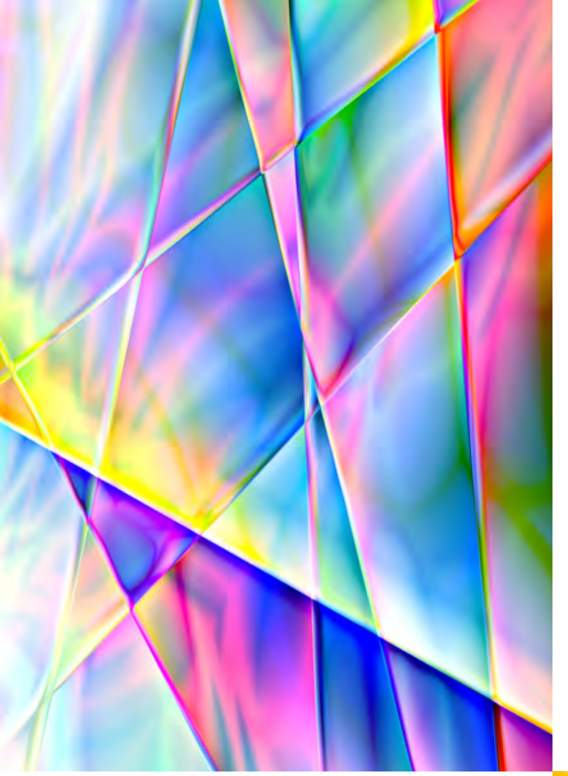
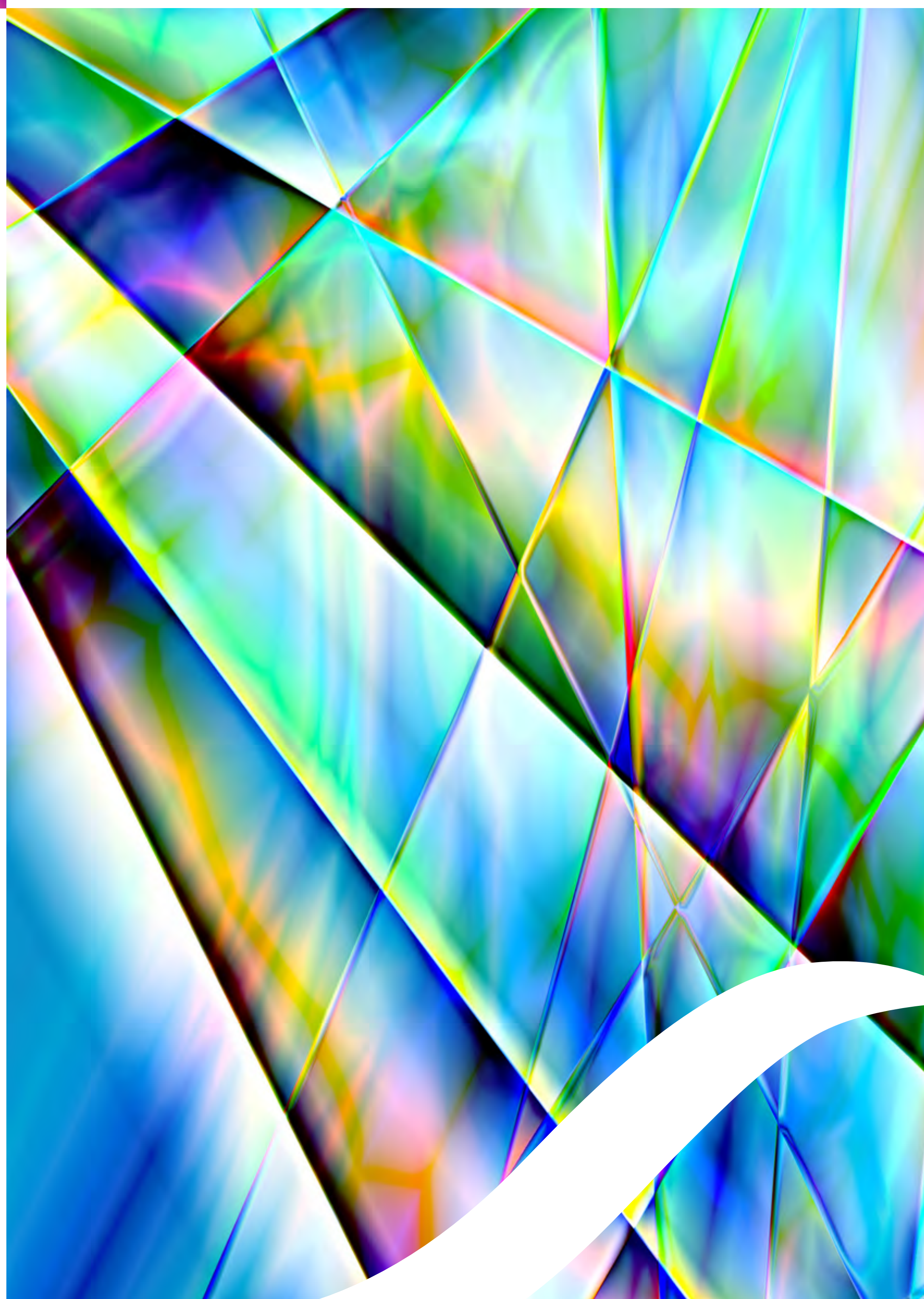


Energy in Sweden 2015



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An overall picture of the energy situation in Sweden

With the publication of *Energy in Sweden*, the Swedish Energy Agency intends to provide an overall picture of the current situation and development of the energy sector in Sweden. As a complement to the publication, the collection of statistics *Energy in Sweden – Facts and Figures* is available on the Agency's website, which contains all statistics from the publication in raw data. *Energy in Sweden – Facts and Figures* also contains additional statistics that are not presented in *Energy in Sweden*.

Energy in Sweden contains information about the use and supply of energy, energy prices, energy markets and fuel markets, as well as current energy policy. The publication presents historical time series of developments in the energy sector. *Energy in Sweden 2015* also includes current events in the energy sector up to and including spring 2015. For forecasts of future developments, refer to the Energy Agency's latest short-term forecast[1] and the Agency's long-term scenarios regarding energy supply[2].

About the statistics

The annual statistics from 2005 onwards mainly come from the Energy Agency's energy balances, also published on the Agency's website. On some points, the energy balance in this year's publication differs from that which has been presented previously in Energy in Sweden, for example, through:

- the total supply now being lower because it no longer includes bunkering for international transport.
- the statistical difference is no longer included in the supply. This means that supply and use may differ.
- biofuel and other fuel (which includes peat and fossil waste) are presented separately.

Statistics that are based on the energy balances extend up to and including 2013. Other statistics, such as price statistics, also cover 2014.

Further information about the statistics for which the Swedish Energy Agency is responsible, as well as the Agency's publications, is available on the Agency's website.

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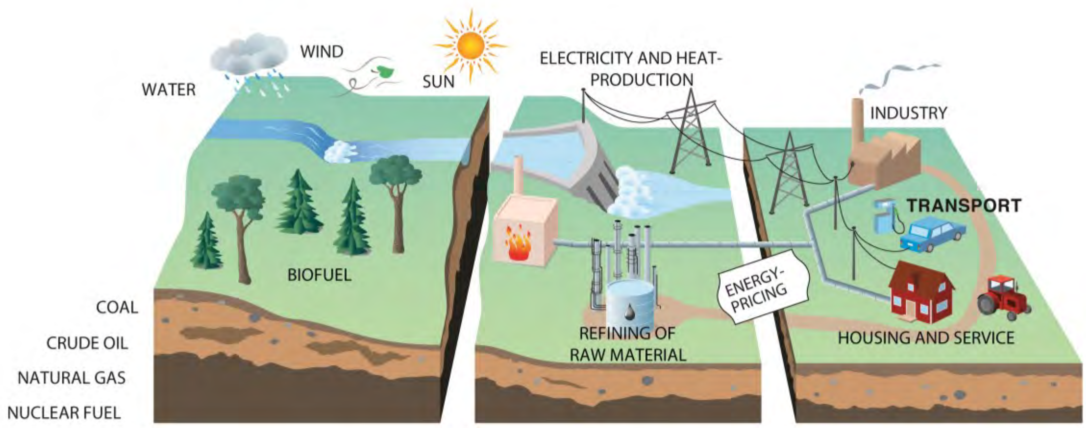
[1] Swedish Energy Agency, ER 2015:19, Kortsiktsprognos över energianvändningen och energitillförsel 2015 – 2017 [Short-term forecast for energy use and energy supply, 2015 – 2017].
[2] Swedish Energy Agency, ER 2014:19, Scenarier över Sveriges energissystem [Scenarios for Sweden's energy system].

Contents

Energy balance

We live in a society that is incredibly dependent on energy. Energy is required in order to heat houses when it is cold outside or makes houses cooler when the outdoor temperature is high, for example. We need energy for lighting, appliances and transport. The production and distribution of goods and services also require energy.

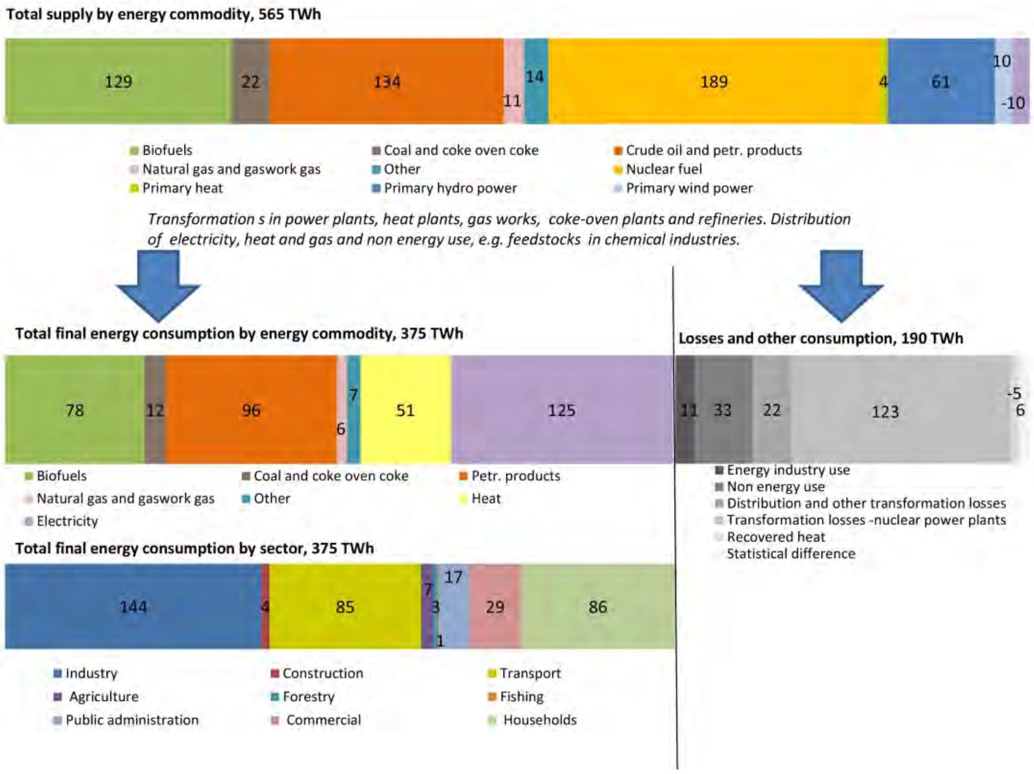


The Swedish energy system is partly based on domestic sources of renewable energy such as water, wind and biofuel. In addition, a large proportion of the energy supplied is dependent on imports such as nuclear fuel for electricity production in nuclear reactors and fossil fuels like oil and natural gas for the transport system. Swedish electricity production is based largely on hydropower and nuclear power, but the expansion of wind power is steadily increasing as well as the use of biofuel for electricity and heat production.

Sweden's final energy use can be divided into three user sectors. In the industrial sector, energy is used to operate processes. This sector primarily uses biofuel and electricity. The transportation of people or goods within the country requires energy in the form of various fuels or electricity. Energy use within transportation is dominated by oil products in the form of petrol, diesel and aviation fuel. The residential and service sector mainly uses energy in the form of district heating, electricity, oil or biofuels.

The energy system is always in balance. The energy input is always equal to the energy used, including losses. Figure 1 gives a simplified overall view of the Swedish energy system, from supply to use.

Figure 1 Energy supply and use in Sweden in 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

Notes 1. Heat pumps are regarded 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 (the United Nations Economic Commission for Europe).

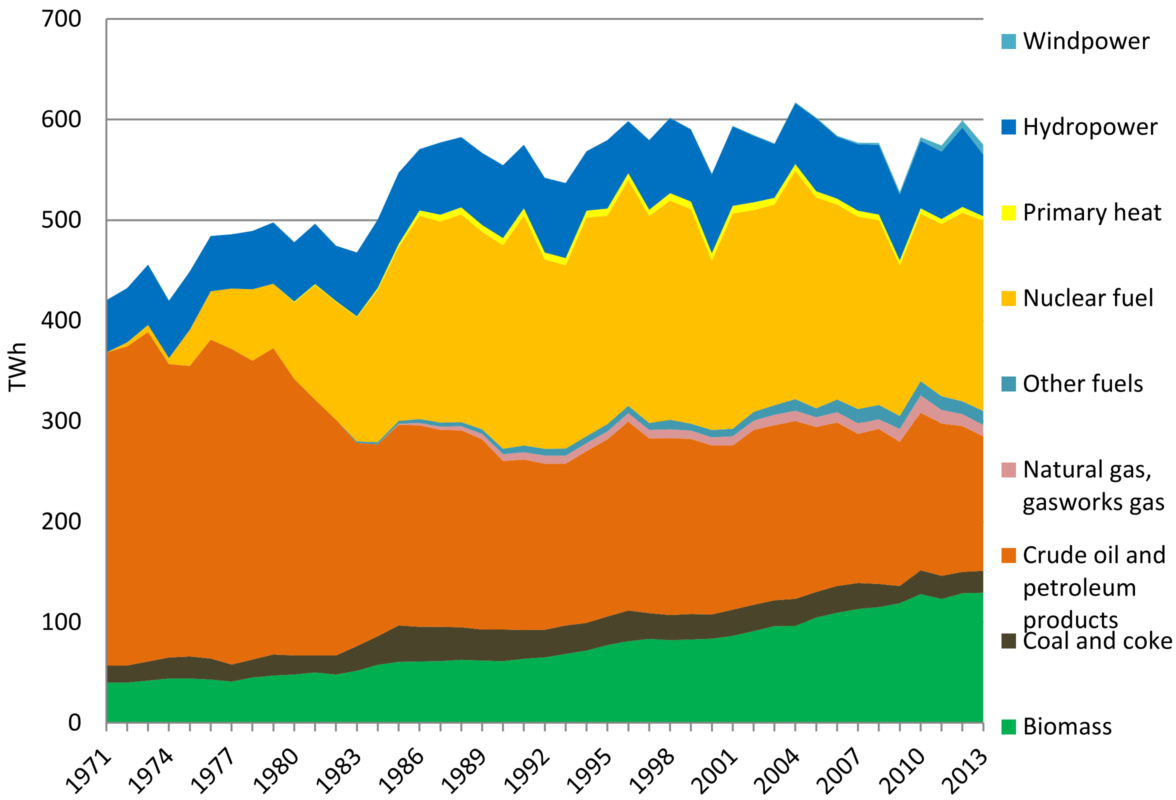
3. Net imports of electricity are counted as supply.

4. The term “biofuel” is used in the energy balance while the term “biomass” is used in the rest of the publication, with the exception of biofuel in the transport sector.

Total energy supplied

The supply to the Swedish energy system has since the mid-80s remained at a level between 550 – 600 TWh. In 2013, the amount of energy supplied amounted to 565 TWh.

Figure 2 Total energy supply by energy commodity 1971 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

In 2013, one-third of the energy supplied, 189 TWh, came from nuclear fuel. Of this, 66 TWh was converted to electricity and the rest was accounted for by conversion losses. The supply of nuclear fuel to the energy system increased from the 1970s until the mid-80s, but has since then remained at a relatively constant level.

Fossil fuels accounted for just under 30 per cent, 167 TWh, of the energy supplied in 2013. Of this, 114 TWh were used in the form of oil products, natural gas, gasworks gas, coal and coke. The remainder is accounted for by losses and uses for non-energy purposes. The supply of primarily crude oil and oil products has fallen sharply since the early 1980s.

During 2013, 129 TWh of the energy supplied came from biomass. The district heating sector and the industrial sector are the major users of biomass, but a certain portion is also used as transport fuel. The use of biomass has grown steadily over the last 40 years.

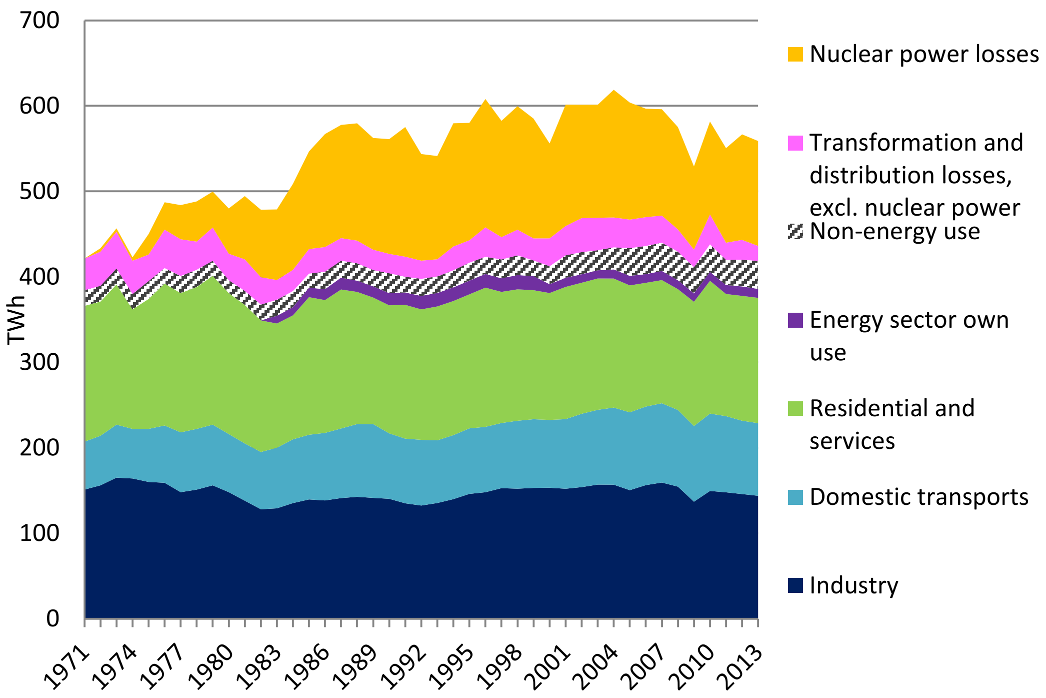
Hydropower produced 61 TWh of electricity and wind power generated 10 TWh of electricity in 2013. Electricity production from wind power has increased significantly in recent years and has more than tripled since 2010. Hydropower is a stable source of power in the energy system and has been producing electricity at a relatively constant level since the 1980s. The level of production is highly dependent on the water supply, which can lead to variations in production from one year to the next.

Total final energy use is decreasing

In 2013, the total final energy use in the user sectors amounted to 375 TWh, which is a further reduction compared with recent years. The industrial sector and the residential and service sector accounted for 144 TWh and 147 TWh respectively, while energy use in the transport sector amounted to 85 TWh, as shown in Figure 3.

For both the residential and service sector and the industrial sector, energy use was at approximately the same level as in previous years. Energy use in the residential and service sector is impacted in the short-term primarily by the outdoor temperature, as a large proportion is used for heating. In the transport sector, energy use has decreased in recent years, starting in 2005.

Figure 3 Total energy use, by final energy, losses etc., 1971 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

Electricity is the dominant form of energy used in Sweden, and the total final electricity use in 2013 was 125 TWh. The residential and service sector used the largest amount of electricity, followed by the industrial sector. Oil products are the next largest energy carrier after electricity, and the total final use amounted to 96 TWh, which represents a continued decline in recent years. In Sweden, the use of oil products is almost exclusively in the transport sector.

Reduced losses in the energy sector

The difference between supplied and used energy consists of losses, own use in the energy sector and uses for non-energy purposes. The development of these items is shown in Figure 3.

In 2013, the item losses and other uses amounted to 190 TWh, which has been reduced over the past five years. The losses were largely accounted for by energy that is cooled away during electricity production in nuclear power plants, 123 TWh. Other losses arise in heating and combined heat and power stations or as distribution losses in the delivery of electricity and district heating. Losses also arise in final use. The energy balance includes these losses in the respective user sectors.

The use for non-energy purposes, such as raw materials for the chemical industry, lubricants and oils for building and construction work, amounted to 33 TWh in 2013.

Own use in the energy sector amounted to 11 TWh in 2013 and includes the use of energy products for the operation of conversion plants. This includes use for heating, lighting and business electricity.

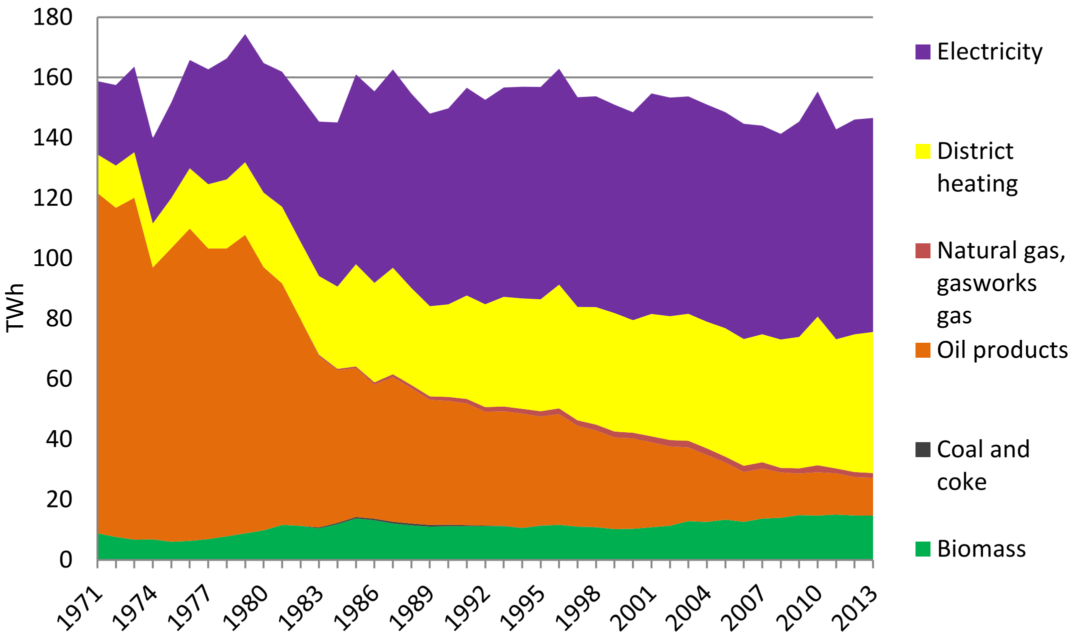
Residential and service sector

The residential and service sector accounts for almost 40 per cent of Sweden's total energy use. The sector consists of households, public administrations, commercial, agriculture, forestry, fishing and construction. Public administration and commercial primarily consist of non-residential buildings, but also street lighting, sewage and water treatment plants, power stations and waterworks. Households and non-residential buildings account for around 90 per cent of the energy use in the sector.

Decreased energy use during the 2000s

In 2013, energy use within the sector was 147 TWh. Figure 4 shows how energy use in this sector decreased between 2000 and 2009, before rising again sharply in 2010. It was mainly the cold weather that caused the increase in 2010. In 2013, the energy use was back at approximately the same level as prior to 2010.

Figure 4 Final energy use in the residential and services sector by energy carrier, 1971 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

It is primarily the amount of energy that is supplied for heating and hot water that has decreased. This development is, for the most part, due to the replacement of oil with electricity and district heating and the increase in the number of heat pumps. Replacing oil with electricity and district heating leads to a reduction in conversion and transmission losses in the sector, but on the other hand results in increased losses for the companies that produce electricity or district heating. In 2013, the total use of oil products in the sector amounted to 13 TWh, a reduction of 70 per cent since 1990.

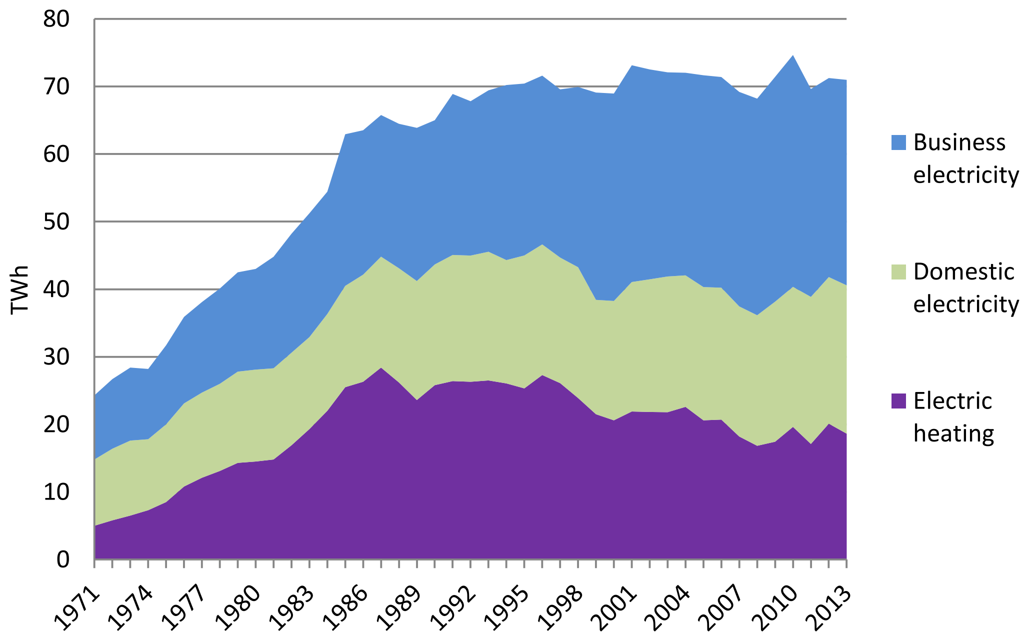
The number of heat pumps has increased, which has contributed to a reduction in the measured energy use for heating and hot water in buildings. The energy output of a heat pump is significantly higher than the amount of energy used to run the pump. The energy output of the heat pump is not included when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

Over half of the energy use in the sector is accounted for by heating and the provision of hot water. The need for heating is affected by the outside temperature, which can lead to large variations in energy use from one year to the next. A cold winter results in increased energy use for heating, while a warm winter results in decreased energy use. Temperature correction is often used to facilitate a comparison of usage from year to year, independent of outdoor temperatures. In 2013, which was nearly 6 per cent warmer than a normal year, the temperature-corrected energy use amounted to 151 TWh, which is a declining trend.

