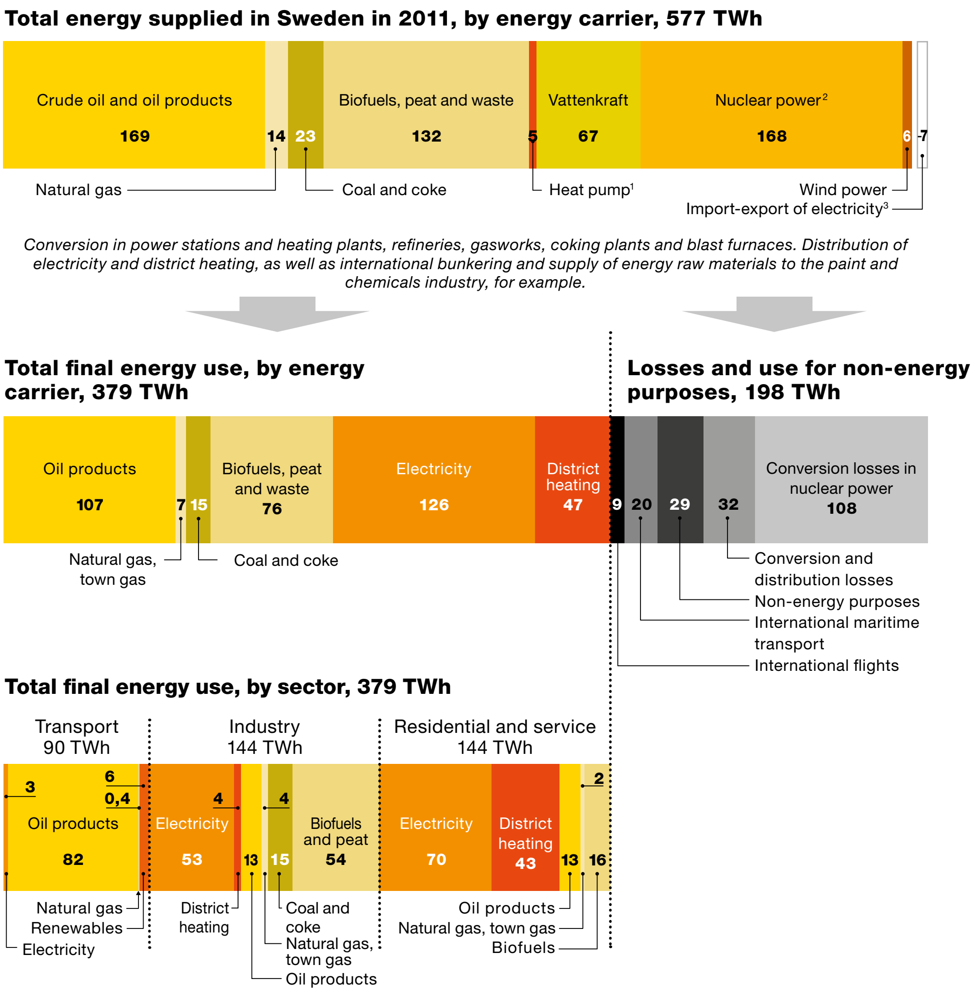


Figure 1 provides a simplified overall view of the Swedish energy system, from total supply to final use.

Figure 1 Total energy supply and final use in Sweden in 2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

Notes 1. Heat pumps are large heat pumps in the energy sector.

2. Nuclear power energy quantity figures are reported gross, i.e. as supplied nuclear fuel energy in accordance with UNECE guidelines.

3. Net imports of electricity are counted as supply.

Total energy supplied

The annual supply of energy in the Swedish energy system is about 600 TWh. In 2011, the amount of energy supplied was 577 TWh. Fossil fuels accounted for about one third, 206 TWh, of the total. Oil products, natural gas, town gas, coal and coke accounted for 129 TWh of the total, with the remainder being made up of losses and use for non-energy purposes.

A total of 132 TWh of the energy supplied in 2011 came from biofuels, peat and waste, with peat accounting for 4 TWh and waste for 13 TWh.[1] The district heating and industrial sectors are the largest users of biofuels, but a small proportion of the total is used as transport fuel.

Electricity production from hydro-power and wind power was 67 TWh and 6 TWh, respectively, in 2011. Wind power's contribution to electricity production increased by more than 70 per cent compared with 2010. About 30 per cent of the energy supplied, 168 TWh, came from nuclear fuel. Of this, 60 TWh was converted to electricity and the rest was accounted for by conversion losses.

Total final energy use

In 2011, total final energy use amounted to 379 TWh, which is a reduction of 4 per cent from 2010. The industrial sector and the residential and services sector each used the same amount of energy, 144 TWh.

This is a reduction of about 7 per cent for the residential and services sector compared with 2010. Energy use in the residential and services sector is affected in the short-term by, primarily, the outdoor temperature as a large proportion is used for heating. Energy use in the transport sector amounted to 90 TWh, which is almost the same as in 2010.

Electricity is the dominant type of energy used in Sweden, and total final electricity use in 2011 was 126 TWh. The residential and services sector used the largest amount of electricity, followed by the industrial sector. Oil products constitute the second largest energy carrier after electricity, and their total final use amounted to 109 TWh. In Sweden, oil products and gas are used almost exclusively in the transport sector.

1 Electricity supply, district heating and supply of natural and gasworks gas 2011. EN11. Swedish Energy Agency.

Losses, international transport and use for non-energy purposes

Losses, international transport and use for non-energy purposes constitute the difference between the energy supplied and the energy used. International transport is comprised of both maritime transport and flights. Certain energy products included among the supplies of crude oil and the imports of oil products may be used in industrial process such as the manufacture of plastics, rather than being used as energy.

In 2011, losses etc. amounted to 198 TWh, which is a reduction of about 10 per cent compared to 2010. About half of the losses, 108 TWh, consist of the energy lost through cooling in nuclear power plants. Other losses, equivalent to 17 TWh, arise in heating plants and combined heat and power (CHP) plants or as distribution losses in the delivery of electricity and district heating. In 2011, the estimated transmission losses were 9 TWh in the electricity network and 6 TWh in the district heating network.[2]

In 2011, 29 TWh were used for non-energy purposes, which includes raw materials for the chemicals industry, lubricants and oils used in construction and civil engineering. International flights and international maritime transport accounted for 9 and 20 TWh, respectively.
Losses also arise in the final use of energy. These losses are accounted for separately in each of the user sectors. The losses that arise in hydro-power and wind power production are not included in the energy balance.

2 Electricity supply, district heating and supply of natural and gasworks gas 2011. EN11. Swedish Energy Agency.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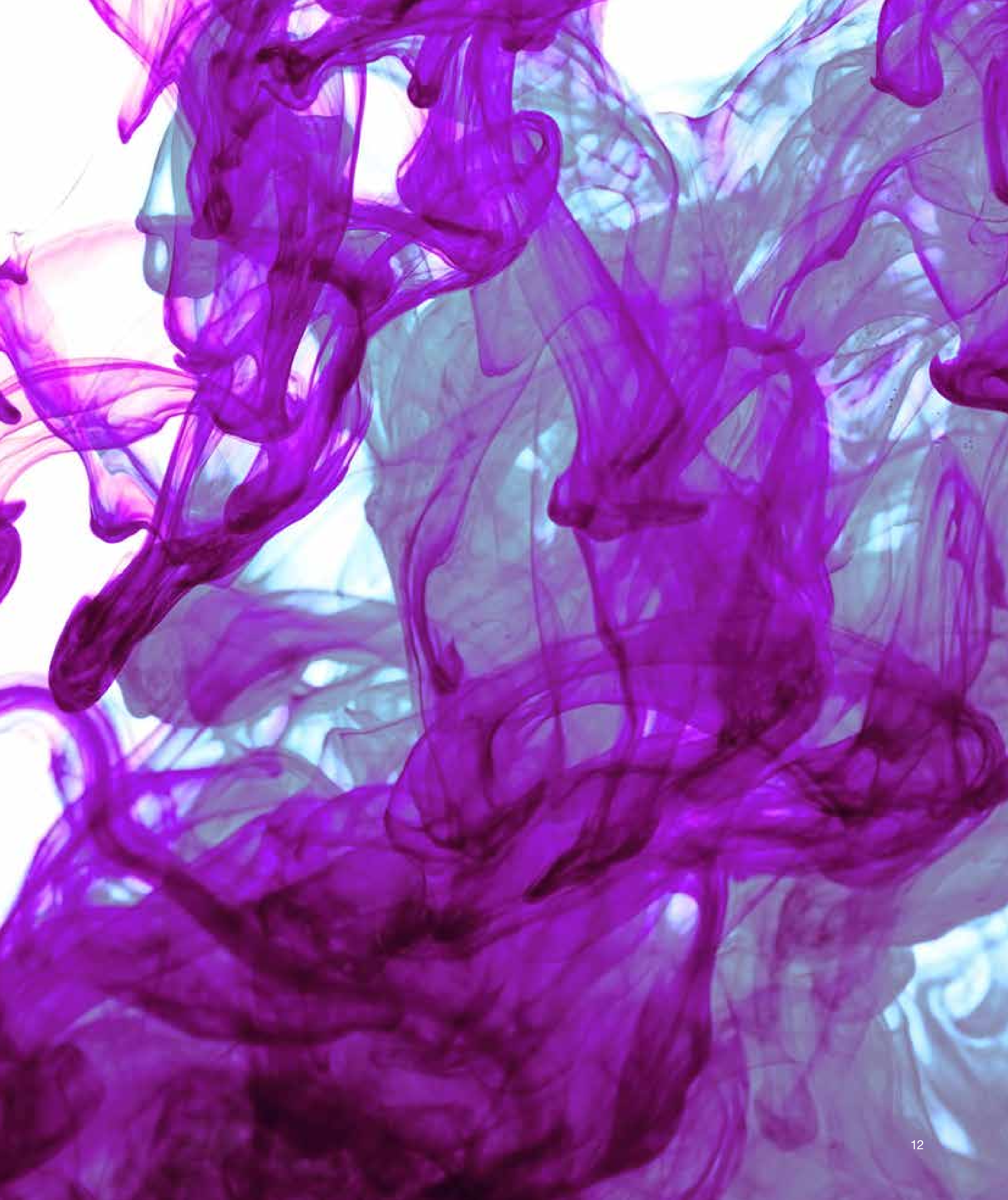
User sectors

All sectors of society are highly dependent on energy. For example, we need energy for heating, for transport and for the production of goods. The use of energy within the residential and services sector and the industrial sector has remained relatively constant over the last 20–30 years. Recent developments indicate that energy use in the transport sector, which has been increasing substantially since the 1970s, is about to decline.



Residential and services sector

In 2011, energy use in the residential and services sector was 144 TWh. This is equivalent to 38 per cent of Sweden's total final energy use. The residential and services sector consists of residential buildings and non-residential premises, land use and other services. Land use includes agriculture, forestry, horticulture and fisheries. Other services include the construction sector, street lighting, sewage and water treatment plants, as well as power stations and waterworks.

Residential buildings and non-residential premises account for about 90 per cent of the energy used in the residential and services sector. Close to 60 per cent of the energy used in residential buildings and non-residential premises is used for heating and to provide hot water. The need for heating is affected by the outdoor temperature, which can lead to large variations in energy use from year to year. A cold winter results in increased energy use for heating, while a warm winter results in decreased energy use. Temperature correction, a statistical correction for temperature variation, is often performed to enable a comparison to be made between usage from year to year, independent of outdoor temperatures. In 2011, which was, on average, 13 per cent warmer than a normal year the temperature-corrected energy use amounted to 154 TWh.

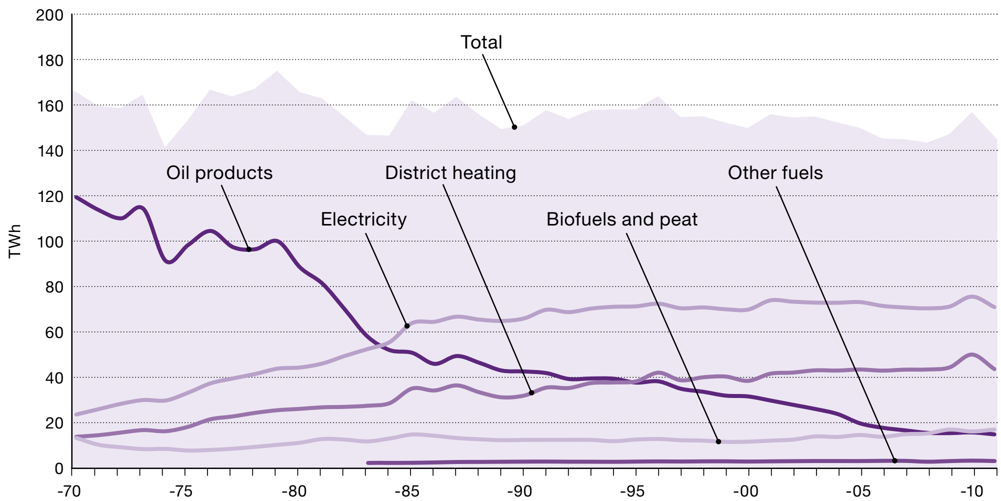
Close to 60 % of the energy used in residential buildings and non-residential premises is used for heating and to provide hot water.

Decreased energy use during the 2000s

Over the course of the past decade, a transition has taken place from oil to electricity, district heating and biofuels. In 2011, the total use of oil products in the residential and services sector amounted to 13 TWh, a reduction of 70 per cent since 1990. The relative prices of the different energy carriers is affected by both their availability and new policy measures, which in turn have an impact on the choice of energy carrier.

Figure 2 shows how energy use in this sector decreased between 2000 and 2009, before rising again sharply in 2010. It is primarily the cold weather that was responsible for the increase. In 2011, the energy use was back at the same level as prior to 2010.

Figure 2 Energy use in the residential and services sector 1970–2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

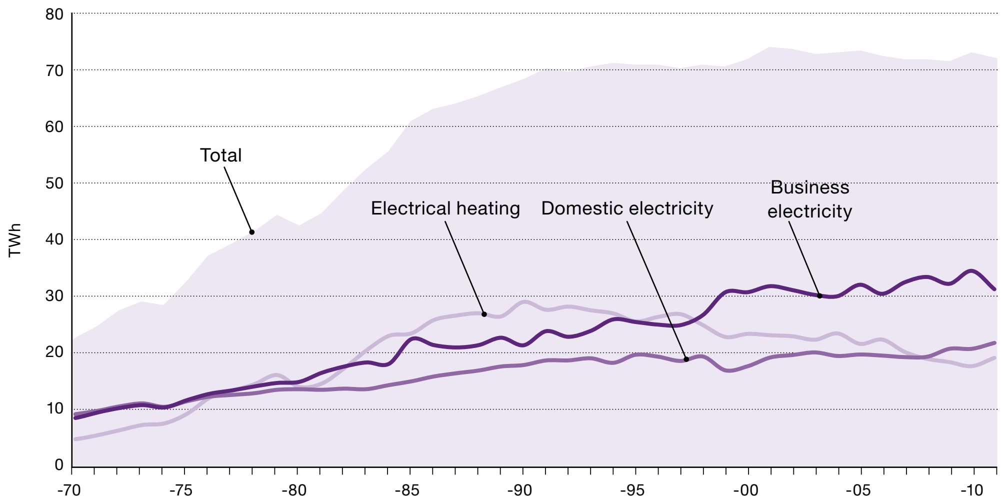
It is primarily the energy supplied for heating and hot water that has decreased. This is mainly because oil has been replaced by electrical and district heating and because the number of heat pumps has increased. Replacing oil with electrical and district heating leads to a reduction in conversion and transmission losses in the residential and services sector, but to increased losses in the production of electricity and district heating.

The energy output of a heat pump is significantly higher than the amount of energy used to run the pump. The energy output of the heat pump is not included when calculating the sector's total energy use. The number of heat pumps has increased, which has contributed to a reduction in the measured energy use for heating and hot water in buildings. Energy-saving measures such as additional insulation and replacing the windows in old buildings also contribute to reducing energy use.

Electricity use has remained stable over the past ten years

Electricity use in the residential and services sector increased continually from the 1970s until the middle of the 1990s. Since then, it has remained relatively stable at a little over 70 TWh. Figure 3 shows the total temperature-corrected electricity use in the sector since 1970, distributed by domestic electricity, business electricity and electrical heating.

Figure 3 Temperature-corrected electricity use in the residential and services sector 1970–2011, TWh



Source: Annual energy balance sheets. EN20. Energy statistics for dwellings and non-residential premises. EN16. Summary of energy statistics for dwellings and non-residential premises. EN0112. Swedish Energy Agency.

Use of *domestic electricity* increased from 9 to 12 TWh between 1970 and 2011. The increase that took place over the course of the 1970s and 1980s is explained by an increasing number of households with a greater number of appliances. Two opposing trends have an impact on the use of domestic electricity: appliances are becoming more energy-efficient, which leads to a decreased use of energy, but the number of appliances in the household and the number of functions of many appliances have both increased, which counteracts the effect of greater efficiency.

Use of *electricity* in non-residential premises increased from 8 to 31 TWh between 1970 and 2011. The electricity used in non-residential premises is a combination of the electricity used by the building and the activities taking place within. The electricity used by the building encompasses the electricity used in the building's fixed installations such as ventilation, lifts, escalators and general lighting. The remainder is the electricity used by the activities taking place inside the building, for example, computers, appliances and lighting. Between 2005 and 2011, the Swedish Energy Agency conducted studies of the electricity used in different types of non-residential premises[3].In all the non-residential premises investigated, lighting and fans accounted for a large proportion of the electricity used.

The use of *electrical heating* in residential buildings and non-residential premises increased from 5 TWh in 1970 to 29 TWh in 1990. After peaking at the beginning of the 1990s, its use has declined. In 2011, the use of electrical heating was 19 TWh. An important reason behind this decline is that the relatively high electricity prices have provided a strong incentive to switch to heat pumps, district heating and pellets.

3 Inventory of business premises and administration buildings. ER 2007:34. Energy use and interior environments in schools and preschools. ER 2007:11. Energy use in care facilities. ER 2008:09. Energy use in sports facilities. ER 2009:10. Energy use in shopping premises. ER 2010:17. Energy use in hotels, restaurants and meeting places. ER 2011:11. Swedish Energy Agency.

Heating accounts for over half of the energy used

The total amount of energy used in homes for heating, including hot water, was 76.5 TWh in 2011, equivalent to 60 per cent of the total energy used in this sector. Single-family and two-family detached dwellings used 44 per cent, multi-dwelling buildings 30 per cent and non-residential premises 26 per cent.

Electricity is the most common form of energy used for heating and hot water in single-family and two-family detached dwellings, with 14 TWh being used in 2011. In recent years, biofuels such as firewood, wood chips, sawdust and pellets have shown the largest increases, and their use was 12 TWh in 2011. The use of district heating was 6 TWh. The use of oil for heating continues to decline, and was only 0.9 TWh in 2011. Throughout the 1990s and onwards, the number of single-family and two-family detached dwellings using heat pumps increased steadily. In 2011 there was some form of heat pump in 923,000 single-family and two-family detached dwellings in Sweden, 46 per cent of the total.

District heating is the most common form of energy used for heating in multi-dwelling buildings, amounting to a total of 21 TWh in 2011. Electrical heating accounted for only 1 TWh and oil for 0.3 TWh.

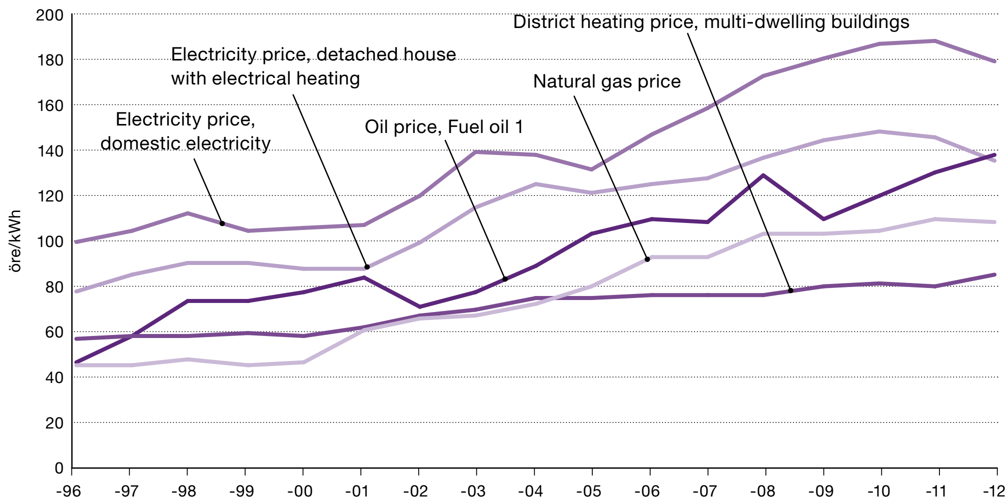
District heating is also the most common form of energy used for heating and producing hot water in non-residential premises, amounting to 16 TWh in 2011. Electricity was second highest and amounted to 2.7 TWh. The use of oil for heating and hot water also continues to decline in non-residential premises; with total use over the course of the year equivalent to 0.7 TWh.

The energy prices for domestic customers have increased

The energy prices for domestic customers were relatively stable over the course of the 1990s, but then increased strongly during the entire 2000s. The increased fuel prices and taxes on energy are the main causes of the rising prices.

Figure 4 shows that all energy prices increased between 1996 and 2011, especially the electricity price. The electricity price decreased somewhat in 2012 for both customers with domestic electricity alone and those with electrical heating. A reduction in the electricity price can increase the use of electricity in households.

Figure 4 Energy prices for the residential and services sector 1996-2012, öre/kWh



Source: Official Statistics of Sweden. EN0302, EN0304, EN0104, PR14. The Swedish Energy Agency. www.spbi.se/statistik/priser. SPBI.

The oil price in Sweden tracks the price on the global crude oil market, which has risen throughout almost the whole of the 2000s. The switch to green taxes, which involves taxes on electricity and fossil fuels gradually increasing, is another reason for the increased cost of oil and is the main reason why more households have switched from oil to other forms of heating. The price of natural gas, which, to a certain extent, tracks the variation in the oil price, also increased throughout the 2000s.

The price of district heating for multi-dwelling buildings increased throughout the 2000s. The differences between different municipalities are very large as district heating in Sweden is comprised of a large number of local district heating systems. It is therefore difficult to draw any general conclusions about the causes of the changes in the price of district heating. However, increased fuel costs are a contributory factor to rising district heating prices.

Biofuels such as firewood and pellets are also important sources of energy for domestic customers. In September 2013, the bulk price of pellets, including taxes, for customers in detached houses was between SEK 2,400 and 2,800 per ton[4]. The price of pellets varies geographically and between different suppliers.

EU directives regulate the energy requirements of buildings and products

There are several EU directives that regulate buildings' energy use. Some of the directives also regulate products that have an impact primarily on electricity use in the residential and services sector. Both the ecodesign and energy labelling require-ments are drawn up in the form of product specific EU regulations that are immediately applicable in all of the EU's member states. The only new directive since the publication of last year's Energy in Sweden is the Energy Efficiency Directive.

The Energy Performance of Buildings Directive[5] governs, amongst other things, minimum requirements for energy performance in buildings and the requirement that energy declarations are performed. This directive has been introduced into Swedish legislation through the Swedish National Board of Housing, Building and Planning's building regulations.

