Publication Year 2009

Energy Indicators 2009

Follow-up of Sweden's energy-policy objectives

Theme: EU

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Preface

The Swedish Energy Agency has been instructed to develop indicators. A first report of indicators was published in 2002 and was called “Energy indicators for 2002 for following up Sweden’s energy policy objectives”. Thereafter, annual reports have been carried out which have covered various themes. Previous themes have been: the electricity market (2003), the district heating and natural gas markets (2004), energy use (2005), oil use (2006), secure energy supply (2007) and renewable energy (2008). This year’s publication is on the subject of the EU.

The purpose of the report is to present indicators for following up Sweden’s energy policy objectives. This year’s theme shows the EU’s objectives for the following areas: climate, renewable energy and energy efficiencies. The report also looks at how far Sweden has come in relation to other countries. The publication begins with a brief review of the energy policy objectives, followed by theme indicators. This is followed by five background indicators and 20 base indicators. Each indicator is described with comments. Theme indicators from the previous years are not included in the update. The previous publications are available on the Swedish Energy Agency’s website, www.energimyndigheten.se.

While this report is intended to serve as a tool for following up the energy policy objectives, we are hoping that it will also serve as a contribution to the discussion on the development on the future Swedish energy system.

The project managers were Katarina Jacobson and Carola Lindberg.

Eskilstuna, July 2009

Tomas Kåberger
Director-General

Content

Swedish energy policy objectives

In spring 2009, the government presented proposals for a new unified climate and energy policy, which were handled by the parliament during summer 2009. The Swedish energy policy will be based on the same foundations as in the EU, i.e. ecological sustainability, security of supply and competitiveness. New objectives have been made for the following areas: climate, renewable energy and energy efficiencies. A maximum of 10 new nuclear reactors will be allowed in the same areas when the old reactors are no longer in service. For the time being, the indicators are reported as per the previous year's structure.

The purpose of the indicators is that they should be used for following up the energy policy objectives. In the 2002 draft bill "Collaboration for a secure, efficient and environmentally friendly energy supply", the objectives of the energy policy were summarised as follows: "The objective of the Swedish energy policy is to secure the availability of electricity and other energy, in the short and long term, on globally competitive terms. The energy policy must create the conditions for efficient and sustainable energy use and a cost-effective Swedish energy supply with a low negative impact on health, the environment and the climate, and to facilitate the conversion to an ecologically sustainable society. Good economic and social development in the whole of Sweden will therefore be promoted."

The objectives of the energy policy are expressed more comprehensively and in greater detail in the further text of the draft bill. There are also reports of further objectives in other documents. The compilation of objectives presented below is based on the following sources:

- Budget Draft Bill 2008/09, Expenditure area 21 (Energy).
- Energy Draft Bill 2001/02:143 "Collaboration for a secure, efficient and environmentally friendly energy supply", from March 2002.
- Draft Bill 2004/05:150 "Swedish environmental objectives – a joint assignment", from 2005, and Environmental and Agricultural Committee report 2005/06:MJU3.

The objectives in the energy policy can be divided into the three activity areas: Electricity market policy, Other energy market policy and Policy for a sustainable energy system. In addition, there are objectives linked to energy in the Swedish environmental objectives and policy area: Protection and preparedness for accidents and difficult circumstances.

Examples of how the indicators agree with the three activity areas in the energy policy are shown below. One indicator may have links to more than one activity area. In the next section, Choice of indicators, examples are given regarding how the indicators are linked to the overall energy objectives: secure energy supply, competitiveness and low impact on the environment.

General energy policy objectives

Secure availability of electricity and other energy on globally competitive terms.
See base indicators "3. Degree of self-sufficiency", "5. Power balance", "10. Energy prices to industrial customers, including relevant taxes", "13. Energy prices to domestic customers, including relevant taxes", "18. Electricity price on the Nord Pool spot market".

Efficient and sustainable energy utilisation

See base indicators "2. Use of fossil fuels in relation to the total energy used", "4. Combined heat and power generation", "8. Energy use of industry per value added", "9. Electricity use in industry per value added", "12. Energy use for heating dwellings and premises" and theme indicators.

Efficient energy use in energy-intensive industries should be promoted while also safeguarding the competitiveness of industry.
See base indicators "8. Energy use of industry per value added", "9. Electricity use of industry per value added", "10. Energy prices to industrial customers, including relevant taxes" and "11. Energy cost as a proportion of the total variable costs, in different sectors of industry".

Electricity market policy

The electricity market policy's objective is to achieve an efficient electricity market that generates reliable access to electricity at internationally competitive prices. The objective reflects an effort to achieve a smoothly performing market with an efficient utilisation of resources and efficient pricing. The objective covers a further development of the joint electricity market in the Nordic countries.
See base indicators "6. Total market share of the three largest electricity suppliers", "7. Proportion of end consumers who have renegotiated their contracts, including those who have switched to a different electricity supplier", "10. Energy prices to industrial customers, including relevant taxes", "13. Energy prices to domestic customers, including relevant taxes", "18. Price of electricity on the Nord Pool spot market" and "19. Total market share of the three largest electricity generators".

Other aspects of energy market policy

Other aspects of energy market policy focus principally on energy rather than electricity, i.e. piped natural gas and district heating. The objective is that the energy policy will be formulated so that the energy markets will provide reliable access to energy – heat, fuel and power – at reasonable prices.
See base indicators "10. Energy prices to industrial customers, including relevant taxes", "11. Energy cost as a proportion of the total variable costs, in different sectors of industry", "13. Energy prices to domestic customers, including relevant taxes" and "14. Energy expenditure by households, including motor fuel, in relation to the total expenditure by the households".

Policy for a sustainable energy system

The objective is that energy should be used as efficiently as possible, taking into account all resources available. Strict demands will be made on safety and care for health and the environment in the conversion and development of all energy technology.
See base indicator "4. Combined heat and power generation", "8. Energy use of industry per value added", "9. Electricity use by industry per value added" and "12. Energy use for heating and domestic electricity/ property electricity/ operating electricity per unit of area for dwellings and non-residential premises".

The use of renewable electricity will increase by 17 TWh from 2002 up to 2016, at the same time as technical development is stimulated and costs are minimised. The Swedish Energy Agency will investigate how an increase in renewable electricity by 25 TWh from 2002 up to 2020 can be carried out. Objectives for wind power were established in 2002. Local authorities shall have agreed plans for 30TWh of wind power production by 2020, of which 20 TWh on land and 10 TWh offshore. The Swedish energy policy emphasises the importance of increasing the input of energy from renewable sources. An increase in renewable energy is regarded as an important step in the direction towards sustainable development.
See theme indicator "II. Energy from renewable energy sources".

The use of fossil fuels should be maintained at a low level.

See base indicator "2. Use of fossil fuels in relation to the total energy used".

Swedish environmental objectives linked to energy

The total energy use per unit of area heated in dwellings and public/commercial premises is declining. The reduction should be 20% up to 2020 and 50% up to 2050 in relation to the use in 1995. The dependence on fossil fuels for energy supply in the built-up sector will be broken by 2020, while the proportion of renewable energy will continuously increase.
See base indicator "12. Energy use for heating and domestic electricity/ property electricity/ operating electricity per unit of area for dwellings and non-residential premises".

The average value of Swedish emissions of greenhouse gases in the period 2008–2012 will be at least 4% lower than the emissions in 1990. The emissions will be calculated as carbon dioxide equivalents and will comprise the six greenhouse gases in accordance with the Kyoto Protocol and the Intergovernmental Plan on Climate Change's (IPCC) definitions. The partial target will be achieved without compensation for take-up in carbon sinks or by means of flexible mechanisms (within the "Limited climatic impact" environmental objective).

The government confirmed this intermediate target in 2006. The EU's emissions trading scheme (ETS), which includes industries and electricity- and heat generation, comprises approximately one third of Swedish emissions. For the trading system as a whole, there is an emissions ceiling, but exactly where the reductions take place is determined by where the cost-effective means of action are. Sweden cannot, therefore, exercise control over what the actual emissions from the trading sector in Sweden are, only over the allocated size of the emission rights.
See base indicator "15. Carbon dioxide emissions by sector".

By 2010, the emission of sulphur dioxide to air in Sweden will have declined to 50,000 tonnes (within the "Only natural acidification" environmental objective).
See base indicator "16. Sulphur dioxide emissions by sector".

The emissions of nitrogen oxide to air by 2010 will have declined to 148,000 tonnes (within the "Only natural acidification" environmental objective).
See base indicator "17. Nitrogen oxide emissions by sector".

Choice of indicators

The energy indicators in this report are divided into three groups: theme indicators, background indicators and base indicators. The theme indicators follow up the energy policy objectives within a special area selected every year. The background indicators do not follow up any energy policy objectives, but their purpose is to provide an increased understanding of causality and what it is that drives development in the Swedish energy system. Base indicators follow up energy policy objectives in various policy areas and are updated every year.

Indicators for the theme area EU

This year indicators for the following areas are reported: climate, renewable energy and energy efficiencies in the EU. Several of the base indicators reflect aspects of this development, but they are reported separately in the report, so that the previous year's structure for reporting is followed.

This year's theme is illustrated by the following indicators:

I. Climate: Primary energy use, Emission greenhouse gases, Tax levels and energy prices.
II. Renewable energy: Total renewable energy, Renewable electricity generation, Renewable motor fuels.
III. Energy efficiencies: Energy intensity, Energy use for heating, transports.

In addition to the theme indicators, the following base indicators have links to this year's theme.

Climate

Base indicator 15 shows the development of greenhouse gas emissions in Sweden. Base indicator 10 shows energy prices for industrial customers, including taxes. Base indicator 13 shows energy prices for domestic customers, including taxes.

The theme section shows how Sweden is faring compared to other countries in the EU regarding the emissions of greenhouse gases, energy prices and tax levels.

Energy from renewable energy sources

Base indicator 1 – shows the proportion of energy from renewable sources in relation to various types of utilisation, and base indicator 20 – shows the quantity of motor biofuels and the number of biofuel-fuelled vehicles. For base indicator 1, the 49% target is reported along with details of the electricity certificate system. In base indicator 20, developments regarding biofuels in Sweden are shown in accordance with the EU directive from 2003. The theme section shows how Sweden is faring compared to other countries in the areas of renewable energy (2005), renewable electricity production and the EU directive for biofuels.

Energy efficiencies

Base indicator 8 shows industry's energy use per value added. Base indicator 12 shows the energy use for heating etc. Base indicator 20 shows the quantity of motor biofuels and the number of biofuel-fuelled vehicles.

The theme section shows how Sweden is faring compared to the EU-15 regarding energy intensity, energy use for heating, vehicle energy use and energy intensity in industry.

Statistics

The statistics for the area climate have been developed as a result of the reporting requirements made in, among other things, the Climate Convention. This means that the statistics has been directed by the international guidelines. In addition to the official statistics, since 2005, there has also been information available regarding emissions within the framework for the EU's emission trading system.

There are limitations in the statistics that make it difficult to follow up the development of certain renewable energy sources. These limitations include non-commercial energy, i.e. energy that is not sold/purchased on any market, such as burning wood for heating purposes, heat from solar collectors, and electricity from solar cells on roofs or from a wind turbine. Other areas where further development of the statistics is required include the combustion of waste and heat pumps.

The statistics for the area increasing energy efficiency is difficult to interpret. There are several different objectives regarding energy efficiencies and there are no simple and clear ways

Year 2003	Theme: Electricity market	Designation
Theme indicator I	Price of electricity on the Nord Pool spot market (Base indicator 18 in the 2008 publication)	–
Theme indicator II	Proportion of Sweden's electricity use procured on the Nord Pool spot market	T03II
Theme indicator III	Limitations in electricity transmission	–
Theme indicator IV	Trading margins for electricity trading companies for sales of purchased electricity to the end customer	T03IV
Theme indicator V	Total market share for the largest electricity generators (Base indicator 19 in the 2008 publication)	–
Year 2004	**Theme: District heating market and natural gas market**	
Theme indicator I	Energy use for space heating	T04I
Theme indicator II	Development of the price of district heating in relation to some other important energy carriers for space heating	T04II
Theme indicator III	Natural gas as a proportion of total energy supplied in Sweden and for the area in which gas is available	T04III
Theme indicator IV	Consumption of natural gas distributed per user sector	T04IV
Year 2005	**Theme: Energy use**	
Theme indicator I	Energy use per capita	T05I
Theme indicator II	Energy use per sector	T05II
Theme indicator III	Energy use for space heating per construction year	T05III
Theme indicator IV	Energy use for space heating	T05IV
Theme indicator V	Number of newly registered biofuel-fuelled vehicles and the amount of motor biofuel used (Theme indicator III in the 2008 publication)	–
Year 2006	**Theme: Oil use**	
Theme indicator I	Oil use per sector, total and as a proportion of total energy used	T06I
Theme indicator II	Index for delivery volume and price of petrol, diesel fuel and Eo1 fuel oil	T06II
Theme indicator III	Oil use for transport per GNP and per fuel type	T06III
Theme indicator IV	Transport of goods distributed between groups of goods	T06IV
Theme indicator V	The Swedish vehicle fleet	T06V
Year 2007	**Theme: Secure energy supply**	
Theme indicator I	Long-term marginal costs of oil, natural gas, coal and electricity compared with current market prices	T07I
Theme indicator II	Capacities and limitations in electricity transmission links to other countries, and differences in the prices of electricity between the Sweden price area and the system price on Nord Pool	T07II
Theme indicator III	Conductor types and interruptions in the electricity distribution network	T07III
Theme indicator IV	Flexibility in the method of heating single-family houses, multi-family homes and commercial premises	T07IV
Theme indicator V	Flexibility in district heating generation	T07V
Year 2008	**Theme: Renewable energy**	
Theme indicator I	Total renewable energy	T08I
Theme indicator II	Renewable electric power, district heating and district cooling generation	T08II
Theme indicator III	Renewable energy in transport	T08III
Theme indicator IV	Use of renewable energy in dwellings, public services/commercial premises	T08IV
Theme indicator V	Bioenergy	T08V

of calculating how targets have been fulfilled. There is a risk that different countries report statistics in different ways. It is difficult to determine how great the trend changes are from energy efficiencies and much is a result of other factors.

Background indicators

In addition to the base indicators and theme indicators, a number of so-called "background indicators" are reported, the purpose of which are to provide as complete a picture of the energy systems as possible. These background indicators will hopefully make it easier for the reader to place the other indicators in a wider context. The following background indicators are displayed:

A. Total energy supply by energy carriers, and the energy intensity at the supply stage.
B. Total final energy use, by energy carriers.
C. Total final energy use, by sectors and the energy intensity at the utilisation stage.
D. Total energy supplied for electricity generation, by energy carriers.
E. Total energy supplied for district heating generation, by energy carriers.

Base indicators

Since many of the energy policy objectives are expressed in general terms and are not quantitative, the choice of indicator is not self-evident. When choosing indicators, a number of requirements have served as a point of departure. The indicators should:

– correspond to one or several objectives, and it is not efficient for them to show something that is of "general interest".
– be easy to understand.
– measure what is intended.
– be based on reliable data information, preferably official statistics.
– be suitable for expressing in time series.
– limited to a maximum of for example 25.

A number of base indicators have evolved from the basis of the energy policy objectives from 2002. These base indicators, numbered from 1 to 20, are updated annually and are developed further in some cases. Since 2002, when the report was published for the first time, some base indicators have been added. The new base indicators have been located at the end, which may seem inconsistent in some cases, since base indicators related to the same area are not located close to each other. In spite of this, we have chosen to retain this numbering of base indicators in order to simplify the comparison of base indicators between the publications in different years. The list below shows the base indicators selected.

1. Share of energy from renewable sources.
2. Use of fossil fuels in relation to total energy used.
3. Degree of self-sufficiency.
4. Combined heat and power (CHP) generation (has been supplemented in 2008 with the fuel used for electric power and heat generation in CHP generating stations connected to the district heating system).
5. Power balance.
6. Total market share of the three largest electricity suppliers.
7. Proportion of electricity consumers who have renegotiated their contracts, including those who have switched to a different electricity supplier.
8. Energy use of industry per value added in a number of industrial sectors.
9. Industry's electricity use per value added in a number of industrial sectors.
10. Energy prices to industrial customers, including relevant taxes.
11. Energy cost as a proportion of the total variable costs, in different industrial sectors.
12. Energy use for heating and domestic electricity/ property electricity/ operating electricity per unit of area for dwellings and non-residential premises.
13. Energy prices to domestic customers, including relevant taxes.
14. Energy expenditure by households, including motor fuels, in relation to a total expenditure by the households.
15. Carbon dioxide emissions, by sector (have, since 2008, been supplemented with emission intensity in the form of total emissions of greenhouse gases per GNP (Gross National Product) and per capita).
16. Sulphur dioxide emissions, by sector.
17. Nitrogen oxide emissions, by sector.
18. Price of electricity on the Nord Pool spot market.
19. Total market share for the three largest electricity generators.
20. The quantity of motor biofuel used and the number of biofuel-fuelled vehicles.

Theme indicators for the previous year

Each year, a special theme is chosen for following up the energy policy objectives within a specific area. The table on page nine shows the themes and theme indicators used in previous years. Theme indicators from the previous year are included in each publication and any updates are shown at the Swedish Energy Agency website www.energimyndigheten.se.

How indicators are connected to each objective

Energy policy objectives from 2002 can be divided up into three parts: secure energy supply, competitiveness and environment. The table below shows which energy policy objectives, as base indicators, are followed up in this report. There are also indicators which follow up environmental policy objectives because overall objectives in the energy policy have a low impact on the environment. The overall objective of a Secure energy supply is also an objective within the policy area Protection and preparedness for accidents and difficult circumstances, whereby the energy supply is considered to be an operation of importance to society and must not break down.

Theme indicators for this and previous years are also linked to the objectives below, but they are not included in the table below.

Objectives	Indicator
Secure energy supply	
Secure the supply of electricity and other energy.	3, 5
The electricity supply will be secured via an energy system based on durable, preferably domestic, and renewable energy sources together with efficient energy use.	1, 3, 4
Good delivery quality for electricity must be established.	3, 5
Energy supply must, to an increasing extent, be based on renewable energy.	1
Investments in research, development and demonstration of new energy technologies will, over the next 10 years, reduce the costs and increase electricity and heat production considerably from renewable energy sources.	
Reduce the risk for and consequences of accidents and difficult circumstances on society during peace times.	5
Competitiveness	
Competitive conditions.	10, 11, 13
Cost-effective Swedish energy supply.	10, 13
Efficient and sustainable energy utilisation.	1, 4, 12
An efficient electricity market that generates a secure supply of electricity at internationally competitive prices.	6, 7, 10, 13, 18,19
Electricity supplier changes will function adequately.	7
Consumers and small to medium-sized companies will have sufficient information in order to act on the deregulated electricity market.	7
The objective is that energy should be used as efficiently as possible, taking into account all resources available.	4, 12
Stable conditions for a competitive economy and for a renewal and development of Swedish industry.	10, 11
Efficient natural gas market with substantial competition.	10, 13
The energy markets will provide a secure supply of energy – heating, fuels and motor fuels – at reasonable prices.	3, 5, 8, 9, 10, 11, 13, 14
Industry's use of electricity will not be limited to anything other than current regulations within tax and environmental legislation.	5
Efficient energy use in energy-intensive industries will be promoted, while also safeguarding the competitiveness of industry.	8, 9, 10, 11

Environment	
Energy supply that has a low negative impact on health, environment and climate.	15, 16, 17
Facilitate the change to an ecologically sustainable society.	1
Consideration of Swedish environmental and climate objectives.	15, 16, 17
The use of fossil fuels should be maintained at a low level.	2, 20
Total energy use per unit area in heated dwellings and public/commercial premises should be reduced by 20% by the year 2020 and 50% by the year 2050 – in relation to energy use figures for 1995.	12, 15, 16, 17
The use of renewable electricity should increase by 17 TWh from 2002 to 2016.	1
The use of biofuels and other renewable fuels in Sweden will make up a minimum of 5.75% of the total of petrol and diesel for transport purposes calculated on the energy content from 2010.	20

Source:
Budget Draft Bill 2008/09, Expenditure area 21 (Energy).
Energy Draft Bill 2001/02:143 “Collaboration for a secure, efficient and environmentally friendly energy supply”, from March 2002.
Draft Bill 2004/05:150 “Swedish environmental objectives – a joint assignment”, from 2005 and Environmental and Agricultural Committee report 2005/06:MJU3.

Introduction to theme section

This year the theme part describes the EU´s objectives for the areas climate, renewable energy and energy efficiency. It also describes how Sweden will implement directives from the EU.

This year, the theme part in the indicator report describes the EU's objectives for the following areas: climate, renewable energy and energy efficiency and how Sweden will implement directives from the EU. Indicators show developments in the EU and how Sweden is faring compared to other countries. The theme part also describes briefly what has recently been decided within the areas, i.e. the more forward-looking objectives for a 20% reduction in greenhouse gas emissions, a 20% share of renewable energy and 20% more efficient energy use by the year 2020. The purpose of these EU objectives is to reduce the impact on the climate and increase security of supply while maintaining or increasing competitiveness. All three areas described in the theme part contribute to this.

The EU is determined to limit the risk of serious climate change.

Today, the EU has set the following overall objectives where the climate objective and the objective to provide energy from renewable energy sources are binding.

- A reduction in greenhouse gas emissions of at least 20% by the year 2020, compared with 1990 levels. A reduction of 30%, assuming that other industrialised areas of the world undertake to carry out similar reductions.
- An obligatory objective, meaning that 20% of the final energy use will be covered by renewable energy by the year 2020, and that the proportion of renewable energy in the transport sector will amount to at least 10%, assuming certain conditions are fulfilled.
- A 20% increase in efficiency in the use of primary energy by the year 2020, compared with 1990.[1]

The EU's energy system is based on fossil fuels (approximately 80%). Renewable energy amounts to less than 10%. More than 50% of the primary energy use is imported, and this amount is increasing. A certain change in energy use is under way. Renewable energy is increasing its share the most, followed by natural gas. Renewable energy has increased, on average, by 3.4% per year since 1990. During the same period, natural gas has increased by 2.8% per year on average. Oil and coal consumption continue to increase, although the rate of increase has declined, mainly because of the transition from oil and coal to natural gas for electricity production.

1 Compared with forecasts on developments (with today's control measures and an estimated level of future energy use).

Figure 0:1 Primary energy use, EU-27 (1990–2005)

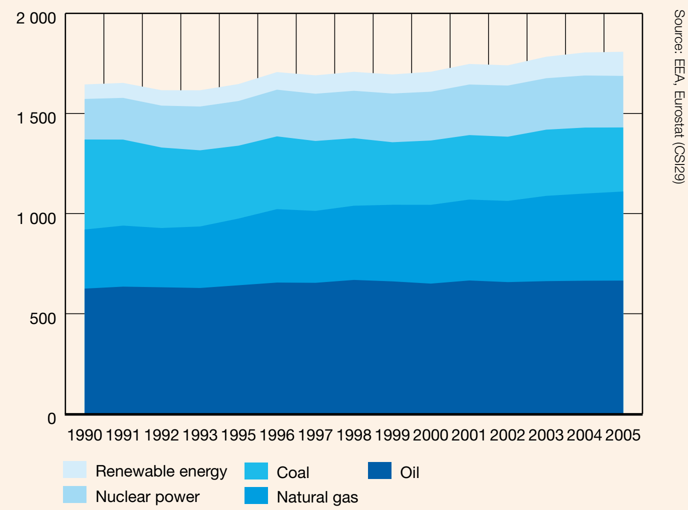
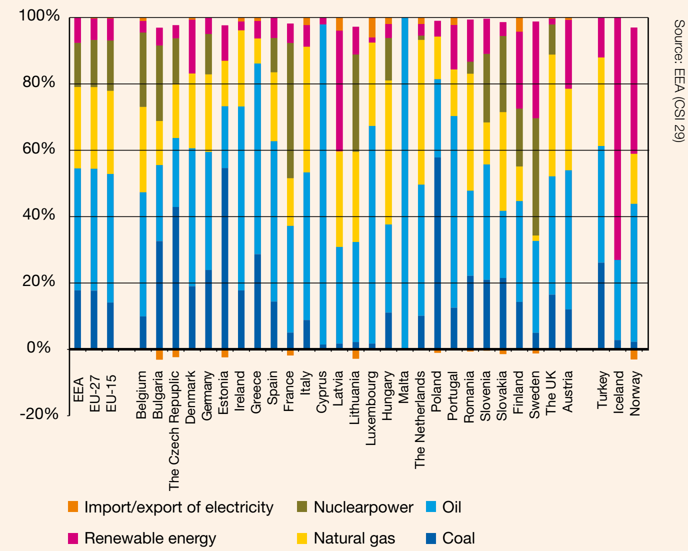


Figure 0:2 Share of primary energy use per fuel EU-27, including Turkey, Iceland and Norway (2005)



Primary energy use within the EU-27 has increased by 9.9% between 1990 and 2006. During this period, the percentage of fossil fuels decreased somewhat, from 83% in 1990 to 79% in 2006. However, in absolute figures, fossil fuel consumption increased by more than 4%. Electricity use is increasing, on average, it has increased by 1.7% per year since 1990. Since 2004, total primary energy use has not increased.

Average for the EU-27 – the following fuels are being used: coal approx. 18%, oil approx. 37%, natural gas approx. 24.5%, nuclear power approx.14% and renewable energy approx. 6,5%.

Energy Systems in different countries look very different:

- Malta uses 100% oil, Cyprus 96.5%.
- The use of coal is greatest in Poland (59%) and Estonia (57.4%).
- Natural gas is used the most in the Netherlands (43.6%), Hungary (43.4%), Italy (37.9%) and UK (36.7%).
- Nuclear power is used in 15 of the countries: France (42.3%), Sweden (36.2%) and Lithuania (31%) use the most.
- When calculating in this way, the percentage of renewable energy varies from 0% to 30%.
- Sweden uses considerably less fossil fuels than the average country in the EU and considerably more nuclear power and renewable energy.

For Sweden, the EU's objective means that it must reach the following target by 2020 – the share of renewable energy, compared with the total amount of energy use in the country, should increase from 39,8% (2005) to 49% (2020), which, at present, is the highest in the EU and more than twice as much as the EU as a whole. For Sweden, greenhouse gas emissions in the sectors not covered by the EU's trading system will decrease by 17% by 2020 compared with 2005 levels. For the trading sector, the objective for all EU countries is a reduction of 21% compared with 2005. The EU's objectives for energy efficiency is the same for all countries.

The Swedish objectives for the renewable energy and climate areas are somewhat more far-reaching than the requirements set by the EU. For the area of energy efficiency, it is difficult today to say whether the national objective is more ambitious or not. The current Swedish government has the following objectives for energy and climate policy by the year 2020:

- 50% renewable energy
- 10% renewable energy in the transport sector
- 20% reduced energy use compared with 2008, calculated as primary energy use per GNP
- 40% reduction of emissions from climate gases compared with 1990. The objective relates to activities that are not included in the EU's emission trading system.[2]

2 Two thirds of these reductions are estimated to take place in Sweden and one third in the form of investments in flexible mechanisms inside or outside of the EU.

FACTS Countries in the EU became members at different times

Up to 1995: Luxembourg, Denmark, Germany, Austria, Great Britain, Belgium, Italy, the Netherlands, Finland, France, Sweden, Ireland, Spain, Greece and Portugal (EU-15)

2004: Cyprus, Estonia, Lithuania, Latvia, Malta, Poland, Slovenia, the Czech Republic and Hungary (EU-10)

2007: Bulgaria and Romania (EU-2)

The countries that joined in 2004 and 2007 are referred to as the EU-12.

Today, there are 27 member countries (EU-27).

FACTS How the EU's work is developing

The commission, which functions as the EU's government, presents its legislative proposals to the council and the parliament. It may be a proposal for a directive or a regulation. The difference is that a directive, when it has been decided at EU level, must be approved in the member countries' domestic legislation, while a regulation applies directly to all member states.

The council consists of the minister for the actual area from all member countries. In the council, the constitution's definitive formulation is discussed based on the member states' various national interests.

The european parliament, directly elected by citizens in the member states, decides, together with the council, on new legislation within certain areas, including the internal market and the environment. This means that legislation which affects the energy area in general is legislated in this way.

The parliament can always express its opinion on the legislation, even within areas where it does not have the right to make a decision.

When a directive has been adopted by the council and the parliament, the member states have a specified timeframe to implement the provisions of the directive in the domestic legislation. Usually, it is between one to two years, depending on how complicated the area is and whether it is a matter of making changes to existing rules and regulations etc. In Sweden, the prevailing legislative process is then followed.

Theme 2009: EU

Greenhouse gas emissions in the EU have decreased since 1990. This trend is expected to continue, but further efforts will be required to reach the objective of a 20 % reduction by the year 2020 compared with 1990 levels.

I How the EU's directives are implemented in Sweden – Climate

Greenhouse gas emissions in the EU have decreased since 1990. This trend is expected to continue, but further efforts will be required to reach the objective of a 20% reduction by the year 2020 compared with 1990 levels. The EU's emissions[3] make up approximately 10% of global emissions[4]. Emissions in the EU mainly come from the EU-15 countries, in particular from Germany, Great Britain, Italy, France and Spain. More than 80% of greenhouse gases come from the energy sector.

The most important directive impacting on the climate area is the EU Emissions trading directive. The directives that concern the areas of renewable energy and raising energy efficiency also contribute to reduced greenhouse gas emissions. These directives are described in subsequent parts of the theme section. The tax directive is estimated to be the next directive that can contribute to reduced greenhouse gas emissions.

