Publication Year 2012

Energy in Sweden 2012

Contents

Preface

The Swedish Energy Agency's main duty is to assist the evolution of Sweden's energy system into a reliable, ecologically and economically sustainable system. The Agency is also responsible for the collection, processing and publication of official statistics in the energy field.

The annual Energy in Sweden report, and its sister publication, Energy in Sweden – Facts and Figures (downloadable from the Agency's web site), are intended to provide decision makers, journalists, businesses, teachers and the public with coherent and easily accessible information on developments in the energy sector. The report also provides an overview of Sweden's current energy and climate policy, policy measures, the use and supply of energy, energy prices and energy markets, together with information on the effects of the energy system on the environment.

Starting with Energy in Sweden 2012, the structure and layout of the report has been revised, to produce a shorter report than in previous years. It is the intention that this shorter format should be published in alternate years, alternating with a longer version.

The new structure means that the division into chapters has been changed. The presentation of energy use is now divided up into chapters in the respective sections for the three sectors of residential and services, industry and transport. The presentation of energy supply is divided into two chapters: Primary Energy Carriers and Secondary Energy Carriers.

The statistics which provide the foundation for the publication are based mainly on official statistics up to and including 2010, complemented where possible by input reflecting current events and decisions up to the summer of 2011. The Agency's annual publication, Energy Indicators, complements this Energy in Sweden report with details of a number of indicators for monitoring the progress towards energy policy objects.

The project manager for preparation of the report has been Brita Lundkvist, with assistant project manager Tobias Persson. In addition, Lars Nilsson, Annika Pers Gustafsson, Ellen Svensson, Anders Dahlberg, Mikaela Sahlin, Daniel Friberg, Anna Andersson, Daniel Andersson, Charlotte Anners and Linn Marjamäki have assisted in the work of producing the report.

Eskilstuna, October 2012

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Sweden in the world

World energy use has increased enormously over the last century, driven by a rising population, industrialisation and economic growth. Nevertheless, there are major differences in energy use between countries: per capita energy use in China, for example, is three times greater than that in Kenya.

A Swede, in turn, uses almost three times as much energy as does a Chinese. With today's technology, the situation would be totally unsustainable if the entire world population used as much energy as we do in Sweden. But what do we use this energy for? And what technologies are used to meet the demand? How effective are Sweden's energy policies in attempting to mould the country's energy system into one that is environmentally sustainable, guarantees a secure supply and supports economic competitiveness? These are questions that are dealt with in this publication.

Swedish energy policy

Swedish energy policy is based on the creation of properly operating and undistorted markets. Correctly priced, the necessary conditions for competitiveness, security of supply and ecologic sustainability should all be capable of coexistence. Responding to these conditions, energy prices can support investment in production facilities having minimum environmental impact and create the right conditions for phasing out the most polluting forms of production.

Removing market failures

If a market is to operate smoothly, it needs to be able to isolate and remove market failures. An example of a market failure is that which occurs when the environmental impact of obtaining, upgrading, conversion and distribution of energy raw materials is not fully included in the price of the energy produced. By introducing policy measures such as the carbon dioxide tax, which has existed in Sweden since 1991, it is possible to include the additional cost. However, not all energy use is exposed to the same degree of competition. As a result, domestic users pay about 20 times higher carbon dioxide tax than does industry. If domestic users paid carbon dioxide tax at the same rate as does industry, there would be many fewer emission reduction measures that would be economically viable for them. If, on the other hand, industry paid carbon dioxide tax at the domestic rate, it could do much more to reduce its use of energy. However, a carbon dioxide tax can result in industries becoming uncompetitive unless other countries have a similar tax.

Other market failures can be those of ineffective competition or distorted information. Information related failures can be divided into two types. In the one, not all information is available to all parties. An example of this occurs when the manufacturer of a product knows how much energy it requires, while the purchaser does not have this information. This situation justifies rules for clearly marking the energy requirement of the products themselves. The second form of information failure is concerned with the fact that knowledge is collective in its nature. Knowledge that is distributed more or less unrestrictedly (e.g. the results of research through publication in scientific journals) tends to be produced on too small a scale on an unregulated market, as it is difficult to recover the cost of obtaining this knowledge. This aspect therefore requires various forms of public response, such as measures to support information, innovation, research and demonstration activities.

Energy policy harmonised within the EU

Sweden is committed to complying with EU legislation, i.e. the treaties (primary legislation) and the legal instruments (secondary legislation) as decided by the EU on the basis of the treaties. Within the energy sector there are several legal instruments in the form of directives that have been incorporated in Swedish law. Several of these directives are based on binding targets to be achieved by 2020. The EU Commission has started work on drafting energy policy up to 2050. The road map for a low carbon dioxide society presents the vision of an EU that has reduced its emissions of greenhouse gases by over 80 % by 2050 without adversely affecting the supply of energy or damaging competitiveness.

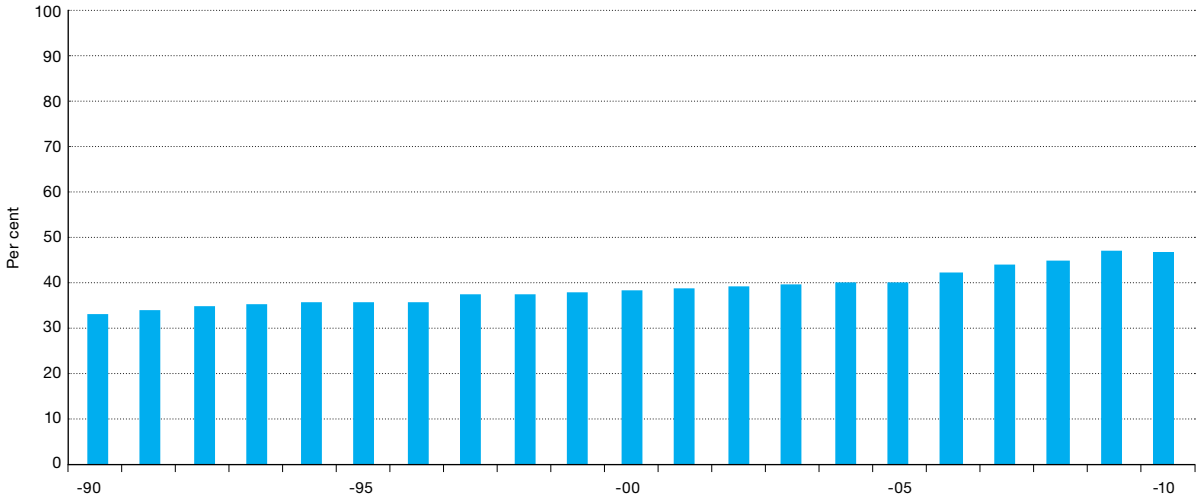
Renewable energy

The Renewables Directive (2009/28/EC) requires 20 % of all energy used in the EU to be supplied from renewable sources by 2020. The Directive also sets out targets for country by country achievement of this target which, for Sweden, requires the country to be meeting 49 % of its energy requirement from renewable sources. Sweden has further raised this target to providing at least 50 % of its final energy use from renewable sources.

In 1990, 33 % of Sweden's energy was coming from renewable sources, and has since then increased to 48 % in 2010. Much of this increase is due to greater use of biofuels, particularly for the production of electricity and heat, and by the forest industry. Recent years have also seen an increase in the use of heat pumps, in turn contributing to a greater proportion of energy from renewable sources.

In the transport sector, by not later than 2020, the proportion of renewable energy used at EU level shall make up at least 10 % of the total demand for motor fuels. Sweden's target for renewable energy in this sector is the same as that of the EU. In addition, the country has a long term aim of the country's vehicle stock being independent of fossil fuels by 2030.

Figure 1 Proportion of energy use in Sweden from renewable sources, 1990–2010



Source: Swedish Energy Agency and Eurostat.
Note: Calculations in accordance with the Renewables Directive. Data for 2005–2009 differs from that for earlier years.

1 Road map for a Competitive Low-Emissions Society, 2050 (KOM[2011] 112 final).

Climate

The EU's common climate policy is based on an interpretation of the Climate Commission' requirement that emissions must be limited to a level that is not dangerous. The EU has assessed that the consequences to the climate will be dangerous if global heating amounts to a temperature rise of two degrees above the pre industrial level.

In 2009, the Council of the European Union decided that greenhouse gas emissions must be reduced by 20 % in 2020, in comparison with the quantity in 1990. The Emissions Trading Directive (2003/87/EC) was also revised, with Sweden being given a target for its emissions from activities not covered by the emissions trading scheme to be reduced by 40 % relative to 1990 emission levels. Finally, the year also saw the introduction of the Carbon Capture and Storage Directive (2009/31/EC).

The companies covered by the emissions trading scheme are energy intensive industries, together with electricity and heat producers. In addition to them, other companies, individual persons and organisations may also participate in the scheme. All those covered by it are required to hold emissions rights units corresponding to their actual verified quantity of carbon dioxide emissions during the year. One emission right unit is equivalent to one tonne of carbon dioxide.

Starting in 2013, the bulk of allocations of emission rights to participants will be by auction, although free allocation will remain for those industries regarded as being exposed to international competition. Airlines and aircraft operators flying from or to airports within the EU will be brought within the remit of the scheme with effect from 2012. Over the period 2008 – 2012, Sweden has allocated emission rights to existing businesses on the basis of a national allocation plan that has been examined and approved by the EU Commission. Together, the various member states' allocation plans form the common ceiling for allocation of emission rights. The aim of the energy efficiency improvement policy is that the use of energy in 2020 should be 20 % less than what it would have been in 2008 if no measures had been taken.

The aim of energy efficiency improvement policy is that energy use in 2020 shall have been reduced by 20 % relative to the value in 2008 if no improvements are made.

Energy efficiency improvement

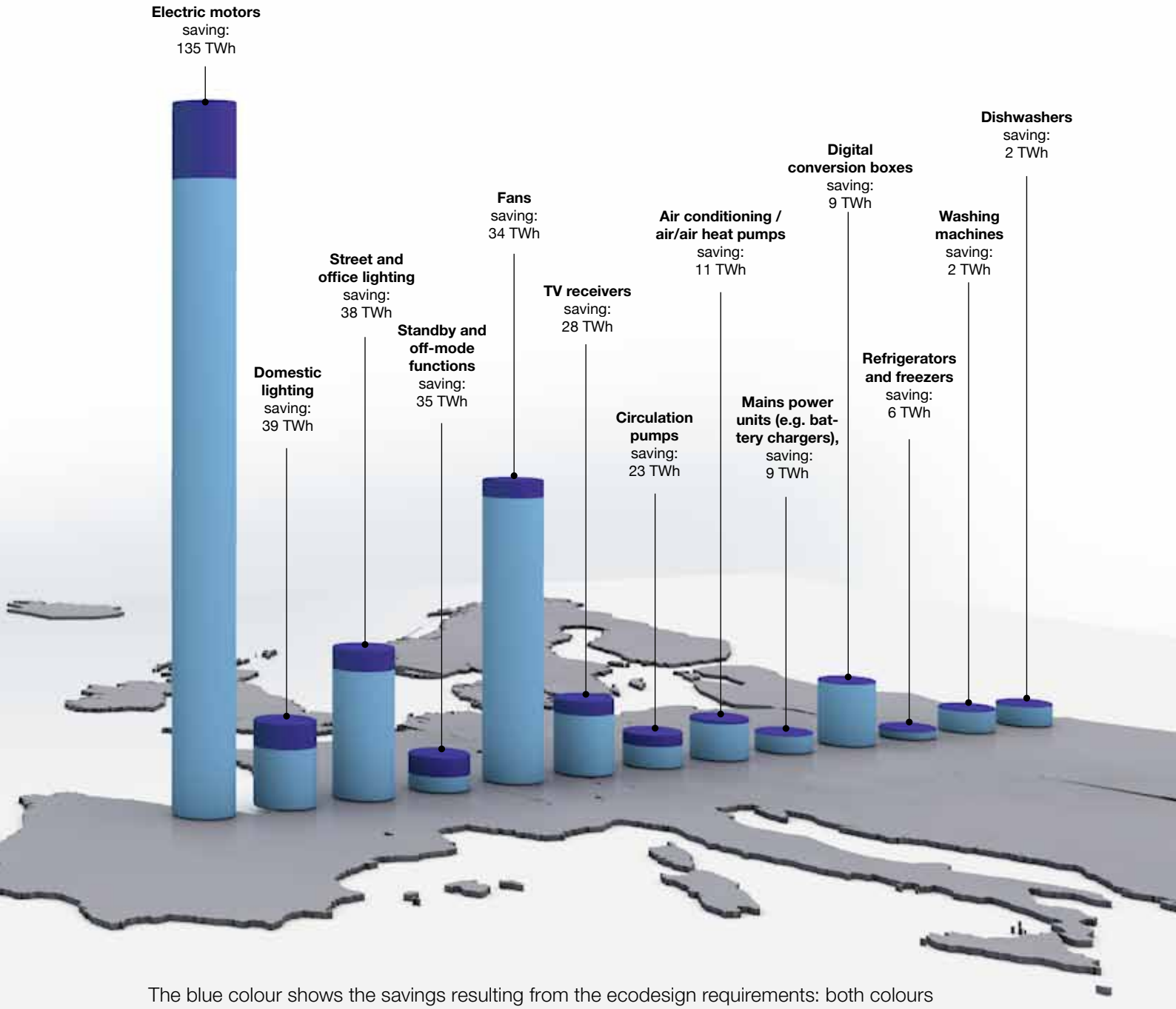
Several legal instruments apply to the energy efficiency improvement area. The aim of energy efficiency improvement policy is that energy use in 2020 shall have been reduced by 20 % relative to the value in 2008 if no improvements are made. This objective is not binding, and on 15th June 2012 the member states agreed on a new directive that will require only a 17 % improvement in the efficiency of energy use by 2020. The new energy efficiency improvement directive will increase the rate of improvement through the application of measures applying to industry, the public sector, domestic users and energy utilities. It will replace two older directives: the Energy Services Directive (2006/32/EC) and the CHP Directive (2004/8/EC).

Several new requirements set by the Ecodesign Directive (2009/125/EC) and the Energy Labelling Directive (2010/30/EU) have come into force. Energy labelling requires products to be labelled to show their energy use, performance, noise and other factors, to help the consumer when purchasing new products. Energy labelling applies to nine product groups.

Ecodesign requirements apply today to 13 product groups, including TV receivers, electric motors and dishwashers. The requirements cover the product's entire life cycle, with specified efficiency levels. Most of the ecodesign requirements are being introduced on a progressive basis, and will be gradually raised over time. Products that do not meet the requirements may not be sold anywhere on the EU single market. Requirements for a further 31 product groups are being developed.

The EU Commission hopes that more ecodesign and energy labelling requirements will be agreed, which would result in a potential energy saving of 5 % within the EU by 2020. The Commission calculates that the ecodesign and energy labelling requirements so far agreed will be saving 383 TWh per year within the EU by 2020. The diagram below shows the potential savings for the product groups.

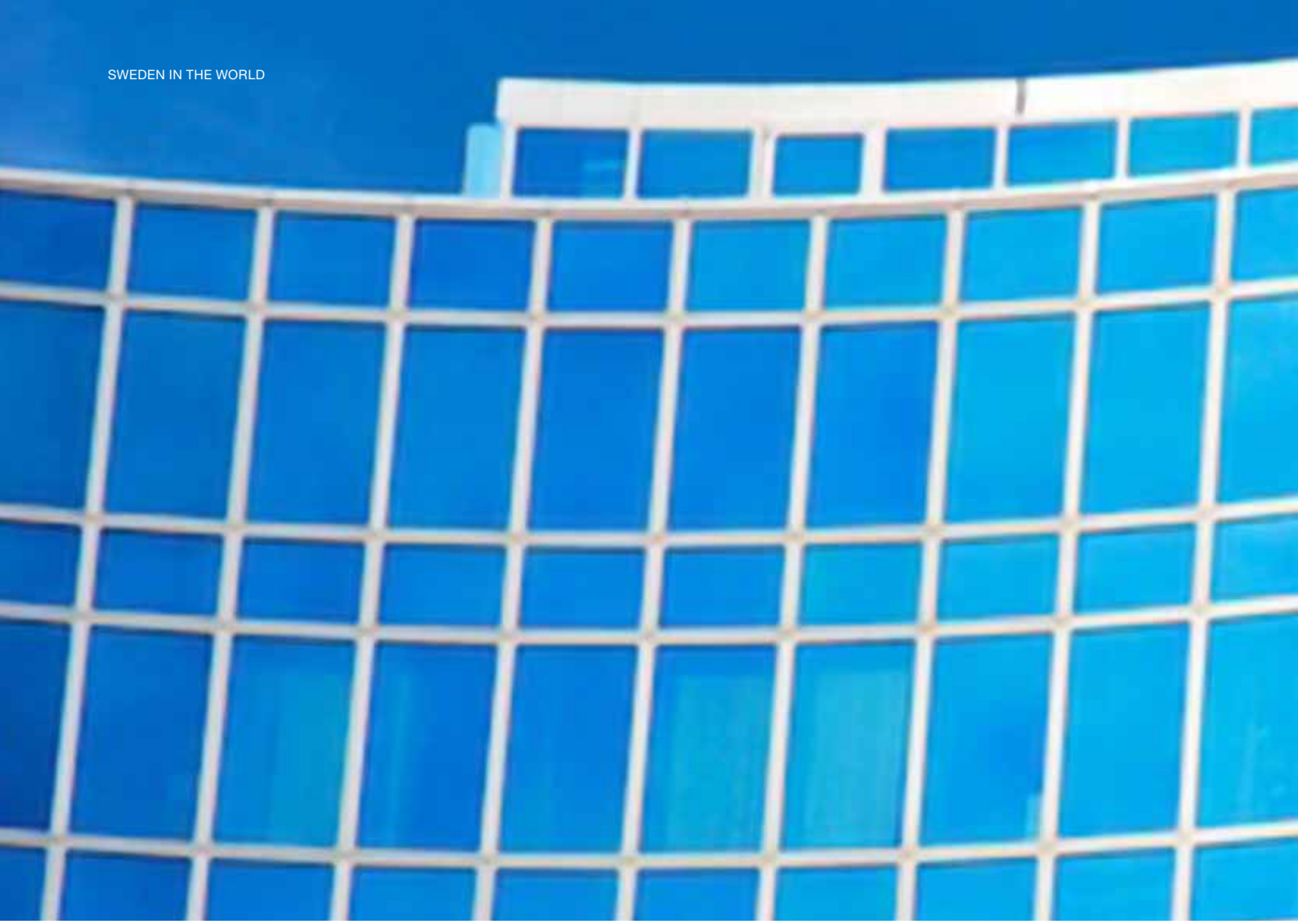
The Energy Performance of Buildings Directive (2010/31/EU) requires member states to introduce minimum requirements for buildings' energy performance in order to achieve an optimum cost balance. These requirements apply for new construction, and should also apply for extensive renovation work on existing buildings. The Directive also requires that, with effect from 31st December 2020, all new buildings must be of Near Zero Energy (NZE) type.



The blue colour shows the savings resulting from the ecodesign requirements: both colours together show what the electricity use would be in 2020 if the products continue without the effects of the legislation.

Electricity use would then have been as follows:

- electric motors 1252 TWh,
- domestic lighting 135 TWh,
- street and office lighting 260 TWh,
- standby and off-mode functions 49 TWh,
- fans 560 TWh,
- dishwashers 35 TWh,
- TV receivers 132 TWh,
- circulation pumps 55 TWh,
- air-conditioning/air/air heat pumps 73 TWh,
- mains power units (e.g. battery chargers) 31 TWh,
- digital conversion boxes 14 TWh (in process of disappearing, and therefore calculated only for 2014),
- refrigerators and freezers 122 TWh and,
- washing machines 38 TWh.