The Ecodesign Directive[6] rregulates that products such as fridges, freezers and washing machines must have a certain level of energy efficiency in order to be sold in the EU. You can read about additional groups of products that are covered on the Swedish Energy Agency's website. The ecodesign requirements lead to energy savings as the most inefficient products are banned.

4 www.pelletspris.com 2 September 2013.
5 The Energy Performance of Buildings Directive (2010/31/EU).
6 The Ecodesign Directive (2009/125/EC).

The Energy Labelling Directive[7] specifies the requirements on energy labelling and makes it clear for the consumer how energy efficient the product actually is. The aim of the directive is to make it easy for consumers to take the energy performance of a product into consideration when making a purchaset.

The Energy Efficiency Directive[8] aims to promote improvements to energy efficiency. The directive regulates requirements on the renovation of buildings and the measurement and billing of electricity, natural gas, district heating, district cooling and hot water for domestic customers.
Buildings owned by the public sector have specific renovation requirements. The intention is for buildings owned by the public sector to set a good example by taking into account good energy performance when renovating.

Energy declarations provide guidance about energy efficiency
According to the Energy Declaration of Buildings Act (2006:985), multi-dwelling buildings and non-residential premises must have had an energy declaration since the beginning of 2009. This is the responsibility of the owner of the property. Single-family and two-family detached dwellings must also have a valid energy declaration when they are sold or let. The energy declaration contains information about the building's energy use, area and technical systems. In addition, it contains proposals for cost-effective energy saving measures. The declaration is valid for ten years.

Tax relief on home repairs and maintenance stimulates energy measures
The ROT deduction was introduced in December 2008 as a financial support in the form of a tax relief on repairs, maintenance, rebuilding and, extensions. The main aim is to increase the demand for services in the construction sector, but the deduction also stimulates reductions in energy use as it encompasses several energy saving measures. For example, after 2011, there is no longer support for investments in solar heating and private individuals are now referred to the ROT deduction instead.

7 The Energy Labelling Directive (2010/30/EU).
8 The Energy Efficiency Directive (2012/27/EU).

Anyone can apply for support for the installation of photovoltaic cells

Since 2009, the government has been supporting the installation of photovoltaic cells. The aim is to contribute to the transformation of the energy system and to industrial development within the field of energy technology. All types of actors can apply for support; companies, public sector organisation and private individuals. Support is available for the installation of all types of grid-connected photovoltaic cell systems, as well as hybrid photovoltaic and solar heating systems.

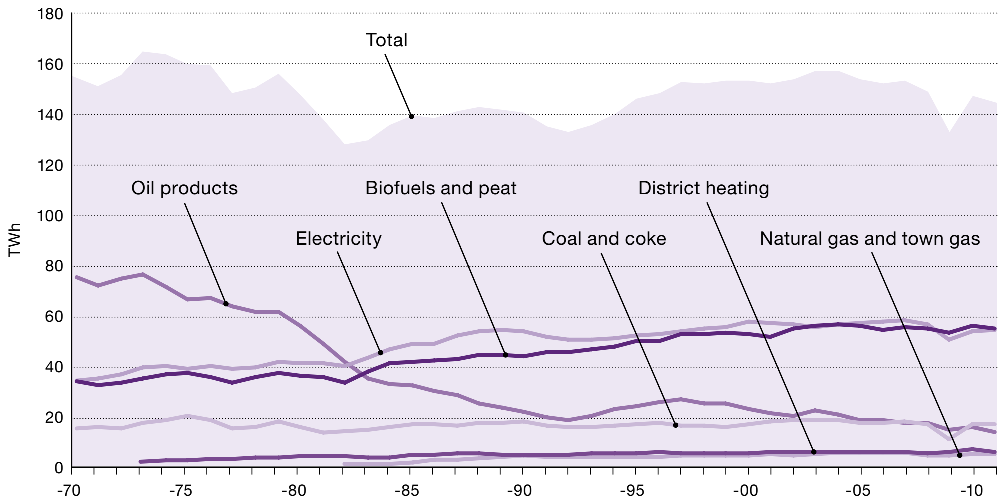
The industrial sector

Energy use in the industrial sector decreased by 2 per cent, to 144 TWh, in 2011 compared with 2010. This means that the industrial sector was responsible for 38 per cent of Sweden's final energy use.

The energy used by Swedish industry comes primarily from the energy sources biofuels and electricity. In 2011, these accounted for 38 and 37 per cent, respectively, of the industrial sector's final energy use. Fossil fuels such as oil products, coal, coke and natural gas constituted 22 per cent of the total energy used by Swedish industry. District heating accounted for the remaining 3 per cent, see Figure 5.

Biofuels and electricity provide more than 75 percent of the energy used in the industrial sector.

Figure 5 Energy use in the industrial sector 1970–2011, TWh



Source: Annual energy balance sheets EN20. Swedish Energy Agency.

The use of biofuels and electricity continue to rise

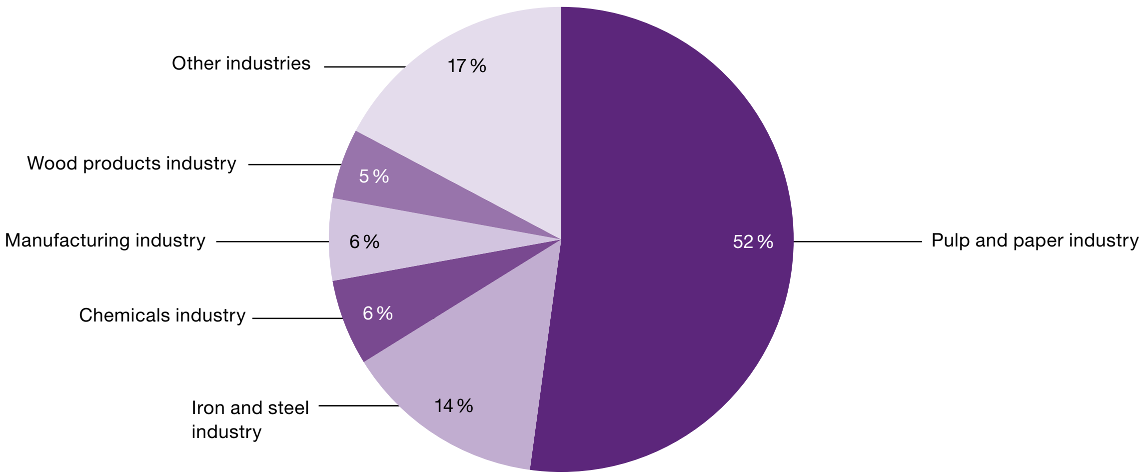
Industrial energy use has been relatively constant since 1970, despite increased industrial production, as a result of both improvements in energy efficiency and a successive transition from oil to electricity and biofuels. Between 1970 and 2011, biofuels increased from 21 to 38 per cent of the total energy used in the industrial sector. Biofuels are the dominant energy carriers in the pulp, paper and wood industry. Statistics for biofuels also incorporate peat and waste, however, these constitute a very small proportion of the total.

Intensive efforts to reduce the use of oil in industry began at the time of the oil crisis in the 1970s. In 1970, oil accounted for 48 per cent of total industrial energy use, compared with 9 per cent today. In contrast, electricity's proportion of total industrial energy use has increased since 1970, from 21 to 37 per cent. Oil use within the industrial sector increased between 1992 and 1997, but has continued to decline since then. The use of oil, as with other fuels, declined sharply during the economic recession, from the end of 2008 and throughout the whole of 2009. Oil use then increased again in 2010, but is now declining, primarily because of the switch to biofuels.

A small number of industries account for the majority of the industrial sector's energy use

In Sweden, a small number of industries account for the majority of the industrial sector's energy use, see Figure 6. The pulp and paper industry is the largest industrial energy user and accounts for about half of the industrial sector's total energy use. The iron and steel industry, the chemicals industry and the wood products industry are together responsible for a quarter of the industrial sector's energy use.

Figure 6 Energy use by industry in 2011, per cent



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

Electricity and black liquor are the predominant energy carrier used in the pulp and paper industry. Black liquor is a by-product of paper manufacture and is what remains of the pulp boil once the cellulose fibres have been removed. It is made up partly of boiling chemicals and partly substances extracted from the wood. Black liquor is combusted in the mills' recovery boilers, where high pressure steam is generated that can then be used to produce energy.

Iron and steel works use mainly coal, coke and electricity as energy carriers. Two major by-product fuels – coke oven and blast furnace gases – are recovered and used to generate steam, preheat blast furnace air or supply heat to other plant processes. Steel is produced either from iron ore or scrap. In iron ore-based steel production, oxygen is removed from iron oxide in a blast furnace with the help of a reduction agent, usually coke. In scrap-based steel production, arc furnaces are the main method used to melt the scrap steel and these require electricity.

The chemicals industry accounts for 6 per cent of industrial energy use and the dominant energy carrier is electricity, mainly used for electrolysis. The wood products industry, which accounts for 5 per cent of industrial energy use, uses mainly biofuels. The manufacturing industry is not classified as an energy-intensive industry, but, as it accounts for a large proportion of Sweden's industrial production, it is still responsible for 6 per cent of total industrial energy use.

The remaining 17 per cent of the industrial sector's energy use is accounted for by other industries. This includes the mining industry, metal working, the food industry, the textiles industry, the graphic industry, the earth and stone industry (manufacturing of glass, cement, lime etc.). Some of these are energy intensive, but their total energy use is relatively low. In the earth and stone industry, for example, fossil fuels are dominant, while electricity constitutes the largest proportion of the metal working industry's energy use.

ENERGY-INTENSIVE COMPANIES

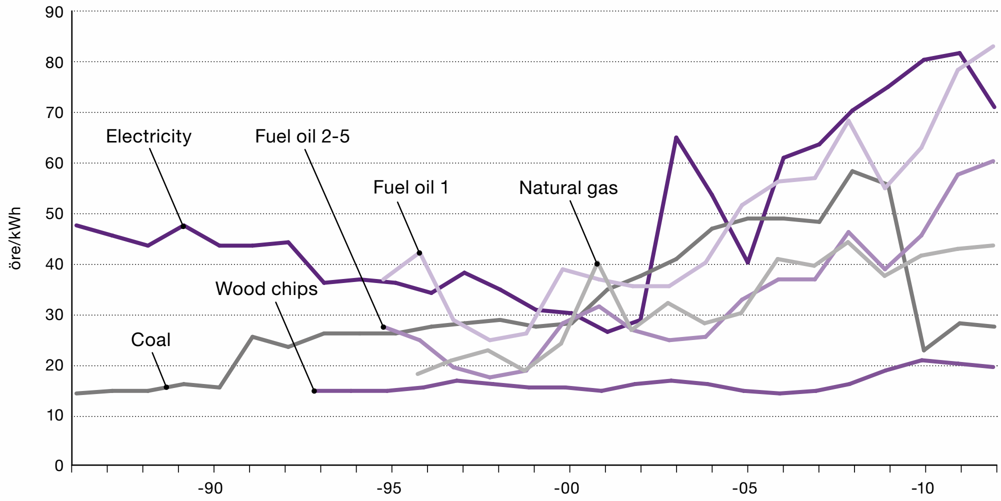
An energy-intensive company is classified as a company whose energy, carbon dioxide and sulphur taxes amount to at least 0.5 per cent of the company's value added[9]. Value added is the value of a company's production minus the value of the input goods.

Energy prices vary for companies in the industrial sector

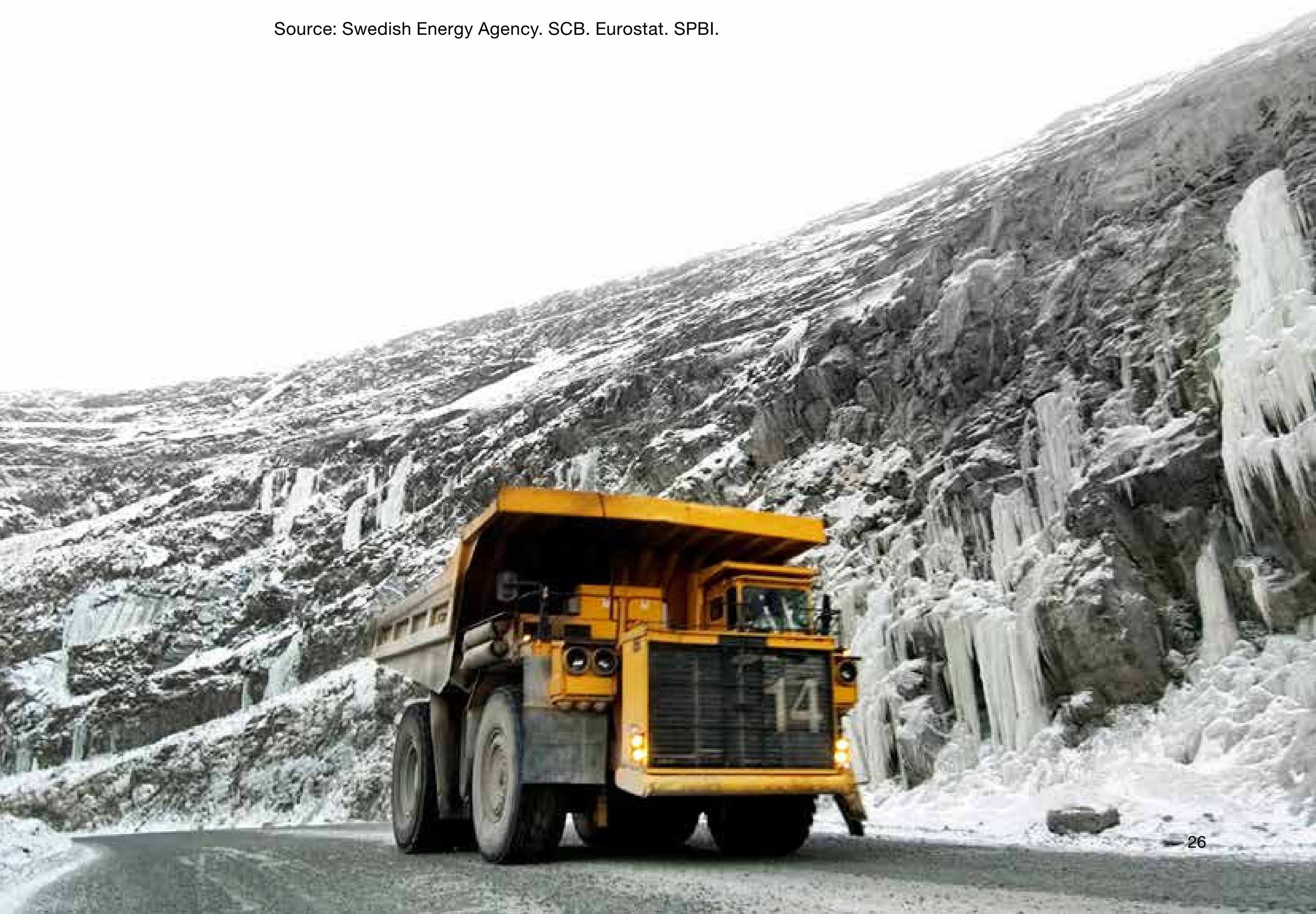
The price of natural gas and fuel oil increased in 2012, while the price of electricity, coal and wood chips decreased. Figure 7 shows energy prices for Swedish industry between 1986 and 2012. Industry's oil price has increased since the recession in 2009. The evolution of the price, combined with current policy measures, has contributed to the use of oil decreasing in almost all industries. The price of fuel oil 1 increased by 7 per cent and fuel oil 2–5 by 4 per cent.

9 The Energy Tax Act (1994:1776).

Figure 7 Energy prices for the industrial sector 1986–2012, öre/kWh



Source: Swedish Energy Agency. SCB. Eurostat. SPBI.



The price of natural gas decreased during the recession in 2009, but has now returned to the same level as prior to 2009. The real, fixed price of natural gas increased by 2 per cent in 2012 compared with 2011. It is mainly the pulp and paper industry and the soil and stone industry that have increased their use of natural gas over the course of 2011, having switched from using other fossil fuels such as oil and coal.

The price of wood chips has been increasing in recent years, however, this stopped in 2011. The increase in price is probably a result of the demand for biofuels having increased over the course of the 2000s. In 2012, the real price of wood chips decreased by 6 per cent compared with the previous year.

Energy and carbon dioxide taxes are levied on energy carriers

Energy and carbon dioxide taxes, together with the EU's emission trading scheme (EU ETS), are the policy measures of the greatest significance to the industrial sector. The Swedish Government introduced a change to the tax rates on 1 January 2011. This meant that an energy tax of 30 per cent of the general energy tax level was levied on all industries, even those that are included in the EU ETS. The manufacturing industries outside of the EU ETS pay 30 per cent of the general carbon dioxide tax on fossil fuels.

Since 1 January 2011, the industries that are included in the EU ETS have been exempt from the carbon dioxide tax. The government has decided to increase the carbon dioxide tax for industries outside of the EU ETS from 1 January 2015[10]. These industries will then have to pay 60 per cent of the general carbon dioxide tax. Read more about energy taxes in the energy policy section.

10 Act (2009:1497) Concerning Changes to the Energy Tax Act (1994:1776).

Policy measures reduce industrial energy use

Larger plants in, for example, the pulp and paper industry and the iron and steel industry are included in the *EU ETS*[11]. In addition, all combustion plants that have a power output of over 20 MW are included, regardless of which industry they belong to. The principles for allocation of emission allowances have been changed for the trading period between 2003 and 2020. In Sweden, 80 per cent of emissions of greenhouse gasses come from industrial facilities, as opposed to the average in the EU ETS, where the figure is 40 per cent.

The electricity certificate system is a market-based policy measure which aims to increase the production of renewable electricity. This policy measure encompasses industries that produce their own renewable electricity. These can be granted electricity certificates for their electricity production. Industrial plants that are intensive users of electricity do not also need to pay for electricity certificates for the electricity that is used in the manufacturing process[12].

The Programme for Improving Energy Efficiency in Energy-intensive Industries (PFE) is being phased out. The programme, which was introduced in 2005, involves companies that have been defined as energy-intensive being given the opportunity to be relieved of electricity tax (0.5 öre/kWh) for a certain type of industrial activities[13]. In return, the participating companies are required to introduce a structured, certified energy management system that improves their energy efficiency. Throughout the period that the programme is in effect, the companies also undertake to implement energy efficiency measures that have a payback period of less than ten years.

Energy audit cheques (EKC) are targeted at companies with and energy use of over 500 MW/year, but which do not qualify for PFE. An audit cheque pays half of the cost of the energy audit, however, only up to a maximum of SEK 30,000. The main purpose of energy audit cheques is to encourage more companies to introduce and maintain energy management systems.

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11 The Emissions Trading Ordinance (2004:1205).
12 The Electricity Certificates Act (2011:1200).
13 The Programme for Improving Energy Efficiency Act (2004:1196).

The transport sector

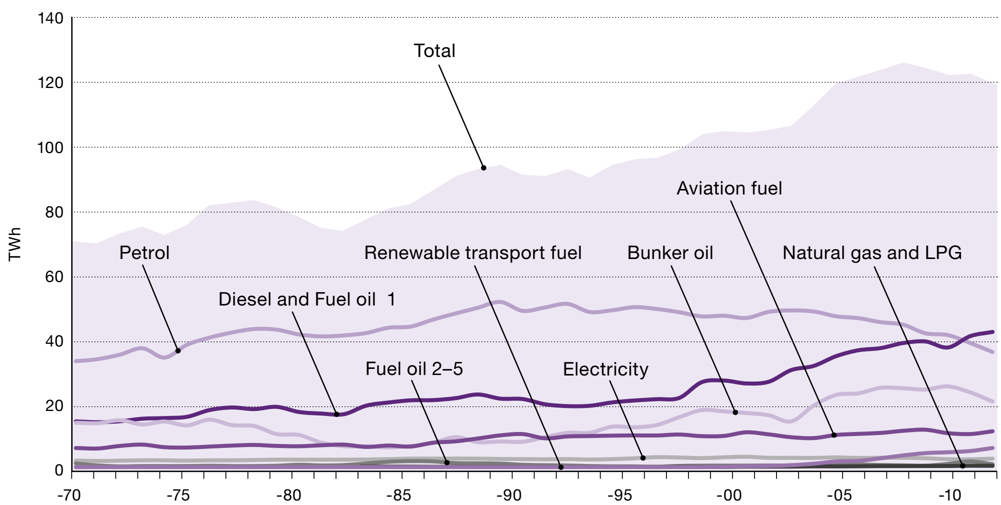
The transport sector's energy use was 90 TWh in 2011, which is equivalent to one quarter of the country's total final energy use. Of these, 30 TWh were used for international transport. The sector is divided into road, rail, air and maritime transport. Road transport accounted for 94 per cent of the transport sector's energy use. The general trend since the 1970s is of increasing energy use in the transport sector and this reached its highest value in 2007. However, the pattern in recent years points to this development being on the wane.

Road transport accounted for 94 % of the transport sector's energy use.

Energy use in the transport sector is decreasing

Since 2005, the total energy used for transport has stabilised and is showing less annual variation. The energy used by both domestic and international transport has decreased in recent years and the figures for 2011 are at the same level as those for 2004, which is shown in Figure 8. The fuels bunker oil and aviation fuel are included in international transport.

Figure 8 Energy use in the transport sector 1970–2011, TWh



Source: Energy Indicators 2013 ER2013:05. Swedish Energy Agency.

There is a clear trend towards a reduction in the use of petrol and an increase in the use of diesel in road transport. This is a result of changes to the car fleet that have taken place in recent years. The proportion of diesel cars in Sweden has increased sharply. In 2012, diesel cars made up 65 per cent of new cars sold, which is a new record. Aside from diesel cars, electric cars are the only category which continues to increase its market share.

Electricity use by rail transport (railways, underground railways and trams) has varied throughout the 2000s; however, these variations have been relatively small. The use of diesel by rail transport also varies, but the long-term trend shows a decline.

Air transport shows a stable energy use. In connection with the recession in 2009, the number of passengers and the use of fuel for domestic and international flights both decreased. Subsequently, the industry has undergone a recovery, and in 2012 the number of passengers was the highest seen throughout the whole of the 2000s. However, this recovery has not led to an equivalently high use of fuels as there was prior to 2009, which points to the efficiency of air transport having increased.

In recent years, the total energy use for domestic maritime transport has decreased significantly and the figures for 2011 are the lowest of the entire 2000s. Bunkering of fuel for international maritime transport increased significantly at the beginning of the 2000s, but decreased following 2009. It is primarily the use of thick fuel oils (Eo2–5) that has decreased in favour of diesel and thin fuel oil; the use of which has increased somewhat. This is probably because of a transition to fuels with lower sulphur content, in line with the new Sulphur Directive that comes into force in 2015[14]. The Sulphur Directive is described in more detail in the section on EU directives governing the transport sector.