Electricity use has been stable over the past ten years

Electricity use in the sector increased steadily from the 1970s to the mid-1990s. Since then, it has remained relatively stable at just over 70 TWh. Figure 5 shows the total electricity use in the sector since 1971, broken down into business electricity, domestic electricity and electric heating.

Figure 5 Electricity use in the residential and services sector, 1971 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

The use of *electric heating* in household and non-residential premises increased from 5 TWh in 1970 to 28 TWh in 1987. After peaking at the end of the 1980s and during the 1990s, its use has declined. In 2013, the use of electric heating was just under 19 TWh. An important reason for the decline was that electricity prices were previously relatively high, which gave strong incentives for switching to heat pumps, district heating and pellets.

The use of *domestic electricity* increased from 9 to 22 TWh between 1970 and 2013. The increase that took place over the course of the 1970s and 1980s is mainly explained by an increasing number of households and a greater number of appliances. Two opposing trends have an impact on the use of domestic electricity. The development is towards more energy-efficient appliances, which leads to a decreased use of energy. However, there is an increase in the number of households and appliances in the households, as well as the number of functions of many appliances, which counters the trend towards greater efficiency.

The use of *business electricity* in non-residential premises increased from 8 to 30 TWh between 1970 and 2013. Business electricity per square metre also increased significantly between 2004 and 2009, but has subsequently returned to the 2004 level. This may be due to investments in energy efficiency, but the statistics are uncertain with regard to business electricity, which is why no firm conclusions can be drawn. Business electricity is a combination of the electricity used in the building and for the business activities. The electricity used in the building encompasses the electricity used in fixed installations in the building such as ventilation, lifts, escalators and general lighting. The electricity used for the business activities encompasses the electricity used by the business activities conducted in the building, for example, computers, appliances and lighting. Between 2005 and 2011, the Swedish Energy Agency conducted studies into the electricity used in different types of non-residential premises, Stil2.[3] Common to all the non-residential premises investigated was that lighting and fans account for a large proportion of the electricity use.

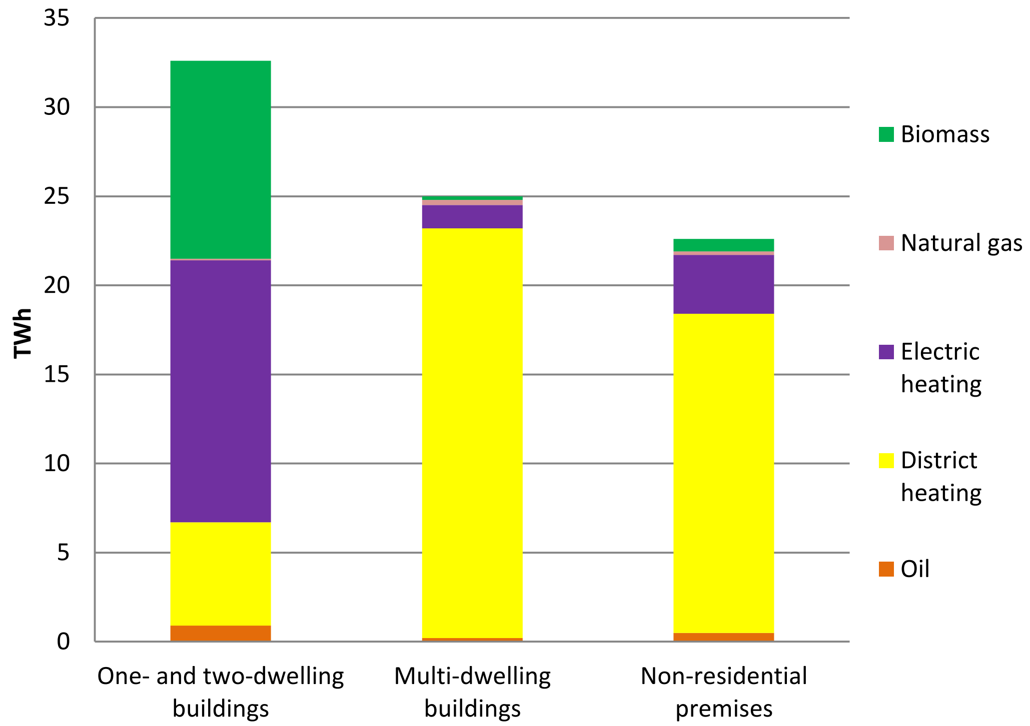
Half of the energy goes to heating

In 2013, energy use for heating and hot water in households and non-residential buildings totalled 80 TWh, which represents 55 per cent of the total energy use within the sector. Households can be divided into single family houses and multi-

[3] Swedish Energy Agency, ER 2007:34 Inventeringar av kontor och förvaltningsbyggnader [Inventory of business premises and administration buildings].
ER 2007:11 Energianvändning och innemiljö i skolor och förskolor [Energy use and interior environments in schools and preschools].
ER 2008:09 Energianvändning i vårdlokaler [Energy use in care facilities].
ER 2009:10 Energianvändning i idrottsanläggningar [Energy use in sports facilities].
ER 2010:17 Energianvändning i handelslokaler [Energy use in shopping premises].
ER 2011:11 Energianvändning i hotell, restauranger och samlingslokaler [Energy use in hotels, restaurants and meeting places].

dwelling buildings, where single family houses correspond to detached houses and terrace houses while multi-dwelling buildings comprise apartments. Single family houses used 41 per cent, multi-dwelling buildings used 31 per cent and non-residential premises used 28 per cent. Figure 6 shows the energy use for heating and hot water broken down into single family houses, multi-dwelling buildings and non-residential premises in 2013.

Figure 6 Energy use for heating and hot water in dwellings and non-residential premises in 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden. Energy statistics for dwellings and non-residential premises.

Electricity is the most common form of energy used for heating and hot water in one-and two-dwelling buildings. The consumption totalled 15 TWh in 2013. Biomass such as firewood, wood chips, sawdust and pellets have accounted for the largest increase in recent years, but over the last two years there has been a decrease. In 2013, consumption was 11 TWh. Consumption through district heating was just under 6 TWh. The use of oil for heating continued to decline and only accounted for 0.9 TWh in 2013. Throughout the 1990s and onwards, the number of one-and two-dwelling buildings that have installed heat pumps increased steadily. In 2013 there was some form of heat pump in 997,000 one-and two-dwelling buildings in the country, which corresponds to 52 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 23 TWh in 2013. Electric heating only accounted for a little over 1 TWh, and the use of oil amounted to 0.2 TWh.

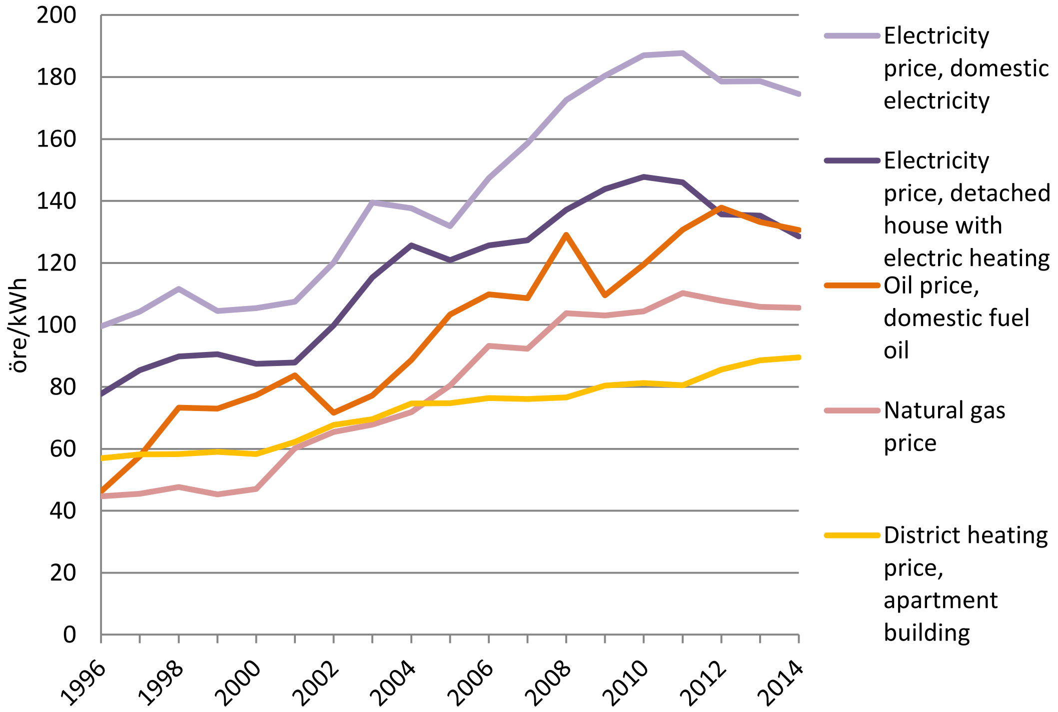
District heating is also the most common form of energy used for heating and producing hot water in non-residential premises. In 2013, consumption for district heating was 18 TWh. Electricity was second highest and amounted to 3.3 TWh. The use of oil for heating and hot water also continues to decline in non-residential premises. The total use of oil over the course of the year was equivalent to 0.5 TWh.

The energy prices have increased

The energy prices for customers with domestic electricity were relatively stable over the course of the 1990-s, only to then see a drastic increase which prevailed throughout the 2000s. The increased fuel prices and taxes on energy are the main causes of the rising prices.

Figure 7 shows that all energy prices increased between 1996 and 2011, especially the electricity price. The electricity price has decreased since 2012, both for customers with only domestic electricity and for those with electric heating. A reduction in the electricity price may result in an increase in the use of electricity in households.

Figure 7 Energy prices for the residential and services sector, 1996–2013, real (2014) öre/kWh



Source: Swedish Energy Agency, Statistics Sweden, SPBI

The oil price in Sweden follows the development of the price on the global crude oil market, which has seen a continual rise through the most part of the 2000s. The switch to green taxes, which involves a gradual increase in taxes on electricity and fossil fuels, is another reason for the rise in the cost of oil. It is the primary reason for the increase in the number of households switching from oil to other forms of heating. The price of natural gas, which to a certain extent follows the variation in the oil price, has also increased throughout the 2000s, but has fallen slowly since 2011.

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 contributing factor to the rising district heating prices.

Biomass such as firewood and pellets are also important sources of energy for one- and two-dwelling buildings and multi-dwelling buildings. In April 2015 the price for bagged pellets for detached houses ranged between 47 öre/kWh and 61 öre/kWh, including VAT, with a weighted average price for Sweden of SEK 2,604/tonne (54 öre/kWh). Bulk deliveries of 3 tonnes ranged between 47 öre/kWh and 57 öre/kWh with an average price of SEK 2,510/tonne (52 öre/kWh). The difference is largely geographically dependent; the cheaper price normally being found in the middle parts of Sweden.[4]

The EU regulates the energy requirements of buildings and products

There are several EU directives that regulate buildings' energy use.[5] Some of the directives also regulate products that primarily have an impact on electricity use in the sector, such as lighting, computers and appliances. Both the ecodesign and energy labelling requirements are drawn up in the form of product-specific EU regulations that are immediately applicable in all of the EU Member States.

The Energy Labelling Directive specifies the requirements on energy labelling and makes it clear for the consumer how energy efficient the product actually is. The aim is to make it easy for consumers to take the energy performance of a product into consideration when making a purchase. As of 26 September 2015, the following products are also covered by the Ecodesign Directive and Energy Labelling Directive: boilers run on electricity, gas and oil, heat pumps, water heaters and storage tanks.

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[4] Swedish Pellet Association, Statistics, http://pelletsforbundet.se/statistik/, (retrieved on 30/09/2015).

[5] The Energy Performance of Buildings Directive (2010/31/EU). The Ecodesign Directive (2009/125/EC). The Energy Labelling Directive (2010/30/EU). The Energy Efficiency Directive (2012/27/EU).

Anyone can apply for financial support for photovoltaic cells

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

On 1 January 2015, the support level was changed to 20 per cent of the installation cost for private individuals and 30 per cent for companies, from the previous level of 35 per cent for all actors. The support is framework-limited, which means that it can only be provided as long as the allocated funds are sufficient.

Other policy measures affecting the sector

- From 1 January 2015, it is possible to receive a tax reduction for microgeneration of renewable electricity.
- The Act on Energy Audits in Large Enterprises forces all large companies to conduct an energy audit.
- The energy and climate advisory services are currently being reviewed.

Further information on these policy measures is available in the section entitled Energy policy.

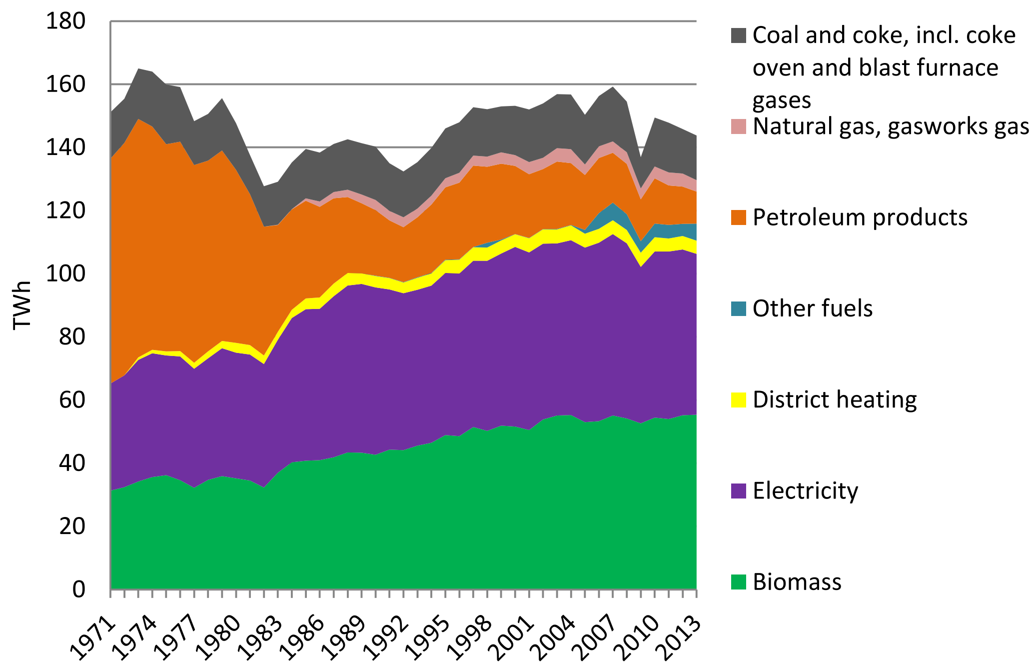
The industrial sector

The energy use in the industrial sector decreased by a little over 1 per cent to 144 TWh in 2013, compared with 2012. This means that industry was responsible for 38 per cent of Sweden's final energy use. Energy use in the sector has been relatively constant since 1970, despite increased industrial production.

Biomass and electricity dominate within industry

Swedish industry primarily uses biomass and electricity as energy carriers. In 2013, these respectively constituted 38 and 35 per cent of industry's final energy use. Fossil fuels such as oil products, coal, coke and natural gas were responsible for 23 per cent of the energy use in the industry. District heating accounted for the remaining 3 per cent. The final energy use for the sector is shown in Figure 8.

Figure 8 Final energy use in industry, by energy carrier 1971 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

The proportion of electricity of the total industrial energy use has increased from 21 per cent in 1970 to 35 per cent in 2013. During the same period, the use of biomass has increased from 21 per cent to 38 per cent of industry's total energy use.

The industries of the pulp, paper and wood products are those that dominate in terms of biomass use within the industrial sector.

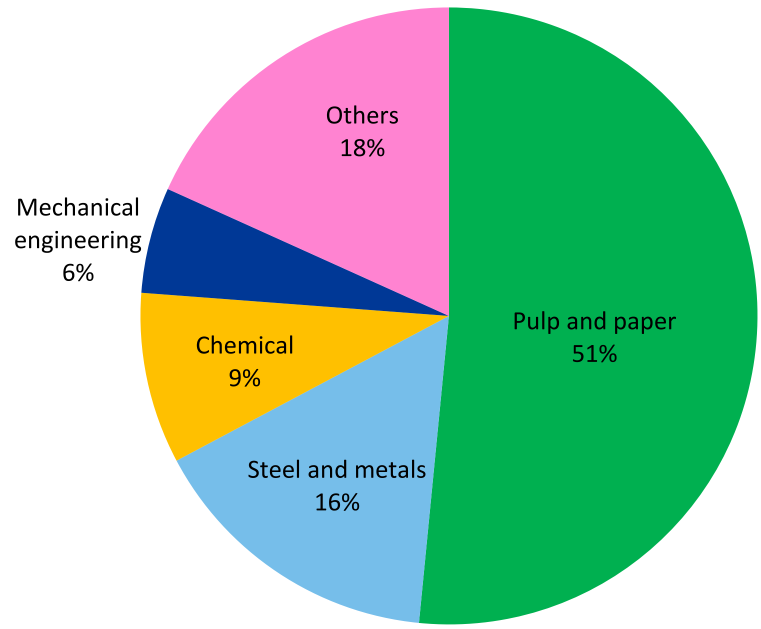
An intensive effort to reduce the use of oil in the industrial sector began as a result of the oil crisis in the 1970s, which also encompassed society as a whole. In 1970, oil products accounted for 48 per cent of total industrial energy use, compared with 7 per cent in 2013. The use of oil products increased between 1992 and 1997 but has since then declined. Industrial use of oil products is dominated by fuel oil, mainly heavy fuel oil, and it is primarily the use of those that has decreased. The use of LPG[6] has increased over the same period.

Coal and coke are mainly used within the iron and steel industry. Use has remained relatively constant, except for during the recession of 2009.

Three specific industries account for the largest share of energy use

In Sweden, a small number of industries are responsible for the majority of the industrial sector's energy use, see Figure 9. Three industries together account for three-quarters of the energy use; the pulp and paper industry, the iron, steel and non-ferrous metals industry and the chemical industry.

Figure 9 Final energy use in the industrial sector, by industry, per cent



Source: Swedish Energy Agency and Statistics Sweden.

[6] Liquefied Petroleum Gas

The pulp and paper industry accounts for about half of industrial energy use and the major energy carriers within the industry are black liquor and electricity. Black liquor is what remains of the pulp boil once the cellulose fibres have been removed following the boiling of paper pulp. It is made up of boiling chemicals and substances extracted from the wood. The liquors are burned in the mills' recovery boilers and the recovered energy is used in the industrial processes.

Iron, steel and non-ferrous metals industry accounts for 16 per cent of industrial energy use. Iron and steel works mainly use coal, coke and electricity as energy carriers. Steel is produced either from iron ore or scrap. In iron ore-based steel production, oxygen is removed from iron oxide 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 this requires electricity. Primary aluminium production mainly uses electricity for electrolysis.

The chemical industry accounts for 9 per cent of industrial energy use and primarily uses electricity for electrolysis. The wood products industry, which accounts for 5 per cent of industrial energy use, uses mainly biomass. The manufacturing industry is not counted among the energy-intensive industries[7] 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 13 per cent is accounted for by other industries. This includes mining, the food industry, the textiles industry, the graphic industry, non-metallic mineral products (manufacturing of glass, cement, lime etc.) and those categorised under 'other industry'. Some of these are energy intensive, but their total energy use is relatively low.

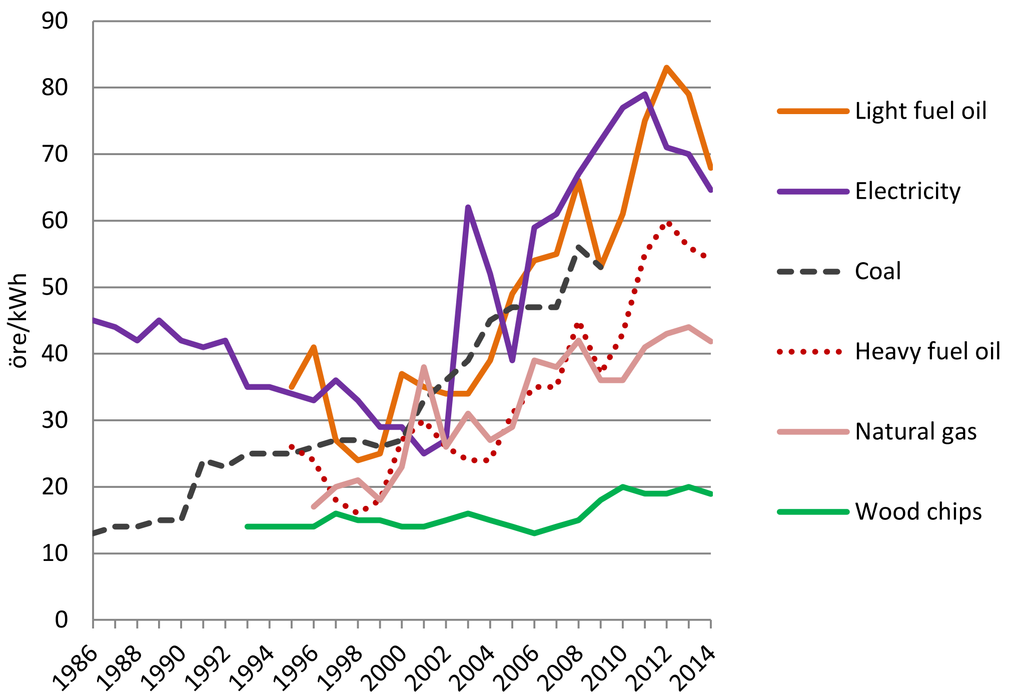
Industry's energy prices vary

Energy prices for the industrial sector dropped in 2014, see Figure 10. Energy prices vary over time, but since the starting point for the time series, they have increased for all energy carriers.

Industry's oil price fell during the recession in 2009 and then increased until 2012, subsequently dropping again until 2014. Since 1995, the price of oil has doubled. The price development, combined with current policy measures, has contributed to the use of oil decreasing in almost all industries. In 2014 the price of fuel oil 1 (light fuel oil) dropped by 14 per cent and fuel oil 2-6 (heavy fuel oil) fell by 3 per cent compared to 2013.

[7] There are several definitions of energy-intensive companies. The Energy Tax Act (1994:1776) and the Energy Taxation Directive (2003/96/EC) use the definition that a company is energy-intensive if its paid energy, carbon dioxide and sulphur taxes amount to at least 0.5 per cent of the company's value added. Value added is the value of a company's production minus the value of the input goods that have been used.

Figure 10 Energy prices for industrial customers 1986–2014, real (2014) öre/kWh



Source: Swedish Energy Agency. Statistics Sweden. Eurostat. SPBI

Notes: Prices for sectors not participating in EU ETS. The taxes are calculated with respect to industry's general tax exemptions.

The natural gas price also fell during the recession in 2009 to subsequently increase and then decrease again in 2014. The price of natural gas is now at the same price levels as before 2009, which is almost three times higher than at the starting point of the time series in 1996. The natural gas price dropped by 5 per cent in 2014 compared to 2013.

The electricity price for the industrial sector declined from 1986 until the early 2000s. It subsequently increased to a record high in 2011 to then fall once more. In 2014, the price of electricity had fallen by almost 18 per cent compared to 2011.

The price of wood chippings increased during the second half of the 2000s and has since remained relatively stable. The increase in price is probably a result of the demand for biomass having increased over the course of the 2000s. In 2014, the price of wood chippings decreased by 5 per cent compared with the previous year.

Taxes and emission allowances – important policy measures

Together with EU ETS – the EU Emissions Trading System – energy and carbon dioxide taxes are the most important policy measures for the industrial sector. All industries have an energy tax imposed of 30 per cent of the general energy tax level.[8] The industries that are included in the EU ETS have been exempted from carbon dioxide tax. The carbon dioxide tax for industry not participating in the EU ETS has been increased so that, as of 1 January 2015, they pay 60 per cent of the general carbon dioxide tax.

The EU ETS includes major facilities within areas such as the pulp and paper industry, iron and steel industry, non-metallic mineral products industry and aluminium industry.[9] In addition, all combustion facilities that have a power output of over 20 MW are included, regardless of which industry they belong to. For the trade period between 2013 and 2020, the principles for allocation of emission allowances have been changed.

Learn more about current energy taxation and the EU ETS in the section entitled Energy policy.

Energy efficiency in industry

The Programme for Improving Energy Efficiency in Energy-intensive Industries (PFE) is being discontinued. This programme involved companies that are defined as energy intensive being given exemption from electricity tax (0.5 öre/kWh) for a certain type of industrial operation.[10] In return, participating companies would employ a structured approach to energy efficiency via a certified energy management system and, for the duration of the programme, implement the identified energy efficiency measures that had a payback period of less than three years. Most of the companies included in the programme concluded their programme period in 2014 and the last batch of companies involved will be finished in 2017.[11]

Support for energy audits is aimed at small and medium-sized enterprises with an energy consumption of 300 MWh/year. The support compensates half of the cost of the energy audit, though only up to a maximum of SEK 50,000. A review of past support for energy audits (2010 – 2014) has been conducted.

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[9] The Energy Tax Act (1994:1776) and the Act (2009:1497) Concerning Changes to the Energy Tax Act (1994:1776).
[9] The Emissions Trading Ordinance (2004:1205).
[10] The Programme for Improving Energy Efficiency Act (2004:1196).
[11] http://www.energimyndigheten.se/Foretag/Energieffektivisering-i-foretag/PFE/, (retrieved on 26/06/2015).

The Act on Energy Audits in Large Enterprises entered into force on 1 June 2014.[12] The Act represents part of the implementation of the Energy Efficiency Directive and entails an obligation for all large companies to perform an energy audit every four years.

Read more about energy audits in the Energy policy section.

Other policy measures within the sector

The electricity certification system is a market-based policy measure which aims to increase the production of renewable electricity. Among other things, this policy measure encompasses industries with their own electricity production – so-called back-pressure production – which can receive electricity certificates for their production of renewable electricity. In addition, industrial facilities that are intensive users of electricity do not need to pay electricity certificates for the electricity used in the manufacturing process.[13] Read more about electricity certificates in The electricity market section.

Furthermore, the industrial sector is also affected by other policy measures such as ecodesign, energy labelling and energy saving requirements in the Environmental Code.

[13] The Act (2014:266) on Energy Audits in Large Enterprises (EKL) in force and http://www.energimyndigheten.se/Foretag/Energikartlaggning-i-stora-foretag/, (retrieved on 26/06/2015).

[13] The Electricity Certificates Act (2011:1200).