Internal energy markets and security of supply

The first directives for electricity and natural gas were adopted at the end of the 1990s, with the aim of opening up these markets for competition. The later directives, from 2003, introduced a requirement for production and transmission of electricity and of natural gas to be separated. The effect of these directives is that, at least in theory, customers will be able to choose their suppliers on a competitive market.

The third directive for the electricity market (2009/72/EC) and the natural gas market (2009/73/EC) created conditions for better insight and thus competition on the markets. Customers must be able to change their electricity or gas suppliers within three weeks, to receive a final bill by not later than six weeks after the change of supplier, and be able to obtain all relevant data concerning their consumption of gas or electricity. The directives, known as the Third Liberalisation Package, established the Agency for the Cooperation of Energy Regulators (ACER), with its main emphasis on transmission. Obligatory mergers for system operators were also introduced – the (European

Network of Transmission System Operators) ENTSO-E (for electricity) and ENTSO-G (for gas) - the duties of which include publication of a ten year network development plan every second year.

EU Regulation no. 994/2010 concerns measures to safeguard the security of natural gas supply. Its purpose is to ensure a properly operating internal market for natural gas by making it possible to take emergency measures during situations in which the market can no longer deliver its normal supply, and by deciding and allocating responsibility between companies, member states and the EU.

Security of supply of oil products is covered by the Oil Storage Directive, which requires member states to maintain minimum stocks of crude oil and/or petroleum products. Similar requirements are included in the IEP agreement (International Energy Programme), an agreement between 26 states requiring each member state to hold oil stocks equivalent to 90 days' net importation. Council Directive 2009/119/EC requires member states to take steps to provide authorised authorities with rights concerning release from storage, allocation to consumers, price control and rationing.

Legislation and regulations

Legislation, regulations and rules establish and control energy markets and remove market failures. The following legislation is of relevance and importance for the energy sector:

The Electricity Act (1997:857)

Specifies requirements for electrical installations, for trading in electricity in certain cases, and for electrical safety. The main emphasis of the Act is on network matters.

The District Heating Act (2008:263)

Specifies requirements for the distribution of district heating, price information and model forms of contract.

The Solid Fuels Act (1981:599)

Requires combustion plant to be so designed or installed that it can be operated with solid fuels and then maintained in this mode of operation for as long as it is in use.

The Act (1984:1049) Concerning Strategic Storage of Oil and Coal

Specifies requirements for sellers and users to maintain strategic stocks of fuels in order to ensure a supply of oil and coal within the country for energy supply during a state of war or other serious supply crises.

The Act (2011:710) Concerning Certification of Grid Distribution Companies for Electricity

Prescribes requirements concerning certification of high voltage grid operating companies.

The Act (2011:1200) Concerning Electricity Certificates

Specifies that producers of renewable electricity shall be entitled to receive an allocation of electricity certificates from the state, together with a requirement for electricity suppliers and certain electricity users to hold the requisite number of certificates in relation to their sales or use of electricity, known as their quota obligation.

The Act (2006:985) Concerning Energy Declarations for Buildings

Prescribes requirements intended to support efficient use of energy and good indoor climate conditions in buildings.

The Act (1992:1537) Concerning Financing of Future Expenditure for Spent Nuclear Fuels etc.

Prescribes that fees shall be paid to finance the management and disposal of spent nuclear fuels and other radioactive waste from nuclear reactors, as well as certain other costs specified in this Act, and in accordance with the Act (1984:3) Concerning Nuclear Activities. Security shall be provided against additional costs not covered by the funding from fees.

The Act (2011:598) Concerning Sustainability Criteria for Biobased Motor Fuels and Liquid Biofuels

Prescribes criteria that must be fulfilled by biobased motor fuels and liquid biofuels if energy from these biofuels is to be regarded as renewable and eligible for support.

The Act (1997:439) Concerning Local Authority Energy Planning

Prescribes that regional local authorities must support energy conservation in their planning, and act such as to ensure safe and adequate supplies of energy.

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

Prescribes that end users of energy related products must be provided with information concerning the products' use of energy and of other important resources.

The Act (2004:1196) Concerning a Programme for Energy Efficiency Improvement

Enables energy intensive companies to participate in five year energy efficiency improvement programmes in exchange for exemption from the energy tax on electricity in accordance with the requirements of the Act (1994:1776) Concerning Taxation of Energy. This Act will cease to apply at the end of 2012.

The Act (1994:1776) Concerning Taxation of Energy

Prescribes taxation of fuels and electric power.

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

Complements EU Regulation no. 994/2010 Concerning the Secure Supply of Natural Gas.

The Act (2010:601) Concerning Guarantees of Origin for High efficiency Production of Electricity in CHP Plants and of Renewable Electricity

Prescribes that the producer of electricity from renewable energy sources or by high efficiency CHP production shall be entitled to receive a document concerning this from a competent public authority.

The Act (1985:620) Concerning Certain Peat Bogs

Specifies the requirements that must be fulfilled in order to receive a concession for investigation and working of peat bogs in order to provide energy.

Environmental Framework Code (1998:808)

The requirements in this code aim to support sustainable development such that present and future generations are assured a good and healthy environment. Such development is based on the realisation that nature is worth protecting and that the right of humans to modify and use nature is combined with a responsibility to manage nature in the best possible way. The Environmental Framework Code shall be applied such that reuse and recovery of materials and energy, together with other conservation and use of energy, are supported in such a way as to form a closed circuit.

The Natural Gas Act (2005:403)

Specifies requirements applicable to natural gas mains, storage facilities and gasification plants, together with the requirements applicable to trading with natural gas in certain cases.

The Oil Crisis Act (1975:197)

Prescribes how Sweden shall ensure compliance with its undertakings in the International Energy Programme (IEP) concerning oil storage.

The Planning and Building Act (2010:900)

Prescribes requirements concerning planning of land and water use and of construction.

The Act Concerning Price Regulation (1989:978)

Prescribes price regulation that can be applied during a state of war for goods and services supplied against payment.

The Act (1978:268) Concerning Rationing

Specifies the Government's powers to employ rationing in the event of a state of war.

Energy use in the residential and services sector

Energy use in the residential and services sector in 2011 amounted to 147 TWh, which is equivalent to 40 % of Sweden's final energy use. Energy use in the sector fell between 2000 and 2009, followed by a substantial increase in 2010 that was due mainly to the cold weather. Increasing fuel costs, coupled with rising taxes on energy, have resulted in domestic energy prices rising throughout the 2000s.

The residential and services sector consists of residential premises and commercial premises (excluding industrial premises), land use and other service activities. Land use includes agriculture, forestry, market gardening and fisheries: other service activities include the construction sector, street lighting, sewage treatment plants, electricity and waterworks.

Policy measures for energy use in the residential and services sector

Within the residential and services sector, it is energy used by residential buildings and services premises that constitutes the greatest part. For this reason, this section, which describes policy measures applied to this sector, concentrates on those policy measures that apply for residential buildings and commercial premises. In addition to carbon dioxide taxation and energy taxes, various policy measures are intended to influence energy use in the sector. Some of the most important are the Building Regulations, the Energy Performance of Buildings Directive, the Ecodesign Directive, the Energy Labelling Directive, energy declarations for buildings, and the rebuilding and conversion tax exemptions.

ON ENERGY USE IN THE RESIDENTIAL AND SERVICES SECTOR

Almost 60 % of energy use in the sector is used for space heating and domestic hot water production. As this is affected by temperature conditions, there can be relatively substantial variations in energy demand from year to year. A cold winter increases the energy demand for heating, and vice versa. To be able to compare energy use from one year to another, regardless of the ambient temperatures, it is necessary to correct for climatic conditions in order to arrive at a statistically average year in terms of the climatic conditions. 2011 was about 13 % warmer than a statistically average year, which therefore meant that the equivalent corrected energy use for 2011 was 157 TWh, as against the actual use of 147 TWh.

2 More product groups covered by the Ecodesign Directive can be found on the Agency's website at: http://www.energimyndigheten.se/sv/Foretag/Ekodesign/Produktgrupper1.

EU directives

The directives that have the most effect on energy use in buildings are:

- The Energy Performance in Buildings Directive (2010/31/EU), which sets minimum requirements for the energy performance of buildings and also requires the production of energy declarations for buildings. The directive also specifies that, with effect from 2020, all new buildings must be near zero energy buildings. However, it is at present unclear how near zero energy buildings will be defined in Sweden.

- The Ecodesign Directive (2009/125/EC), which controls the energy efficiency of a range of products. The directive has been embodied in Swedish legislation in the form of the Act (2008:112) Concerning Ecodesign. Statutory requirements for Ecodesign are published in the form of product specific EU regulations, which come into immediate force in all member states. Examples of products that must meet specified energy efficiency requirements if they are to be released on the European market include refrigerators, freezers, washing machines[2] and lighting. The directive therefore results in energy savings, as the least energy efficient products are banned from the market

- The Energy Labelling Directive (2010/30/EU), which specifies energy labelling that must be applied to products to indicate to consumers how energy efficient the product is. The directive has been embodied in Swedish legislation through the Act (2011:721) Concerning Labelling of Energy related Products. The purpose of the Directive is to enable consumers, when buying a product, easily to be able to see and consider the energy performance of the product. The products to be labelled are specified in product specific EU regulations, which come into immediate force in all member states. Examples of products to be marked include washing machines and TV receivers.

Energy conservation requirements in the National Board of Housing, Building and Planning's Building Regulations

The Building Regulations apply to the design and construction of new buildings, and also to conversions of existing buildings. Buildings shall be so designed and constructed that their energy use is restricted through low heat losses, low cooling requirements, efficient use of heating and cooling and efficient use of electricity.

The Building Regulations specify requirements in respect of:

- the building's energy use,
- the building's thermal insulation,
- heating, cooling and air conditioning/ventilation systems,
- efficient use of electricity,
- installation of metering systems for monitoring the energy use of the building.

The performance metric for specific energy use of a building is expressed in the form of the annual purchased energy quantity per square metre of floor area. Requirements are specified for residential and commercial premises, as well as for three different climate zones in the country. Requirements are stricter if the building is electrically heated.

Energy declarations to provide advice on improving energy efficiency

Since the beginning of 2009, apartment buildings and commercial premises have been required to have formal energy declarations in accordance with the Act (2006:985) Concerning Energy Declaration of Buildings. Declarations are required in respect of detached houses when sold or rented. Property owners are responsible for arranging for declarations to be prepared. Declarations are valid for ten years.

Declarations are prepared by an independent energy expert, who supplies the results for entry in the National Board of Housing, Building and Planning's energy declarations register. The details that are registered are information on the building's energy use, floor areas, services systems and suggestions for cost efficient energy conservation measures.

Rebuilding, conversion and extension work for energy conservation improvements

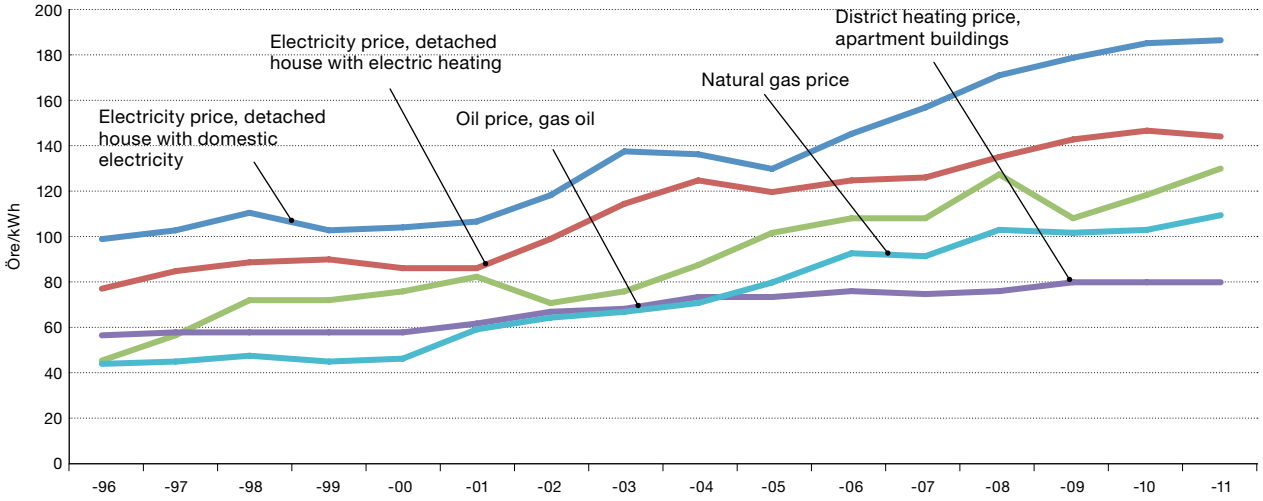
December 2008 saw the introduction of economic assistance in the form of tax relief for repair, maintenance, conversion and extension building work. The main purpose of tax relief for such work is to help to create jobs in the building industry, but it also helps to reduce energy consumption by classifying several energy saving measures as repair, maintenance, conversion or extension work, thus making them tax deductible. They include, for example, drilling for ground-source heat pumps, replacement of windows, and the installation of classical Swedish tiled stoves.

Grants for investment in solar heating, which were previously available to private persons, companies and public parties, were withdrawn at the end of 2011. However, private persons may still seek the tax relief for repair, maintenance and conversion/ extension work as described above.

Energy prices for domestic customers

Figure 2 shows that energy prices for domestic customers were relatively stable during the second half of the 1990s, before rising steeply throughout the 2000s. The main reasons for the rising prices for domestic customers are increased fuel prices and higher taxes on energy. The price of electricity in Sweden, excluding network charges, is determined by the Nordic Electricity Exchange, Nord Pool. Nord Pool sets a price, known as the spot price, for electricity on an hour by hour basis throughout the year. In the end, the spot price (which can vary widely from one year to another and within any given year) affects the price that domestic users pay for electricity. Read more about the electricity price market in the chapter on the electricity market on page 45.

Figure 2 Energy prices in the residential and service sector, 1996–2011



Source: Swedish Energy Agency and Statistics Sweden

Rising oil and district heating prices

The price of oil in Sweden follows the price pattern on the world market for crude oil, which has risen throughout most of the 2000s. One reason for the increased costs of oil for domestic consumers has been the shift towards green taxation, which has meant that taxation rates on electricity and fossil fuels have been gradually increased. To some extent, the price of natural gas tracks that of oil, which is due to the fact that natural gas contracts in Europe are often linked to changes in the price of oil.

The cost of district heating for apartment buildings

has increased every year during the 2000s. As district heating in Sweden is supplied by a large number of local district heating systems, operating under different conditions, there can be very wide differences in the price of district heating from one area to another, which means that it is difficult to pin down any general reasons for the rise in district heating prices. Increased fuel costs, of course, are a contributory cause. To some extent, the price of district heating is determined by the price of alternative methods of heating: this means, for example, that the price of district heating can rise if the price of electricity rises. Figure 2 is an attempt to show the general development of the price of district heating for apartment buildings in Sweden, and therefore does not show any details of local variations.

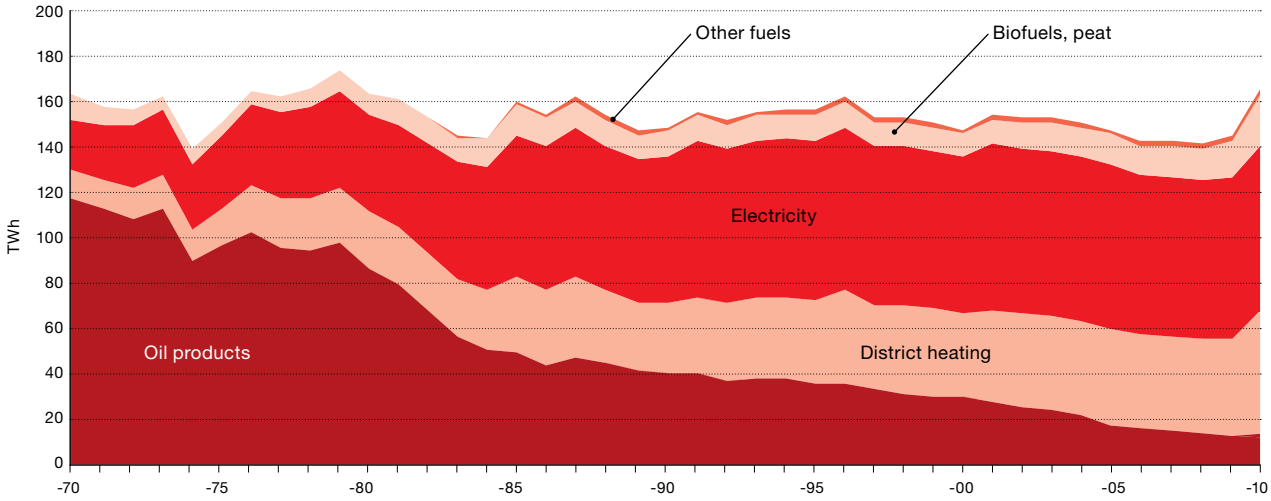
Biofuels, such as logs and pellets, are also important energy sources for domestic customers. The price of pellets, including taxes, for domestic customers in April 2012 was between SEK 2500–3000 per tonne in sacks, and between SEK 2200–2700 per tonne for bulk deliveries. These prices are equivalent to 55–65 öre per kWh for customers purchasing by the sack-load, at 48–58 öre per kWh for those buying in bulk. The price of pellets varies from one part of the country to another, and between different suppliers.

Electric heating, district heating and biofuels on the increase

Figure 3 shows how the shares of different energy carriers have changed with time. The availability of energy carriers and the application of various policy measures have affected the relative price ratios between energy carriers, resulting in a move away from oil to electricity, district heating and biofuels. It can be seen in the figure how energy use in the sector has fallen between 2000 and 2009, before increasing substantially in 2010. A contributory reason for this increase in energy use during 2010 was the cold weather.

IN 2011, FINAL ENERGY USE OF OIL PRODUCTS IN THIS SECTOR AMOUNTED TO 12 TWH, WHICH IS A 70 % REDUCTION ON CONSUMPTION IN 1990.

Figure 3 Final energy use in the residential and service sector, 1970–2010, TWh



Source: Swedish Energy Agency and Statistics Sweden.

The main reduction has been in the amount of energy supplied for space heating and domestic hot water production, which has been due to at least three reasons. For the first, oil has been replaced by electric heating or district heating, resulting in reduced losses in the residential and services sector, but increased losses in the conversion sector. Secondly, the number of heat pumps has increased. A heat pump supplies up to three times as much energy as is used for powering it. The use of heat pumps therefore helps to reduce the metered energy consumption for space heating and domestic hot water production in a building. The heat extracted from the surroundings and delivered by the heat pump is not included in calculation of the sector's total energy use. Thirdly, there is also the contribution of actual energy conservation measures, such as additional insulation and upgrading of windows in old buildings, which helps to reduce the overall use of energy.

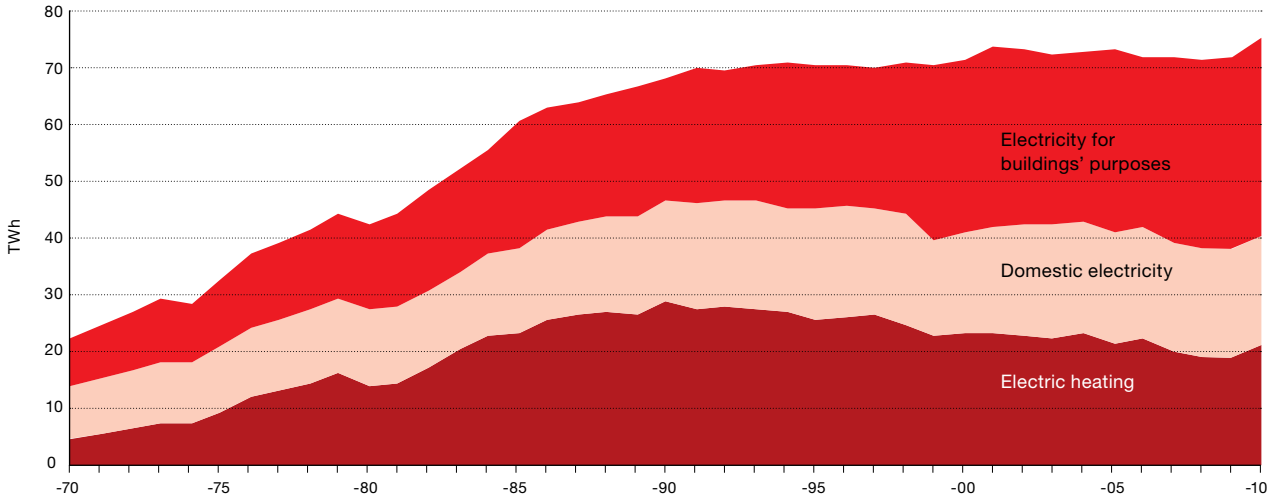
Stable use of electricity over the last ten years

Figure 4 shows the total temperature corrected use of electricity in the sector since 1970, broken down into domestic electricity, electricity for building purposes and electric heating. The use of electricity increased steadily from the 1970s until the middle of the 1990s, after which it has remained relatively stable at somewhat over 70 TWh.