14 The Sulphur Directive (1999/32/EC).

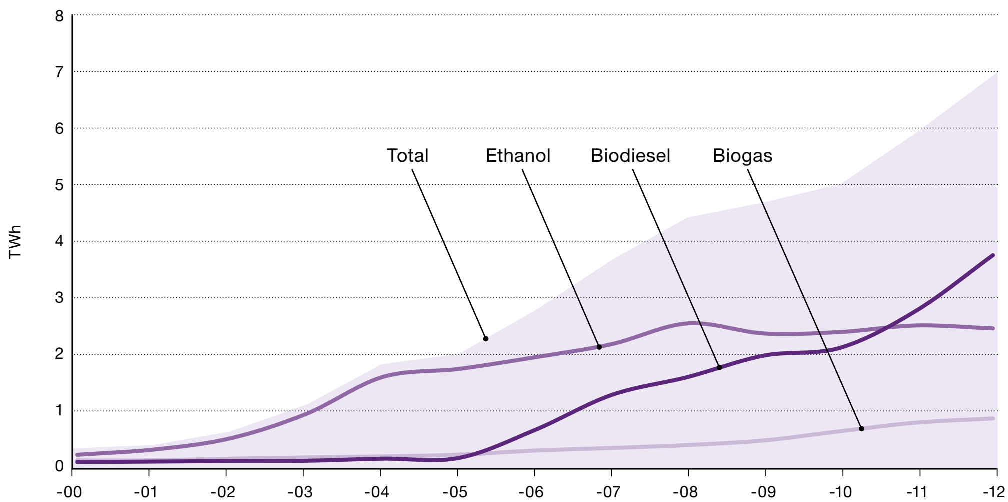
The use of transport biofuels is increasing

The main transport biofuels used in Sweden are biodiesel, ethanol and biogas. The use of transport biofuels increased by 17 per cent between the years 2011 and 2012. The proportion of the fuel used in road transport accounted for by transport biofuels was 8.1 per cent in 2012, which is equivalent to 7 TWh, see figure 9. The use of biodiesel has increased most, accounting for more than half of the biofuels used in the Swedish transport sector.

The use of ethanol decreased, constituting 35 per cent of the total, while the use of biogas continued to rise, accounting for 12 per cent of the total. Read more about energy taxes in the fuel markets section.

The use of transport biofuels increased by 17 % between 2011 and 2012.

Figure 9 Use of transport biofuels in the transport sector between 2000–2012, TWh

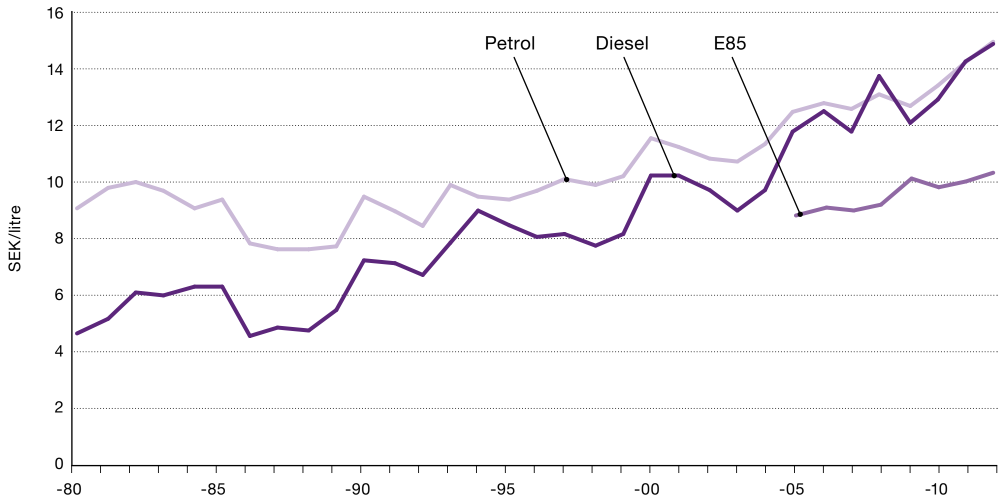


Source: Energy Indicators 2013 ER2013:05. Swedish Energy Agency.

The prices of transport fuels continues to rise

In 2012, the average price of diesel was SEK 14.81 per litre and petrol was SEK 14.98 per litre, see Figure 10. Historically, diesel has been a cheaper alternative to petrol. This trend has been changing in recent years as diesel was more expensive in 2008 and at the same level as petrol in 2011. In the last decade, the price of diesel has increased by 123 per cent, while the petrol price has increased by 77 per cent. A crucial factor in the rapid price change is that the tax rate on diesel has increased more than on petrol.

Figure 10 Transport fuel prices, 1980–2012, SEK/litre, constant prices indexed at the level for 2012



Source: SPBI. SCB.

The trend for increasing numbers of diesel cars and a reduction in the number of petrol cars in the Swedish car fleet is leading to a reduction in the demand for petrol and an increase in the demand for diesel, which is reflected in the prices of these fuels. The transport fuel prices in Figure 10 are reported per litre; the energy content of each of the fuels is not included. If the energy content is included in the calculations, SEK/kWh, the average price of diesel has been about 12 per cent lower than petrol for the last ten years.

The total number of cars continues to increase and at the turn of 2013, there were 4.4 million cars on the road in Sweden. Of these, about 5.9 per cent are powered mainly by renewable energy such as ethanol, gas or electricity[15]. The price of transport fossil fuels is, as a rule, always higher than that of transport biofuels. This should play a large role in the choice of transport fuel for flexible-fuel vehicles, which can use both renewable and fossil fuels.

Despite ethanol (E85) always being cheaper than petrol, aside from 2009, sales of this fuel decreased somewhat in 2012 compared to 2011. How sales of E85 will develop in the future is uncertain as sales of new ethanol cars have declined successively over the last four years.

Sales of new CNG-powered cars have also begun to level out in the last two years, in contrast to sales of CNG, which have increased steadily. This indicates that owners of flexible-fuel vehicles are filling up with CNG instead of petrol. For a definition of CNG and explanations of other transport biofuels, please see Table 1.

15Vehicle Statistics 2011. Transport Analysis

Table 1 Explanations of transport biofuels and bioliquids

Transport biofuels and liquid biofuels	
Ethanol	E5, E85, ED95, ETBE
Biodiesel	B5, B100, RME, FAME, HVO
CNG	Compressed natural gas, mainly methane, which can be composed of biogas, natural gas or a mixture of the two.
Bioliquids	Biological oils: rapeseed oil, palm oil, tall oil, waste oils, MFA
Other gaseous transport biofuels	DME
Glossary	
FAME	Fatty acid methyl ester
HVO	Hydrogenated vegetable oil
ETBE	Ethyl tertiary butyl ether
DME	Dimethyl ether
RME	Rapeseed methyl ester
E5	95 per cent petrol and 5 per cent ethanol
E85	85 per cent ethanol and 15 per cent petrol (summertime) or 75 per cent ethanol and 25 per cent petrol (wintertime)
ED95	95 per cent ethanol plus ignition improver and an anti-corrosion agent
B5	Fuel consisting of 5 per cent biodiesel and 95 per cent diesel
B100	Pure biodiesel
MFA	Mixed Fatty Acids

Vehicle tax rates promote eco-cars

Since 2006, the vehicle tax has been based on the vehicle's carbon dioxide emissions instead of the vehicle's weight. Beginning in 2013, the tax also includes light buses, light duty trucks and camper vans. The carbon dioxide emission level has been reduced from 120 to 117 grams per kilometre. This has led to an increased vehicle tax for petrol-powered vehicles. The vehicle tax for diesel-powered vehicles has, however, been reduced by about 4 per cent as a result of the increased energy tax on diesel.

In January 2013 the definition of eco-cars changed. An eco-car may not emit more than a set amount of carbon dioxide, related to the vehicle's unladen weight including the driver and fuel. For example, a petrol-powered vehicle of the average European unladen weight, 1,372 kg, may emit a maximum of 95 grams of carbon dioxide per kilometre. Vehicles powered by ethanol and CNG, however, are allowed to emit up to 150 grams of carbon dioxide because the fuel's origin is renewable. Aside from cars, the definition now also encompasses camper vans, light duty trucks and minibuses.

Additional tax rules that benefit eco-cars are the tax rates of company cars[16] and the super eco-car premium ordinance[17]. There have been no recent changes to these regulations. However, a new energy tax has applied to low admixture transport biofuels since January 2013. Low admixture transport biofuels are petrol with up to 6.5 per cent ethanol and diesel with up to 5 per cent FAME. The new tax will probably not have an impact on the price as the petrol tax has been lowered by the same amount as the new energy tax on ethanol. The new tax rate is necessary in order to comply with the EU's regulations covering state aid. This means that the tax exemption on transport biofuels is not permitted if it contributes to unbalancing the competition between diesel and petrol.

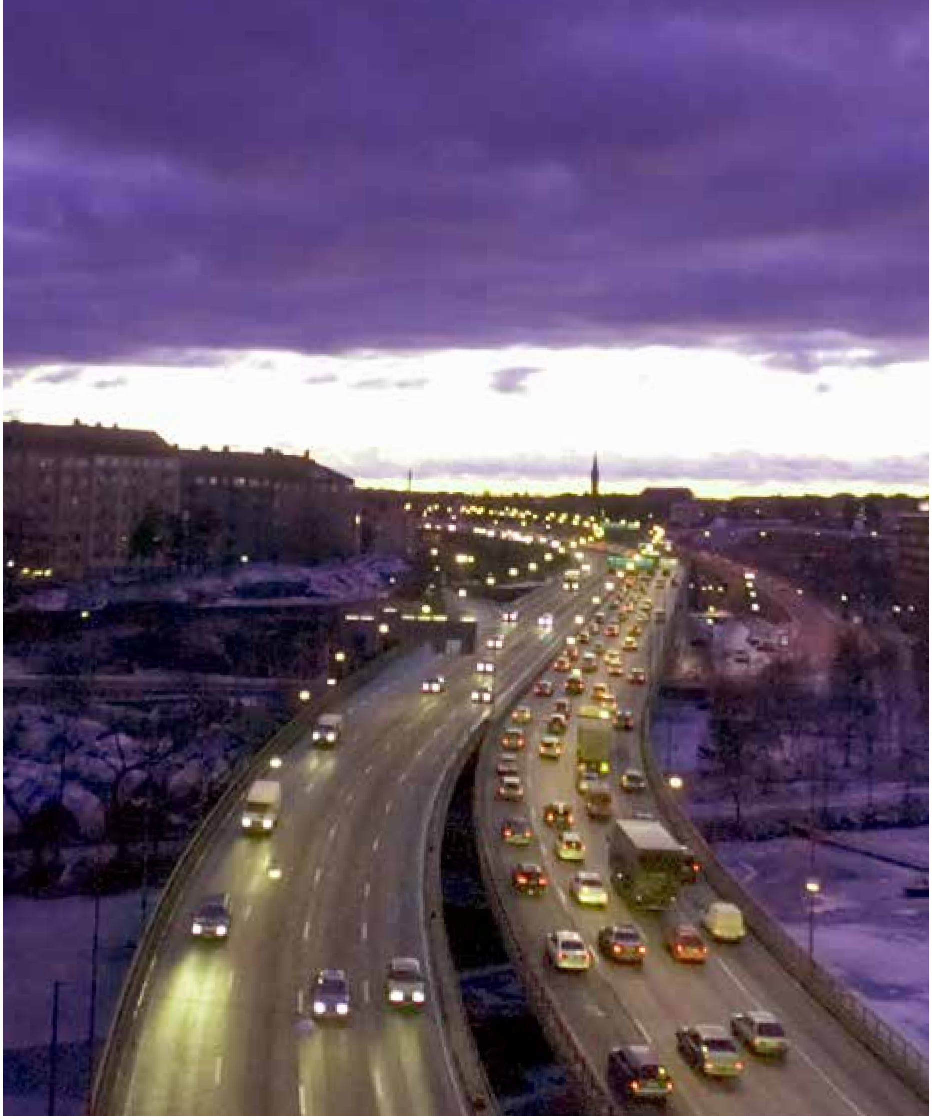
The government propose a quota obligation for low admixtures

The government has drawn up a proposal for a quota obligation for adding small amounts of transport biofuels to petrol and diesel. This proposal is to come into force on 1 May 2014, when the fuel suppliers' switch to summer quality. During the winter, the amount of transport biofuels in low admixture fossil fuels is lower than during the summer. The reason for this is that the cold has a negative impact on the properties of transport biofuels. The purpose of the quota obligation system is to ensure an increased use of low admixture transport biofuels and thus an increase in the amount of renewable energy used in the transport sector.

The proposed quotas mean that companies which sell transport fuels must have a low admixture of at least 4.8 per cent by volume of ethanol in petrol and 9.5 per cent by volume of biodiesel in diesel. Of the diesel quota, 6 per cent will consist of FAME and 3 per cent of transport biofuel that has other environmental benefits in addition to the sustainability criteria.18 For example, this can be HVO or another synthetic biodiesel that is made from residual products or waste. Read more about the sustainability criteria in the section on the fuel markets.

The low admixture quota for ethanol in petrol is set at 7 per cent from 1 May 2015. However, the level for diesel will remain unchanged. A few older petrol-powered car models are unable to run on petrol that contains more than 5 per cent ethanol, which is why the two-stage process is necessary. However, there are no technical barriers such as this that apply to the proposed quota obligation levels for diesel.

16 The Income Tax Act (1999:1229)
17 The Super-eco Car Premium Ordinance (2011:1590).
18 The Sustainability Criteria for Transport Biofuels and Liquid Biofuels Act (2010:598).



EU directives governing the transport sector

The Renewables Directive[19] contains binding targets for each EU member state to have 10 per cent renewable energy in the transport sector by 2020. According to the Swedish Energy Agency's calculations, the proportion of renewable energy in the transport sector in Sweden amounted to 11.8 per cent in 2012. However, this does not mean that the proportion will be 10 per cent or more in 2020.

19 The Renewables Directive (2009/28/EC).

In 2009, the EU introduced a fuel efficiency requirement for all new cars and light duty trucks in the European market. This target has resulted in an ordinance[20] that sets out a limit of 130 grams of carbon dioxide per kilometre for cars and 175 grams of carbon dioxide per kilometre for light duty trucks from 2015. It has been proposed that the requirement be made more stringent from 2020. In 2011, the European average was higher than the limit for both cars and light duty trucks. In Sweden the average is higher than the European average[22] for cars[21], but lower for light trucks.

The European Parliament has adopted changes[23] to the Sulphur Directive that make the limits for the sulphur content in maritime transport fuel more stringent, lowering the permitted level from 1.0 to 0.1 per cent by weight from 2015. The directive will apply to the sulphur emission control areas in the Baltic, the North Sea and the English Channel. This may involve the maritime transport industry having to make a transition to fuels with lower sulphur content such as diesel, light oils and LNG, or instead install purification technology on vessels.

Since 2012, air transport has been included in the EU ETS. This means that, beginning in 2013, aircraft operators that land or take off from airports in the EU must surrender emission allowances annually in the Union Registry, the EU's common registry for emission allowances. The emission allowances will be equivalent to their actual emissions of carbon dioxide from fossil fuels over the course of the previous year for all flights that took off or landed at airports in the EU, Norway, Iceland and Liechtenstein. However, in 2012, the European Commission announced that flights to and from the EU would be temporarily exempt from the trading system up until autumn 2013. The purpose of the exemption is to make it easier for the International Civil Aviation Organization to drawing up a proposal for a global system that will deal with the climate impact of international air transport. If the proposal is not ready by 2013, flights to and from the EU will again be included in the trading system.

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20 Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles.

21 Emissions from road transport in 2012 Press release 02/09/2013 The Swedish Transport Administration.

22 European Environment Agency (EEA). Vans' average CO2 emissions and average mass by country.

23 Amendments (2012/33/EU) to the Sulphur Directive (1999/32/EC).

Energy Markets

Hydro-power and nuclear power have been the dominant sources of electricity in Sweden for a many years. However, the use of biofuels has increased since the end of the 1990s, concurrent with the growth of wind power. The conditions in the market for district heating are also changing, with increasing competition for the raw materials for both biofuels and other types of heating.

The electricity market

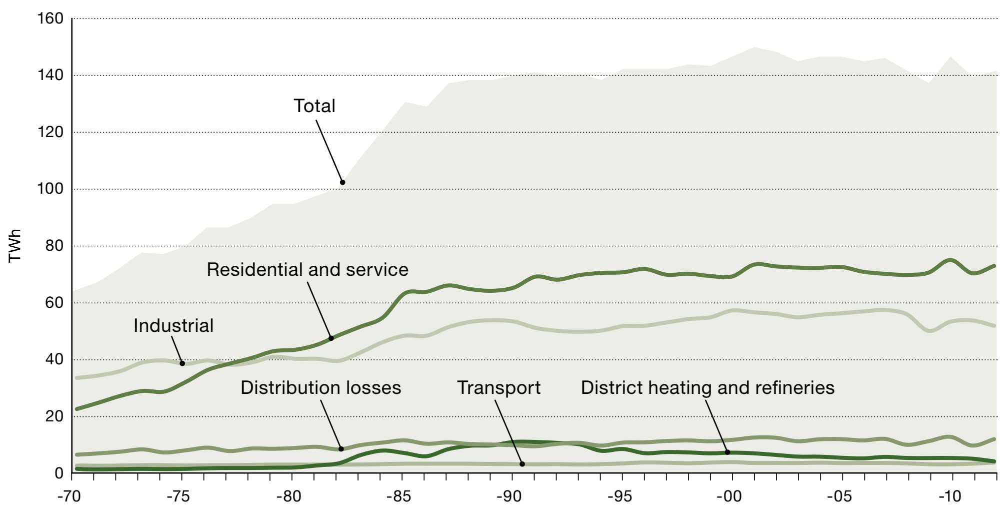
Total electricity production has never been as high as in 2012. Because electricity use in 2012 was about the same as it was in 2011, this resulted in the largest ever net exports of electricity. The good hydrological balance, i.e. good inflow of water and well-filled reservoirs, contributed to significant reductions in electricity prices in 2012, compared with the previous year.

Electricity use has increased to 142 TWh

The total amount of electricity used in 2012, including distribution losses, amounted to close to 142 TWh, see Figure 11. This is an increase compared with 2011, when total electricity use was 140 TWh. Electricity use in Sweden increased by an average of 5 per cent per year between 1970 and 1987, before levelling out.

Factors such as economic and technological development, fluctuations in energy prices and the structure of industry have an impact on the use of electricity. Population changes and outdoor temperatures also have an impact.

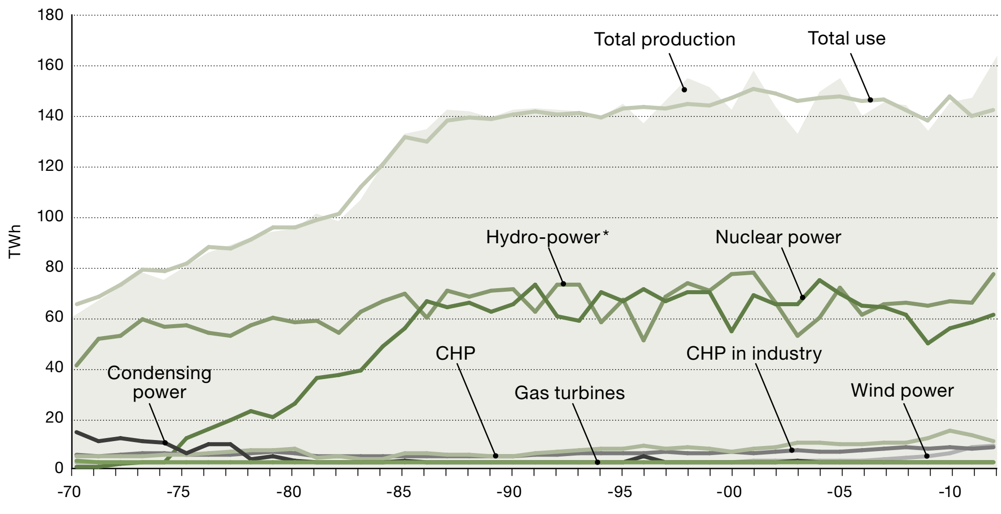
Figure 11 Electricity use in Sweden by sector, 1970–2012, TWh



Source: Annual and quarterly energy balances EN20. Swedish Energy Agency.

Hydro-power and nuclear power dominate electricity production
Total electricity production amounted to 162 TWh in 2012, which is the highest annual electricity production ever, see Figure 12. The previous record was 158 TWh, achieved in 2000. In 2012, electricity production was composed of 48 per cent hydro-power, 38 per cent nuclear power and 4 per cent wind power. The remaining 10 per cent was combustion-based production, mainly from CHP plants and industry. At the beginning of the 1970s, 69 per cent of electricity was produced by hydro-power plants and 20 per cent by oil-fired condensing power plants. Oil-fired condensing power plants use oil to product electricity alone. The total amount of electricity produced was then lower than it is today.

Figure 12 Electricity production, by type of power, and total electricity use in Sweden 1970–2012, TWh



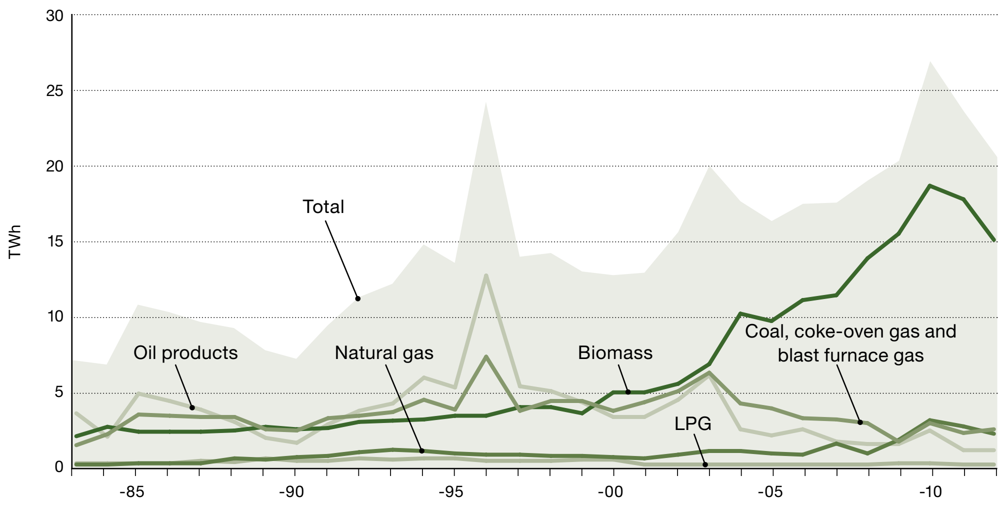
Source: Annual and quarterly energy balances EN20. Swedish Energy Agency.
*The Hydro-power item includes wind power up to and including 1996

In 2012, the reservoirs were well-filled and their water levels were above average throughout the entire year. Hydro-power produced nearly 78 TWh, which is close to the record production of 78.4 TWh in 2001. Swedish nuclear power plants produced about 61 TWh in 2012. This level of production is higher than in the previous three years, but is still lower than can normally be produced by nuclear power. Wind power production was 7.1 TWh in 2012, an increase of 17 percent compared to the previous year. This increase was significantly lower than the increase of 74 per cent between 2010 and 2011.

Combustion-based electricity production accounted for 15.5 TWh in 2012. This is mainly produced in CHP plants, which produced 8.9 TWh, and in industry, which produced 6.2 TWh. Oil-fired condensing power plants and gas turbines primarily provide reserve capacity.

Figure 13 shows that the largest proportion of the fuel used for electricity production is composed of biofuels, which account for 73 per cent. The remainder is natural gas, coal and oil. Nineteen ninety six was a dry year, with the lowest historic levels in the reservoirs, which meant that the use of oil increased dramatically during the winter.