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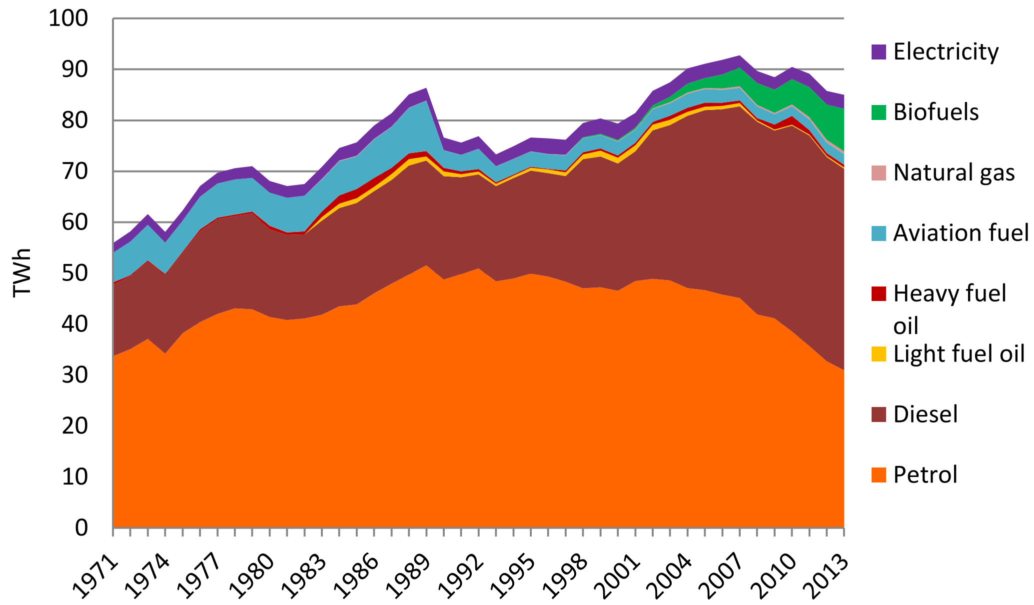
The transport sector

In 2013, the energy use in the transport sector amounted to 113 TWh. Of this, 28 TWh were used in international transports, i.e., international flights and international shipping. The other 85 TWh were used in domestic transports, and is equivalent to one quarter of Sweden's total final energy use. The transport sector is divided into road transport, rail transport, aviation and shipping. Road transport is the largest user and accounted for 93 per cent of domestic energy use for the transport sector in 2013.

Energy use in transport is declining

The general trend since the 1970s has been that energy use in domestic transport is increasing. In 2007, record highs in the use were noted in the official statistics. Since then, however, energy use has decreased by a total of 8 TWh, as shown in Figure 11. Up until 1989, all aviation fuel was included under domestic flights, but from 1990 a division was made in aviation fuel between domestic and international energy use.

Figure 11 Final energy use in the transport sector, domestic, 1971 – 2013, TWh



Source: Swedish Energy Agency, Statistics Sweden and the Swedish Transport Agency.

For road transport, there has been a trend for a long time towards reduced petrol usage and an increased use of diesel. This is a result of changes in the private car fleet in recent years, where the share of diesel cars in the Swedish car fleet has increased. In 2012, diesel cars made up 65 per cent of new cars sold, which is a record high. Since then the share has decreased slightly and amounted in 2014 to

58 per cent. Sales of new cars in the categories of electric cars and cars that use CNG[14] increased in 2014, while sales of cars that can run on E85 continued to decline.

Electricity consumption in rail transport[15] has varied very little from year to year during the 2000s; statistics point to a slight increase since 2010. The use of diesel in rail transport is marginal, and the long-term trend indicates a decline.

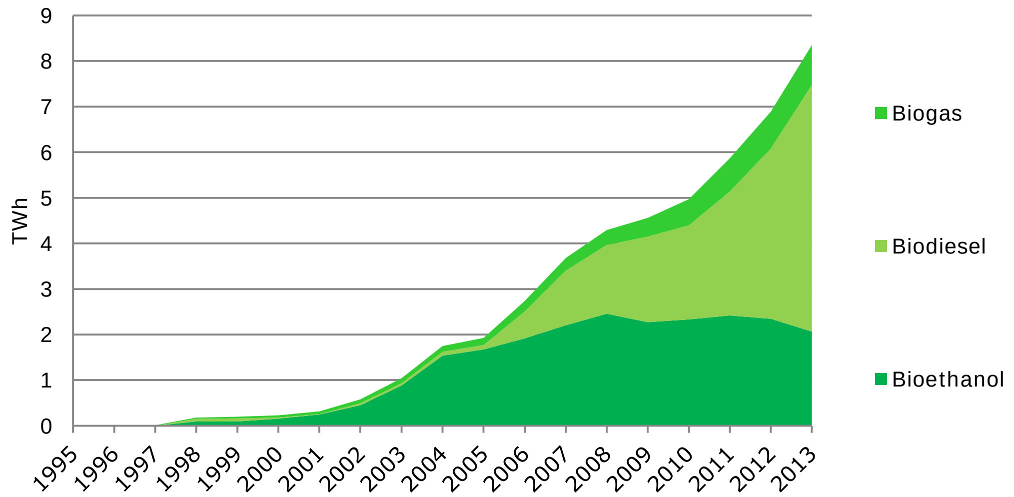
Domestic aviation shows a relatively stable level of energy use. In connection with the recession in 2008, the number of passengers and the use of fuel for domestic and international flights both decreased. Since 2010, passenger numbers have increased again. The resurgence in the number of passengers has, however, not led to as high level of fuel consumption as prior to the recession, which indicated an increase in efficiency.

Energy use in the maritime sector has decreased in recent years, especially in international shipping. The statistics indicate a trend from heavy fuel oils to medium distillates and to diesel, which is in line with the amendments to the Sulphur Directive that came into force on 1 January 2015.[16] Energy statistics for shipping are uncertain as the sector is characterised by certain problems with data collection. In autumn 2015, the statistics will be evaluated and, if necessary, improved.

The use of transport biofuels is increasing

The use of biofuels in road transport continues to increase, see Figure 12.

Figure 12 Biofuels in the transport sector (domestic), by fuel, 1995 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

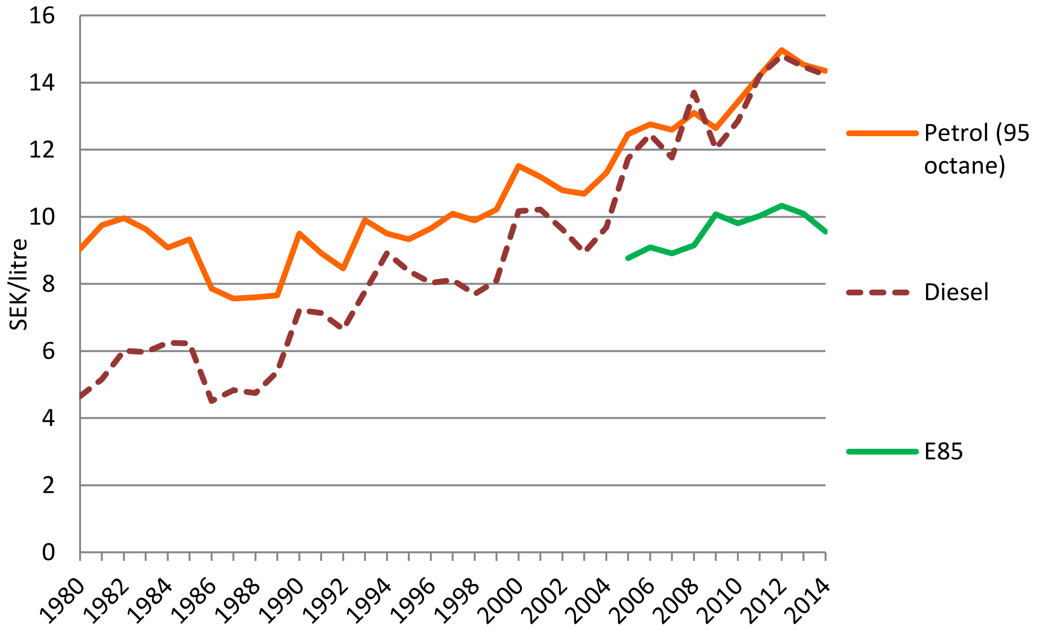
[14] Compressed Natural Gas
[15] This encompasses railway, subway and tram services.
[16] The Sulphur Directive (1999/32/EC), last amendment (2012/33/EC).

In total, biofuels accounted for 12 per cent of domestic transports in 2013,[17] of which 10 per cent was in road transport. The biofuels available on the market today are ethanol, biogas and biodiesel. Between 2012 and 2013, the usage of biofuels increased by 21 per cent which accounted for the largest increase ever in absolute terms. There was mainly an increase in biodiesel usage. Biogas use increased marginally, while ethanol use decreased. In 2013, biodiesel accounted for 64 per cent of the total volume of transport biofuel.

The prices of transport fuels continue to rise

Figure 13 indicates that the price of diesel has historically been lower than the price of petrol. However, in 2008 the price of diesel was higher than that of petrol, and since then the prices have remained around the same levels even though the diesel price is always a few öre lower.

Figure 13 Road transport fuel prices 1980–2014, real (2014) SEK/litre



Source: Swedish Energy Agency and Statistics Sweden.

The transport fuel prices in the figure are presented as litre price, where the price for each transport fuel has not been adjusted based on energy content. When adjusted, the diesel average price in the last ten years has been around 12 per cent lower than the petrol price. A crucial factor as to why the prices are approaching each other is that the percentage of the diesel price constituted by taxes has increased more than the tax percentage of the petrol price. There are no price statistics for biodiesel at present, which is why they are not presented here.

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[17] This includes the use of electricity in railway operations, where 62 per cent is counted as biofuel in 2013 (in accordance with the Renewable Energy Directive).

The price of biofuels is often based on the price of the fossil fuel comparator and not on their cost of production. The reason for this is to make the biofuel a competitive transport fuel. However, this does not automatically lead to the biofuel in question being chosen. Although E85 at the pump has essentially always been cheaper than petrol, there has been a substantial decrease in usage since 2011. Sales of new private cars that can run on E85 have also dropped in the last four years. This can be partly explained by the fact that the preferential reduction for ethanol cars was amended in 2011. Previously, 80 per cent of the benefit value was reduced for ethanol cars. The amendment meant that the benefit value for ethanol cars was only adjusted down to that of a comparable car without environmental technology. In addition, the refuelling rate of E85 in existing ethanol vehicles has decreased, which means that the cars that can run on E85 are increasingly using petrol. This may partly be due to the energy content of ethanol being lower than that of petrol, and partly because a large percentage of the ethanol cars come from the second-hand market, where it is mainly the price and not the alternative fuel that is important for the buyer. For a definition of E85 and explanations of other biofuels, see Table 1 at the end of the section.

Also read the section entitled The biofuel market for more information on price-influencing factors for liquefied biofuels.

New rules and definitions for environmentally-friendly cars

In January 2013, the definition of environmentally-friendly cars was changed. An environmentally-friendly vehicle may not emit more than a set amount of carbon dioxide in relation to the vehicle's kerb weight. For example, a petrol-powered vehicle with an average European kerb weight of 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 of the fuel's renewable origin. Aside from private cars, the definition now also encompasses camper vans, light trucks and minibuses.
Additional tax rules that benefit environmentally-friendly vehicles include the taxation of company cars[18] and the Ordinance on the Super-Green Vehicle Premium.[19] Since 2012, buyers of so-called super-green cars have been eligible for a premium of maximum SEK 40,000 per super-green car. In 2015, SEK 215 million was allocated for the premium, but the appropriation has been expended during the year. This also happened in 2014, but buyers of new cars then had the premium paid in 2015 with parts of the 2015 appropriation.[20]

Bonus–malus system

The Government has commissioned an investigator to submit a proposal for a so-called bonus-malus system for light vehicles. Generally, such a system entails that

[18] The Income Tax Act (1999:1229)
[19] Ordinance on the Super-Green Vehicle Premium (2011:1590).
[20] Government, http://www.regeringen.se/artiklar/2015/07/stor-efterfragan-pa-supermiljobilspremien/ (retrieved on 24/08/2015).

the car buyers who choose cars with relatively low carbon emissions receive some kind of bonus, while vehicles with relatively high emissions of carbon dioxide are burdened with a higher tax. There are different ways to implement such a system, but the Government has decided that the implementation will take place within the framework of the existing system with the super-green vehicle premium and vehicle taxation. The proposal will be presented no later than 29 April 2016.[21]

News at the EU level

Infrastructure Directive
The *Directive on the deployment of alternative fuels infrastructure*, the so-called Infrastructure Directive, was adopted by European Parliament and the Council on 29 September 2014 and issued on 22 October of the same year. [22] The directive implies, inter alia, that Sweden must develop a national action programme to ensure the availability of alternative transport fuels. The directive also calls for the establishment of common EU standards for charging and refuelling for alternative transport fuels such as electricity, hydrogen, LNG and CNG.

Amendments to the Sulphur Directive
On 1 January 2015, the emission limits for sulphur that apply in so-called Sulphur Emission Control Areas, SECA, were tightened. Previously, a 1.0 per cent sulphur content was allowed in marine fuels, but since 1 January the new limit is 0.1 per cent. Sulphur Emission Control Areas in Europe include the Baltic Sea, North Sea and the English Channel. The increased stringency means that shipping operators active within SECA can choose to either use a low-sulphur marine fuel, an alternative fuel such as LNG (liquefied natural gas) or methanol, or install scrubbers[23].[24]

EU ETS
Currently, flights within the European Economic Area, EEA, are included in the emissions trading system, EU ETS. Learn more about flights within the EU ETS in the section entitled Energy policy.

Euro 6
Within the EU, motor vehicle emissions are regulated through harmonised rules in the EU regulations.[25] Euro 6 requirements entered into effect in 2014 for heavy vehicles and in 2015 for light vehicles and involve stricter requirements for emission reductions of nitrogen and particles. For heavy vehicles, it also means

[21] Committee Directive (2015:59) A bonus-malus system for light vehicles.
[22] Directive (2014/94/EU) of the European Parliament and of the Council on the deployment of alternative fuels infrastructure.
[23] Scrubbers means that the exhaust gases are cleaned of sulphur impurities and in some cases particles as well.
[24] The Sulphur Directive (1999/32/EC), last amendment (2012/33/EC).
[25] Regulation (715/2007/EC) of the European Parliament and of the Council on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information.

that vehicle manufacturers must ensure that the fuels they approve for use in their vehicles fulfil the new emission requirements. This is a change from Euro 5 when the vehicle manufacturer only guaranteed that the alternative transport fuel worked in the vehicle in question.

Table 1 Transport biofuels

Transport biofuels	
Ethanol	E5, E85, ED95, ETBE
Biodiesel	B5, B100, RME, FAME, HVO
CNG	Collective name for methane gases: biogas, natural gas and mixtures thereof
Liquid biofuels	Biological oils: Rapeseed oil, palm oil, tall oil, waste oils, MFA, LBG
Other gaseous transport biofuels	DME
Fuel explanation	
FAME	Fatty acid methyl esters
HVO	Hydrotreated vegetable oils
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
LBG	Liquefied Biogas

The electricity market

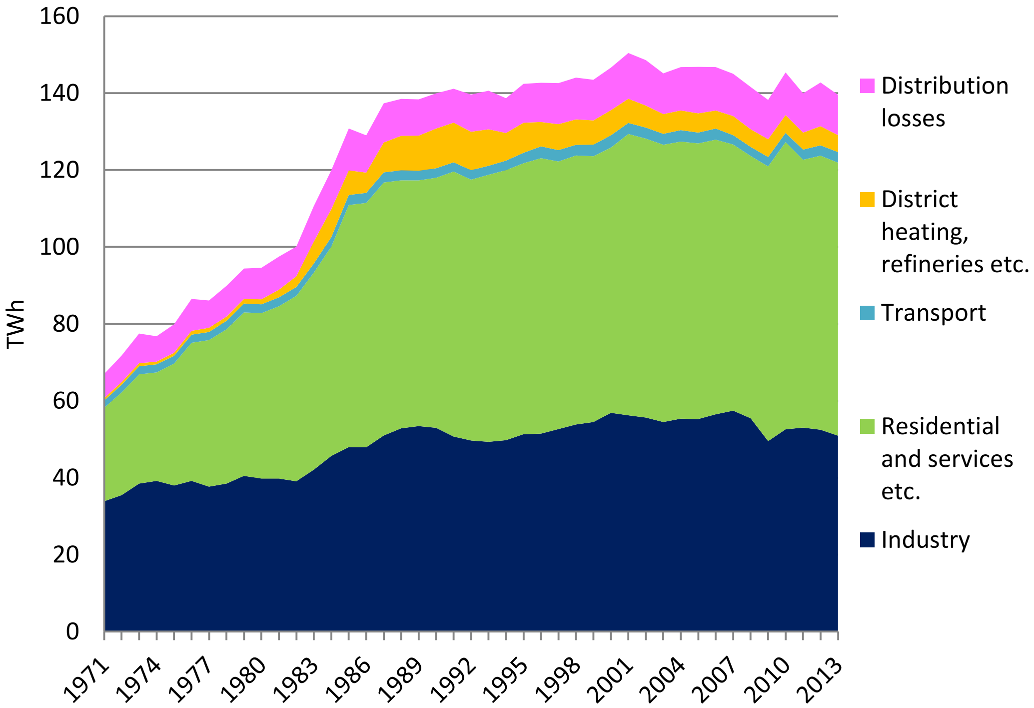
The Swedish electricity supply is based largely on hydropower and nuclear power. The expansion of renewable electricity has however been extensive during the 2000s, with wind power accounting for the largest portion of the increase. In 2013, wind power established a new production record and electricity prices continued to be relatively low.

Electricity use has decreased to 140 TWh

In 2013, the total amount of electricity used, including distribution losses, amounted to 140 TWh, see Figure 14. This is an increase compared with 2012, when the total electricity consumption was 143 TWh.

Factors such as economic and technological development, the development of 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 14 Electricity use by sector 1971 – 2013, TWh

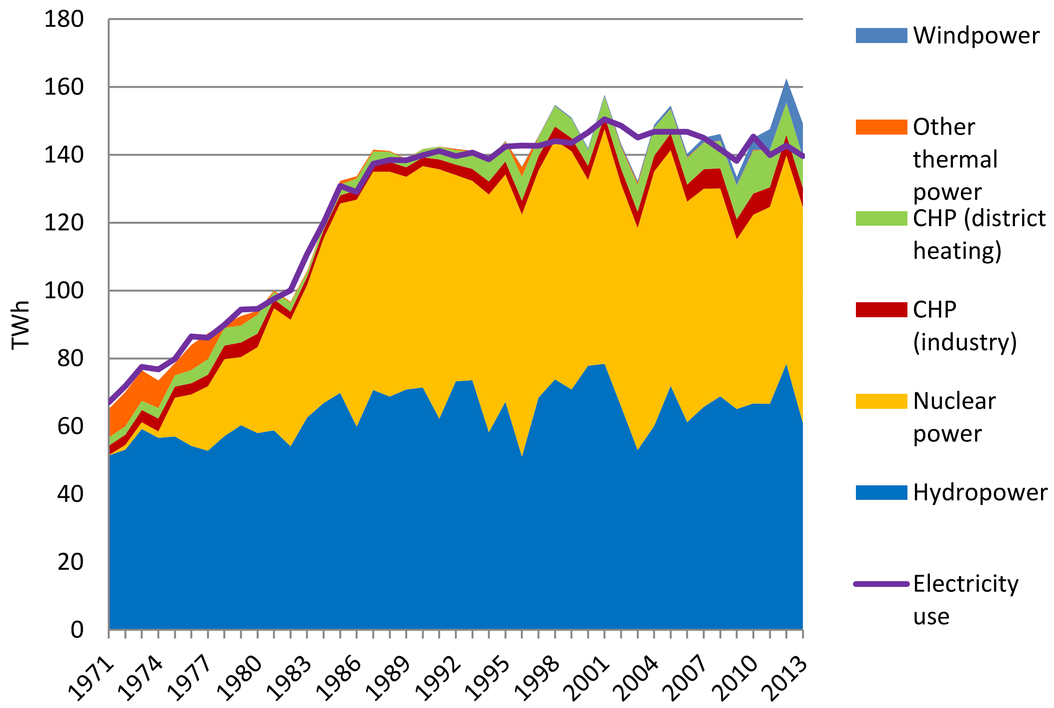


Source: Swedish Energy Agency and Statistics Sweden.

Hydropower and nuclear power dominate electricity production

The total electricity production amounted to 149 TWh in 2013, see Figure 15. This is a decrease of 8 per cent compared with 2012, which was a record year with the highest electricity output ever. In 2013, electricity production was composed of 41 per cent hydropower, 43 per cent nuclear power and 7 per cent wind power. The remaining 10 per cent was combustion-based production, which mainly takes place in combined heat and power plants and within industry. In the early 1970s, 69 per cent of electricity was produced by hydropower plants and 20 per cent by oil-fired condensing power plants[26]. The total amount of electricity produced was lower then than it is today.

Figure 15 Net electricity production, 1971 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.
Notes: The hydropower item includes wind power up to and including 1996.

In 2013, the reservoir levels in the hydropower plants were above the average level in the beginning of the year, to then fall below the average level for the rest of the year. Hydropower produced close to 61 TWh, which is significantly lower than in 2012 when a total of 78 TWh was produced. This is a difference of 17 TWh between two consecutive years, which clearly shows how large the variations can be with hydropower.

[26] Oil-fired condensing power plants use oil to produce electricity alone.

Swedish nuclear power plants produced just below 64 TWh in 2013. Production was thus higher than in 2012 but still slightly lower than what would normally be produced in a year, which is around 67 TWh.

Combustion-based electricity production accounted for close to 15 TWh in 2013. This is mainly produced in combined heat and power plants, which produced 9 TWh, and within industry, so-called industrial cogeneration. The largest portion of fuel used for combustion-based electricity production is biomass, accounting for 74 per cent. The remainder is natural gas, coal and oil. Oil-fired condensing power plants and gas turbines primarily provide reserve capacity.

Wind power production continued to increase sharply in 2013 and reached a level of 9.8 TWh. In 2014 wind power production was 11.2 TWh; an increase of 14 per cent compared with 2013. 2014 was 902 MW of wind power installed in Sweden and a total of 322 turbines put into operation. By the end of 2014, the total number of wind turbines was 2,961, with a total of 5,097 MW of installed power.[27]

The electricity produced using photovoltaic cells still accounts for a very small share of the electricity supply. The installed photovoltaic capacity was around 60 MW by the end of 2014. The photovoltaic market consists of both grid-connected and independent systems where the grid-connected systems account for over 80 per cent of the capacity (about 50 MW).[28] The total capacity produces approximately 57 GWh per year, which represents about 0.04 per cent of Sweden's total electricity production.

The installed power is increasing in the electricity system

Following the deregulation of the Swedish electricity market in 1996, there was a marked decrease in the installed electricity production capacity. It was primarily expensive condensing power that was no longer profitable which was phased out. After 2000, the capacity increased again and it is now greater than prior to the deregulation. Wind power accounts for the largest proportion of the increase in installed capacity. Combined heat and power plants, industry and increases in the output of nuclear power plants have also contributed to the capacity increase.

In December 2014, the total installed electricity production capacity was 39,549 MW. Hydropower accounted for 41 per cent, nuclear power accounted for 24 per cent and wind power represented 14 per cent. Other thermal power accounted for 21 per cent. The installed electricity production by type of power is presented in Figure 16.

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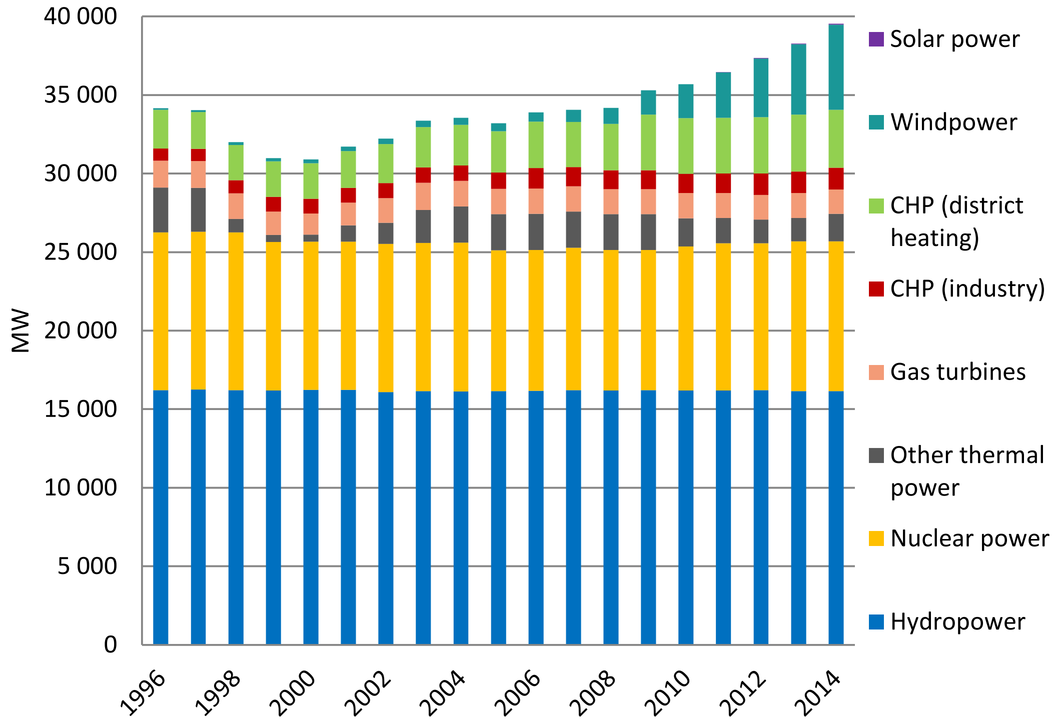
[27] Swedish Energy Agency, ES2015:02, Vindkraftsstatistik 2014 [Wind Power Statistics 2014].
[28] Swedish Energy Agency, Preliminary data collected from Annual Electricity, Gas and District Heating Supply 2014.

Figure 16 Electricity production capacity, 1996 – 2014, MW



Source: The Electricity Year 2013, Swedenergy.
Notes: Industrial back-pressure is synonymous with industrial cogeneration

The highest power output in 2014 happened on 13 December, between 4 and 5 pm, and amounted to 24,760 MW. Despite the fact that the difference between the installed capacity and the maximum power output appears to be large, the power situation may become 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 from one type of power to the next. Hydropower stations located on the same water course are, for example, dependent on one another and the availability of water, thus all of the hydropower capacity is not available concurrently at all times. Availability in nuclear power plants depends on the operational situation. In the case of wind power, the availability depends on where it is windy and whether it is windy. The power situation can become strained in periods with higher than normal usage and/or low available capacity. Prior to each winter, Svenska kraftnät, which maintains and operates the national grid, conducts an assessment of the power situation for the coming winter.[29]

[29] Svenska kraftnät, 2015/1231, Kraftbalansen på den svenska elmarknaden vintrarna 2014/2015 och 2015/2016 [The power balance in the Swedish electricity market in the winters of 2014/2015 and 2015/2016].