Between 1970 and 2010, the use of domestic electricity increased from 9 TWh to 20 TWh. Most of this increase occurred during the 1970s and 1980s, and can be explained by an increasing number of households and greater numbers of domestic appliances. The use of domestic electricity has remained relatively constant since 2000. Use is affected by two opposing trends: on the one hand, we have the development towards more energy efficient apparatus, which should reduce the total use of energy, while on the other hand we have both an increasing number of household appliances and a growing number of functions on some items, which run counter to the efficiency improvement trend.

Electricity for building purposes, which is a statistical combination of electricity for building services systems and electricity for activities in non-residential buildings, accounts for a large proportion of the

Figure 4 Electricity use in the residential and service sector, 1970–2010, TWh



Source: Swedish Energy Agency and Statistics Sweden.
Note: Correction for statistically average climate year conditions has been applied, in accordance with the Swedish Energy Agency's method.

electricity used in the sector. The former is used for fixed equipment for climate control in a building, and for such applications as lifts, escalators and general lighting, while the latter is used for activities performed in the building, such as for computers, equipment and lighting. The combined use has increased from 8 TWh to 33 TWh between 1970 and 2010.

Since 2005, the Swedish Energy Agency has been conducting surveys of electricity use in different types of premises. A common feature found in all of them is that lighting and ventilation account for a substantial proportion of electricity use. The use of electricity for building purposes is affected by an increasing number of electrical products, which is outweighing the potential savings effect of increasing electrical efficiency of the products.

The use of electricity for heating in the sector increased from 5 TWh in 1970 to 29 TWh in 1990, reaching a peak at the beginning of the 1990s, and then falling. In 2010, 20 TWh of electricity were used for heating. Important reasons for the fall in the use of electric heating are the relatively high prices of electricity, together with the availability of conversion grants, which have given strong incentives to convert to alternatives in the forms of heat pumps, district heating or pellets.

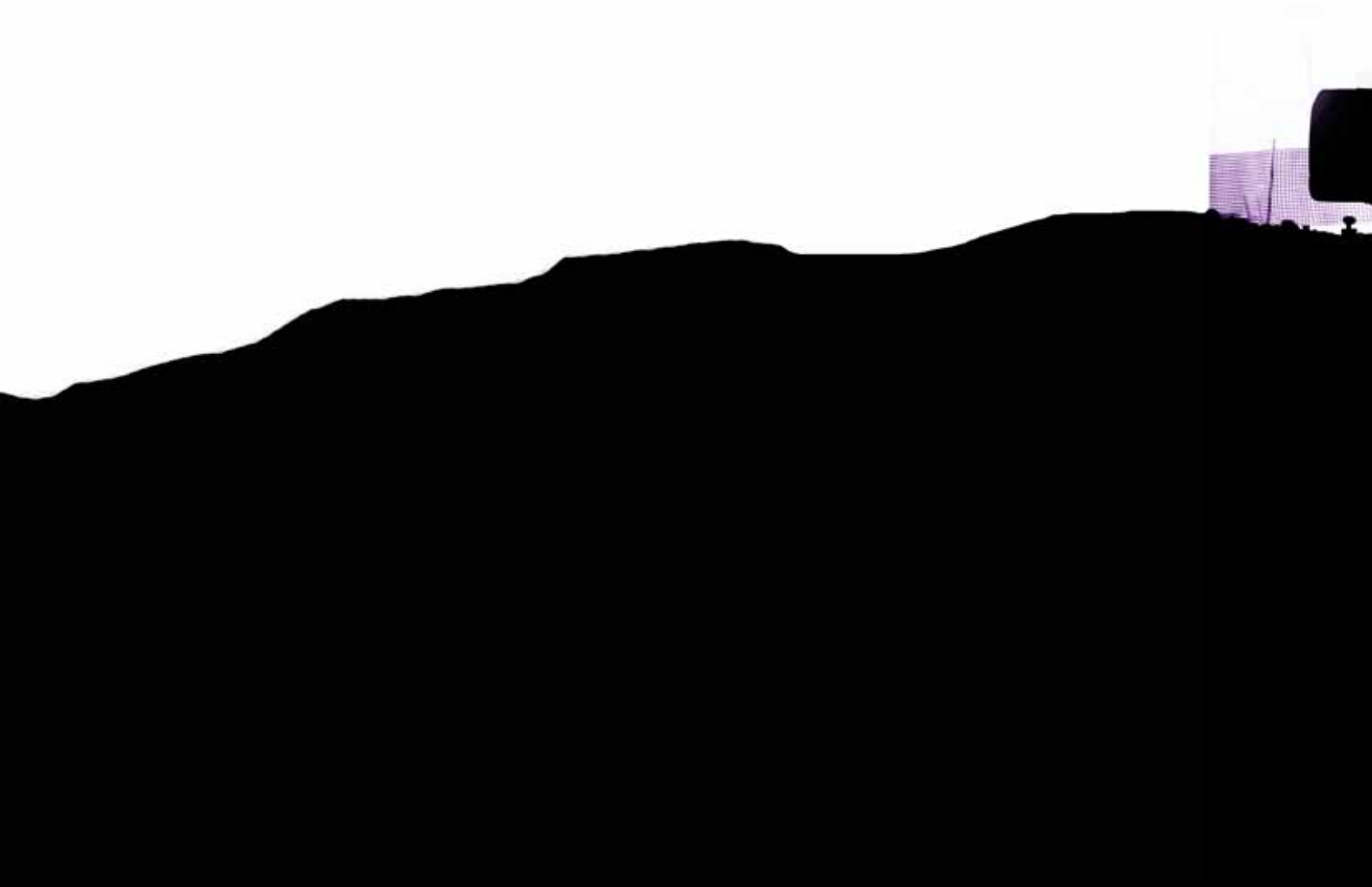
Electric heating, district heating and biofuels for heating of residential buildings and commercial premises

Residential buildings and commercial premises used a total of 85 TWh for space heating and domestic hot water production in 2010. Of this, 42 % was used in detached houses, 32 % in apartment buildings and 26 % in commercial premises.

Electricity is the commonest form of energy carrier for space heating and domestic hot water production in detached houses, delivering a total of 16 TWh in 2010. Over the last few years, the form of energy source of which use has increased the most is that of biofuels (logs, wood chips, sawdust and pellets). The use of biofuels in 2010 amounted to 12 TWh, while district heating supplied 6 TWh. The use of oil for heating purposes continued to decline, down to 1,3 TWh in 2010. The number of detached houses for which heat pumps were being installed increased steadily during the 1990s, so that by 2010 some form of heat pump was in use in 46 % of the country's detached houses.

District heating is the commonest form of energy carrier for space heating and domestic hot water production in apartment buildings, followed by electric heating. A total of 25 TWh of district heating was used in 2010, trailed by 1 TWh for electric heating and 0,4 TWh of oil heating.

District heating is also the commonest form of energy carrier for space heating and domestic hot water production in commercial premises, amounting to 16 TWh in 2010. Electric heating supplied 2 TWh, while the use of oil continued to decline, amounting to 0,9 TWh during the year.



Energy use in industry

In 2010, the use of energy by industry amounted to 148 TWh, or 12 % more than in 2009, to make up 37 % of Sweden's total final energy use. Industry's main energy sources or carriers are biofuels and electricity. Iron and steel works, together with the pulp and paper industry and the chemical industry, account for three quarters of final energy use within the sector.

Policy measures affecting the use of energy by industry

The most important policy measures affecting the industrial sector are energy and carbon dioxide taxes, together with the EU Emissions Trading System for trading emission rights. Other policy measures that affect industry include the Programme for Electrically Intensive Industry (PFE), the electricity certificate system, the environment framework code and energy audit checks.

Protecting the environment with the Emissions Trading Directive

The Emissions Trading System Directive (2009/29/EC) regulates the trading of emission rights in industry. The purpose of the trading system (EU ETS), is to reduce greenhouse gas emissions at minimum cost.

EU ETS embraces all combustion plant with a thermal power output of 20 MW or above, regardless of its sector. Sweden has also included combustion plants of less than 20 MW output if they supply heat to district heating networks. 80 % of Sweden's greenhouse gas emissions come from industrial plants. This differs from the average within EU ETS as a whole, where 60 % of emissions come from electricity and heating plants, with only 40 % from industrial plants.

Phase III of the ETS, covering the trading period 2013–2020, will see changed allocation principles for certificates. The main principle will be auctioning of certificates but, in order to favour the most efficient plants, those that are exposed to international competition will receive free allocations.

Read more about the emissions trading system and allocation principles in the Climate section of this report on Page 7.

Energy and carbon dioxide tax on energy carriers

Energy and carbon dioxide taxes are levied on the use of energy carriers by industry. Energy tax is based on the energy content of fossil fuels, and on electricity use, while carbon dioxide tax is paid per emitted kilogram of carbon dioxide from all fuels apart from biofuels and peat. In addition to this, there is a sulphur tax on coal, peat and oil.

Manufacturing industry that is not in the ETS pays carbon dioxide tax at 30 % of the general rate of the tax. Industries covered by the ETS were exempted from the carbon dioxide tax on 1st January 2011: at the same time, energy tax at 30 % of the general energy tax rate was applied to all industries[3].

Parliament has decided that the carbon dioxide tax rate for industries not in the ETS will be increased, so that they pay 60 % of the general carbon dioxide tax rate with effect from 1st January 2015[4].

An energy tax was introduced on 1st July 2004 on electricity used in manufacturing industry, equivalent to the minimum tax rate formulated in the Energy Taxation Directive. The present rate of taxation of electricity used in manufacturing processes is 0,5 öre per kWh.

PFE - Programme for Energy Efficiency Improvement in Energy-Intensive Industry

In June 2004, the Government put forward a bill concerning a programme for improving the efficiency of energy use. The programme came into force on 1st January 2005: a requirement for being able to participate in it is that the company concerned must be energy intensive.

Companies participating in the five-year programme receive a full relief for the energy tax on electricity that they would otherwise have to pay. In return, they undertake to intro- duce, within the first two years, an energy management system and to perform an energy audit in order to determine their potentials for improving their efficiency of energy use. In addition, they undertake to implement, within the five-year duration of the programme, all the energy efficiency improvement measures that have been identified as having a payback time of less than three years, and also to introduce procurement and planning procedures.

The second phase of the programme is now running, and new companies can join the programme up to the end of December 2012. At present, about 90 companies are in the programme. However, EU rules on public subsidies have been changed, and it has been decided that the programme will not be able to continue in its present form after 2012, although companies already covered by the programme will be allowed to continue.

3 Read more about the energy and carbon dioxide taxes in Energy in Sweden 2011.
4 SFS 2009:1494 Changes to the Act (1994:1776) concerning tax on energy.

Other policy measures that affect industry

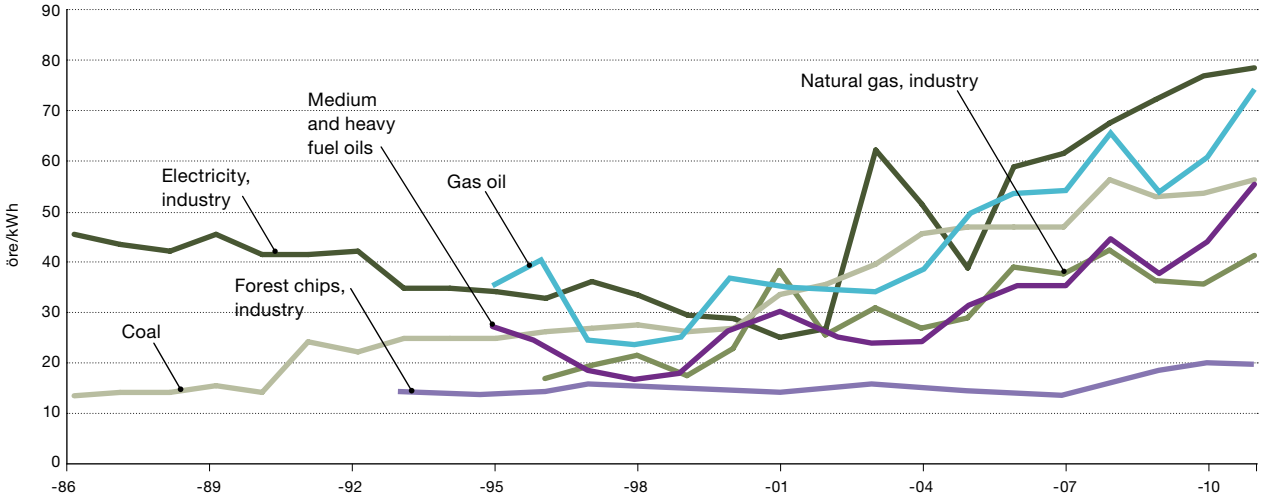
The electricity certificate system is a market based policy measure intended to increase the production of electricity from renewable sources. The system includes certain industrial sectors that generate back pressure power from renewable sources, and which are therefore eligible to receive certificates for their electricity production.

Electricity intensive industries are exempted from having a quota liability for electricity used in manufacturing processes.

The Environment Framework Code requires all industrial production to use the best possible technology and to make efficient use of energy. All businesses must conserve energy and, where possible, use renewable energy sources. This means that companies need to become aware of how they use energy, to identify possible potentials for improvement and constantly to implement reasonable improvement measures.

Energy audit checks qualify for public support for companies wishing to perform an audit of their energy use. The support is intended to encourage action and create an awareness of energy efficiency improvement potentials. The scheme covers 50 % of the cost of an energy audit, with a maximum of SEK 30 000, and is available to companies using more than 500 MWh of energy per year.

Figure 5 Real energy prices for industry in Sweden, including energy taxes, 1986–2011, öre per kWh



Source: Swedish Energy Agency and Statistics Sweden.

Electricity and energy prices for industry

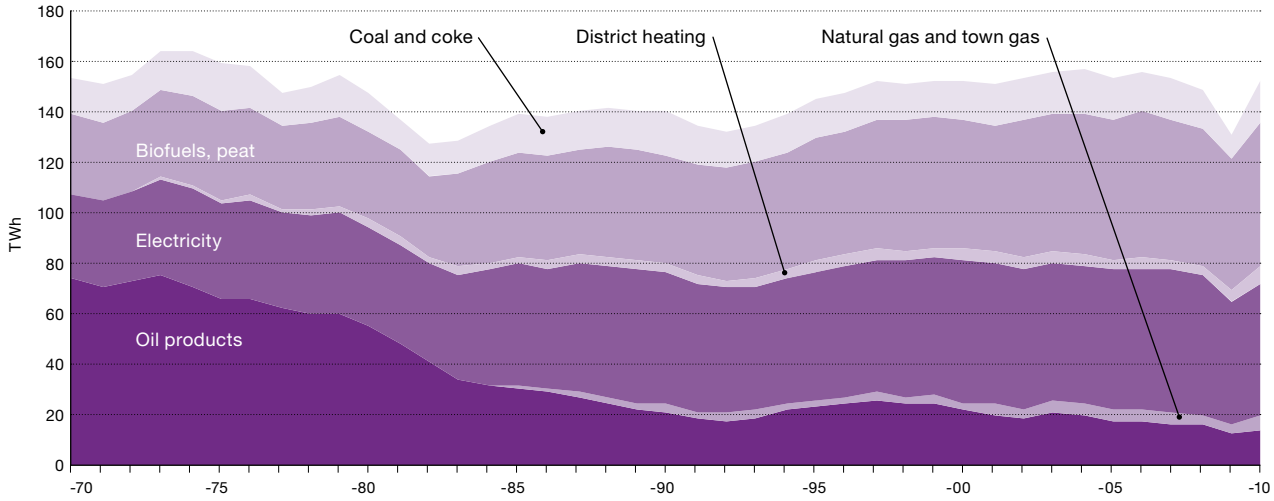
Energy prices for industry increased during 2011, mainly as a result of changes to tax rates. Energy prices for oil, natural gas and coal have risen since 2005, to fall during the downturn of 2009 and continuing to rise when the economy improved again. Much of the increase in oil prices during 2011 is due to the political situations in North Africa and the Middle East. The price of gas oil rose by 27 %, and that of heavy fuel oils by 31 %. The price of forest chips purchased by industry had been relatively constant until 2008, but showing an upturn in recent years that can be due to an increase in the demand for biofuels during the 2000s.

The price of electricity fell between 1986 and 2002, but has subsequently risen. A price increase in 2003 was mainly due to poor water availability in the Swedish hydro power reservoirs during that year. With effect from 2004, industry pays an electricity tax of 0.5 öre per kWh, which led to afurther price increase. The price of electricity rose by 5 % in 2011, relative to 2010. The prices of coal and natural gas increased by 8 % and 18 % respectively during 2011.

Biofuels and electricity – main energy providers in industry

Most of the energy use in industry comes from biofuels and electricity, supplying 37 % and 36 % respectively of final energy use in the industrial sector. Fossil fuels, in the form of oil products, coal, coke and natural gas, provided 23 % of industry's use of energy, with district heating providing the remaining 4 % (see Figure 6).

Figure 6 Final energy use in the industry sector, 1970–2010, TWh



Source: Swedish Energy Agency and Statistics Sweden.
Note: See Secondary Energy Carriers on Page 44.

The bulk of industrial energy use is accounted for by a few sectors

About half of the final energy use in industry in Sweden is accounted for by the pulp and paper industry, supplied mainly in the form of electricity and black liquors. Black liquors are a by-product of the sulphate process for pulp manufacture. Burnt in what are known as soda recovery boilers, they recover chemicals for re-use in the process and deliver thermal energy for steam-raising and electricity production. The electricity is used mainly for grinders producing mechanical pulp.

The pulp and paper industry, iron and steelworks and the chemical industry account for about three-quarters of total energy use in industry.

The iron and steel industry uses about 14 % of industry's energy, mainly in the form of coal, coke and electricity. Coal and coke are used as the reducing agents in blast furnaces, while the electricity is used chiefly for arc furnaces for melting steel scrap.