Figur 13 Fuel used for electricity production, excluding nuclear fuel, 1983–2012, TWh

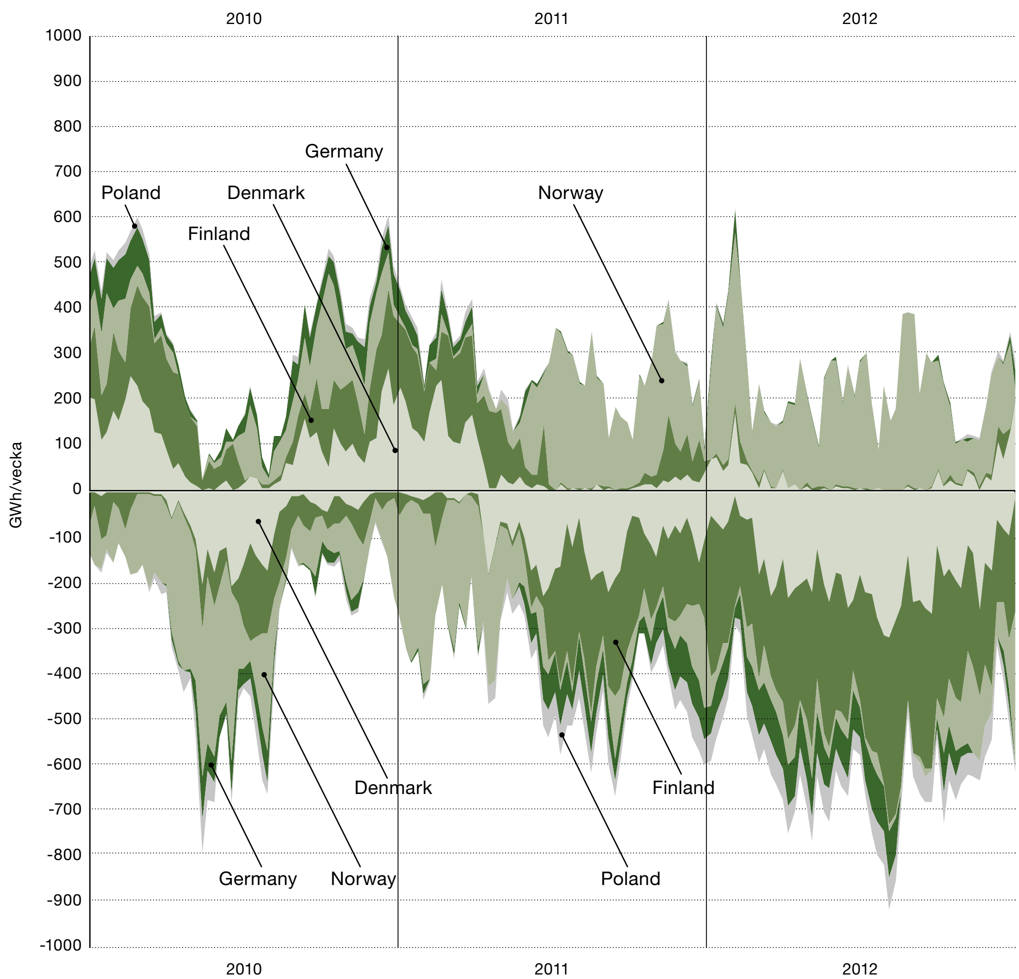


Source: Annual and quarterly energy balances EN20. Swedish Energy Agency.

Sharp increase led to a tripling of net exports

In 2012, Sweden's net exports of electricity amounted to 19.6 TWh, which is a new record and a sharp increase from 2011, when Sweden's net exports were 7.2 TWh. The previous record was 10.7 TWh, achieved in 1998. The flow of trade between Sweden and neighbouring countries varies both from year to year and throughout the year, see Figure 14. Trade in electricity between countries depends on price differences between different electricity areas. Price differences can result from the availability of water, the availability of nuclear power, transmission capacities and electricity use. In 2012, the Nordic countries' net exports of electricity amounted to 14 TWh, compared with a net import the previous year of 5 TWh.

Figure 14 Trade in electricity with other countries 2010–2012, GWh/week



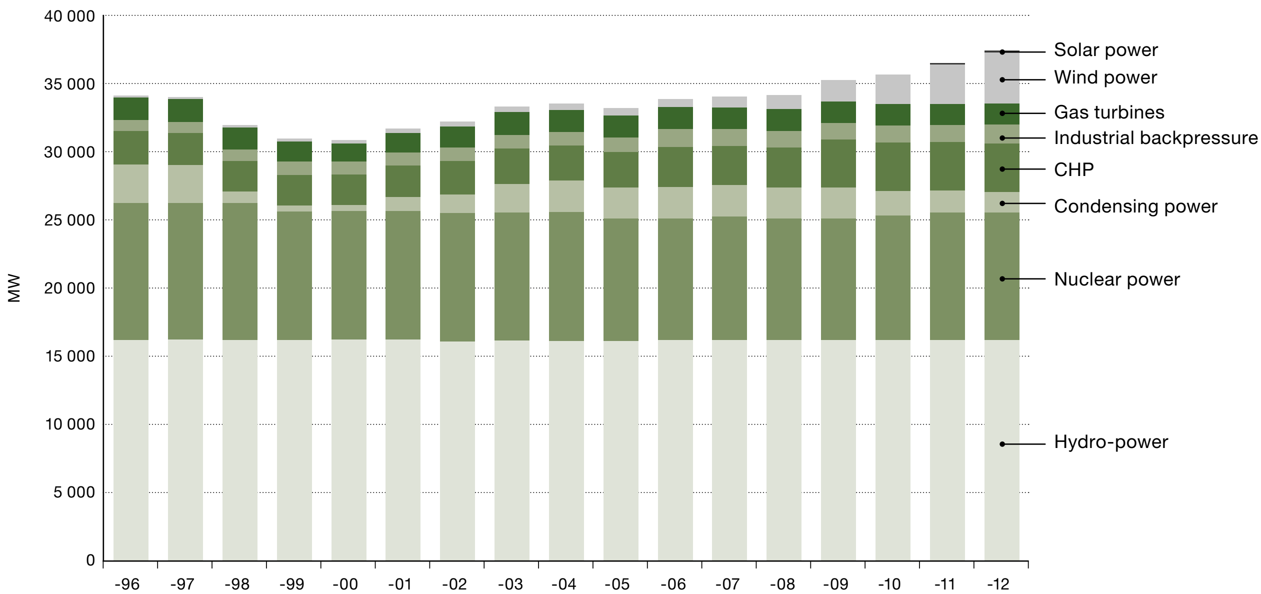
Source: Weekly statistics. Swedenergy.

Installed capacity in Sweden is increasing

Following the deregulation of the Swedish electricity market in 1996, there was a marked decrease in the installed electricity production capacity. This was mainly the expensive condensing power plants that were no longer profitable. Subsequent to 2000, the capacity increased again and is now greater that prior to the deregulation, see Figure 15. Wind power accounts for the largest proportion of the increase in installed capacity. CHP plants, industry and increases in the output of nuclear power plants have also contributed to the capacity increase.

In December 2012, the total installed electricity production capacity was 37,353 MW. Hydro-power accounted for 43 per cent, nuclear power 25 per cent and wind power 10 per cent. Other thermal power accounted for 22 per cent.

Figure 15 Installed electricity production capacity in Sweden by type of power 1996–2012, MW



Source: The Electricity Year 2012. Swedenergy.

The highest power usage in 2012 happened on 13 December, between 5 and 6 pm and amounted to 26,200 MW. Despite the difference between the installed capacity and highest power usage appearing to be large, the power situation can be strained. It is not possible to use the entire installed capacity at the same time as there are limitations on availability. The available capacity differs between types of power. Hydro-power stations that lie on the same watercourse are, for example, dependent on one another and the availability of water, thus all of the hydro-power capacity is not available concurrently at all times. The availability of nuclear power plants depends on the operational situation. The availability of wind power depends on where it is windy and whether it is windy.

The highest power usage in 2012 happened 13 December, between 5 and 6 pm and amounted to 26,200 MW

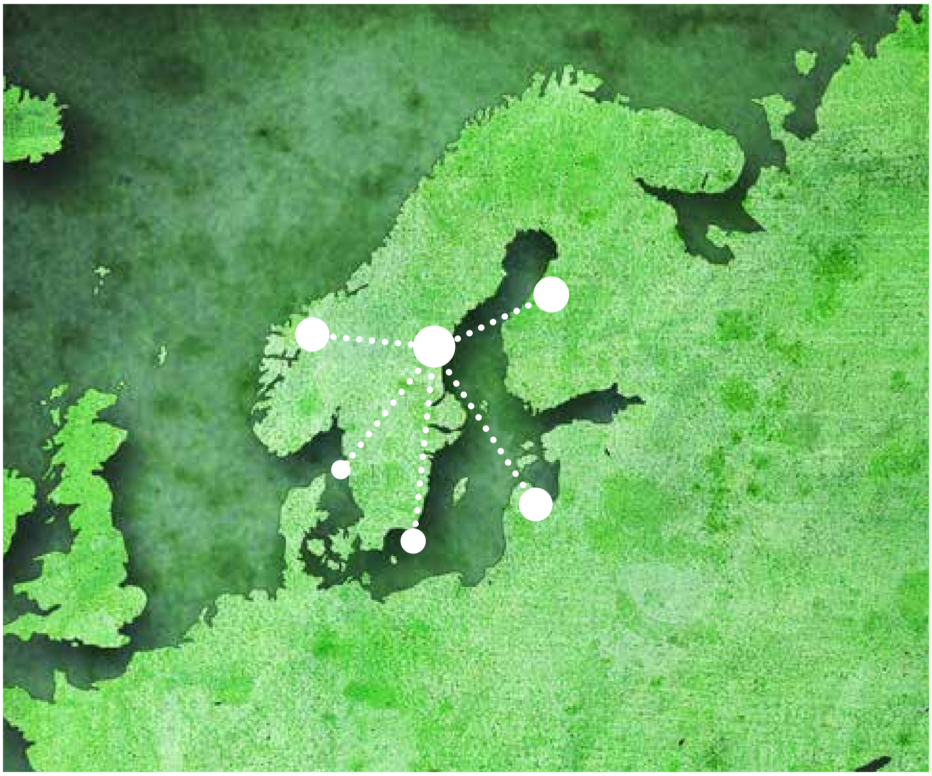
The power situation can become strained in periods with higher use than normal and/or low available capacity. Svenska Kraftnät, the state-owned public utility that maintains and runs the national grid, conducts an assessment of the power situation in advance of winter every year24.

24 The power balance in the Swedish electricity market in the winters of 2012/2013 and 2013/2014. A report to the Ministry of Enterprise, Energy and Communications. 2013/1310. Svenska Kraftnät.

Balance and development simultaneously

There must always be a balance between production and use of electricity in the national electricity system. Svenska Kraftnät is responsible for maintaning this balance. In addition to maintaining the balance, the power network must also be adapted to new sources of energy that vary over time such as wind power. Variable power places new demands on flexibility and balance regulation. Hydro-power is an excellent source for regulating the variation and thus maintaining the balance in the electricity network.

Sweden currently has transmission connections with Norway, Finland, Denmark, Germany and Poland. A new cable between Sweden and Finland, known as Fenno-Skan 2, has been in operation since the end of 2011. Around the end of 2015 or beginning of 2016, a new cable between Sweden and Lithuania, known as Nordbalt, will be completed. In April 2013, Statnett and Svenska Kraftnät decided not to increase the transmission capacity between Norway and Sweden through a previously-planned western branch of the South West Link.



Security of supply

Electricity occupies a special position in the energy system as it is often a prerequisite for the supply of all other forms of energy. Technical systems, on which our energy systems are dependent, often require electricity in order to function. Because electricity cannot be stored, there must constantly be a balance between the supply and use of electricity in the electricity system. This means that disruptions to the electricity system often have immediate consequences for the electricity supply.

The electricity market must be able to prevent and alleviate power cuts and shortages. Those who supply electricity have a far-reaching responsibility to prevent and alleviate the power cuts that may arise. Power cuts that took place in conjunction with the storm Gudrun in 2005 led to the Electricity Act being amended to place more stringent requirements on the suppliers and distributors of electricity. Electricity customers now have the right to compensation for power cuts in the case of continuous cuts lasting longer than 12 hours. Electricity users, in turn, are themselves responsible for dealing with the consequences of disruptions and cuts to the electricity supply.

The risk of electricity shortages is greatest during the winter when a lot of electricity is used to heat residential buildings and non-residential premises. The connection of the Swedish electricity system with those of neighbouring countries means that the security of supply in the Nordic countries is improved as electricity can be imported or exported depending on where a shortage arises. However, if a shortage arises in Sweden as a result of cold weather, our neighbouring countries most often also have a high level of electricity use, which means that Sweden cannot always rely on being able to import electricity when it is required.

A widespread shortage of electricity has never arisen in Sweden. However, if this did take place, and the market could not deal with it in a satisfactory way, there would need to be emergency preparedness plans in place. If the electricity market does not function or if the functioning of the market leads to unacceptable societal consequences, measures that remove the electricity market's functions from the equation can be used. These measures can only be activated following a political decision. The rationing of electricity is one example of such measures.

If an acute electricity shortage did occur, electricity users may need to be disconnected in order to protect the electricity network. In such situations, there are plans in place to enable the electricity supply to societally-important functions to be prioritised. The aim is to minimise the negative consequences to society.

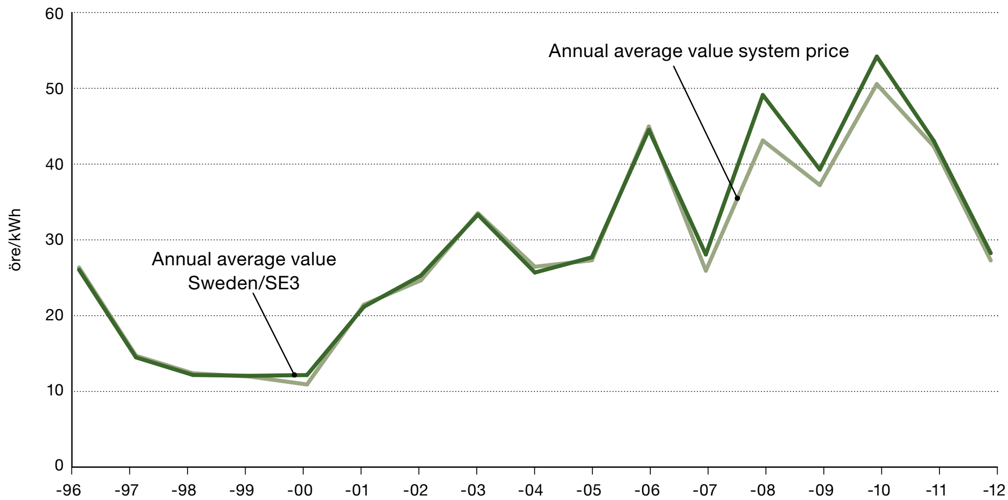
The electricity price on the exchange was low in 2012

In 2012, the annual average value of the system price of electricity on Nord Pool was 27.2 öre/kWh, see Figure 16. This is a low electricity price and the last time the price was this low was in 2007. The Nord Pool system price was significantly higher in both 2010 and 2011, at 50.6 öre/kWh and 42.5 öre/kWh, respectively. The high price in 2010 was, to a large extent, a result of a cold winter and low availability of the Swedish nuclear power plants. A milder year and better availability of the nuclear power plants was the cause of the somewhat lower price in 2011. For nine months of 2012, the price was below 30 öre/kWh, with the lowest market price in July, when it was 11.8 öre/kWh. The availability of water for hydro- power production was very good throughout the year and the availability of nuclear power was relatively good.

The electricity price can differ between different electricity areas depending on the restrictions between these areas. Sweden has been divided into four electricity areas since 1 November 2011 as a result of a demand by the European Commission that Sweden change the method used to managing restrictions on transmission within the Swedish electricity network. The aim of the partitioning into electricity areas is to make it clear where in Sweden there is a need to reinforce and expand the national grid. It also provides a clear indication of where in the country there is a need to increase electricity production in order to better match the use in that specific area.

Following the partitioning into electricity areas, there is no ’Swedish Price’ for electricity, and, in Figure 16, SE3 has been set as an estimated value for what was previously the ’Swedish Price’. The annual average value for the area Sweden/SE3 was 28.2 öre/kWh in 2012.

Figure 16 The spot prices on Nord Pool, annual average value for the system price and for the price area Sweden/SE3 1996–2012, öre/kWh



Source: Nord Pool Spot.

The electricity prices described here are not the consumer electricity price, rather the price resulting from trading on the electricity exchange Nord Pool Spot. Trade on Nord Pool takes place between power producers, electricity traders, large end-users, portfolio managers, capital managers and brokers. Sweden and Norway started the Nordic electricity exchange Nord Pool in 1996. In addition to Statnett and Svenska Kraftnät, the transmission system operators in Finland, Denmark, Estonia and Lithuania own the Nordic electricity exchange. In 2012, the companies trading on Nord Pool Spot turned over 334 TWh of electricity, which is equivalent to 77 per cent of the electricity that was used in the Nordic countries[25]. Electricity can also be traded directly between a seller and a buyer or internally amongst the electricity companies.

25 The power of transparency. Annual report 2012. Nord Pool Spot.

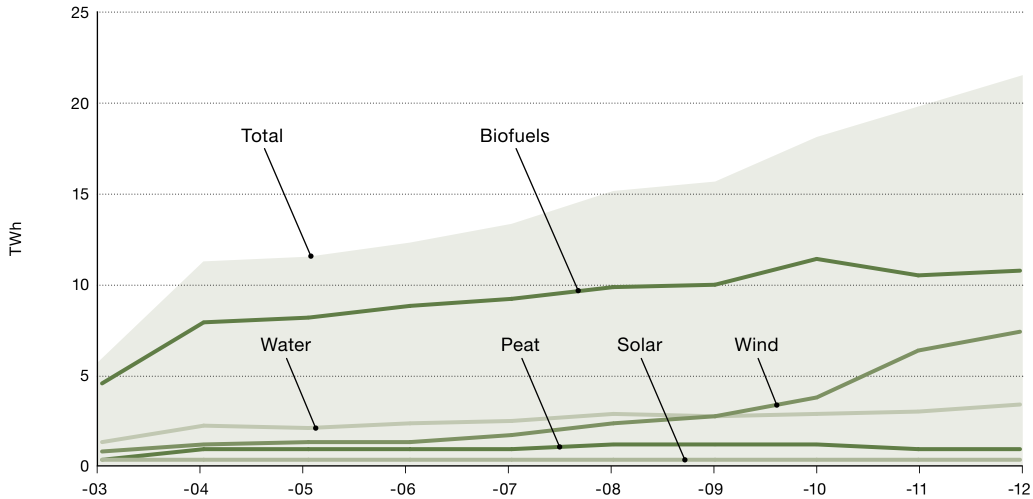
The electricity certificate system supports the production of renewable electricity

The electricity certificate system is a market-based support that aims to increase the proportion of electricity that is produced from renewable sources. For every MWh of electricity produced by an approved facility from a renewable energy source, the owner of the facility receives an electricity certificate that then has a resale value. The buyers of electricity certificates are organisations (electricity suppliers and certain electricity users) with a quota obligation, i.e. they are obliged to buy a certain proportion of electricity certificates in relation to their electricity sales or electricity use. The size of this proportion is set through a percentage rate (quota) for each year. The quotas are calculated based on the expected expansion of renewable electricity, expected electricity sales and electricity use of the organisations with the quota obligations.

The price of electricity certificates has varied since the system was introduced in Sweden in 2003 and was, at its highest, a little over SEK 350 per electricity certificate during parts of 2008. At the end of 2011, the price fell to around SEK 150 and was somewhat lower at the beginning of 2012. Over the course of the remainder of 2012, the price rose steadily, and by the end of the year was just over SEK 200 per electricity certificate. One reason for the relatively low price in recent years is that the expansion has been fast and the production high, leading to an oversupply of certificates. The demand for electricity certificates has also been lower than expected as Sweden’s electricity use has been lower than was assessed when the quotas were determined.

In 2012, electricity production from renewable energy sources and peat amounted to 21.4 TWh. Of these, 6.5 TWh existed prior to the start of the electricity certificate system in 2003. Figure 17 shows how the production of renewable electricity has increased from 2003 up to and including 2012 and how production is distributed between different sources of energy.

Figure 17 Electricity production, by type of power in the electricity certificate system 2003–2012, TWh



Source: Svenska Kraftnät's certificate register Cesar. Swedish Energy Agency.

SWEDEN AND NORWAY HAVE A COMMON ELECTRICITY CERTIFICATE MARKET

Since 1 January 2012, Sweden and Norway have had a common electricity certificate market. Actors can build renewable electricity production in both Norway and Sweden and trade in electricity certificates across national boundaries. The goal of the common electricity certificate market is to increase the production of renewable electricity by 26.4 TWh in both countries between 2012 and 2020.

Before the end of 2015, the Norwegian Water Resources and Energy Directorate (NVE) and the Swedish Energy Agency will report on the progress in the electricity certificate system. Joint investigations will analyse the chances of achieving the goal and, as required, make regulatory changes or adjust quotas in the system.

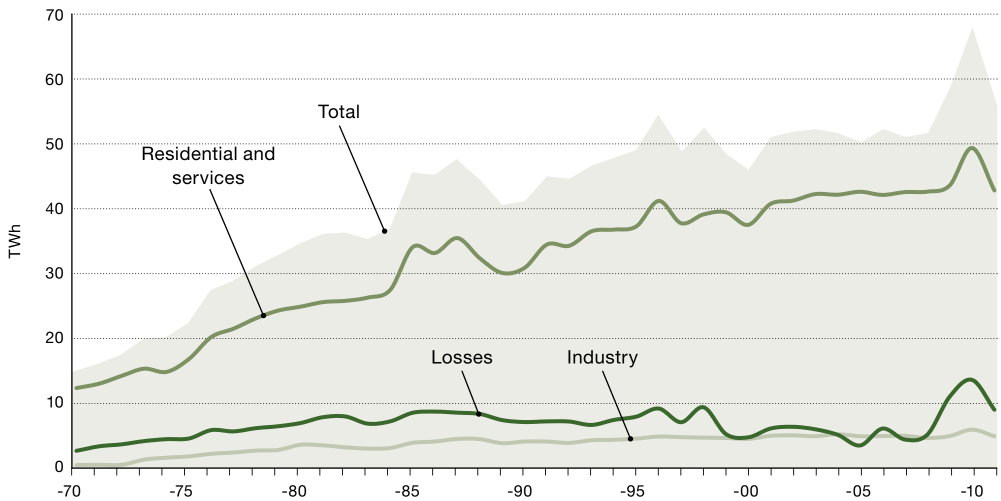
The district heating market

District heating has been available in Sweden since the 1950s and was previously produced mainly in heating plants. More recently, it has become increasingly common to produce district heating in CHP plants. In 2011, district heating amounted to 56 per cent of the total energy use in residential buildings and non-residential premises. Half of all district heating is used in multi-dwelling buildings, 36 per cent in non-residential premises and the remainder, 14 per cent, in single-family and two-family detached dwellings.

The entire district heating industry has an annual turnover of SEK 30–40 billion. In recent years, the price of district heating has risen, mainly due to increased costs for the district heating companies resulting from increased fuel costs[26].

As a result of improved technology, a more efficient use of district heating networks and an increased proportion of thermal heat, the distribution and conversion losses in district heating systems have decreased over the years. Between 1990 and 1999, these losses amounted to an average of 17 per cent, before decreasing to, on average, 10 per cent between 2000 and 2009. In 2011, losses constituted 15.5 per cent of the total use of district heating. Figure 18 shows the use of district heating between 1970 and 2011. The large increase in 2009 and 2010 was primarily due to the cold winters.