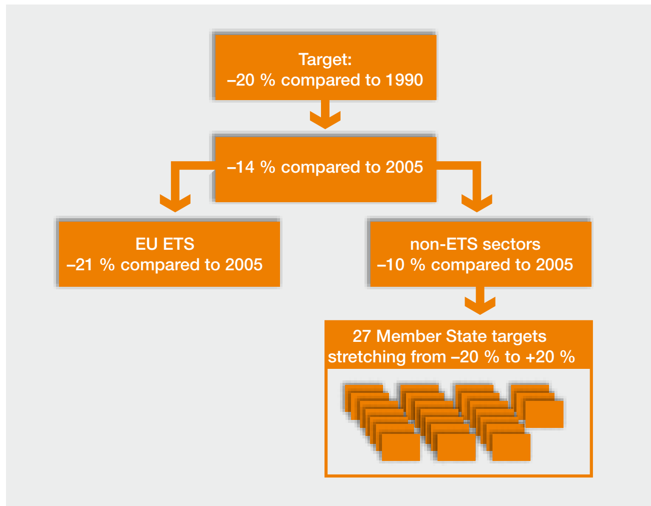
Energy policy objectives

The EU is determined to limit the risk of serious climate change. As early as 1996, before the Kyoto negotiations, the EU adopted the objective of striving for a maximum increase in the average global temperature of 2°C compared with pre-industrial temperatures. To have a reasonable chance of managing this, global greenhouse gas emissions must have decreased by 50% by the year 2050 compared with 1990 levels. It is emissions reductions of this size that form a part of the EU's vision to 2050. The EU recommends such reductions in the climate talks at the UN organisation UNFCCC, and which will result in, among other things, quantitative commitments for the periods following 2012.

On the road to 2050, the EU wants, as its target for 2020, to achieve a reduction in greenhouse gas emissions by 20% compared with 1990 levels. If other industrialised countries undertake to carry out comparable reductions in their countries, and if the developing countries also implement measures, the EU is prepared to reduce emissions by 30% to 2020. The emissions objective of -20% has been divided up, partly on those operations that form a part of the EU's emission trading system, and partly on operations that do not form a part of the trading system. For the trading sector, a common target for all EU countries is a reduction of 21% compared with 2005. Greenhouse gas emissions in the sectors not covered by the EU's trading system will decrease by a total of 10% by the year 2020 compared with the levels emitted in 2005, with responsibility divided between the countries. The levels vary between +20% and -20%. Sweden will reduce its emissions by 17% by the year 2020 compared with 2005 levels.

The member states that made up the EU prior to 2004 (EU-15) have formed their own part of the Kyoto Protocol and have their own targets for the period 2008–2012. Within the framework of this agreement, the objective is an annual emissions quota for the period 2008–2012, which is the equivalent of

Figure I:1 Distribution of target of 20% reduced greenhouse gas emissions by 2020, EU-27



Source: EC Commission 2008.

Note: "EU ETS" is the EU Emission Tradin g Scheme, "non-ETS sectors" are those activities that are not included in the system.

3 EU-27.

4 Within the United Nations Framework Convention on Climate Change (UNFCCC).

up to 92% of the emission levels for 1990, i.e. a reduction of 8%. This can be compared to the industrialised countries, the so-called Annex 1 countries,[5] which will reduce emissions collectively by approximately 5% during the same period.

National objectives have been set by the EU for each of the member states, these take into consideration each country's starting position, energy use and potential. The EU, on the basis of its common commitment, has carried out an assignment of responsibilities, meaning that Sweden has been given an annual emissions quota for the period 2008–2012 which is the equivalent of 104% relative to 1990 levels. This objective includes both that which is now called the trading sector and the activities that are not covered by the EU's system for emissions trading.[6] The EU Emissions trading scheme is the EU's most important control instrument to reduce emissions, followed by directives on renewable energy and energy efficiencies. The energy tax directive, which regulates the tax structure and specifies minimum tax levels, is also important.

The Swedish objective for 2008–2012, from 2002, signifies greater reductions than the requirement according to the EU's allocation. Instead of allowing an increase of 4%, total greenhouse gas emissions will decrease by 4%, i.e. the average during the 2008–2012 period was a maximum of 96% of the 1990 emissions level[7]. The target will also be achieved without compensation for take-up in carbon sinks[8] or by means of flexible mechanisms [9] used. The EU's emissions trading scheme was started after this target was set and encompasses approximately one third of Swedish emissions. For the trading system as a whole, there is an emissions ceiling, but exactly where the reductions take place is determined by where the cost-effective means of action are. Sweden cannot, therefore, exercise control over what the actual emissions from the trading sector in Sweden are, only over the allocated size of the emission allowances.

Sweden's participation in the EU's trading system has changed the prerequisites for the execution of the Swedish target.

The current Swedish government has as a vision for 2050, that Sweden will not have net greenhouse emissions released into the atmosphere.

In the draft bill 2008/09:162, the government has proposed objectives for 2020, whereby greenhouse gas emissions will be 40% lower than 1990 levels. The objective is somewhat more far-reaching than the EU's target for Sweden. The objective relates to those activities not included in the EU emissions trading scheme. The reduction will take place via emissions restrictions in Sweden or via investments in flexible mechanisms inside or outside of the EU. Admission and discharge to and from forestry and other land use should not, at present, be included in the national target, because they are difficult to measure. Models for calculations of this type all look different. When the results of the negotiations regarding a future international climate regime are available, the issue can be re-examined.

Trends and analysis

Sweden's climate strategy has been developed gradually since the 1980s. Energy and carbon dioxide taxation of fossil fuels are important control instruments and have been progressively tightened. The price development of fossil fuels has also contributed. Between 2001–2006, the introduction of one tax in favour of another has been carried out (Green tax reforms). Legislation and economic instruments within the area of waste management and support for local climate work have also contributed, as has the electricity certificate system which was introduced 2003. Joint efforts within the EU have also become increasingly important.

Greenhouse gas emissions are decreasing in Sweden. During the 1990s, emissions fluctuated to some degree, because of variations in the availability of hydropower. Emissions in 2007 were 9.1% lower than in 1990 at the same time as GNP increased by 48%. Sweden has low national emissions, calculated per capita and taking into consideration GNP growth, compared with other industrialised countries. The annual emissions per capita is 7.3 tonnes of CO2 equivalents. The relatively low level of emissions is due to the energy and climate policy, the high proportion of hydropower and nuclear power in elec-

5 Industrial countries and transitional economies in Central and Eastern Europe which form part of the Climate Convention's Annex 1 and which, according to the Kyoto Protocol, have quantitative obligations on emission limitations.

6 Natural emissions are not covered by emissions reductions, nor are emissions from international aviation services and shipping trade.

7 Total emissions for the five years 2008–2012 are divided by five. It is most likely that we will not know, until 2014, if the Kyoto objectives have been met, this is because the statistics for 2012 will not be available until 2013/2014.

8 Take-up of greenhouse gases in forests or other vegetation.

9 The Kyoto Protocol includes three so-called flexible mechanisms: Joint Implementation, CDM and Trade with emission rights.

tricity generation and good access to biofuels. Base indicator 15 shows greenhouse gas emissions in Sweden since 1990.

In 2006, the average amount of greenhouse gas emissions in the EU, per capita, was 10.4 tonnes (EU-27). The differences in emissions from one country to the next is considerable. This is due to the energy intensity in the country and on the energy mix. Only Latvia and Lithuania, out of all the EU countries, are the countries that have lower emissions per capita compared to Sweden. These countries have low energy use. In Latvia, more than 45% of its electricity comes from hydropower and, after Sweden, it has the second highest share of renewable energy in the EU. The largest emissions per capita can be found in Luxembourg, Ireland, Finland and Iceland. Luxembourg is a country that many people travel through, and therefore it sells a lot of vehicle fuel. Ireland has a large agricultural sector and a relatively low share of renewable energy. Finland and Iceland have cold climates and a large industrial sector. It is difficult, and not entirely relevant, to compare the figures for different countries. It should not be assumed that a low per capita emissions level is a measure of a country's efforts to reduce emissions.

If consideration is given to GNP, Sweden has the lowest greenhouse gas emissions per capita within the EU-27 (2006). The contrast between countries is considerable. Countries with the lowest values are all of the EU-15 countries, while those countries with the highest values can be found in the EU-12. France, Austria, the UK, Italy and Spain have the lowest values after Sweden. Bulgaria, Estonia, Poland, Romania and the Czech Republic have the highest values.

In Sweden, emissions from different sectors have developed very differently during the period 1990–2007. Emissions from electricity and heat production have increased somewhat. These emissions vary from year to year because heating requirements and hydropower production varies with changes in temperature and rainfall. Emissions from industry have been constant throughout the period (1990–2007), with substantial variations within the industrial sectors. Emissions from the domestic and service sectors have decreased, primarily, because of the transition from oil- to biofuel-based district heating, pellets boilers and heat pumps. The development is, primarily, because of energy and carbon dioxide taxes, oil price increases and investment subsidies. Emissions from the transport sector have increased despite vehicles becoming more energy efficient. The increase has been reduced somewhat over the past few years following the introduction of biofuels. The average carbon dioxide emission

Figure I:2 Emissions per capita 2006 EU-27 [CO2 equivalents]

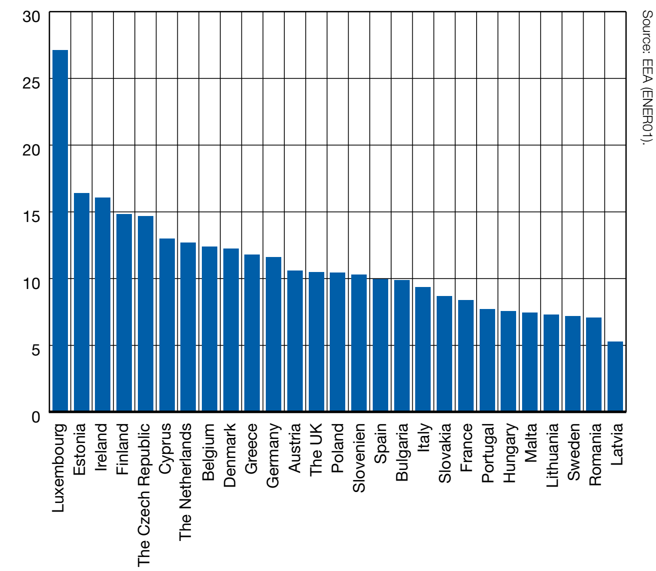


Figure I:3 Greenhouse gas emissions EU-27, EU-15 and EU-12, 1990–2006

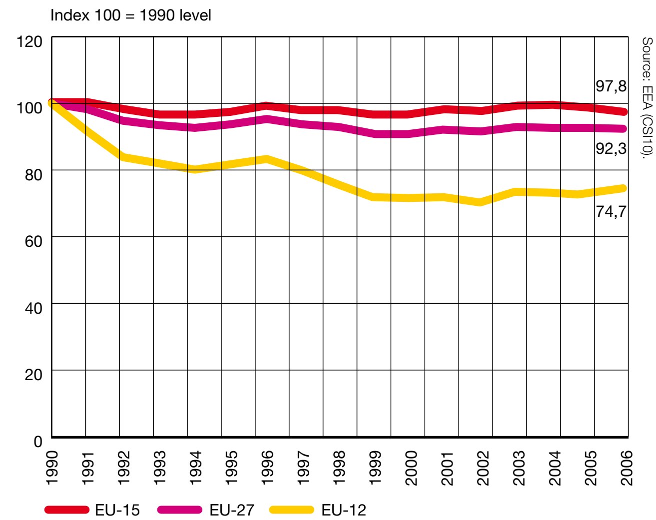
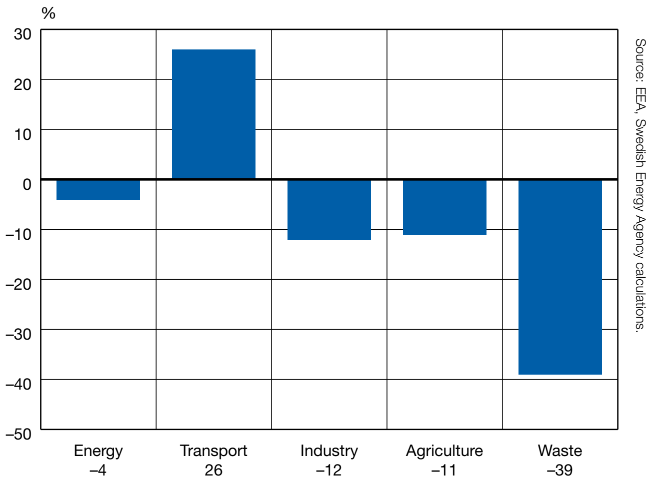
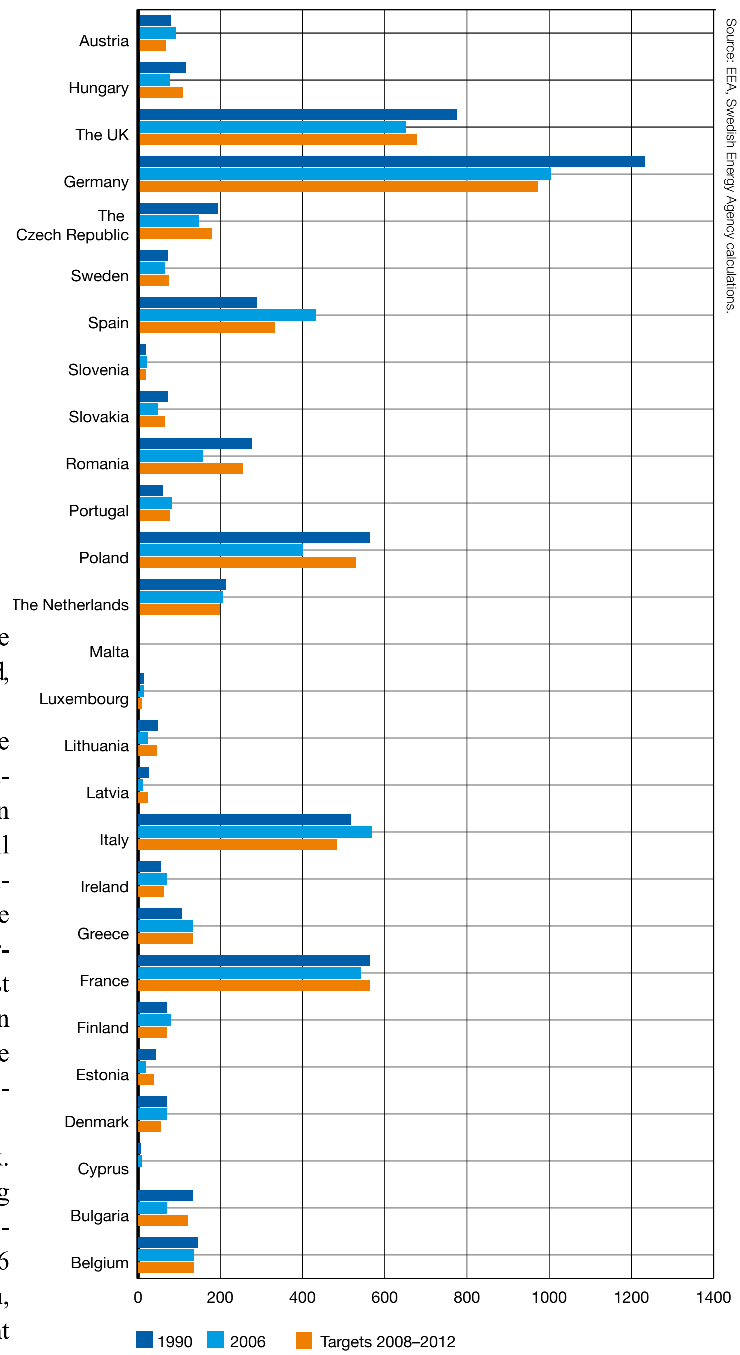


Figure I:4 Changes in greenhouse gas emissions 1990–2006 (%), EU-15



Note: The agricultural sector accounts for 9% of greenhouse gas emissions, the waste sector for 3% (2006).

Figure I:5 Greenhouse gas emissions (1990 and 2006) and the Kyoto objectives 2008–2012, EU-27 (Mt CO2 equivalents)



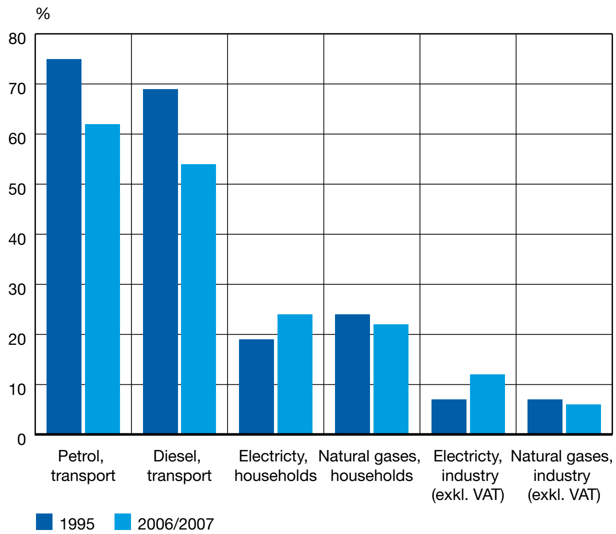
Note: Cyprus, Malta and the EU-27, as a group, do not have any targets according to the Kyoto Protocol. The EU-12 has a -8% obligation, compared with 1990, except for Poland and Hungary, which have -6%. Malta and Cyprus are not classed as industrial countries.

level from new vehicles in Sweden is 20–25% higher than the EU average. The increase from the transport sector has occurred, primarily, because of increased road transport.

Between 1990 and 2006, greenhouse gas emissions for the EU-27 have decreased by 7.7% at the same time as the population has increased by 4.5%. The total reduction is due to an increasing share of renewable energy and a transition from oil and coal to natural gas. Since 1990, more and more far-reaching control measures have been employed to limit greenhouse gas emissions. The largest reductions have taken place in Germany and the UK, which are also the countries with the highest total emissions level, and within the EU-12. The reduction in the EU-12 is, primarily, because of structural changes in the economies at the beginning of the 1990s. The greatest increases have taken place in Spain, Portugal, Greece and Italy.

The energy-related emissions in the EU-15 amount to approx. 80% of the total emissions. Emissions are continuously being reduced in all sectors except for the transport sector, where emissions have increased in the EU-15 by 26% during the 1990–2006 period. The increase here is for the same reason as in Sweden, primarily because of increased road transport. More efficient vehicles and a shift over to biofuels have meant that the increase has not been even greater. In the energy sector (excluding trans-

Figure I:6 Proportion of tax in energy prices, EU-15 (EU-25 for transport)



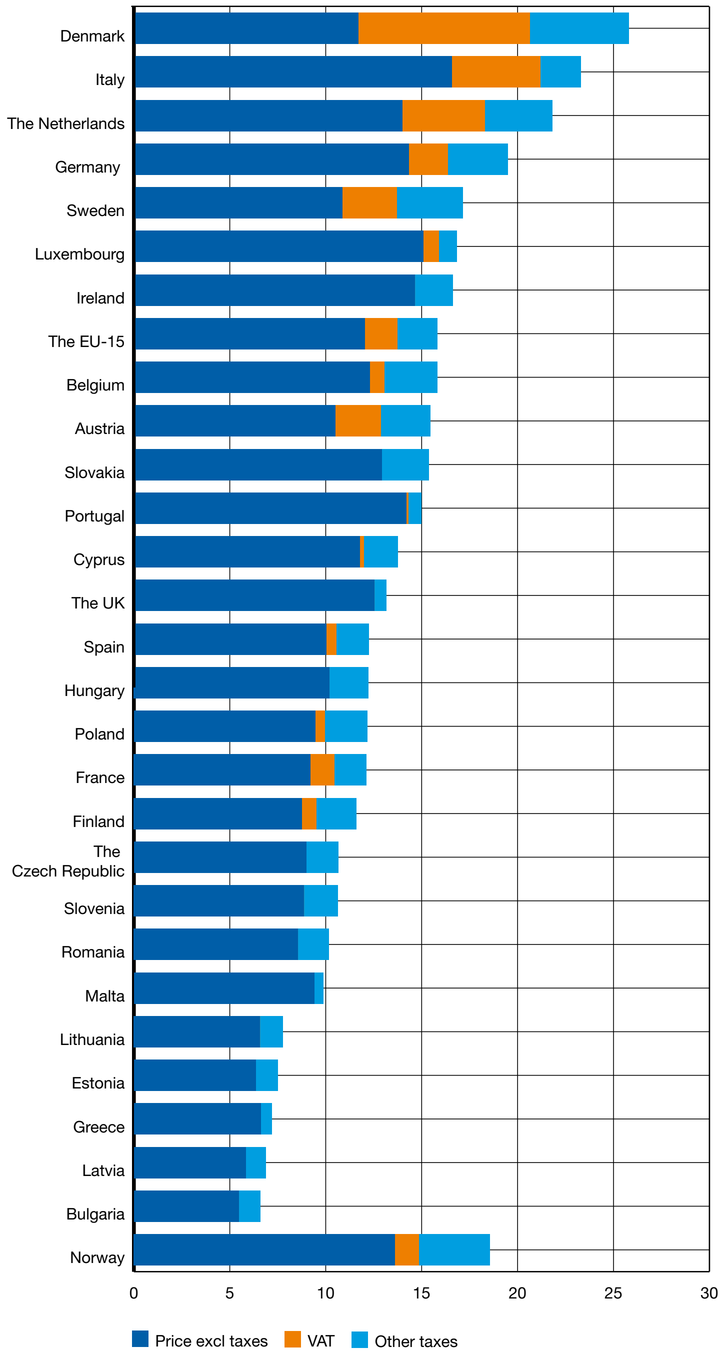
Source: EEA, Eurostat, DG TREN (ENER32). Data from 2006 for petrol and diesel in the EU-25, data from 2007 for electricity and gas in the EU-15. Excluding VAT for industry. January prices.

port), emissions have reduced by 4%. An increased use of district heating and combined heat and power generation can be seen, which in itself produces a displacement of emissions between sectors. The largest individual reductions of emissions within the energy sector are due to energy efficiencies and a transition from oil and coal to natural gas. The industrial sector in the EU-15 has reduced its emissions by 12%. Energy efficiencies there have balanced out the production increases.

In 2006, four member states in the EU-15 produced a level of greenhouse gas emissions which was below the international commitment which the member states in question have in respect of the Kyoto period 2008–2012. Besides Sweden, France, Greece and the UK, a further eight member states are expected to meet their obligations with existing and new measures. Denmark, Italy and Spain do not, however, according to forecasts, look like they will be able to comply with their obligations even if they allow the country to take up the so-called carbon sinks, which allows a country to offset its emissions in relation to the planned use of flexible mechanisms and uptakes in forest and land (so-called carbon sinks).[10]

10 EEA 2008.

Figure I:7 Proportion of taxes in electricity prices for households in the EU-27, EU-15 and Norway (2007)



Source: EEA, Eurostat. Note: Average consumer, 3,500 kWh, of which, 1,300 kWh during the night.

With existing and planned measures, including carbon sinks and flexible mechanisms, it is estimated that the EU-15 can achieve a reduction of greenhouse gas emissions by up to 11.3% by the year 2010 compared with 1990 levels. This can be compared with the EU-15 undertaking to reduce emissions by 8% by 2008–2012, this objective will most likely be met by the EU as a whole.

All members of the EU-12 are expected to meet their climate obligations according to the Kyoto Protocol, using current strategies and measures, with the exception of Slovenia which, in order to comply with its obligations, needs to introduce further measures and also make use of flexible mechanisms and carbon sinks.

Energy prices and energy taxes

Energy prices in the EU vary. This is because each country's tax structures, tax levels and market structure vary. In 2007, the average nominal end-consumer[11] price for electricity in the domestic sector in the EU-15 had increased by 17% compared with 1995 prices. During the same period, disposable income increased by 60%. The UK and Ireland have had a 50% increase in the price of electricity. Sweden has had higher electricity prices than the average prices in the EU. The equivalent figures for natural gas in the EU-15 amount to an average increase of 75% between 1995 and 2007. This is mainly because of increasing international prices. In the UK and Ireland, the price of natural gas increased more than average.

During the period 1995 to 2006/2007, the share of taxes in the total price for transport and natural gas in the EU-15 decreased, while it increased for electricity. Increasing end-consumer prices apply to all fuels. The average proportion of environmental taxes in the total state revenues in the EU-15 reduced from 6.9% in 1995 to 6.2% in 2006. The proportion of energy taxes (excluding transport) reduced from 5.3% to 4.4%. Energy taxes are lower in the new member states compared with the EU-15. The differences are generally substantial from one country to the next, this is because there are differing views on how to use taxation to achieve objectives.

11 Ongoing.

FACTS Emissions trading scheme

The EU has the world's first major scheme for trade with greenhouse gases. Regional systems outside of the EU can be found in other parts of the world, for example Australia and the USA. Approx. 40% of EU greenhouse gas emissions are covered by the emissions trading system. The proportions in the EU countries vary depending on each country's energy balance and industrial culture. In Sweden, 30% of greenhouse gas emissions are covered by the system, produced by 700 facilities.

Within the EU, a number of initiatives are being generated to develop emissions trade so that more countries, sectors within society and greenhouse gases will be included. From 2008, new industrial plant was included. The aviation sector will most likely be included in the trade from 2012; emissions are to be monitored from 2011. Two new gases, nitrogen dioxide and perfluorocarbons (PFCs), will be included from 2012. At the same time, more activities will be included.

Today (2008–2012), the trading sector's carbon dioxide emissions, from combustion to production of heat and electricity, oil refineries, coke ovens, iron and steel, cement, lime, glass and ceramic industries and the pulp and paper industry, are included – approx. 13,000 establishments in the EU.

The non-trading sector includes transports, individual heating, smaller industries and farming.

FACTS Important directives with an impact on greenhouse gases

Emission trading directive (2003/87/EC)

The directive on renewable energy (2009/28/EG)

Electricity from renewable energy sources (2001/77/EG)

The directive on renewable vehicle fuels (2003/30/EG)

Energy performance of buildings (2002/91/EG)

The Energy Tax Directive (2003/96/EG)

The District Heating Power Directive (2004/8/EG)

The Energy Services Directive (2006/32/EG)

The Eco-design Directive (2005/32/EG)

II How the EU's directives are implemented in Sweden – Energy from renewable sources

The use of energy from renewable sources has increased, between 2000 and 2005, from an average of 7.6% to 8.5% of the total energy use in the EU. The use of renewable energy varies substantially between the various member states. Sweden and Latvia are the countries in the EU with the highest share of renewable energy, while Luxembourg, the UK and Malta are the countries with the smallest share.

The EU's energy policy objectives for an increase in the use of renewable energy have contributed to an increase in the share of renewable electricity production in the EU from approx. 13% to 16% from 1997 to 2007 and the use of biofuels has also increased. The recently adopted EU target that the share of energy from renewable sources by 2020 will amount to 20% of total energy use means that heating and cooling is now included in the EU directive. The EU's ambitious targets mean that effective action to increase the use of renewable energy will be taken by the EU member states over the next 10-year period.

Energy policy objectives

The Swedish energy policy objectives over the past 10 years have, to an increasing degree, been influenced by energy policy ambitions within the EU regarding the increased use of renewable energy. In 1997, the EU started to work towards its objective – that the share of renewable energy compared with gross energy use within the EU would double by 2010.[12] The efforts made at EU level since 1997 have resulted in a number of objectives, action plans and directives for renewable energy. In 2001, the directive for the promotion of electricity produced from renewable energy sources was adopted[13] and in 2003 the directive for the promotion of biofuels was adopted[14]. In these directives, targets were adopted, the aim was that 21% of the electricity use in the EU-27 countries by the year 2010 would be produced from renewable sources and that 5.75% of petrol and diesel use for transport would comprise of biofuels.

In light of the road path[15] for renewable energy, which the European Commission presented in 2007, the European Parliament and the European Council adopted a further directive in December 2008[16] which, along with the two previous directives (which only affected electricity and biofuels), also encompassed heating and cooling. Via this sweeping directive, targets have been agreed that 20% of energy use in the EU will come from renewable sources by 2020. The directive contains binding national targets for the member states regarding the total use of renewable energy and the use of renewable energy for transports. The targets for the year 2020 for Sweden are that 49% of the total energy use will be renewable and 10% of the energy use for transports will be renewable.

Trends and analysis

Use of energy from renewable sources

According to Eurostat's statistics, the use of energy from renewable sources in the EU's 27 member states increased from 7.6% in the year 2000 to 8.5% in the year 2005. The use of renewable energy varies greatly between the various member states. Sweden is the EU country where the use of renewable energy is greatest. In 2005, the proportion of renewable energy in Sweden amounted to almost 40%, followed by Latvia and Finland with 35% and 29% respectively. The UK, Luxemburg and Malta accounted for the lowest figures in 2005. The contrasts between the various countries is due to the different conditions that prevail in the various countries regarding renewable energy, such as the availability of hydropower and biomass, and also to what extent active energy policies have been carried on by countries which has encouraged the use of energy from renewable sources.

The EU target of 20% energy from renewable sources by the year 2020, which has been distributed among the member states

12 KOM (1997) 599: Energy for the future: Renewable energy sources – White book for a common strategy and action plan.

13 Directive 2001/77/EC.

14 Directive 2003/30/EC.

15 KOM (2006) 848: Road path for renewable energy – Renewable energy sources in the 21st century: building a sustainable future.

16 Directive 2009/28/EC.

in the form of binding national targets, means that powerful measures will be required in order to reach the targets. Sweden's target for 2020 is 49%, which is the equivalent of an increase of nine percentage points from 2005. According to the Energy Agency's calculations, the use of renewable energy continued to increase after 2005. The calculation shows that the share of energy from renewable sources, in accordance with the directive's definition in 2007, amounted to a little more than 42%[17].