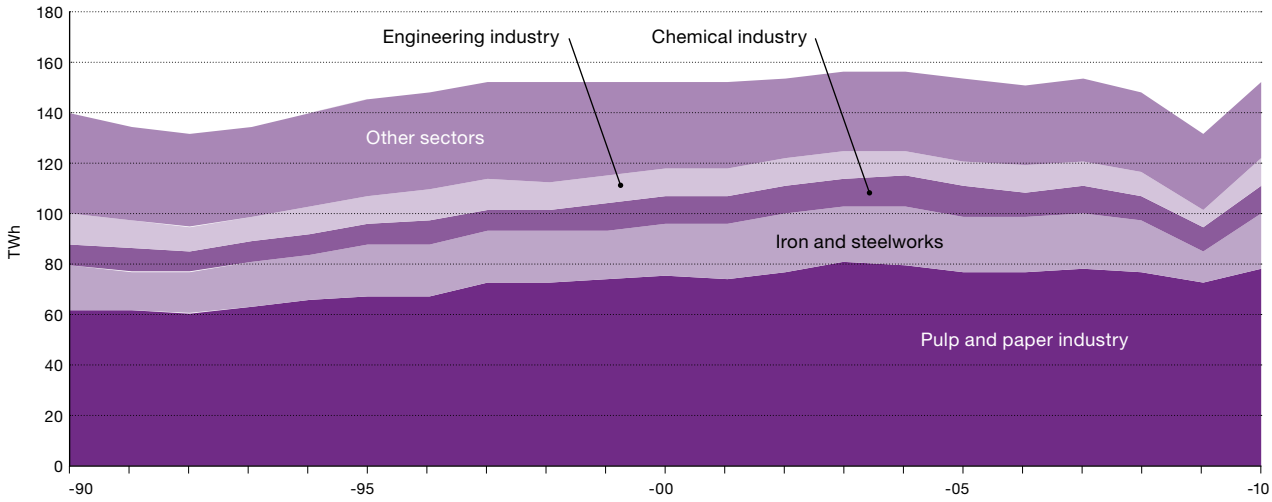
The chemical industry accounts for 6 % of industrial energy use: electricity is used by it mainly for electrolysis processes.

The engineering industry, although not regarded as energy intensive, nevertheless accounts for 6 % of total energy use in industry, as a result of its high proportion of Sweden's total industrial output.

The remaining 22 % of the energy used by industry meets the needs of other sectors[5]. Although some of them can be regarded as energy intensive, their total energy use is relatively low. Some sectors are dominated by the use of fossil energy, such as the sand and gravel industry, while others, such as metal machining industries, are dominated by the use of electricity.

5 SNI 31-33.

Figure 7 Energy use in industry, by sector, 1990–2010, TWh



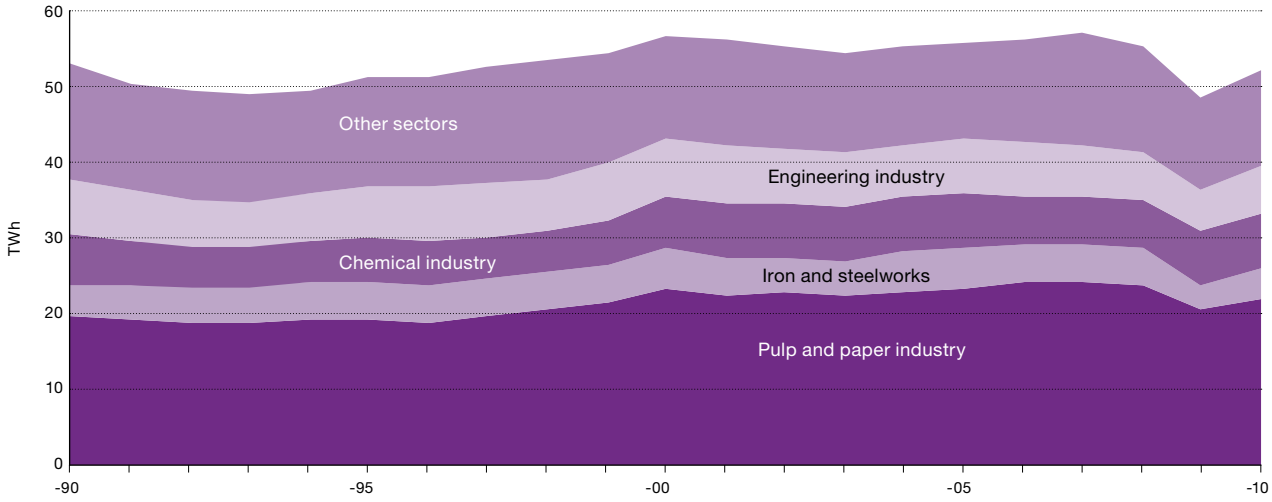
Source: Swedish Energy Agency and Statistics Sweden.

Factors that affect energy use

In the short term, energy use in industry essentially follows variations in industrial output[6]. In the longer term, it is affected also by such factors as taxation, changes in energy prices, improvements in the efficiency of energy use, investment, technical development, structural changes in the sector and changes in the types of goods produced.

2010 saw substantial increases, of 16 % and 12 % respectively, in industrial production volumes and the use of energy. This was the result of a downturn for Swedish industry during the second half of 2008 and into 2009, resulting in a 22 % loss of production and a reduction of 18 % in energy use. Some sectors were hit harder than others: The iron and steel industry suffered the greatest reduction in output and the use of energy, resulting in turn in a reduction in the use of coal and coke throughout the industry as a whole.

Figure 8 Electricity use in industry, by sector, 1990–2010, TWh



Source: Swedish Energy Agency and Statistics Sweden.

6 Read more about energy use per unit of added value in Energy in Sweden 2011.

The proportion of biofuels and electricity continues to rise

Energy use by industry has remained relatively constant since 1970, despite increasing industrial output. This is a result of improvements in the efficiency of energy use, coupled with a progressive change from oil to electricity. Since 1970, electricity use has increased from 21 % to 36 % of total energy use by industry.

This trend started in connection with the oil crises of the 1970s, which resulted in both state and business starting intensive work aimed at reducing the use of oil. In 1970, the use of oil provided 48 % of industry's total energy use, which can be compared with the present proportion of 10 %. Admittedly, the use of oil increased over the period 1992–1997, after which the downward trend resumed. The use of oil and other fuels decreased substantially during the economic downturn of 2009, followed by an increase in the use of oil in 2010.

Between 1970 and 2010, the proportion total energy use by industry provided by biofuels, peat etc. has increased from 21 % to 37 %. Biofuels are the main energy source in the pulp and paper industry and in the wood products industry.

Energy use in the transport sector

The transport sector accounts for about one third, 123 TWh, of the country's final energy use. Energy use in the sector has risen since the 1970s, although the rate of rise has started to decrease in recent years. Energy use for foreign transport, for example, has fallen significantly. The figures for aviation, on the other hand, indicate an increased use of energy.

Policy measures for the transport sector

Policy measures for the transport sector are concentrated on encouragement of the use of sustainable motor fuels and increased use of energy efficient vehicles. In the transport sector in particular, the relative price differences between fossil fuels and bio-based fuels play a substantial part. If, in terms of cost per unit of energy, the price of biobased motor fuels is lower than that of petrol or diesel oil, there is a considerable effect on the sales of the respective fuels.

Taxation of vehicles

2006 saw the introduction of vehicle taxes based on a vehicle's carbon dioxide emissions instead of on its weight as previously. The Government proposes that this differentiation should also include light goods vehicles and camping vans, and that the tax should be increased by reducing the carbon dioxide emission level boundary from 120 to 117 grams per with effect from 2013. Carbon dioxide tax is levied on emissions above a certain value which, in Sweden at present, is 120 grams per kilometre.

Passenger cars with better environmental performance, known as 'eco cars', pay no vehicle tax for five years. With effect from the start of 2013, this exemption will be based on a maximum carbon dioxide emission level in relation to the vehicle's weight. This will mean that there will no longer be a fixed limit for all vehicles, but a sliding scale depending on vehicle weight. A car of average European weight may emit a maximum 95 grams per kilometre of carbon dioxide, while eco cars running on ethanol or vehicle gas will be exempted for an as yet undecided time into the future, and be permitted to emit up to 150 grams per kilometre on the basis of the fuel's renewable origin.

The rules for taxation of car benefit also encourage the selection of cars running on biofuels, as the notional taxable value can be reduced if the vehicle is capable of running on electricity or other green fuel other than petrol or diesel oil[7]. The notional value in 2012 and 2013 will be reduced by 40 %, with a maximum SEK 16 000, and only for vehicles running on electricity or vehicle gas.

7 61 Chapter (1999:1229) of the Income Tax Act.

What are eco cars?

The following requirements must be met if a car is to be classified as an eco car:

- For conventional passenger cars, including hybrids, carbon dioxide emissions must not exceed 120 grams per km. For diesel cars, there is an additional requirement that parti- culate emissions must not exceed 5 milligrams per kilometres.

- For cars running on alternative fuels (i.e. other than petrol, diesel oil or LPG), fuel consumption must not exceed the equivalent of 0,92 litres of petrol per 10 km or 0,97 m^3 of gas per 10 kilometres.

- For electric cars, electrical energy use per 100 kilometres must not exceed 37 kWh.

The definition of an eco car affects its liability to a number of taxes and requirements, including fuel taxes and requirements for public authorities to purchase such vehicles. The definition of an eco car will become more stringent with effect from 2013.

If a private car is to be regarded as a super-eco car, it must:

- be type approved in accordance with the vehicle regulations, 3 Chapter (2009:211),

- fulfil the emission requirements as set out in Directive 2007/715/EC, the 'Emissions Directive',

- be shown in the road traffic register as emitting not more than 50 grams per kilometre of carbon dioxide in the combined cycle driving mode.

From 2012 to 2014, private persons and businesses may apply for a super-eco car subsidy, not exceeding SEK 40 000 per vehicle, in accordance with the Super-Eco Car Subsidy Regulations (2011:1590).

Tabell 1: Fuel constituents

Biobased motor fuels and liquid biofuels	
Ethanol	E5, E85, ED95, ETBE
Biodiesel	B5, B100, RME, FAME
Vehicle gas	Umbrella name for methane gases: biogas, natural gas and mixtures thereof
Liquid biofuels	Bio-oils: Rapeseed oil, palm oil, tall oil and waste oils

Key	
FAME	Fatty acid methyl ester
HVO	Hydrogenated vegetable oil
ETBE	Ethyl tertiary butyl ether
DME	Dimethyl ether
RME	Rapeseed methyl ester
E5	95 % petrol and 5 % ethanol
E85	85 % ethanol and 15 % petrol (summer), or 75 % ethanol and 25 % petrol (winter)
ED95	95 % ethanol and ignition improver and corrosion protector
B5	Fuel consisting of 5 % biodiesel and 95 % mineral diesel oil
B100	Pure biodiesel

Quota obligation and low admixture

In order to increase the proportion of renewable energy used in the transport sector, the Government has presented a proposal for new regulations to come into force in 2014 introducing a quota obligation aimed at doubling the ethanol admixture in petrol and increasing the proportion of FAME in diesel fuel. The present low admixtures in motor fuels are also one way of reducing emissions of fossil carbon dioxide and increasing the proportion of renewable energy used in the transport sector. Low admixture means that a smaller quantity of biobased fuel is mixed with fossil fuels, such as the present 5 % of ethanol in petrol and 7 % of FAME in diesel fuel. Today, biobased motor fuels[8] are entirely exempt from energy and carbon dioxide taxes if they meet the sustainability criteria for biobased motor fuels. With effect from January 2013, low admixture biobased motor fuels will be subject to energy tax.

High-admixture biobased motor fuels, together with hydrogenated vegetable oils and fats, HVO, in low-admixture proportions of up to 15 % in diesel fuel, will continue to be free from tax.

8 Since 1st January 2011, the tax exemption level for low admixture motor fuels is limited to 6.5 % low admixture in petrol, and 5 % low admixture in diesel fuel. Low admixtures above these levels are taxed in the same way as the fossil fuel.

Filling stations

The Act (2005:1248) Concerning Requirement to Offer Renewable Motor Fuels came into force in 2006, requiring filling stations selling more than 1000 m^3 of petrol or diesel fuel per year also to offer at least one renewable motor fuel, such as ethanol or biogas. The purpose of the Act is, by increasing the availability of renewable motor fuels, to encourage the use of such fuels and thus reduce carbon dioxide emissions. Of the country's somewhat under 3000 filling stations, about 63 % were offering at least one renewable fuel in December 2011, as against about 10 % in 2005.

Renewable energy sources

The Renewables Directive (2009/28/EC) is intended to support the use of energy from renewable energy sources. It includes a binding national target for every member state, requiring at least 10 % of energy in the transport sector to be from renewable sources by 2020. The Directive also contains requirements for sustainability criteria for biobased motor fuels and liquid biofuels. They include, for example, a requirement for 35 % reduction in greenhouse gas emissions resulting from the production of biobased motor fuels, in comparison with the corresponding emissions from fossil fuels. The sustainability criteria also include requirements forbidding the change of use of certain types of land for the production of fuels. Land which, for example, in 2008 was under forest cannot be converted to agricultural use. The requirements relating to reduction of greenhouse gas emissions will be progressively tightened up, so that a reduction of at least 50 % will be required in 2017. The Fuel Quality Directive (2009/30/EC) sets out requirements for fuel qualities, together with requirements for progressively reduced greenhouse gas emissions from suppliers of motor fuels. The permitted maximum level for low admixture of ethanol in petrol is 10 % by volume, while that of FAME in diesel is 7 % by volume.

The EU has introduced fuel efficiency requirements for new passenger cars to be sold on the European market. EU Regulation 2009/443/EC specifies an average limit value of 130 grams of Carbon dioxide per kilometre, which will be gradually introduced for application in 2015. There are proposals that fuel efficiency should be further tightened up to 95 grams of Carbon dioxide per kilometre for 2020. In 2010, the average fuel efficiency of new cars on the European market was 140 grams of Carbon dioxide per kilometre[9], which can be compared with Sweden's figure for that year of 144 g of CO_2 per kilometre[10].

It is estimated that the new energy tax on low-admixture ethanol and FAME will increase the price at the pumps by about 2 öre per litre for petrol and diesel fuel in 2013. These price increases are not expected to be greater, as changes to the tax rate that have already been decided have a counter-effect. The new taxation is being applied in order not to breach EU rules on public subsidies that specify that tax relief on biobased motor fuels must not result in overcompensation for these fuels in comparison with diesel fuel or petrol.

9 Reduced Emissions of Carbon Dioxide from Road Traffic, Swedish Transport Administration, 2012-05-09.
10 As calculated by the EU model in Regulation 443/20.

Prices of energy carriers

Except in 2008, diesel fuel has always been a cheaper fuel than petrol, although this is a trend that has changed in recent years. The price of diesel fuel has risen more rapidly that that of petrol: since 1991, its price has increased by almost 100 %, while that of petrol has increased by about 60 %. An important factor in these price changes is that the tax on diesel fuel has increased more than that on petrol. In 2011, the average price per litre of both fuels was SEK 14:09.

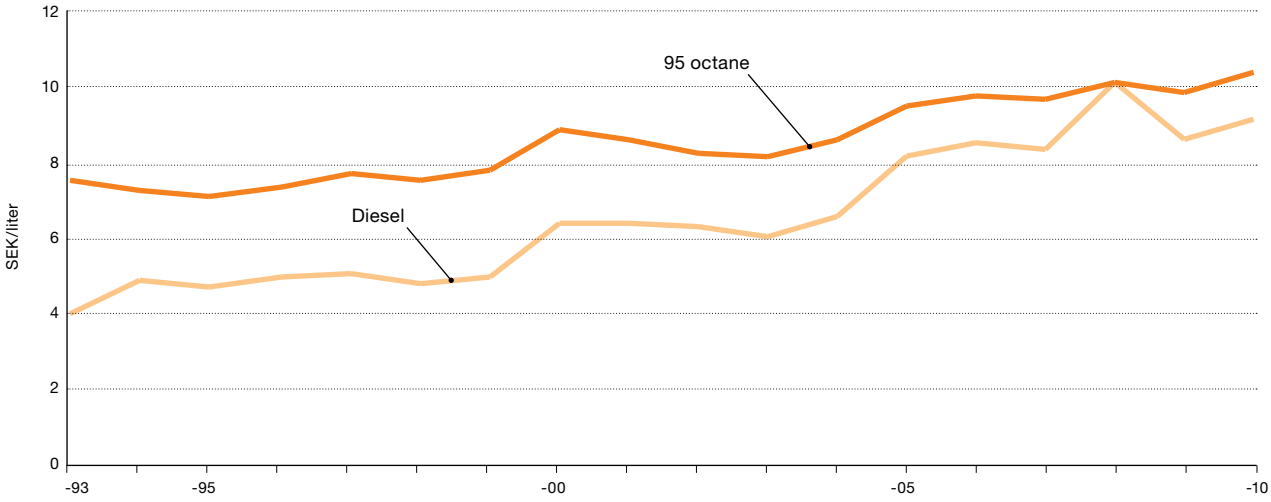
The total number of passenger cars in the country is continuing to rise, reaching 4.4 million vehicles at the end of 2011. Of them, 5,7 % could run on a predominant proportion of renewable motor fuels[11].

In 2011, diesel cars made up 61,5 % of new car sales. This continued trend, with an increasing number of diesel cars and fewer petrol cars in the Swedish vehicle fleet, is reducing the demand for petrol and increasing that for diesel fuel. This change will probably be reflected in the prices of fuels.

Although the sales of E85 continue to rise, the long term outlook for the ethanol market is uncertain as the number of new registrations of ethanol cars is falling steadily, and it is not known how a possible quota obligation will affect the price of ethanol fuel. Since the record year for sales of 2008, when 63 222 ethanol fuelled cars were sold, sales have fallen by over 25 %.

The number of cars running mainly on vehicle gas is increasing steadily, reaching 30 992 vehicles on the road at the end of 2011.

Figure 9 Real annual average prices for motor fuels in Sweden, including energy taxes but excluding VAT, 1993–2010, SEK/liter



Source: Swedish Energy Agency and Statistics Sweden.

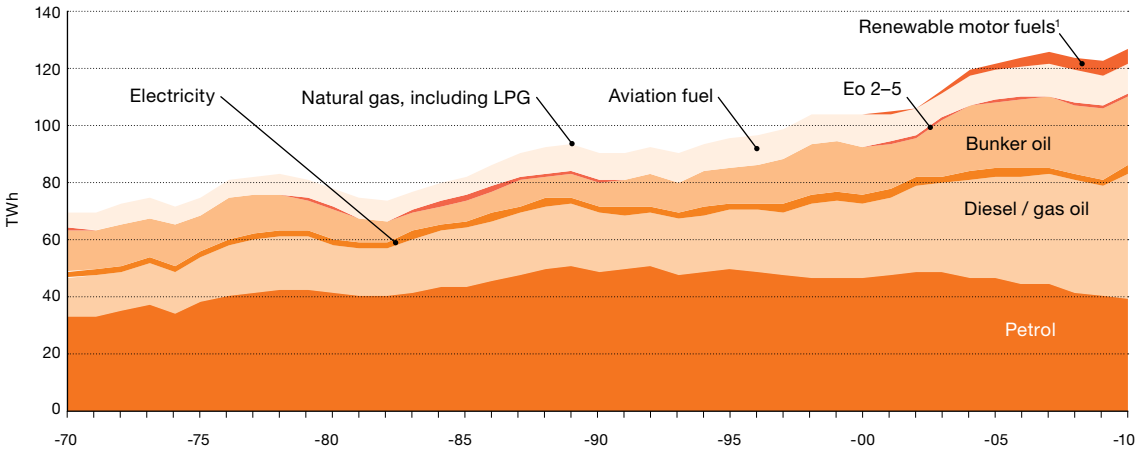
11 Vehicles 2011, Version 2, 2012-04-18, Traffic analysis. The vehicles covered here are those that can run on ethanol, vehicle gas or electricity.

Of the country's final energy use in 2011, energy for transport within Sweden used 25 % to meet the demands of road traffic, rail traffic, aviation and maritime traffic. Road traffic used by far the greater proportion, of 93 % of total energy use in the sector.