Figure 18 Use of district heating 1970–2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

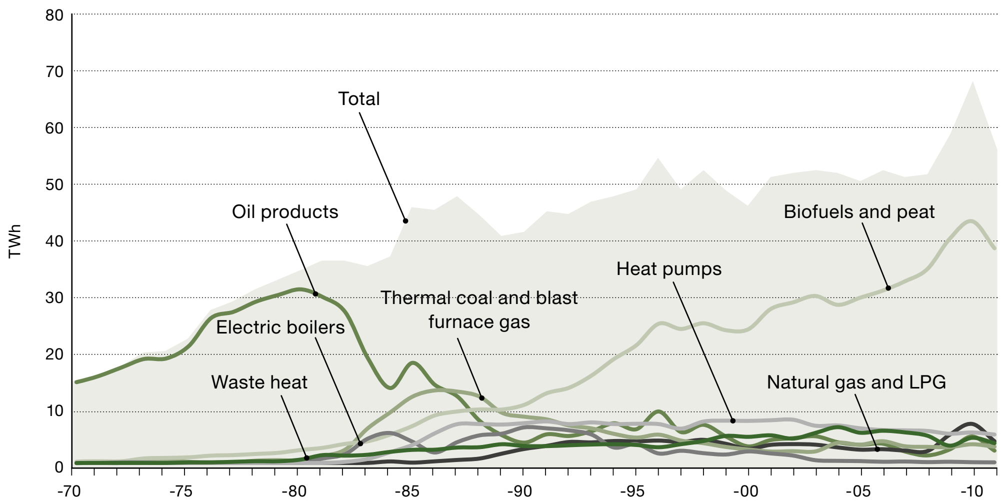
26 Analysis of the development of district heating companies' revenues and costs. EI R 2011:08. Swedish Energy Markets Inspectorate.

District heating can use several different fuels

Several different fuels can be used to produce district heating and a major transition towards renewable fuels has taken place since the 1970s. In 2011, wood fuels accounted for 38 per cent, waste for 19 per cent, peat for 4 per cent and waste heat for 6 per cent of the input energy used to produce district heating in Sweden.

The use of waste has increased in the past decade. The heat from incinerating waste is used as the basis for district heating in several Swedish cities. The increase is due to the prohibition against dumping combustible waste from 2002 and the prohibition against dumping of organic waste from 2005. The number of electric boilers and heat pumps in the district heating system has decreased. Figure 19 shows the input energy used in the production of district heating in the period from 1970 to 2011.

Figure 19 Input energy used in the production of district heating 1970–2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

Prices and forms of ownership differ greatly

There are significant differences in the price of district heating between different municipalities. In 2012, Luleå Municipality had Sweden's lowest district heating price at SEK 100,000 per year for a multi-dwelling building rated as 193 MWh, while Falkenberg Municipality had Sweden's highest price, more than twice as high[27].

The price differences between municipalities depend on factors such as the district heating companies' ownership structures, yield requirements and input fuels. Geographical conditions for the installation of district heating also have an impact on the price28. The heating options available to the customer thus depend, to a large extent, on where they live.

Security of district heating supply

District heating is available in about 250 of Sweden's 290 municipalities. In most cases, district heating is the dominant form of heating in these towns. In general, the district heating supply has been regarded as a secure system, with several different types of inbuilt redundancies. However, the increased use of biofuels with limited opportunities for storage at the production facilities has an impact on the level of risk.

As the proportion of district heating users increases, the individual user's flexibility with regard to heating supply decreases. Simultaneously, society becomes more vulnerable, from a supply perspective, to disruptions to the delivery of heating. The result may be increasing expectations and demands on the district heating suppliers to take responsibility for the individual's heating supply, regardless of the current circumstances.

A large proportion of the heating of non-residential premises and residential buildings in Sweden is dependent on electricity. Even district heating systems require electricity in both the supply chain and in the user's building. A disruption to the district heating supply can cause problems for residents, as well as industry, as early as 24 hours after the disruption starts, if this takes place during a cold season.

Increasing the security of supply is not a duty of the individual company or organisation. This requires collaboration between all of the stakeholders in the supply chain; the energy suppliers (producers and distributors), the district heating and district cooling customers (users) and various authorities at the local, regional and national level.

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27 Energy Indicators 2013 ER 2013:05. Swedish Energy Agency.

28 Analysis of the development of district heating companies' revenues and costs. EIR 2011:08. Swedish Energy Markets Inspectorate.

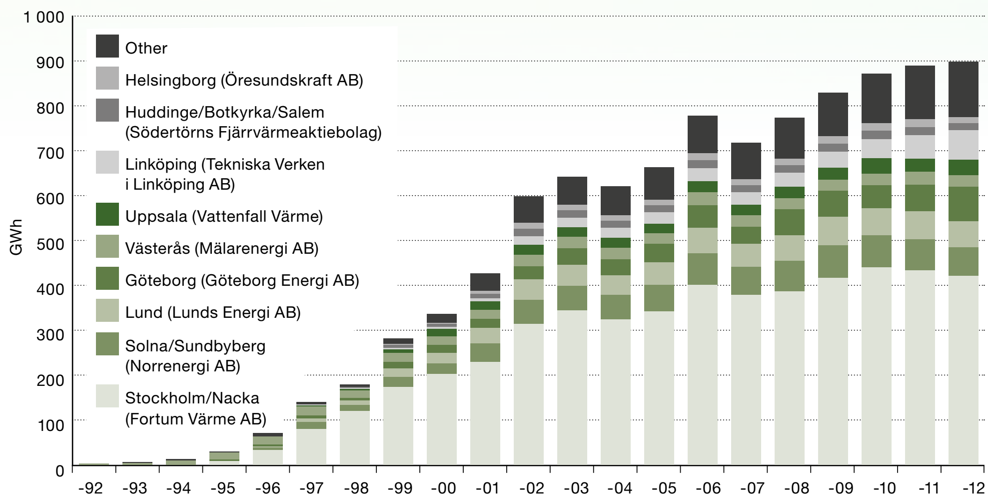
District cooling is increasing

District cooling is used mainly in offices and business premises and for cooling industrial processes. The principal of district cooling is the same as for district heating. This involves the production of cold water in a large facility for distribution in pipes to customers.

The most common method is to utilise waste heat or sea water to produce district cooling with the help of refrigeration machines. Sometimes this takes place at the same time as the production of district heating. Another common method of production is to use cold water directly from the bottom of the sea or a lake, which is known as free cooling.

The market for district cooling has expanded a great deal since the first facility was built in 1992. Supplies of district cooling increased somewhat, from 888 GWh in 2011 to 898 GWh in 2012, see Figure 20. In 2012, a total of 33 companies supplied district cooling, which is the same number as in 2011. The district cooling network was expanded by 371 kilometres in 2012.

Figure 20 Supplied district cooling 1992–2012, GWh



Source: Swedish District Heating Association, adapted by the Swedish Energy Agency.

Consumer power in the district heating market has to increase

The government has set up various investigations in order to strengthen the consumers' position in the district heating market and provide them with greater security when it comes to price and conditions. The Swedish Energy Markets Inspectorate has investigated the opportunities for external heating producers to gain access to the existing district heating networks.[29] A proposal for the review of price changes has also been drawn up, with the aim of tackling unreasonably high district heating prices.[30]

The Swedish Energy Agency has investigated and proposed a principle for the reporting of waste heat potential in the planning of new district heating production plants. Part of this investigation has involved looking at how Article 14.5 of the Energy Efficiency Directive should be implemented in order to promote efficient heating and cooling.[31] All of the investigations are currently out for consultation.

In accordance with the District Heating Act (2008:263), the role of the Swedish District Heating Board is to negotiate between the district heating companies and customers concerning prices and conditions, as well as network access rights. The investigations conducted by the Swedish Energy Markets Inspectorate that have been delivered to the Government Offices of Sweden may result in significant changes to the role of the Swedish District Heating Board or to its abolition.

Electricity certificates and carbon dioxide tax contribute to renewable district heating

In recent years, the interest in CHP, primarily based on biomass, has again increased in Sweden. In 2011, CHP accounted for 45 per cent of the district heating supplied. A strong contributory factor is the electricity certificate system, which has contributed to subsidising electricity produced in biomass CHP plants since 2003. In 2011, CHP generation accounted for nearly 17 TWh of electricity, of which 11 TWh were entitled to electricity certificates. In 2012, a large number of district heating facilities were phased out of the electricity certificate system, in accordance with the quota levels that had previously been set.

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29 Regulated access to the district heating networks. EI R2013:04. Swedish Energy Markets Inspectorate.

30 Scrutinising price change and the principle of equality of treatment for district heating. EI R2013:07. Swedish Energy Markets Inspectorate.

31 The principle for reporting of waste heat potential in the planning of new district heating production. ER 2013:09. Swedish Energy Agency.

In 2011, the carbon dioxide tax was reduced for heat produced by CHP, from 15 per cent to 7 per cent of the basic amount. The basic amount is 105 öre/kg of carbon dioxide for facilities in the EU ETS, which includes basically all facilities. The equivalent carbon dioxide tax rate for heating plants is 94 per cent of the basic amount. Beginning on 1 January 2013, the carbon dioxide tax was withdrawn from CHP produced by facilities in the EU ETS. This also applies to heating supplied to industry from heating plants.

45 per cent of district heating supplied in 2011 came from CHP generation.

The allocation of emission allowances benefits district heating

District heating producers in Sweden are included in the EU ETS. Beginning in 2013, district heating producers will be allocated emission allowances free of charge. The allocation is based on a target. The heating target has been calculated based on a reference facility using natural gas as its fuel, which means 62.3 emission allowances per TJ of heat supplied to the district heating network or 0.22 emission allowances per MWh.

The district heating producers are receiving allocations up to 80 per cent of the target free of charge in 2013. The calculated allocation is adjusted downwards in a linear fashion over the course of the period from 2013 to 2020, from 80 to 30 per cent. In practice this means that all of the district heating producers in Sweden are subsidised as the allocation is based on natural gas and the majority of Swedish district heating facilities have already transitioned from fossil fuels to renewable fuels.

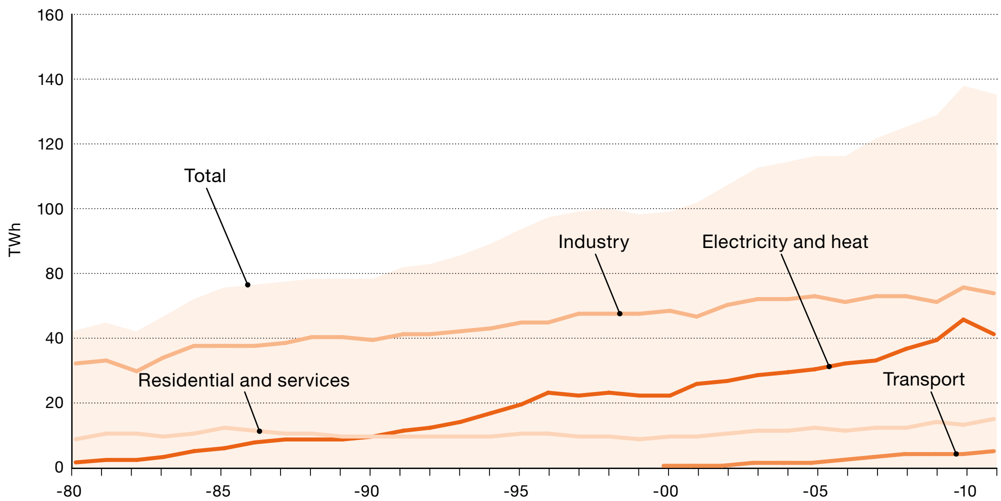
Fuel markets

The fuel markets include both fossil fuels and biofuels. Fossil fuels are, to a great extent, imported, while a large proportion of biofuels are produced within Sweden. The use of biofuels for both heating and transport has increased in Sweden since the 1970s, while the use of fossil fuels has decreased. A continued increase in the use of biofuels could mean that Sweden becomes more dependent on imports of biofuels in the future.

Biofuels and peat

The use of biofuels in the Swedish energy system has increased over the years. Peat and biofuels made up about 10 per cent or 48 TWh of the energy use in 1980. In 2011, this figure had increased to 132 TWh, which is equivalent to 23 per cent of the total energy use. Figure 21 shows the use of biofuels and peat in the industrial sector, residential and services sector, transport sector, as well as in the production of electricity and heat.

Figure 21 Use of biofuels and peat by sector 1980–2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

At the beginning of the 1990s, both a carbon dioxide tax and higher energy taxes were introduced in Sweden. However, biofuels are exempt from both energy and carbon dioxide taxes, which has contributed to a substantial increase in their use. The rising prices of fossil fuels have also benefited biofuels, as has the introduction of the electricity certificate system in 2003 and of the EU ETS in 2005. In addition to wood fuels, the term biofuels also encompasses various types of waste products.

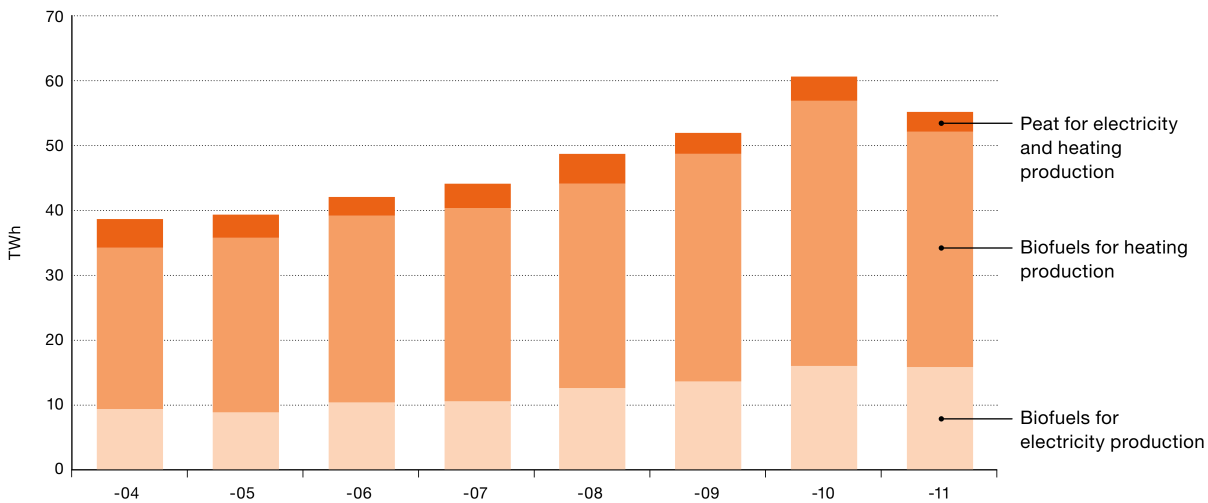
WHAT ARE BIOFUELS?

- Unrefined wood fuels such as bark, sawdust, recycled wood, felling remains and energy forest
- Refined wood fuels such as pellets, briquettes and wood powder
- Intermediate products and by-products from the pulp industry such as black liquor, tall oil and tall oil pitch
- Biofuels from agriculture such as cereals, energy grass and straw
- Combustible domestic and industrial waste
- Pure ethanol used in industry, mixed with 95 octane petrol and as the main ingredient in the motor fuels E85 and ED95
- Biodiesel
- Biogas

Taxes have an impact on the fuel mix in electricity and heat production

It is mainly tax policy that has had an impact on the fuel mix used in electricity and heating production, but also other governing factors have been of significance. Biofuels for electricity production increased from 9.2 TWh to 15 TWh between 2004 and 2011, at the same time as the use of peat has decreased from 1 TWh to 0.6 TWh[32]. The trend is the same for heating production, with an increase in the use of biofuels, from 25 to 36 TWh in 2011. The use of peat has also decreased here by close to half, from 4.4 TWh to 2.2 TWh over the course of the same period, see Figure 22.

Figure 22 Use of biofuels and peat for electricity and heating production 2004–2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

The use of peat in electricity and heating production is, as with biofuels, exempt from energy and carbon dioxide tax. However, the use of peat is subject to sulphur tax. Peat is defined in the emissions trading scheme as a fossil fuel and thus electricity and heating producers pay for their emission allowances. Since 1 April 2004, electricity produced from peat has, however, been entitled to electricity certificates when the production takes pace in approved combined heat and power plants[33]. This is one reason why peat remains part of the energy mix in Sweden.

32 Peat 2012. MI 25 SM 1301. SCB.
33 Peat in the electricity certificate system. Govt. Bill 2003/04:40.

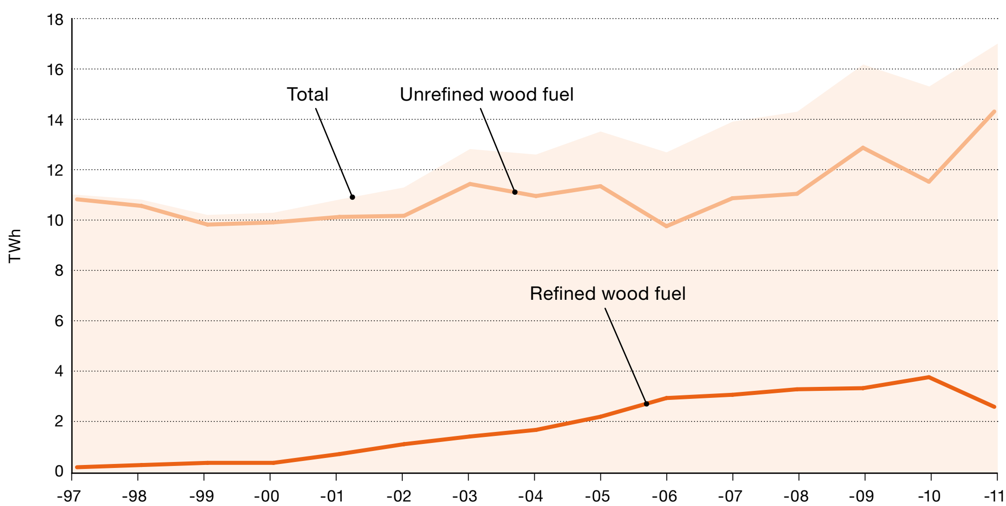
The residential and services sector is a large market for wood fuels

The residential and services sector has almost doubled its use of wood fuels in the last ten years. At the beginning of the 2000s, the amount of wood fuels was about 10 TWh, with this figure rising to 17 TWh in 2011, see Figure 23. It is mainly the use of refined wood fuels that has

increased since the end of the 1990s. Following a very cold winter in 2009/2010, the use of refined wood fuels has decreased rapidly in electricity and heat production and also in the residential and services sector as a result of warmer winters. Biofuels have mainly replaced oil used for heating purposes in the residential and services sector because of, amongst other things, the increasing oil price, taxes and grants for converting boilers from heating oil to biofuels.

The residential and services sector has nearly doubled its use ofwoodfuels in 10 years.

Figure 23 Use of unrefined and refined wood fuels in the residential and services sector 1997–2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency. www.pelletsforbundet.se. Swedish Association of Pellet Producers.

A large proportion of imported biofuels are used in district heating

The bulk of biofuels and peat are produced in Sweden. There are also substantial imports of, primarily, ethanol, wood pellets and peat. In 2011, the import of wood pellets amounted to 2.3 TWh and export to 0.6 TWh. The import of energy peat was 1.0 TWh in 2011.

There is currently no comprehensive gathering of statistical data about the import of biofuels and it is therefore difficult to determine its volume. In addition to import of ethanol, pellets and peat, the import can also consist of waste, recycled wood and similar biofuels. There are also indirect imports; when forestry companies import roundwood for industrial processes, the by-products and waste such as bark and sawdust can be used as fuel or as raw materials for pellets, briquettes and powder. As a result, indirect imports are included among domestically produced fuels in the energy balance for Sweden. Total imports of biofuels are estimated at between 5 and 9 TWh, with the bulk of this quantity being used to supply district heating.

The price of biofuels and peat is decreasing

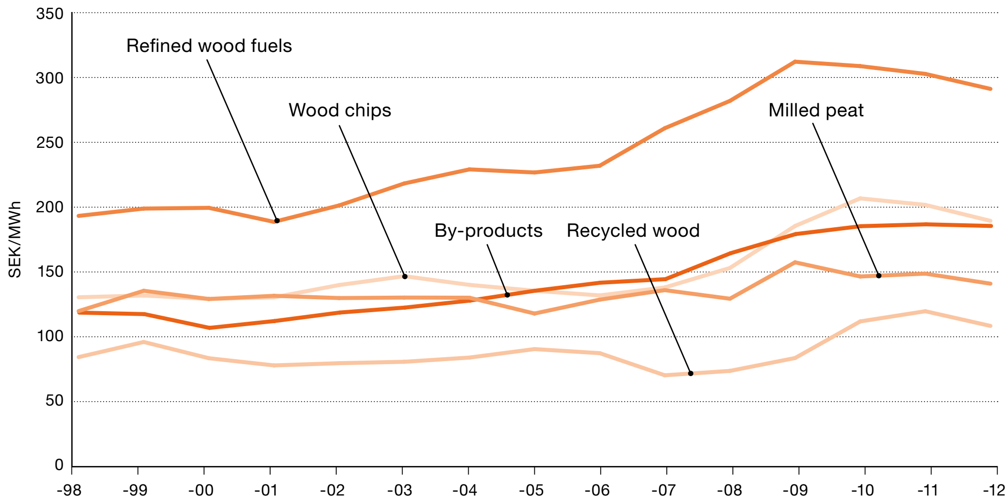
Increased use of biofuels for electricity and heat production has led to an increased demand for, mainly, wood fuels. Throughout the 1980s and 90s, the prices of wood fuels and peat for heating plants remained practically unchanged. Good availability of cheap and easily accessible biofuels depends on the surplus of by-products and waste generated by the forestry industry.

The increased demand for wood fuels led to increased competition, which caused prices to rise during the 2000s. Greater extraction of wood fuels from forests is the main reason why this increase has been possible. The market is expected to grow further in the near future. There are strong indications that the increased use of waste for electricity and heat production may hold back the expected increase in prices[34]. The growing market is also expected to stimulate imports of biofuels that can compete on price with domestic biofuels.

34 Energy Indicators 2012 ER 2012:20. Swedish Energy Agency.

Figure 24 shows the annual average spot price for biofuels and peat, i.e. their nominal prices. The figure shows that the decrease in prices, which began following the cold winter in 2009/2010, is continuing and also applies not only to refined wood fuels, but also wood chips, recycled wood and peat. Only by-product prices are increasing. There may be several reasons for the general decrease in prices, among them the increased import opportunities, which may keep the prices down. The decreased demand, resulting from warmer winters in the last three years, may also have had an impact on the prices.

Figure 24 Prices for wood fuel and peat for heating plants 1998–2012, SEK/MWh



Source: Wood fuel and peat prices. EN0307. Swedish Energy Agency.

Biodiesel and ethanol

In 2012, 407,000 cubic metres of ethanol and 404,000 cubic metres of biodiesel were used35. Swedish production of ethanol and various types of biodiesel is not sufficient to meet the demand. Consequently, Sweden is dependent on imports of transport biofuels, mainly from other EU countries, but also from the rest of the world. In addition, Swedish producers need to import a proportion of their raw materials for transport biofuels from other EU countries.

The suppliers of transport fuels are exempt from carbon dioxide tax and energy tax for the transport biofuels they sell. One condition of this is that the suppliers must be able to demonstrate the biofuels fulfil the sustainability criteria[36].

WHAT ARE THE SUSTAINABILITY CRITERIA?