Share of renewable electricity production

The renewable electricity production in the 27 EU member states has increased from a little more than 13% in 1997 to 16% in 2007. The follow-up report[18], which the European Commission disclosed in 2007, regarding the target for renewable electricity production, stated that the renewable electricity production in the EU, in the year 2010, is estimated to be close to the target, i.e. 21%. The Commission also noted that several countries, including Sweden, have made tremendous progress in the development of renewable power production. Except for Spain and Germany, these countries' electricity production form a minor part of the total electricity production in the EU. Therefore, developments have not been as positive at EU level as they have among certain member states.

Renewable electricity production varies considerably between the various member states. Countries with favourable natural conditions for hydropower, such as Sweden and Austria, also have the highest renewable electricity production figures in the EU. It should be noted that the fluctuations in the water supply from one year to the next mean that renewable electricity production may vary substantially for countries with a lot of hydropower. The renewable electricity production for Sweden amounted to 52% in 2007.

The positive development for renewable electricity production in the EU is, to a great extent, because of increased wind power production and also, to a lesser extent, because of increased biofuel-based power production.

Share of biofuels

The EC directive from 2003 aims to encourage the use of renewable motor fuels. The directive requires that the targets

Figure II:1 Proportion of renewable energy for all 27 EU member states in 2000, 2005 and targets for 2020, according to the directive 2009/28/EC, %

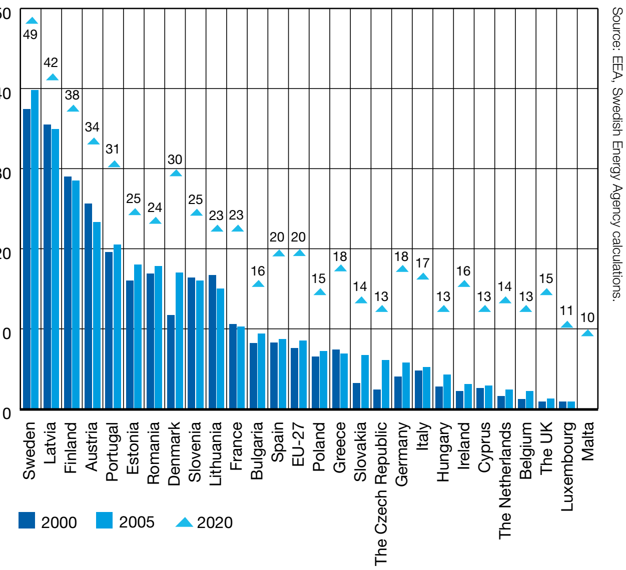
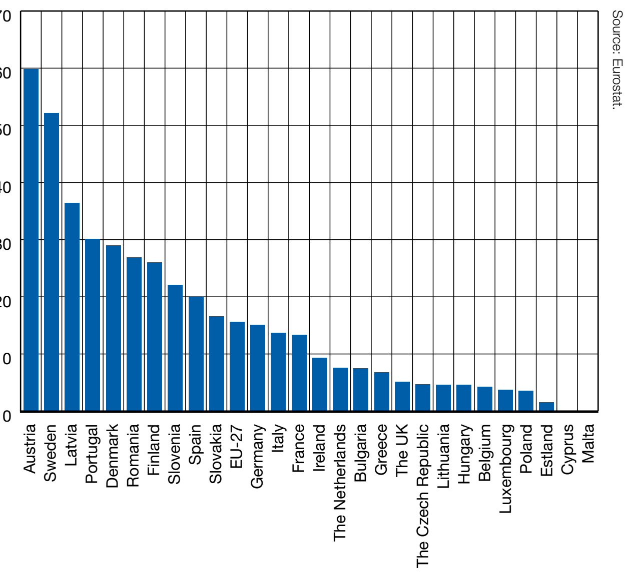


Figure II:2 Renewable electricity production in relation to gross use of electricity in 2007, EU-27, %

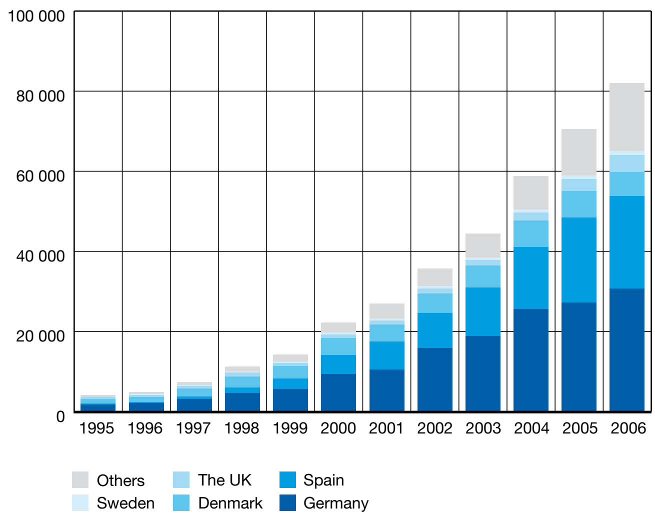


must be established for each member state based on reference values which apply to the community as a whole. The reference level for the community in 2010 is outlined in the directive and has been set at 5.75%, and it relates to the energy content of replaced petrol and diesel for transports on the market.

17 The use of energy from renewable sources in Sweden is described in more detail in base indicator 1.

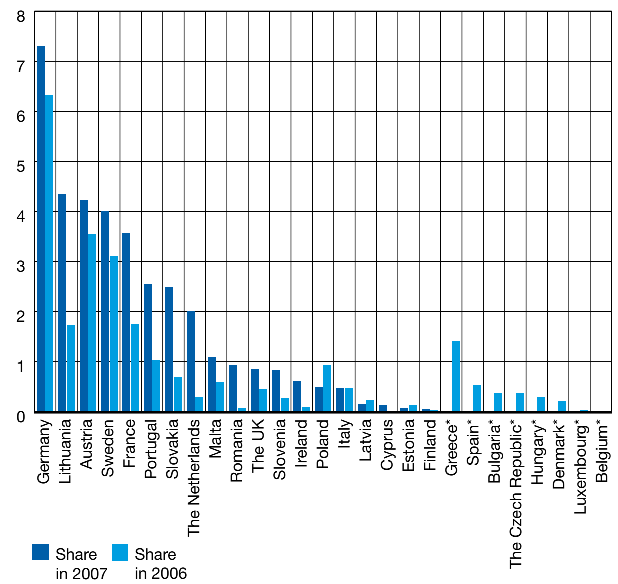
18 KOM (2006) 849 Follow-up measure for the green book – Report on progress for renewable energy.

Figure II:3 Wind power production in the EU's 27 member states, 1995–2006, GWh



Source: Eurostat.

Figure II:4 Share of biofuel among the EU-27, 2006 and 2007, %



Source: Report in accordance with EC Directive 2003/30/EC, Swedish Energy Agency calculations. Countries marked with a * have not presented a report for their renewable energy share for the year 2007

The proportion of biofuels, calculated in accordance with the directive from 2003, amounted to 4.9% in the year 2008 for Sweden. The equivalent figure for 2007 was 4%. The proportion of biofuels is the ratio between the total use of biofuels (ethanol, FAME and biogas) and the total use of petrol, diesel and biofuels.

Among the EU-27 countries, only Germany, Lithuania and Austria had a higher proportion of biofuels than Sweden in 2007. Sweden's use of biofuels is different from that of most other European countries because Sweden uses a relatively large amount of ethanol. On the one hand, Sweden has a high mixture level of ethanol in petrol and, on the other hand, the use of E85 is widespread. In other parts of Europe, biodiesel is the dominating biofuel.

In the renewable energy directive there is a binding target for each member state, that 10% of the energy in the transport sector must be renewable by 2020. The calculation of renewable energy in the transport sector in the renewable energy directive differs slightly from the calculation procedure in the directive from 2003. When calculating the share of renewable energy in the transport sector in accordance with the renewable energy directive, the use of petrol, diesel and biofuels for road transports, and the use of electricity for all transports, should be included in the denominator. In the numerator, all use of renewable energy for all types of transport should be included. The calculation of the addition from renewable electricity is either done in accordance with the EU mix of electricity production or in accordance with the mix of electricity production in the country in question, measured two years prior to the actual year. With regard to electricity use in electrical road vehicles, i.e. rechargeable hybrids or electric cars, use should be multiplied by a factor of 2.5 on compliance with the national transport target. Biofuels produced from waste and/or ligno-cellulose as a raw material can be multiplied by a factor of 2.[19]

The model used to calculate the share of renewable energy in the renewable energy directive differs significantly from the 2003.directive. For 2008, the share of renewable energy in the transport sector in Sweden amounted to 4.9% according to the 2003 directive. According to the calculation model in the renewable energy directive, the share of renewable energy for 2008 was 6.8%. This is assuming that 50% of the electricity is renewable and that all biogas is produced from waste and can therefore be multiplied by two when calculating the target fulfilment figure.

19 This means that, in the numerator, in the quotient for the share of renewable energy, the quantity of energy can be multiplied by 2 for biogas from waste/ligno-cellulose and 2.5 for renewable electricity used for road vehicles. It should therefore be: the share renewable energy = (quantity of energy biogas * 2 + quantity of energy other biofuels + renewable electricity for road vehicles * 2.5 + other renewable use of electricity for transport purposes)/(quantity of energy petrol, diesel, biofuels and electricity for transport purposes).

III How the EU's directives are implemented in Sweden – Energy saving

FACTS Concepts within the area of energy-saving measures

Increasing energy efficiency is a way of achieving more efficient use of energy through some form of advancement in technology, and it means that with less amount of energy you provide the same benefit. It may also mean an increase in benefit but with the same amount of energy use.

Efficient energy use may mean that there is an opportunity to supply excess energy to a different energy user, for example using waste heat from industry to heat up a local company or housing estate. A community may also plan to minimise its energy use. The difference between increasing energy efficiency and efficient energy use is that increasing energy efficiency can be linked to making products more efficient, such as industrial processes or properties, while efficient energy use also means ensuring that energy is used as efficiently as possible.

Energy saving implies an actual reduction of energy use which can also lead to reduced benefits. However, needs and experienced benefits depend on different lifestyle choices and values. Reducing your energy use by lowering the temperature in your home, showering for a shorter period of time or ensuring your electrical equipment is not left on standby may be experienced as maintaining benefits for some people, while for others the change may feel like a drop in standards.

Energy economising is a broad and all-embracing term. By increasing energy efficiency, being more efficient with energy use and being economical with energy, we are able to economise on the use of energy. Energy saving may also imply abstaining from something.

There are several objectives with energy saving, both at a national and at an international level. But the objectives are designed differently and they are also difficult to follow up because there are no simple and clear ways of calculating whether the objectives have been fulfilled. The objectives, at the same time, are important because they indicate a goal to strive for; they also promote energy efficiencies and the sensible use of energy as important issues. Today, there is a broad consensus and desire in society to improve on energy-saving measures. Energy saving, as an overall objective, is generally favourable both in terms of increasing energy efficiency and environmental objectives, for example in limiting impacts on the climate.

Energy policy objectives

The EC directives that primarily regulate energy economising include: the energy services and efficient end-consumer use of energy (the Energy Service Directive); the energy performance of individual buildings; the labelling and eco-design of household appliances and consumer appliances and a directive for energy efficiency through the promotion of highly efficient cogeneration. However, there is no directive which regulates the harmonised monitoring of energy efficiency processes and energy economising throughout society. In addition to this is the EC Commission's action plan for a reduced use of primary energy and their Green Book on more efficient energy utilisation, EU objectives for new motor vehicles, plus a number of national efficiency objectives.

The energy services directive

The EU's energy services directive stipulates that member states must establish a national and guiding objective for more efficient energy use within the following sectors: building, industry and transport. This objective must provide 9% greater energy efficiencies by the year 2016 based on average use throughout the years 2001–2005. Companies included in the EU's system for emissions trading are exempt. Therefore, the objective may be expressed as an absolute amount of energy and may be a figure higher than 9%. The member states are not legally obliged to reach this objective, it is merely a guideline objective, but they are, on the other hand, obliged to try to reach the objective through the use of cost-efficient, implementable and reasonable measures. Measures which have been carried out from 1991 and ahead may be included (so-called "early measures"), if their effect can be assumed to last until 2016.

Directive on the energy performance of buildings

An important aspect of the directive on the energy performance of buildings is contained in the Energy Declaration of Buildings Act. This means that the owner of a property is obliged to establish an energy declaration for their buildings. On the whole, the directive contains five requirements which must be introduced in the member states: 1) a method to calculate a building's integrated energy performance, 2) minimum requirements on energy performance for new buildings, 3) minimum requirements on energy performance for large renovations or changes to buildings, 4) energy certification of buildings and 5) inspection and evaluation of heating systems over 15 years old.

Eco-design directive

The eco-design requirements mean that producers, importers and retailers must deliver energy-efficient products. This means that consumers no longer need to purchase products on the market that consume unnecessarily large amounts of energy. In addition, energy labelling will provide companies and individuals with the opportunity to make a climate-smart choice which will save both money and the environment. The eco-design requirements will be introduced to the EU member states in three stages. In 2005, the Framework Directive (the eco-design directive/EuP directive) came into force and was implemented in Sweden via the Eco-design Act, which became law in May 2008. Real requirements will be introduced in the form of product-specific EC regulations which will apply directly in the member states.

Directive on the promotion of cogeneration

The cogeneration directive states that the possibility of using cogeneration to save energy is utilised insufficiently among the EU member states. The promotion and development of highly effective cogeneration is a prioritised area because the benefits of cogeneration can be substantial considering the savings of primary energy, the avoidance of transmission losses and the reduction of emissions, particularly greenhouse gas emissions. In addition, the efficient use of energy through cogeneration can contribute positively to the security of supply and to improve the EU's economic competitiveness.

The Commission's action plan for a reduction in the use of primary energy

The Commission's action plan for energy efficiency points to the possibility and economic feasibility of being able to save at least 20% of the total primary energy by 2020 in addition to what happens as a result of price effects, structural changes, the natural development of technology and existing measures. The proposed target is designed in a completely different way than, for example, the energy services directive, and the target is not mandatory, but was adopted by the heads of state and government in 2007.

EU's targets for new passenger vehicles

In December 2008, the EU made a decision on emissions norms for new passenger vehicles, meaning that carbon dioxide emissions from new passenger vehicles, on average, should not be greater than 130 g CO2/km from 2012, with a gradual escalation to 2015 when it applies in full. The target must be fulfilled. Car manufacturers that do not meet the target will have to pay a fine. From 2020, the objective is to achieve an average emissions level of 95 g CO2/km. This really means a measure of the vehicles' energy efficiency rather than their carbon dioxide emissions.

National targets in the environmental target system

In Sweden, there is a target for increased energy efficiency within the buildings sector which has been adopted by the Swedish parliament and which forms part of the environmental target system as a sub-target under "A Good Built Environment". The target means that total energy use per unit of area heated in dwellings and public/commercial premises should be reduced by 20% by the year 2020 and by 50% by the year 2050, in relation to energy use figures for 1995. By 2020, the dependence on fossil fuels for energy use in the buildings sector must be broken, at the same time as the share of renewable energy must increase continuously.

The energy draft bill's target on reduced energy intensity

The energy draft bill 2008/09:163 includes a target of 20% more efficient energy use by the year 2020. The target is widesweeping for the sector aimed at reducing energy intensity by 20% between 2008 and 2020. The government believes that this target must be expressed as a reduction of energy intensity which should be achieved between 2008 and 2020, i.e. that the added energy per GNP unit in fixed prices must be reduced by 20%. The target for 2020 will embrace all sectors of society and include efficiencies at every stage of the energy supply process, including transformation/processing, distribution and end use. The government's objective here is, at the same time, to break the relationship between economic growth and an increase in the use of energy and raw materials.

Trends and analysis

It is difficult to follow up energy efficiency targets. The difficulty lies mainly in knowing which measures should be taken into account and then determining how the effects of these should be measured. In order to become more efficient, often some form of quantitative target is determined. But because energy efficiencies are difficult to monitor quantitatively, there is the risk that such targets create too great a focus on the calculation of target fulfilment instead of really achieving cost-effective controls towards increased energy economising. Therefore, targets which are set should instead specify a desired direction and take up increased energy efficiency as an important issue rather than creating a large administration to calculate the impact of measures the level of which cannot be verified.

Energy efficiency, in particular, should be evaluated from a system perspective. This means that the benefit achieved in the form of a decrease in the utilisation of resources and reduced emissions – which impact on the environment – and in the long-term also lower costs, must be regarded as the real purpose of increasing energy efficiency. Efficiency in itself should not be regarded as the actual objective.

The target, according to the energy services directive, is about working out measures which together will be able to achieve a total aggregated volume of increased energy efficiency (TWh) calculated on the base years' (2001–2005) energy use levels. This means that anything can happen with energy use in the directive's final year (2016). Rather, the objective is to systematically be able to find and include all types of measures which produce increased energy efficiency throughout the whole period up to 2016.

In order to meet the objectives of the Swedish energy policy, the government has proposed a national 20% objective, which is designed differently than that of the energy services directive. The base year is the same as in the energy services directive, i.e. 2008, which makes it clear that Sweden regards these two objectives as working in parallel with each other. The objective for 2016 means an increase in energy efficiency of 1% a year, while the objective for 2020 means a reduction in energy intensity by approx. 1.7% per year. However, the different ways of measuring efficiency and the different proportions of the objectives means that they are not entirely compatible.

Different approaches and calculation models are required, on the one hand, to be able to evaluate an increase in energy efficiency as a result of a specific action and, on the other hand, in order to follow up increased energy efficiency at an aggregate level in society. The development of energy efficiency within society at an aggregate level is often described in ways which include the total effects of various actions from a systems perspective. Energy intensity is one of these concepts. This relates to the relationship between society's total production and total use of energy in the form of supplied primary energy, including the transmission losses which take place up to the end-user's use of, for example, electricity. The energy services directive is about the promotion of the efficient end-use of energy and imposes demands on the member states to provide a precise objective which should act as a guide and which should amount to at least 9% by 2016.

In order to be able to summarise all energy forms to one numeric value, a recalculation is required so that there is a common dimension. But, at the same time, there is not one relevant and scientifically correct formula for all situations for the recalculation of all energy types or energy carriers to one common numeric value which can be used to determine whether, for example, a target level of a 9% improvement in efficiency has been achieved. Locally produced solar heating or utilised waste heat is not quantitatively compatible with the withdrawal of electricity during a peak period in the electricity system. (Appendix II of the energy services directive provides examples of factors for certain energy carriers which may be employed when the use of different energy forms is added together to form one common numeric value which is then used to calculate the achieved energy efficiency. For electricity, the factors 1.0 or 2.5 are specified as factors which a member state may choose without specifying any reason for the choice.)

The design of the Commission's 20% target aims to limit the total use of primary energy to the level used in 2020, in relation to forecast growth, without further efforts being made for more efficient energy use to the same year. Whether this is all about a reduction or an increase in energy use in TWh calculated from current levels depends on how the development is forecast. How difficult this objective is to achieve will greatly depend on which forecast is used.

Energy intensity as a measure of general level

When energy use is related to GNP it will be possible to identify how efficiency is to be developed at a very general level. Energy intensity is a very aggregated measure and, in itself, says nothing about the underlying causes. For example, it says nothing of the type of fuel used or whether the industrial structure or the state of the market has changed. The indicator is, however, widely used internationally and is of interest together with additional information.

Between 1983 and 2007, energy intensity in Sweden decreased by approx. 1.2% per year. Since 1990, the pace of improvement increased somewhat and was on average approx. 1.5% per year, to once again return to 1.2% per year between 2000 and 2007. The decrease during the 1970s and 1980s is primarily because of reduction in energy intensity within certain industries, which can be explained by the increases in energy prices during the period. During the period after 1993, the reduction in energy intensity is better explained as a result of the structural changes that took place, the development of less energy-intensive industries, such as telecommunications products, pharmaceuticals and service industries, which have experienced heavy growth.

Sweden, as with most other EU-15 countries, except for Portugal and Spain, has a declining energy intensity. Despite the fact that the climate is cold and that there is still a large proportion of heavy industry, energy intensity is roughly the same as the average for other EU countries.

Figure III:1 Energy intensity, expressed as the relationship between gross domestic use of energy (kilogram oil equivalents) and gross national product, GNP (Euro). Gross domestic use of energy is calculated as the total use of coal, electricity, oil, natural gas and renewable energy sources. GNP is calculated i n fixed prices with the base year 1995 (ESA95).

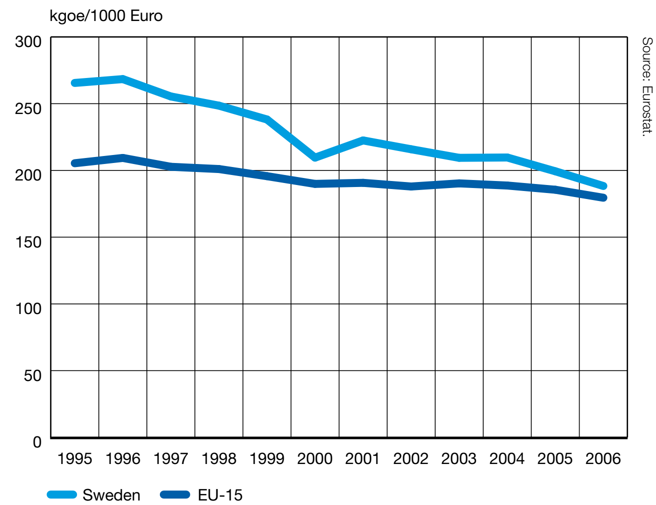


Figure III:2 Specific energy use for heating, excluding hot water, climate-corrected and expressed in kilogram oil equivalents per square metre.

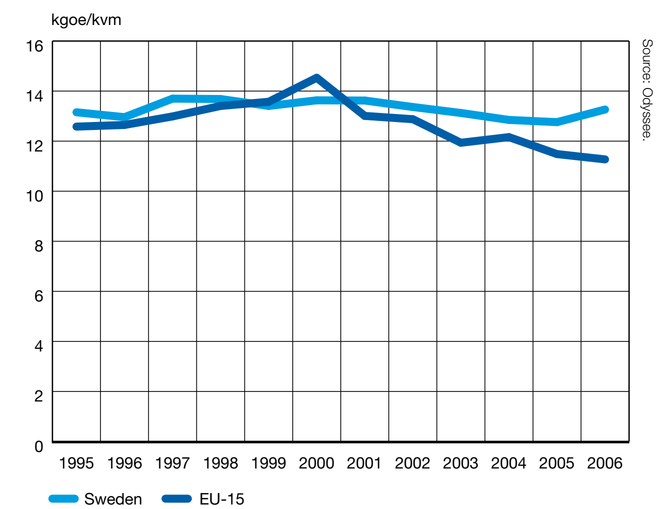


Figure III:3 Vehicles' specific energy use in kilograms of oil equivalents per passenger kilometre.

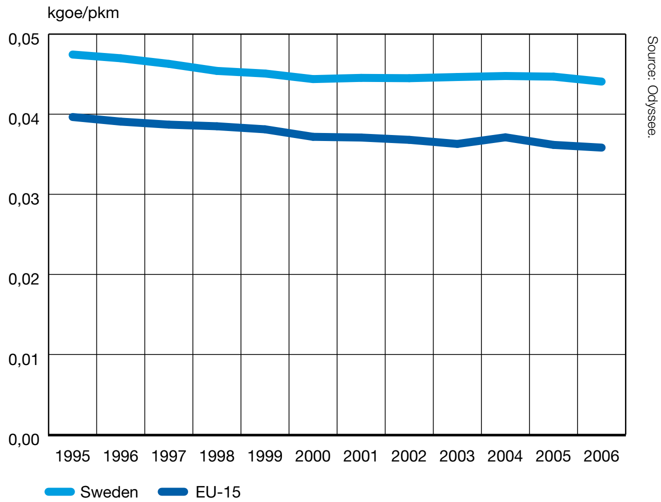
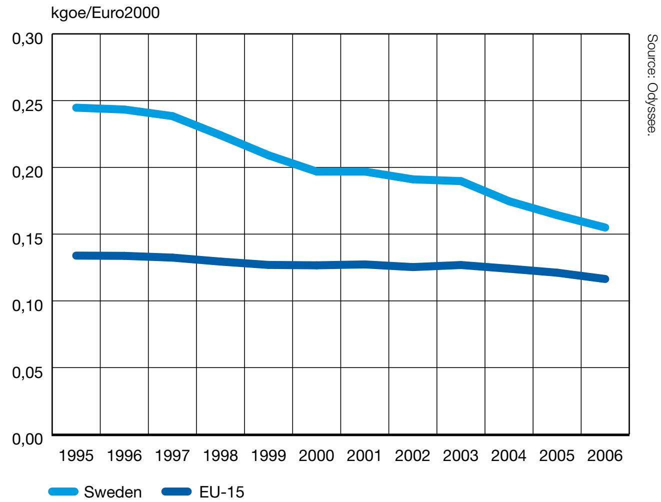


Figure III:4 Industry's energy intensity, calculated as the relationship between final energy use in kilogram oil equivalents and the value of refinement in national prices (2000) and currencies which were later converted to the Euro in 2000.



A comparison of EU countries' energy intensity is not entirely unproblematic. There are a number of differing factors which influence energy intensity, such as the countries' different geographic conditions, climate and the type of industries they have. In countries with a cold climate, energy requirements for heating will be higher than for other countries with a milder climate. At the same time, countries with a hot climate require energy to be able to provide cooling. Countries that have a high proportion of raw material industries, as a rule, use more energy than countries that import products that are already processed for use in different industries.

Energy-efficient heating in buildings

In Sweden, the sector dwellings and public/commercial premises has a long tradition of making demands on how energy is used in buildings. A part of the reduction in the Swedish temperature-corrected energy use is due to conversions to heating systems, e.g. from oil to heat pumps or district heating. At the same time, these statistics only include losses which arise in the building's own energy system. The losses occurring in the generation and distribution of electricity and district heating are assigned to the supply sector. If a customer changes, for instance, from oil-fired heating to electric heating or district heating, the energy use in the dwellings and services sector will therefore decrease, while the energy use in the supply sector will increase. (For further information, see base indicator 12).

Energy-efficient passenger vehicle transports

The Swedish Road Administration's reviews show that Swedish passenger vehicles are among the largest consumer of fuel in Europe, a situation which, to a great extent, can be assigned to the size of Sweden's passenger vehicles. The overall efficiency level of the Swedish transport sector is about average within the EU-15, but Sweden still has the highest level of energy use per 10 km in the EU. (For further information, see base indicator 20).

Energy efficiency in industry

Sweden's industry shows a reduction in energy use compared with value added. However, in an international comparison, the energy use of Swedish industry per value added is high. This does not necessarily mean that Swedish industry makes use of energy less efficiently than industries in other countries. This is due to the different roles the international division of labour has where Sweden's industrial production, to a greater extent, is based on unprocessed raw materials. (For further information, see base indicator 8).

Background indicators

The background indicators shall make it easier for the reader to place the other indicators in a wider context. The aim is to provide a picture of the energy system as complete as possible.

A Total energy supply by energy carriers

Figure A:1. Total energy supply by energy carriers

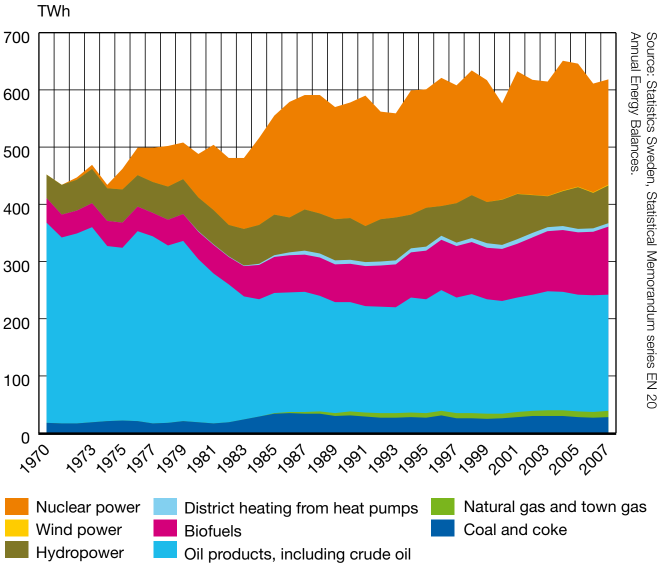
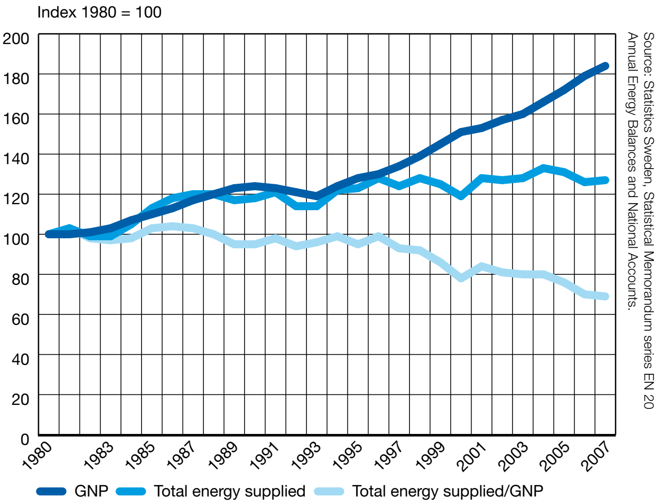


Figure A:2. Energy intensity, total energy supplied and GNP



Since the beginning of the 1970s, the total energy supplied has increased by 35%.[20] The energy supply during 1970 amounted to 457 TWh, and in 2007 it was 619 TWh.[21] The composition of the energy supply has changed significantly in the past 37 years. In 1970, 350 TWh of the total energy supply consisted of crude oil and oil products, compared with 203 TWh in 2007. During the same period, nuclear power and biofuels have mainly replaced oil. In 2007, nuclear power accounted for 184 TWh of the total energy supplied, which gave 64 TWh of electricity (the remainder were conversion losses in nuclear power plants). With regard to biofuels[22] (including peat and waste etc.) supply has more than doubled since 1970. In 1970, biofuels contributed 43 TWh, and in 2007 this increased to 119 TWh. Hydropower contributed 41 TWh in 1970 and 66 TWh in 2007[23]. Wind power has greatly increased from the time when wind power parks started to be built around 1997, but it only makes up a small part of the total energy supply, 1.4 TWh per year in 2007. From 1980, district heating from heat pumps has increased, and today makes a little less than 6 TWh. The energy supplied from coal and coke has basically remained constant during this period. Since the introduction of natural gas in 1985, supplies have increased to 11 TWh in 2007.