Final energy use

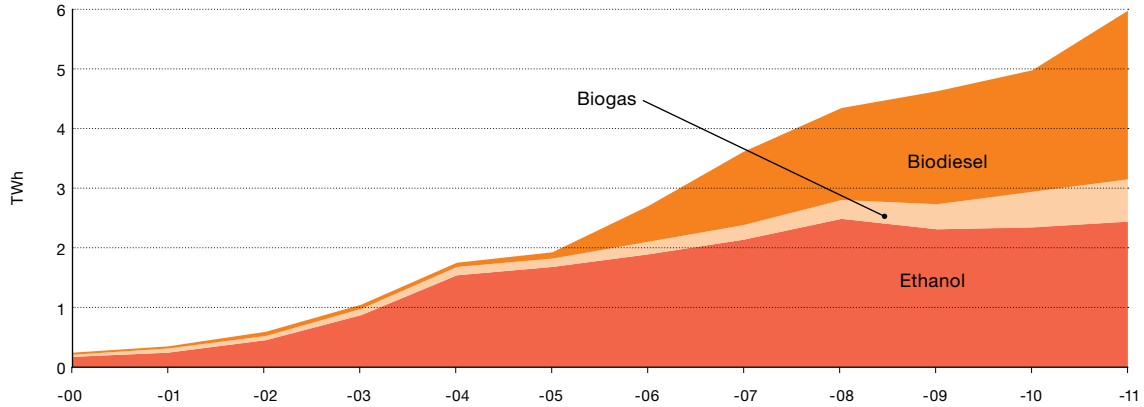
The general trend since the 1970s has been that of an increase in the use of energy by the transport sector. This trend has continued into the 2000s, although figures for recent years show that it may be declining. Since 2005, energy use for internal transport has shown only minor changes from year to year, while preliminary statistics show that energy use in 2011 is about the same as it was in 2005[12]. This is paralleled by energy use for foreign transport, which is no longer increasing: it has, in fact, fallen significantly over the last two years.

Figure 10 Final energy use in the transport sector, 1970–2010, including overseas transport, TWh



Source: Swedish Energy Agency, SCB and Energigas Sverige.
Note: 1. Quantity for 1999 is for ethanol alone. Quantities for following years include ethanol, FAME and biogas.

Figure 11 Final energy use of renewable motor fuels, 2000–2011, TWh



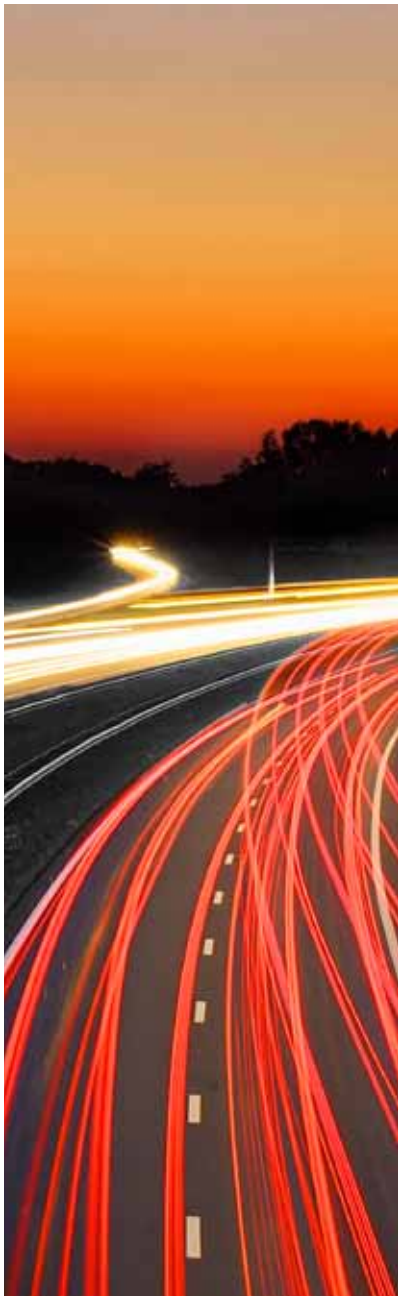
Source: Swedish Energy Agency, SCB and Energigas Sverige.

12 Quarterly statistics, Swedish Energy Agency.

Road and rail traffic

Road traffic shows a clear trend towards less use of petrol and more use of diesel fuel as a result of changes in the country's vehicle fleet over the last few years, with the number of diesel vehicles increasing substantially and the use of alternative fuels also increasing. The number of vehicles powered by vehicle gas has increased the most rapidly.

During the 2000s, the amount of electricity used by rail traffic has varied from year to year, although with only relatively minor variations. The use of diesel fuel for rail traffic also varies, although the long term trend is towards a reduction in its use.



Aviation and maritime traffic

As opposed to the overall trend shown by the transport sector as a whole, of a reduction in energy use, aviation statistics show rising figures for 2011. During the first years of the 2000 decade, aviation fuel consumption fell in step with a falling number of total landings at Swedish airports. However, from 2003, the total use of aviation fuels for internal and overseas traffic from Sweden has increased, which can be explained by an increase in the number of landings by overseas traffic. The trend towards less use of fuel for internal flights was broken in 2011, with an increase of almost 9 % in comparison with that of 2010. During the same period, the number of passengers increased by over 13 %.

The total energy use for internal maritime traffic has fallen considerably in recent years, in comparison with energy use at the beginning of the 2000s. A common trend is also towards increasing quantities of diesel fuel and a decline in the demand for gas oil, which is presumably due to a switch to diesel fuel in the maritime sector.

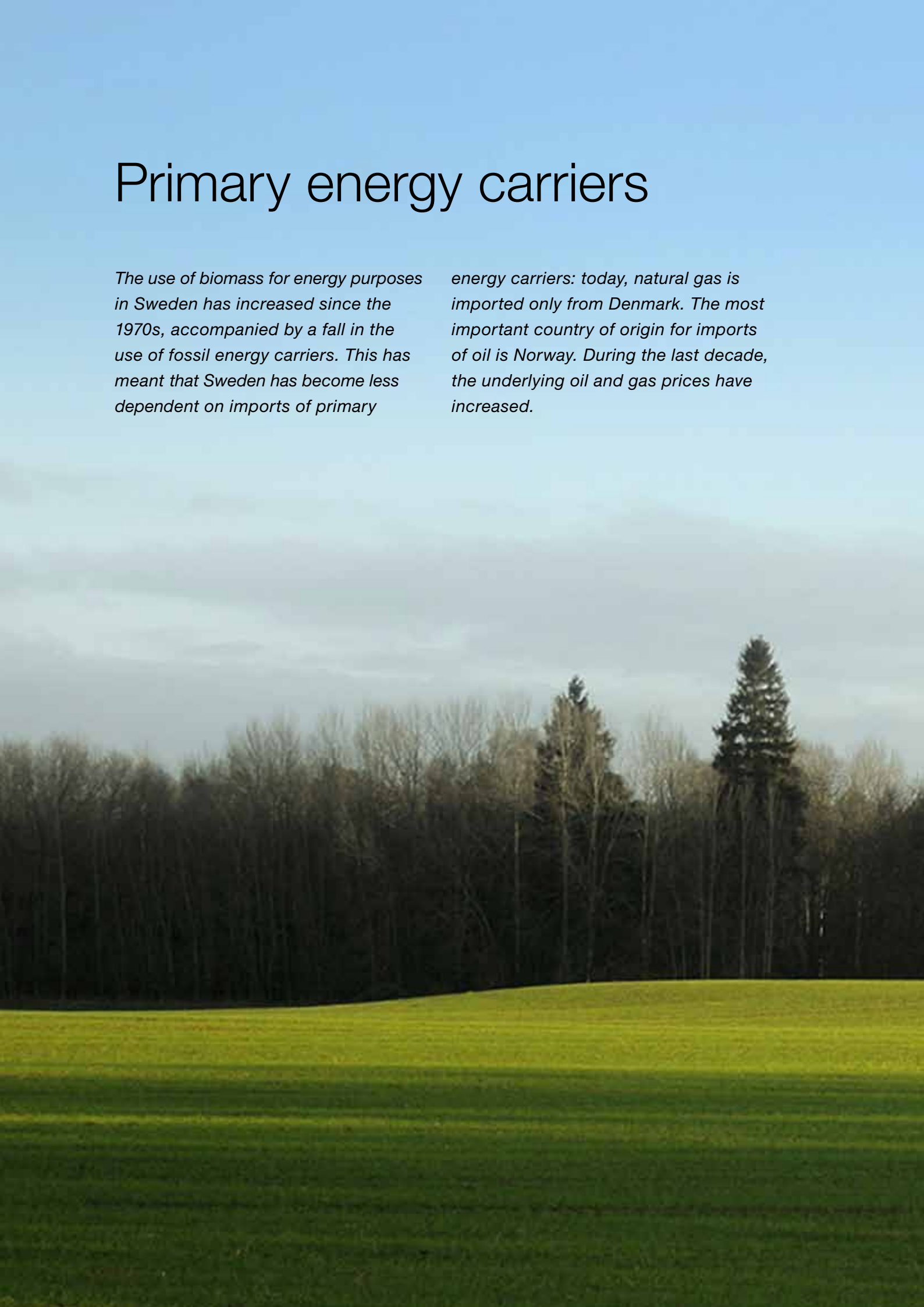
Bunkering of heavy fuel oils for foreign maritime traffic increased significantly at the beginning of the 2000s, before remaining at a constant level for some years. 2010 and 2011, however, showed reduced total volumes of such fuels. The use of heavier fuel oils has decreased, being replaced by diesel fuel and gas oil.

The proportion of biodiesel increasing the most among other biobased motor fuels

The biobased motor fuels used in Sweden are primarily ethanol, biodiesel and biogas. The statistics for 2011 show that the proportion of biobased motor fuels used during the year amounted to 6.8 %. It is biodiesel in particular that increased the most in 2011, making up 46 % of the total use of biobased motor fuels. The proportions of ethanol and biogas increased by 42 % and 12 % respectively. In actual figures, the use of biobased motor fuels increased by 20 % between 2010 and 2011.

Primary energy carriers

The use of biomass for energy purposes in Sweden has increased since the 1970s, accompanied by a fall in the use of fossil energy carriers. This has meant that Sweden has become less dependent on imports of primary energy carriers: today, natural gas is imported only from Denmark. The most important country of origin for imports of oil is Norway. During the last decade, the underlying oil and gas prices have increased.



Biofuels

A tax on carbon dioxide emissions was introduced at the beginning of the 1990s and, in combination with increased energy taxes, has contributed to a substantial increase in the use of biofuels. The rising price of fossil fuels has also favoured the use of biofuels, as has the introduction of the electricity certificate system in 2003.

Rising price of biofuels during the 2000s

The increased use of biofuels for electricity and heat production has particularly increased the demand for wood fuels. During the 1980s and 1990s, the prices of wood fuels for heating plants remained essentially unchanged. A long period of surplus of byproducts from the forest industry, with no potential sales outlets, meant that there were good stocks of cheap and easily available fuels.

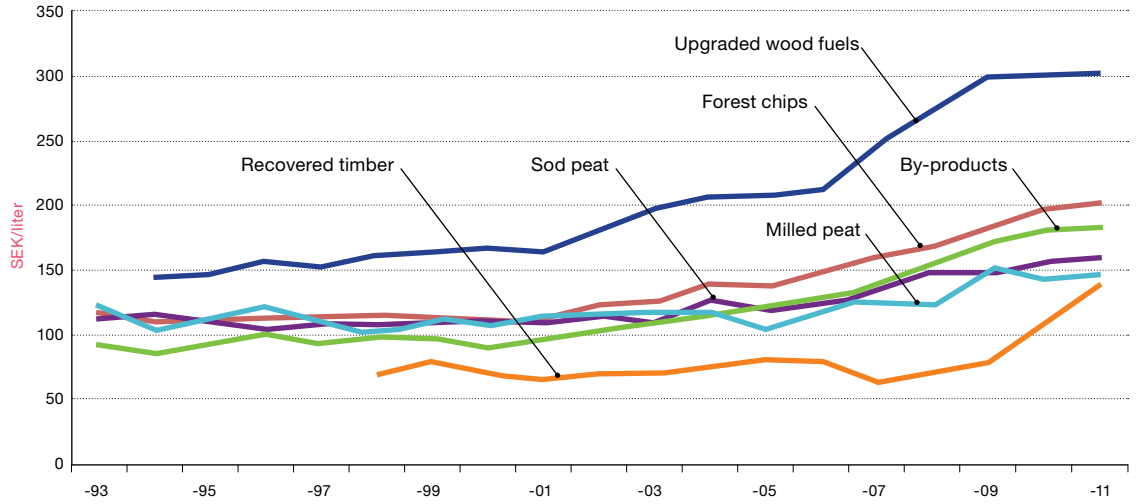
The increased demand increased competition for wood fuels, and price levels rose during the 2000s. Greater recovery of branches and tops from clear felling has been the main factor in enabling the use of these fuels to be increased. The market is expected to grow further, which will probably mean that buyers will be willing to pay more and that prices will continue to rise. However, several factors indicate that greater use of waste for electricity and heat production can help to restrain expected future rising prices.[13]

13 Energy Indicators 2012, Swedish Energy Agency, ER 2012:20.

Peat

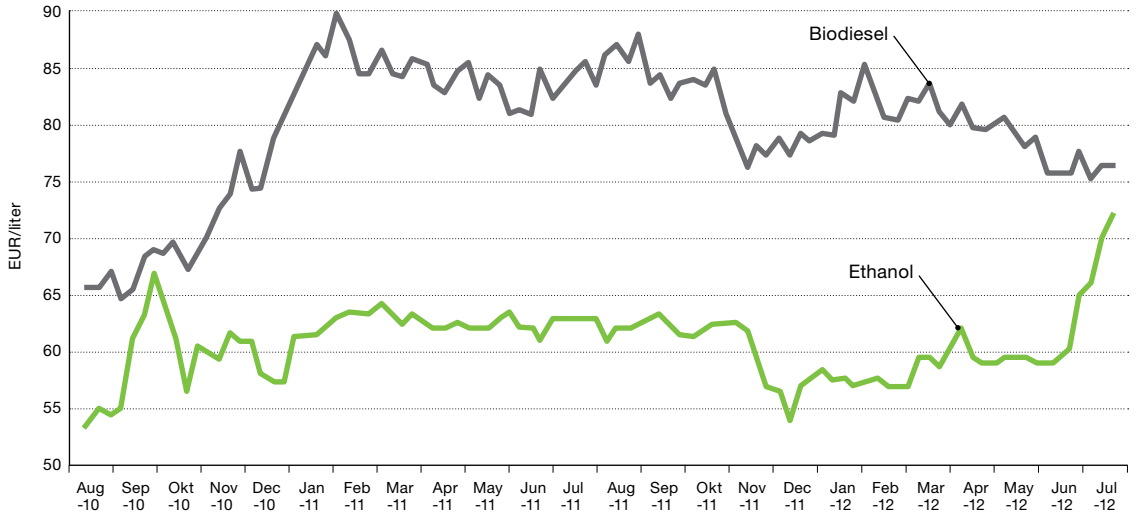
Peat is neither renewable in the short term nor of fossil origin in the geological meaning. When burnt for heating purposes, peat is exempt from energy and carbon dioxide tax, but not from sulphur tax. The Emissions Trading System (ETS) regards peat as being of fossil origin, and so its use therefore attracts a cost for emission rights. At the same time, peat qualifies for allocation of electricity certificates for electricity production in CHP plants, which encourages its use.

Figure 12 Prices of wood fuels and peat for heating plants, SEK per MWh, nominal prices



Source: Swedish Energy Agency and Statistics Sweden.

Figure 13 Ethanol and biodiesel prices on the European market, August 2010–July 2012, EUR per 100 liter



Source: F.O. Licht's Interactive Data 2012.

Ethanol and biodiesel

2011 saw the use of 420 000 m³ of ethanol and 295 000 m³ of biodiesel in Sweden, with use continuing to rise.[14] Although both ethanol and biodiesel are produced in Sweden, quantities are far from sufficient to meet demand. Much of these biobased motor fuels are imported primarily from other EU states, as well as from the rest of the world. The Swedish producers also import some of the raw materials for their production from other countries.

Support for competition with fossil alternatives

The price of biobased motor fuels is very dependent on the price of the raw materials used for their production. As the price of agricultural products can vary considerably, this also has an effect on the price of biobased motor fuels (see Figure 13). In exactly the same way as for biofuels used for electricity and heat production, biobased motor fuels at present receive various forms of support, including tax exemption, in order to compete with fossil alternatives.

Ethanol is classified as an agricultural product, which means that the customs regulations that apply to it are different from those that apply to biodiesel, which is classified as an industrial product. If Swedish parties are to be entitled to tax exemption for ethanol intended for low admixture ratio use in petrol, the ethanol must be imported under a rate of duty equivalent to about SEK 1:70 per litre[15].

Major variations in the prices of bio-oils

Bio-oils have progressed from being a marginal fuel used by the electricity and district heating sector to an increasingly common substitute for fossil fuels. 3 TWh of bio-oils were used for energy purposes in Sweden in 2011.15 The market for bio-oils is still in a development stage, with substantial price variations between different types of oils. In 2011, prices varied between 56 öre per kWh for unrefined oils, up to 100 öre per kWh for better quality oils[16].

Oil

The price of crude oil is set by supply and demand on the world market. Demand is determined primarily by global growth, although short term variations in demand also occur. As oil is often used as a reserve fuel, demand for it increases, for example, when cooling or heating demands rise.

Supply and price of oil

The OPEC states supply over 40 % of world oil production, and so production levels in these countries have a strong effect on the price of oil. Supply and price are also affected by the political situation in the oil producing states. The situation is particularly sensitive when demand is high in relation to supply, when any interruptions or problems on the supply side can result in substantial price rises. In recent times, it is the unstable situations in North Africa and the Middle East that have affected the price.

Supply is also affected by refinery and production capacity around the world. Refinery capacities have been limited in recent years, and have thus been an important factor behind the rising price of oil.

14 Energy use in the transport sector, 2011, Swedish Energy Agency, ES 2012:01.
15 Sustainable biobased motor fuels and liquid biofuels in 2011, Swedish Energy Agency, ET 2012:12.
16 Overview report on tax exemption for certain biofuels when used as a fuel for heating, 2011, Swedish Energy Agency.

Oil in Sweden

Approximately half of Swedish imports of crude oil in 2011 – i.e. almost 19 million tonnes – came from Russia, with the rest being produced primarily by Norway, Denmark and the UK. Although Sweden has no oil production of its own, it has been a net exporter of refined oil products for over 20 years. The country's greatest internal use of oil is for transport.

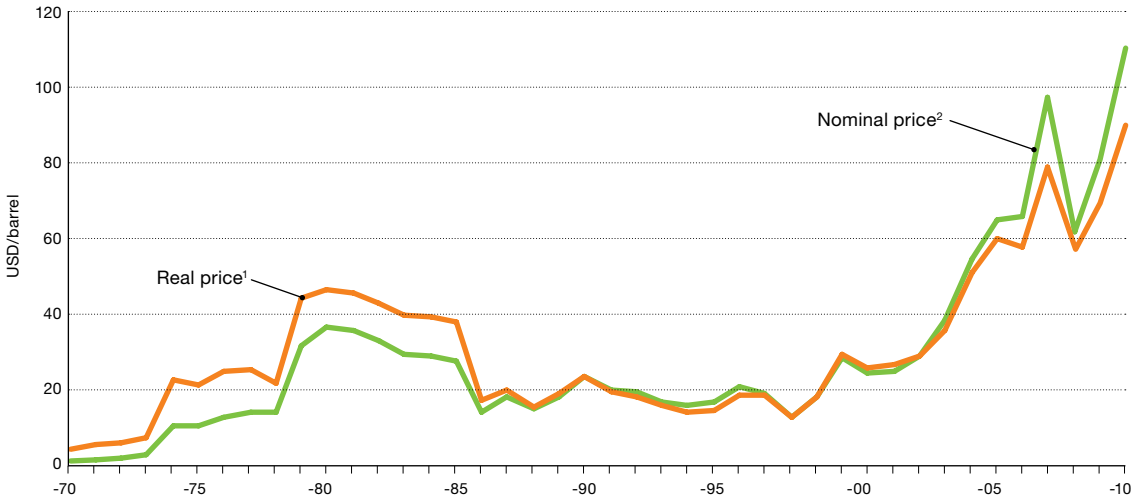
Strategic stocks

Sweden is dependent on a functional international trade in oil. Strategic stocks of oil products are held in order to reduce the country's vulnerability to the effects of conflicts affecting the oil market. Problems in the supply of oil are tackled primarily through the agreements that have been signed with the IEA and the EU. Importers, sellers and larger users of oil and coal are required by law to maintain strategic stocks. This is in accordance with Sweden's commitments under the IEP Treaty, which is an agreement on a common energy programme between 26 states. One of the points of the treaty is that every member state must hold strategic stocks of oil equivalent to 90 days' net importation.