- Transport biofuels and bioliquids must result in reduction in greenhouse gas emissions of at least 35 % compared to their fossil fuel comparators. Beginning in 2017, this reduction must be 50 %.
- Biomass for transport biofuels and liquid biofuels may not be grown on land that is natural forest, grassland with a high biodiversity, or land that is a protected natural area.
- Nor is it permissible to use biomass that has been grown on land that has been converted from forested land, wetland or peatland to some other category of land, for example, cultivated land, since January 2008.

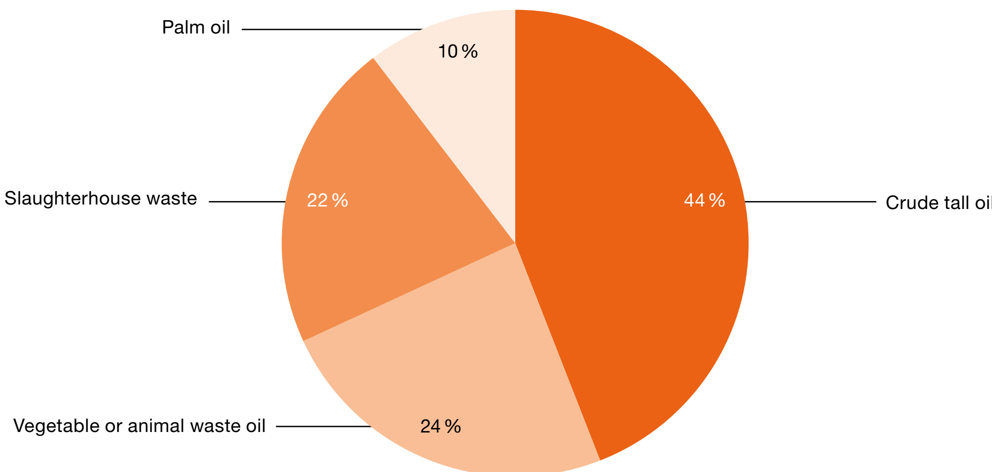
35The Transport Sector's Energy Use 2012. ES 2013:02. Swedish Energy Agency.
36In accordance with the Sustainability Criteria for Transport Biofuels and Liquid Biofuels Act (2010:598).

Synthetic diesel is increasing significantly in Sweden

Biodiesel includes both FAME and HVO. FAME is one type of biodiesel that is created from different types of oil, with methanol as an ingredient. FAME is mainly used in low admixtures in normal diesel, but is also sold to a certain extent in its pure form, called B100. The FAME that is on sale in Sweden is almost exclusively produced from rapeseed oil. See Table 1 on page 37 for explanations of transport biofuels.

HVO is a synthetic diesel that is mainly made from various residues and waste. When the fuel was introduced onto the market in 2011, the dominant raw material was crude tall oil, however, a range of new raw materials have appeared on the market in 2012, see Figure 25. The use of HVO in the Swedish market has also increased significantly compared with the previous year as several of the large transport fuel suppliers have begun mixing HVO into normal diesel.

Figure 25 Distribution of raw materials for the HVO used in Sweden in 2012, per cent

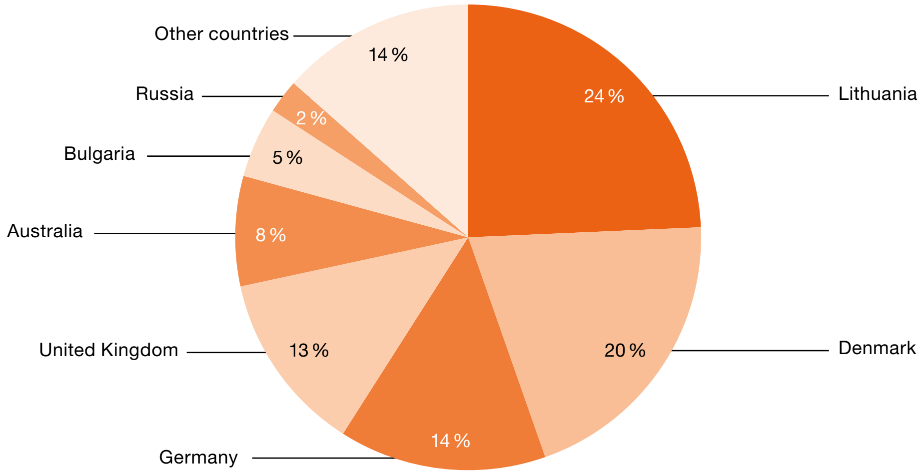


Source: Sustainable biofuels and bioliquids 2012. ET2013:06. Swedish Energy Agency.

Raw materials for biodiesel come mainly from Europe

The majority of the FAME that is produced in Sweden is based on rapeseed oil imported from other EU countries, see Figure 26. The raw materials for imported FAME most often originate in Europe, but some also originate in Australia and the Middle East.

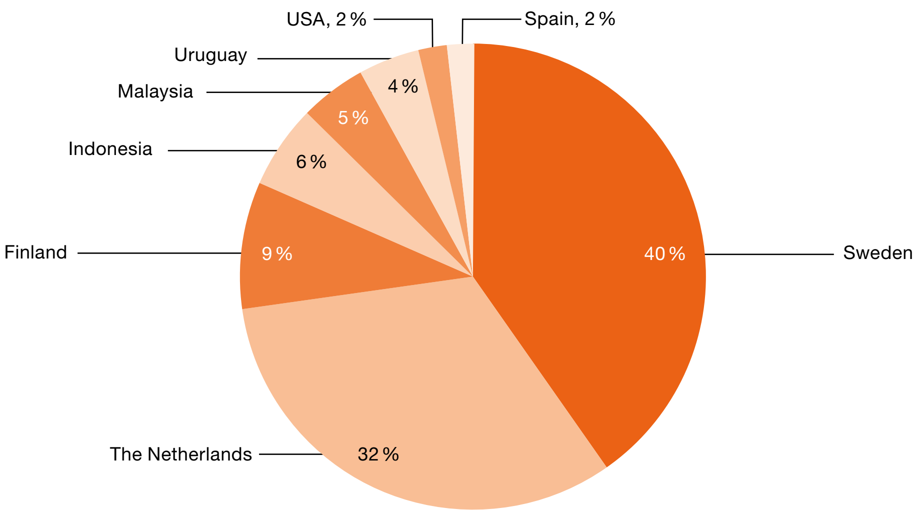
Figure 26 Distribution of the country of origin of the raw materials for the FAME used in Sweden in 2012, per cent



Source: Sustainable transport biofuels and bioliquids 2012. ET2013:06. Swedish Energy Agency.

The raw material used to produce HVO in Sweden is primarily Swedish crude tall oil. Imported HVO is made from raw materials originating in a variety of countries, including, aside from other EU countries, South-east Asia, South America and the USA, see Figure 27.

Figure 27 Distribution of the country of origin of the raw materials for the HVO used in Sweden in 2012, per cent

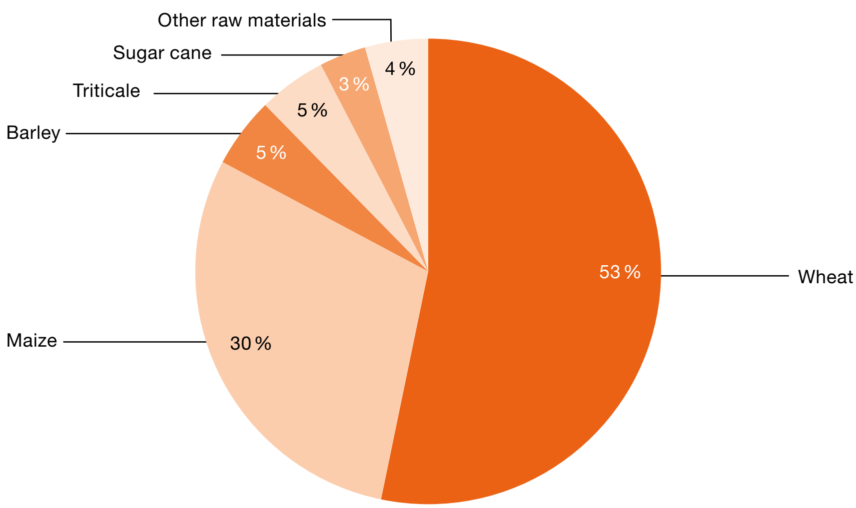


Source: Sustainable biofuels and bioliquids 2012. ET2013:06. Swedish Energy Agency.

Ethanol is mainly produced from cereals

Ethanol is included both in low admixtures in normal petrol and as high admixtures in the alternative transport fuels E85 and ED95. The volumes used in the alternative transport biofuels are somewhat higher than those used in low admixtures. The production of ethanol in Sweden is mainly based on cereals such as wheat, triticale, barley and rye. There is also a demonstration plant where ethanol is produced from brown liquor, a waste product from the paper pulp industry. Cereals are also the dominant raw materials when imported ethanol is included, see Figure 28. The remaining volume is mainly produced from maize and only a small proportion is based on sugar cane.

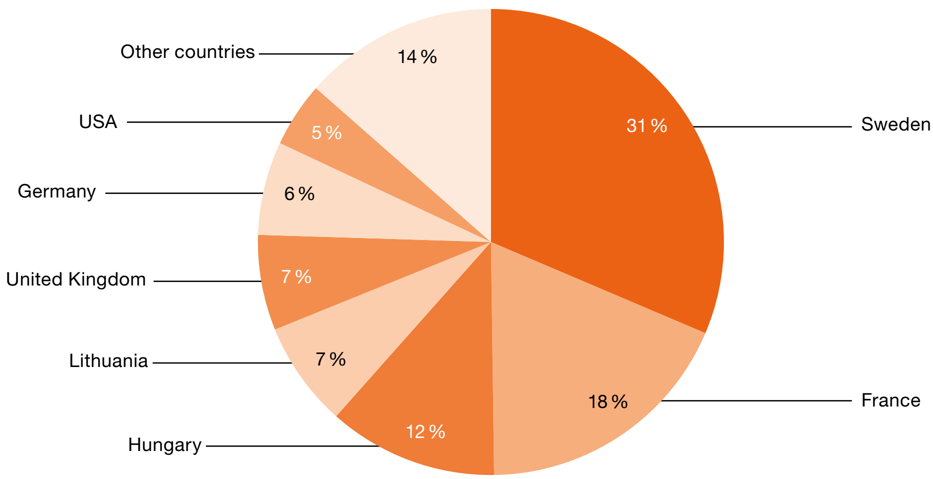
Figure 28 Distribution of raw materials for the ethanol used in Sweden in 2012, per cent



Source: Sustainable biofuels and bioliquids 2012. ET2013:06. Swedish Energy Agency.

The production of ethanol in Sweden satisfies about half of the demand. The remainder is imported from other countries. The raw materials for over 90 per cent of the ethanol sold in Sweden in 2012 originated in European countries, see Figure 29. The remaining quantity of ethanol was produced from raw materials from the USA and South America.

Figure 29 Distribution of the country of origin of the raw materials for the ethanol used in Sweden in 2012, per cent



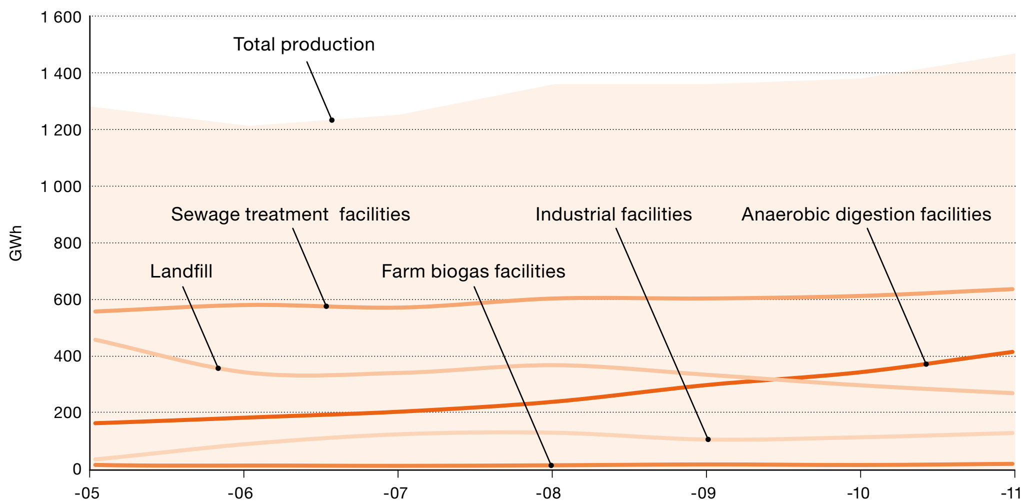
Source: Sustainable biofuels and bioliquids 2012. ET2013:06. Swedish Energy Agency.

Biogas

Total biogas production in 2011 amounted to 1,473 GWh, see Figure 30. There are two clear trends when it comes to biogas in Sweden: total production is increasing and an increasingly large proportion is upgraded for use in the transport sector. In the upgrading process, the proportion of methane is increased from about 60 per cent to over 90 per cent. This is necessary in order to be able to pump the gas into the natural gas network or to be able to use it as CNG (compressed natural gas) in vehicles.

About half of total biogas production was upgraded in 2011; in addition, 38 per cent went into heat production and 3 per cent into electricity production. The remaining quantities may, for example, be thermal losses, but also surpluses of biogas that are combusted in instances of reduced demand for heating.

Figure 30 Sweden's production of biogas by category of plant 2005–2011, GWh



Source: Production and use of biogas Swedish Energy Agency and the Swedish Gas Association

Sewage treatment facilities are the largest producers

Slurry from sewage treatment facilities, as well as food waste and manure are the main ingredients for the production of biogas. The anaerobic digestion of waste and various energy crops also contributes. In Sweden there are a total of 233 biogas production facilities in which the digestion of raw materials produces raw gas. In addition, there are 47 upgrading facilities for the modification of biogas to transport fuel quality.

Biogas is currently sold as both pure biogas and in mixtures with natural gas. Traditional gas companies, rather than the producers themselves, are increasingly taking over the distribution of upgraded biogas. Distribution takes place via pipelines or, as is the case in Stockholm, via tankers. The majority of the gas filling stations in Sweden are in southern Sweden and in the regions surrounding the major cities. Skåne, Stockholm and Västra Götaland account for 50 per cent of the countries biogas production.

Oil

Oil is the dominant form of energy globally and accounts for over 30 per cent of the world's energy supply. Supply and demand in the global oil market is influenced by the rate of economic growth, production levels, geopolitical and security factors, and also the weather and the amount currently in storage. Additional factors have had an impact on the global oil market in recent years, but despite many uncertainties, the market and the price have remained relatively stable. The recession in the largest consumer markets has led to a reduced demand for crude oil and petroleum products. Demand in developing markets and in the oil producing countries has, however, increased. The political situation and unrest in the Middle East and North Africa have led to falling production especially in certain key producing countries such as Iran and Libya. This has led to a reduction in the global supply of crude oil. Thanks to its spare capacity, Saudi Arabia has, on many occasions, been able to balance the reduction in supplies from other producers by increasing its own production.

Shale oil provides an increased supply to the global market

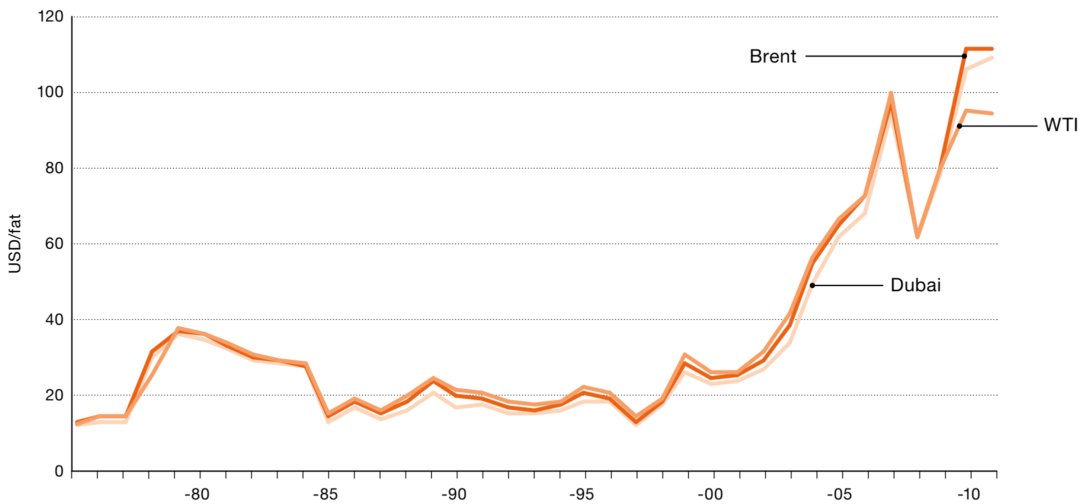
The fastest development of shale oil extraction has taken place in the USA, which has led to an increased supply in the global market. Shale oil production increased from 2.5 per cent of total crude oil production in 2003 to 40 per cent in 2012. The increased production in the USA has made it possible for the country to reduce its imports of crude oil from 10.1 million barrels per day in 2005 to 8.5 million barrels per day in 2012[37]. Shale oil is crude oil that is produced from oil shale by hydraulic fracturing, more commonly called 'fracking'. The technique involves fracturing the rock by injecting large quantities of water mixed with chemicals to release the oil, and also gas, located deep underground.

37 The US Tight Oil Revolution: What Kind of a Revolution? Energy Aspects. 28 June 2013. Oxford Institute for Energy Studies.

Brent crude serves as a global benchmark
Brent crude is a type of crude oil that is produced in the North Sea. Brent crude has an important role as its serves as a benchmark for global market prices. West Texas Intermediate (WTI) is another benchmark for setting the price of crude oil, but mainly in the North American market. The Dubai benchmark is used mainly to set the price of crude oil from the Persian Gulf traded on the Asian oil market.

Historically, the three reference prices have tracked each other, but the price of WTI has decreased in recent years, see Figure 31. This is due to the limited infrastructure in the USA, where the large trading hub in Cushing, Oklahoma, has constituted a bottleneck.

Figure 31 Crude oil prices 1976–2012, USD/barrel

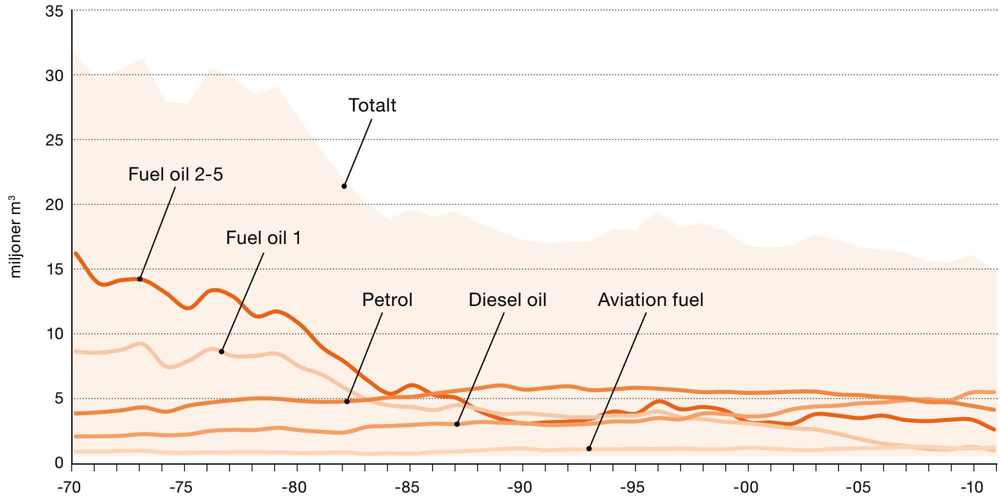


Source: Statistical Review of World Energy 2013. British Petroleum.

Oil use in Sweden has halved

Oil use in Sweden has halved since 1970, see Figure 32. It is primarily the use of fuel oil that has decreased in recent years, particularly by customers in detached houses.

Figure 32 Use of oil products in Sweden, including international maritime transport, 1970–2011, million m³

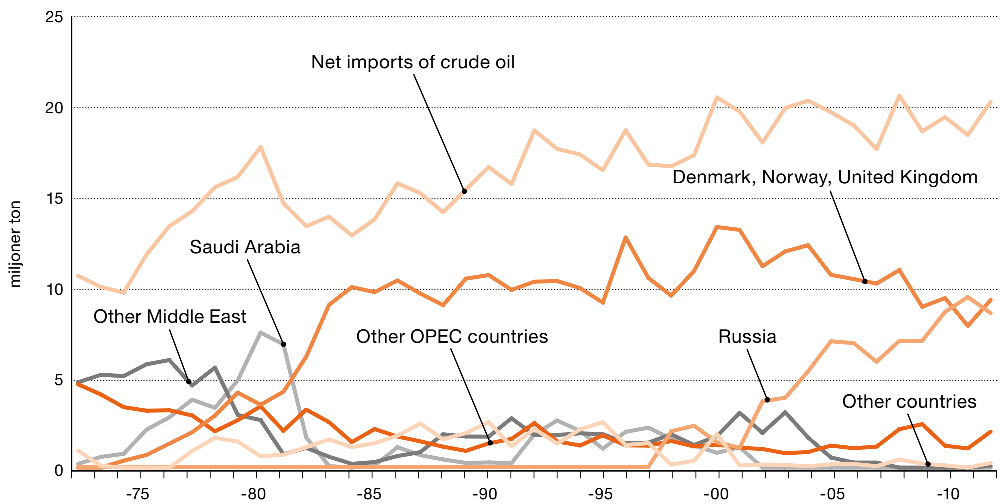


Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

Increased oil imports from Russia

In 2012, Sweden imported 20.4 million tonnes of oil. About half of Sweden's total imports of crude oil came from the North Sea area, mainly Norway and Denmark, see Figure 33. Imports of crude oil from Russia have increased sharply in the past decade and amounted to 42 per cent in 2012.

Figure 33 Swedish net imports of crude oil and oil products, distributed by country of origin 1972–2012, million tonnes



Source: Monthly fuel, gas and storage statistics. EN0107. Swedish Energy Agency.

Security of oil and transport fuel supply

Sweden is dependent on a functioning international oil market. The transport sector is about 90 per cent dependent on oil-based fuels, mainly petrol and diesel. Transport is in turn vital to other sectors. The use of bioenergy is dependent on daily deliveries of fuel to CHP/heating plants and without the transport of goods to supermarkets, industrial facilities and pharmacies and healthcare facilities, for example, these would not be able to operate.

A serious disruption in the supply of transport fuels would thus have serious consequences for the whole of society. In order to reduce this vulnerability, Sweden has a stockpile of oil that is equivalent to 90 days of average daily net imports. Large-scale vendors and importers are legally obliged to keep stockpiles. This obligation stems from Sweden's membership of the EU and from the IEP agreement. The IEP agreement (International Energy Programme) is a common energy programme agreed on between 26 countries. The Swedish Energy Agency decides which organisations are obliged to maintain stockpiles and how extensive these must be.