20 In the reported energy supply figures, net imports of electrical energy are included. However, this net import is not included in the diagram, as these values may be negative.

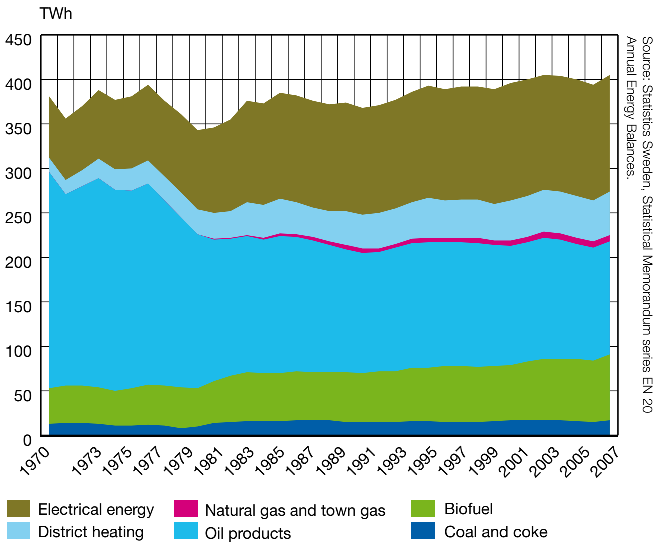
21 Reported in accordance with the international method, i.e. conversion losses in nuclear power are included.

22 In this and other background indicators, peat and waste have been included in the record for biofuel. However, peat is neither renewable (in the short term) nor a fossil fuel, from a geological point of view, and waste, to a certain extent, also has fossil content.

23 Actual production.

B Total final energy use by energy carriers

Figure B. Total final energy use by energy carriers



The total final energy use has increased from 381 TWh in 1973 to 404 TWh in 2007. This means that the final energy use has increased by only 6% in almost 35 years. The use of all energy carriers, with the exception of oil products, has increased at different rates. Oil use in Sweden has declined from 243 TWh to 127 TWh between 1973 and 2007. After the oil crises in the 1970s, the Swedish energy policy has focused on reducing the use of fuel oils. In 1973, oil use accounted for 64% of the total final use, and in 2007, the proportion was 31%. Electricity, district heating and biofuels[24] have largely replaced oil for heating. Electricity use has increased from 69 TWh in 1973 to 131 TWh in 2007. During the same period, the use of district heating has increased from 16 TWh to 49 TWh. During the period, biofuel use has increased from 40 TWh to 74 TWh.

24 In this and other background indicators, peat and waste have been included in the record for biofuel. However, peat is neither renewable (in the short term) nor a fossil fuel, from a geological point of view, and waste, to a certain extent, also has fossil content.

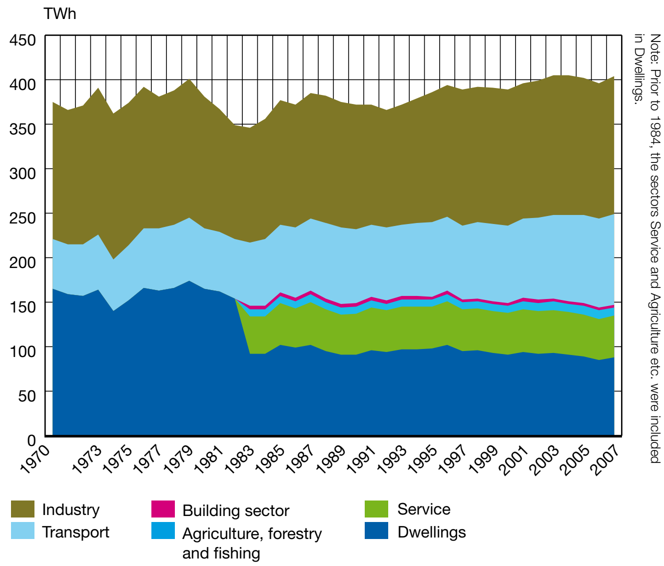
C Total final energy use by sectors

The total final energy use (excluding conversion and distribution losses) in the transport sector has increased the most, by 78% since 1970. The energy use in industry decreased between 1970 and 1982, and then resumed the upward trend. In 2007, the use was at the same level as in 1970; at the same time, industrial production during the period has increased and continuous efficiency improvement work in industry has resulted in less energy being used per unit produced.

In 1990, the Swedish pulp and paper industry accounted for 58% of the total Swedish biofuel use, and in 2006, for 48%. After 1983, statistics are available for the individual sectors and show that the energy use in these sectors has remained relatively constant. The energy use in the residential sector (calculated as purchased energy) is 4% lower than in 1983. Since 2007 was a warm year, the space heating requirements were lower. During the cold years (e.g. 1985–1987 and 1996), energy use in the residential sector was higher.

The energy intensity in the user sector, i.e. final use per GNP, has dropped during the whole of the period. The reduction is due to the GNP having increased, while the total final energy use has remained relatively constant. An important factor is also that oil for space heating during the same period has been replaced, to a large extent, by electric heating and district heating. This means that the energy conversion losses have been moved from the end user sector to the energy conversion sector.[25] For a given heating requirement, the energy use at the end user stage therefore decreases.

Figure C:1 Total final energy use by sectors



25 The Energy Agency and Ångpanneföreningen AB, "Allt eller inget – Om systemgränser för byggnaders uppvärmning", 2004 [Everything or nothing – System limitations for the heating of buildings].

Figure C:2 Energy intensity, total final energy use and GNP

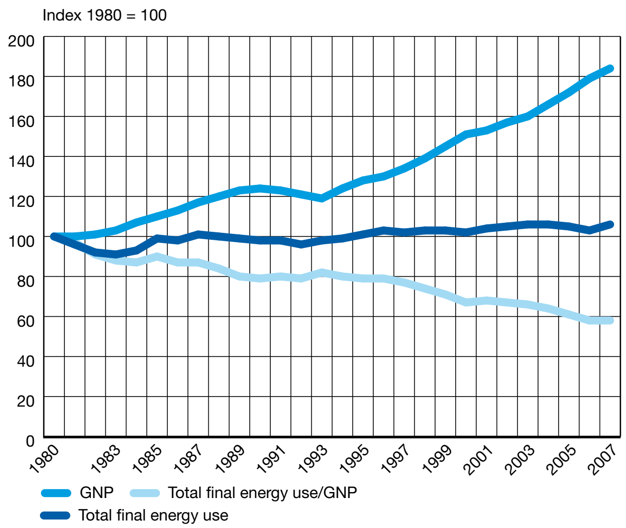
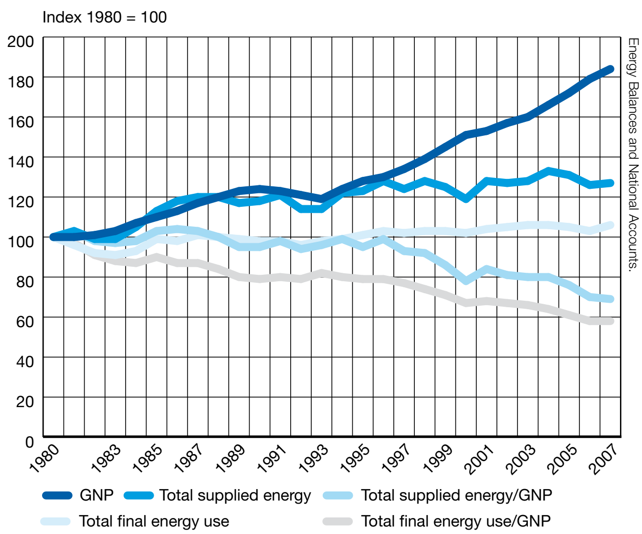


Figure C:3 Total energy supplied, total final energy use and GNP



Source: Statistics Sweden, Statistical Memorandum series EN 20 Annual Energy Balances and National Accounts.

D Total energy supplied for electricity generation by energy carriers

Since 1970, the total energy supplied for electricity generation has increased from 89 TWh to 269 TWh in 2007. The use of the energy for electricity generation has changed radically since the 1970s. In the early 1970s, hydropower and fossil fuel based condensing power accounted for most of the power generation in Sweden. One of the results for the change in the Swedish energy policy was an extensive expansion of nuclear power, which substantially increased the amount of energy supplied for power generation. The use of oil for electricity generation decreased substantially, and just over 1.5 TWh of oil were used in 2007 for electricity generation in Sweden. Today, nuclear power and hydropower accounts for approximately 90% of the total supply of electricity. Wind power has greatly increased in relative terms since 1993, but it still makes only a small contribution and accounts for 1% of the total power generation. In 1993, wind power accounted for 0.05 TWh, which has increased to approx. 1.4 TWh by 2007. CHP generation and industrial back-pressure dominate combustion-based electricity generation (see Figure D:2), whereas oil-fired condensing power stations and gas turbines mainly serve as reserve capacity.

The use of biofuels[26] for generating electricity increased substantially in recent years, amounting to 12 TWh in 2007. Regulatory instruments in the form of the electricity certificates system and investment grants for biofuel-based CHP generation have made a substantial contribution to the increase in biofuel use for electricity generation.

Figure D:1. Total energy supplied for electricity generation by energy carriers

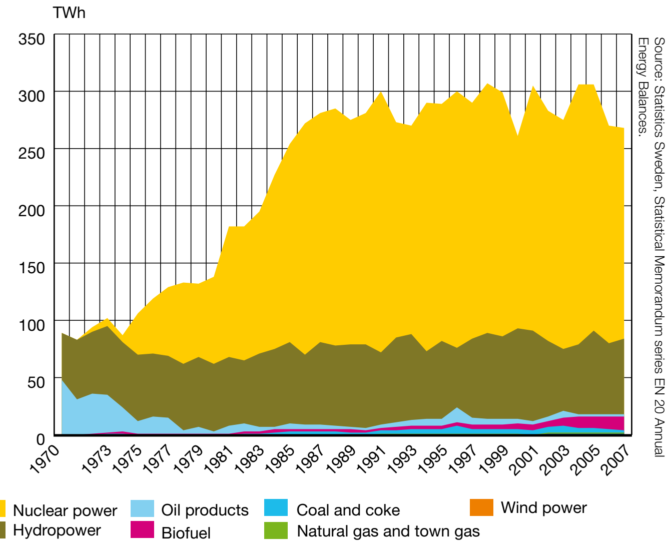
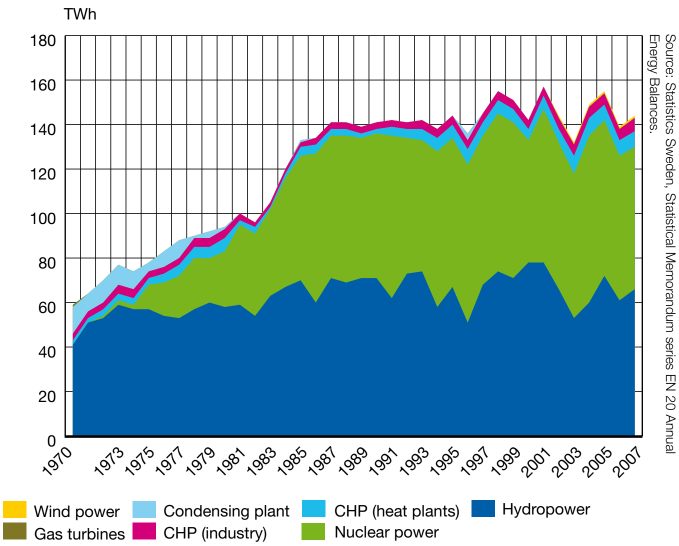


Figure D:2 Total electricity generation by generation technologies

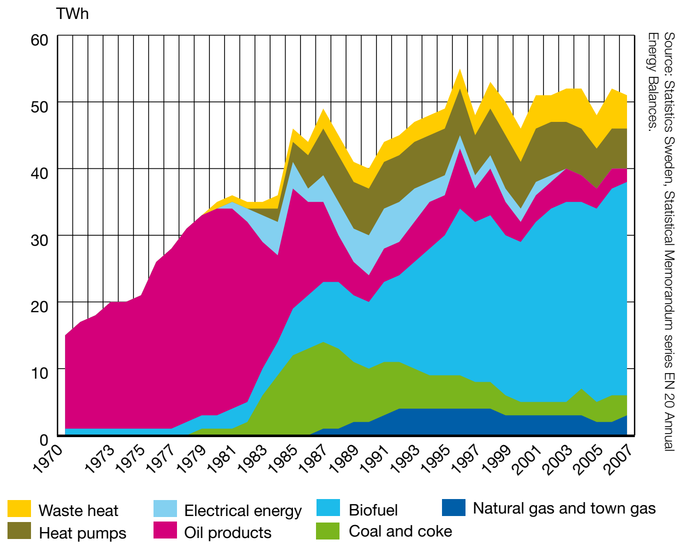


26 In this and other background indicators, peat and waste have been included in the record for biofuel. However, peat is neither renewable (in the short term) nor a fossil fuel, from a geological point of view, and waste, to a certain extent, also has fossil content.

E Total energy supplied for district heating generation by energy carriers

In the early 1970s, oil was virtually the only fuel used for district heating generation. In spite of the oil crises in the 1970s, it was not until well into the 1980s that the use of oil for district heating generation declined. When oil was phased out in earnest in the early 1980s, the use of coal and coke for district heating generation increased, but this application also decreased during the 1990s. At the same time as the use of oil decreased, the energy supplied for district heating generation from electric boilers, heat pumps and waste heat from industry increased. Since the 1990s, the use of biofuels[27] for district heating generation has increased dramatically and has largely replaced oil. In 2007, the total energy supplied from biofuels for district heating production was 32 TWh, this compares with the figure for 1970, which amounted to 1 TWh. During years with cold winters, such as 1996, the use of oil increased for district heating production. The reason for the increased use of oil during those years is that oil is generally used for peak load generation.

Figure E Total energy supplied for district heating generation by energy carriers



27 In this and other background indicators, peat and waste have been included in the record for biofuel. However, peat is neither renewable (in the short term) nor a fossil fuel, from a geological point of view, and waste, to a certain extent, also has fossil content.

Base indicators

The 20 base indicators are used for following up of the Swedish energy policy objectives and they are updated annually.

1 Share of energy from renewable sources

The use of renewable energy in relation to final energy use in Sweden has increased steadily since the beginning of the 1990s and amounted to 42% in 2007. An increase in the use of renewable energy for district heating production and a heavy increase in the use of biofuels in industry are important explanations to developments since 1990. Since 2003, when the electricity certificate system was introduced in Sweden, an increased electricity production from renewable sources has also contributed to a higher share of renewable energy. The renewable electricity production and the use of biofuels in industry accounted for the largest contribution to the share of energy from renewable sources in 2007.

Energy policy objectives

The energy policy objectives emphasise the importance of increasing the use of energy from renewable sources and maintaining the use of fossil fuels at a low level. A continued adaptation of the energy system and a higher level of supply security through greater diversification are two important reasons to promote the use of renewable energy sources in Sweden.

The national energy policy objectives for renewable energy are being increasingly influenced by the EU's ambitions and efforts made to increase the use of renewable energy in the EU.

The EU decided, in December 2008, that 20% of the energy use in the EU in 2020 must come from renewable energy sources. Through the directive,[28] binding objectives have been adopted for all member states for 2020. For Sweden, the directive means that the use of renewable energy will increase to 49% by 2020.

The EC directive[29] on the promotion of electricity production from renewable sources aims to increase the share of renewable electricity production in relation to energy use. The directive sets no binding targets, but requires the member states to set national targets and gives reference values for these targets. The national target for renewable electricity generation in Sweden is to increase the annual electricity generation from renewable energy sources in the electricity certificate system by 17 TWh by 2016 compared with the 2002 level (6.5 TWh). There will be an increase in the target. The Swedish Energy Agency will investigate how an increase by 25 TWh from 2002 up to 2020 can be carried out.

28 2009/28/EC.

29 2001/77/EC.

Trends in Sweden

Share of renewable energy

The use of renewable energy is reported here in accordance with the definition provided in the EU directive on the promotion of energy from renewable sources.[30] According to the directive, the proportion of renewable energy is calculated as the ratio of renewable energy to final energy use, including transmission losses and use of electricity and heat for electricity and heat generation (see the FACTS box).

The use of renewable energy increased in Sweden from 33% in 1990 to 42% in 2007. The final amount of energy use, the denominator, increased from 392 TWh to 437 TWh between 1990 and 2007, while renewable energy, the numerator, increased from 130 TWh to 185 TWh during the same period.

The increased use of renewable energy that has taken place since 1990 can, to a great extent, be explained through the increase in the use of renewable district heating production and the increase in the use of biofuels in the industrial sector, primarily the forestry industry. Of the absolute increase in renewable energy between 1990 and 2007, 36% is attributable to renewable district heating production and 22% to an increased use of biofuels in industry. Renewable electricity production accounts for 10% of the increase. Since 2000, the increase in renewable energy can also be explained through an increased use of heat pumps.

Of the total amount of renewable energy in 2007, renewable electricity and use of biofuels in industry (185 TWh) accounted for the largest sub-posts. Renewable electricity production accounted for 79 TWh and biofuel use in industry for 55 TWh.

30 2009/28/EC.

Figure 1:1 Share of renewable energy in Sweden 1990–2007, %

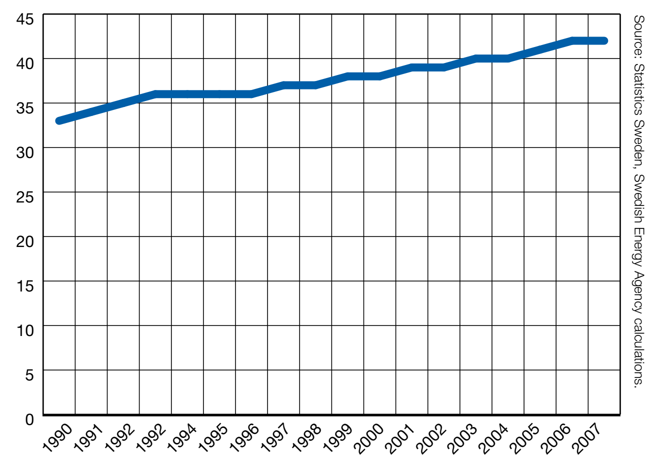
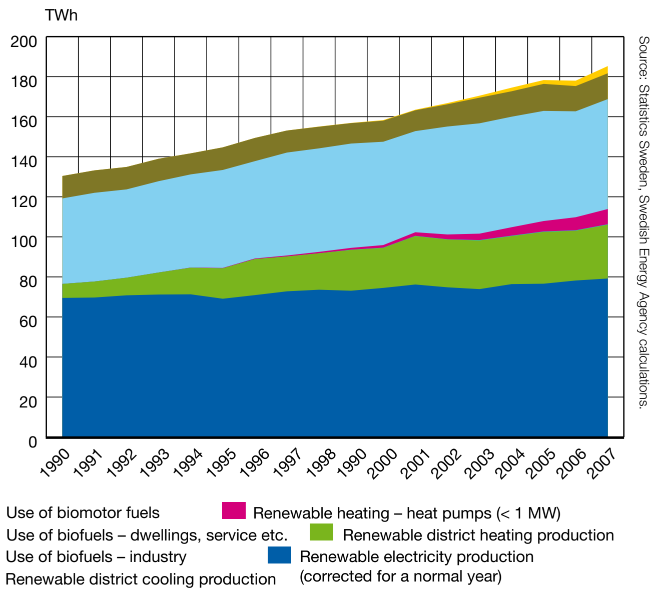


Figure 1:2 Renewable energy in Sweden 1990–2007, TWh



Electricity production from renewable sources

Electricity production from renewable sources amounted to 79.2 TWh in 2007, of which, hydropower (corrected for a normal year) accounted for 68.1 TWh,[31] wind power for 1.4 TWh and biofuel-based[32] CHP generation for 9.7 TWh. In the same year, total electricity production (corrected for a normal year with hydropower) amounted to 149 TWh, meaning that less than 53% of the total electricity production came from renewable energy sources. The trend for the share of renewable electricity production in relation to total electricity production is increasing. Biofuel-based electricity production has increased dramatically over the past few years, which can be seen as a result of a direct policy, strong government measures, such as investment grants to biofuel-based cogeneration plant, and the electricity certificate system.

The electricity certificate system was introduced on 1 May 2003, and is a market-based support system for renewable electricity production, see the FACTS box. The system aims to achieve national targets for renewable electricity production in a cost-effective manner. The objective of the electricity certificate system is to increase annual electricity generation from renewable energy sources and peat by 25 TWh by 2020, compared with the 2002 level.

During 2007, the amount of electricity generation that was entitled to electricity certificates amounted to 15.0 TWh, with peat accounting for 0.8 TWh. Biofuel-based cogeneration accounted for 60% in 2008, hydropower for 18% and wind power for 40% of the total amount of renewable electricity production in the electricity certificate system.

Reasons and relationships

Renewable energy has increased significantly in Sweden throughout the period 1990–2006. To a great extent, developments can be explained through the use of an active energy policy aimed at a transition to a more sustainable energy system where renewable energy sources play an extremely important role. Energy taxation, which includes energy tax, carbon dioxide tax and sulphur tax, has been a means of control which, to a great extent, has increased the use of renewable energy

31 According to the calculation model in the renewable energy directive. There is a degree of correction for dry/wet years, i.e. not the same as the actual production reported in background indicator A, 66 TWh.

32 Including renewable waste.

Figure 1:3 Total supply of biofuels*, biofuel-based electricity production and district heating from biofuels, TWh

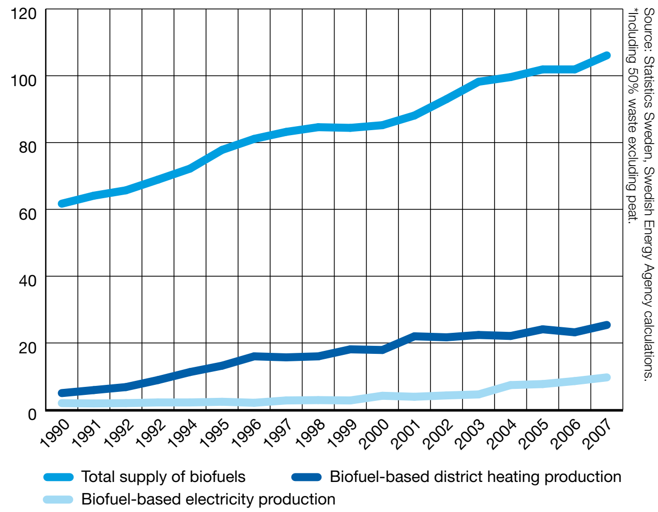


Figure 1:4 Share of renewable electricity production in relation to the total amount of electricity produced (corrected for a normal year – hydropower) during the period 1990–2007, %

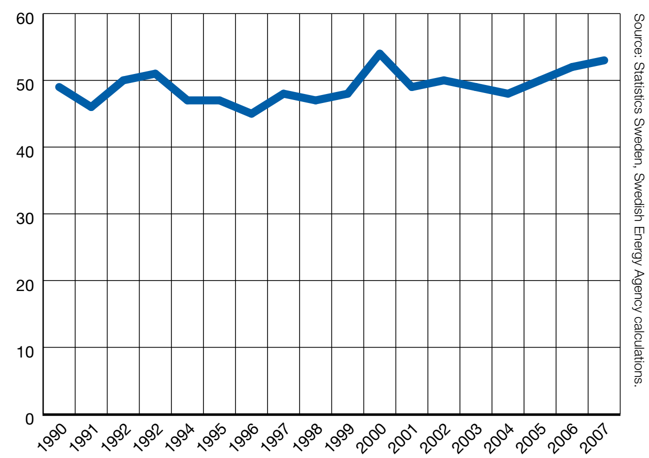
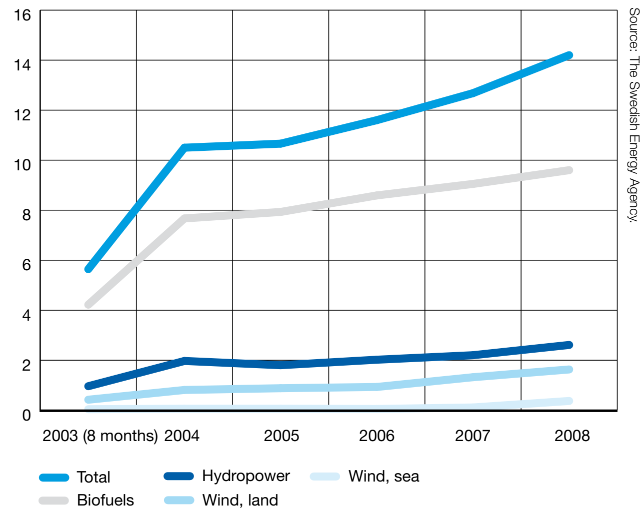


Figure 1:5 Renewable electricity generation in the electricity certificate system distributed between hydropower, wind power (onshore and offshore) and biofuel-based power, TWh.



for heating purposes. Energy and carbon dioxide taxation has meant that the competitiveness of biofuels has been given a boost compared with fossil fuels. The energy taxes for fossil fuels have been successively increased since 1990. Another important means of control which directly promotes the use of renewable energy for electricity production, and which has had a considerable effect, is the electricity certificate system, which was introduced in 2003.

Further examples of government measures which have promoted the use of renewable energy include: support for biofuel-based CHP generation (1991–1997), the local investment programme (LIP) (1998–2002), the climate investment programme (KLIMP) (2003–2008), the Emissions trading scheme (2005–), support for conversion from electric heating and oil in single-family houses and support for conversion in public premises (2005-).

The landfill prohibition introduced in 2002, regarding the waste disposal of sorted combustible waste and which from 2005 was expanded to include all organic waste, is an important explanation to the increase in waste combustion in the district heating system from the year 2000 and onwards.

In addition to the use of renewable energy which has increased the dependence on strong control measures, the forestry industry's production increase since 1990 has also contributed to an increased use of renewable energy. The forestry industry uses large amounts of wood fuels and spent liquors in the industrial processes. The internal use of biofuels in the Swedish pulp and paper industry alone accounted for approximately 27% of the total renewable energy use in Sweden.

FACTS Share of renewable energy in accordance with the 2009/28/EC directive

The share of renewable energy in accordance with the EU directive with binding targets until 2020 regarding renewable energy, should be calculated as the ratio between renewable energy and final energy use. Renewable energy according to the directive should be calculated as the sum of:

a) electricity produced from renewable sources.

b) district heating and district cooling produced from renewable energy.

c) use of other renewable energy for heating purposes and processes in industry, households, the service sector, agriculture, forestry and the fishing industry.

d) the use of renewable energy for transports.

The final energy use is made up of final energy use in the industrial sector, the transport sector, dwellings and service, agriculture, forestry and the fishing industry. In addition, the use of electricity and heating in the energy sector in connection with electricity and district heating production and the transmission losses in the electricity and district heating networks are included.

FACTS Electricity certificate system

On 1 May 2003, a market-based support system was introduced for renewable electricity generation based on electricity certificates. The system aims to achieve the national targets for renewable electricity production. The aim of the system is to increase the amount of electricity generated using renewable sources of energy by 17 TWh from 2002 to 2016. There will be an increase in the target. The Swedish Energy Agency will investigate how an increase by 25 TWh from 2002 up to 2020 can be carried out.

The electricity certificate system will reduce production costs and strengthen the development of new renewable electricity production via the electricity producers receiving an electricity certificate for each MWh on electricity produced. With all users of electricity having to purchase electricity certificates in relation to electricity use, with the exception of electricity-intensive industry, a market arises which produces a value for an electricity certificate. The proportion of electricity certificates that should be purchased (quota) is regulated by law and varies from year to year. The system includes a time limit for the right to be allocated electricity certificates in order to avoid costs for electricity consumers for commercially self-sustaining plants, and so that competition will not be distorted by subsidising commercially self-sustaining generation. Plants that have been taken into operation after the introduction of the system have the right to electricity certificates for 15 years, although no later than to the end of 2030.

2 Use of fossil fuels in relation to total energy used

Compared with many other countries, Sweden has a low proportion of fossil fuels.[33] During the past 20-year period, the proportion of fossil fuels in relation to total energy use has declined. However, the use of fossil fuels varies widely in the different user sectors.

Energy policy objectives

The Swedish energy policy expresses the ambition to maintain a low level of fossil fuel use. In December 2008, the EU decided that 20% of the energy use in the EU in 2020 must come from renewable energy sources, and that 10% of the energy in the transport sector must be renewable. For Sweden, the division of responsibility that has been agreed means that 49% of energy use will be renewable by 2020. The share within the transport sector is the same for all countries.