Saudi Arabia and Russia are the world's largest oil producers, with the USA being the largest consumer.

Oil can also be recovered from unconventional sources, such as oil sands. Canada, in particular, has substantial reserves, with the result that production there has increased considerably in recent years.

Figure 14 Nominal and real prices of light crude oil, 1970–2011, USD/barrel



Source: BP and the World Bank.
Anm. 1. 1970–1975 prices are for Dubai crude. 1976– prices are for Brent crude.
2. Global real prices have been deflated by the MUV Index from the World Bank: base year, 2005.

Natural gas

The natural gas market is more regional than the oil market, as it is dependent on a physical infrastructure in the form of pipes. It can also be transported in liquid form, under the name of LNG (liquefied natural gas).

The USA and Russia are the largest producers of natural gas, with 20 % each of total world production. The USA is also the largest consumer of natural gas. Among the EU states, which consumed 14 % of global natural gas in 2011, it is the UK that is the largest consumer.

In the USA, the use of new technology has permitted a substantial increase in production of shale gas in recent years. This higher production on the American market has meant that gas prices in the USA are below those in Europe (see Figure 15), but the export potentials are not sufficient to enable the prices to even out.

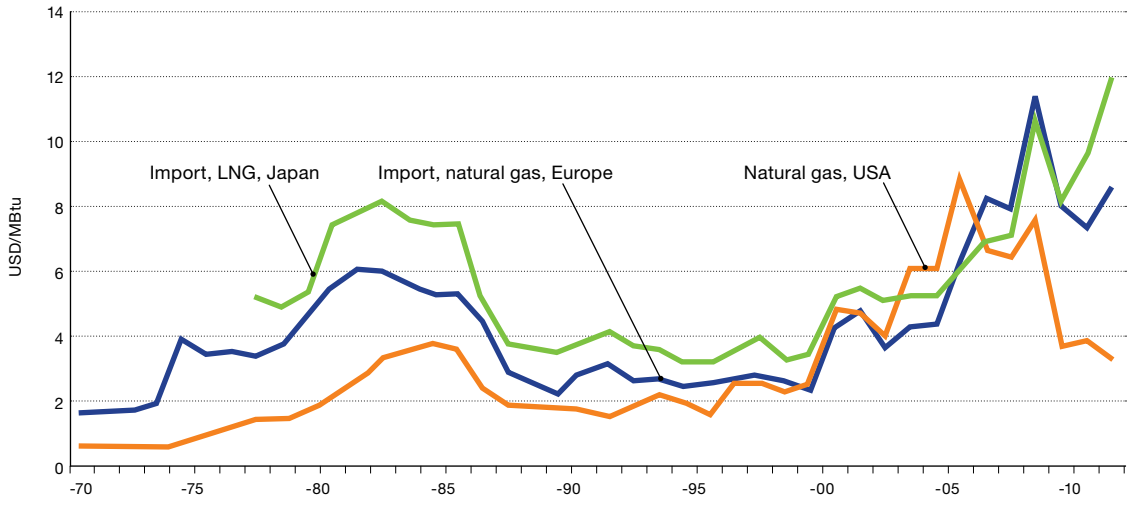
Sweden imports from Denmark

Sweden has hitherto imported all the natural gas that it uses from Denmark. The natural gas network today extends from Trelleborg in the south to Göteborg, with a number of branches, such as to Gnosjö in Småland and to Stenungssund, north of Göteborg. However, smaller quantities of LNG have recently started to be imported from Norway.

Although natural gas meets over one fifth of world energy requirements, it supplies less than 3 % of Sweden's energy demand. Its uses include electricity production, heating in residential buildings and use as a fuel and raw material in industry.

Shale gas is what is known as an unconventional fossil fuel that can be extracted from shale strata in the bedrock. New technology, known as fracking, has come to be used in recent years, but has a major environmental impact.

Figure 15 Fixed prices for natural gas, 1970–2011, USD/MBtu (index year 2005)



Source: World Bank.

Coal

The world's largest coal reserves are in the USA, followed by Russia and China.[17] Although coal is plentiful in the world's crust, production is limited for various reasons, including inadequate infrastructure and high transport costs.

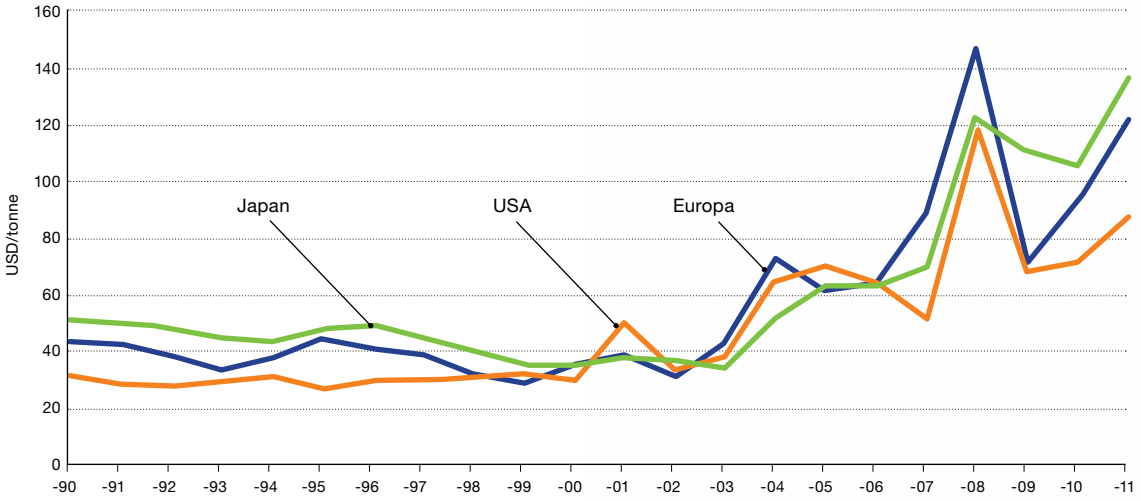
China produces and consumes most

China produces almost half of the world's output of coal, and is also its largest consumer. For many years, Japan was the largest net importer of coal, but was overtaken by China in 2011, despite the fact that, until a few years ago, China was a net exporter of coal. The country has many coal fired power stations, and its growing import requirements are an important factor on the coal market. The world's largest exporter of coal is Australia.

Much of the world's coal is used for electricity production: in Sweden, however, most of it is used by the iron and steel industry.

About 40 % of world electricity is produced by burning coal.

Figure 16 Coal prices in Europe, USA and Japan, 1990–2011, USD/tonne



Source: BP Statistical Review of World Energy, 2012.

17 BP Statistical Review of World Energy, 2012.

Secondary energy carriers

Electricity and district heating production in Sweden have increased since the 1970s. Sweden's electricity system is linked to its neighbouring countries, which means that electricity is imported and exported during the year. On an annual basis, it is weather conditions that decide whether Sweden is a net importer or exporter of electricity. Warm years, and those with high precipitation, tend to result in a net export of electricity, while cold and/or dry years result in a need to import electricity. District heating systems are local, and prices can vary considerably between them.

The electricity market

2011 saw a dry year turn into a wet year, while the cold 2010 was followed by a considerably warmer 2011. Total electricity production was about the same as in previous years and, together with a lower demand for electricity, turned a net import in 2010 to a relatively large net export in 2011. Electricity prices were considerably lower than in 2010, despite the fact that the country's nuclear power stations did not produce as much power as in an average year.

Changes to policy measures

Sweden and Norway have operated a joint electricity certificate market since the beginning of 2012. Renewable electricity production that is approved by the system receives electricity certificates that can be used in both countries. The target of the joint electricity certificate market is to increase renewable electricity production by 26.4 TWh between 2012 and 2020.

All electricity production plants pay an industrial property tax which, for hydro power plants, and with effect from 2011, was raised to 2.8 % of the property's taxation value. Between 2007 and 2011 it was temporarily raised to 2.2 %. The tax is 0.2 % for wind power plants, and 0.5 % for other electricity production facilities.

Support for electricity production

The support provided for electricity production is that which operates via the electricity certificate system.[18] For each MWh of electricity produced from renewable energy sources, the producer receives one certificate unit which can be sold to subsidise the cost of the electricity production. The price of certificates has varied since the system was introduced in 2003: the highest price to date was reached in 2008, when it amounted to somewhat over SEK 350 per MWh. At the end of 2011, the price had fallen to about SEK 150 per MWh.

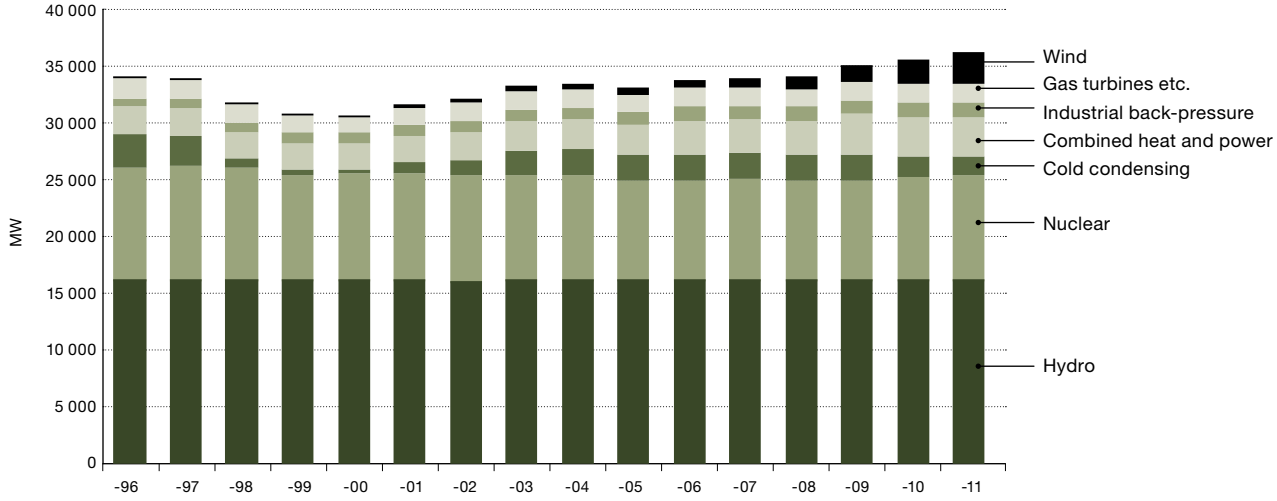
Availability of production capacity

Deregulation of the Swedish electricity market in 1996 resulted in a reduction in the country's installed production capacity, with particularly expensive cold condensing plant no longer being viable. Installed capacity increased again after 2000, and is now greater than it was before deregulation. Most of this new capacity has occurred in the form of expansion of wind power production and production from biofuels, supported by the electricity certificate system, as well as output capacity increases in the country's nuclear power stations.

At any one time, not all installed capacity is available for operation. The country's entire hydro production capacity is never used to the full at the same time, while the availability of the nuclear power stations depends on their operational status. Availability of wind power depends on where and when wind speeds are suitable. All this means that the available capacity of the different forms of power production cannot be directly compared. Power shortage situations can arise during a cold winter, and particularly if the nuclear power plants are not in operation at these times, as occurred in 2009 and 2010.

18 Read more about the electricity certificate systems in the Agency's report 'The Electricity Certificate System 2011', ET 2011:32.

Figure 17 Installed electricity production capacity in Sweden, by type, 1996–2011, MW



Source: Svensk Energi.

Sweden's total installed capacity in December 2011 was 36 420 MW, made up of 44 % of hydro power, 8 % of wind power, 26 % of nuclear power and 22 % of other thermal power. Maximum demand occurred on 3rd February 2012, and amounted to 26 035 MW.[19] During this metered hour, Sweden imported electricity via all its cross-border links except Poland, and exported electricity to Finland. Internal production amounted to 23 560 MW. This can be compared with Sweden's hitherto highest demand of 27 000 MW, which occurred in January 2001.

Electricity production dominated by hydro and nuclear power

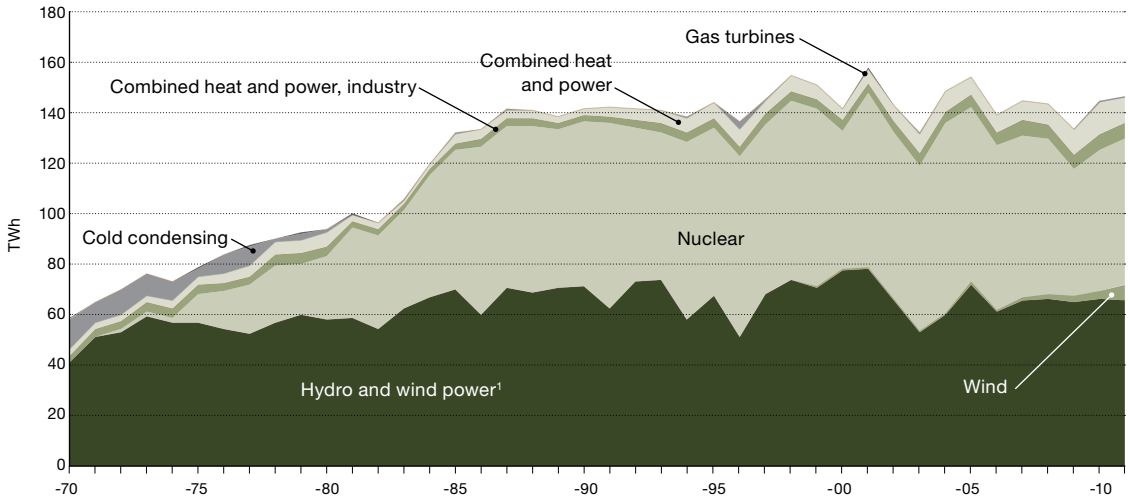
Total electricity production in 2011 amounted to 146 TWh, of which 45 % was produced by hydro power, 40 % by nuclear power, 4 % by wind power and the remaining 11 % by biofuelled and fossil based production. Much has happened since the beginning of the 1970s, when hydro power provided 69 % and oil fired cold condensing power provided 20 % of the country's electricity production, which was also considerably less than it is today.

Construction of hydro power in Sweden started around the turn of the century, 1800–1900, with most of the capacity having been built before the 1960s. At that time there were about 1800 hydro power stations in Sweden, with the greatest production from power stations on the Luleå river. The Vindel river, Pite river, Kalix river and Torne river are protected from hydro power construction under Swedish law, together with a number of smaller rivers and stretches of rivers.

The oil crises in the 1970s coincided with Sweden's expansion of nuclear power production capacity. The first commercial reactor, Oskarshamn 1, was synchronised to the grid in December 1971, and the last two of the country's then ten reactors were commissioned in 1985.

19 The Power Balance on the Swedish Electricity Market, Winters of 2011/2012 and 2012/2013, Svenska kraftnät.

Figure 18 Sweden's electricity production, by type, 1970–2011, TWh



Source: Swedish Energy Agency and Statistics Sweden.
Note: 1. Hydro power and wind power were quoted jointly until 1996, after which wind power was quoted separately.

In 2011, hydro power produced 66 TWh of electricity, which is approximately the same as during a statistically average year. Although the year started with very low reservoir levels, an early spring thaw, accompanied by high precipitation, turned a dry year into a wet year.

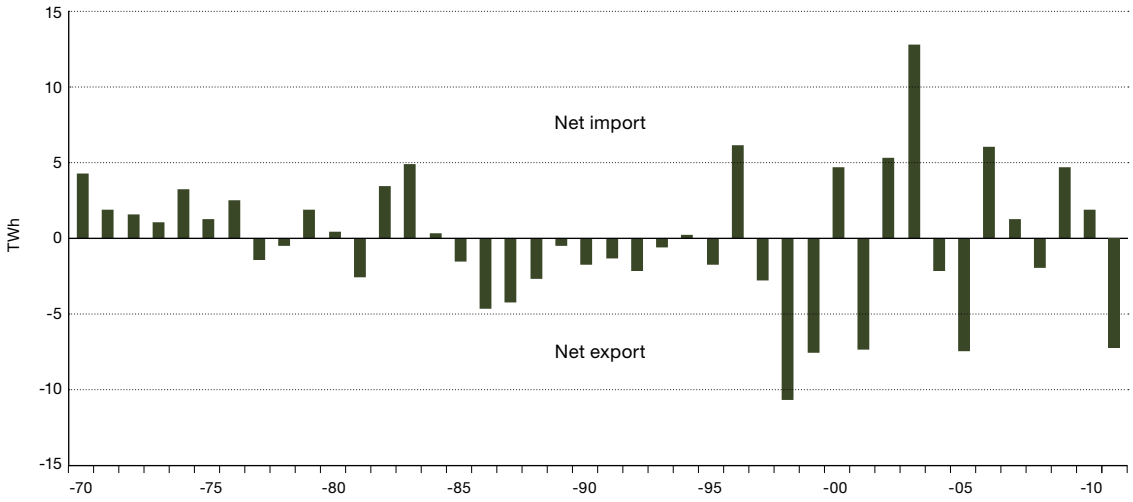
Production of electricity from nuclear power amounted to 58 TWh in 2011, which is somewhat higher than the previous year but lower than the expected average production. This expected average production from nuclear power in Sweden amounts to about 68 TWh, and there are several reasons for the shortfall of recent years. Complicated work has been performed to modernise and increase the output from several reactors, which has required long shutdown periods. In addition to this, the power stations have also been affected by minor and larger problems, all of which have contributed to reduce overall production.

Combustion based electricity production generated 16.6 TWh in 2011. 68 % of the fuel input was supplied by biofuels, by waste and by peat, with the remaining 32 % being provided by fossil fuels. Combined heat and power production (CHP) of 10.4 TWh, together with 5.9 TWh of industrial back pressure power production, dominated the combustion based electricity production, while oil fired cold condensing power plants and gas turbines constituted primarily reserve capacity.

Wind power production has increased very substantially in recent years: between 2010 and 2011 it increased by 74 %.

After a net importation of 2 TWh of electricity in 2010, 2011 saw this changed to a net export of 7.2 TWh. 5 TWh were imported to the Nordic countries as a whole, which can be compared with a net import of 19 TWh in 2010.

Figure 19 Sweden's net imports (+) and net exports (–) of electricity 1970–2011, TWh



Source: Swedish Energy Agency and Statistics Sweden.

ELECTRICITY TRADING BETWEEN SWEDEN AND OTHER COUNTRIES

Traded flows of electricity between Sweden and its neighbouring countries occur at all and any times of the day, and can vary between years and during years. Importation or exportation between countries result from price differences between different areas or different countries, depending in turn on hydrological conditions, production in nuclear power plants, transmission capacity, wind, temperature, electricity demand and other factors.

The trade is measured as the difference between import and export on an hour-by-hour basis (the net difference) which, after total summing, quantifies net imports or exports for some period, e.g. a year.

Table 2 Import / export of electricity between Sweden and neighbouring countries, 2011, TWh

TWh	Import / to Sweden	Export / from Sweden
Norway	7,1	7
Finland	4	6,1
Denmark	2,8	5,3
Germany	0,6	2,1
Poland	0,3	1,5
Total	**14,8**	**22**

Electricity networks in balance

The Nordic electricity system is based on a balance between production and use. In Sweden, it is Svenska kraftnät (Svk) that has the responsibility for maintaining the overall balance. It also operates and administers the country's high voltage electricity grid.

The electricity network needs to be changed to accommodate new energy sources. Expansion of electricity production that can vary rapidly in time requires greater flexibility and production control, as major variations in production must be quickly compensated by changes in production from other sources.