Natural gas

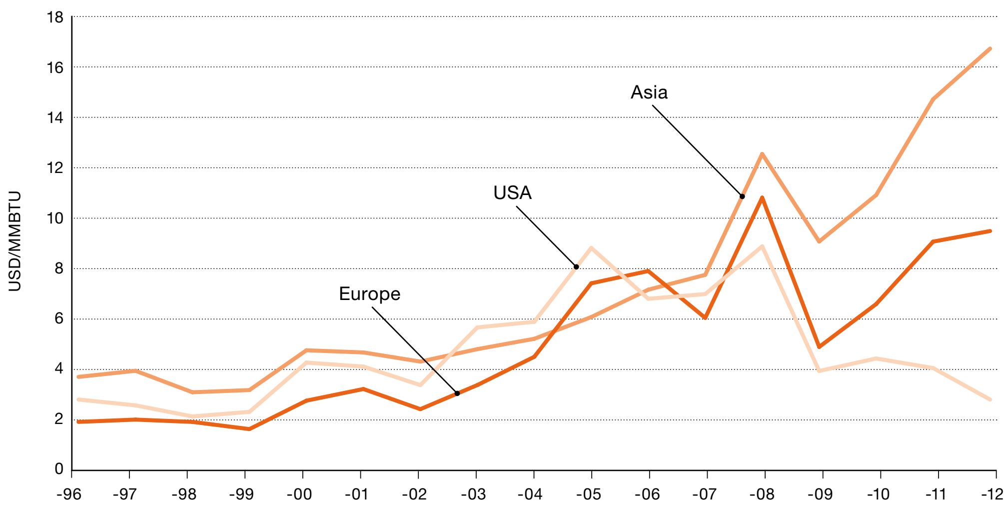
Natural gas accounts for 21 per cent of primary global energy use, in third place behind coal and oil. The use of natural gas has increased, primarily in the USA and Asia. In the USA the increase was 4.1 per cent in 2012. In Europe, as opposed to in Asia and the USA, the trend has been downward, and the use of coal has instead increased as a result of favourable prices. The use of natural gas in Europe decreased by 2.3 per cent in 2012[38].

Natural gas has gained a greater role in the global energy mix in recent years, mainly because of the rapid development of shale gas extraction in the USA. Shale gas is extracted in the same way as shale oil. The international trade in gas is more regional and less integrated than the international trade in oil and coal. The supply situation varies between regions, depending on how developed the infrastructure is. Historically, there has been little trade between the different regional markets, resulting in their isolation.

A large proportion of Europe´s imported natural gas is transported through pipelines, mainly from Russia. In Asia, the majority of natural gas is delivered in liquid form, known as LNG (liquefied natural gas), by cargo vessels. Another big difference between the different markets is the price of gas. The gas price in Asia is five times higher than in the USA and about three times higher than in Europe for exactly the same product[39], see Figure 34.

38 2012 in review: Natural Gas. British Petroleum.
39 Natural Gas Programme, Stern presentation; Oxford Energy Seminar, 18/09/2012. Oxford Institute for Energy Studies.

Figure 34 Average natural gas prices in Europe, the USA and Asia 1996–2012, USD/MMBTU*



Source: Statistical Review of World Energy 2013. British Petroleum.
*Million Metric British Thermal Unit.

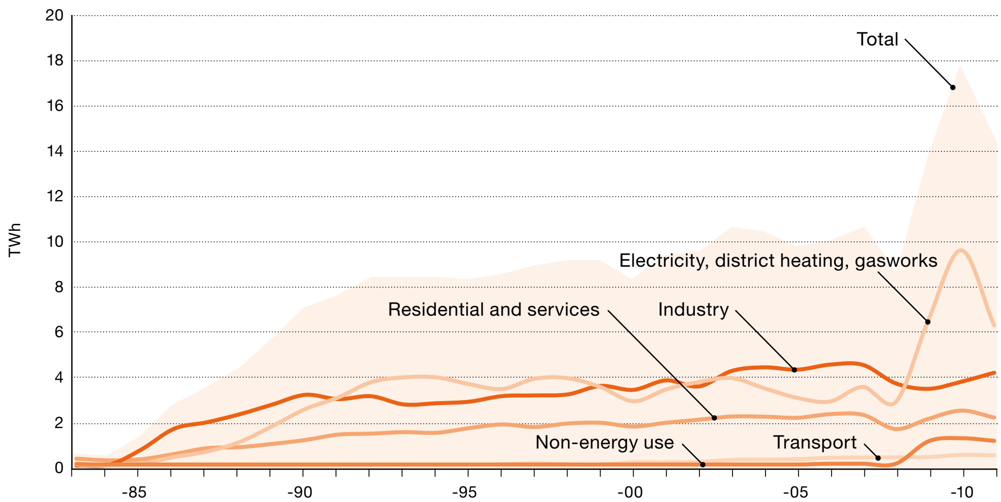
In the USA, the price of natural gas is based on supply and demand. However, natural gas prices in Europe and Asia are, to a large extent, negotiated prices set in bilateral long-term contracts. Until now, there has not been a liquid spot market for natural gas in either Europe or Asia. The price of natural gas has been strongly linked to the price of oil products in Europe and the crude oil price in Asia. However, as the oil price rose sharply in 2008, a hub-based market for natural gas has started to emerge in Europe mainly, but also in Asia. The rapid increase in shale gas production in the USA may lead to exports of LNG in the future. Future exports from the USA could potentially open up a more integrated global natural gas market in which there is less regional price variation.

Natural gas accounts for a small proportion of Sweden's energy use

Natural gas was introduced to Sweden in 1985 and accounts for a relatively small proportion of total energy use, about 3 per cent or just below 14 TWh. Its use increased rapidly up until the beginning of the 1990s and then levelled off. However, Swedish imports of natural gas increased sharply in 2010, to 17 TWh, mainly because of investments in gas-powered CHP. In 2011, imports decreased to about 13.6 TWh.

Almost all of the imports take place via a pipeline from Denmark that supplies the south-western parts of Sweden. The Danish system is in turn interconnected with the continental system. Small quantities of LNG are imported, mainly from Norway. Ninety per cent of natural gas customers are domestic, but the gas they used was equivalent to only 4.5 per cent of the total use[40]. It is instead electricity, district heating and industry that are the large users. Together, electricity, district heating and gasworks account for 44 per cent and industry for 29 per cent of the total use of natural gas, see Figure 35.

Figure 35 Use of natural gas in Sweden 1983-2011, TWh



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.

40 The Swedish electricity and natural gas markets 2012. EI R2013:10. Swedish Energy Markets Inspectorate.

Security of natural gas supply

The Swedish natural infrastructure stretches from Trelleborg to Gothenburg and has branches along the way, to places such as Gnosjö and Stenungsund. In these parts of the country, natural gas accounts for about 25 per cent of primary energy use. Because Sweden imports almost all of its natural gas from Denmark, the Swedish natural gas system is completely dependent on the functioning of the Danish natural gas system.

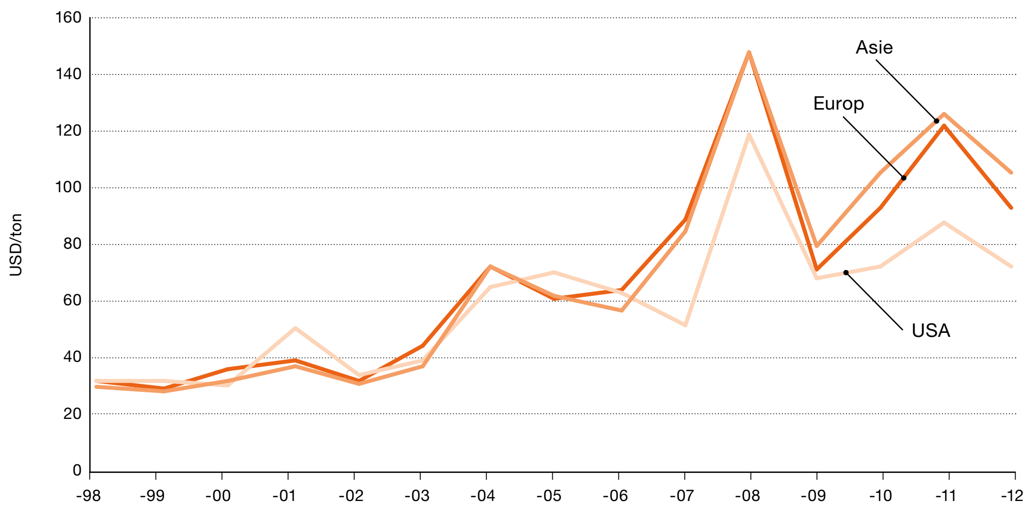
During March and April 2013, two events occurred that made the Swedish Energy Agency, which is the authority responsible for securing the gas supply in Sweden, activate measures in accordance with the national emergency plan for the supply of natural gas in Sweden. The first was a strained situation in the Danish gas market, which occurred as a result of cold weather in Europe in combination with abnormally low levels of stored gas in Denmark. The other event was due to disruptions to production in the Danish sector of the North Sea at the same time as the gas storage facility at Stenlille in Denmark has technical problems. Neither of these events had an impact on deliveries of gas to Swedish customers, but they did lead to increased gas prise on the spot market.

Coal

The global use of coal continues to increase and it is the second largest energy source, after oil. However, coal is the largest source of carbon dioxide emissions in the world and took over the lead from oil as recently as 2004. World production and consumption of coal is increasing, primarily in China. Total consumption among the OECD countries decreased by 4.2 per cent in 2012, mainly because of reduced consumption in the USA, while consumption in both Europe and Japan increased[41].

There has recently been an oversupply situation in the global coal market and the global price of coal has decreased sharply, see Figure 36. An explanation for the falling prices in, primarily, the European coal market is the increased production of shale gas in the USA. As a result of the low gas prices in the USA, many American electricity producers have switched from coal to gas, which has led to the USA increasing its exports of cheap coal to Europe[42].

Figure 36 Coal prices in Europe, the USA and Asia 1998–2012, USD/tonne



Source: Statistical Review of World Energy 2013. British Petroleum

41 2012 in review: Other fuels. British Petroleum.
42 Medium-Term Coal Market Report 2012. International Energy Agency.

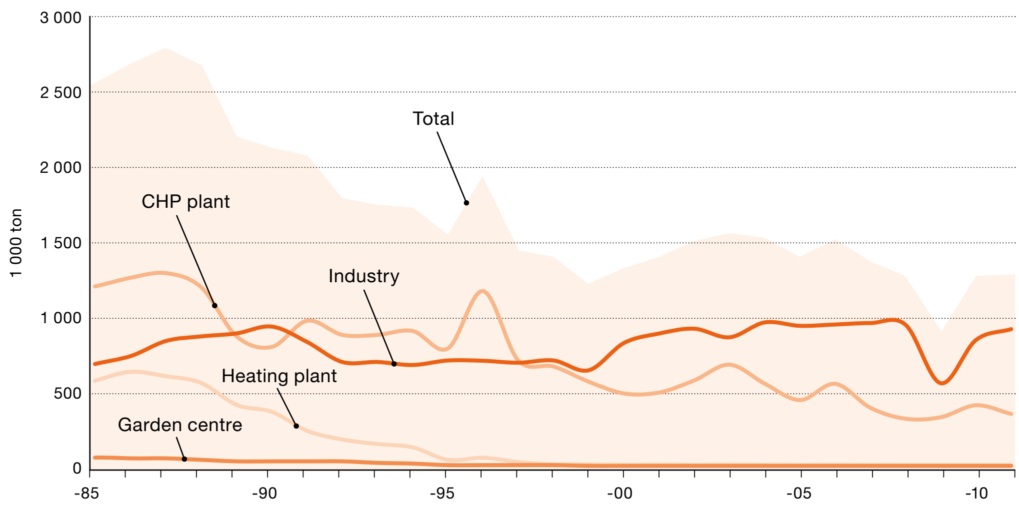
Coal is used mainly by industry in Sweden

In Sweden, industry is the primary user of coal, mainly thermal coal, coking coal and coke. Coke-oven gas is also created in coking plants and is used to produce heat and electricity in iron and steel mills, as well as in the district heating sector. The production of iron creates blast furnace gas, which is used to produce heat and electricity.

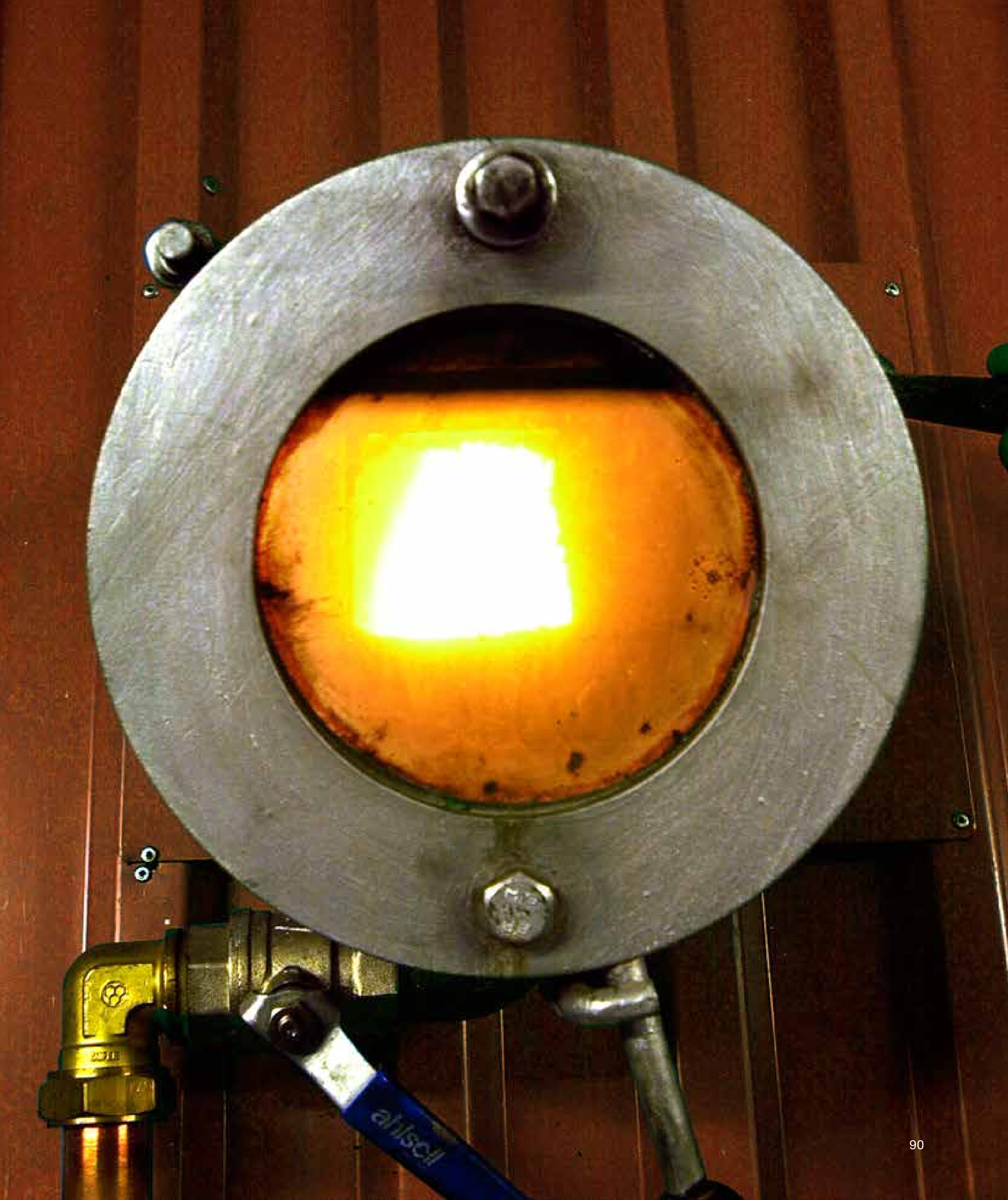
The use of coal in the Swedish district heating sector decreased sharply over the course of the 1990s following the introduction of the carbon dioxide and sulphur taxes. However, CHP plants still use some coal and one reason for this is that the tax regulation for CHP production are more beneficial than for the production of heat alone. The aim of this tax differential is to increase the competitiveness of CHP plants compared to facilities that only produce electricity or heat.

In 2011, the equivalent of 2.8 TW of coal and 2.4 TWh of coke-oven and blast furnace gas were used in the production of electricity and district heating. The use of coal, coke and coke-oven and blast furnace gas in industry amounted to a total of 15.4 TWh.

Figure 37 Use of thermal coal in Sweden 1985-2011, 1,000 tonnes



Source: Annual energy balance sheets. EN20. Swedish Energy Agency.



Energy policy

The energy policy of both Sweden and the EU is motivated by the aim of developing an energy system with competitive energy prices, secure energy supplies and ecological sustainability. Energy prices play a key role in the creation of such an energy system. Investments in energy supplies with a low environmental impact become profitable, provided that all of the external environmental effects are factored into the energy price.

The EU's roadmap towards reductions in carbon dioxide emissions

Sweden has to adhere to EU law, that is to say the treaties and acts that the EU has decided upon. In the energy area, there are several acts taking the form of directives that have been incorporated into Swedish law. Several of the directives are based on binding targets for 2020. The European Commission has begun working to shape the energy policy for 2050. The roadmap for moving towards a zero carbon dioxide society[43] presents a vision of an EU that reduces emissions of greenhouse gases by over 80 per cent by 2050 without disrupting the energy supply or harming competitiveness. In 2013, the European Commission presented the first draft of the energy and climate policy targets for 2030[44].

Renewable energy will be equivalent to 20 per cent

By 2020, the proportion of renewable energy in the EU will be equivalent to 20 per cent of all energy used, according to the Renewables Directive. The directive also contains details of how the burden of the EU targets will be distributed between the member states. The proportion of renewable energy in Sweden will be 49 per cent. Sweden has the additional ambition to source at least 50 per cent of its final energy use from renewables.

In 1990, Sweden's proportion of renewable energy was 33 per cent and has increased since then to 48 per cent in 2011. The increase since 1990 is, to a large degree, down to the increased use of biofuels, primarily in electricity and heat production and in the forestry industry. In recent years, the use of heat pumps has also increased and this has contributed to an increased proportion of renewables.

In the transport sector, the proportion of renewable energy will constitute at least 10 per cent of the total use of transport fuels across the whole of the EU by 2020. Sweden's target for renewable energy in the transport sector is the same as the EU's. In addition, Sweden's long-term ambition is to have a vehicle fleet that is independent of fossil fuels by 2030. The transport sector section contains further information.

43 A Roadmap for moving to a competitive low carbon economy in 2050. COM(2011) 112 final. European Commission.
44 Green Paper on a 2030 framework for climate and energy policies COM(2013) 169 European Commission.

Energy efficiency targets are set out in several acts

The energy efficiency target in the EU is a 20 per cent reduction in energy use compared with the predicted energy use in 2020. The target is binding. Sweden also has a national target of a 20 per cent reduction in energy intensity (supplied units of energy per unit of gross domestic product) in 2020 compared with 2008. In the summer of 2012, the member states came to an agreement on a new energy efficiency directive. Certain assessments indicate that the directive will involve a 17 per cent increase in energy efficiency by 2020. The new directive will lead to industry, the public sector, households and energy companies implementing several measures. The directive will be incorporated into Swedish law in June 2014 and will replace the earlier Energy Services Directive and Combined Heat and Power Directive.

The Ecodesign Directive and Energy Labelling Directive affect many products that must fulfil tough energy, environmental and labelling requirements. Energy labelling visualises, among other things, energy use and noise and will make things easier for the consumer.
There are now energy labels on ten groups of products and thirteen groups of products have ecodesign requirements. Ecodesign takes into account the entire product life cycle and sets efficiency requirements. Models that do not meet the requirements may not be sold in the EU's common market. Requirements set according to the Ecodesign Directive are being developed for a further 30 products. The Commission calculate that the ecodesign and energy labelling requirements that have been decided on so far will save 484 TWh electricity per year within the EU in 2020.

The Energy Performance of Buildings Directive requires member states to introduce minimum requirements with regard to energy use. The minimum requirements apply to new builds and should also apply to extensive renovations of existing buildings. The directive also requires all buildings to be nearly zero-energy buildings from 31 December 2020. The individual member states decide themselves which level the energy use will be in order to be classed as nearly zero-energy buildings.

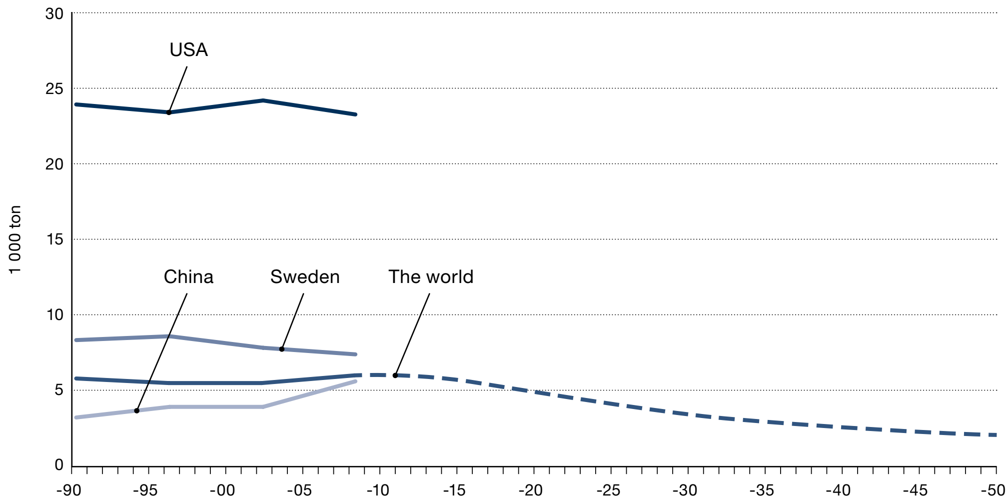
If the temperature rises by more than 2°C the ecological consequences have been deemed to be unacceptable

Climate policy will limit emissions

The EU's common climate policy is based on an interpretation of the climate commission's requirement that emissions be limited to a level that is not hazardous. The UN's climate panel has concluded that the consequences are hazardous if global temperature rise by two degrees above the pre-industrial level. The total current concentration of greenhouse gasses in the atmosphere is about 465 parts per million of carbon dioxide equivalents, which is an increase of about 30 per cent compared with 1990. In order to achieve the two-degree target with a certainty of 66 per cent45, global emissions of greenhouse gasses need to begin decreasing before 2020. The average greenhouse gas emissions per capita need to decrease to less than 2 tonnes by 2050, see Figure 38, which is equivalent to about a quarter of Sweden's current per capita emissions. If emissions don't begin to decrease before 2020, there will need to be significantly larger emission reductions if the two-degree target is to be achieved.

45 Proposal for a Swedish roadmap towards a Sweden without climate emissions 2050. Progress report 6487. Swedish Environmental Protection Agency.

Figure 38 Greenhouse gas emissions per capita 1990–2005 and forecast up to 2050 in order to achieve the two-degree target



Source: UN population statistics and National communication UNFCCC. UN.

In order to reduce carbon dioxide emissions at the rate desired, intensive discussions are ongoing with the aim of reaching an agreement on a climate convention in 2015. The idea is for this to come into force in 2020. The second period of the Kyoto Protocol, 2013 to 2020, is a form of transition period in advance of the new agreement. The countries that have said they intend to sign on for the second commitment period of the Kyoto Protocol include the EU's member states, Australia, Norway and Switzerland. Together, these countries are responsible for about 15 per cent of global greenhouse gas emissions.

In 2009, the European Council decided that, by 2020, greenhouse gas emissions will decrease by 20 per cent compared with 1990. The European Commission also decided, in conjunction with this, on a revised directive on emissions trading and a distribution of the burden. This decision means that Sweden's emission for activities that are not included in the emissions trading scheme will decrease by 40 per cent compared with 1990. The European Council has also subsequently decided on a directive on carbon capture and storage.

The companies that are included in the EU emissions trading system (EU ETS) are energy-intensive industries, as well as electricity and heat producers. In addition to these, other companies, individuals and organisations are also participating. All the participants are obliged each year to report their emission allowances corresponding to the number of verified emissions of carbon dioxide the participant has been responsible for over the course of the year. One emission allowance is equivalent to one tonne of carbon dioxide.