Trends

Overall, the proportion of fossil fuels has decreased since the 1980s. No sector shows a long-term increase in the share of fossil fuels.

The transport sector still uses predominantly fossil fuels (petrol, diesel fuel, oil, aviation kerosene etc.). The share of fossil fuels in relation to the total energy use in the transport sector has remained relatively stable for a long period, but the share has decreased in recent years. Oil bunkered for foreign shipping is not included in the indicator. During the whole of the period, electricity generation has been largely free from the use of fossil fuels, although its use can be expected to increase somewhat in the future if CHP generation plants are built using natural gas as the fuel.

The share of fossil fuels used in other sectors has decreased during the period. The reduction was highest for district heating generation, the residential sector and the public services sector. The proportion of fossil fuels used in industry has decreased somewhat.[34]

Reasons and relationships

The transport sector is the sector that has the most difficulty in changing to a different energy carrier. Energy use for transport is continually increasing, and alternative solutions for transport are therefore one of the greatest policy challenges.

The fossil fuels used in dwellings and public services consist mainly of oil, but the use of oil in these sectors has steadily declined. An important reason for this is that the competitiveness of oil, compared with other sources of energy, has been significantly impaired because of increased taxes and higher world market prices. Oil is being replaced, principally, by heat pumps, district heating and pellet-fired boilers. Various regulatory instruments, in the form of conversion grants and investment grants, have contributed to the development.

The proportion of fossil energy used in industry has decreased, which is due to a combination of increasing energy prices and international competitive pressure. These factors have encouraged continuous efficiency improvement work in energy-intensive industries, at the same time as production has increased. The European emissions trading system introduced in 2005 provides industry with increasing incentives for reducing the use of fossil fuels. Industrial companies that are included in the programme for energy efficiency improvement in electricity-intensive industry (PFE) are given tax relief on the electricity used in manufacturing processes, ranging from the ordinary 0.5 öre/kWh to 0 öre/kWh. All industrial companies pay 21% of the carbon dioxide tax.[35]

The low proportion of fossil fuels in the Swedish energy system can be explained, in part, by Sweden's high electricity

33 Calculations in this indicator follow the same definitions as in the previous year's publication. The definitions differ in some cases from the definitions in the theme indicators on renewable energy, but have been kept so that they can be compared with previous years' calculations.

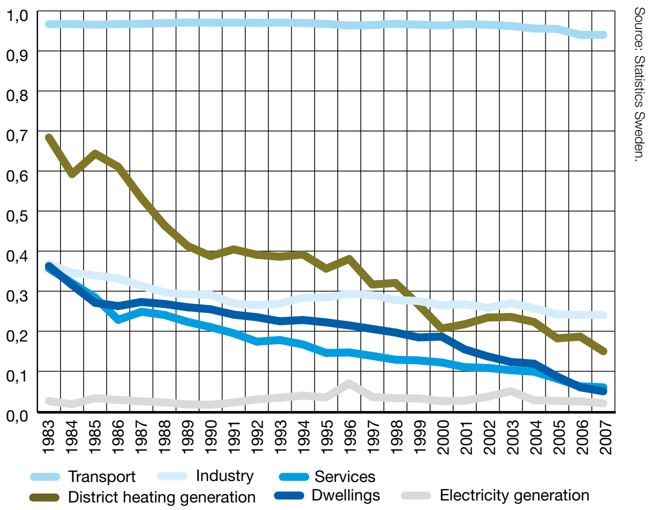
34 For industry, the consumption of fossil fuels is intended for energy purposes, for example heating, fuel for ovens and for the operation of stationary machinery. Fossil fuels used as a raw material within industry are not included in the indicator.

35 More about industry and PFE can be found in base indicator 9 – Electricity consumption by industry per value added.

FACTS

The fossil fuels in this indicator are coal, coke, oil, natural gas and town gas. Peat is also included in the calculation of the fossil proportion, although peat is neither renewable (in the short term) nor fossil in the geological sense. To a certain extent, waste has a fossil content, but is not included in the fossil proportion in this indicator.

Figure 2. Use of fossil fuels (and peat) in relation to the total energy used (including losses) in various sectors



use compared with other countries, and the fact that electricity generation is largely based on non-fossil energy carriers (hydropower, nuclear power, biofuels and wind). Biofuels are used, to a large extent, in industry, principally the forest industry, instead of fossil fuels.

Sweden has an extensive district heating sector that uses only small amounts of fossil fuels. Twenty years ago, district heating generation was mostly based on fossil fuels, but district heating generators have largely changed over to other energy carriers, principally wood fuels, waste, waste heat and heat pumps, in pace with increasing fuels prices.

3 Degree of self-sufficiency

The use of domestic energy carriers in the form of hydropower and biofuels is high, but since all oil, natural gas, coal and uranium are imported, the degree of self-sufficiency is stable at around 30%. The proportion of domestic electricity generation corresponds to the domestic demand, but varies mainly with the weather conditions and hydrology.

Energy policy objectives

The energy policy objectives emphasise the importance of a safe and secure energy supply. However, in pace with increased internationalisation and the deregulated Nordic electricity market, the importance of the degree of self-sufficiency for a secure energy supply has been toned down. The degree of self-sufficiency is still an interesting measure, as long as the legislation is not harmonised between the various countries. According to the objectives, electricity supply will be secured by an energy system that is based on durable, preferably domestic, and renewable energy sources, and on efficient energy utilisation.

Trends

The degree of self-sufficiency in the Swedish energy supply is relatively low and has been just below 30% in the past 10 years. This means that more than 70% of the energy used is imported. The trend is, however, a weak increase in the degree of self-sufficiency. From the security of supply aspect, it is important to point out that, although just over 70% of the energy used in Sweden is imported, it is only 2% that cannot be replaced at short notice with energy from a different supplier or without the need for major investments. For Finland, the equivalent amount is 10% and for Germany it is 26%. In Sweden and Finland, it is natural gas that accounts for non-substitutable energy, whereas Germany has both a specific gas and oil requirement.[36]

Even though the total trend is slightly on the increase, the changes in the respective shares of the various energy carriers are greater. The proportion of biofuels has increased significantly, and wind power has also increased. The proportion of heat pumps[37] increased dramatically at the beginning of the period, but this figure has declined in recent years. The proportion of hydropower has decreased somewhat, while the proportion of nuclear fuel has remained fairly stable. The proportion of oil has dropped significantly between 1983 and 1990, but has remained relatively stable since then. The proportion of natural gas has increased, whereas the proportion of coal has remained fairly constant during the period.

The proportion of domestic electricity generation remained relatively constant, at more than 100% up to the deregulation of the electricity market in 1996. After deregulation, the proportion fluctuated somewhat from year to year, partly because of the increased trade between countries, but mostly because of the decommissioning of less profitable generation capacity and because of purely meteorological conditions. During 1996, 2000, 2002 and 2003, which were dry and cold years, Sweden was a net importer of electricity. A degree of self-sufficiency in electricity higher than 1 means that Sweden generates more electricity than that needed in the country. It is important to emphasise that a degree of self-sufficiency higher than 1 in electricity means, admittedly, that Sweden is a net exporter of electricity, but additional electricity imports are still necessary during high-load periods, and there are many hours during the year when Sweden imports electricity from neighbouring countries, depending on where the generation cost is lowest.

36 IEA's OECD Countries Energy Balances 2006 for 2004, and the Energy Agency's calculations.

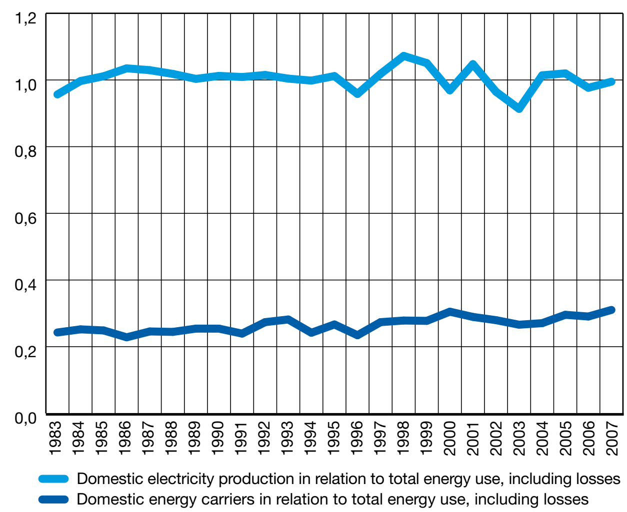
37 Official statistics in the district heating systems only include heat pumps. There has been a large increase in the number of small heat pumps, but these figures are not included in the official statistics used here.

Reasons and relationships

Domestic energy in Sweden consists of hydropower, biofuels,[38] district heating from heat pumps[39] and wind power. The imported energy consists principally of nuclear fuel, oil, coal and natural gas and, in certain years, imported electricity. Domestically generated electricity is all electricity generated in the country, regardless of the fuel on which generation is based. This means that, for example, nuclear power generation, which accounts for around 45% of the total electricity generation, is domestic electricity generation, even though the nuclear fuel is imported. This also applies to electricity generation based on fossil fuels.

Since 1987, which was the first year when all nuclear power plants were already commissioned, renewable energy, principally biofuels, basically accounted for the whole of the increase in energy use. The use of biofuels has been stimulated principally by taxes on fossil fuels and by support measures, such as electricity certificates, which have made biofuels more competitive.

Figure 3. Degree of self-sufficiency



Source: SCB Statistical Memorandum series EN 20 processed by the Swedish Energy Agency, Annual energy balances and EN 11, Electricity, gas and district heating supplies.

38 Note that biofuels in this indicator are classed as domestic. Some of the biofuels are in fact imported.

39 Constituent energy content to heat pumps from underground, lakes, land and air.

4 Combined Heat and Power generation

A CHP generation plant simultaneously generates electricity and heat. This is an efficient energy conversion method with low total losses. Sweden uses a relatively low proportion of the heat demand in district heating networks and in industrial plants as a base for electricity and heat generation in CHP plants. In 2007, around 34% of the heat demand was supplied by district heating systems through CHP plant. The generation of electricity in CHP operation accounted for 9% of the Swedish electricity generated, including transmission losses.

Energy policy objectives

The energy policy objectives emphasise the importance of high energy efficiency and good conservation of resources. CHP generation provides scope for energy conversion at high efficiency and therefore leads to both of these objectives.

Trends

The long-term CHP generation trend in relation to energy use is on the increase. In 2007, 9% of the electricity used was generated in CHP plants. The trend towards heat generation in CHP plants is also on the increase. In 2007, 34% of the heat demand was supplied by district heating systems with CHP generation, which is a relatively small proportion. A contributory reason for the heat base in the district heating systems not being used to a higher degree for CHP generation is that the district heating system consists of a large number of local networks in which the actors are sometimes small companies that would find it difficult to raise the funds for investing in electricity generation.

The fuel used for generating electricity and heat in CHP plants in the district heating network has changed over the years. In 1983, just over 7% of the fuel used was biofuel,[40] while oil was the most common fuel (57%), followed by coal (36%). In 2007, the proportion of biofuel had increased to almost 71%, while coal accounted for 15%. The amount of coal used is at the same level as in 1983, but this figure has fluctuated during the period. Oil has been largely replaced by biofuels and now accounts for only 4%, even though, today, much more electricity and heat are generated in Sweden's CHP plants.

A high proportion of biofuels was used at an early stage for power generation in industry, but the development was similar to that for electricity generation in the district heating network, although the increase has taken place somewhat later in time. Since the mid-1990s, a clear increase is discernible in the use of biofuels and a reduction in the use of oil. Today, biofuel accounts for more than 83% compared with 54% in 1983.

Reasons and relationships

CHP generation is used both in district heating systems and in industry. The use of CHP generation in Sweden is still relatively low compared to Finland, for example, and there are several reasons for this. One reason is that Sweden decided to invest in nuclear power as a supplement to hydropower, and did not, therefore, have the need for this electricity generation. The investments meant that an electricity surplus and interest shown by the power companies to invest in municipal cogeneration plants was small. Another reason is that electricity generation in CHP plants had previously been treated unfavourably with regard to taxation compared with Nordic electricity generation in condensing power stations. Long periods of low electricity prices have made CHP generation unprofitable, even in existing plants.

The conditions for CHP generation have changed radically over time. In the early 1990s, investment support was introduced for biofuel-based CHP generation, which resulted in an increase in generation. When the electricity market was deregulated in 1996, electricity prices fell so much that CHP generation became economically uncompetitive and generation tapered off. New investment support was introduced in 1997 for biofuel-based CHP generation, and additional generation capacity was built. Today, the investment grant has been replaced by the electricity certificate system.

40 In this and other background indicators, peat and waste have been included in the record for biofuel. However, peat is neither renewable (in the short term) nor a fossil fuel, from a geological point of view, and waste, to a certain extent, also has fossil content.

The electricity certificate system has been operative since 1 May 2003, which favours biofuel-fired CHP generation. Because of this regulatory instrument, biofuel-based CHP generation is normally by the far the most profitable alternative for district heating companies that need new heat generation. Before the introduction of the electricity certificate system, many biofuel-fired hot water boilers were built, i.e. systems without electricity generation.

From 1 January 2004, CHP generation in district heating systems was put on an equal footing with CHP generation in industry, also known as industrial back-pressure generation, from the point of view of taxation, meaning that the taxation of CHP generation in district heating systems is taxed more favourably than in the past. The electricity generated is still tax exempt, whereas the heat generated is not subject to energy tax and carbon dioxide tax is reduced to 21%.

Plants over a certain size can be included in the EU system for Emissions trading, which imposes an extra cost on plants that use fossil fuels,[41] which is in-line with the work being done to achieve the climate objective.

The technical potential of CHP generation depends on the available heat base provided by the district heating systems and the process heat demand in industry. Two important parameters for the development of CHP generation are the extent to which the existing heat base is utilised and how the magnitude of the heat base develops.

Although the use of CHP generating stations is profitable, there are also other ways of generating heat for district heating, which are valuable from the point of view of resource conservation and environmental considerations. One example is the utilisation of industrial waste heat, i.e. heat that would otherwise not be put to use. Oil is being replaced principally by heat pumps, district heating and pellet-fired boilers. However, the magnitude is still limited.

Figure 4:1 Electricity generation in CHP operation (district heating and industry) in relation to the total electricity use (including transmission losses).

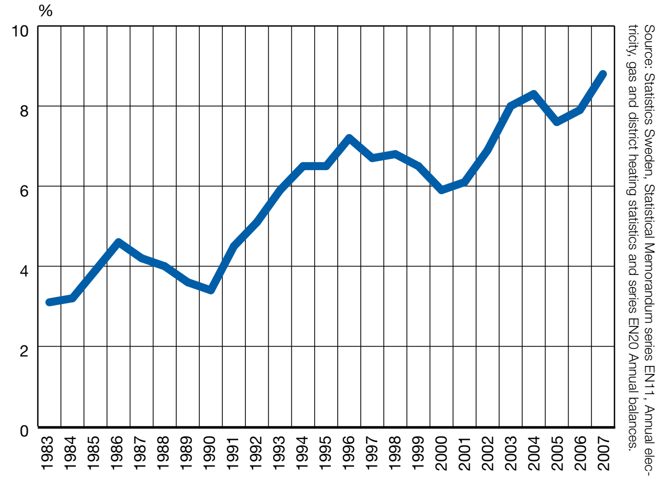
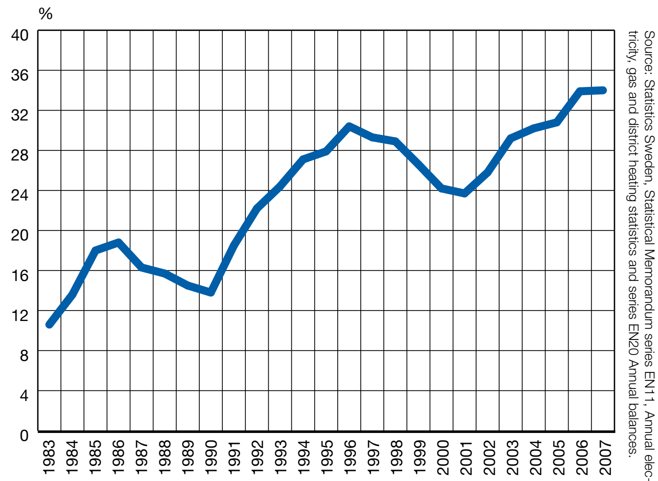
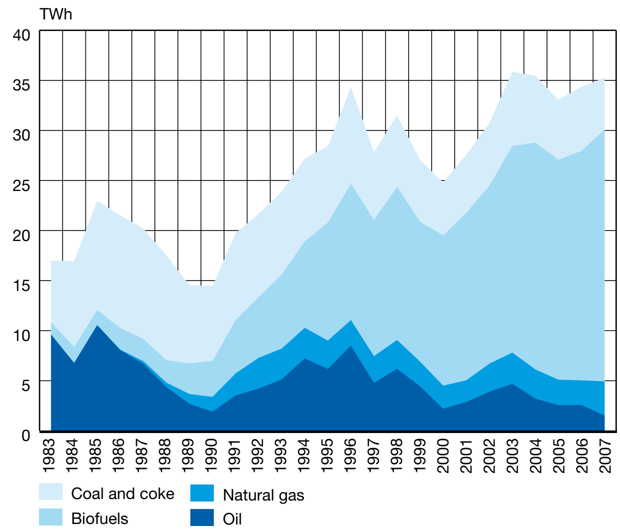


Figure 4:2 Generation of heat for district heating in CHP operation in relation to the total heat use of district heating (including transmission losses)



41 From 1 January 2008, these plants do not receive free allocations of emission rights but need to purchase their entire requirements. At the same time, they do receive a tax exemption of 85% on the carbon dioxide tax for the consumption of other fuels other than petrol and oil, which is taxed highly during the manufacturing processes in industrial operations. A tax exemption is granted at 85% of the carbon dioxide tax on fuel used for the production of heating during CHP generation.

Figure 4:3 Fuel input for electricity and heat generation in CHP plants in the district heating network



Source: Statistics Sweden, Statistical Memorandum series EN11, Annual electricity, gas and district heating statistics and series EN20 Annual balances.

FACTS Combined heat and power generation

The concept of combined heat and power (CHP) generation means that electricity and heat are generated simultaneously. CHP generation is much more efficient than other alternatives for fuel-based separate electricity generation and separate heat generation, viewed from the total utilisation of the energy in the fuel. System efficiency is roughly twice as high. A prerequisite for CHP generation is the proximity to an area where there is a heat requirement. Heat generation can be used either for district heating or for process heat in industry.

5 Power balance

The historically strong Swedish electricity balance was weakened drastically following deregulation; power stations were shut down, while the demand for electricity increased. However, since 2000, the installed capacity has steadily increased, while the peak load demand has remained stable in recent years. The electricity balance is now largely satisfactory, particularly taking into account the import capacity.

Energy policy objectives

Securing the availability of electricity is a focal part of the energy policy objectives. These also state that the secure availability of electricity at a reasonable price is an important condition for the international competitiveness of Swedish industry. Secure availability of electricity means that generation and/or import resources will always be available, corresponding with a reasonable margin of safety to electricity demand. In the "Protection and preparedness for accidents and difficult circumstances" policy area, it is stated that one of the objectives for our safety should be to protect the functionality of society. Energy supply and electricity supply is classified as a socially important activity that must not break down.

Trends

The indicator shows the maximum hourly power demand for electricity compared with the installed electricity generation capacity in Sweden. The indicator also shows the estimated available electricity generation and electricity import capacity compared with the estimated maximum power demand in a 10-year winter.[42] The maximum hourly power requirement is the measured mean power during the hour every year when the electricity use is at its highest. The occasion on which this peak load occurs varies from year to year, but normally occurs in very cold weather in densely populated parts of the country, at the same time as the electricity use by industry is high. The maximum hourly power demand has increased slowly over time, but has fluctuated around 26,000 MW since 1996.

The installed generation capacity in Swedish power stations increased slowly up to the mid-1990s. However, the capacity decreased significantly during the second half of the 1990s. The installed capacity again increased after 2000, and is basically back at the same level as before deregulation. However, the power situation can still be strained during a so-called 10-year winter.

Reasons and relationships

The maximum hourly power demand has flattened out during the past 10 years. This can be explained, in part, by the fact that the electricity energy use in recent years has flattened out, for reasons such as increased electricity prices. The maximum electric power demand is influenced by factors such as industrial business activity, price of electricity and temperature conditions during the relevant year. Low temperatures increase the space heating requirements and the electricity demand of heating systems that are based on electricity. The high increase in the heat pump capacity, principally for heat from rock, for heating single-family houses, contributes to an increased power demand during the winter. Heat pumps are not normally rated for meeting the heat demand in very cold weather, when electricity is used instead for heating. This contributes to an increased electricity demand at times of the year when the power supply is at its most critical. At the same time, the use of district heating has increased somewhat in recent years, which promotes lower electric power demand for space heating. The conversion of electrically heated dwellings to other heating alternatives, such as district heating or biofuel boilers, could also be one way of reducing the power demand.

There are a number of difficulties associated with the interpretation of the relationship between maximum electric power demand and the installed power generation capacity. The electric power demand varies with the outdoor temperature and industrial business activity. This means that even if the maximum electric power demand is lower, with a comfortable

42 The 10-year winter is defined as the lowest average value of the temperature over a three-day period that statistically occurs every 10 years.

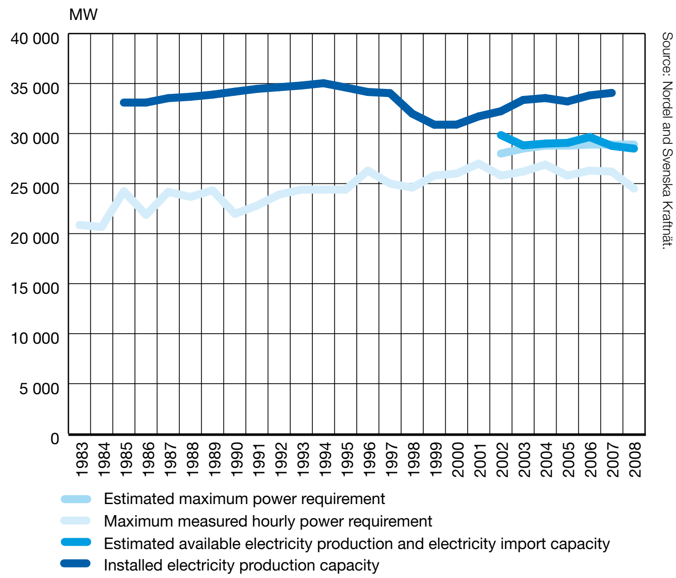
margin, than the installed generation capacity over a number of years, this need not mean that the electricity supply is secure for the coming years. This may be due to earlier years having been mild, at the same time as the electricity demand in a coming year may be substantially higher. It should be emphasised, in this context, that all of the past 10 years have been warmer than normal.

The estimated available electricity generation and electricity import capacities are reported annually by Svenska Kraftnät to the government before the coming winter. The report includes all electricity generation capacity that is estimated to be available before every winter, excluding the disturbance reserves,[43] with an estimate of the expected unavailability that reduces the capacity. The import capacity included is the one that can be expected during a 10-year winter, i.e. that because of the power situation in neighbouring countries, all import capacity cannot be expected to be available.

The reduction in electricity generation capacity at the end of the 1990s was due to stand-by plants (condensing) being mothballed and the fact that Barsebäck 1 was shut down. At the same time, the additional capacity in the form of CHP plant and wind power was low. The increase after 2000 consists mainly of recommissioning of plants in the power reserve that were previously mothballed.

The shutdown of Barsebäck 2 on 31 May 2005 caused the loss of 600 MW of power. This was partly compensated by implementing and raising the power output in other nuclear power stations. Wind power accounted for the largest additional power contribution in Sweden in 2007, as 242 MW of new wind power plant was put into operation. In 2008, a further 217 MW of wind power was added; the increase over the past two years has been substantial compared with the

Figure 5:1 Maximum measured hourly power demand for electricity compared with the installed capacity and estimated available electricity generation and electricity import capacities compared with the estimated maximum power demand.



43 Disturbance reserves are made up of production capacity that has a quick response, in the form of gas turbines. Disturbance reserves are used in the event of disruptions to the power system, i.e. in the event of unplanned incidents. These reserves are not used for balance regulation during normal operations, but may need to be used if there is a risk of a power shortage.

years before when approx. 60 MW of new wind power plant was installed every year.[44] There are also plans for expanding biopower and CHP generation among companies in the forest industry and district heating sector. According to a newly published report on the expansion of CHP generation between 2007 and 2015,[45] an increase of 1250 MW in the installed electric power generation capacity is expected by 2015 in CHP plants in the district heating system and by 300 MW in plants in the forest industry.

As a result of the deterioration in the power balance at the beginning of the 21st century, the Swedish Parliament decided, in 2003, to pass a temporary law on power reserves. According to the law, Svenska Kraftnät was given the responsibility to procure a power reserve not exceeding 2000 MW. The power reserve is achieved by Svenska Kraftnät entering into agreements with electricity generators and electricity consumers for making further generation capacity available or allowing for a reduction in use. The validity of this law has now been extended by a further three years, until 15 March 2011. The Energy Markets Inspectorate has proposed that the temporary power reserve should be gradually discontinued after 2011.

Figure 5:2 Installed electricity generation capacity in Sweden per power source between 1996 and 2006

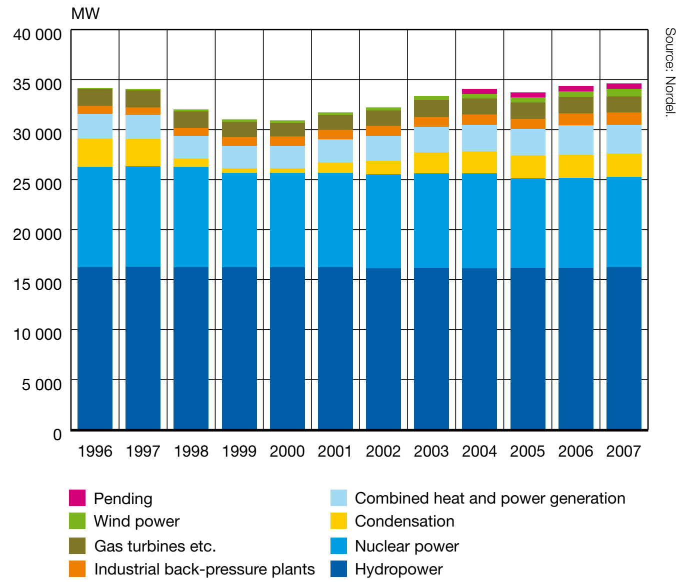
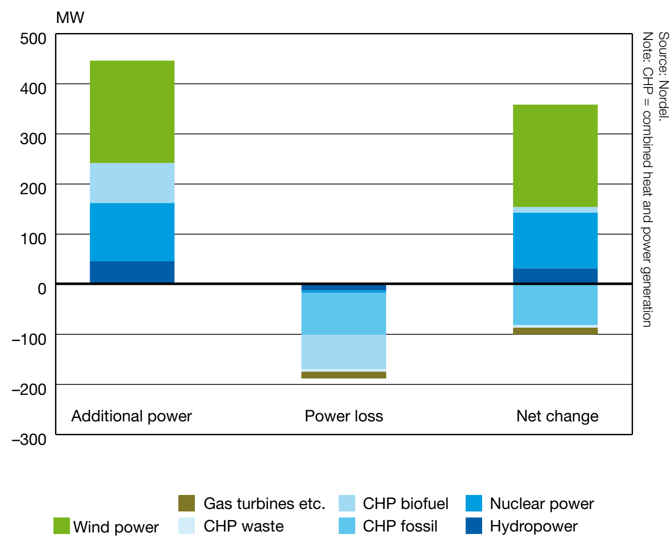


Figure 5:3 Change in installed power generation capacity in Sweden in 2007



44 Wind power statistics 2008, ES 2009:03, the Energy Agency.

45 The report has been produced by Svebio, Skogsindustrierna, Svensk fjärrvärme and Svensk energi and was published in April 2008.

6 Total market share of the three largest electricity suppliers

Efficiency and competition are characteristics of the Swedish electricity market. Statistics show that the market share of the three largest electricity trading companies increased from 48% to 50% between 2004 and 2007.[46] *The market share dropped in preceding years, which is due in part to a couple of new electricity companies establishing themselves on the market. The fact that the three largest electricity trading companies then regained market shares may be due to their intensified marketing.*

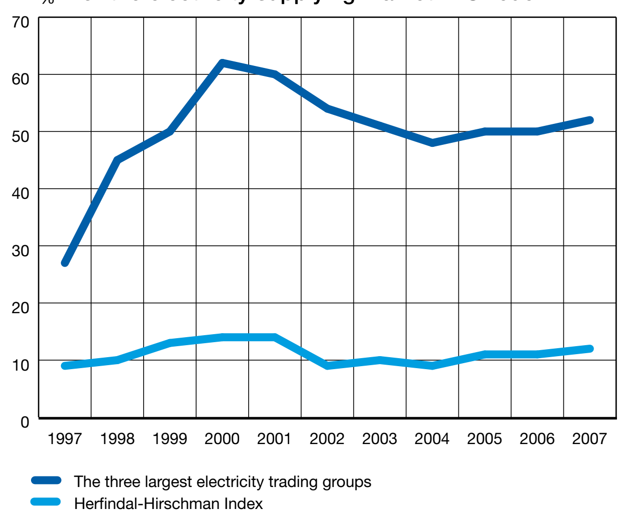
Energy policy objectives

Electricity supply has a very important function in Swedish society. Electrical energy is consumed daily by households and is included in virtually all production of goods and services. In the energy policy objectives, emphasis is placed on the importance of an efficient electricity market. Good conditions must be created for consumers and companies to act on the competitive electricity market. An electricity market that performs well and has a sound structure conversion and efficient utilisation of resources creates an effective pricing system.