There must always be a balance between production and use of electricity in the electricity system. Traditional grids entail centralised and large-scale electricity production with a flow of electricity from producer to consumer. With an increase in the installation of small-scale wind parks and photovoltaic arrays there is a resultant increase in decentralised production and more variable power in the electricity system, which places new demands on flexibility and balance regulations in the electricity grid. Hydropower is an excellent source for regulating variations and thus maintaining the balance in the electricity grid. Electricity grids also need to become smarter as consumers can now also be producers and the electricity flows in multiple directions.

Measures to increase the security of electricity supply

As large-scale electricity storage solutions are not possible, there must be a constant balance between the supply and use of electricity in the electricity system. 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.

Electricity customers may experience three fundamentally different forms of disruptions in electricity supply; power outages, electrical energy shortages and electrical power shortages. Power outages that took place in conjunction with 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 outages lasting longer than twelve hours. A functional requirement was introduced into the Electricity Act on 1 January 2011, stipulating that unplanned interruptions in electricity transmission may not exceed 24 hours unless it is due to reasons that are beyond the electricity network companies' control. Among other things, this functional requirement has contributed to an increasing number of electricity network companies implementing comprehensive weatherproofing measures.

An *electrical energy shortage* refers to a prolonged situation where the total availability of electrical energy[30] is not expected to equal the total demand for electricity. If the electricity market is not functioning or if the functioning of the market leads to unacceptable societal consequences, measures that sideline the electricity market's function are used; for example, rationing that is only implemented following a political decision. The Swedish Energy Agency has prepared a proposal for a rationing model that encompasses all the country's industrial enterprises.[31]

[30] Electrical energy refers to the raw material used to produce electricity, such as water in reservoirs, oil, nuclear fuel or gas.
[31] Swedish Energy Agency, ER 2014:08, Förslag till hanteringsmodell för storskalig ransonering [Proposal for management model for large-scale rationing].

Electrical power shortages arise when the demand for electricity is greater than the availability. An electrical power shortage may occur in parts of the country due to problems with the transfer of power, or across the entire country if the overall availability of power is not sufficient. A widespread shortage of electrical power has never arisen in Sweden. However, the risk of an electrical power shortage was exacerbated in conjunction with an elevated power output in the winter of 2009.[32]

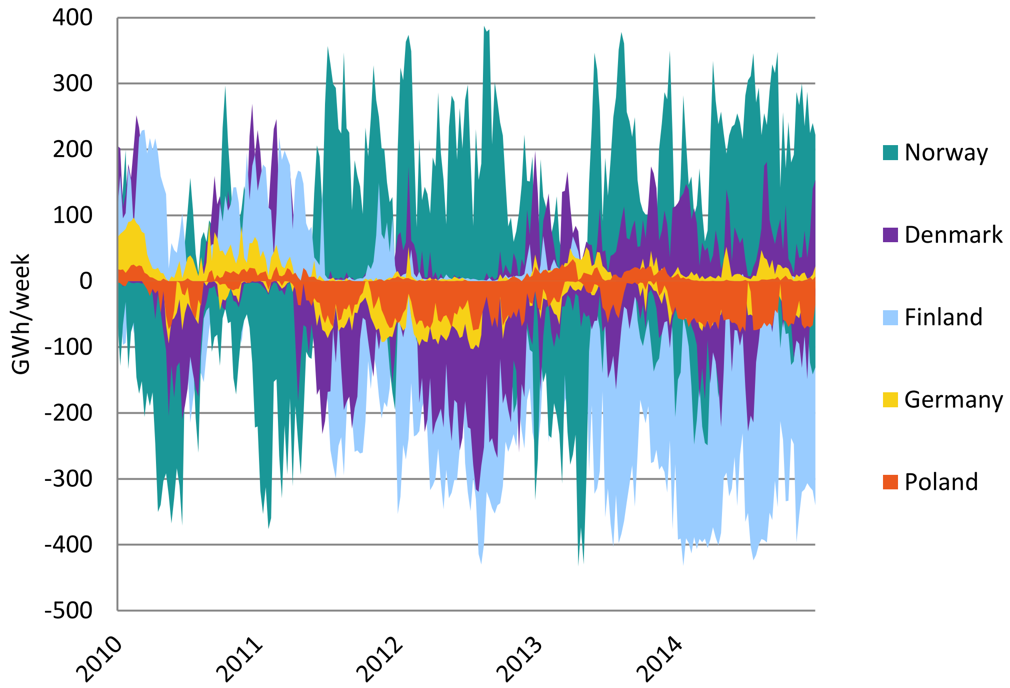
As part of its system responsibility, Svenska kraftnät has the task of preventing and managing electrical power shortages. In order to avoid such shortages, Svenska kraftnät has a number of technical and commercial mechanisms available, such as a disturbance reserve and power reserve.[33] If an electrical power shortage would arise despite the disturbance and power reserves, the electricity consumption must be reduced by disconnecting users. It is Svenska kraftnät that orders the electricity network companies to disconnect users. In order to alleviate the consequences for society, a method, Styrel, has been developed for planning the prioritisation of socially vital electricity users. Styrel is implemented in order to prepare the documentation that will form the basis for the electricity network companies' planning for manual consumption disconnection (MFK).[34]

Second-largest net exports ever in 2014

In 2014, Swedish net exports amounted to 15.6 TWh, which is the second largest net exports figure since the record year 2012 when net exports reached 19.6 TWh. The flows of trade between Sweden and neighbouring countries vary both from year to year and throughout the year; see Figure 17. Trade in electricity between countries depends on price differences between different electricity areas. Price differences may be the result of the availability of water, the availability of nuclear power, transmission capacities and electricity use. In 2014, the Nordic countries' net exports of electricity amounted to 11.8 TWh, compared with net exports of 9.5 TWh the previous year.

[32] Swedish Energy Agency, ER 2013:25, Ansvar och roller för en trygg energiförsörjning [Responsibilities and roles for a secure energy supply].
[33] There is currently an ongoing investigation addressing the future needs of this power reserve.
[34] Swedish Energy Agency, ET 2013:28, Styrel – Handbok för styrels planeringsomgång 2014 – 2015 [Styrel – Manual for Styrel's planning round 2014 – 2015].

Figure 17 Electricity trade with other countries 2010 – 2014, GWh/week



Source: Weekly Statistics Power Situation, Swedenergy.

Sweden currently has transmission connections with Norway, Finland, Denmark, Germany and Poland. In late 2015/early 2016, a new cable between Sweden and Lithuania, known as Nordbalt, may be completed. Svenska kraftnät has sought authorisation for a new electricity connection between Gotland and the mainland, with construction planned to start in 2016. The aim is to make it possible to expand wind power on Gotland. 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.

The electricity price on the exchange was low in 2013 and 2014

In 2013, the annual average value of the system price of electricity on Nord Pool was 32.9 öre and in 2014 the system price was even lower, 26.95 öre/kWh, see Figure 18. 2013 was warmer than normal and 2014 was an exceptionally warm year. The Nord Pool system price was significantly higher in both 2010 and 2011, at 50.6 öre/kWh and 42.4 öre/kWh respectively. The high price in 2010 was to a large extent the result of a cold winter and low availability in the Swedish nuclear power plants. A milder year and better availability in the nuclear power plants was the cause of the somewhat lower price in 2011.

Figure 18 Electricity spot prices, yearly averages, 1996 – 2014, öre/kWh

Source: Nord Pool Spot.

The electricity price can differ from one electricity area to the next depending on the restrictions between these areas. Since 1 November 2011, Sweden has been divided into four electricity areas as a result of the European Commission demanding that Sweden change its previous method of managing transmission limitations 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 level of consumption in that specific area.

Following the partitioning into electricity areas, there is no “Swedish Price” for electricity, and in Figure 18, SE3 has been set as an estimated value for what was previously the “Swedish Price”. The annual average value for the area of Sweden/SE3 was 34.1 öre/kWh in 2013 and 28.8 öre/kWh in 2014, which is slightly higher than the Nord Pool system price.

The electricity prices described here are not the electricity prices that the consumer pays, rather they are the electricity prices resulting from trade on the electricity exchange Nord Pool Spot. Sweden and Norway started the Nordic electricity exchange Nord Pool in 1996. In addition to Statnett and Svenska kraftnät, transmission system operators in Finland, Denmark, Estonia and Lithuania also own the Nordic electricity exchange. Nord Pool's actors consist of power producers, electricity suppliers, major end-users, portfolio managers, capital managers and brokers. In 2013, the companies trading on Nord Pool Spot turned over 349 TWh of electricity, which is equivalent to 84 per cent of the electricity that was used in the Nordic countries[35]. Electricity can also be traded directly between a seller and a buyer or internally amongst the electricity companies.

The electricity certificate system supports renewable electricity production

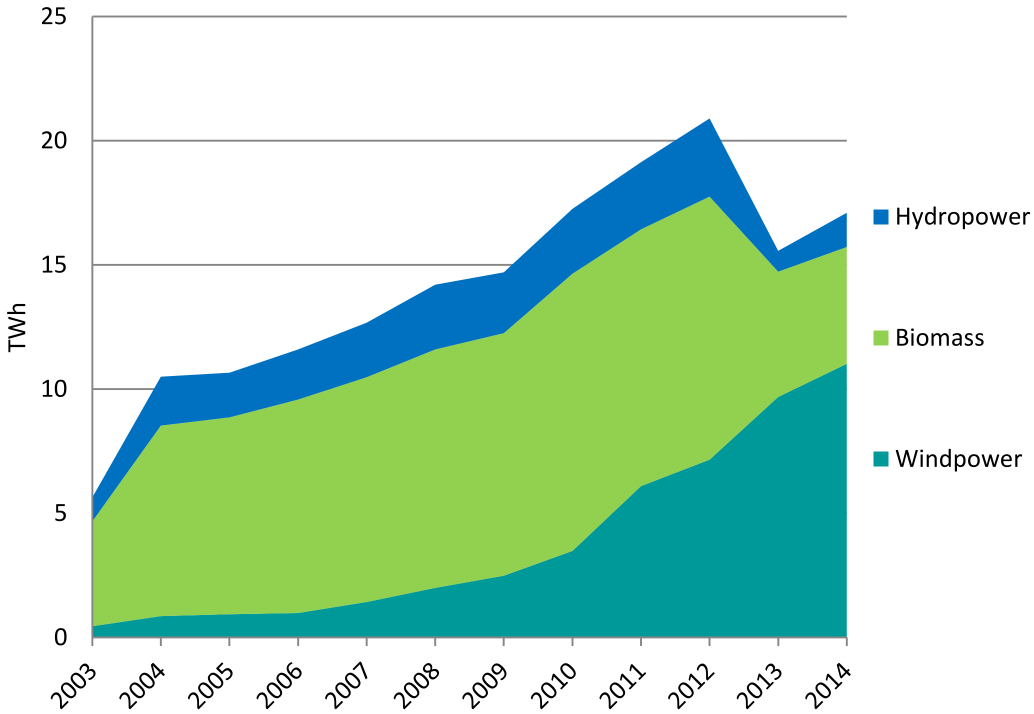
The electricity certificate system is a market-based support system that aims to increase the proportion of renewable electricity production. For every MWh of electricity produced by an approved facility from a renewable energy source, the owner of the facility receives an electricity certificate that then has a resale value. The buyers of electricity certificates are organisations that have what is known as a quota obligation. These are electricity suppliers and certain electricity users who 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 by 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. In 2014 the average price of a certificate was just under SEK 180 per certificate. One reason for the relatively low price in recent years is that the expansion of renewable electricity has been fast and the production has been high, which has led to the supply of certificates being greater than the demand. 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 2014, electricity production from renewable energy sources and peat in the electricity certificate system amounted to 17.2 TWh. Of these, 6.5 TWh existed prior to the start of the electricity certificate system in 2003. Figure 19 shows how the production of renewable electricity has increased from 2003 up to and including 2014 and how production is distributed between different sources of energy. In 2013, the electricity production that gave entitlement to electricity certificates decreased, primarily from biopower but also from hydropower. This is because many older plants were phased out of the system at the turn of 2012/2013 and were no longer entitled to electricity certificates.

[35] Nord Pool Spot, Annual report 2012, The power of transparency.

Figure 19 Electricity production per type of power in the electricity certificate system 2003 – 2014, TWh



Source: Swedish Energy Agency, The Account Management System Cesar.

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 TW h in both countries over the course of the period 2012 – 2020. The Swedish Energy Agency investigation Kontrollstation 2015[36] was presented in February 2014. It indicated that changes need to be made in the current regulatory framework for the common goal to be reached. In April 2015, a Government Bill was produced regarding a higher level of ambition for the electricity certificate system,[37] in which the Government proposes that Sweden shall finance 30 TWh of renewable electricity production by 2020 compared to 2002. The amendments to the Electricity Certificates Act are due to enter into force on 1 January 2016.

[36] Swedish Energy Agency and Swedish Environmental Protection Agency, ER 2014:17, Underlag till kontrollstation 2015 [Supporting data for Kontrollstation 2015].
[37] Bill (2014/15:123) on raising the level of ambition for renewable electricity and checkpoints for the electricity certificate system 2015.

Read more about the electricity certificate market in the publication *A Swedish-Norwegian electricity certificate market* from the Swedish Energy Agency and Norwegian Water Resources and Energy Directorate (NVE).[38]

Promoting efficient use of the electricity grid

In May 2015, the Swedish Energy Markets Inspectorate published a report entitled *Efficient use of the electricity grid* and an associated regulation.[39] The aim of the new regulation is to reduce network losses and achieve a more evenly spread load on the electricity grid across all hours of the day in order to utilise the electricity grid more efficiently. The regulation is a result of the EU's Energy Efficiency Directive adopted in autumn 2012. In conjunction with the directive, the Electricity Act was amended so that the network companies' revenue frameworks will be affected by how efficiently the network is being utilised. The new factors that will impact the size of the electricity network companies' revenue frameworks are network losses and load on the electricity grid. The regulation entered into force on 1 June 2015.

Reduced threshold effects during wind power development

As of 1 May 2015, an ordinance takes effect wherein network companies can apply for a grid reinforcement loan from Svenska kraftnät.[40] This is to bridge the so-called threshold effects within wind power development. The threshold effect means that the actor who is first to establish wind power in a place where the network needs to be reinforced must bear the entire cost of the investment, which creates a bottleneck for investments in wind power plants. The solution is therefore that Svenska kraftnät cover the cost to begin with and that it then be shared with other actors who establish themselves later, so that everyone pays their share. At any given time, Svenska kraftnät may have a maximum of SEK 700 million loaned to network companies. This is an interim solution until a permanent solution is in place that is adapted to the market and where the state does not have to bear the financial risk.

The Swedish Energy Markets Inspectorate has developed a proposal for a permanent solution, the implementation of which is planned for 2016. The solution involves the creation of a fund that is able to go in as a financier if the network owner cannot manage the costs. The support is provided as a loan and is paid off in pace with connections being made in the reinforced grid. The fund's resources are accumulated through a special fee on the national grid tariff and thus

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[38] Swedish Energy Agency and Norwegian Water Resources and Energy Directorate, ET 2015:06, En svensk norsk elcertifikatmarknad [A Swedish-Norwegian electricity certificate market] – Annual Report for 2014.

[39] Swedish Energy Markets Inspectorate, Ei R2015:07, Incitament för effektivt utnyttjande av elnätet [Incentives for efficient use of the electricity grid].

[40] Ordinance (2015:213) on loans to network companies to facilitate the connection of renewable electricity production in power.

shared by all of Sweden's electricity customers. The fund analyses the socioeconomic consequences of various reinforcement measures in determining which projects should be supported or not.

New policy measures and investigations in the electricity market

From 1 August 2015, the tax on the thermal output in nuclear reactors was raised from SEK 12,648 to SEK 14,770/MWh of the maximum thermal output and month.[41]

Since 1 January 2015, a party producing renewable electricity can receive a tax reduction of 60 öre/kWh. The tax reduction applies to micro-producers and may not exceed SEK 18,000 per year. Read more about the tax reduction for microgeneration of renewable electricity in the section on Energy policy.

"Vattenverksamhetsutredningen", a government commission on activities using or impacting on water, started in 2012 and submitted an interim report in September 2013. The final report was submitted to the Government in 2014.[42] The inquiry's mandate was to ensure that all water-related activities requiring permits have obtained such permits in accordance with the Environmental Code's environmental requirements and the EU requirements.

At the end of 2014, the Swedish Coordination Council for Smart Grid submitted its final report to the Government, including a draft national action plan for the development of smart electricity grids for the period 2015 – 2030.[43] The action plan includes proposals for regulatory changes, new incentive measures and programmes, and suggestions for improved collaboration and knowledge dissemination. In its work, the Coordination Council has proposed that a forum for continued coordination be established to drive the work with the implementation, monitoring and development of the plan, where the Government is expected to decide on the matter.

In the report *Offshore wind power*, the Swedish Energy Agency has investigated how a strengthened support mechanism for offshore wind power should be designed in the event that such would be introduced.[44] If the goal is a large-scale expansion (the assumed expansion is 15 TWh), a tender procedure with accompanying operational support is proposed. The operational support should be designed in the form of a so-called *sliding premium*, where the support level is determined in competition and based on the electricity price level. The higher the electricity price, the lower the level of support required.

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[41] Amendments to the Energy Tax Act (1994:1776).
[42] SOU2014:35, I vått och torrt-förslag till ändrade vattenrättsliga regler [Come rain or come shine - proposal for revised water law regulations].
[43] SOU2014:84, Planera för effekt! [Planning for power!] Final Report of the Swedish Coordination Council for Smart Grid.
[44] Swedish Energy Agency, ER2015:12, Havsbaserad vindkraft [Offshore wind power].


FISKARTORPET
STORA SKUGGAN
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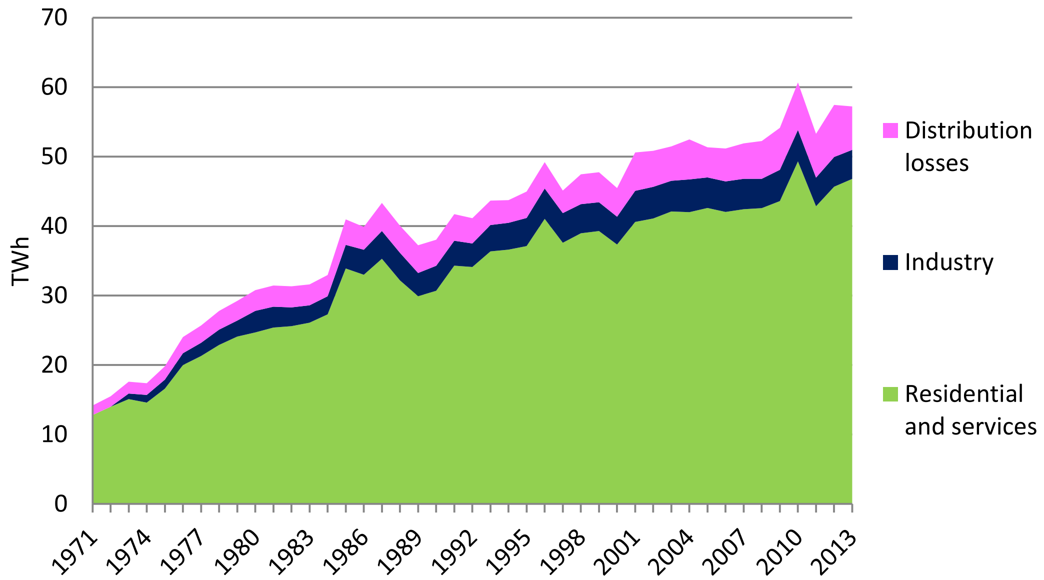
The district heating market

District heating has been available in Sweden since the 1950s and was previously produced mainly in thermal power plants. In 2013, district heating was responsible for 58 per cent of the total energy use in dwelling and non-residential premises. Half of the district heating was used in multi-dwelling buildings, while the non-residential premises accounted for 38 per cent and one- and two-dwelling accounted for 12 per cent. The proportion of district heating produced by cogeneration has increased steadily and currently represents around 40 per cent compared with 30 per cent in 2003.

Continued increase in district heating use

Thanks to improved technology, a more efficient use of the district heating networks and an increased proportion of ready heat[45], the distribution and conversion losses in the district heating systems have decreased over the years. During the period 1990 – 1999, the losses amounted to an average of 17 per cent, before decreasing to an average of 10 per cent between 2000 and 2009. In 2013, losses constituted 11 per cent of the total use of district heating. Figure 20 shows the use of district heating between 1971 and 2013. The significant increase in 2010 is mainly a result of a cold winter.

Figure 20 District heating consumption 1971 – 2013, TWh



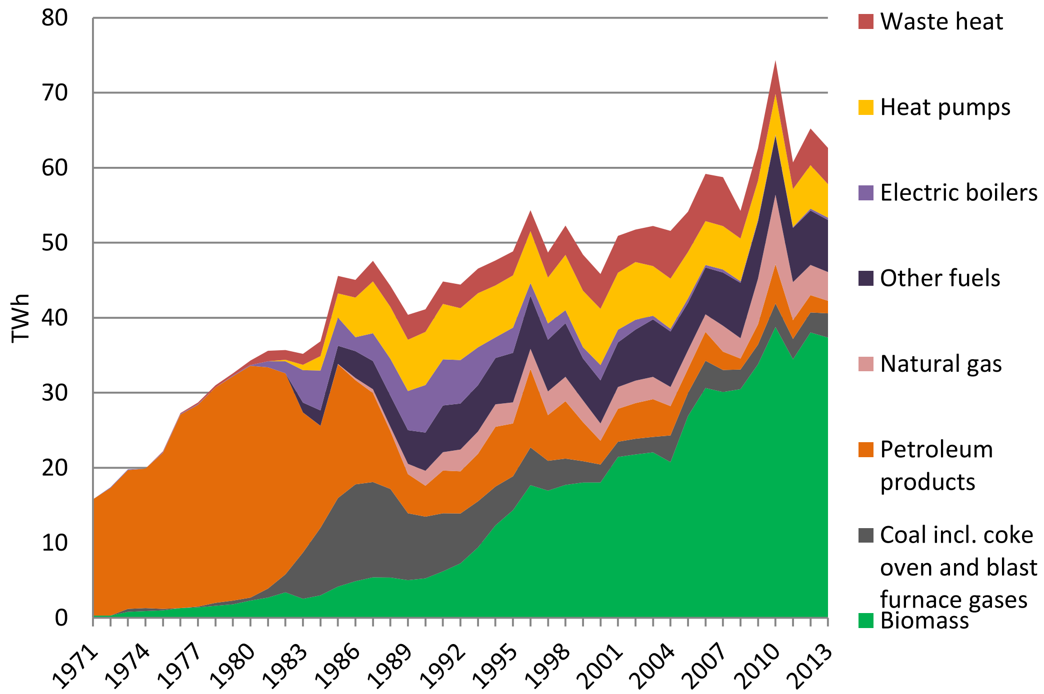
Source: Swedish Energy Agency and Statistics Sweden.

[45] Locally produced heat outside the district heating network.

District heating can utilise several different fuels

Several different fuels can be used for district heating production, and a major transition towards renewable fuels has taken place since the 1970s. Figure 21 shows the input energy used in district heating production in the period from 1970 to 2013.

Figure 21 Input energy used in the production of district heating 1971 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

In 2013, biomass accounted for 60 per cent and waste heat for 8 per cent of the input energy in district heating production. The use of heat pumps has decreased in the district heating system in recent years and the use of electric boilers has almost completely disappeared since the early 2000s. 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 ban on dumping combustible waste in effect from 2002 and the ban against dumping organic waste in effect from 2005. Waste is included in the statistical item biomass (organic waste) and other fuels (fossil waste). Peat is also included in the 'other fuels' item.

Prices and forms of ownership differ greatly

There are significant differences in the prices of district heating from one municipality to the next. In 2014, Luleå Municipality had Sweden's lowest district heating price at SEK 94/m^2 for an apartment building (at 193 MWh), while Mörbylånga Municipality had Sweden's highest price at SEK 201/m^2.

The price differences between municipalities depend on factors such as the district heating companies' ownership structures, yield requirements and input fuels. Geographical conditions for district heating installation also affect the price, as well as the age of the installations. The customer's options in the heating market thus depend, to a large extent, on where they live.

The overall turnover of the district heating sector was SEK 32.5 billion in 2013 and yielded an annual average of 31 billion between 2009 and 2013. The average annual price increases from 2009 to 2012 have been 3 to 4 per cent, before falling to 2 per cent in 2013 and 1 per cent in 2014.[46]

Secure supply of district heating with few disruptions

Today, district heating experiences few disruptions with limited consequences and is considered relatively secure for residences and other premises. However, with a large percentage of users of district heating, the individual user's flexibility decreases with regard to heat supply, which increases vulnerability in society. The increased use of biomass with limited opportunities for storage at the production facilities also has an impact on the level of risk.

For heat supply, there are currently no state-regulated functional requirements. For 2015, the Swedish Energy Agency is tasked with evaluating the district heating companies' financial position and capacity to handle significant changes in the environment that impact the companies' financial position.[47] The Agency shall also analyse the district heating companies' ability to prevent and remedy disruptions in the district heating supply.

District cooling is increasing somewhat

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 of production 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, what is known as free cooling.