The trading period between 2008 and 2012 had a surplus of emission allowances, which led to a declining emission allowance price. In 2012, the price was EUR 6.5 per tonne of carbon dioxide at its lowest and EUR 9.5 at its highest.[46] In turn, this has not led to the desired emission reductions. As a consequence, the European Commission is adjusting the calculated allocations linearly over the course of the new period, from 80 per cent in 2013 to 30 per cent in 2020.

Beginning in 2013, the main allocations of emission allowances to participants will take place by auctions in the emissions trading system. Free allocations will still be available for industries that are judged to be vulnerable to international competition. Flights and airlines that take off and land at airports in the EU are included in the system from 2012. Flights to and from the EU are temporarily exempt until autumn 2013, see the section about transport.

46 Development of the emission allowances market 2012. ER 2012:25. Swedish Energy Agency.

Security of energy supply

It is hard to imagine a society without energy as most of our daily activities and needs require energy in some way. The functioning of our society is conditional on access to energy. This means that there are great demands placed on the reliability of the energy system – that the energy supply is secure.

Secure energy supply based on the users' needs

What constitutes a secure energy supply varies based on the specific needs and circumstances of different energy users. Because of this, it is not entirely clear what constitutes a secure energy supply in all situations.

A fundamental starting point is that the security is based on users' individual and collective needs. Security will be ensured, primarily, through well-functioning energy markets. Many actors are responsible for the security of the energy supply. The markets must be able to prevent and alleviate disruptions and shortages. The public sector has an important role in shaping and controlling energy markets in order to ensure they function well. The distribution of roles and responsibilities should be clearly defined and well known. Those who supply energy have a far-reaching responsibility to prevent and alleviate the disruptions that may arise. Energy users have a responsibility to be able to deal with the consequences of the disturbances and disruptions to energy deliveries that occur.

If the energy markets cannot satisfactorily prevent and alleviate the disruptions that occur, emergency preparedness plans shall be in place. These should primarily build on and reinforce existing market functions. Such plans should be developed and shared, to the greatest extent possible, in association with others within the market's geographical range. Ultimately, if a market is not working or if the way the market functions during a disruption or shortage leads to completely unacceptable consequences for society, measures can be used to remove the market's function from play. These plans will only be implemented following a political decision.

The development of energy markets has an impact on the security of the energy supply

The development of energy markets within the EU has an impact on the security of the energy supply and the development of a competitive EU. The first EU directives for electricity and natural gas, respectively, were adopted at the end of the 1990s with the aim of opening these markets up to competition. In the later directive from 2003, there are requirements for the production and transmission of electricity and natural gas to be separate activities. The aim of this directive is for customers to be able to choose electricity suppliers in a competitive marketplace.

The third directive for the electricity market and natural gas market creates the conditions for improved insight and thus competitiveness in these markets. The customers will, for example, be able to switch electricity and gas suppliers within three weeks, receive a final bill a maximum of six weeks following the change of supplier, and they will also be able to access all of the relevant data about their consumption of gas or electricity. The directive also includes the establishment of a common European organisation for the regulatory authorities with a focus on the distribution of electricity. Obligatory associations for the gas and electricity system operators are also introduced. These publish a ten-year network development plan every other year.

Society is vulnerable during extensive energy disruptions

The most severe disruptions to the Swedish energy supply in the last ten years happened in connection with the storms Gudrun and Per, which occurred in 2005 and 2007, respectively. Together the storms led to the electricity being cut off to several million people. The consequences were that lights were extinguished, it was not possible to cook food and many people were unable to heat their homes. Petrol stations also stopped working, industrial production stopped, trains were cancelled and telecommunications stopped working in large areas. The disruptions to telecommunications were a huge problem for emergency management as it was hard to coordinate initiatives without fixed-line or mobile telephony. For some electricity customers, the power cut lasted up to 45 days.

However, it was not just the electricity supply that was exposed to the storms. Many roads became unusable as a result of fallen trees, which in turn meant that fuel supplies to backup electricity plants and petrol stations could not get through. The cost to society of the storms is estimated at several billion SEK.

Read more about secure energy supplies for different forms of energy under the sections about energy markets and fuel markets.

Energy taxes

There are energy taxes in all of the EU's member states and these taxes are partly harmonised at the EU level. The current energy tax directive was adopted in 2003 and was primarily designed to avoid distorting competition in the internal market for energy. The directive contains common regulations about what will be taxable, when this will take place and which exceptions are allowable.

The directive also sets out the lowest allowable tax rates, primarily based on the amount of energy used, for products that are used for heating, electricity production and as motor fuels. The European Commission is working on a revised energy tax directive that aims to apply energy taxes on the road towards a lower carbon and more energy efficient society, at the same time as avoiding problems in the internal market.

In Sweden there are taxes on electricity and fuels, on emissions of carbon dioxide and sulphur and a fee for emissions of nitrogen oxide. The taxes on fuel vary depending on whether the fuel is used for heating or as a transport fuel. There are also variations depending on whether the fuel is used in a domestic setting, in industry or in the energy conversion sector. The taxes on electricity vary depending on which area the electricity will be used in and on whether the use will take place in northern Sweden or some other part of the country. The revenues from the energy and carbon dioxide taxes were about SEK 70 billion in 2012. This is equivalent to about four per cent of central government's revenues.

The general energy tax is paid on the majority of fuels and is based, amongst other things on the energy content.

The carbon dioxide tax is paid per emission of one kilo of carbon dioxide for all fuels except biofuels and peat. The general level of the carbon dioxide tax amounts to 110 öre per kilo for 2013.

The sulphur tax is SEK 30 per kilo of sulphur emissions from coal and peat. For emissions from oil it is SEK 27 for every tenth of one per cent by weight of sulphur per cubic metre of oil. Oil with less than 0.05 per cent by weight of sulphur is exempt from sulphur tax.

The environmental charge for emissions of nitrogen oxides is SEK 50 per kilo of nitrogen oxide emitted for boilers, gas turbines and stationary combustion facilities with an output of at least 25 GWh per year. However, the charge is revenue neutral in terms of central government finances as it is repaid in proportion to the amount of useful energy produced by each facility. This means that only those facilities with the highest level of emissions per unit of useful energy produced become net payers.

Table 2 General energy and carbon dioxide taxes from 1 January 2013, excluding VAT

	Energy tax	Carbon dioxide	Sulphur tax	Total tax	Tax öre/kWh
Fuel oil 1 (< 0,05 % sulphur), SEK/m³	817	3 093		3 910	39,3
Fuel oil 5 (0,4 % sulphur), SEK/m³	817	3 093	108	4 018	37,9
Coal (0,5 % sulphur), SEK/ton	621	2 691	150	3 462	45,8
LPG, SEK/ton	1 050	3 254		4 304	33,6
Natural gas, SEK/1 000 m³	903	2 316		3 219	29,2
Crude tall oil, SEK/m³	3 910			3 910	39,9
Peat (45 % moisture content, 0,3 % sulphur), SEK/ton			49,5	49,5	1,8
Petrol (unleaded, environ-mental class 1) SEK/liter	3,13	2,50		5,63	62,2
Diesel (environmental class 1), SEK/liter	1,76	3,09		4,85	48,7
Natural gas/methane, SEK/m³		1 853		1,853	16,9
Electricity (northern Sweden), öre/kWh	19,4			19,4	19,4
Electricity (southern Sweden), öre/kWh	29,3			29,3	29,3
Electricity (industrial processes), öre/kWh	0,5			0,5	0,5

Source: Swedish Tax Agency.

Acts and ordinances

Acts, ordinances and regulations shape the energy markets and eliminate market failures. The following acts are important in the energy field:

The Oil Crisis Act (1975:197)

Sets out how Sweden ensures adherence to measures in the International Energy Programme (IEP) agreement about oil stockpiling.

The Municipal Energy Planning Act (1977:439)

Stipulates that municipalities will promote energy efficiency in their planning and work to ensure a safe and sufficient energy supply.

The Rationing Act (1978:268)

Sets out the government's opportunity to impose rationing in the case of a war.

The Solid Fuels Act (1981:599)

Stipulates that a combustion facility will built or installed so that it can be fuelled with solid fuel and thereafter maintained in such a state as long as it is in use.

The Act (1985:620) Concerning Certain Peat Deposits

Sets out the requirements that need to be fulfilled in order to be granted permission (concession) to investigate and work peat deposits in order to extract energy.

The Price Regulation Act (1989:978)

Contains stipulations on the regulation of prices of goods and services, which are provided in return for compensation, that can be applied in the event of war.

The Energy Tax Act (1994:1776)

Stipulates when taxes on fuels and electrical power will be paid.

The Electricity Act (1997:857)

Stipulates requirements for electrical facilities, trade in electricity in certain cases and electrical safety. Above all, the act concerns network issues.

The Environmental Code (1998:808)

The provisions in this code aim to promote sustainable development that ensures existing and future generations have a healthy and pleasant environment. Such development builds on the understanding that nature has a protective value and that the right of mankind to alter and utilise nature is associated with a responsibility to manage nature well. The Environmental Code will be applied in order to promote, for example, reuse, recycling and energy efficiency so that a cycle is achieved.

The Programme for Improving Energy Efficiency Act (2004:1196)

Stipulates that energy intensive companies have the opportunity to participate in five-year programmes for improving energy efficiency in exchange for being exempted from energy taxes on electrical power in accordance with the provisions in the Energy Tax Act (1994:1776). This law expired at the end of 2012.

The Natural Gas Act (2005:403)

Stipulates requirements for natural gas pipelines, storage facilities and gasification facilities, as well as on trade in natural gas in certain cases.

The Act (2005:1248) Concerning the Obligation to Supply Renewable Transport Fuels

This act aims to increase the availability of renewable transport fuels and places requirements on fuel vendors to supply at least one renewable transport fuel at their retail facilities.

The Energy Declaration of Buildings Act (2006:985)

Stipulates requirements that aim to promote the efficient use of energy and a good indoor environment in buildings.

The District Heating Act (2008:263)

Stipulates requirements about the distribution of district heating, price information and the design of contracts.

The Sustainability Criteria for Transport Biofuels and Liquid Biofuels Act (2010:598)

Sets out the criteria that transport biofuels and liquid biofuels must fulfil in order for energy from these forms of energy to be eligible for support and to be considered renewable.

The Guarantees of Origin for Electricity Act (2010:601)

Stipulates that the electricity producers that use renewable sources of energy or highly-efficient combined heat and power will have the right to receive a certificate to prove this from a public authority.

The Planning and Building Act (2010:900)

Sets out requirements for the planning of land, water and construction.

The Transport Fuels Act (2011:319)

Aims to prevent fuels that are intended for use in motors from damaging or causing trouble for human health or the environment.

The Act (2011:710) Concerning the Certification of Transmission System Operators for Electricity

Stipulates requirements about the certification of transmission system operators.

The Act (2011:721) Concerning the Labelling of Energy-related Products

Stipulates that the end-users of energy-related products will be provided with information about these products' energy use and other material resources.

The Electricity Certificates Act (2011:1200)

Stipulates that producers of renewable electricity have the right to be allocated electricity certificates by the state and that electricity suppliers and certain electricity users are obliged to possess electricity certificates in relation to their sales and use of electricity, respectively (quota obligation).

The Act (2012:273) Concerning the Security of Natural Gas Supply

Complements Regulation (EU) No 994/2010 concerning the security of natural gas supply.

The Act (2012:806) Concerning the Stockpiling of Oil

Stipulates requirements on vendors and users to hold stockpiles of fuels in order to ensure the availability of oil in the country for supplying energy in the event of serious supply disruptions.

EU directives

The EU directives that are discussed in Energy in Sweden 2013 are listed below with their common name and full name.

The Fuel Quality Directive (2009/30/EC)

DIRECTIVE 2009/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC.

The Energy Performance of Buildings Directive (2010/31/EU)

DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings. In addition to the requirements on energy performance, this directive requires that energy declarations be conducted.

The Carbon Capture and Storage Directive (2009/31/EC)

DIRECTIVE 2009/31/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the geological storage of carbon dioxide. A legal framework for environmentally secure geological storage of carbon dioxide is established via this directive, the aim being to combat climate change.

The Ecodesign Directive (2009/125/EC)

DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast). A review of the Ecodesign Directive was conducted over the course of 2011 and 2012 which indicated that the directive has had many positive effects, but also that there are some areas for improvement. An additional review will be conducted in connection with the evaluation of the Energy Labelling Directive in 2013.

The Internal Market in Electricity Directive (2009/72/EC)

DIRECTIVE 2009/72/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC.

The Energy Efficiency Directive (2012/27/EU)

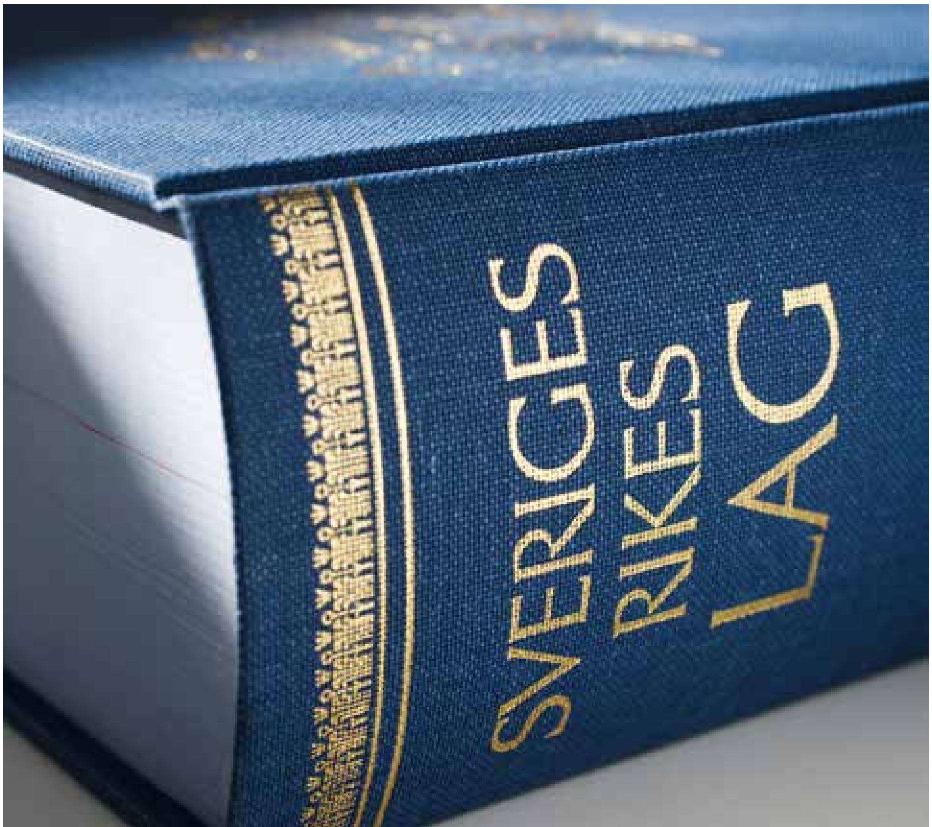
DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2012 on energy efficiency. This new directive replaces the Energy Services Directive (2006/32/EC) and the Combined Heat and Power Directive (2004/8/EC) This directive requires member states to adopt guiding, national targets for energy efficiency and encompasses cross-sectoral measures as well as measures within industry, the public sector and buildings

The Energy Labelling Directive (2010/30/EU)

DIRECTIVE 2010/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products.

The Energy Taxation Directive (2003/96/EC)

COUNCIL DIRECTIVE 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity. A proposal for a new energy taxation directive was adopted by the European Commission on 13 April 2011. It is proposed that the new directive will come into force in 2013, 2015 and 2018.



The Renewables Directive (2009/28/EC)

DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

The Internal Market in Gas Directive (2009/73/EC)

DIRECTIVE 2009/73/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC.

The Emissions Trading Directive (2009/29/EC)

DIRECTIVE 2009/29/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

The Framework Directive for Water (2000/60/EC)

DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy.

The Framework Directive for Waste (2008/98/EC)

DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives.

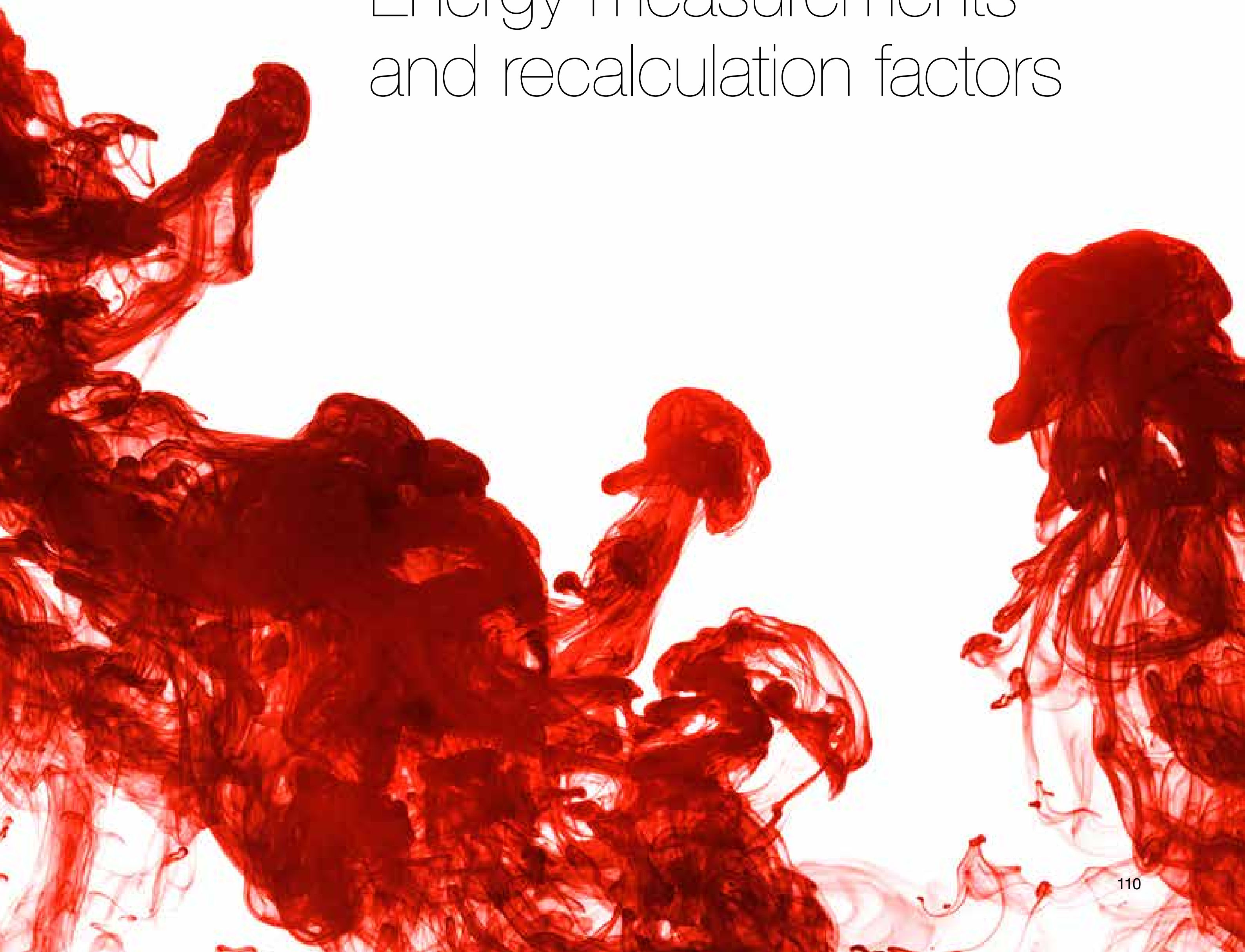
The Sulphur Directive (1999/32/EC)

COUNCIL DIRECTIVE 1999/32/EC, last amended through Directive 2012/33/EU contains the EU's common regulations concerning the sulphur content of certain fuels.

The Oil Reserves Directive (2009/119/EC)

COUNCIL DIRECTIVE 2009/119/EC of 14 September 2009 imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products.

Energy measurements and recalculation factors



The international standard unit for energy is the joule (J). However, Sweden often uses watt hours (Wh). The units of measurement tonne of oil equivalent (toe) and in certain applications calorie (cal) are common in international comparisons. Relationships between several different units of measurement are reported in Table 3.

Table 3 Conversion factors between units of measurement

	GJ	MWh	toe	Mcal	BTU
GJ	1	0,28	0,02	239	0,95
MWh	3,6	1	0,086	860	3,412
toe	41,9	11,63	1	10 000	39,72
Mcal	0,0419	0,00116	0,0001	1	0,0398
MMBTU	1,055	0,2954	0,0211	252,145	1

At the national and international level, the quantities of energy are so large that it is more practical to ad prefixes. Table 4 shows these prefixes.

Table 4 Prefixes for energy units

Prefix	Factor	Magnitude	Numerical value
k	kilo	10^3	Thousand
M	Mega	10^6	Million
G	Giga	10^9	Billion
T	Tera	10^{12}	Trillion
P	Peta	10^{15}	Quadrillion

Recalculation factors are reported in Table 5 and constitute an average effective calorific value, with the exception of wood fuels, which display an interval. Variations in calorific values are found mainly in wood fuels and coal. For natural gas, the net calorific value is listed.

Table 5 Recalculation factors for effective calorific values

Fuel	Physical	MWh	GJ
Wood chips	1 tonne	2,00–4,00	7,20–14,4
Peat	1 tonne	2,50–3,00	9,00–11,0
Pellets, briquettes	1 tonne	4,50–5,00	16,0–18,0
Coal	1 tonne	7,56	27,2
Coke	1 tonne	7,79	28,1
Nuclear fuel	1 toe	11,6	41,9
Crude oil	1 m^3	10,1	36,3
Topped crude oil	1 m^3	11,1	40,1
Petroleum coke	1 tonne	9,67	34,8
Asphalt, road oils	1 tonne	11,6	41,9
Lubricating oils	1 tonne	11,5	41,4
Petrol for vehicles	1 m^3	9,00	32,6
Aviation petrol	1 m^3	9,08	32,7
Light petrol	1 tonne	8,74	31,5
White spirit	1 m^3	9,34	33,6
Jet fuel and other intermediate oils	1 tonne	9,58	34,5
Other kerosene	1 m^3	9,54	34,3
Diesel and fuel oil 1	1 m^3	10,0	35,9
Heavy fuel oils 2–5	1 m^3	10,6	38,1
Propane and butane	1 tonne	12,8	46,1
Town gas, coke-oven gas	1 000 m^3	4,65	16,8
Natural gas	1 000 m^3	11,1	39,8
Blast furnace gas	1 000 m^3	0,93	3,35
Ethanol	1 m^3	5,90	21,2
Biogas	1 000 m^3	9,70	34,9
FAME	1 m^3	9,17	33,0

A sustainable energy system benefits society

The Swedish Energy Agency is working to create a sustainable energy system that unites ecological sustainability, competitiveness and security of supply. The Agency is also responsible for producing the official energy statistics.

Energy in Sweden is a report and collection of statistics published by the Swedish Energy Agency. The aim is to provide easily-accessible information about developments in the energy sector in Sweden. The figures used in Energy in Sweden are collected from stakeholders in the energy sector, both producers and users.

In addition to this publication, Energy in Sweden 2013 consists of *Energy in Sweden – Facts and Figures and Energy in Sweden – Collection of Figures*. The original Swedish title of these publications is *Energiläget*.

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