Trends

The electricity market in Sweden is characterised by vertically integrated groups of companies. Vertical integration means that groups of companies in the electricity market control the operations in electricity generation, electricity trading and electricity distribution. Vattenfall, E.ON and Fortum are the three companies that now dominate electricity generation, trading and distribution in Sweden. The market share of the three biggest electricity trading groups in Sweden, in terms of electrical energy sold, dropped from 62% in 2000 to 48% in 2004. A contrasting development took place during the period between 1997 and 2000, when the market concentration rose from 27% to 62%. From

Figure 6. Total market share in Sweden of the three largest electricity supplying groups and the Herfindahl index for the electricity supplying market in Sweden



2005 to 2007, the market shares for the three largest electricity trading groups increased again, to approximately 52%.[47]

The so-called Herfindahl-Hirschman Index (see the FACTS box), which is a way of measuring the market concentration, reveals a corresponding development. After deregulation of the electricity market, the index rose from 0.09 in 1997 to 0.14 in 2001. In 2002, the index dropped to approximately 0.10, whereby it then increased to 0.12 in 2007. According to the "US horizontal merger guidelines", the Herfindahl-Hirschman Index shows that the market for electricity trading in 2007 was moderately concentrated. The Herfindahl-Hirschman Index should be viewed with caution, since certain observers consider that the make-up of the index is not well suited for the electricity market. A comprehensive picture is needed for a good assessment of the competition in the electricity market, whereby additional factors are considered, such as information, transparency and liquidity, and the effect of vertical and

46 As part of the process in improving the quality, this indicator has been calculated with a new method from the 2007 edition. The old time series was calculated in accordance with the new method. The reason for this change is that the old method, in all probability, overestimated the market concentration and, as a result of this, the total market size was underestimated.

47 See also base indicator 19 – Total market share for the three largest electricity generators.

horizontal integration. This index should be regarded as one measure among several that can be used for assessing the competition in the electricity market.

Reasons and relationships

If the electricity market is to perform efficiently with effective competition on equal terms, there must be few obstacles on the market or none at all. The electricity market is divided into a raw power market (wholesaler sector) and an end-customer market (retailer sector). Conditions differ on the two parts of the market. The end-customer market is mainly national, whereas the raw power market is highly international.

On 1 January 2007, a number of new rules were introduced in the Electricity Act, in order to strengthen the position of the customer in the electricity market. The new rules give the electricity consumer clearer rights to information, and the time for implementing a change of electricity supplier was shortened. The increased information is intended to encourage consumers to be more active in the electricity market, to make a larger number of rational choices, and thereby make the market more efficient.

A condition for the electricity market to perform efficiently is also that cross-subsidising between monopoly operations and competitive operations must be minimised. There were historical indications that profits from electricity distribution were used to cover losses in other electricity operations. The Electricity Act specifies that the corporate body that runs electricity network operations must not run the generation of or trade in electricity. This reduces the opportunities available for cross-subsidising electricity generation and electricity trading by network operations. The EC Commission and the European supervisory authorities act towards creating equal conditions on the EU internal market for electricity.

The number of electricity trading companies on the Swedish market has been falling over many years. In the mid-1950s, there were more than 1,500 companies that distributed and sold electricity. Twenty years later, the number of companies had fallen to just over 500. Since the electricity market was deregulated on 1 January 1996, the number of electricity suppliers that pursue active sales of electricity to end customers has fallen from 221 companies to around 124 (in 2008). Out of these, most suppliers sell electricity to customers throughout the country, although few of them actively market their services nationally. Only approx. 20 are entirely independent of the three large energy groups.

An important reason for the initially increasing market concentration is that, after deregulation of the electricity market, small independent and municipal companies faced the choice of either merging with other companies or selling their operations. The larger electricity trading companies were looking for scale benefits and were thus interested in buying smaller companies, while many municipalities tried to sell their operations. There were benefits to be gained for both sellers and buyers, which led to many of the smaller companies being sold to larger electricity trading companies. The number of municipally owned electricity trading companies decreased from 143 to 56 between 1996 to 2004.

Sources: Statistics Sweden and the Energy Markets Inspectorate

FACTS Index for measuring market concentration

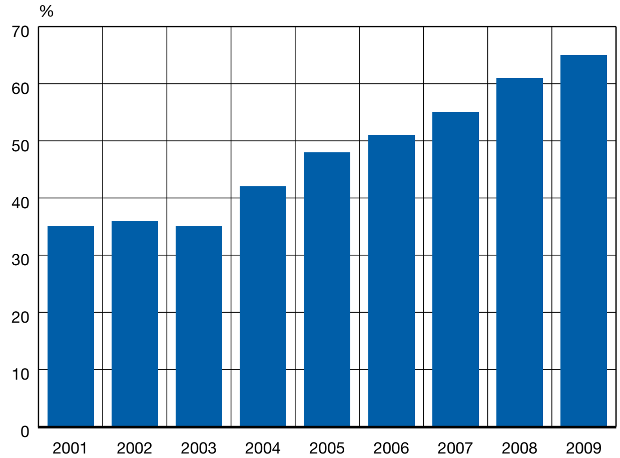
When assessing the market concentration, it is practical to use an index that provides information using a single figure as a reflection of the competitive conditions in that particular market. Several such indexes have been developed, two of which are more generally used. These are the Herfindahl-Hirschman Index (sum of the squares of the market shares) and the total market share of the largest companies on the market (where the number of companies can usually be between 3 and 10). The figures for both indexes are between 0 and 1, whereby lower values of the concentration index indicate better conditions for competition. According to the "US horizontal merger guidelines", the market can be characterised in the following manner at different values of the Herfindahl-Hirschman Index:

< 0.10:	Unconcentrated market
0.10 – 0.18:	Moderately concentrated market
> 0.18:	Highly concentrated market

7 Proportion of end customers of electricity who have renegotiated their contracts, including those who have switched to a different electricity supplier

For a number of years, electricity customers have had the freedom to choose their electricity supplier. The information on how the electricity market operates and the possibility of comparing the various electricity supplying companies to see whether what they have to offer has improved over the past year. On 1 January 2009, more than 65% of electricity customers had renegotiated their electricity contracts and/or switched to a different electricity supplier.

Figure 7:1 Proportion of end customers of electricity who have renegotiated their contracts, including those who have changed to a different electricity supplier.



Energy policy objectives

An electricity market that performs well and is efficient is an important objective in the Swedish energy policy. A market that performs well creates competitive electricity prices, which is of great importance to the international competitiveness of Swedish industry and to households' finances. For the market to perform well, consumers must be well informed and take action to ensure they are receiving the best deal possible. The Swedish energy policy therefore emphasises that electricity supplier changes should be performed in a satisfactory manner. A number of new rules in the Electricity Act were introduced on 1 January 2007, with the aim of strengthening the customers' position in the electricity market.

Trends

During the period between 2001 and 2003, the proportion of end customers of electricity who had switched to a different electricity trader or renegotiated their contracts was relatively constant, at around 35%. This was followed by a marked upswing and, by 1 January 2009, more than 65% of end customers had renegotiated their contracts or switched to a different electricity supplier. This trend continued during the early part of 2009. Over the past year, end customers who had decided to conclude variable price contracts had increased from 16% to 22%. On the other hand, those customers that chose a one-year or two-year contract continued to fall between 2008 and 2009, while the share of customers that chose a contract of at least three years has remained relatively unchanged: around 19%. From 2008, other types of contracts (for example mixed contracts) are reported, which amounted to just less than 7% at the end of the year.

Viewed over the year, there are certain seasonal variations when customers change their electricity supplier, e.g. a low proportion make the change during June and a very high proportion of changes take place in January. The latter is presumably because, for practical reasons, many agreements begin on 1 January, although an additional reason may be that one or more electricity suppliers have price campaigns, in which contracts begin on 1 January.

Reasons and relationships

End customers can choose from various contract forms, such as fixed prices of electricity with different contract durations and variable prices for electricity linked to the Nord Pool spot price. Customers who do not make an active choice are assigned to an open-ended contract (until further notice). The electricity user has full freedom to switch to a different electricity supplier and/or renegotiate his/her electricity contract. However, the electricity user cannot switch to a different supplier if the contract runs for a specific time frame. Since 1 January 2007, electricity sup-

Figure 7:2 Number of administered electricity supplier changes in the period 1 April 2005–28 February 2009

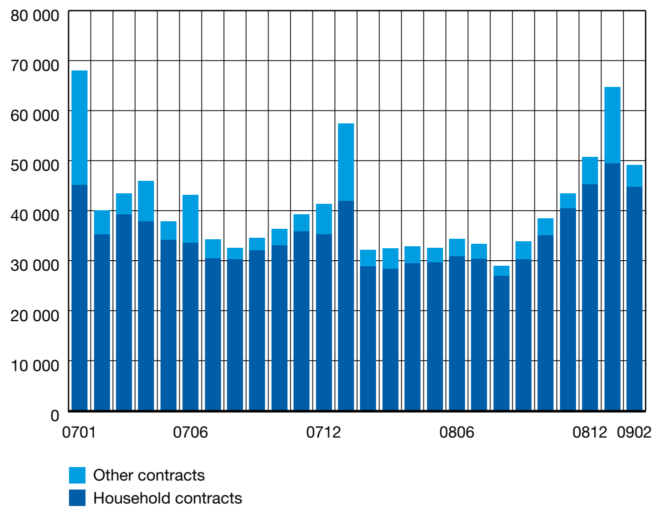
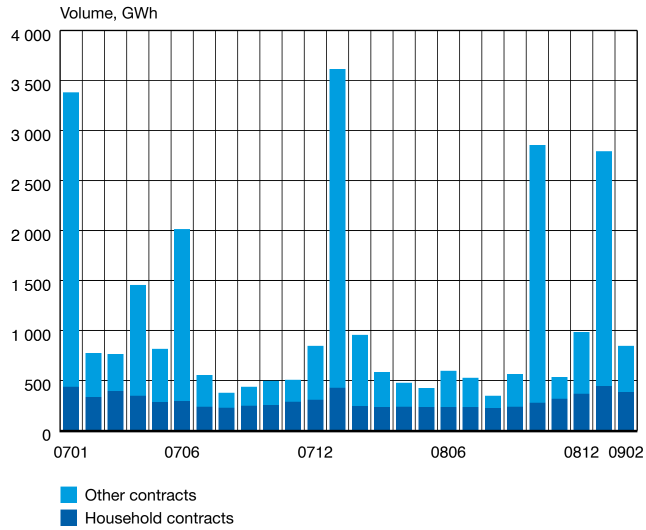


Figure 7:3 Calculated annual volume of administered electricity supplier changes in the period 2006–2008



pliers must notify the network company of a supplier change no later than the 15th of the calendar month before the change is to take place. This means that the time for supplier change has been shortened to a maximum of one and a half months.

There are several explanations for the increase in supplier changes and renegotiations of contracts from 2004 onwards. Electricity prices during 2004 and 2005 were much lower than the record prices during the winter of 2002/2003. A consequence may be that many customers have used the opportunity to conclude contracts running for several years at a relatively low price compared with the previous year. Another reason may be that electricity customers' knowledge of how the market performs has increased as a result of the electricity companies being given a great deal of attention in the media in recent years. Moreover, several electricity trading companies have intensified their marketing during the past few years.

End customers with high electricity use have the most to gain by seeking alternative suppliers on the market, although customers living in apartments with a low energy use may also benefit from an active choice of electricity supplier. In addition to finding an electricity supplier with a low price of electricity, consumers with a low electricity use should choose an electricity trader that can offer an agreement either with no annual charge whatsoever or with a low, fixed charge. The total price of electricity consists of the price of electrical energy (from 1 January 2007, including the price of electricity certificates), the price of network service and taxes (energy tax and VAT). The end consumer can only influence the first parameter by renegotiating his contract.

A number of new rules were introduced in the Electricity Act on 1 January 2007 in order to increase the activity in the electricity market and strengthen the position of consumers. According to the changes, only a consumer who has a network agreement can conclude an electricity trading agreement, meaning that the same person in the household must be responsible for both agreements. Another change to safeguard the consumer is that the consumer will receive information on who the designated electricity trader is and when an electricity delivery agreement ceases. Moreover, as mentioned earlier, the notification time for changing the electricity trader has been shortened.

Source: Statistics Sweden series EN17 (which from June 2007 was replaced by EN24), prices of network services and electrical energy and monthly electricity statistics.

8 Energy use of industry per value added, in a number of industrial sectors

The energy use of industry per value added varies between different sectors. For most sectors of industry in Sweden, energy use per value added demonstrates a reduction in energy use, but, during 2007, energy intensity increased in all industries studied except for the iron, steel and metalwork industries. In an international comparison, the energy use per value added of Swedish industry is high. On the other hand, it is not correct to claim, on the basis of the relevant indicator, that Swedish industry uses energy less efficiently than industry in other countries. It is rather an expression of the different roles in the international work distribution, so that industrial production in Sweden uses non-processed raw materials as the point of departure. However, in three out of four sectors studied, Swedish industry has a lower energy use per value added than the EU average.

Energy policy objectives

In the energy policy objectives, the importance is emphasized of reliable availability of energy at reasonable prices for the international competiveness of industry. This particular indicator is of interest, since it shows the energy intensity in Swedish industry compared with other countries and how heterogeneous Swedish industry is from the energy aspect. The indicator also shows how important energy is as an input commodity for different industries, and thus how sensitive different industries are to changes in the price of energy.

Trends

The trend for most industrial sectors in Sweden is steadily declining energy use per value added. The energy intensity has decreased by 45% between 1993 and 2007 in the whole of the manufacturing industry and by 61% in the engineering industry. However, in the pulp and paper industry,[48] the energy intensity increased by approx. 30% during the same period. The iron, steel and metalwork industries in Sweden displayed increasing energy use per value added during the latter end of the 1990s. The upturn was broken in 2000, and the energy use of the sector per value added has decreased substantially, and is today less than it was in 1993. During 2007, the energy use per value added increased in all industries studied, with the exception of the iron, steel and metalwork industries, in which the indicator continued to fall.

The difference in energy use per value added is very wide between different industries. In 2007, the energy intensity was more than 0.3 kWh/Euro per value added in the engineering industry, while it was a little more than 11.6 kWh/Euro in the pulp and paper industry and 9.4 kWh/Euro in the iron, steel and metalwork industries. In each sector of industry, the differences are also wide between various parts of a given sector.

The energy use per value added in the EU-15 has been decreasing since 1993 in the whole of the manufacturing industry, basic chemical industry, engineering industry and the iron, steel and metalwork industries.

For the pulp and paper industry, information for the past 15 years in the EU-15 is lacking. However, data for previous years indicates that energy use per value added for the Swedish pulp and paper industry is four times as large as the pulp and paper industry in the EU-15. The manufacturing industry in Sweden also has higher energy use per value added than the average for the EU-15, but the engineering industry, chemical industry and iron, steel and metalwork industries in Sweden have a lower energy use per value added than the EU-15. Since 1993, energy intensity in the Swedish manufacturing industry has been decreasing at a higher rate than in the EU-15

Reasons and relationships

Sweden has long been characterised by a large energy-intensive industry, partly because of the availability of raw materials, such as forests and iron ore. A contributory factor for declining energy use per value added in Sweden is that the growth rates in the Swedish engineering and pharmaceuticals industries have been high in recent years. These industries are not particularly

48 The paper and pulp industry are covered by SNI 21-22, i.e. pulp, paper, paper products and the printing industry.

Figure 8:1 Industrial energy use per value added, in a number of industrial sectors in Sweden

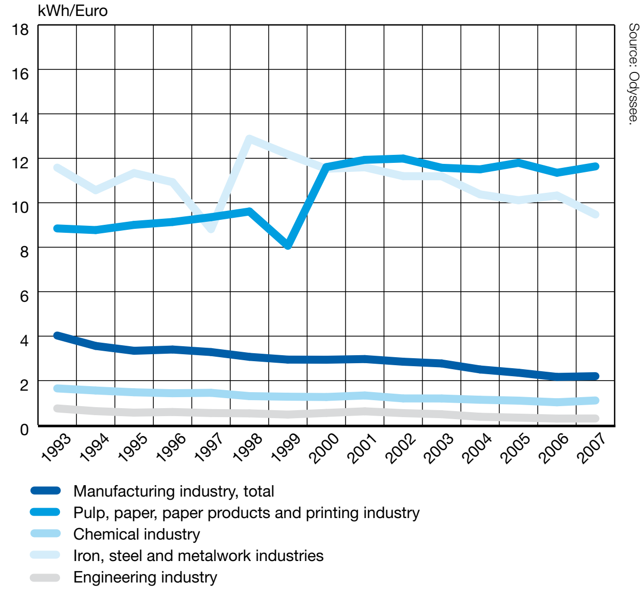
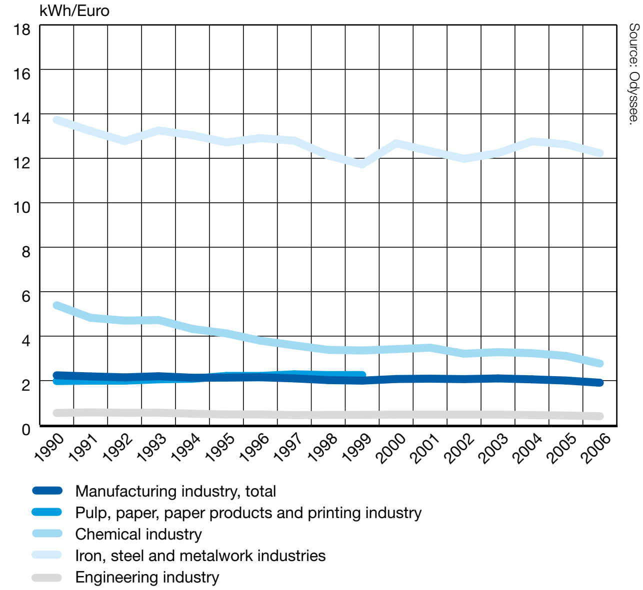


Figure 8:2 Industrial energy use per value added, in a number of industrial sectors, EU-15



Note: Revised statistics from 2000. Previously, Sweden's energy use per value added has been calculated with the help of statistics from the Energy Agency and Statistics Sweden (Industry's energy use and National Accounts), but now these statistics are taken from the Odyssee database. Therefore the values are different this year from the reported values in previous publications.

energy intensive, which leads to value added increasing more quickly than energy use.

It is easy to interpret the indicator as a measure of how efficient energy is used. However, this particular indicator is not a good instrument for following up energy efficiency, since the development of the indicator is influenced by a great deal more than actual energy efficiency. Some examples of factors that lower energy use per value added without a change in actual energy efficiency are:

- Structural changes in a particular sector of industry. If part of a sector of industry with a low energy use expands at the expense of a part with a high energy use, the indicator will show a lower energy use per value added.
- Process changes in the sector of industry, e.g. that the demand switches to products with other properties.
- For the same reasons, it is not correct to use this indicator as the basis for claiming that Swedish industry uses energy less efficiently than industry in other countries. Part of the explanation for appreciably higher energy use per value added, mainly in the pulp and paper industry, is that Swedish industry is focused on products and processes that give rise to high energy use per value added, i.e. an expression for the different roles in the international work distribution. In Sweden and Finland, industry is based largely on unprocessed raw materials, e.g. forest, whereas countries in the remainder of Europe are largely based on recycled paper, for instance. This is the main reason for the difference in energy use, and in view of the unprocessed raw materials, Sweden and Finland will never reach the "EU level".

9 Electricity use in industry per value added, in a number of industrial sectors

The electricity use in industry per value added varies widely between different sectors. Historically, electricity use per value added has fallen in Swedish industry as a whole and in all sectors studied, except for the pulp and paper industry.[49] However, in 2007, Swedish industry's electricity intensity increased marginally.

Energy policy objectives

The importance of reliable access to electricity at reasonable prices for the international competitiveness of industry was emphasised in the energy policy objectives. The indicator also indicates how the competitiveness of different sectors of industry is affected by changes in the price of electricity.

Trends

Since 1993, electricity use per value added has been declining in most sectors of industry. However, this does not mean that total electricity use has dropped, but indicates that value added has been increasing more rapidly than electricity use. During 2007, electricity use per value added increased marginally in the whole of the manufacturing industry. In the iron, steel and metalwork industries, and in the engineering industry, electricity use per value added fell in 2007, while it increased in the chemical industry and in the pulp and paper industry.

Electricity use per value added in the pulp and paper industry increased during the period between 1996 and 2001, then decreased up to 2003, followed again by an upturn. In 2000, a large increase in electricity use per value added can be seen, which is partly explained by the fact that the statistics were reviewed 2000–2007. This review also impacts on the chemical industry, where a large increase in electricity intensity occurred in 2000, which makes it difficult to compare the level on the indicator before and after this year. However, the trend in the chemical industry indicates decreasing electricity intensity during the periods 1993–2000 and 2000–2006. In 2007, a minor increase in the indicator is visible for the chemical industry. The engineering industry and the iron, steel and metalwork industries show, as does the industry in total, a historic reduction in the use of electricity per value added.

The electricity use per value added differs widely between different sectors of industry in Sweden. In 2005, electricity intensity was a little less than 0.2 kWh/Euro per value added in the engineering industry, while it amounted to a little more than 3.6 kWh/Euro for the pulp and paper industry. In each sector of industry, the differences are also considerable when comparing different sub-sectors.

The difference in electricity intensity between different countries in the EU-15 and between individual sectors of industry is also considerable. Electricity use per value added for the iron, steel and metalwork industries in the EU-15 is higher than in Sweden. It is interesting to note that electricity intensity in the iron, steel and metalwork industries is increasing in the EU-15. The engineering and chemical industries are at roughly the same level in Sweden and in the EU. For the pulp and paper industry, there are no statistics regarding electricity intensity in the EU-15 for the past few years. However, studies of historical data indicate that the electricity intensity is almost three times as large in Sweden as in the EU-15.

Reasons and relationships

The indicator shows electricity intensity in Swedish industry compared with the EU-15 and how heterogeneous Swedish industry is from an electricity use point of view. The indicator also shows how important electricity is as an input commodity for various sectors of industry and how sensitive these sectors are to changes in the price of electricity. However, this particular indicator is not an accurate instrument for following up the efficiency of electricity use, since the development of the indicator is affected by factors other than actual electricity efficiency. In principle, electricity can be used all the more efficiently even if the electricity use per value added indicator increases. Such development can be explained, for instance, by structural changes in the industry and by process changes. The variation in electric-

49 The paper and pulp industry are covered by SNI 21-22, i.e. pulp, paper, paper products and the printing industry.

Figure 9:1 Industrial electricity use per value added in a number of industrial sectors in Sweden

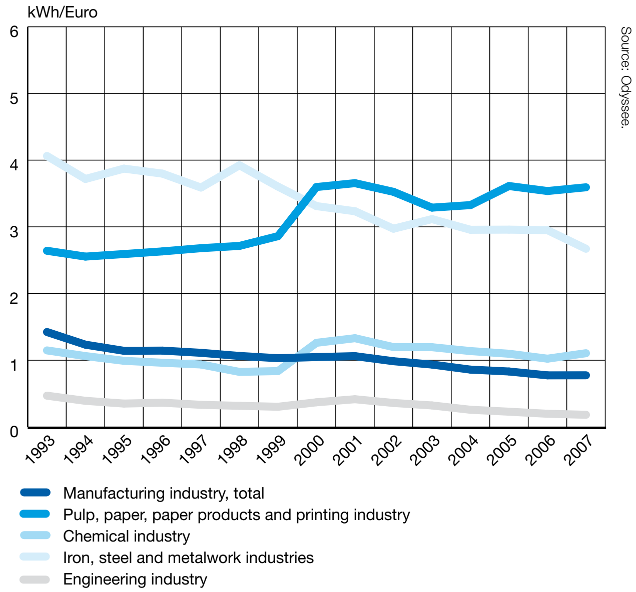
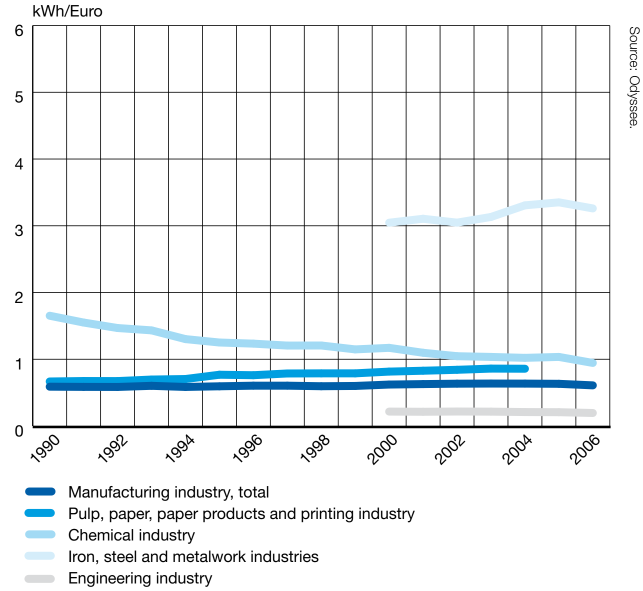


Figure 9:2 Industrial electricity use per value added in a number of industrial sectors, EU-15



Note: Revised statistics from 2000. Previously, Sweden's energy use per added value has been calculated with the help of statistics from the Energy Agency and Statistics Sweden (Industry's energy use and National Accounts), but now these statistics are taken from the Odyssee database. Therefore the values are different this year from the reported values in previous publications.

ity intensity in the pulp and paper industry can, to some extent, be explained by the share of mechanical pulp in pulp production. The manufacture of mechanical pulp requires a lot of electricity compared with other pulp production, and the development of the indicator, more or less, follows the development of the share of mechanical pulp in pulp production.

The fact that the Swedish pulp and paper industry seems to use significantly more electricity per value added than corresponding industries in the EU-15 need not mean that electricity use in Sweden is less efficient than in the EU. The main reason for high electricity use is that Swedish industry has focused on products and processes that involve high electricity use per value added. Unprocessed raw materials, such as wood are used to a large extent in Sweden and Finland, whereas countries in the remainder of Europe mainly use more highly processed raw materials, such as recycled paper. The indicator alone can therefore not be used for electricity efficiency comparisons between different countries. In an international comparison, electricity is an important input commodity to Swedish industry.

FACTS Programme for energy efficiency

Since 2005, a programme for energy efficiency improvement (PFE) has been in operation in energy-intensive companies. By participating in the programme, companies receive complete exemption from the energy tax for electricity – payable from 1 July 2004. There are 110 companies participating in the programme. These companies use a total of about 30 TWh of electricity annually in their production processes, which corresponds to roughly 50% of industrial electricity use. This means that they now receive total tax exemptions amounting to around MSEK 150 annually. The participating companies include the pulp and paper industry, the mining industry and the chemical industry.

10 Energy prices to industrial customers, including relevant taxes

In 2007, the price of oil increased. Electricity and network prices have increased throughout 2007–2008, while the price of natural gas for industry has remained relatively stable. The reporting of statistics for electricity and natural gas prices has been revised, which makes it difficult to make direct comparisons with earlier years.

Energy policy objectives

The energy policy guidelines state that reliable access to energy at reasonable prices is important to the international competitiveness of industry. It is therefore important to monitor energy prices. Having efficient electricity and natural gas markets are also highlighted as objectives for the energy policy. There are also specific objectives for the electricity market, for example, that the pricing system performs efficiently, that customers can easily change supplier and that there is access to information in the electricity market.

Trends

The reporting of statistics for electricity and gas prices has been revised. For electricity and natural gas prices, there are now statistics for 2007 and 2008 in the new report series. During these two years, the price of electricity increased continuously, in total, approximately 37% between the first half of 2007 and the second half of 2008.[50] The price of natural gas increased somewhat during the second half of 2007, but has been relatively stable since.

Up to 1 January 2007, statistics relate to the price a company had to pay if it signed a one-year contract from 1 January that year. The prices of electricity and natural gas are then reported as an average price per six months, calculated on the price that the companies actually paid, i.e. current contracts. Companies with contract times longer than one year are also included here. Typical customers for whom statistics are collected have also been altered (see the FACTS box). These half-yearly prices, therefore, cannot be directly compared with prices for 1 January. In the earlier January price series, the industrial electricity and network prices for 2005–2007 increased. During the second half of 2008, the price of electricity and the network price were higher for all three user categories compared with the record year 2003 for the old survey method. The difference in the price of electricity for small and large users has fluctuated, but has fallen over time. During 2008, the difference between large and small users increased again. However, it is too early to say whether this is a break in the trend or a temporary fluctuation.