There are at present cross-border links between Sweden and Norway, Finland, Denmark, Germany and Poland. The new Fenno-Skan2 cable between Sweden and Finland was commissioned at the end of 2011. Work is also in progress on building a cable to Lithuania, under the name of Nordbalt, which is expected to come into use at about the end of 2015. The network will also be reinforced by the southwest link, which will increase operational reliability and deal with limitations in transmission capacity to southern Sweden and between Norway and Sweden.

The price of electricity

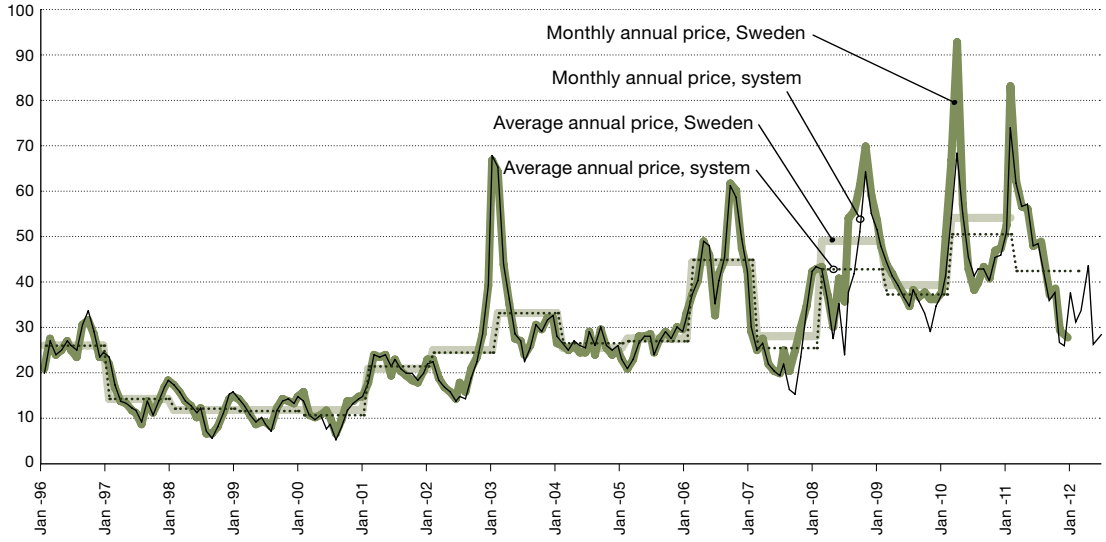
Physical trading in electricity occurs on the Elspot and Elbas markets on the Nord Pool Spot exchange. Most of the electricity produced in the Nordic and neighbouring countries is traded on the Elspot physical market. 294 TWh of electricity were traded on Elspot in 2011, equivalent to 73 % of the electricity used in the Nordic countries. The remaining physical electricity is traded internally between electricity utilities or by bilateral agreements. The members of Nord Pool are power producers, electricity traders, larger end users, portfolio managers, capital managers and brokers.

Both the start and finish of 2010 were marked by low temperatures, resulting in an increase in the demand for electricity which, in combination with reduced nuclear power availability at the beginning of the year, led to high prices on Nord Pool. The highest 24 hour average price occurred on 22nd February 2010, at just under SEK 5:00 per kWh. The price was even higher during individual hours, reaching a maximum of almost SEK 14:00 per kWh. Such conditions bring reserve capacity into use, in the form of oil fired and other power plant. The price fell during the spring and summer in comparison with the levels noted at the beginning of the year. They rose again during the last two months of the year, mainly as a result of cold weather, low reservoir levels and continued problems with nuclear power production. The average spot price on Nord Pool for Sweden in 2010 was 54 öre per kWh, which is the highest year average price that has been noted.

At the beginning of 2011, the price fell in relation to 2010, due to milder and wetter weather, coupled with nuclear power production reaching almost full capacity. The prices remained high at first, due to a deficit in hydrological balance. However, the Nordic hydro power reservoirs, which were at historically low levels, were refilled when the spring thaw started earlier than usual, bringing down the prices of electricity. The price fell further at the beginning of the autumn as a result of unusually heavy precipitation, dropping to below 10 öre per kWh for several hours. The average price of electricity for the Swedish region on Nord Pool in 2011[20] was about 44 öre per kWh.

20 The country wide price applied only until October 2011, as Sweden was divided into four supply areas on 1st November.

Figure 20 Spot prices on Nord Pool. Monthly and annual average system prices and prices for the Swedish price zone, January 1996 – April 2012, öre per kWh



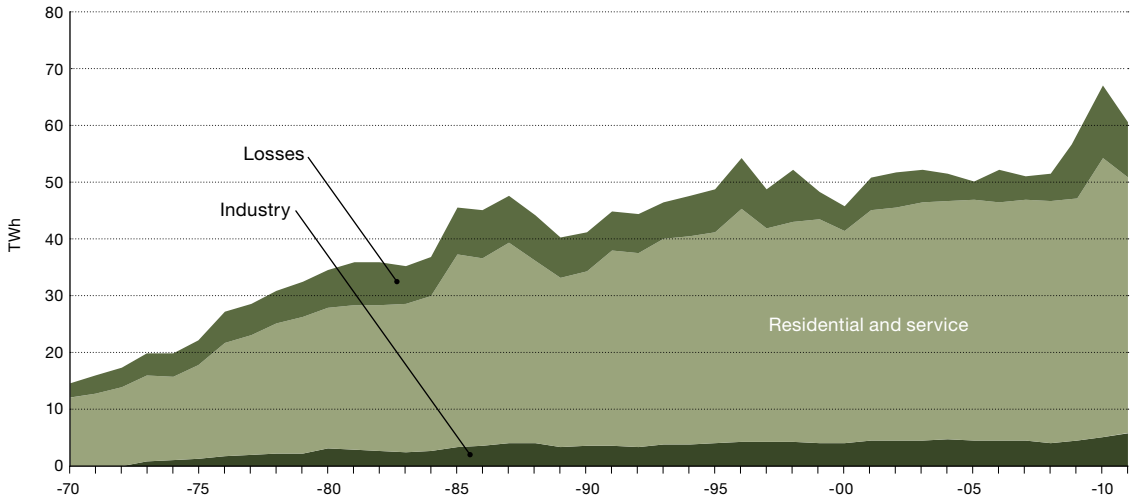
Source: Nord Pool Spot.
Note: Sweden has been divided into four supply areas since 1st November 2011, thus replacing the previous single-zone price for Sweden.

Four electricity areas

With effect from 1st November 2011, Sweden has been divided into four electricity supply areas: SE1 (Luleå), SE2 (Sundsvall), SE3 (Stockholm) and SE4 (Malmö). This means that a single national price of electricity has been replaced by four regional prices, which better reflect the relationship between supply and demand of electricity in different parts of the country.

The background to this division is that the EU Commission has demanded that Sweden should change the way in which it deals with transmission limitations on the Swedish grid. The purpose of dividing the country into electricity supply areas is to make it clear whether transmission links to neighbouring countries are required, and where in Sweden there is a need to reinforce and expand the backbone grid or to improve the balance between production and use. As there is a considerable electricity production deficit in southern Sweden (SE3 and particularly SE4), the division into supply areas has resulted (at least in the short term) in a relatively higher price of electricity in the southern parts of the country in comparison with the north (SE1 and SE2) where there is a surplus of production.

Figure 21 Use of district heating, 1970–2011, TWh



Source: Statistics Sweden and the Swedish Energy Agency, EN 20 SM.
Note: The substantial increase in 2009/2010 is due mainly to unusually cold winters, and particularly so for 2010.
Figures for 2011 are preliminary, and also from not entirely comparable sources.

The district heating market

District heating is the dominant form of heating for apartment buildings and commercial and other premises, meeting 93 % and 83 % of the respective markets in 2010. For detached houses, the proportion of the market supplied by district heating was lower at 12 %. Recent years have seen prices rise, reflecting increased costs for the district heating companies, particularly in the form of higher fuel prices.[21] District cooling was introduced in the 1990s, and is at present a small but expanding market.

The district heating market

As a result of improved technology, higher utilisation of district heating networks and an increasing proportion of locally produced and used hot water (packaged heating), distribution and conversion losses in district heating systems have fallen over the years, despite the networks having been expanded to bring them within reach of detached house customers. In 2011, average losses amounted to 16 % of the total quantity of district heating used. Losses vary noticeably between local networks. Figure 21 shows the use of district heating over the period 1970–2011.

Changes in policy measures

Competition on the district heating market is limited: production and distribution often have the same owner, and it is often difficult for suppliers of waste heat to obtain access to the distribution network. However, alternative forms of heating systems, such as heat pumps, do compete with district heating.

21 The Energy Market Inspectorate EI R 2011:08.

The Energy Markets Inspectorate is the surveillance authority in accordance with the District Heating Regulations (2008:526). The Inspectorate's regulations[22] set out companies' obligations in terms of providing price information, and of how this should be done. In addition, market transparency is improved by the companies being required to report operational and business details to the Energy Market Inspectorate.[23]

Since 2008, district heating companies have also been required to provide separate details of their district heating activities in order to prevent any excess charges from being used to finance price discrimination between customers or cross subsidising of other activities (e.g. electricity trading and electricity distribution).[24]

A possible opening for increased competition

There is today no explicit right of access to a district heating system for any party other than the owner. For this reason, a commission was set up to look into the conditions for obligatory third party access in order to open up the district heating market for access by suppliers of industrial waste heat. The Third Party Access investigation (SOU 2011:44) proposed dividing up the market in order to make networks accessible to competing production and trading companies. However, uncertainties regarding the effects and costs of introducing obligatory third party access resulted in the Energy Markets Inspectorate being instructed to investigate the matter in more detail. The Inspectorate's report is due not later than 31st March 2013.[25]

The role of the District Heating Board may be changed

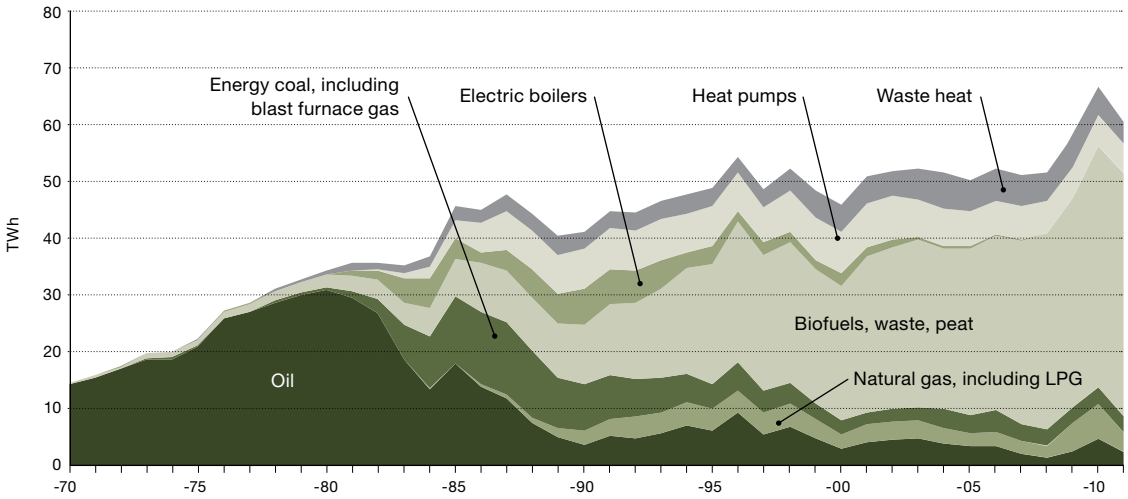
Since 2008, the district heating market in Sweden has been governed by the District Heating Act (2008:263). The Energy Market Inspectorate is the surveillance authority. District heating companies are, for example, required to negotiate with individual district heating customers concerning certain terms and conditions for the supply of district heating. If they cannot reach agreement, they can apply to the District Heating Board for arbitration. The Board shall also arbitrate negotiations between district heating companies and other parties wishing to obtain access to the distribution networks. The Inspectorate's investigation of regulated access to district heating networks also includes investigation of the District Heating Board's future role in these contexts.

Renewable district heating supported by the electricity certificate system

Recent years have seen a resurgence in interest in combined heat and power production (CHP) in Sweden, based primarily on the use of biomass fuels. In 2010, CHP provided 40 % of the country's total district heating supplies. A major contributory factor to this is the fact that, between 2003 and 2010, electricity production in CHP plants received total subsidies from the electricity certificate system to the value of about SEK 17 000 million.[26] In 2011, CHP supplied 16 TWh of electricity, of which 11 TWh qualified for support from electricity certificates.

22 EIFS 2009:2.
23 Heating in Sweden 2011, Energy Market Inspectorate, EI R 2011:06.
24 Separate accounting of district heating activities, EI R 2009:11.
25 Instruction to investigate and propose a format for a model for controlled access to district heating networks, Government Decision II8, N2012/2611/E, 2012-05-06.
26 Sweden's reporting in accordance with the CHP Directive, 2004/8/EC.
27 For plants within the EU ETS. The price base amount is 105 öre/ kilogram of carbon dioxide.
28 Certain taxation matters prior to the Budget Bill for 2013, Ministry of Finance, 16th April 2012.

Figure 22 Energy sources for district heating, 1970–2011, TWh



Source: Statistics Sweden and the Swedish Energy Agency, EN 20 SM.
Note: With effect from and including 2009, more fuels are included in the indicator. Figures for 2011 are preliminary, and also from not entirely comparable sources.

Reduced carbon dioxide tax for CHP

In 2011, the carbon dioxide tax rate on heat produced in CHP plants was reduced from 15 % to 7 % of the price base amount[27]. This can be compared with the carbon dioxide tax rate of 94 % of the price base amount for plants supplying only heat. With effect from 1st January 2013, the Government's proposal to remove carbon dioxide tax in its entirety from CHP production will come into force, and will also cover supplies of heat to industry from heating plants.[28]

Low prices of emission rights and a new trading period favour district heating

In Sweden, district heating producers are included in the EU Emissions Trading System (ETS). With effect from 2013, district heating producers will receive an allocation of emission rights based on a guideline value for district heating, which is proposed to amount to 62.3 emission rights units per TJ of heat supplied to a district heating network. This allocation is based on data for historic supplies of heat. The calculated allocation will then be reduced linearly from 80 % in 2013 to 30 % in 2020.

Supply of district heating

An advantage of district heating is its flexibility in terms of utilisation of different fuels. Since the 1970s, there has been a major shift towards the use of renewable fuels. In 2011, biofuels accounted for 47 %, waste for 20 %, peat for 4 %, oil for 4 %, natural gas for 5 %, coal for 5 %, heat pumps for 9 % and waste heat for 6 % of the energy input for district heating production in Sweden.

The use of waste has increased over the last decade, to the extent that the heat from refuse incineration now provides the base output for district heating. This increase is a result of the ban on disposal of combustible waste in landfill from 2002, coupled with a ban on landfill disposal of organic waste in 2005. The reduction in the use of (particularly) electric boilers, but also to some extent of heat pumps, has reduced the amount of electricity used in district heating sector. Figure 22 shows energy input for district heating between 1970 and 2011.

Major price differences for district heating in different parts of the country

There are significant price differences for district heating between different parts of the country. In 2011, Luleå had the country's lowest average district heating price for apartment buildings of 44,1 öre per kWh, while Hammarö had the highest price at 97, 1 öre per kWh.[30] The price differences between one town and another are due to such factors as the district heating companies' ownership structures, required rates of return, type of fuel, and geographical conditions for network installations.[31] Heating costs are therefore largely dependent on where customers live.

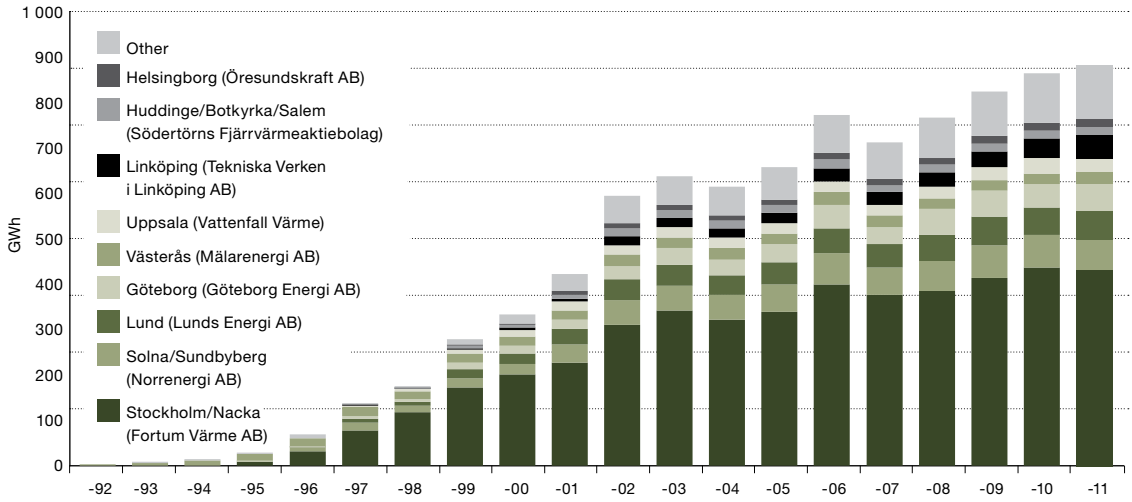
29 District heating market and world, Fjärrsyn, Report 2009:38.
30 Heating in Sweden 2012, EI R 2012:09.
31 Information and analysis of various factors affecting the prices of district heating can be found in the Energy Market Inspectorate's report, Analysis of district heating companies' revenue and costs developments, EI R 2011:08.

District cooling continues to grow but at a slower rate

District cooling is used primarily in office and shop premises, as well as for cooling of industrial processes. Its principle is the same as that of district heating, involving the production of cooled water in a larger plant and its distribution in pipes to customers. The commonest means of production in Sweden is to use waste heat or lake water as the heat source for heat pumps, with the cooled water from which heat has been abstracted providing the district cooling water. The heated output water from the heat pumps is sometimes used for district heating. Another common method of production is simply to use cold bottom water from the sea or a lake, i.e. free cooling.

The market for district cooling has expanded strongly since the first system was started up in 1992. Supplies of district cooling increased somewhat from 871 GWh in 2010 to 888 GWh in 2011: an increase of 2 %, in comparison with a 5 % increase in the preceding year. District cooling was supplied by a total of 33 companies, which is the same as in 2010. Network length increased somewhat from 362 kilometres in 2010 to 371 kilometres in 2011.

Figure 23 District cooling supplies, 1992–2011, GWh



Source: Svensk Fjärrvärme, additional processing by the Swedish Energy Agency.
Note: The statistics show only commercial district cooling, i.e. where the suppliers and property-owners are different companies.

The energy balance

Energy can never be destroyed or consumed, but only converted. The total quantity of energy used must therefore always be balanced by a corresponding quantity of energy supplied. Energy is supplied as needed to meet users' demands for energy. Demand, in turn, depends on what functions the users have need of, such as transport, lighting, heating, cooling or processes. It is this use that determines how much energy, in the form of heat or electricity, needs to be supplied.

The illustration below shows the overall structure of the energy system, from supply to final end use.
It is available for download from the Agency's website.