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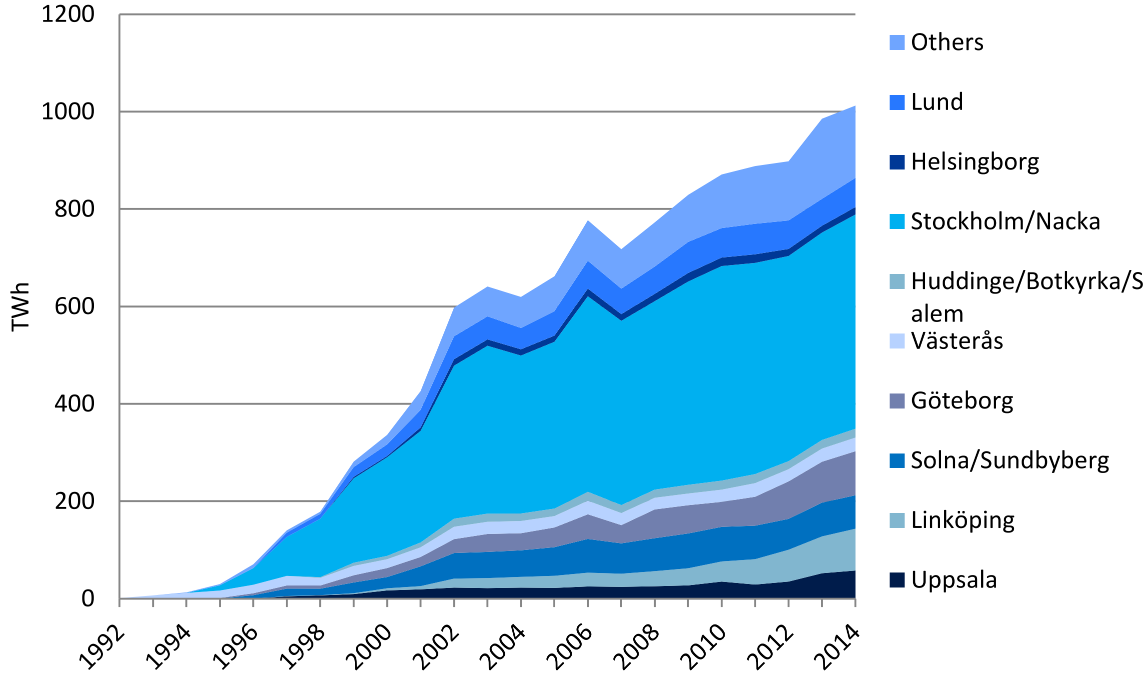
[46] Swedish Energy Markets Inspectorate, Ei R2015:04, Utvärdering av branschinitiativet prisdialogen [Evaluation of the industry initiative the Price Dialogue].
[47] Appropriation directions for the budget year 2015 relating to the Swedish Energy Agency within Expenditure Area 21, Energy.

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 986 GWh in 2013 to 1,013 GWh in 2014, see Figure 22. In 2014, a total of 35 companies supplied district cooling. In 2013, district cooling was expanded by 506 km.

Figure 22 District cooling supply 1992 – 2014, GWh



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

Regulated access to the district heating networks

In 2013, the Swedish Energy Markets Inspectorate carried out the investigation *Regulated access to the district heating networks*. The investigation suggested that a third party may invoke the right to connect to existing networks under the condition that the owner is kept indemnified and has their production costs covered, provided it has not been possible to come to an agreement. The proposals were adopted and became the law on 1 August 2014.[48] However, it is unlikely that the law will have any great effect as the waste heat collaborations that are profitable – and which the law is primarily written for – are generally carried out regardless.

The Price Dialogue increases confidence in the industry

In 2013, the Swedish District Heating Association, the Swedish Association of Public Housing Companies (SABO) and Riksbyggen AB created a consultation

[48] Government Bill (2013/14:187) on regulated access to the district heating networks.

process in connection with price changes called the Price Dialogue [Prisdialogen]. The initiative is an agreement between the parties on the district heating market in order to improve the dialogue. In 2015, 46 per cent of the district heating supplied was included in the dialogue and 38 per cent of the customers. The Swedish Energy Markets Inspectorate's evaluation indicated that the dialogue has led to increased confidence and a more coherent pricing system, but that it is still too early to say whether the initiative has a moderating effect on the district heating prices.[49]

[49] Swedish Energy Markets Inspectorate, Ei R2015:04, Utvärdering av branschinitiativet Prisdialogen [Evaluation of the industry initiative the Price Dialogue].

The biomass market

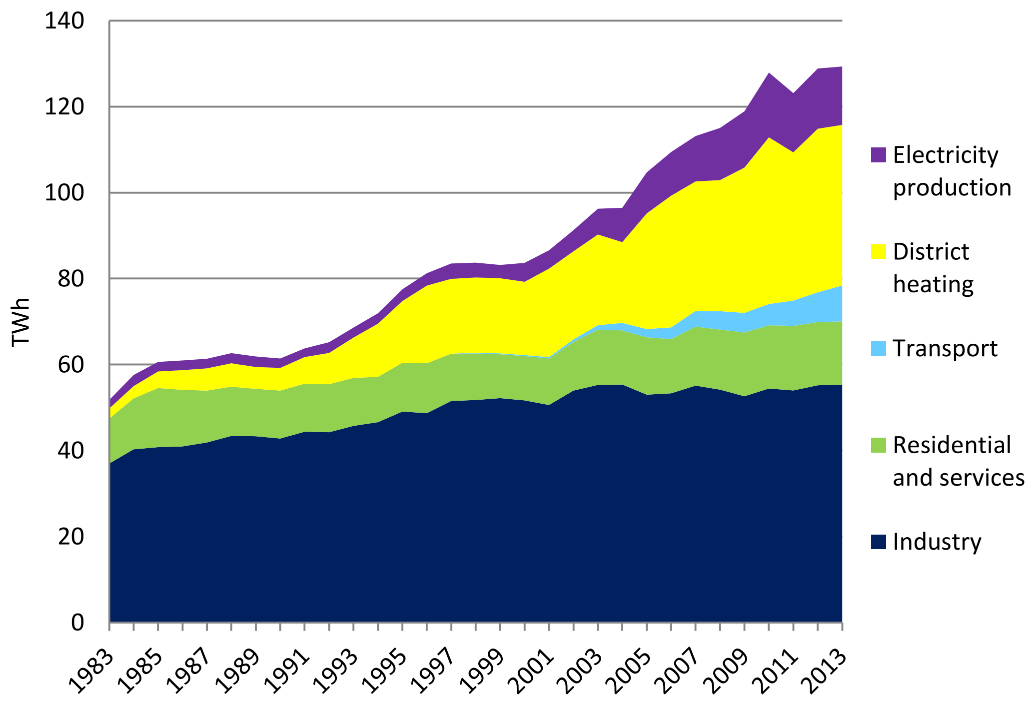
The use of biomass has grown steadily in recent decades for both electricity and heat production, as well as within the transport sector. Biomass is a collective term for several different types of fuels. In addition to unprocessed and processed wood fuels, the term also encompasses biofuels from agriculture, combustible waste, bioethanol, biodiesel and biogas. The markets for bioethanol, biodiesel and biogas are described separately.

Increased use of biomass

The use of biomass in the Swedish energy system has increased over the years. Biomass accounted for 11 per cent or 52 TWh of the total energy supply in 1983. In 2013, the use of biomass has increased to 129 TWh, which is equivalent to 23 per cent of the total supply.

Figure 23 shows the use of biomass in the industrial sector, residential and service sector, transport sector and for electricity and district heating production.

Figure 23 Use of biomass per sector 1983 – 2013, TWh

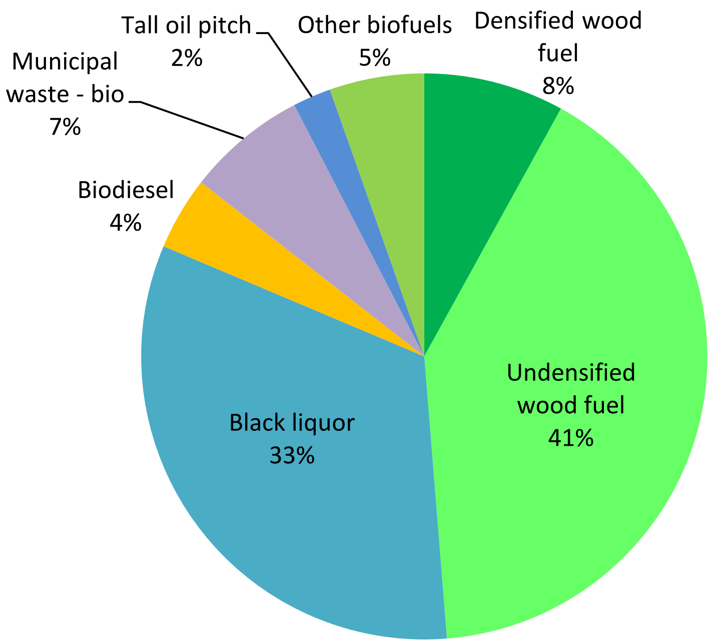


Source: Swedish Energy Agency and Statistics Sweden.

At the beginning of the 1990s, Sweden introduced both a tax on emissions of carbon dioxide and higher energy taxes. However, biomass became exempt from both energy and carbon dioxide taxes, which has contributed to a sharp increase in the use of biomass. The previous rising prices of fossil fuels have also benefited the use of biomass, as have the introduction of the electricity certificate system in 2003 and the emission trading system in 2005.

Figure 24 shows the use of biomass by fuel type in 2013. The two largest segments consist of undensified wood fuel and black liquor[50], followed by densified wood fuel and municipal waste-bio. The term "other biofuels" encompasses other solid biofuels, bioethanol, vegetable and animal oils, other liquid biofuels and biogas.

Figure 24 Use of biomass per fuel category 2013



Source: Swedish Energy Agency and Statistics Sweden.

Previously, peat was also recognised together with biomass in the statistics, which is not done any longer. Nowadays peat is reported under the item Other fuels along with fossil waste. The use of peat in electricity and heat production is, as with biomass, exempt from energy and carbon dioxide taxes. However, the use of peat is subject to sulphur tax. Peat is defined in the emissions trading system as a fossil fuel and thus electricity and heating producers pay a cost for emission allowances. Since 2004, electricity produced from peat has been entitled to electricity certificates when the production takes place in approved combined heat and power facilities.[51] This is one reason why peat remains part of the energy system. The use of peat for electricity and heat production has, however, declined over the past ten years.

[50] Black liquor is a by-product of the pulp and paper industry which is formed when boiling wood chips into pulp.
[51] Bill (2003/04:40) Peat in the electricity certificate system.

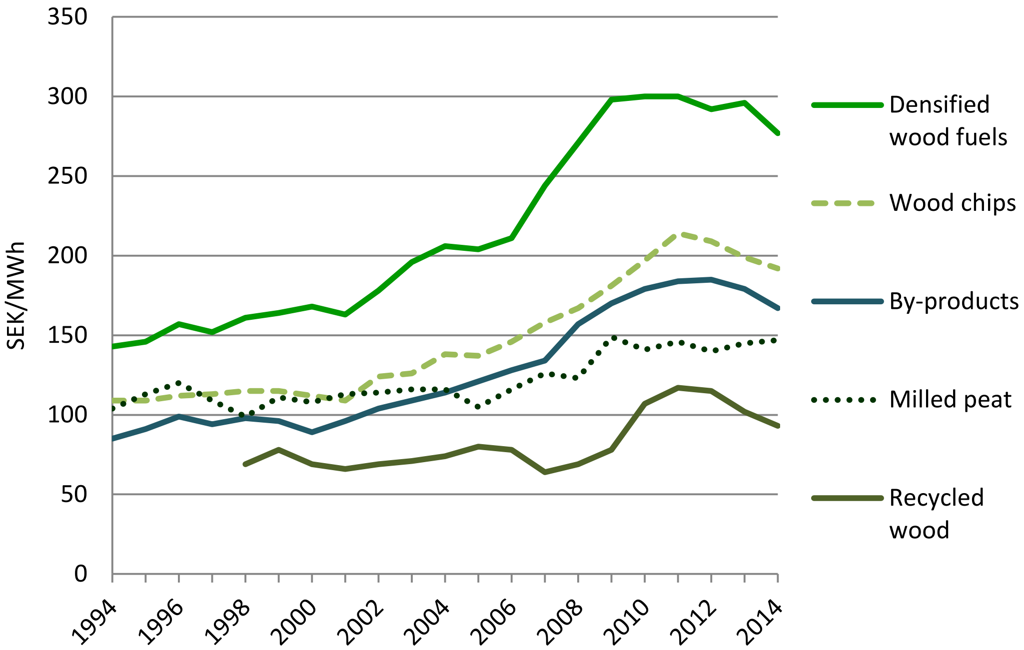
Falling prices for wood fuels

The increased use of biomass for electricity and heat production has led to an increased demand for wood fuels in particular. Throughout the 1980s and 90s, the prices of wood fuels for thermal power plants remained more or less unchanged. Good availability of cheap and easily accessible biomass is the result of a long period involving a surplus of waste production from the forestry industry.

The increased demand for wood fuels led to increased competition, which caused prices to rise during the 2000s. Greater extraction of fuel from forests is the main reason why the increased use has been possible. The market is expected to grow further in the near future.[52]

Figure 25 shows the annual average values for current rates for biomass, i.e. their nominal prices. The figure indicates that the decrease in prices that began following the coldest winter thus far, in 2009/2010, has continued for both densified wood fuels and for wood chips, by-products and recycled wood.

Figure 25 Wood fuel and peat prices for heating plants 1994 – 2014, current prices, SEK/MWh



Source: Swedish Energy Agency and Statistics Sweden.

The majority of the wood fuels are produced in Sweden, but they are also imported to a certain extent. There is currently no comprehensive gathering of statistical data on

[52] Swedish Energy Agency, ER 2013:24, Heltäckande bedömning av potentialen för att använda högeffektiv kraftvärme, fjärrvärme och fjärrkyla [Comprehensive assessment of the potential for using high efficiency cogeneration, district heating and district cooling]. Swedish Energy Agency, ER 2015:19, Kortsiktsprognos [Short-term forecast].

the import of wood fuels, and it is therefore difficult to determine the extent of this. Imports consist of pellets, timber from demolitions, and similar biomass. There are also what is known as indirect imports, when forestry companies import round timber for industrial processes, from which by-products and waste products such as bark and sawdust can be used as fuel or as raw materials in the production of pellets, briquettes and dust. As a result of this, indirect imports may also be included in the item "domestically produced fuel" in Sweden's energy balance.

Biofuel used in the transport sector

The production and use of biofuel in Sweden has grown sharply since the mid-2000s. The proportion of biofuel used in road transport in 2013 was 12 per cent, as previously described in the section on the transport sector. According to the calculation method in the Renewable Energy Directive,[53] the share of renewables in 2013 amounted to 15 per cent, partly due to the fact that biofuels from certain Biofules can be double-counted for. Sweden was then the EU country with the highest percentage of biofuels in the transport sector, and according to preliminary statistics for 2014, the percentage of renewables has increased further.

The use of transport biofuel in Sweden consists of low-level and high-level biodiesel blends, biogas in pure form or mixed with natural gas, and low- and high-level ethanol blends. Low-admixture ethanol can also be also be designated E5, while high-admixture ethanol includes E85 and ED95. There are two different types of biodiesel in the Swedish market; HVO (hydrotreated vegetable oils) and FAME (fatty acid methyl esters). For further definitions of biofuel, see Table 1 in the section on the transport sector.

Biodiesel

Both HVO and FAME can be produced from various types of oil plants such as rape, soy and palm. Animal fats are also used for production, for example, various types of offal. In Sweden, rapeseed oil is most commonly used in the production of FAME. In 2014, the feedstocks for HVO were mainly slaughterhouse waste, crude tall oil and palm oil.

FAME

The use of low-admixture FAME has increased since 2005, to be somewhat stabilised in recent years. This is partly because the use of fossil diesel has been stabilised in even though it is still increasing slowly, and partly because low-admixture HVO has taken some of the market share. In Sweden it is permitted to blend up to 7 per cent by volume of FAME in fossil diesel, according to the Swedish Environmental Class 1 standard for diesel. The EU's Fuel Quality Directive also governs the blending level and sets a ceiling of 7 per cent by volume.

[53] The Renewable Energy Directive (2009/28/EC).

High-admixture FAME, known as B100, has increased during the period 2005 to 2013, accounting for a growing part of the total FAME use. B100 has been available on the market for a long time but requires some material adjustments to a normal diesel engine. It also requires approval from the engine manufacturer.[54]

HVO

HVO appeared on the Swedish market in 2011. Its use has since then increased rapidly and was in 2013 the most widely used transport biofuel in Sweden. Low-admixture HVO blends accounted for 36 per cent of the total volume of renewable transport fuels in 2013. In 2015, pure HVO has been made available on the market for use in heavy vehicles. Because a standard does not yet exist for pure HVO as a transport fuel, the vehicle manufacturer's approval is required. Preliminary statistics from 2014 indicate that the use of pure HVO is increasing steadily.

Unlike FAME, HVO is chemically identical to fossil diesel, allowing a considerably higher percentage to be mixed with the fossil diesel, and it can be used in standard diesel engines without any adjustments.

Ethanol

Ethanol is produced through the fermentation of sugar and other carbohydrate-rich feedstocks such as sugar cane, maize, cereals and sugar beet. It is also possible to produce ethanol from cellulosic feedstocks such as straw and firewood, provided the cellulose is broken down into lighter fermentable constituents first. A low admixture of ethanol is essentially in all 95-octane petrol and in some volumes of 98-octane petrol delivered to the Swedish market, and is sold as a high-level blend through the transport fuels E85 and ED95. In 2014, the feedstocks for ethanol consisted mainly of wheat, maize, rye and sugar cane.

Sales of E85 increased between 2005 and 2009. The recession in 2009 meant that sales dropped, but recovered later in 2010 and 2011. In 2012, sales of E85 decreased again, and have since declined significantly. Previously, E85 sales have been connected to the price of petrol because the lower price of E85 has driven demand to a large degree. However, this is not true for the last few years, when sales have decreased despite the ethanol price being lower than the price of petrol. In addition, new car sales of ethanol cars have dropped sharply since the peak of 59,024 private cars in 2008. In 2014 2,691 ethanol cars were sold.[55] Statistics from 2015 indicate the same trend, i.e., a continued decline in newly registered ethanol cars, despite the fact that 2015 has so far been a very strong year for new car sales. There are several reasons for the decline in E85 use, including engine problems, increased competition from fuel-efficient diesel cars and a discussion that has questioned the actual environmental impact of ethanol.

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[54] SPBI, Fact Database, http://spbi.se/blog/faktadatabas/artiklar/fame/ (retrieved on 24/06/2015).
[55] Transport Analysis, Vehicle Statistics, http://trafa.se/PageDocuments/Fordonsstatistik_maanadsfil.xls (retrieved on 23/06/2015).

Falling prices for transport biofuels

Some transport biofuel prices are directly linked to the price of its fossil counterpart, while others follow market quotations. For ethanol, it is mainly the price of cereals and sugar cane that impacts the price. Ethanol is traded on a world market where the largest producing country is the USA followed by Brazil. During the summer of 2012, the price of ethanol increased within the EU as a result of a sharp rise in ethanol prices in the USA. The harvests in 2013 were significantly better compared with the previous year, resulting in improved production margins. The harvests in 2014 were also good, which was reflected in falling prices for agricultural products. However, lower demand lead to lower margins for ethanol producers in the EU.

Biodiesel is also traded globally, but the market is dominated by the EU, which is both the largest producer and user. It is primarily the price of soybeans, rapeseed and other oil plants that affects the price of biodiesel. As mentioned above, approximately the same feedstocks in theory can be used to produce both HVO and FAME. In practice, however, the feedstock base differs. In addition, the mode of production differs substantially between FAME and HVO. The production of FAME is relatively simple and can be pursued in smaller facilities, while the production of HVO requires a refinery and more advanced technology. This causes the production cost of HVO to be higher than that of FAME. The differences in the production costs can be seen in the state aid reports that have been produced as supporting data for the Government's report to the European Commission on tax exemptions for biofuels. The state aid reports obtain information on production costs from Swedish actors and compare it with the price on fossil fuels. These production costs for the period January – March 2015 and how they are calculated are presented in the Swedish Energy Agency report *Indicative monitoring report on tax exemptions for liquid transport biofuels during the period January – March 2015* which was submitted to the Government Offices of Sweden on 30 June 2015.[56]

During the summer of 2013, FAME producers in the EU were subjected to more favourable economic conditions as a result of lower feedstock prices and increased competitiveness with FAME from Indonesia and Argentina thanks to anti-dumping duties. The price fell in late 2013 and continued to decline in 2014, albeit at a slower pace. The price of vegetable oils was lower in 2014 than in 2013, which largely explains the lower prices of FAME. Since the technology used to produce FAME is mature, price changes are essentially only dependant on feedstock prices and any currency effects.

[56] Swedish Energy Agency, Indikativ övervakningsrapport avseende skattebefrielse för flytande biodrivmedel under perioden januari–mars 2015 [Indicative monitoring report on tax exemptions for liquid transport biofuels during the period January - March 2015].

New taxes for biofuels

Since 1 January 2015, new energy taxes are imposed on low-level and high-level biofuel blends, excluding CNG. The energy tax on low-admixture ethanol was increased from 0.34 to 0.36 per litre, as a result of the energy tax on petrol being raised. The energy tax for low-admixture FAME was increased by SEK 1.4 per litre and amounted to SEK 1,686 per litre. High-admixture FAME, which previously had been fully tax exempt, was at the same time subjected to an energy tax of SEK 1,026 per litre. All biofuels remain fully exempt from carbon dioxide tax.

In the Council on Legislation's submission *Specific excise duty proposals for the 2016 Budget Bill,* the Government proposes that the energy tax on low-admixture ethanol and E85 be raised from 1 December 2015 so as not to be in breach of the EU's state aid rules. It is further proposed that the energy tax on petrol and fossil diesel be raised, which means additional increases for low-admixture ethanol and E85 as well as low- and high-admixture FAME, as these tax exemptions are based on the energy tax on the fossil counterpart. However, the Council on Legislation's submission also proposes that the tax exemption for high-admixture FAME be increased from 46 to 50 per cent, while HVO, biogas, ED95 and other transport biofuels or biocomponents continue to be fully tax exempt.

The Council on Legislation's submission also proposes that the limit for the blending of ethanol in petrol and FAME in diesel – which is currently set at max 5 per cent – be abolished. This means that even FAME, which is blended in over 5 per cent by volume, will be subject to a tax reduction.[57]

Changed conditions for the transport sector's share of renewables

In April 2015, the European Parliament adopted a proposal for amendments to the Renewable Energy Directive and Fuel Quality Directive, known as the ILUC proposal.[58] Sweden will implement the changes in Swedish law by 2017 at the latest. The new proposal does not entail any change in the rules for the types of feedstock found in the fuel mix today which can be double-counted for.

The amendments also entail the introduction of a ceiling of 7 per cent for crop-based transport fuels, a level just above where Sweden currently finds itself. If the proportion of crop-based transport biofuels increases, this means that the proportion exceeding 7 per cent of the total transport fuel volumes may not be included in the target of 10 per cent renewable transport fuels in 2020.

[57] Government Offices. Vissa punktskattefrågor inför budgetpropositionen 2016 [Specific excise duty proposals for the 2016 Budget Bill]. http://www.regeringen.se/rattsdokument/lagradsremiss/2015/06/vissa-punktskattefragor-infor-budgetpropositionen-2016/.

[58] Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

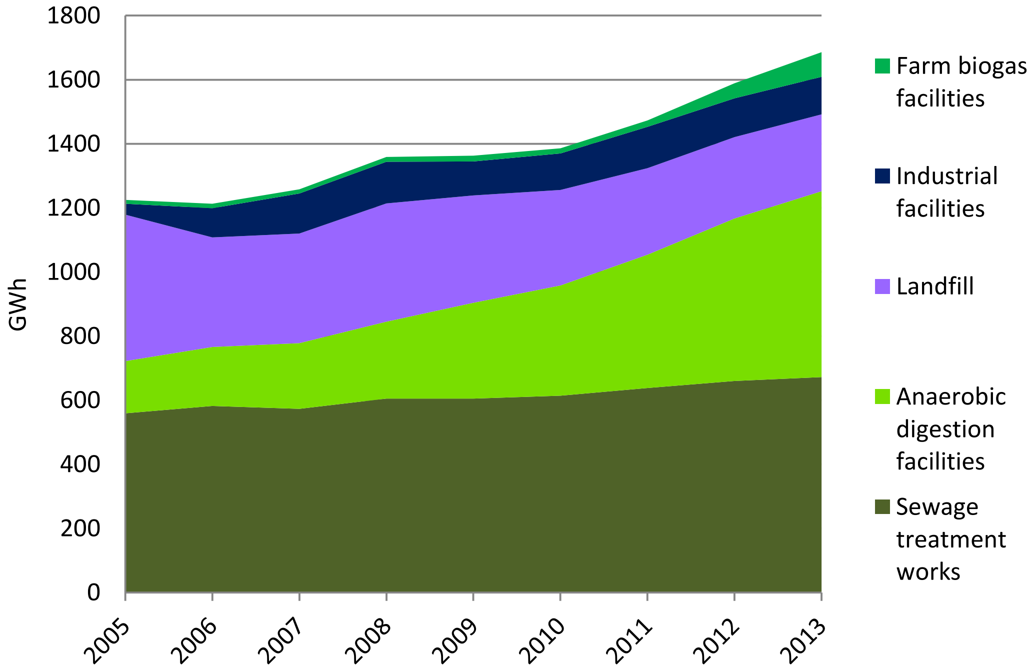
The changes also mean that the proportion of renewable electricity used for the railway may be multiplied by 2.5, while in the present situation it is only counted for once. Renewable electricity used in road transport will be multiplied by 5, which increases the incentive for Sweden to produce statistics on the use of electricity in road transport. Electricity consumption in road transport is estimated to be relatively small at present but is likely to increase in the future, so it is of interest to gain an accurate overview of electricity use as soon as possible.

Biogas

Increased use and production of biogas

The total production of biogas in 2013 amounted to 1,686 GWh, an increase of 6 per cent since 2012. Most of the biogas is produced in sewage treatment works and anaerobic digestion facilities, as shown in Figure 26. The production in farm facilities is relatively small but has increased in recent years.

Figure 26 Production of biogas, by category of facility 2005 – 2013, GWh



Source: Swedish Energy Agency

More than half of the biogas was upgraded to CNG in 2013. The upgrade means that the gas is cleansed of corrosive substances, particles and water, and that the energy value is raised by removing carbon dioxide. About 30 per cent of the biogas went on to heat production, including thermal losses, and 3 per cent went to electricity production. The remaining amounts were torched, i.e., burned and released. The share of biogas which goes to upgrading has increased slightly, while the share that goes to heat production has decreased.[59]

Biogas used as transport fuel is known as CNG. CNG sold in Sweden always contains at least 50 per cent biogas with the remainder being natural gas, but may consist of as much as 100 per cent biogas. Biogas used as transport fuel is upgraded to increase the methane content to the corresponding methane content of natural gas. CNG was introduced to the Swedish market in the early 1990s and initially consisted mainly of natural gas. As biogas production was expanded in Sweden in the mid-1990s, the opportunity arose to upgrade and utilise it as fuel within the transport sector.

Since first making a mark in the transport fuel statistics in 1996, the proportion of biogas has gradually increased. In 2008 the proportion of biogas exceeded that of natural gas in terms of energy content and has since constituted the dominant share in CNG. Since 2009, the average mix has hovered around 60 per cent biogas and 40 per cent natural gas. At the end of 2013, there were 147 public filling stations around the country and 58 non-public, such as for example bus depots.[60]

A new progression in the past three years is that liquefied natural gas, LNG, has begun to be used both as bunker fuel within shipping and as truck fuel within road transport. Although it does not involve any large volumes of liquid gas, there is an increase in usage each year.[61] In 2012, liquid biogas, LBG, was produced in Sweden for the first time. In 2013, the total production of LBG amounted to 33.5 GWh, a doubling of the figure from 2012, and went exclusively to heavy transport.[62]

The price of biogas lower than fossil fuels

As with certain liquid biofuels, CNG is priced based on fossil transport fuels; on average 10 to 20 per cent below the price of petrol. The price of fossil fuels thus establishes a ceiling for which type of biogas is profitable to produce, as CNG is the path of disposal for biogas in Sweden that produces the greatest revenue due to the end customer's high willingness to pay.