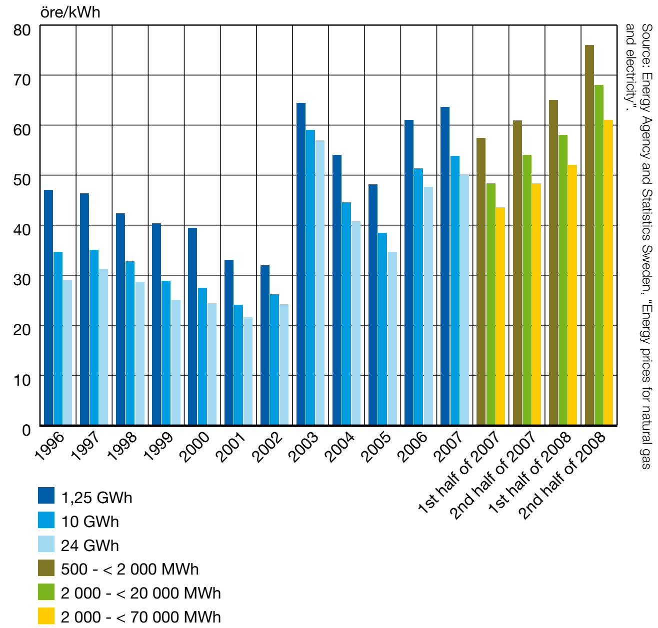
A comparison of the price of electricity on 1 January and the average price for the first half of 2007 shows how different these prices can be and how uncertain a comparison between these time series is. The average price is significantly lower than the January price. The average price for the second half of the year is higher than for the first half and approaches the January price for 2006. The fact that the average price is lower than the January price is, in part, because companies with longer contracts are also being included in the average price. In general, the longer the agreement period, the lower the price will be. The price of electricity in January also tends to be higher than in May, for example, but since the January price in the statistics applied to one-year contracts, consideration should have been given to when the price was set. The development of prices in the Nord Pool electricity exchange should also have influenced the electricity prices for the indicator. The exchange price was relatively high during 2006 and was much lower during 2007. Up to 1 July 2004, industry paid no electricity tax. Since then, the electricity tax for industry has amounted to 0.5 öre per kWh.

When the previous reporting method with January prices was used, the price development for natural gas was more or less in-line with the price development for oil. However, price fluctuations for natural gas were more moderate than those for oil. This covariance cannot be seen as clearly now as the two price series are reported in different ways.

No changes have taken place in the reporting of the oil price, and it still relates to the price on 1 January of each year. Between January 2008 and January 2009, the price of light fuel oil decreased by approximately 26% and the price of heavy

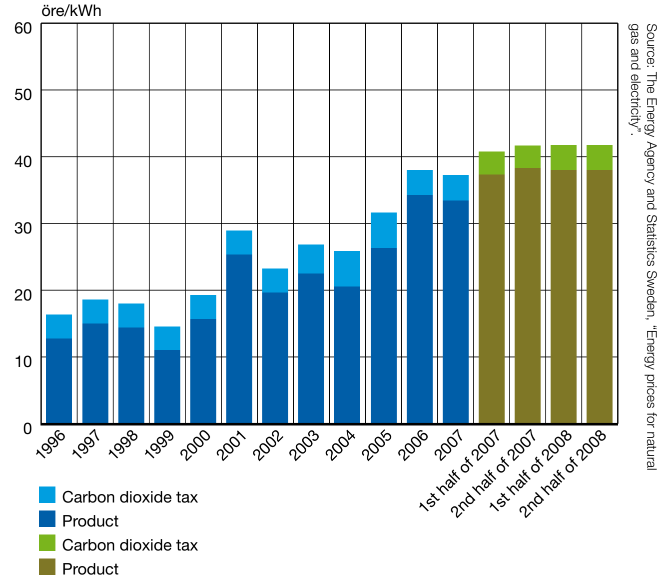
50 Average for the three reported typical customers.

Figure 10:1 Electricity and network price for industrial consumers, including relevant taxes



Note: Disrupted time series 2003. Changed collection method and typical customer category, see the FACTS box.

Figure 10:2 Gas price for industrial customers, including relevant taxes



Note: Disrupted time series 2003. Changed collection method and typical customer category, see the FACTS box.

fuel oil by approximately 17%. The prices of oil and natural gas include carbon dioxide tax, and the price of heavy fuel oil also includes sulphur tax. The taxes on these fuels have mainly been constant during the period studied, apart from the carbon dioxide tax on oil, which has increased somewhat. The price development for biofuels is not reported, since insufficient statistical material is available.

Reasons and relationships

The price of electricity fell between 1996 and 2001. The most important reason is the capacity of hydropower generation. The years between 1998 and 2001 were all wet years, to varying degrees, which contributed to low electricity prices. Another factor that assisted in maintaining low electricity prices was the surplus electricity generation capacity during the early part of the period studied. The declining prices also indicate that the deregulation of the electricity market may initially have contributed to increased competition and lower prices. However, electricity prices rose drastically in 2003, which was partly due to 2003 being a dry year with low inflow to water reservoirs. Prices then decreased, only to increase again during 2005–2007 (prices for January). The half-yearly prices for 2007–2008 have also increased steadily. This increase in the price of electricity may be partially explained by increased fossil fuel prices and the introduction of the emission trading system.

FACTS Energy prices to industrial customers, and typical customers

In 2007, the study of electricity and gas prices was changed to conform to EC directives. The change means that the information given from this year consists of average prices over six months, distributed between customer groups according to use. The results of the first survey in accordance with the altered method relate to the average prices during the period January–June 2007, and the results of the second survey, using the new method, relate to the period July–December 2007 and so on. Prices are based on the prices which the companies actually pay, i.e. prices in accordance with current contracts which may have a longer duration than one year. In the previous method, the price stated was the one that a typical consumer within the specified customer category had to pay for a one-year contract from 1 January for each year.

The indicator is based on different typical electricity customers, and those have also been altered in the new survey method. The new method classifies the typical electricity customer according to the standard use. The table below shows the new customers which this indicator provides statistics for:

500 MWh to < 2,000 MWh

2,000 MWh to < 20 000 MWh

20,000 MWh to < 70,000 MWh

In the past, typical customers were classified according to three criteria: maximum annual use in MWh, maximum annual power demand in kW and maximum annual utilisation time in hours. Three typical customers are used in this indicator up to and including 1 January 2007, as shown in the table below.

Max. annual use	Max. power	Max. time in hours
1 250	500	2 500
10 000	2 500	4 000
24 000	4 000	6 000

For natural gas, annual use is used in the new typical customer classification, and the indicator shows an industrial customer who has an annual use of between 30,000 and 300,000 MWh. Previous typical customers were classified according to annual use and use profile. For the years up to and including 1 January 2007, the indicator shows a typical customer with an annual use of 11,630 MWh who uses gas for 250 days or 4,500 hours a year.

Consideration has been given to the fact that the industrial sector may apply mark-down rules that reduce the tax.

The method used for collecting the price of oil shown in the indicator remains unchanged and relates to the price on 1 January of each year.

The price of oil to industry follows the variations in the world market price fairly closely. The world market price of oil is reflected more in the price to industrial customers than to domestic customers, since the tax rate for industry is lower.

For electricity, the indicator clearly shows the relationship between the magnitude of the electricity use of the individual user and the specific price of electricity. Customers with a high electricity use pay a lower price for electricity. The electricity price difference between small and large users has decreased historically, but the 2008 statistics indicate that the price difference increased once again. The reason for this is uncertain. It should be noted that the largest typical customer in the indicator, i.e. 70 GWh/year, is still a comparatively small industrial electricity user. The electricity use of electricity-intensive industry may be many times higher. There are several energy-intensive industrial plants that use up to 2 TWh of electricity. According to a survey carried out in 2007, electricity-intensive industries have experienced a relatively high electricity price increase during the period 2002–2006. Of the 40 plants studied, the average plant has experienced an electricity price increase of more than 60% during the period[51]. The competitiveness of these industries is heavily affected by the price of electricity.

51 Ungernet AB, Electricity price changes from 2002 to 2006 at 40 energy-intensive plants, 2007.

Figure 10:3 Oil price (Eo1) for industrial customers, including relevant taxes

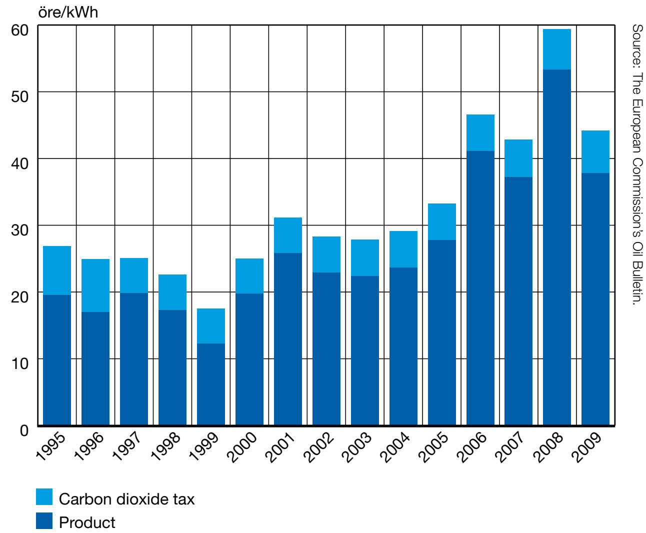
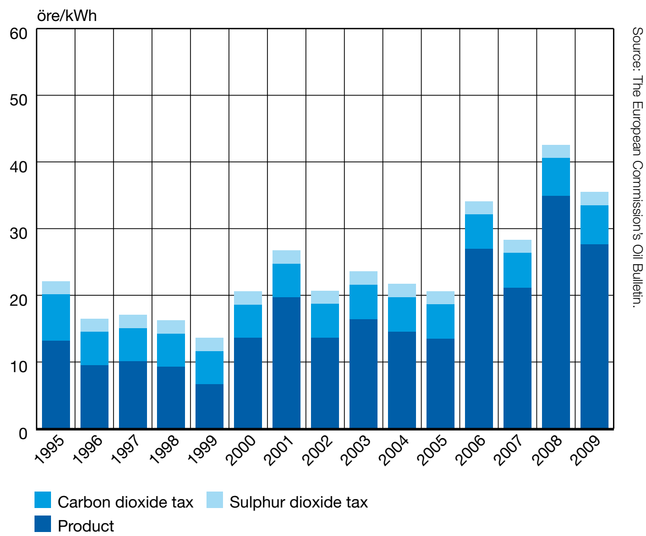


Figure 10:4 Oil price (Eo5) for industrial customers, including relevant taxes



11 Energy cost as a proportion of the total variable costs, in different sectors of industry

Energy costs as a share of industry's total variable costs has reduced over a long period of time within all analysed sectors, even if there is a considerable difference at absolute levels. But since 2004, the energy costs' share in the pulp and paper industry and the base chemical industry has increased greatly. However, energy costs as a share of the costs in the engineering industry and the iron, steel and metalwork industries have reduced.

Energy policy objectives

The importance of reliable access to electricity at reasonable prices for the international competitiveness of industry was emphasised in the energy policy objectives. Industry's energy cost depends on the size of the energy use and also on energy prices. Industry's competitiveness is also affected by other factors, other than the cost of energy, for example salary costs and the costs of raw materials.

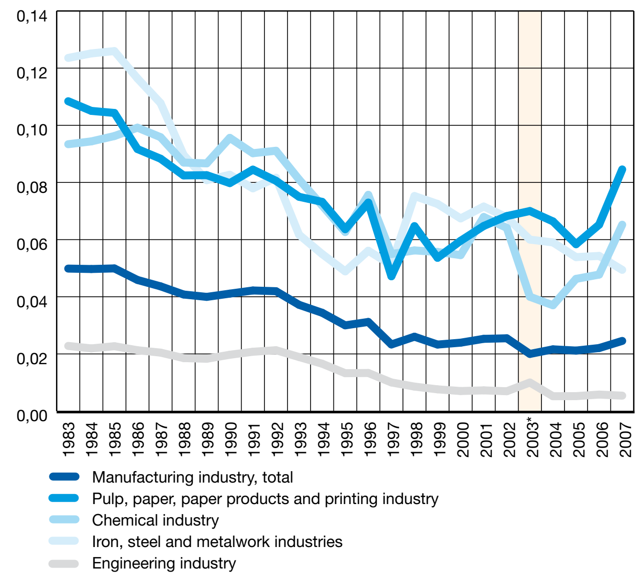
Trends

Energy cost's share of the total variable costs has fallen since the beginning of the 1980s. In 1983, energy costs as a share of total variable costs for the manufacturing industry amounted to 5%. In 2006, this share had dropped to 2.4%. Thus, for the manufacturing industry as a whole, the share of energy costs has fallen since the beginning of the 1980s – with the exception of 2004–2006, when it increased. From a long-term perspective, all industrial sectors analysed show a reducing energy cost share. But since the end of the 1990s, the reduction has fallen off somewhat, and within the base chemical industry and the pulp and paper industry, the share of energy costs has increased greatly over the past few years. However, the iron, steel and metalwork and the engineering industries show a steady decrease in the energy cost share.

Reasons and relationships

There are several reasons why energy costs, as a share of industry's total variable costs, have fallen. Base indicator 8 shows industry's energy use per value added, which has

Figure 11 Industry's energy costs in relation to a company's total variable costs in different sectors



Source: Statistics Sweden. Variable costs include salaries, raw materials, energy costs etc., but, according to praxis national insurance, costs (payroll costs), rental expenses, salary processing at another company, purchased maintenance and repair work on the company's buildings and facilities are not included.

Note: Disrupted time series 2003.

reduced. Indicator 11 shows the development of a number of different industrial sectors, and it can be seen that the differences in energy costs as a share of the total variable costs is considerable. Even within each industrial sector, there are large variations. This means that individual industries may have an energy cost share which is much greater than the levels the indicator shows. It may be, for example, industries with electricity-intensive processes, such as the manufacturing of mechanical pulp or electrolytic and electro-reduction processes. The energy cost for these industries may be of crucial importance for competitiveness. Similarly, individual industries may have an energy cost share which is lower than the indicator shows for the sector in question. The underlying survey for the indicator was changed in 2003 from a total survey to a sample survey. This change means that the time series are disrupted time so that the indicator from 2003 is based on the new survey method. Direct conclusions based on the indicators' absolute level between the years before and after 2003 cannot be made. But if 2003 is adjusted in accordance with the old survey method, it appears that the energy cost share for 2003 increased greatly in several industrial sectors, including the manufacturing industry as a whole. This increase may be partly due to the electricity price which shows, as with indicator 10, fell in 2003, increasing greatly after that to fall once again by 2005. Price trends for other forms of energy, such as coal and coke, can also affect the energy cost share in certain industries.

12 Energy use for heating and domestic electricity/ property electricity/operating electricity per unit of area for dwellings and non-residential premises

The total energy use per unit of area for dwellings and commercial and public premises has decreased by around 15% between 1995 and 2007. To some extent, the reduction is due to the fact that recent years have been relatively warm. The reduction is also due to the conversion to other sources of energy and energy-efficiency measures. The use of electricity for applications other than heating has increased.

Energy policy objectives

The energy policy objectives state that energy should be used as efficiently as possible, taking into account all resources available. Therefore, it is not entirely a matter of minimising energy use, but efforts should mainly be made to achieve low energy use in relation to the utilities achieved.

The environmental objective "A Good Built Environment" includes the objective of reducing energy use in built-up areas. The objective was reformulated in 2006 and is now worded as follows: *"The total energy use per unit of heated area in dwellings and public and commercial premises is decreasing. The reduction should be 20% by 2020 and 50% by 2050, in relation to the use in 1995. By 2020, the dependence on fossil fuels for energy use in the built-up sector should be broken, while the proportion of renewable energy should continually increase."*

The Energy Services Directive means that energy use by 2016 in the buildings, industry and transport sectors should be 9% more efficient than the average for 2001–2005. The eco-design directive means that minimum requirements are made on different product groups.

Trends

Total energy use per unit of area for dwellings and commercial and public premises has decreased by around 15% between 1995 and 2007. Energy use for heating during the period has decreased, while electricity use for other purposes has increased. The reduction is, to some extent, due to the fact that, since 1995, most years have been relatively warm. Other contributory reasons include heating system conversions, for example, oil to heat pumps and district heating, and also energy-efficiency measures.

Since 2000, energy use for space heating per unit of area has reduced in dwellings and non-residential premises. The largest decrease has occurred in one and two-dwelling buildings, which is due to the large increase in the use of heat pumps. More action is needed so that the target levels in the sub-target for "A Good Built Environment" will be achieved in time. The use of domestic electricity in dwellings has been relatively constant during the beginning of this century, after having increased slightly in previous years, see Figure 12:10. Statistics for domestic electricity use in one and two-dwelling buildings also include a degree of comfort heating, for example underfloor heating.

Domestic electricity is influenced by two contradictory trends. While the ownership of appliances is increasing, particularly home electronics such as TVs, computers, home movie equipment and peripheral equipment, development is moving towards more energy-efficient installations. The current measurements of domestic electricity[52] by the Swedish Energy Agency show that almost one third of the households in single-family houses have three or more TV sets and the same proportion have two or more computers.

The measurements also show that variations in electricity use between individual households are very wide. This is due to habits and behaviours, and also to installations such as lighting. The number of lamps per unit of area varies by a factor of three between different single-family houses, which explains, to some extent, the wide differences in electricity use between different households. Lighting, refrigeration and deep freezing account for the majority of a household's electricity use. Domestic electricity use in multi-dwelling buildings is not included in the official energy statistics, but is based on an average value, the equivalent of 40 kWh/m^2. This is in line with the results from the Energy Agency's electricity measurements in multi-dwelling buildings.

52 Electricity consumption at device level is measured in 200 one and two-dwelling buildings and 200 apartments in the project entitled Improved energy statistics in built-up areas, www.energimyndigheten.se.

Figure 12:1 Energy use for heating and hot water in one and two-dwelling buildings, multi-dwelling buildings och non-residential premises (not corrected for a normal year)

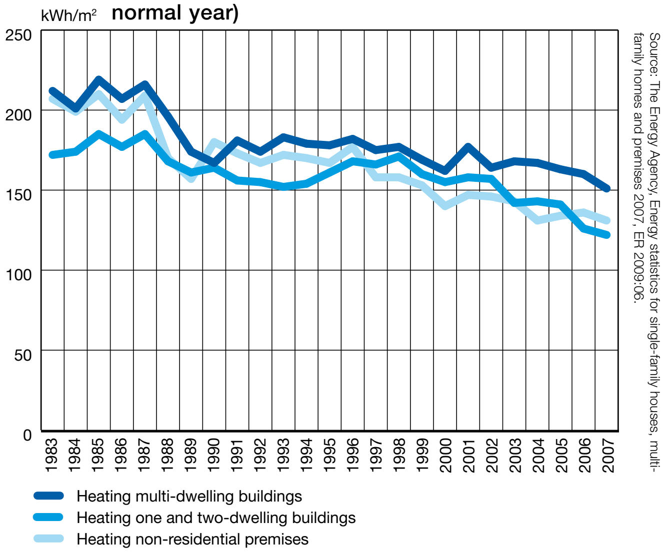
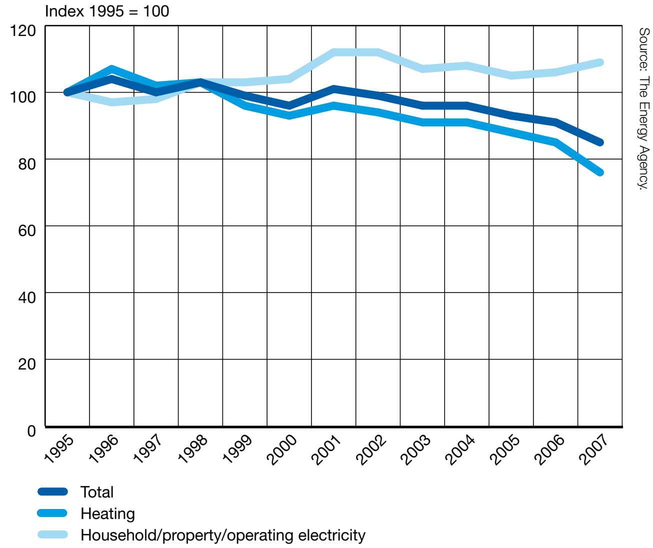


Figure 12:2 Index of total energy use per unit of area in dwellings and non-residential premises



Relates to energy consumption in one and two-dwelling buildings, multi-dwelling buildings and non-residential premises (not temperature corrected). Energy consumption is not weighted in relation to type of energy.

In 2007, 211 kWh/m² was consumed, of which 134 kWh/m² was for heating purposes and 77kWh/m² was for household electricity/operating electricity

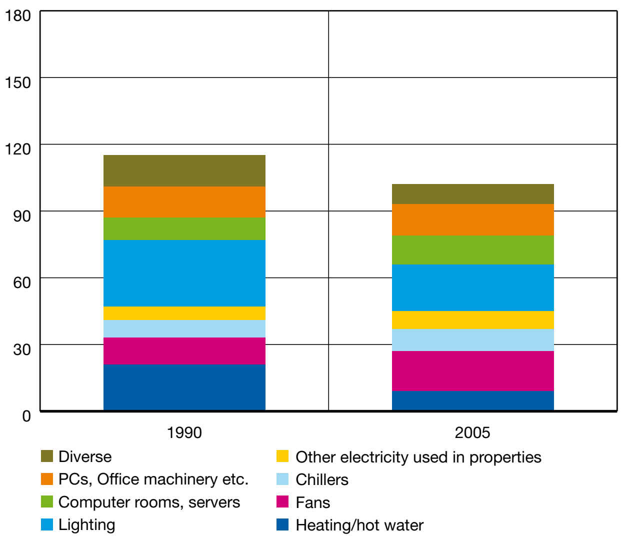
Electricity use for purposes other than heating in premises has varied, around 150 kWh/m² since the middle of the 1990s, see Figure 12:10. The variation can partly be explained by the fact that this item includes the sector's residual item. In total, domestic electricity and operating electricity per unit of area has increased by 9% since 1995, see Figure 12:2.

Since 2005, the Energy Agency has been carrying out energy inspections on various types of non-residential premises, the project is called STIL2.[53] Since the start, inspections have been made at office premises, health clinics, schools and sports arenas. An analysis of how electricity is used in these premises and the results can be seen in Figures 12:3 to Figures 12:6[54]. The specific electricity use per unit of area is greatest in sports arenas and lowest in schools and health clinics. A comparison with measurements carried out during the 1990s shows that electricity use per unit of area has decreased in all types of premises except for schools and preschools. Common to all types of non-residential premises is that lighting and fans make up a large share of the amount of electricity consumed, which corresponds with the results from 1990. Sports arenas are characterised by air-conditioning systems and other equipment which represent the largest posts.

53 The Energy Agency, Improved energy statistics in dwellings.

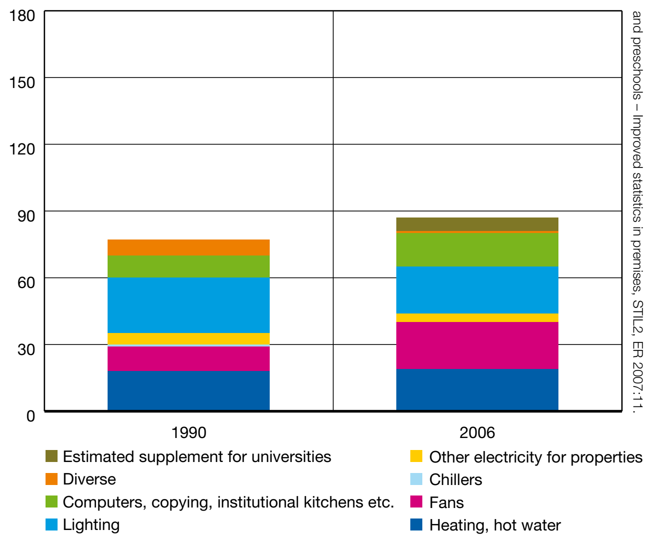
54 Note that the values in the figures have been estimated to represent a total national level.

Figure 12:3 Electricity use, including electric heating, in offices and administrative buildings, specific electricity per application in 1990 and 2005, kWh/m²



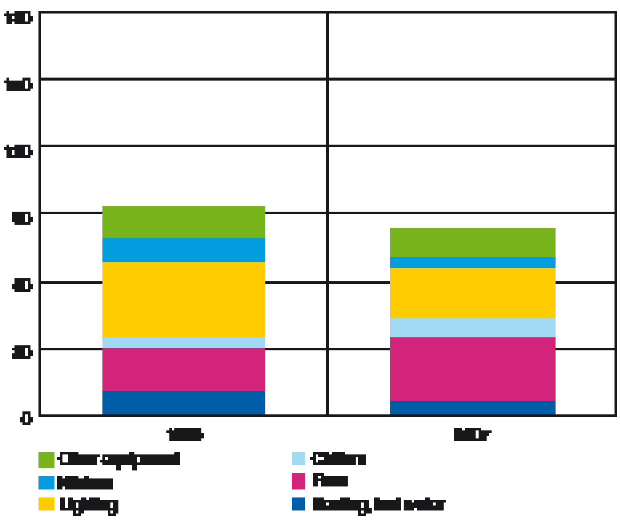
Source: The Energy Agency, Improved energy statistics – In stages STIL – report for year 1, ER 2007:34.

Figure 12:4 Electricity use, including electric heating, in schools and preschools, specific electricity per application in 1990 and 2006, including estimated addition for universities, kWh/m²



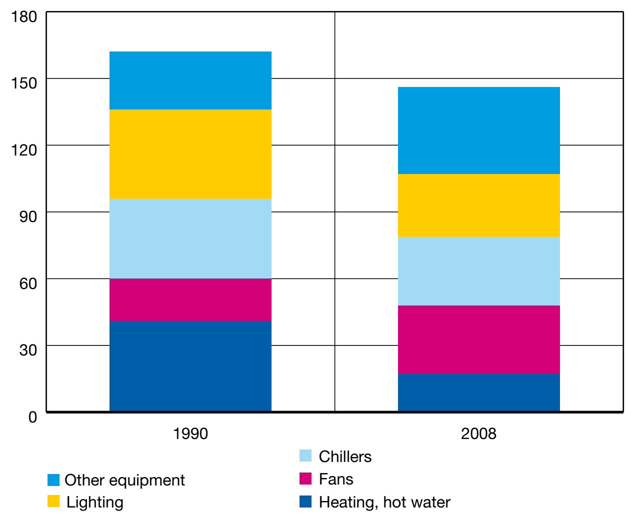
Source: The Energy Agency, Energy use and interior environments in schools and preschools – Improved statistics in premises, STIL2, ER 2007:11.

Figure 12:5 Electricity use, including electric heating in health clinics, specific electricity per application in 1990 and 2007, kWh/m²



Source: The Energy Authority, Energy use in health clinics, Improved statistics for premises, STIL2, ER 2008:09.

Figure 12:6 Electricity use, including electric heating in sports arenas, specific electricity per application, 1990 and 2008



Source: The Energy Authority, Energy use in sports arenas, Improved statistics for premises, STIL2, ER 2009:10.

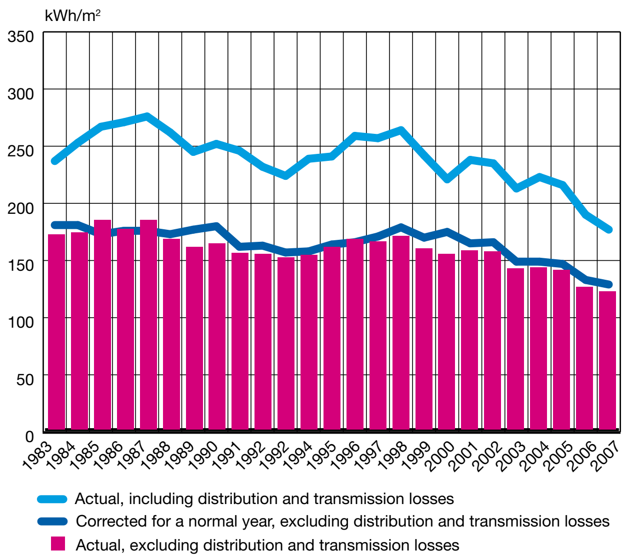
Reasons and relationships

The space heating demand during a particular year is affected by temperature conditions. The space heating demand is high during a cold winter. After 1987, all years, except 1996, were warmer than normal[55]. The year 2007 was approximately 12% warmer than normal, the calculation being based on the number of degree days for a normal year. This reduces the effective heating needs.

To compensate for the variations in temperature, energy use is corrected for a normal year. A part of the reduction in the normal year-corrected energy use is due to conversions in heating systems, e.g. from oil-fired heating systems to heat pumps in one and two-dwelling buildings. The magnitude of the conversion losses before energy is utilised depends on the energy carrier used. The official statistics of energy use in dwellings and premises includes only the losses occurring in the energy system of the building itself when different energy carriers are used. The losses occurring in the generation and distribution of electricity and district heating are assigned to the supply sector. If a customer changes, for instance, from oil-fired heating to electric heating or district heating, the energy use in the residential and services sector will therefore decrease, while the energy use in the supply sector will increase. The conversion rate for oil-heated single-family houses accelerated in conjunction with the introduction of the conversion grant which

55 SMHI.

Figure 12:7 Energy use for heating and hot water, one and two-dwelling buildings



Note: The reduction in energy use per square metre in one and two-dwelling buildings in 2003 is due, to some extent, to the whole residential area being included in the 2003 annual survey. In other years, only the area heated to more than 10°C was included.