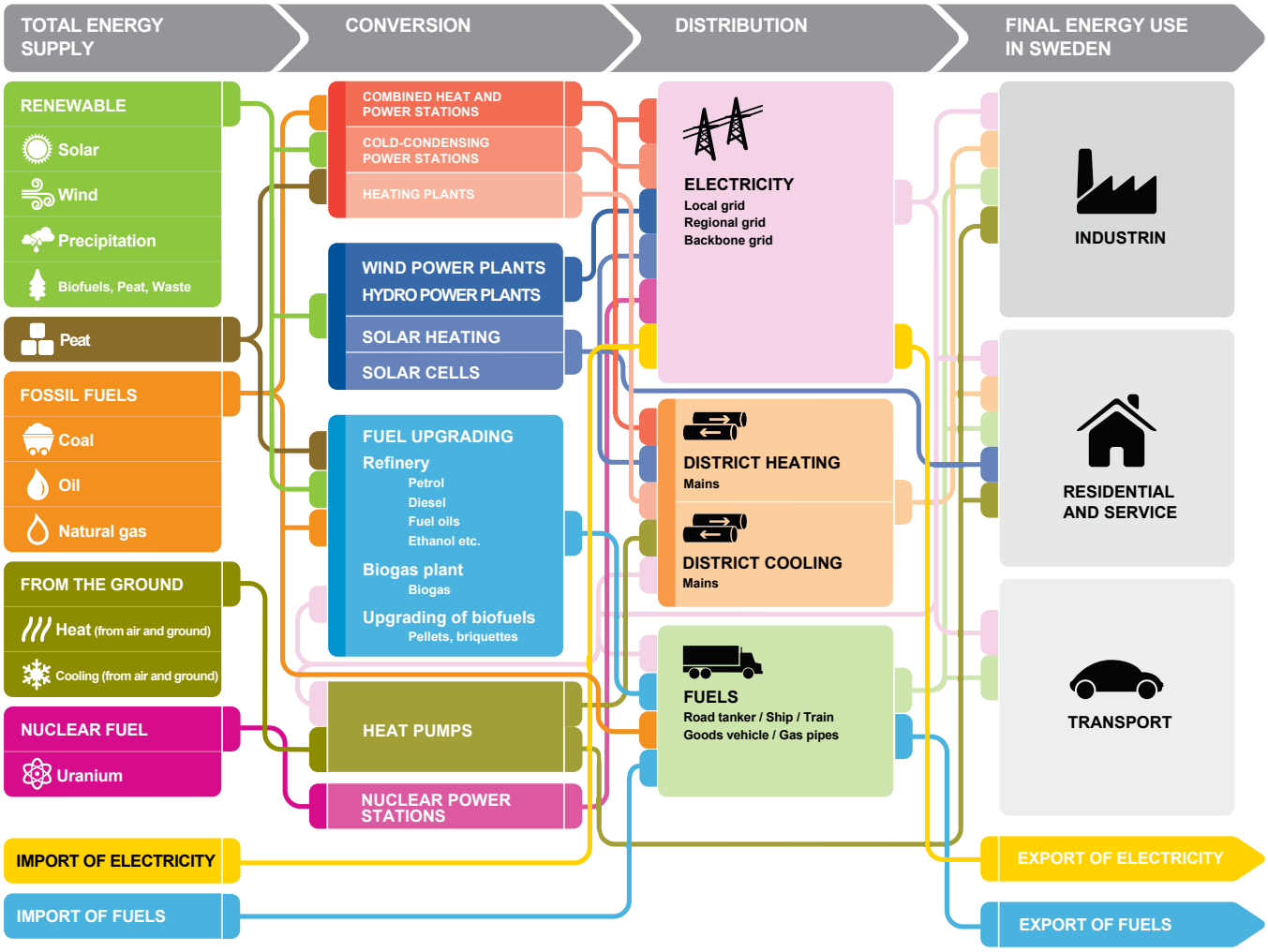
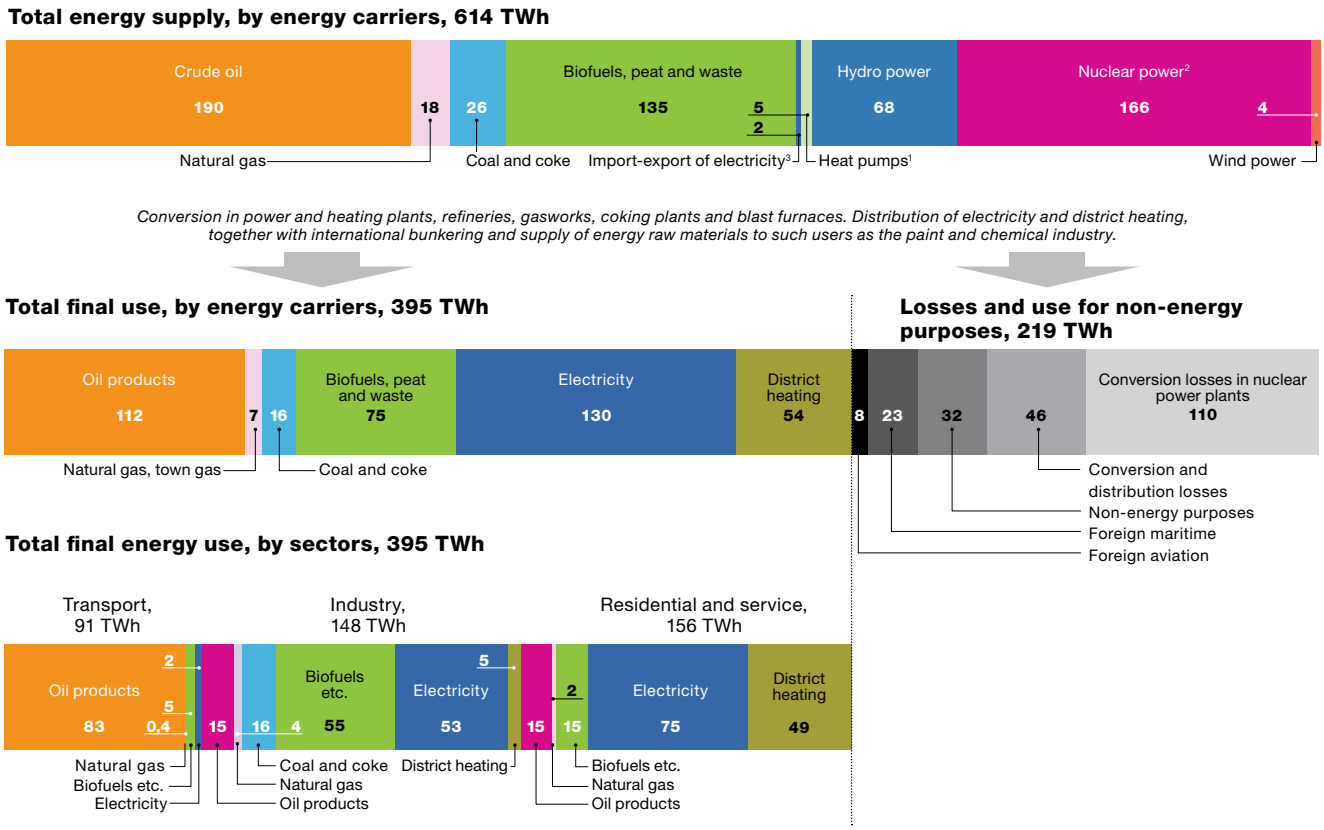


Figure 24
Energy supply and energy use in Sweden in 2010, TWh



Source: Swedish Energy Agency and Statistics Sweden.
Note: 1. Heat pumps are large heat pumps in the energy sector.
2. Nuclear power energy quantities are gross, i.e. as nuclear fuel energy input in accordance with UN/ECE guidelines.
3. Net imports of electricity are counted as supply.

Total energy supply

The quantity of total energy supplied has increased by 34 % since the beginning of the 1970s, reaching 614 TWh in 2010. The actual make up of this supply has changed greatly during the period. In 1970, crude oil and oil products supplied 77 % of Sweden's total energy input, falling to 31 % in 2010. Oil has been replaced primarily by nuclear power and biofuels, peat and waste. In 2010, nuclear power delivered 166 TWh of the country's total energy supply, supported by 135 TWh from biofuels, peat and waste, representing an increase of 214 % since 1970.

Hydro power production has increased by 66 % since 1970, reaching 68 TWh in 2010. The energy input from coal and coke, on the other hand, has remained largely unchanged since the 1970s. The supply of natural gas has increased to 18 TWh in 2010 since its introduction in 1985. Wind power and heat pumps also contribute to the country's total energy supply.

Final end use

Final end use of energy has increased from 375 TWh in 1970 to 395 TWh in 2010. Industry reduced its use of energy between 1970 and 1982, but then started to increase its use again. Nevertheless, industrial energy use was 4 % lower in 2010 than in 1970, reaching 148 TWh. As much of the energy use in the residential and services sector is for heating, the quantity used is considerably affected by outdoor temperatures. In 2010, energy use in the sector amounted to 156 TWh, compared to 165 TWh in 1970. As far as the total final energy use in the transport sector is concerned, this has increased by 63 % since 1970, reaching 91 TWh in 2010.

Losses, overseas transport and use for non energy purposes

Losses, energy use for overseas transport and materials used for non energy purposes have increased from 82 TWh in 1970 to 219 TWh in 2010, or an increase of 167 %. The difference between supply and use is made up of losses, overseas transport and non energy purposes. The greatest part of this consists of conversion losses in the nuclear power plants, which amounted to 110 TWh in 2010. Other conversion losses also arise in electricity and district heating production, refineries, gasworks, coking plants and blast furnaces. Distribution losses occur in connection with supplies of electricity, district heating, natural and town gas, coking plant gas and blast furnace gas. Overseas transport use covers both maritime and aviation transport. Use for non energy purposes consists of raw materials for the chemical industry, lubricating oils and speciality products for building construction and civil engineering activities.

Energy facts

Collection of statistics

The Government has instructed a total of 26 public authorities to collect statistics over a wide range of areas. Since 1998, the Swedish Energy Agency has been responsible for collecting statistics in the field of energy. This means that the Agency is empowered to collect statistics in order to provide information on the energy sector. The Agency determines which investigations are required, and in so doing must also consider the needs and requirements of various users. As part of their work of gathering statistics, public authorities are also required to follow public procurement procedures when deciding which organisation is to process and publish the statistics.

Within the energy sector there are three areas of statistics: energy balances, price developments in the energy sector, and supply and use of energy. As the responsible authority for collection of these statistics, the Agency is required to comply with all legislation, regulations and rules applicable at national level and at EU level. In addition to them, there are a number of guidelines and policies that have been published by the Official Statistics Council, ROS.[32] Although compliance with these guidelines and policies is not mandatory, the Agency attempts to do so as far as possible. The Agency intends, in 2014, to implement the ROS 2006:1 Quality Guideline in 2017. A commission has been appointed by the Government to review the country's system of collecting and processing statistics from a number of perspectives: quality, availability, secrecy and clarity. The commission is due to report on 10th December 2012.[33]

Energy units and conversion factors

This section presents and defines units and conversion factors. Relationships between various energy units are also given, in order to make it possible to compare statistics with other international statistics. It should be noted that the conversion factors relate to the average values for various fuels, and that there are variations between qualities. This applies particularly for wood fuels and for coal.

The international standard unit for energy is the joule (J), which is equal to 1 watt-second. Sweden generally uses the watt-hour (Wh). International comparisons and statistics often use the unit of toe (tonne of oil equivalent). In some applications, calories (cal) are still used. However, all these units are impractically small for dealing with large energy quantities: instead, larger units are used through the additions of prefixes, such as petajoule (PJ) or terawatt-hour (TWh).

32 Acceptable quality and criteria for official statistics, Statistics Sweden.
33 Commission to investigate Statistics Sweden and the National Statistics System, Dir. 2011:32, Fi 2011:05.

Table 3 Prefixes used before energy units

Prefix		Factor	
k	kilo	10^3	thousand
M	mega	10^6	million
G	giga	10^9	milliard
T	tera	101^2	billion
P	peta	101^5	thousand billion

Table 4 Conversion factors between energy units

	GJ	MWh	toe	Mcal
GJ	1	0,28	0,02	239
MWh	3,6	1	0,086	860
toe	41,9	11,63	1	10 000
Mcal	0,0419	0,00116	0,0001	1

Table 5 Calorific values in MWh and GJ per physical quantity

Fuel	Physical quantity	MWh	GJ
Chipped forest timber	1 tonne	2,00-4,00	7,20-14,40
Peat	1 tonne	2,50-3,00	9,00-11,0
Pellets, briquettes	1 tonne	4,50-5,00	16,0-18,0
Coal	1 tonne	7,56	27,2
Coke	1 tonne	7,79	28,1
Nuclear fuel	1 toe	11,6	41,9
Crude oil	1 m^3	10,1	36,3
Topped crude oil	1 m^3	11,1	40,1
Petroleum coke	1 tonne	9,67	34,8
Asphalt, surface dressings	1 tonne	11,6	41,9
Lubricating oils	1 tonne	11,5	41,4
Vehicle petrol	1 m^3	9,00	32,6
Aviation petrol	1 m^3	9,08	32,7
Virgin naphtha	1 tonne	8,74	31,5
Petroleum naphtha	1 m^3	9,34	33,6
Aviation kerosene and other intermediate distillates	1 tonne	9,58	34,5
Other kerosene	1 m^3	9,54	34,3
Diesel fuel and gas oil[1]	1 m^3	10,00	35,9
Heavy fuel oils nos. 2 - 5	1 m^3	10,6	38,1
Propane and butane	1 tonne	12,8	46,1
Town gas, coke retort gas	1000 m^3	4,65	16,8
Natural gas[1]	1000 m^3	11,1	39,8
Blast furnace gas	1000 m^3	0,93	3,35
Ethanol	1 m^3	5,90	21,2
Biogas	1000 m^3	9,70	34,9
FAME	1 m^3	9,17	33,0

1) The values for natural gas are for the lower calorific value, i.e. without the contribution from latent heat of condensation.
Note: The table shows conversion factors to three significant figures. Calculations use a greater number of significant figures.

Terminology and definitions

Biobased motor fuels are liquid or gaseous fuels produced from biomass and intended for transport purposes.

Biofuels are a renewable resource that has a physical limit. All combustible biological materials are some form of biofuel, such as logs, forest chips, bark, sawdust and energy forest. Processed and upgraded forms are such as wood pellets, ethanol and biogas.

Biomass is the biologically degradable part of products, waste and waste products from agriculture and forestry, as well as from industrial waste and domestic waste.

Black liquor is a by-product from the manufacture of sulphate pulp for paper manufacture, and is often used as an energy source in the pulp industry.

Combined heat and power production (CHP) is the use of a thermal process, usually a boiler, for the combined production of electricity and heat.

An eco car is a passenger car powered by biofuels such as electricity, ethanol, biogas or some other renewable motor fuel. In the Road Traffic Taxation Act, eco cars are defined as:

- *passenger cars powered by petrol, or petrol in combination with electricity from batteries, and from which the carbon dioxide emissions in the combined cycle driving mode do not exceed 120 g/km,*
- *passenger cars powered by diesel fuel or diesel fuel in combination with electricity from batteries, and from which the carbon dioxide emissions in the combined cycle driving mode do not exceed 0.92 litres of petrol per 10 km or 0.97 m^3 of gas per 10 km,*
- *passenger cars that are capable of being partly or solely powered by some fuel other than petrol or LPG, or by some other fuel in combination with electricity from batteries, and of which fuel consumption in the combined cycle driving mode does not exceed 9.2 litres of petrol per 100 km or 9.7 m^3 of gas per 100 km,*
- *passenger cars that are classified as Environmental Class EI, and which have a maximum electrical energy consumption not exceeding 37 kWh per 100 km.*

Electricity-intensive industries, as defined in the Act Concerning Electricity Certificates, are companies that, either in their entirety or as a particular part of a company that constitutes an independent business or performs an independent activity

- *have performed for the last three years an industrial manufacturing process using an average of at least 190 MWh per million SEK of the added value of the industry's production, or*

- *use electricity in a new industrial manufacturing process at a historic or expected average rate of at least 190 MWh per million SEK of the added value of the industry's production, or*
- *use electricity for purposes that qualify for exemption from energy tax on electricity, in accordance with Section 11 9 § 2, 3 or 5 of the Act (1994: 1776) Concerning Taxation of Energy.*

The Emissions Trading System (EU ETS) is the EU's trading system for emission rights for greenhouse gases. The system imposes a ceiling for magnitude of emissions from certain activities within the EU. This creates a price for greenhouse gas emission rights, thus making measures to reduce greenhouse gas emissions economically viable.

Energy carriers store or transport energy. Examples include electricity, hot water, petrol and diesel fuel.

Flowing energy sources are renewable energy sources: hydro power, solar energy, wind power, wave energy, biomass, geothermal energy and tidal energy.

Fossil fuels are oil, coal and natural gas, created millions of years ago from dead plant and animal matter. The use of fossil fuels will decline, as the rate at which they are being extracted is very much greater than the rate at which they are being recreated.

Fracking is a method for recovering oil and gas, involving fracturing rock by injecting large quantities of water in order to release oil and gas through the fractures.

Geothermal energy is heat from the interior of the earth, such as volcanic heat.

Hydrological balance refers to the hydrological situation, i.e. the quantity of snow, run off, ground water and the amount of water in the hydro power reservoirs, all in comparison with the normal situations for these sources.

Industrial back pressure production is the process of producing both electricity and heat (process steam) in industry.

Low admixture is the addition of a few percentage parts of biobased motor fuels to petrol or diesel fuel.

Motor fuels are gaseous, liquid or solid materials for starting, running or warming up machines, engines etc.

Natural gas is a fossil fuel, of which 90 % consists of methane. Its combustion produces lower levels of environmentally hazardous substances than does combustion of oil. The gas is used for such purposes as fuel in industry, for motor vehicles and for domestic purposes.

The National Board of Housing, Building and Planning is the public authority having responsibility for matters concerning the built environment, conservation of land and water areas, physical planning, construction and administration of the built environment, and matters relating to housing.

NZE is the abbreviation for near zero energy buildings: i.e. buildings that fulfil the energy performance requirements in accordance with the National Board of Housing and Planning's requirements. The EU Building Performance Directive specifies that after December 2020, all new buildings must be of NZE type.

PFE stands for Programme For Energy Efficiency improvement, and is aimed at Swedish energy intensive industrial companies. Companies following a structured plan for energy efficiency improvements and implementing improvement measures can be exempted from electricity tax on electricity used in their manufacturing processes.

Policy measures introduced by the state are statutory measures, in the form of acts or regulations. They can apply to economic, mandatory or informative acts and regulations:

- *In the form of economic legislation to influence actions by modifying the market.*
- *In the form of mandatory legislation imposing requirements on public choices and awareness.*
- *In the form of information by assisting society to respond in a more favourable manner.*

Renewable energy sources are the flowing energy sources that are constantly recreated through the effect of the sun on the earth and nature. They are therefore referred to as renewable sources. Water, wind and wave energy are flowing energy sources, as is tidal energy. Biomass is regarded as a solar based energy source, and is therefore also a renewable energy source, as is solar energy itself. In addition to these sources there are also geothermal energy sources which have their origin in the interior of the earth.

Shale gas is natural gas (methane) that has collected in certain shale bodies.

The spot price of electricity is the hour by hour price of electricity on the Nord Pool Nordic electricity exchange, and based on supply and demand.

Stored energy sources are the fossil fuels of natural gas, crude oil, coal and, to some extent, also peat.

The super-eco car subsidy was introduced by the Government on 22nd December 2011. It amounts to a maximum of SEK 40 000 per vehicle, and applies to passenger cars having very low greenhouse gas emissions, not exceeding 50 g CO_2 per km. This means that qualifying vehicles will mostly be of hybrid or 100 % electrical type.

Material published by the Swedish Energy Agency can be ordered or downloaded via the Agency's web site www.energimyndigheten.se, or be ordered by sending an e-mail to energimyndigheten@cm.se, or by fax from +46 8 505 933 99.

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Our objective – smarter use of energy

The Swedish Energy Agency is a public authority, the objective of the work of which is to bring about the establishment of a reliable, minimum-environmental-impact and efficient energy system. Through international cooperation and engagement, we can contribute to achieving worldwide climate objectives. The Agency finances research and development of new energy technologies. We actively support commercial ideas and innovations that can in due course lead to the setting up of new companies. We also show Swedish households and companies how they can make better use of their energy.

Energy in Sweden is published annually, and is intended to provide decision-makers, journalists, teachers and the public with coherent and easily available information on developments in the energy sector.

Energy in Figures 2012, which complements Energy in Sweden 2012 with more detailed statistics, can be downloaded from the Agency's website.

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