The price of CNG may vary between different filling stations, depending on how close to a production and upgrading plant the filling station is located and the

[59] Swedish Energy Agency, ES 2014:08, Produktion och användning av biogas och rötrester år 2013 [Production and use of biogas and digestate in 2013].
[60] Swedish Gas Association, Gasbilen, Number of filling stations in Sweden in 2013, http://www.gasbilen.se/Att-tanka-pa-miljon/Fordonsgas-i-siffror/TankstallenUtveckling, (retrieved on 23/06/2015).
[61] Swedish Energy Agency, ES 2015:01, Transportsektorns energianvändning [Energy use in the transport sector 2014].
[62] Swedish Energy Agency, ES 2014:08, Produktion och användning av biogas och rötrester år 2013 [Production and use of biogas and digestate in 2013].

distribution possibilities available.[63] In the future, the price will also likely be affected by the increased supply of LNG which will be made possible through more and larger import terminals in Sweden. The gas price will also include a network fee which together constitutes the total gas price in Sweden.

For biogas produced in municipally-owned facilities, slightly different conditions prevail compared to other biogas produced. In part it is the competitive landscape that differs, but also economic conditions. There is no clear picture of what the differences mean in pure costs. However, it is important to keep in mind, as a large portion of the biogas is produced in municipal property. Other reports on biogas production costs also point to the difficulties of specifying general costs, since many plants and actors have completely different conditions for their activities, and thus profitability is often achieved through a combination of several production facilities, distribution centres and end-users.[64]

Investment support for biogas and other renewable gases

Since 2010, the Government has annually allocated funds to support the market introduction of new technologies and solutions that enhance biogas profitability and contribute to increased production. This aims to promote efficient and expanded production, distribution and use of biogas and other renewable gases. In 2013 and 2014, the Swedish Energy Agency paid out SEK 180 million to projects within the framework of the support. There are no plans at present for any further funding announcements as selected projects are ongoing during 2015 and 2016, after which the support is being phased out.

Support for biogas production from manure

In the Budget Bill for 2014, the Government announced the project *Reimbursement for double environmental benefit*, a proposal for investment in the anaerobic digestion of farmyard manure to produce raw methane gas. The aim was to compensate biogas production from manure due to its climate and environmental benefits, such as decreased methane emissions from manure and a reduced need for fossil fuels.

In April 2015 the Swedish Board of Agriculture published instructions regarding state aid for the production of biogas from manure[65]. The support is designed as a project that runs from 2014 to 2023. The aid amount is 20 öre per kWh multiplied by the production during the subsidy period. The total aid amount may be less in some cases, such as if the budget does not cover the full amount. In other words, it

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[63] Swedish Gas Association, Gasbilen, Gasbilen, Varför varierar fordonsgaspriset mer än andra drivmedel? [Why does the price of CNG vary more than other transport fuel?] http://www.gasbilen.se/Att-tanka-din-gasbil/FAQFordonsgas/FAQGaspriser, (retrieved on 23/06/2015).

[64] SGC, Rapport 2014:296, Kostnadsbild för produktion och distribution av fordonsgas [Cost structure for production and distribution of CNG].

[65] SJVFS 2015:10, the Swedish Board of Agriculture's instructions regarding state aid for the production of biogas from manure.

is not possible to calculate the exact amount of aid in advance. Over a ten year period, there is a budget of SEK 240 million to be distributed in the project according to a plan established by the Government.[66] The Board of Agriculture administers the aid.

Investment aid within the Rural Development Programme 2014 – 2020

Farmers and other rural entrepreneurs who want to invest in the production or processing of biogas will be able to apply for aid in autumn 2015 within the Rural Development Programme.[67] The payment may amount to 40 per cent in investment aid, and in northern Sweden the aid may be as much as 50 per cent in certain cases. The investment aid is part of the Rural Development Programme 2014 – 2020 and can be applied for from September 2015.

[66] Swedish Board of Agriculture, Manure Gas Support, Support for Rural Areas. http://www.jordbruksverket.se/amnesomraden/stod/foretagsochprojektstod/godselgasstod.4.ac526c214a28250ac23333e.html, (retrieved on 13/08/2015).
[67] Swedish Board of Agriculture, What is the Rural Development Programme?, the Rural Development Programme. http://www.jordbruksverket.se/amnesomraden/landsbygdsutveckling/programochvisioner/landsbygdsprogrammet20142020/vadarlandsbygdsprogrammet.4.1b8a384c144437186ea10a.html, (retrieved on 14/08/2015).

Fossil fuel markets

Included in the fossil fuel markets are oil, coal and natural gas. In Sweden, oil products are mainly used within the transport sector and coal is mostly used within industry. Natural gas accounts for a small proportion of Sweden's energy use and is mainly used for electricity and heat production and in the industrial sector.

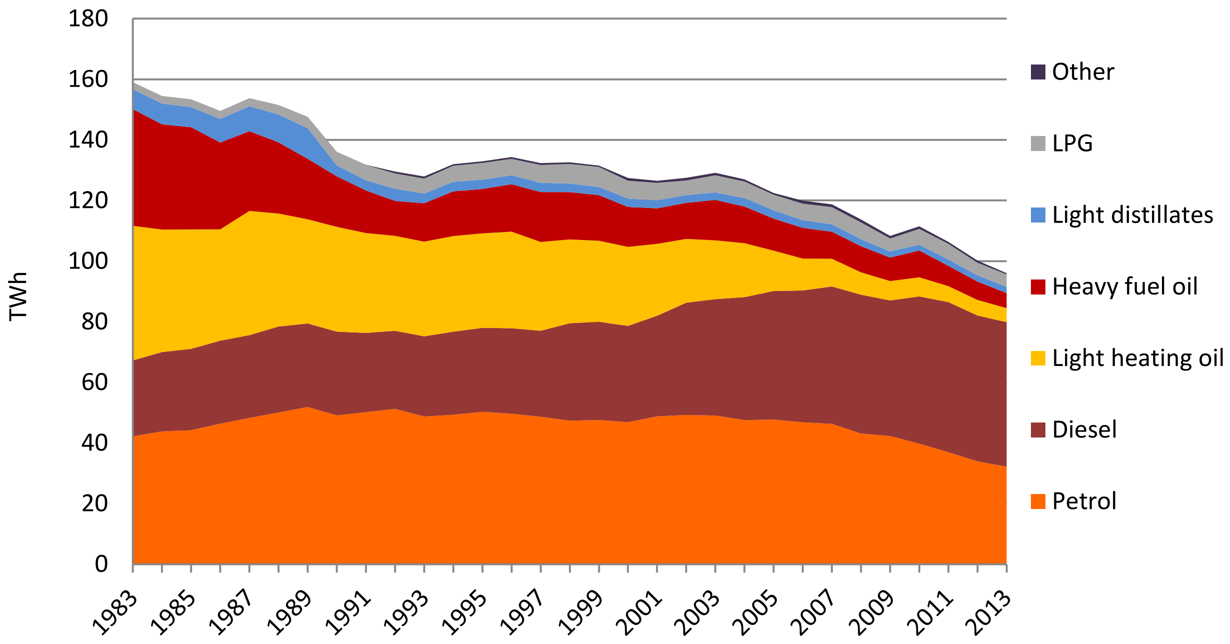
Oil

Oil is the dominant source of energy globally and accounts for over 30 per cent of the world's total energy supply. Crude oil is the world's most traded commodity. Supply and demand in the global oil market is affected by economic growth as well as production levels, but also by geopolitical and security policy factors, in addition to the weather and the amount currently in storage. Despite many uncertainties, the market and the price have remained relatively stable, until the summer of 2014 when a sharp decline in price began.

The use of oil products in Sweden has halved

Vehicle fuel currently represents the clear primary final use of oil products in Sweden. Since the 70s, the use of oil products in Sweden has more than halved, and the past 30 years have seen a reduction in use of over 60 TWh, as shown in Figure 27. It is primarily the use of fuel oils that has decreased, particularly in the detached house market. See the chapters for each user sector for more information about what has led to decreased use.

Figure 27 Final use of petroleum products, by product 1983 – 2013, TWh



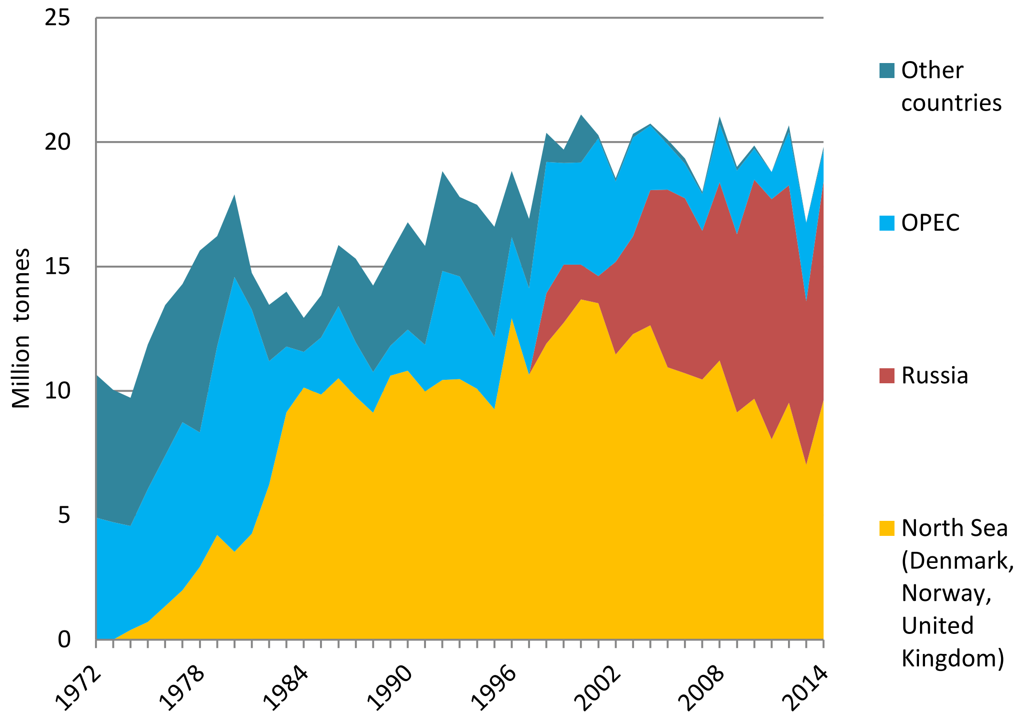
Source: Swedish Energy Agency and Statistics Sweden.

Sweden imports crude oil and exports refined oil products

Sweden has a relatively large refinery industry with the capacity to produce more transport fuels and other refined oil products than is used in the country. This makes Sweden a net exporter of refined petroleum products. However, some of the transport fuels used in the country are imported. There are, for example, distributors of transport fuel that do not have their own refinery capacity and instead buy from other suppliers. Swedish transport fuel production is concentrated to the west coast, which means that imported refined products from countries such as Finland may have lower transportation costs on the Swedish east coast. It may therefore be profitable to import refined products from other countries, primarily from the Baltic region.

Since Sweden does not produce any crude oil of its own, it dependence on imports. In 2014, just below 20 million tonnes of crude oil was imported. Figure 28 shows imports of crude oil broken down by source country of origin.

Figure 28 Swedish import of crude oil, by country of origin 1972–2014, million tonnes



Source: Swedish Energy Agency and Statistics Sweden.

The crude oil that Sweden imports mainly comes from the North Sea and Russia, which is a natural consequence of the geographical position between these two major oil-producing regions. Russia's crude oil exports across the Baltic Sea have increased over the past decade, while crude oil production from the North Sea has declined.

Shale oil has increased supply on the global market

Shale oil is crude oil produced from oil shale through hydraulic fracturing or fracking, which is the term in common usage. The technique involves creating fractures in rock by injecting large quantities of water mixed with chemicals. The purpose is to release the oil, and also gas, that is located deep underground. The fastest development of shale oil extraction has taken place in the USA, which has led to an increased supply on the global market. Production of shale oil increased from 2.5 per cent of total crude oil production in the USA in 2003 to around 49 per cent in 2014.[68] The increased production in the USA has led to the country reducing its imports of crude oil from 10.1 million barrels per day in 2005 to

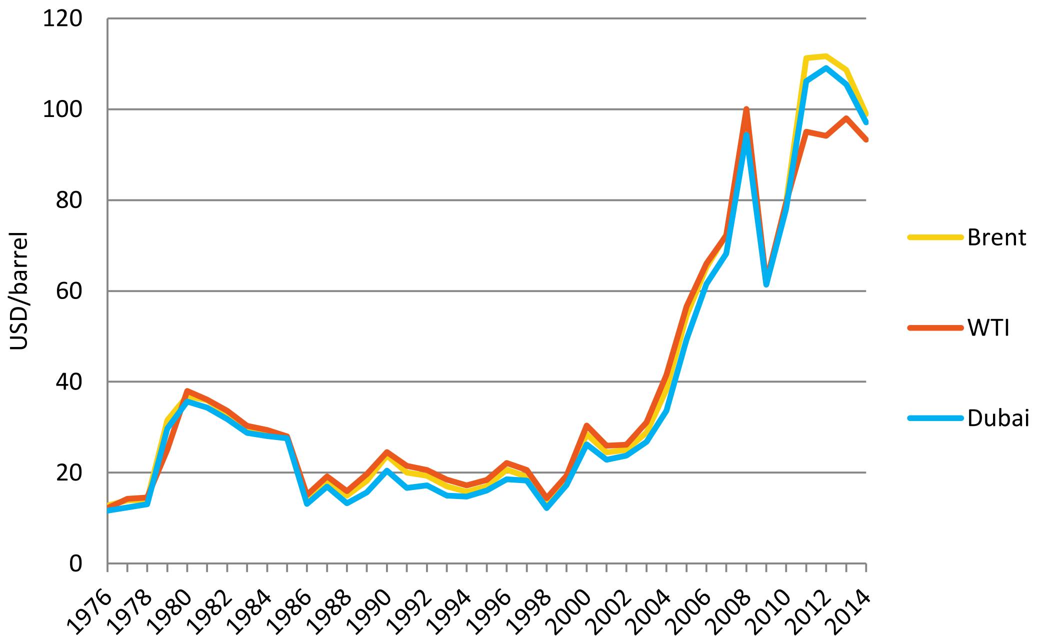
[68] IEA, Annual Energy Outlook 2015.

7.3 million barrels per day in 2014.[69] The increased supply on the global oil market affects the pricing globally for importing countries, such as Sweden.

Reference oils serve as a basis for pricing

Brent is a type of crude oil that is extracted from the North Sea. It fills an important role as a reference price and constitutes the basis for setting the price of global crude oil. Like Brent, West Texas Intermediate (WTI) constitutes a basis for setting the price of global crude oil, but is more reflecting the U.S market. The price in Dubai constitutes a reference for pricing global crude oil, but is used mainly to set the price of crude oil export from the Persian Gulf to the Asian market. See Figure 29 for prices of crude oil. The prices are presented here in annual average values.

Figure 29 Crude oil prices 1976 – 2014, USD/barrel



Source: BP, Statistical Review of World Energy 2015.

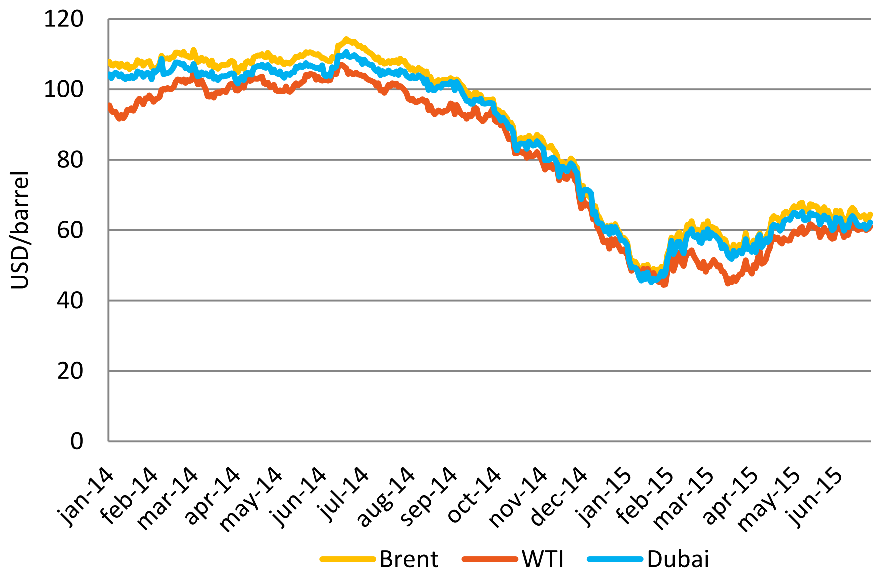
Historically, the three reference prices have followed one other, but the price of WTI has decreased in recent years. This is due to limitations of the infrastructure in the USA, where the large trading point in Cushing, Oklahoma, has constituted a bottleneck.

Significant drop in oil price in 2014

After a long period of time with high and stable crude oil prices, a substantial fall in price began in June 2014 and continued throughout the autumn and winter, see Figure 30.

[69] BP, Statistical Review of World Energy 2015.

Figure 30 Crude oil prices, front month ICE, USD/barrel



Source: Montel.

There are several explanations for why the price of oil fell. One of the influential factors is the downward revisions of expectations for the global demand for oil. The economic outlook has led to the forecasts predicting a drop in the demand for crude oil. Before the price drop occurred, the oil market was characterised by a period of both economic uncertainty and geopolitical risks, especially in the Middle East and North Africa. At the same time, the production growth of shale oil in North America was unexpectedly high. When the market's focus shifted from geopolitical risk factors to the actual oversupply in the global crude oil market, the price stability that had long prevailed crumbled in June 2014. The prices fell dramatically during the autumn and winter, to then recover slightly in the spring 2015.

At OPEC's ministerial meeting in November 2014, the oil producer group decided to keep its production cap at 30 million barrels per day, which perpetuated the fall in prices that had begun in the summer. Saudi Arabia, which is an influential member of OPEC and holds a significant reserve capacity, has historically balanced the market by increasing or reducing its oil production during critical market changes. In the choice between maximising its revenues in the short term or defending market shares against other oil producers in the long term, OPEC chose the latter. At the ministerial meeting in June 2015, OPEC also decided to keep its production cap at the same level.

Secure oil supply with stockpiles

Sweden is dependent on a functioning international trade in oil. The transport sector is 90 per cent dependent on oil-based fuels; mainly petrol and diesel.

Several other sectors are in turn dependent on transport, including the transport of goods to grocery stores, industries, pharmacies and healthcare services.

A serious disruption in the supply of oil could 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 vendors and importers that have sold or used oil are legally obliged to keep stockpiles. This is connected to Sweden's membership of the EU and to commitments under the IEP agreement. The IEP agreement (International Energy Programme) is an agreement between 29 countries about a common energy programme. The Swedish Energy Agency decides which organisations that are obliged to stockpile and how extensive the stockpiles will be.

The recent sharp fall in prices of crude oil has led to actors with a stockpile obligation, including refineries, having to perform significant write-downs on the value of their stock. This concern the refineries' crude oil inventories in particular. The refinery industry has had several years of tight margins, and low profitability does not make the situation easier to handle. It could have extensive consequences for the Swedish stockpile system if Swedish refineries are forced to shut down.

Coal

After oil, coal is the most common source of energy worldwide and accounts for nearly 30 per cent of the world's energy supply. It is also the energy source whose use has increased the most during the 2000s, where China has accounted for the vast majority of the increase. In 2004, coal took over the lead as the largest source of carbon dioxide emissions in the world.[70] Globally, coal is used primarily as fuel for electricity production. Coal is also used in industry, especially for the manufacture of iron and steel, where coal can be used both as a source of energy and as raw material for the process. In Sweden, coal represents only a small part of the energy system today, where coal and coke together account for about 4 per cent of the total energy supply.

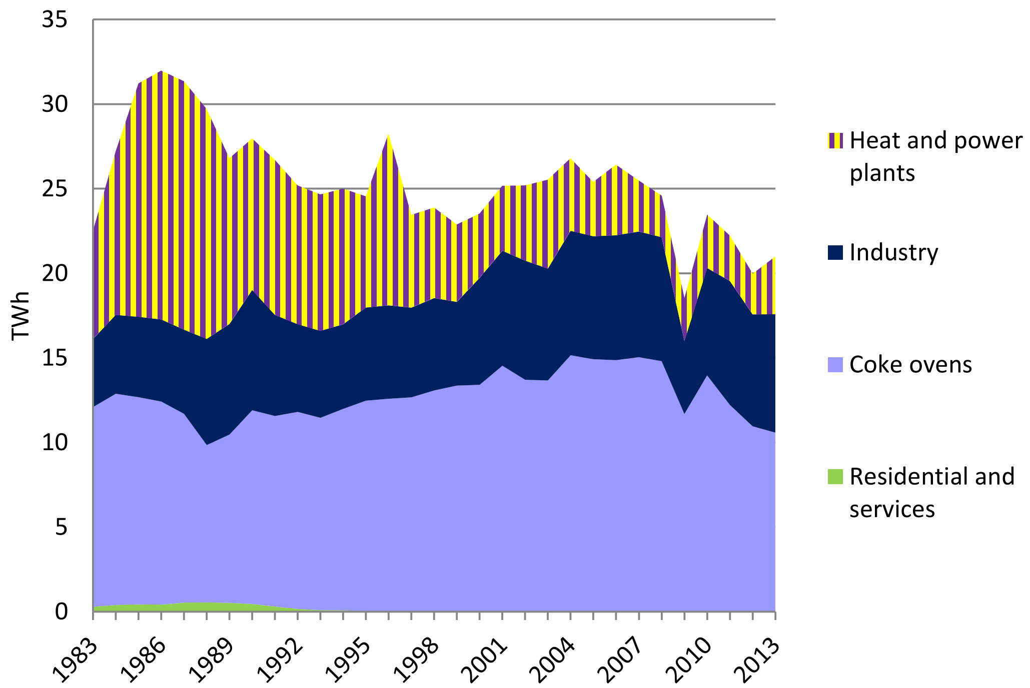
Coal is a term for several types of solid fossil fuels that contain high levels of the element carbon, and which has been formed by the mouldering of organic material and its subsequent transformation in the earth crust over a long period under high pressure. Depending on how long the transformation process has been in effect, the energy content varies. Lignite is a young form of coal that contains more liquid and therefore has relatively low energy content, while pit coal has been stored in the earth crust for a long time and has higher energy content and contains less liquid.

Coal is used primarily within industry in Sweden

In Sweden, it is primarily the industrial sector that uses coal. A little more than half of the coal consumption takes place in coking plants to produce coke, which in turn is mainly used as a reductant in iron production. In coking plants, the process also causes the formation of energy-rich coke-oven gas, which is used, inter alia, in heat and electricity production in the iron and steel works, as well as within the district heating and electricity sector. During iron production in blast furnaces, blast furnace gas is produced, which is also used for heat and electricity production, among other things. Figure 31 shows the use of coal by sector.

[70]IEA, CO_2 Emissions from Fuel Combustion 2014.

Figure 31 Use of coal by sector, 1983 – 2013, TWh



Source: Swedish Energy Agency and Statistics Sweden.

Within the Swedish electricity and district heating sector, coal consumption decreased significantly during the 1990s as a result of carbon dioxide and sulphur taxes being introduced. However, combined heat and power plants still use some coal. One reason for this is that the tax regulations for combined heat and power production are more beneficial than for the production of heat alone. The aim of this tax differential is to increase the competitiveness of combined heat and power plants compared to facilities that produce only electricity or only heat.

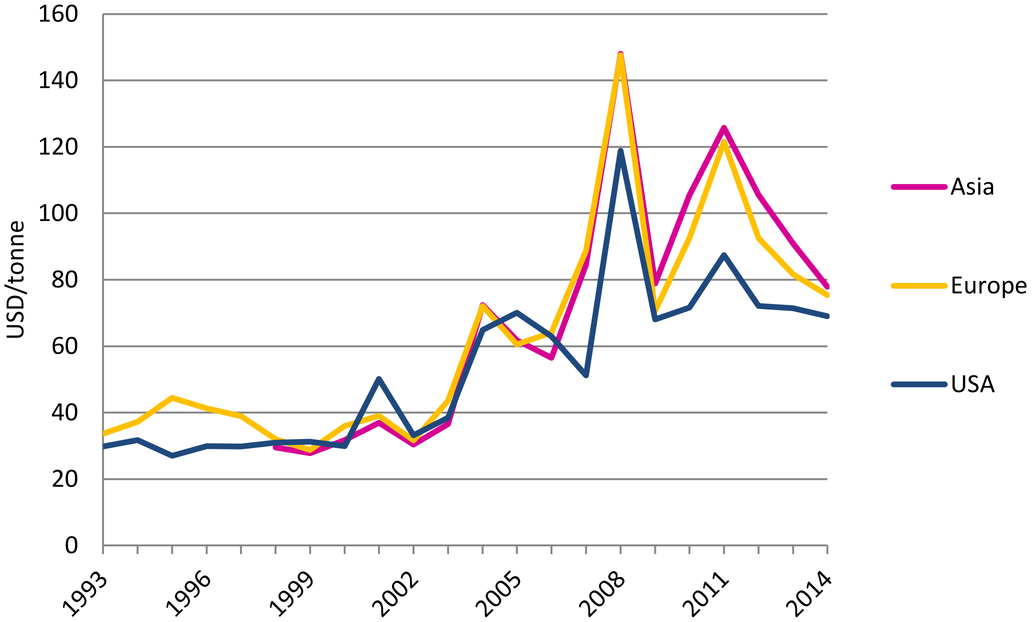
Global coal trade primarily takes place by boat

Most coal is mined in the vicinity of where it is used. However, there is also a global international trade in coal where the long-distance transport mainly occurs via shipping. In 2013, the international coal trade amounted to 1.333 billion tonnes, equivalent to 17 per cent of the total demand.[71] It is almost exclusively hard coal that is traded internationally because lignite's lower energy content makes it less profitable to transport. Swedish coal imports in 2014 came primarily from Australia and the USA.

In recent years, the supply in the global coal market has been greater than the demand, and the global prices of coal have therefore decreased sharply, see Figure 32.

[71] IEA, Medium-Term Coal Market Report 2014.

Figure 32 Coal prices in Europe, the USA and Asia 1993 – 2014, USD/tonne



Source: BP, Statistical Review of World Energy 2015.

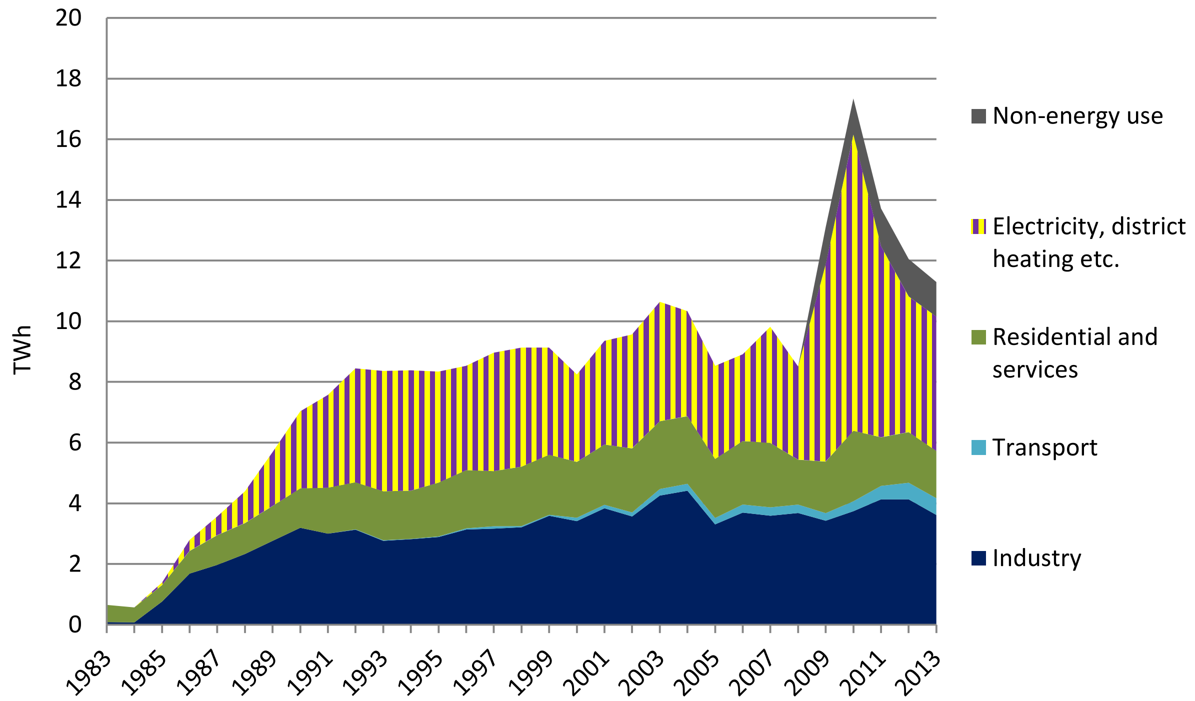
Natural gas

In third place after coal and oil comes natural gas, which accounts for just over 20 per cent of the primary global energy consumption. Natural gas has gained a greater role in the global energy mix in recent years, to a great extent due to the rapid development of shale gas production in the USA. Shale gas can be extracted with the same technology as for shale oil, as described in the previous section on oil.

Natural gas accounts for a small part of Sweden's energy consumption

Natural gas, which was introduced in Sweden in 1985, accounts for a relatively small portion of the total energy supply; around 2 per cent in 2013. There are large regional differences in the use of natural gas depending on the reach of the natural gas network. Its use increased rapidly up until the beginning of the 1990s and then levelled off. In 2010, there was an increase in use once more, mainly due to investments in gas-fired combined heat and power at the same time as it was a cold winter. At present, natural gas is primarily used in Sweden as a fuel for electricity and heat production as well as in industry. To some extent, natural gas is used by households connected to the gas network for heating and cooking purposes, and it is used within the transport sector as a vehicle fuel. Natural gas is further used as a raw material in industry. For natural gas use by sector, see Figure 33.

Figure 33 Use of natural gas and gasworks gas, by sector, 1983 – 2013, TWh



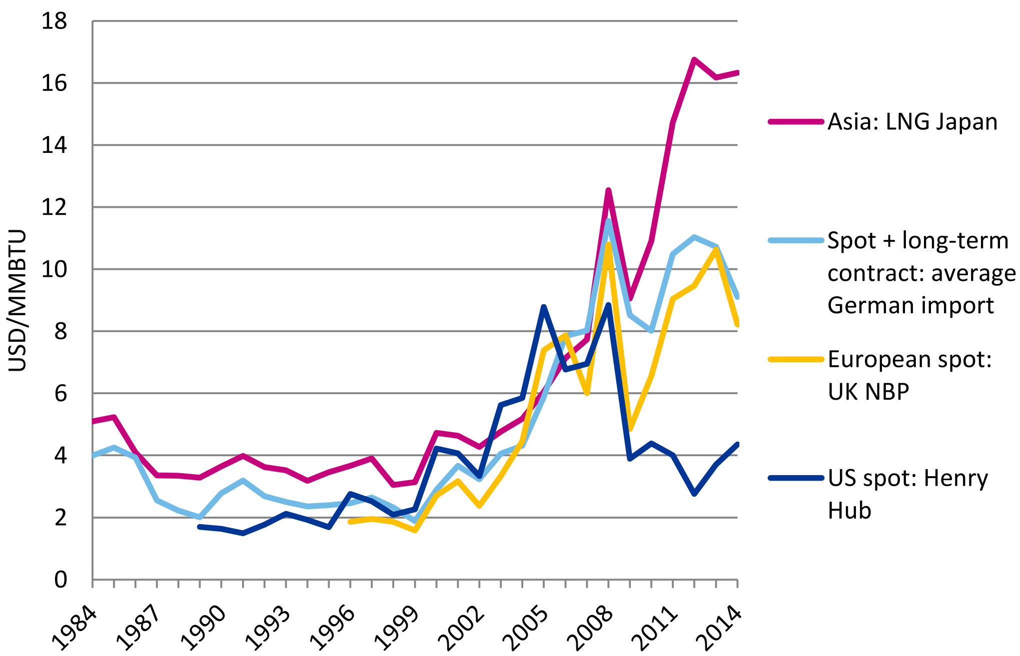
Source: Swedish Energy Agency and Statistics Sweden.

The Swedish natural gas network stretches from Trelleborg to Göteborg and branches off along the way, to places such as Gnosjö and Stenungsund. In this part of the country, natural gas accounts for 25 per cent of the primary energy supply. It is also nearby the natural gas network that most gas is used. Since Sweden does not produce any natural gas of its own, all of it comes from imports. Almost all imports come via pipeline from Denmark, where the Danish natural gas system in turn is linked to the continental gas network in Europe. Smaller quantities of liquefied natural gas, LNG, are also imported, mainly from Norway.

Regional markets for natural gas

The global trade in gas is less integrated and more regional than the trade of oil and coal. The supply situation looks different, depending on how developed the infrastructure is in the different regions. Trade between the regional markets has historically not occurred to any great extent, which has made the various markets isolated. A large proportion of the natural gas that is supplied to Europe comes through pipelines from Russia in particular. In Asia, the majority of natural gas is supplied as LNG using cargo ships. Another large difference between the different markets is the price of gas. The gas prices in Asia was on average about four times higher than in the USA and twice as high as in Europe in 2014, see Figure 34.

Figure 34 Average natural gas prices in Europe, the USA and Asia 1984 – 2014, current prices, USD/MMBTU*



Source: BP, Statistical Review of World Energy 2015.

* Million Metric British Thermal Unit

In the USA, the price of natural gas is primarily based on supply and demand, and varies accordingly. Prices in Europe and Asia are instead often based on negotiated prices in bilateral long-term contracts. The price in the long-term contracts has often been strongly linked to the price of oil products in Europe and the crude oil price in Asia. Until recently, there has not been a liquid spot market for natural gas in either Europe or Asia. After the oil price rose sharply in 2008, however, spot markets for natural gas have emerged, particularly in Europe but also in Asia.

2014 was a year with relatively low gas prices, which in large part was due to the low demand. The declining crude oil price has also pushed down gas prices in the contracts, but to a much lesser extent than had been the case a couple of years ago when gas prices in Europe were more linked to oil prices.

The rapid increase in shale gas production in the USA may, in the future, lead to greater exports of LNG from the country. Such a development could potentially open up a more integrated global natural gas market in which the regional prices move closer to one another.

Risk analysis for Swedish gas supply

Today, about half of Russia's gas exports to Europe go through Ukraine. Therefore, it was not unexpected that the gas market reacted with concern when Russia seized the Crimean peninsula in Ukraine in March 2014. In light of the gas crises of 2006 and 2009, which were caused by disagreements between Russia and Ukraine, there was a concern that a new energy crisis could occur.

The political tension between Russia and Ukraine continued to escalate gradually during the first half of 2014. This led to the European Commission, during the summer, urging member countries to carry out a risk analysis for the gas supply in each country. The main purpose of this was to get an overall picture of the EU's ability to handle a situation where Russian gas supplies via Ukraine are discontinued or where all Russian gas supplies to the EU are stopped.

The focus of the risk analysis for Sweden was a scenario involving a complete halt in gas supplies from Russia from 1 September 2014 to 28 February 2015.[72] The results showed that if such an event had occurred, the gas supply in Sweden would initially not be affected. This is thanks to the stable flow of gas to the Danish stockpiles from gas extraction in the North Sea as well as gas storage facilities in Denmark — being deemed well stocked. The analysis showed that the gas storage facilities in Denmark would gradually be emptied during the autumn and winter. During February 2015, the situation in Denmark and Sweden would be so strained that gas supply on a cold day[73] would not cover the demand. Thus,

[72] Swedish Energy Agency, Ref. no.: 2014-4076, "Stress Test" for the Swedish natural gas system Summary.

[73] The term "cold day" refers to a so-called 20th year winter where the temperature is below -13 degrees C.

gas customers, who according to EU regulation[74] and Danish and Swedish law are not protected customers, would have to be disconnected.[75] A disconnection of "non-protected customers" in Sweden would have a substantial impact on both industry and critical societal operations that depend on gas as, for Sweden's part, protected customers only constitute 2 per cent of the total natural gas market. Protected customers in Sweden are domestic customers who are connected to the distribution network for gas.

[74] EU Regulation (2010:994) concerning natural gas supply.
[75] National emergency plan for Sweden's natural gas supply - according to the European Parliament and Council Regulation (EU) No 994/2010.

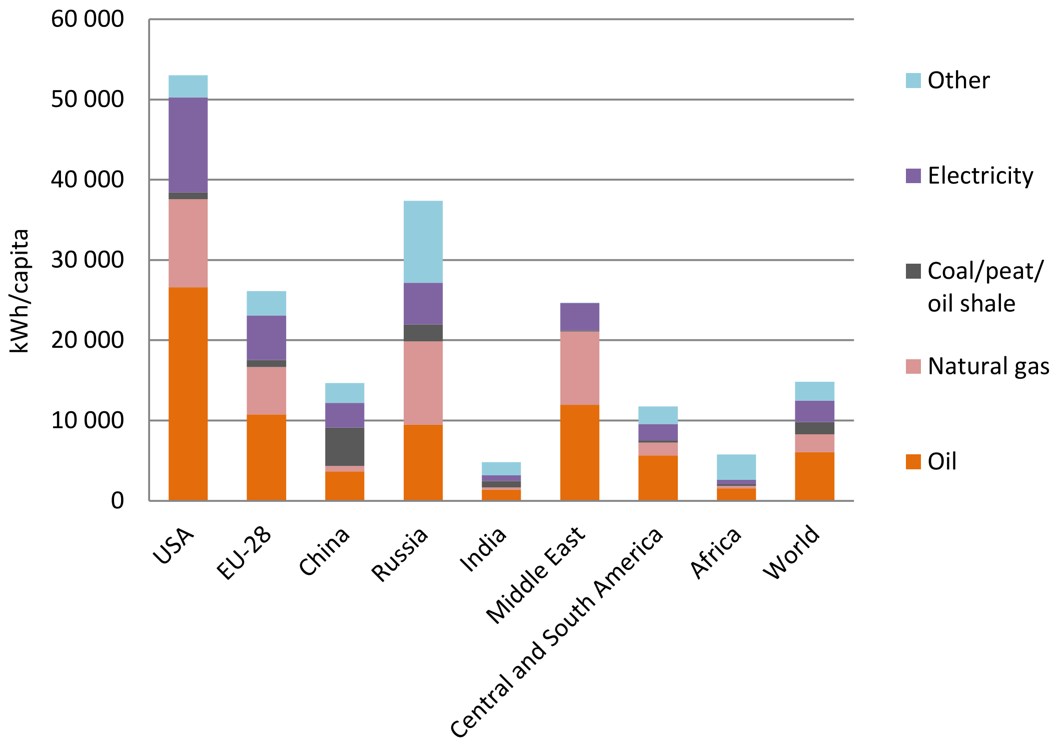
An international perspective

There are large differences in energy use between countries, both in use per capita and per type of energy. The differences are due to the countries' different conditions in terms of access to energy, economic development, infrastructure and climate. It is important that countries' energy needs can be met because it affects both global economic growth and national development. Imbalances in the relationship between supply and demand that occur anywhere in the world, impact the rest of the world's energy markets to a greater or lesser extent. Energy raw materials' price volatility also leads to the energy market being affected by speculations within the financial system.

Energy use continues to rise in the world

The economic disparities between regions of the world is clearly reflected in energy use per capita, see Figure 35.

Figure 35 World energy consumption per capita, by region, for 2012, kWh/capita



Source: IEA.

In the USA, the average inhabitant uses by far the most energy, followed by the inhabitants of Russia and the EU. However, these three regions have reduced their energy use per capita in 2012 compared to 1990, while other regions have increased their average energy use. As an increasing number of regions are moving towards a higher standard of living, it will require a greater energy output, not least in the form of fossil fuels that still dominate the world's energy use.

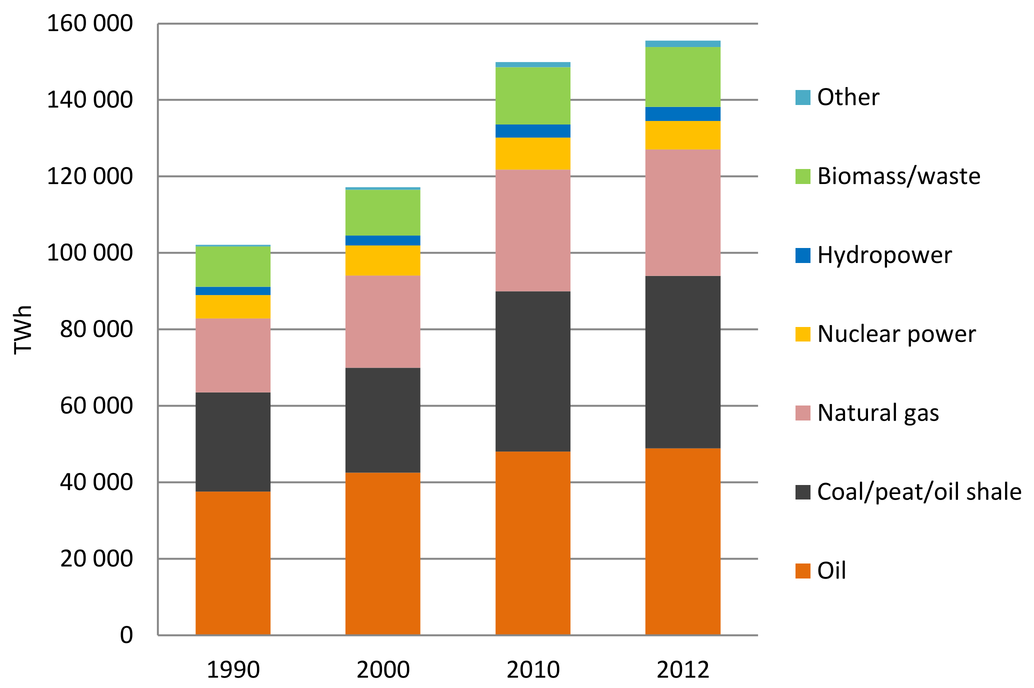
The total energy use in the world in 2012 was more than 104,000 TWh. If one compares the period 2010 to 2012 with the decade before, the average annual increase has slowed somewhat. During 2000 to 2010 the average increase was 2.1 per cent per year, while the increase during 2010 to 2012 corresponded to 1.4 per cent per year.

Energy use has increased globally by over 40 per cent between 1990 and 2012. However, the distribution between different user sectors has generally remained unchanged between 1990 and 2012. The transport sector, which is often described as the fastest growing sector, has during the 2000s remained relatively constant at around 28 per cent of the energy use. Energy use in the residential and service sector have in recent years experienced a slight downward trend and accounted for 35 per cent of the energy used in 2012. The industrial sector is increasing its use compared to the other sectors and is the largest user sector with 37 per cent of the use.

The world depend on fossil fuels

The global energy supply in 2012 amounted to just over 155,000 TWh, as shown in Figure 36.

Figure 36 World total primary energy supply, by fuel, 1990 – 2012, TWh



Source: IEA.

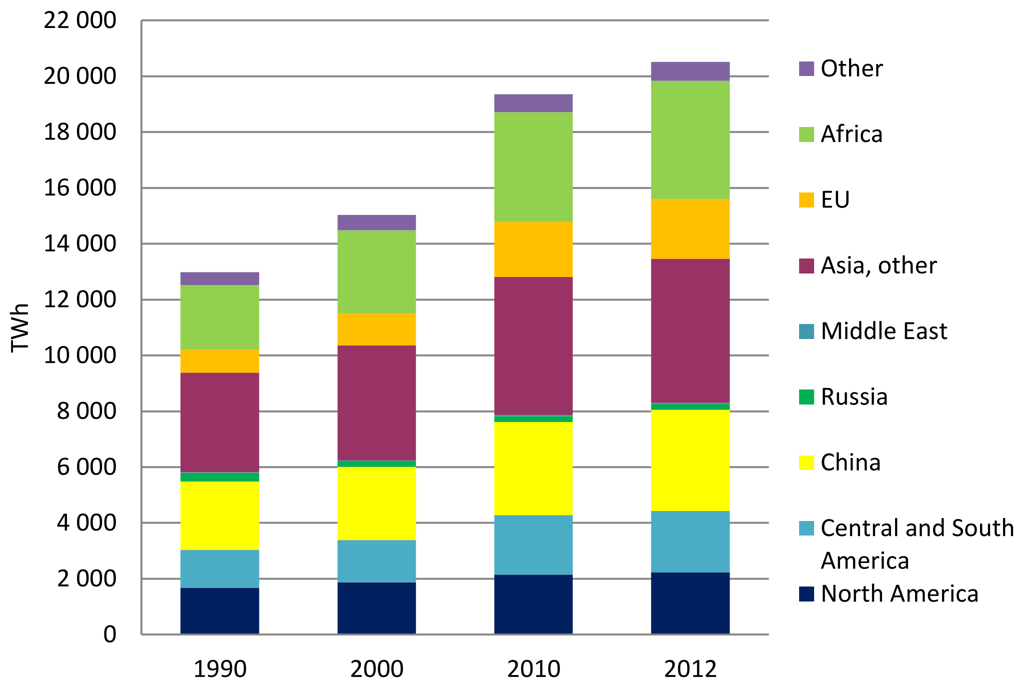
Fossil fuels represent over 81 per cent of the supply, where oil dominates with 31 per cent, followed by coal with 29 per cent and natural gas with 21 per cent. Renewable energy, including hydropower, has amounted to a share of over 13 per cent in the past ten-year period. In 2012, nuclear power accounted for 5 per cent of the energy supply, which is a decrease resulting primarily from the nuclear accident in Fukushima.

In 2012 there was a slowdown in the growth of the global energy supply, partly as a result of lower economic growth, but also due to individuals and companies having reacted to higher prices by becoming more efficient in their energy use. Growth in 2012 compared to 2011 was 1.8 per cent. In the OECD countries, however, the energy supply decreased by 1 per cent, while it increased by 4.2 per cent in non-OECD countries. It was mainly China and India that accounted for the increase in the global energy supply.

The global supply of renewable energy is increasing

In 2012, renewable energy accounted for 20,960 TWh or 13.5 per cent of the world's energy supply, see Figure 37.

Figure 37 World supply of renewable energy, by region, 1990 – 2012, TWh



Source: IEA.

The global supply of renewable continued to increase, but not to the extent that it significantly affected the renewable energy's overall share of the energy supply. Solar and wind power admittedly only accounted for about 1 per cent of global energy supply, but they accounted for the largest percentage increase between

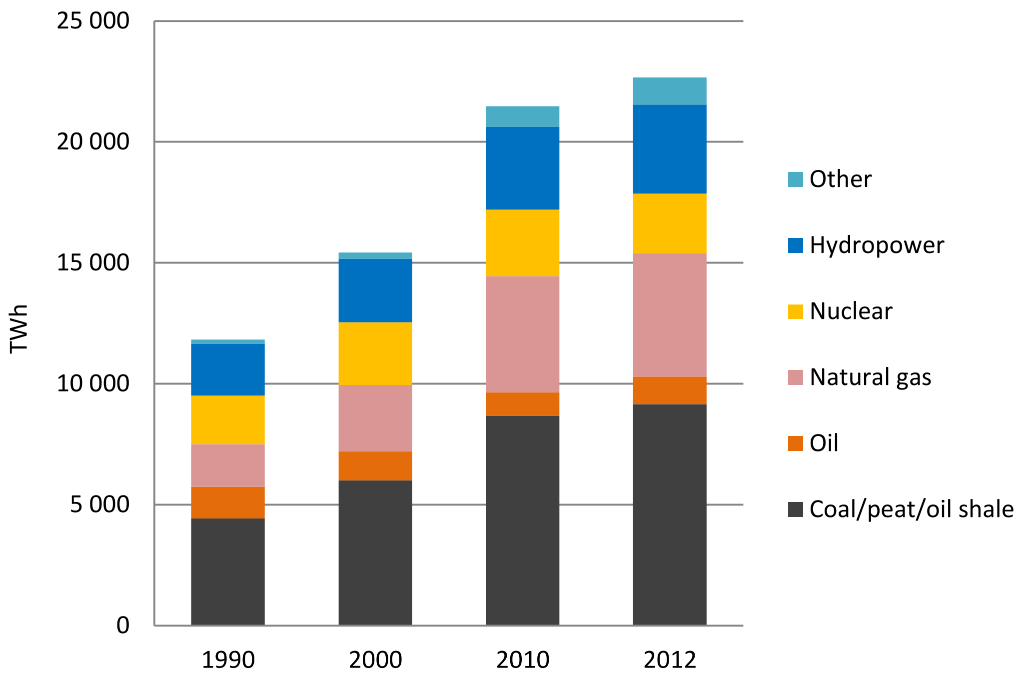
2011 and 2012, where photovoltaic cells increased by 56 per cent, solar heating by 19 per cent and wind power by 20 per cent.[76]

Renewables increased in all regions, though at different speeds. During the years 2010 to 2012, the EU had the highest annual increase with 4.5 per cent, followed by China with 4.1 per cent. In addition to economic factors, political decisions impact the development, where goals for greenhouse gas reductions and reduced reliance on fossil fuels are the main driving forces.

Fossil fuels dominate the global electricity production

The world's production of electricity amounted to over 22,000 TWh in 2012, see Figure 38.

Figure 38 World electricity generation, by energy source 1990 – 2012, TWh



Source: IEA.

Combustion of fossil fuels was still the most common way to produce electricity. Coal, peat and oil shale have increased their share of the global electricity mix and accounted for 40 per cent of the mix. The same applies to natural gas, while the importance of oil in the electricity mix has decreased slightly. After fossil fuels, hydropower and nuclear power were the most common energy sources for electricity generation. Electricity produced with biomass and wind power increased, but still accounted for only 5 per cent of the electricity mix.

[76] IEA, Energy Balances of non-OECD Countries – 2014 Edition.

Energy policy

In recent years, the EU's adopted objectives for 2020 and the EU's energy strategy for the period until 2030 have formed the basis for energy policy in Europe. Since autumn 2014, there are also adopted objectives for climate and energy policy for 2030. The objectives of the EU constitute the basis for the adopted energy and climate goals in Sweden. Through its work in the energy sector, the EU hopes to put Europe on the right track – towards a sustainable future in a low-carbon and energy-efficient economy.

Energy and climate goals within the EU

The goals set by the EU, with 2020 as a target year, entail the Union committing to reduce greenhouse gas emissions by 20 per cent, reduce energy consumption by 20 per cent through improved energy efficiency, that 20 per cent of energy will come from renewable sources and that the share of renewable energy in the transport sector will constitute at least 10 per cent of total fuel use.

By 2030 the EU also undertakes to reduce greenhouse gas emissions by 40 per cent compared to emissions in 1990, reduce energy consumption by 27 per cent through improved energy efficiency, and ensure that 27 per cent of energy comes from renewable sources.

Legislation is a means for the EU to reach the objectives established in the energy and climate field. EU targets for 2020 have been transformed into directives and regulations which have been incorporated into Swedish law. These include the Renewable Energy Directive, the Energy Efficiency Directive, the Energy Performance of Buildings Directive, the Ecodesign Directive and the Energy Labelling Directive.

The Swedish energy and climate goals

The overall goal of Swedish energy policy in the short and long term is to secure the supply of energy on competitive terms. Energy policy must create conditions for efficient and sustainable energy use and cost-effective energy provision with a low impact on health, the environment and climate.

Swedish energy policy is based on the legislation that has been adopted within the EU. The climate and energy goals adopted by the Swedish Parliament specify that:

- the proportion of renewable energy in 2020 shall be at least 50 per cent of the total energy use
- the proportion of renewable energy in the transport sector shall be at least 10 per cent in 2020

- the energy consumption shall be 20 per cent more efficient in 2020 compared to 2008 (a cross-sectoral goal of reduce energy intensity)
- the emissions of greenhouse gases in 2020 shall be 40 per cent lower than in 1990 (relates to activities not covered by the EU's system for emissions trading)

In addition, Sweden's long-term ambition is to have a vehicle fleet that is independent of fossil fuels by 2030.

According to the latest data for Kontrollstation 2015, Sweden is deemed to reach the national targets set for renewable energy, renewable energy in the transport sector and the target for greenhouse gas emissions (when taking into account investments in emission reductions in other countries).[77] The proportion of renewable energy amounted to 52 per cent in 2013 and it is estimated that the percentage will further increase slightly by 2020. The proportion of renewable energy in the transport sector amounted to 15 per cent in 2013. However, as regards the objective of a more efficient energy use, it is not certain that Sweden will reach the goal.[78] The goal is formulated as an intensity goal, which means that the energy supplied per unit of GDP at fixed prices must be at least 20 per cent lower in 2020 than in 2008. With the current policy measures, energy consumption is expected to be 19 per cent more efficient in 2020 than in 2008. Whether or not the goal is reached depends on the relationship between the GDP development and the energy supply, and there are uncertainties in the assumptions about how this will look in the future. For example, low GDP growth means that the target will be more difficult to reach. If, on the other hand, the energy supply decreases, which may be the case if nuclear reactors shut down prematurely, it may help to achieve this goal.

Learn more about monitoring the energy policy objectives in the Swedish Energy Agency's annual publication *Energy Indicators*.[79]

A secure energy supply is an important part of the energy policy

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 systems. The Swedish energy policy therefore aims to combine ecological sustainability with competitiveness and security of supply. In addition to the energy policy

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[77] Swedish Energy Agency and Swedish Environmental Protection Agency, ER 2014:17, Underlag till kontrollstation 2015 [Supporting data for Kontrollstation 2015].
[78] Swedish Energy Agency and Swedish Environmental Protection Agency, ER 2014:17, Underlag till kontrollstation 2015 [Supporting data for Kontrollstation 2015]. Swedish Energy Agency, ER 2015:15, Energiindikatorer – Uppföljning av Sveriges energipolitiska mål [Energy Indicators 2015 – Monitoring Sweden's energy policy objectives].
[79] Swedish Energy Agency, ER 2015:15, Energiindikatorer – Uppföljning av Sveriges energipolitiska mål [Energy Indicators 2015 – Monitoring Sweden's energy policy objectives].

objectives, there are policy goals within other areas with clear links to security of supply. For example, the objectives for emergency preparedness and security policy, various environmental objectives and goals linked to health and social security.

A prerequisite for a secure energy supply is well-functioning energy markets. Global events create the need for market mechanisms and other measures that can prevent and mitigate the effects of disruptions in the energy markets. In order for these mechanisms to work, there is cooperation at the international, national, regional and local level. These mechanisms, which interact with the scope of different energy markets, are part of society's emergency management system.

Energy is an important issue in the EU

There are extensive efforts underway in the EU regarding future energy and climate policy. Below is a summary of current activities.

Energy Union with a forward-looking climate change policy

When the present European Commission took office in autumn 2014, the idea of an Energy Union was raised as one of ten priority areas. The Energy Union shall aim to provide comprehensive support to, and accelerate the implementation of, the EU climate and energy policy, including the fulfilment of the objectives by 2020 and 2030.

In February 2015 the European Commission presented *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*,[80] where the Energy Union is proposed to include five areas:

- security of supply
- internal energy market
- energy efficiency
- reduced greenhouse gas emissions
- research, innovation and competition

Concrete measures and proposals for new initiatives and legislative proposals covering all five areas are planned in the coming years. The European Commission also plans to review current legislation within the area of energy efficiency and propose changes when necessary. In addition, the European Commission intends to propose a new package for renewable energy as well as a European strategy for research and innovation which also includes an updated strategic plan for energy technology and a strategic agenda for research and innovation for the transport area. In the area of climate change, the European

[80] European Commission, COM(2015) 80 final Energy Union Package. A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy.

Commission will propose legislation to achieve the EU targets for reducing greenhouse gases. Legislative proposals will cover both sectors within the EU emissions trading system and sectors outside this system, the so-called Effort Sharing Decision for the national goals.

In July 2015 the European Commission presented, as part of the Energy Union, a so-called summer package which consisted of several elements[81]: a new design for the electricity market, a proposal for developing the end-user market in the energy sector, a proposal for a regulation on the energy labelling of products, and proposals regarding the review of the EU emissions trading system. A public consultation on the security of electricity supply is proposed as a part of the work on a new electricity market design.

The EU and climate negotiations in Paris

As part of the Energy Union, and to prepare the EU in the negotiations prior to the Paris conference in December 2015, the European Commission presented *The Paris Protocol – A blueprint for tackling global climate change beyond 2020.*[82]

The climate negotiations in Paris are taking place within the framework of the United Nations Framework Convention on Climate Change (UNFCCC) and aim to establish consensus on a new legally binding agreement involving all parties. The idea is for the world's countries to agree on the basis for the new agreement in Paris in December 2015, and for the agreement to enter into force in 2020. More specific rules concerning the implementation will be determined in the years running up to 2020.

The European Commission's ambition is for the agreement to be legally binding and enter into force once it has been signed by the countries that together account for emissions totalling 40 gigatonnes of carbon dioxide equivalents (corresponding to around 80 per cent of global emissions in 2010).[83] Countries shall be encouraged to participate in climate finance, technology development and transfer, and capacity building. The European Commission also emphasises that the protocol must include requirements on the reduction of greenhouse gas emissions from all sectors, including aviation and shipping, and fluorinated gases.

The EU's contribution to the negotiations in Paris entails the Union's commitment to reduce the emissions of greenhouse gases by 40 per cent by 2030 compared with emissions in 1990. To achieve this overall objective, sectors covered by the

[81] European Commission - Press release Transforming Europe's energy system - Commission's energy summer package leads the way, http://europa.eu/rapid/press-release_IP-15-5358_sv.htm (retrieved on 24/09/2015).
[82] European Commission, COM(2015) 81 final Energy Union Package Communication The Paris Protocol – A blueprint for tackling global climate change beyond 2020.
[83] European Commission - Fact Sheet Questions and Answers on the European Commission Communication: The Paris Protocol – A blueprint for tackling global climate change beyond 2020, Brussels, 25 February 2015 http://europa.eu/rapid/press-release_MEMO-15-4487_sv.htm (retrieved on 24/09/2015).

EU emissions trading system must reduce their emissions by 43 per cent by 2030 compared to 2005, and sectors outside the EU ETS must reduce their emissions by 30 per cent.

The EU Emissions Trading System is important

The EU's system for trading emission allowances, called EU ETS (EU Emissions Trading System) is an important part of the Union's efforts to combat climate change. Carbon dioxide emissions from 13,000 facilities in the industrial and energy sectors are included in the system, which covers about 45 per cent of total EU greenhouse gas emissions. Apart from the EU's 28 member countries, the trading system also includes Norway, Liechtenstein and Iceland. Two trading periods have been conducted so far; the first between 2005 and 2007 and the second between 2008 and 2012. In January 2013 the trading system's third period began, and it will continue until 2020.

As from 2013, the main allocation of allowances to participants in the system is handled via auctioning. However, free allocation is still available for industries that are considered to be vulnerable to international competition. Flights and airlines that take off and land at airports within the EU are included in the system from 2012. For the years 2013 to 2016, in addition to flights within the EU, emissions from flights within other countries in the European Economic Area EEA (Norway, Iceland and Liechtenstein) are also covered by the system. There are exemptions for operators with low emissions.

In conjunction with the European Commission's presentation in January 2014 of a framework for climate and energy policy up until 2030, a reform of the EU's emissions trading system was proposed.[84] As part of this reform, a proposal was made for the establishment of a so-called market stability reserve.[85] Current imbalances in the trading system, in terms of supply and demand for emission allowances, have led to a huge surplus of allowances. The surplus is also expected to increase in coming years. The aim of the market stability reserve is manage the imbalances in the trading system and make the system more resilient to any future large-scale balance-disrupting events. In spring 2015, the Council of the European Union and the European Parliament reached an agreement in principle on the proposal.[86]

In 2015, as part of the summer package, the European Commission presented a proposal for changes to the legislation governing the EU emissions trading

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[84] European Commission, COM(2014) 15 final/2, A policy framework for climate and energy in the period from 2020 to 2030.

[85] European Commission, COM(2014) 20 Proposal for a DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC.

[86] Council of the European Union, http://www.consilium.europa.eu/sv/policies/climate-change/reform-eu-ets/ (retrieved on 04/06/2015).

system.[87] The proposal aims to ensure that the system remains the most effective way to reduce emissions. This will be achieved through measures such as stronger incentives for innovation, through guarantees given for the industry's competitiveness on international markets, and through the modernisation of the energy systems, especially in Member States with lower incomes. The revision is also expected to improve the internal energy market's function and provide better long-term price signals for investments.

Strategic investment plan for Europe

In late 2014 the European Commission presented an investment plan for Europe.[88] The plan is intended to complement national and regional initiatives to stimulate investment in support for jobs and growth. At the beginning of 2015, the plan was followed by a proposed regulation on the *European Fund for Strategic Investments* in Europe (EFSI).[89] Here, the European Commission proposed that EFSI shall support strategic investments and individual projects with, inter alia, the development of infrastructure as well as investments in education, research, development, ICT and innovation. Other priority areas include the expansion of renewable energy and energy efficiency, environmental infrastructure projects and urban development, or risk financing to small- and medium-sized enterprises.

A decision in the summer of 2015 now makes it possible for Swedish and others actors to apply for loans for their projects from the fund.

Long-term rules for Swedish energy provision

In March 2015, the Government appointed a parliamentary commission charged with developing a basis for a broad political agreement on the direction of the energy policy with a focus on 2025 and forward.[90] The Energy Commission is headed by Energy Minister Ibrahim Baylan and consists of eleven representatives from the parliamentary parties as well as the Directors General of the Swedish Energy Markets Inspectorate, Svenska kraftnät and the Swedish Energy Agency.

The Energy Commission's task is to review future energy needs based on current and existing research. The Commission will identify the challenges and opportunities that exist for future energy provision. Electricity supply is an important issue for Sweden's development and competitiveness, which is why the Commission has focused on electricity in particular.

[87] European Commission, COM (2015)337 final Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments.
[88] European Commission, COM (2014)903 final An Investment Plan for Europe
[89] European Commission, COM (2015)10 Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the European Fund for Strategic Investments and amending Regulations (EU) No 1291/2013 and (EU) No 1316/2013
[90] Swedish Government Official Reports, Energy Commission, 2015, www.energikommisionen.se, (retrieved on 27/08/015)

The Energy Commission's work is conducted in three phases:

- A knowledge-gathering phase focusing on fact-finding and the formulation of alternatives
- An analytical phase where the impact of various scenarios is studied and proposed amendments to the regulations are developed
- A negotiation phase in which the Commission agrees on the main points of a political agreement on energy policy for the period up to 2050

The work is also divided into the four focus areas; use, supply, transmission and market.

The Energy Commission shall report on its work no later than 1 January 2017.

Cross-sectoral instruments and inquiries

Policy instruments and inquiries of a cross-sectoral character are presented below. Instruments and inquiries relating to a specific sector or market are found in the respective section.

Energy audits of companies

To achieve the objectives of 20 per cent more efficient use of energy by 2020, there are varying types of initiatives within several sectors aimed at different target groups in society. Large aspects of the work with energy efficiency are governed by various EU directives such as the Energy Performance of Buildings Directive (EPBD2), the Energy Efficiency Directive, the Energy Labelling Directive and the Ecodesign Directive.

On 1 June 2014, the Act on Energy Audits in Large Enterprises entered into force.[91] The Act aims to promote improved energy efficiency in large enterprises. The Act is part of fulfilling the requirements that the EU Energy Efficiency Directive[92] imposes on Member States.

According to the Act, large companies have an obligation to conduct quality-assured energy audits at least every four years. The energy audit can provide answers to how much energy is annually supplied and used to run the business. It is to also include proposals for cost-effective measures that the company can take to reduce their costs, reduce energy consumption and thus improve energy efficiency.

During the introduction of the Act, the Swedish Energy Agency has developed a special process to enable enterprises to conduct an energy audit of the operations that yields good data for decision-making when implementing measures. The process is done in three steps, and the first step is for companies to submit a report

[91] The Act (2014:266) on Energy Audits in Large Enterprises.
[92] The Energy Efficiency Directive (Directive 2012/27/EU).

by 5 December 2015 on the activities covered by the Act and the parts of the business to be energy-audited.

As a result of the Government's revision of the Ordinance on state aid for energy audits,[93] which took effect on 1 January 2015, the Swedish Energy Agency has reviewed the regulations for the aid directed at small- and medium-sized enterprises. This includes companies with an energy consumption of 300 MWh per year and agricultural holdings with more than 100 animal units. The aid compensates 50 per cent of the energy audit's cost, but with a maximum of SEK 50,000. The Swedish Energy Agency has also taken decisions on new regulations applicable from 18 June 2015. These contain provisions on the energy audit's content, the information to be provided in the application for aid and in conjunction with the request for payment of aid, and the information to be provided prior to monitoring and evaluation of the aid.

During the period 2010 to 2014, all municipalities and county councils could apply for energy efficiency aid from the Swedish Energy Agency. The programme is finished and no new aid is planned. The energy efficiency aid involved financial aid equivalent to a half-time position, where the money could be used for strategic work with energy efficiency within the organisation receiving the support. The background to the support was the EU Energy Services Directive which states that the public sector should be a model for energy efficiency improvements.

Energy and climate advisory services

Energy and climate advisory services are conducted in Swedish municipalities. The focus of the advice is impartial, free and technology-neutral and addresses the following target groups: the general public, small- and medium-sized enterprises and organisations and associations. The purpose of the energy and climate advisory services has been to communicate locally and regionally adapted knowledge on energy efficiency, energy use and climate impact.

During autumn 2015, the Swedish Energy Agency's report *Review of the municipal energy and climate advisory services*[94] is being circulated for consultation. The report is a review of the energy and climate advisory services in order to develop the organisation and increase socioeconomic efficiency.

Sustainable Municipality

The Swedish Energy Agency's programme Sustainable Municipality was a collaboration between the Energy Agency and the 37 selected municipalities in Sweden that lasted from 2003 to 2014. Sustainable Municipality was one of many support initiatives provided to municipalities by the Energy Agency. Support for municipalities within the framework of Sustainable Municipality consisted of knowledge transferral, project funding for cooperation, and assistance with

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[93] Ordinance (2009:1577) on state aid for energy audits.
[94] Swedish Energy Agency, ER2015:14, Översyn av den kommunala energi- och klimatrådgivningen [Review of the municipal energy and climate advisory services].

structures for networking. The last phase of the programme ran between 2011 and 2014.

Modified aid for photovoltaic cells

Since 2009, state aid is available for the installation of photovoltaic cells. The aim of the aid is to contribute to the transformation of the electricity system and to industrial development within the field of energy technology. This support is available to all types of actors – companies, public organisations and private individuals. The maximum level of aid, as of 1 January 2015, is 30 per cent for companies and 20 per cent for other actors. The support is calculated on the basis of the installation costs. The highest possible aid amount per photovoltaic system is SEK 1.2 million, and the eligible costs may not exceed SEK 37,000.

For applications received before 1 January 2015, the previous support level applies, i.e., 35 per cent. Applications are processed in the order received by the County Administrative Boards. The support is framework-limited, which means that it can only be provided as long as the allocated funds are sufficient.

Tax reduction for microgeneration of renewable electricity

To make it easier for individuals and companies to invest in the production of electricity from renewable energy sources for their own consumption, micro-producers receive financial compensation for the excess electricity they feed into the grid.[95] As of 1 January 2015, the opportunity of a tax reduction is provided for the excess electricity fed from one's own production into the grid. The reduction is a financial compensation for the electricity that these producers often feed into the electricity system without compensation. It could also serve well as an encouragement for micro-producers, or as an incentive for electricity trading companies or network companies to provide micro-producers compensation for the renewable electricity they produce.

The tax reduction applies to those that produce renewable electricity, feed in renewable electricity and take out electricity at one and the same connection point, have a fuse of a maximum of 100 amps at the connection point and have reported their microgeneration to the network concession. The tax reduction is given to private individuals and businesses. The basis for this tax reduction consists of the kilowatt-hours of renewable electricity that have been fed into the connection point during the calendar year, though a maximum of the number of kilowatt-hours of electricity that have been taken out at the connection point during the year applies. The basis for the tax reduction cannot exceed

[95] Bill 2013/14:151, Tax reduction for microgeneration of renewable electricity.

30,000 kilowatt-hours per person or connection point. The tax reduction amounts to the basis multiplied by 0.6 SEK.[96]

Current energy taxes in 2015

Energy taxation is a collective term for excise duties on fuels and electricity. Energy, carbon dioxide and sulphur taxes are regulated in the Energy Tax Act (1994:1776). Energy tax is paid on the majority of fuels and is based on the energy content, among other things. Carbon dioxide tax is paid per emission of one kilo of carbon dioxide on all fuels except biomass and peat. Sulphur tax amounts to SEK 30 per kilo of sulphur emission on coal and peat, and SEK 27 per cubic metre for each tenth of one per cent by weight of sulphur content in oil. Oil with a maximum of 0.05 per cent by weight of sulphur content is exempt from sulphur tax.

The established carbon dioxide and energy tax rates on fuels for 2015 are higher than 2014's tax rates. The rates for fuels will be 4.2 per cent higher in 2015 compared to 2014. The significant increase in rates is due to the inflation that was forecast for the conversion to the 2015 tax rates having been higher than the actual inflation for the same period. A VAT effect will come about if the price of fuel is changed correspondingly and if the purchaser is a private individual.

[96] Swedish Tax Agency, Tax reduction in the production of excess electricity from renewable sources, http://www.skatteverket.se/privat/fastigheterbostad/mikroproduktionavfornybarel/skattereduktionformikroproduktionavfornybarel.4.12815e4f14a62bc048f4220.html (retrieved on 24/06/2015).

Table 2 General energy and carbon dioxide taxes from 1 January 2015, excluding VAT

	Energy tax	CO_2 tax	Sulphur tax	Total tax	Tax öre/kWh
Fuels					
Fuel oil 1, SEK/m^3 (<0.05 % sulphur)	850	3,218	-	4,068	**40.9**
Fuel oil 5, SEK/m^3 (<0.4 % sulphur)	850	3,218	108	4,176	**39.5**
Coal, SEK/tonne (0.5 % sulphur)	646	2,800	150	3,596	**46.7**
LPG, SEK/tonne	1,048	3,385	-	4,477	**35.0**
Natural gas, SEK/1,000 m^3	939	2,409	-	3,348	**30.3**
Raw tall oil, SEK/m^3	4,068	-	-	4,068	**41.5**
Peat, SEK/tonne, 45 % moisture content (0.3 % sulphur)	-	-	50	50	**1.8**
Transport fuels					
Petrol, unleaded, environmental class 1, SEK/litre	3.25	2.60	-	5.85	**64.3**
Low-admixture ethanol, SEK/litre	0.36	-	-	0.36	**6.1**
Diesel, environmental class 1, SEK/litre	1.83	3.22	-	5.05	**51.5**
Low-admixture FAME, SEK/litre	1.69	-	-	1.69	**18.4**
High-admixture FAME, SEK/litre	1.03			1.03	**11.2**
Natural gas/methane, SEK/m^3	-	2.41	-	2.41	**21.8**
LPG, SEK/kg		3		3	**27**
Electricity use					
Electricity, northern Sweden, öre/kWh	19.4	-	-	19.4	**19.4**
Electricity, rest of Sweden, öre/kWh	29.4	-	-	29.4	**29.4**
Electricity use, industrial processes, öre/kWh	0.5	-	-	0.5	**0.5**

The current Energy Taxation Directive[97] is outdated. In order to align energy taxation with the previously adopted EU measures in the climate and energy area, the Commission presented a proposal in April 2011 for a revised Energy Taxation Directive. The negotiations in the ECOFIN Council[98] are long and are still ongoing in 2015, with an unclear timetable for completion.

The Energy System beyond 2020

In 2013, the Swedish Energy Agency initiated an inquiry entitled The Energy System beyond 2020. The inquiry examines and describes potential development paths for the energy system beyond 2020 and up until 2050. The starting point for this work has been the vision of Sweden in 2050 having a sustainable and

[97] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.
[98] The ECOFIN Council is made up of all EU Member States' economics and finance ministers. Relevant European Commissioners also participate in meetings.

resource-efficient energy supply and zero net emissions of greenhouse gases in the atmosphere. In the initial phase, the inquiry has identified a number of critical issues linked to path choices and challenges for the energy system's long-term development. Five areas have been of particular interest: energy conservation, the power supply system, the transport sector, bio-energy and the role of various actors in the energy transition. The results are found in the publication *Path choices and challenges for the energy system beyond 2020.*[99]

The inquiry's second phase has focused on developing explorative scenarios that can show possible development paths for the energy system based on different strategic choices and priorities. The scenarios focus on the energy system's development beyond 2020 and up until 2050. The scenarios are analysed both from an economic perspective and from a sustainability perspective. The results of this have not yet been published as the inquiry is still in progress in 2015.

White certificates for more efficient energy use

White certificates is an collective term for a number of similar policy instruments, the common denominator being that they require that energy companies (suppliers or distributors) work under a specific obligation to actively promote energy efficiency among end users of energy.

In light of provisions in the Energy Efficiency Directive, the Swedish Energy Agency has investigated the need to introduce a compulsory quota system for energy efficiency (also called *white certificates*) and the economic consequences of such an instrument.[100] The assignment involved a knowledge update regarding white certificates, including experiences from other countries. One of the conclusions was that the effectiveness of white certificates may depend on the purpose and the planning of targets for energy efficiency to be achieved.

The inquiry suggests that, in Sweden, the potential for cost-effective energy efficiency is significantly greater within industry and business than within homes and buildings. This indicates that such a system would benefit from targeting industry if it were to be introduced.

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[99] Swedish Energy Agency, 2015, Vägval och utmaningar för energisystemet efter 2020 - ett underlag till Energimyndighetens utredning Energisystemet bortom 2020 [Path choices and challenges for the energy system beyond 2020 - a basis for the Swedish Energy Agency's inquiry The Energy System beyond 2020].

[100] Swedish Energy Agency, ER 2015:11, Aspekter på vita certifikat – mot bakgrund av nya förutsättningar och erfarenheter [Aspects of white certificates - in light of new circumstances and experiences].

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), calorie (cal) and British Thermal Unit (BTU) are common in international comparisons. Relationships between several different units of measurement are reported in Table 3.

Table 3 Conversion factors between energy units

	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 use prefixes. Table 4 shows these prefixes.

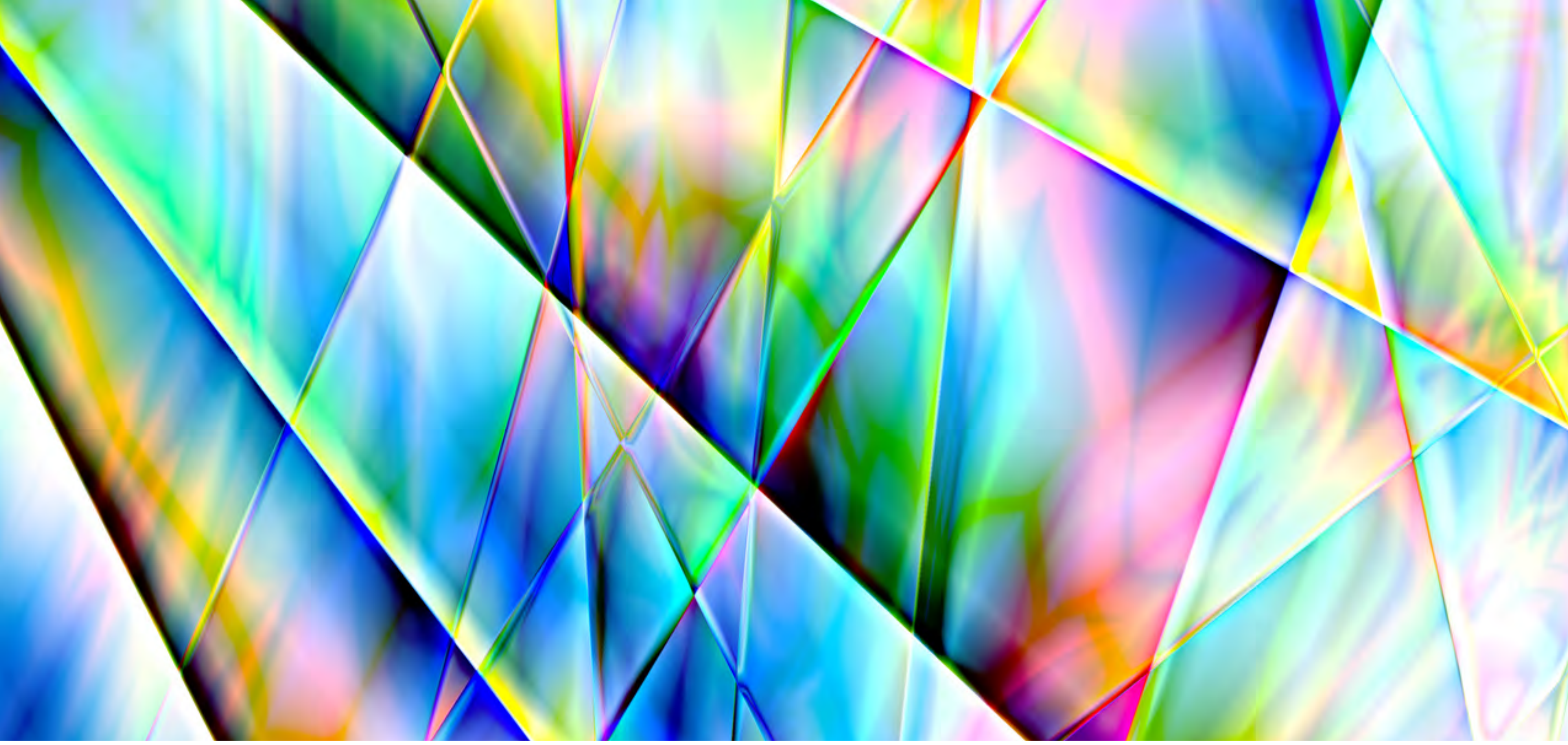
Table 4 Prefixes for energy units

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

Table 5 Recalculation factors for effective thermal values

Fuel	Physical quantity	MWh	GJ
Wood chips, bark, sawdust	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	10.07	36.3
Topped crude oil	1 m^3	11.1	40.1
Petroleum coke	1 tonne	9.67	34.8
Asphalt (bitumen)	1 tonne	11.4	41.0
Lubricating oils	1 tonne	11.5	41.4
Motor gasoline	1 m^3	9.10	32.6
Aviation gasoline	1 m^3	8.67	32.8
Light virgin naphtha	1 tonne	7.91	28.5
White spirit	1 m^3	9.34	33.6
Aviation kerosene and other intermediate oils	1 tonne	9.60	34.6
Other kerosene	1 m^3	9.54	34.3
Diesel and fuel oil 1	1 m^3	9.95	35.8
Heavy fuel oils	1 m^3	10.58	38.1
Propane and butane	1 tonne	12.8	46.1
Gasworks gas	1,000 m^3	5.8	20.9
Coke-oven gas	1,000 m^3	4.65	16.7
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
E85	1 m^3	6.59	23.7
HVO	1 m^3	9.44	34.0
CNG	1,000 m^3	10.16	36.6



A sustainable energy system benefits society

The Swedish Energy Agency works for a sustainable energy system, combining ecological sustainability, competitiveness and security of supply. The Agency also provides energy system analysis, energy forecasts and 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 2015 consists of *Energy in Sweden – Facts and Figures.* The original Swedish title of these publications is *Energiläget*.

Download or order publications from the Swedish Energy Agency's online shop at www.energimyndigheten.se

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