Figure 12:8 Energy use for heating and hot water, multi-dwelling buildings

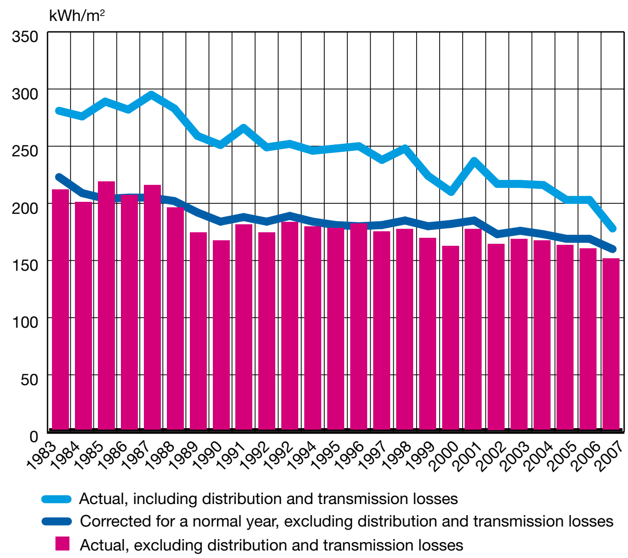
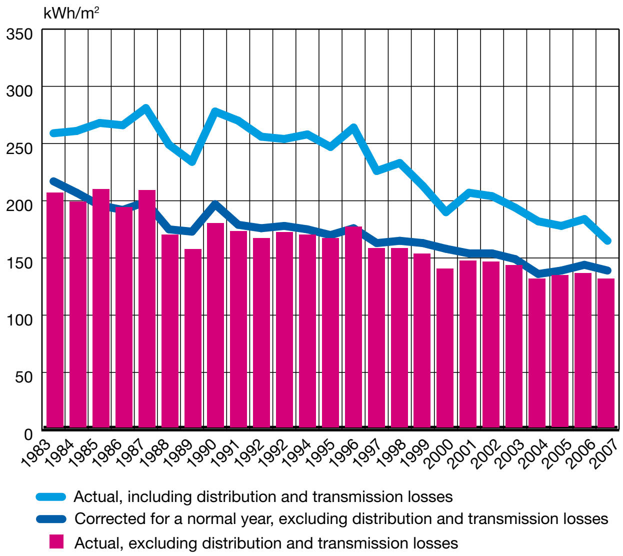
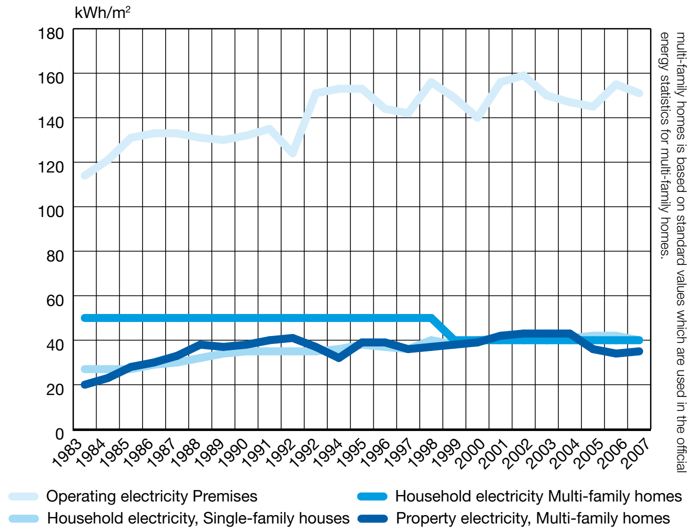


Figure 12:9 Energy use for heating and hot water, non-residential premises



Source: The Energy Agency, Energy statistics for dwellings and non-residential premises 2007, and Statistics Sweden, SM series EN16 – Energy statistics for single-family houses, multi-family homes and premises for previous years. Statistics Sweden SM series EN11, Annual statistics for electricity, gas and district heating. The energy use has been divided into residential and public and commercial premises areas and heated garage areas. Basements, stairwells and laundries are not included in the area calculations. For a normal year correction of heating requirements, Statistics Sweden has used the temperature correction principle, where half of the space heating demand is assumed to be linked to the temperature conditions and half is assumed to be temperature-independent. The temperature conditions are described by means of the number of so-called degree days for that particular year in relation to the assumed number of degree days for a normal year. Degree days are obtained from SMHI.

Figure 12:10 Household electricity and operating electricity in one and two-dwelling buildings, multi-dwelling buildings and non-residential premises



Source: The Energy Agency and Statistics Sweden. Household electricity in multi-family homes is based on standard values which are used in the official energy statistics for multi-family homes.

Note: In Figure 12:10, the distribution of electricity use is associated with uncertainty. Electricity used for operational purposes and in properties is based on delivery statistics and great differences compared with previous years may be a result of the fact that customer files have been revised in connection with the integration of network companies following mergers and acquisitions. Household electricity is based on standard values and calculations.

the owners of one and two-dwelling buildings could apply for during 2006 and 2007. By 31 December 2007, 36,950 applications had been granted.[56] Out of the 36,950 conversions made, 43% were to heat pumps, 37% to biofuel and 20% to district heating.

The fact that energy use for space heating is decreasing may also be due to energy-efficiency improvements in existing houses and therefore a reduction in the average energy use. Increased use of heat pumps also contributes to reducing the energy use for space heating.[57] The energy costs have increased for many households in recent years because of the higher cost of electricity and oil and increased taxes, which produce an incentive to adopt energy-saving measures. More energy-efficient equipment and installations may be assumed to be the reason why electricity use has increased only moderately, in spite of the growing numbers of appliances and installations in homes and at workplaces.

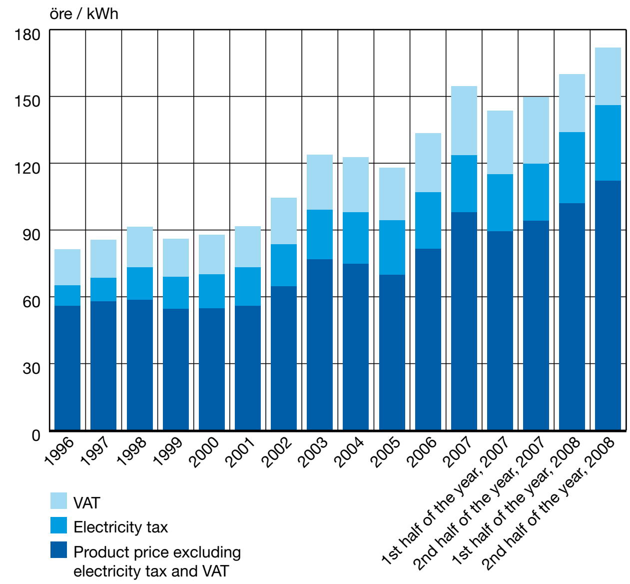
56 Boverket.

57 The heat extracted by heat pumps in the consumer sector is not reported in the official energy statistics.

13 Energy prices to domestic customers, including relevant taxes

Energy prices for domestic customers were relatively stable throughout the second half of the 1990s, but they increased significantly from the year 2000 onwards. The price of oil (including taxes) for one and two-dwelling buildings customers was twice as high on 1 January 2009 compared with 1 January 2000, this despite the fact that the price fell by 15% compared with 1 January 2008. The price of electricity (including taxes) has risen by approximately 70% since 2000 and the price of district heating for customers in multi-dwelling buildings has increased by approx. 60%. Increased fuel prices and increased taxes on energy are the main reasons for rising prices for household customer.

Figure 13:1 Electricity and network price to domestic customers with annual use of 2,500–5,000 kWh



Note: The surveys have changed. 1996–2007 relates to the price on 1 January for each year. After that, the average price for each half of the year is reported. Note that the typical customer, for which the price is reported up to 2007, has an annual use the equivalent of 3,500 kWh.

Energy policy objectives

The energy policy objectives emphasise the importance of reliable access to energy at reasonable prices. Efficient electricity and natural gas markets are also highlighted as objectives within the energy policy. The objectives also specify that the energy policy will contribute to conversion to an ecologically sustainable society and to an energy supply with a low negative impact on health, the environment and the climate.

Review of statistics

Reporting of statistics for electricity and natural gas prices has been revised, which makes comparisons with previous years difficult. Up to January 2007, the statistics relate to the price that a typical user had to pay in fixed and variable charges on 1 January every year. After January 2007, the price of electricity and natural gas was reported as an average price per six months, calculated on the price that customers actually paid. The typical customers for whom the statistics are gathered have also been changed. These six-monthly prices cannot, therefore, be compared directly with the prices prior to 2007. See also the FACTS box.

Trends

During a number of years at the end of the 1990s, the price of electricity was constant or even decreased, whereas high price increases were noted during the years from 2000 to 2009. Taking an overall view, the price of electricity, including taxes, has risen by 80% between 1997 and 2007.

The price of electricity on 1 January 2007 was significantly higher than the average price for the first half of 2007, which indicates how unreliable it is to make a comparison between these time periods. The average price for the second half of 2007 was higher than for the first half, but still lower than the price on 1 January 2007. The average prices for electricity for 2008 follow the same pattern as the prices for 2007, with a higher price for the second part of the year. However, the average prices for 2008 are 11–15% higher than for 2007, depending on the type of consumer.

The price of oil remained relatively unchanged during the period between 1995 and 1999, but subsequently increased. The price over the past few years has fluctuated considerably, peaking in 2008. In January 2009, the price of oil was at the

FACTS Energy prices to domestic customers, and typical customers

In 2007, the study of electricity and gas prices was changed to conform to EC directives. The change means that the details reported from this year are average prices over a period of six months instead of the price on 1 January for each year, as used before. The prices are reported for various typical customers common across the entire EU. The definition of these was also changed in 2007. The method of gathering the price of district heating and oil given in the indicator remains unchanged and relates to the price on 1 January every year.

Previous method

The prices reported up to 2007 are the prices from 1 January for each year. Electricity customers were divided up into groups based on annual use of electricity in kWh and type of household. The electricity prices are reported in the diagram for the following typical customers:

Annual use	Corresponds to household
3,500 kWh	4 rooms and kitchen, approx. 90 m^2 (household electricity)
20,000 kWh	5 rooms and kitchen, approx. 120 m^2 (house with electric heating)

Natural gas customer were divided up into groups based on annual use and the type of equipment. The indicator reports prices for a typical customer with an annual use of 34,890 kWh, which is the equivalent of a house that has gas for heating and for domestic use.

Present method

Prices reported on a six-month basis for 2007 and 2008 are average prices during the periods January–June and July–December for each year. The electricity prices are reported in the diagram for the following typical example of customers:

Annual use
2,500–5,000 kWh
At least 15,000 kWh

For natural gas, prices are reported for households that have an annual use of between 5,500 and 55,000 kWh.

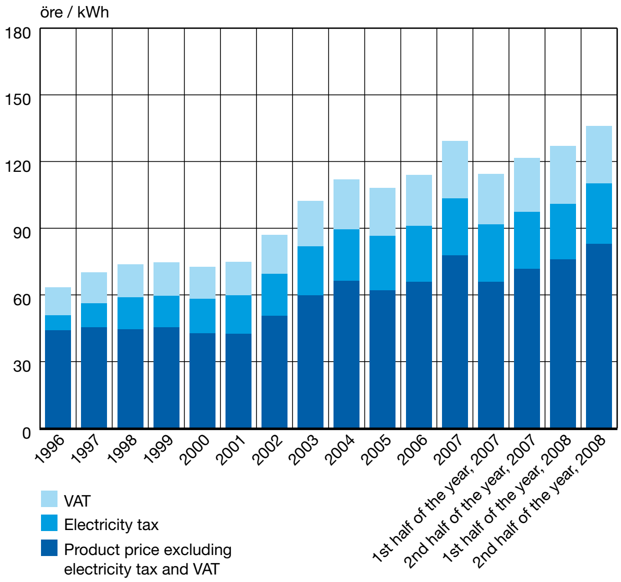
same level as on 1 January 2006 – approx. 15% lower than January 2008. Taking an overall view, the price of oil to domestic customers, including taxes, more than doubled between 2000 and 2009.

The price of natural gas follows the same pattern as the other energy prices. Energy prices for domestic customer were relatively stable throughout the second half of the 1990s, to increase significantly from the year 2000 onwards. From 2007, average natural gas prices are reported every six months, just as those for electricity. During the second half of 2008, the average price of natural gas was almost 20% higher than for the same period in 2007.

The price of district heating for domestic customers in multi-dwelling buildings has increased by a few percentage points each year from 2000 to 2009. In January 2009, the price was almost 8% higher than 1 January 2008. The Nils Holgersson report[58] shows that the differences between municipalities can be considerable. In 2007, the annual cost per square metre

58 HSB Riksförbund, Hyresgästföreningens Riksförbund, Riksbyggen, SABO and Sveriges Fastighetsägare have formed Avgiftsgruppen, which carries out annual surveys (the so-called Nils Holgersson survey) which take a look at municipal charges for heating, hot water, water and sewerage, electricity and waste collection.

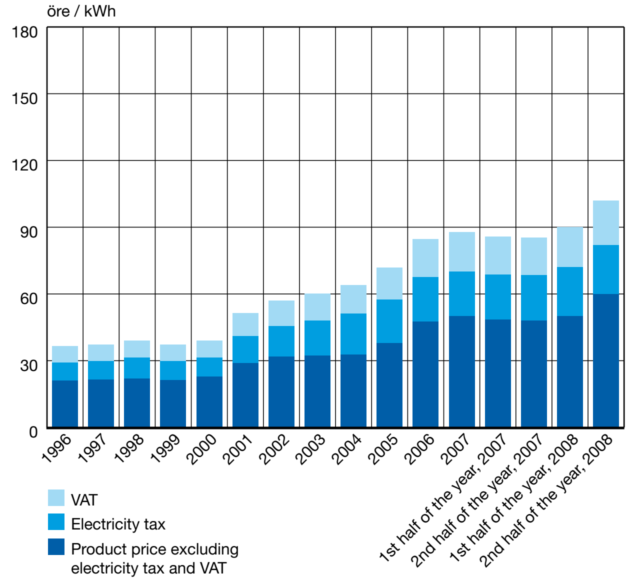
Figure 13:2 Electricity and network price to domestic customers with annual use of 15,000 kWh



Source: District heating prices have been taken from Statistics Sweden, series EN 24 SM. The prices of electricity, oil and natural gas have been obtained from Sweden's reports to Eurostat.

Note: The surveys have changed. 1996–2007 relates to the price on 1 January for each year. After that, the average price for each half of the year is reported. Note that the typical customer, for which the price is reported up to 2007, has an annual use the equivalent of 20,000 kWh.

Figure 13:3 Natural gas price to domestic customers with annual use of 5,500–55,000 kWh



Source: District heating prices have been taken from Statistics Sweden, series EN 24 SM. The prices of electricity, oil and natural gas have been obtained from Sweden's reports to Eurostat.

Note: The surveys have changed. 1996–2007 relates to the price on 1 January for each year. After that, the average price for each half of the year is reported. Note that the typical customer, for which the price is reported up to 2007, has an annual use the equivalent of 34,890 kWh.

was SEK 78 in the least expensive municipality and SEK 157 in the most expensive. The average annual cost was SEK 129 per square metre. The price of district heating from 2000 to 2009 has increased by approx. 50%.

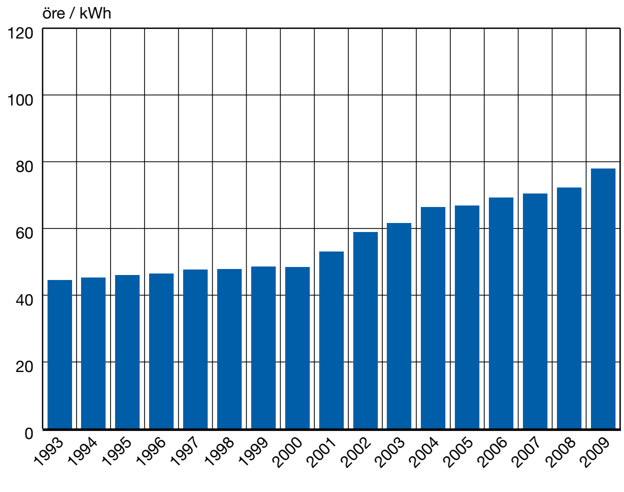
Solid biofuels, such as wood and pellets, are important energy sources for domestic customers. A total of almost 11.9 TWh of biofuel was used in one and two-dwelling buildings, multi-dwelling buildings and non-residential premises in 2007, of which more than 90% was used in one and two-dwelling buildings. The reason that time periods for the price of biofuel are not presented here is the shortage of statistical material. There are no official price statistics for pellets, and only compilations by the industry itself are available at the present time. In April 2009, the price of pellets, including taxes, to customers in one and two-dwelling buildings was about 2,600–2,800 SEK per ton.[59] Most of the wood used by domestic customers is not purchased and sold on the market.

Reasons and relationships

The price of electricity is governed by supply and demand. The price of emission rights also influences the price of electricity during certain periods. The electricity exchange, Nord Pool's spot price, provides a price reference for the Swedish electric-

59 www.pelletspris.com.

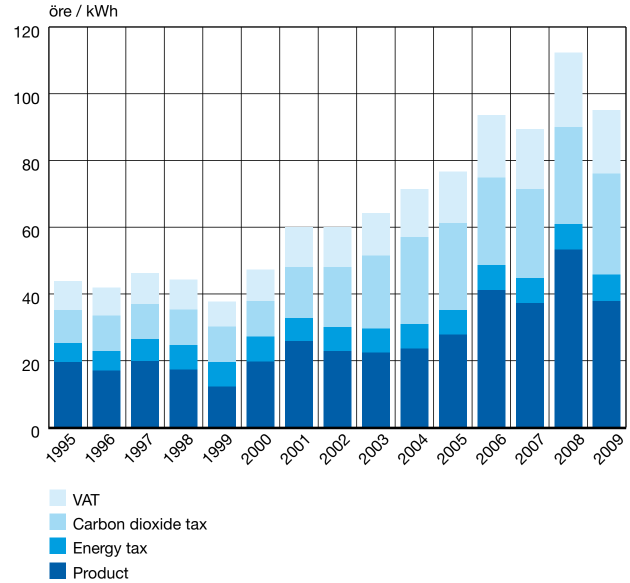
Figure 13:4 District heating price to domestic customers in multi-dwelling buildings, including relevant taxes and VAT



Source: District heating prices have been taken from Statistics Sweden, series EN 24 SM. The prices of electricity, oil and natural gas have been obtained from Sweden's reports to Eurostat.

Note: The surveys have changed. 1996–2007 relates to the price on 1 January for each year. After that, the average price for each half of the year is reported. Note that the typical customer, for which the price is reported up to 2007, has an annual use the equivalent of 34,890 kWh.

Figure 13:5 Oil price (E0 1) for domestic customers



Source: District heating prices have been taken from Statistics Sweden, series EN 24 SM. The prices of electricity, oil and natural gas have been obtained from Sweden's reports to Eurostat.

ity market and the price the customer is charged is influenced by developments there. More information regarding spot price developments and what determines the electricity price can be found in indicator 18.

The price of oil follows developments on the world market for crude oil and the price of natural gas, to some extent, follows the price developments for oil. The reason for the increasing prices of oil and natural gas to households has been the green tax exchange, whereby taxes on electricity and fossil fuels were gradually raised and transferred back to households and companies in the form of a reduced tax on work.

The reasons for the price development in district heating are difficult to specify generally, since Swedish district heating consists of the sum of a large number of district heating systems. The increased cost of the energy carriers used is a contributory factor in the increasing prices of district heating. Another reason is that the rules for pricing district heating at cost no longer apply, and the price is instead increasingly set in relation to the prices of alternatives and on the basis of the return on capital requirements of the companies.

Since the indicator shows running prices, it is of interest to set the energy price increases in relation to general price developments, e.g. expressed as consumer price index (CPI). It can be noted that energy prices, in general, have increased faster than the CPI. This applies to all user areas: transports, heating and electricity use.

14 Energy expenditure by households, including motor fuels, in relation to total expenditure by households

The energy expenditure as a proportion of the total expenditure of households is around 9%. The trend has been gradually increasing during the years since 2000, but since 2003, only small changes have taken place. Both the share of the costs for fuel and for energy for dwellings has increased. Up to 2003, they made up an equal share of the total costs for a household. From 2004, expenses for motor fuel account for a larger share than energy for the home.

Energy policy objectives

The energy policy objectives state that dependable access to energy at a reasonable price is important. The objectives also specify that the energy policy will contribute to conversion to an ecologically sustainable society and to an energy supply with a low negative impact on health, the environment and the climate.

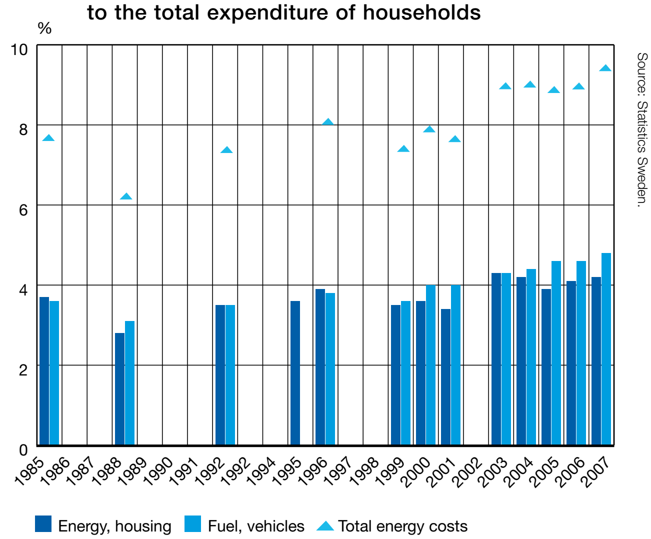
Trends

The energy expenditure as a share of the total expenditure of households is around 9% (2007). The share has been relatively unchanged since 2003, but has increased by a little less than 0.5 percentage points from 2006 to 2007. The expenditure for the energy use of dwellings (space heating, hot water and domestic electricity) and the expenditure for motor fuel for household vehicles was, up to 2003, more or less of the same size for the average household.

The share spent on energy for dwellings displayed a decreasing trend, although it began increasing again in 2006. The amount of money spent on motor fuel has increased between 2003 and 2007, and expenses for motor fuel are now larger than expenses for energy in the home.

The energy expenditures included in the indicator are those that are paid directly by the household for energy. The space heating costs that comprise part of the rent, for example, are therefore not included. Motor fuel costs that are indirectly paid for public transport are not included either. Taking an overall

Figure 14:1 Energy expenditure by households, including motor fuel costs in relation to the total expenditure of households



view, energy expenditures account for a larger share of household expenditures than that revealed by the indicator[60].

Reasons and relationships

Taxes on energy have increased significantly since the middle of the 1990s.[61] The green tax exchange, introduced in 2001, means that tax increases on fossil fuels and electricity are repaid to taxpayers in the form of reduced tax on work to companies and households.

The effect of the tax exchange on households with a low use of electricity and fossil fuels may lead to an increase in the amount of disposable income, whereas the amount of disposable income for households with high energy use decreases.

The energy costs are greatly influenced by various circumstances throughout the years, e.g. the temperature conditions, hydropower water inflow (and therefore the price of electricity[62]) and the price of oil on the world market.

The high electricity price in 2003 contributed to the increase in energy expenditure during that year. In 2004, the price of oil increased substantially, while the price of electricity remained at a relatively high level.

The disposable incomes of households increased by 40% between 1995 and 2007[63] and the energy expenditure of households during the same period decreased somewhat.[64] The fact that energy costs for households, as a proportion of total expenditure, has nevertheless increased during the same period is partially due to tighter economic regulatory instruments for household customers, e.g. increased carbon dioxide tax.

60 Further discussion regarding the risks of high energy prices is available in the Swedish Energy Agency's report, How safe is our energy supply? ER 2007:06.

61 The development of energy taxes is illustrated in the Base indicator 13 – Energy prices for domestic consumers, including relevant taxes.

62 The electricity price on Nord Pool's sport market is reported in Base indicator 18.

63 Statistics Sweden.

64 Which is illustrated in Base indicator 12 – Electricity consumption for heating and household electricity/electricity in properties/operating electricity per unit of area for dwellings and premises.

15 Carbon dioxide emissions by sector

The carbon dioxide emissions in 2007 were roughly 8% lower than in 1990. The transport sector caused the highest emissions, and these have increased slightly since 1990. On the other hand, carbon dioxide emissions from the residential sector have decreased. The main reason is the displacement of carbon dioxide emissions from the residential sector to the energy sector (electricity and district heating generation) during the period. The emission intensity, in terms of emissions per GNP, has decreased by one third during the period 1990–2007, and the emissions per capita have also decreased during the same period.

Energy policy objectives

According to the energy policy objectives, the energy supply should have a low negative impact on health, the environment and the climate. It is also emphasised that the Swedish environmental and climatic objectives will be taken into account. As a result of Sweden's undertaking in accordance with the Kyoto Protocol and the EU's distribution of responsibilities, Sweden can increase its emission of greenhouse gases by 4%, calculated as the average for 2008–2012, compared with the level in 1990. However, the Swedish climate strategy specifies that the average emissions of greenhouse gases during the period 2008–2012 will decrease by 4% compared with the emissions in1990. The objective will be achieved without compensation for sequestration in carbon sinks or utilisation of the so-called flexible mechanisms. There is also a specific national objective that the environmental loading from dwellings and premises will decrease.

Trends

Carbon dioxide emissions increased somewhat during the period 2001–2003, but decreased again during 2004 and ended up 8% lower in 2007 compared to 1990. The emissions level has varied between years during the period, and there are examples of both lower and higher emissions than in 1990.

The sector that contributes the highest emissions is the transport sector (domestic transport). Carbon dioxide emissions in the transport sector have increased by 13% from 1990 to 2007, and the carbon dioxide emissions account for more than 95% of the total emissions of greenhouse gases by the transport sector. In terms of magnitude, this is followed by the energy sector (electricity and district heating generation and refineries) and the manufacturing and building industries (excluding industrial processes). Industrial processes are ranked second in terms of a percentage increase of carbon dioxide emissions from 1990 to 2007, with an increase of 12%. However, emissions from district heating generation have decreased during the period studied, in spite of an increase in the heat delivered. This is mainly because of the increased use of biofuels for district heating generation. The sector from which emissions have decreased is the residential sector. The carbon dioxide emissions from the residential sector in 2007 were only a quarter of the value in 1990.

The official Swedish emissions statistics have been revised since the 2008 indicator publication, which has resulted in a reduction in the total emissions of greenhouse gases, compared with earlier reporting, by an average of 0.4%. The reporting of carbon dioxide is 0.1% lower.

The emission intensity calculated as emissions of greenhouse gases per GNP and emissions per capita has decreased substantially since 1990. The emission intensity per GNP has decreased most and was about 37% lower in 2007 than in 1990. This denotes that economic development is possible without a corresponding increase in emissions. During the same period, GNP increased by 45%. The emissions of greenhouse gases per capita have decreased by 15% between 1990 and 2007, and were 7.2 tonnes of CO2 per capita in 2007 compared with 8.4 tonnes in 1990. The population increased by 6% during the period.

Reasons and relationships

Emissions of carbon dioxide from the residential sector have continuously decreased. This is due, to a large extent, to the decrease in oil use, which has largely been replaced by biofuels, heat pumps, electricity and district heating. This has led to increased use of electricity and district heating. However, this increase has taken place without a corresponding carbon dioxide increase in the energy sector in which electricity and district heating generation are included. This can be explained by the fact that the additional electricity and district heating generation is based, to a large extent, on non-fossil energy carriers, mainly biofuels. The emission intensity in the transport sector has decreased, i.e. the emissions have increased at a lower rate when compared to the amount of work done in this sector, which can be explained by more fuel-efficient vehicles and increased low admixture of motor biofuel to petrol and diesel fuels.

To a great extent, carbon dioxide emissions vary with outdoor temperatures, the general economic climate and also with the generation capacity of different energy sources, such as hydropower and nuclear power. The year that differs most, with carbon dioxide emissions that were 9% higher than 1990, is 1996. That was a dry year in the Nordic countries, and hydropower generation was therefore much lower than normal. In addition, it was a cold year. This led to more fuel-based electricity generation being used, which is demonstrated by much higher emissions from the energy sector than in other years. The precipitation pattern in 2002 and 2003 was also very different from that in a normal year, which may be a contributory factor to the increased emissions. During the 2002/2003 winter, the problems associated with dry years did not lead to emissions that were as high as in 1996, since the shortage of hydropower generation was largely compensated by imports. On the other hand, the precipitation in the winters of 2004 and 2005 was normal, which explains why the emissions have again decreased.

Increasingly strong regulatory instruments were used during the period between 1990 and 2007 in order to restrict carbon dioxide emissions. Increased carbon dioxide taxes on fossil fuels for household customers are an example of such a regulatory instrument. The EU Emissions trading scheme is another regulatory instrument aimed at restricting carbon dioxide emissions. Evaluations have shown that the emissions of carbon dioxide would have been at a much higher level today if these carbon dioxide tax increases had not been implemented. Increases in the prices of fossil fuels have made a further contribution to the development.

Figure 15:1 Carbon dioxide emissions and total emissions of greenhouse gases

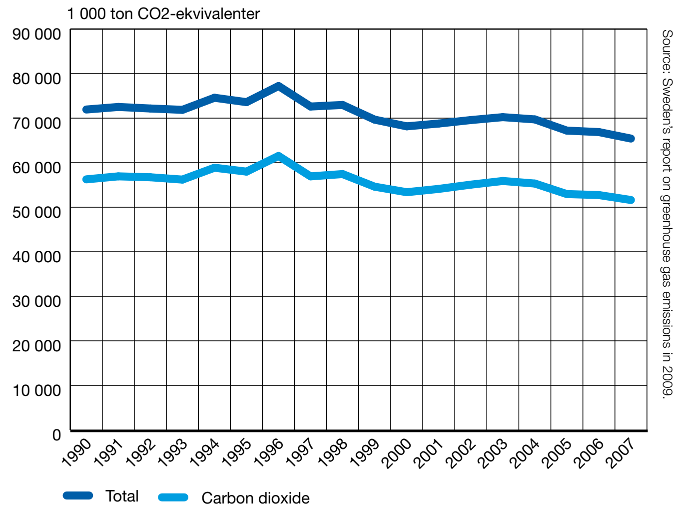


Figure 15:2 Index of total emissions of greenhouse gases

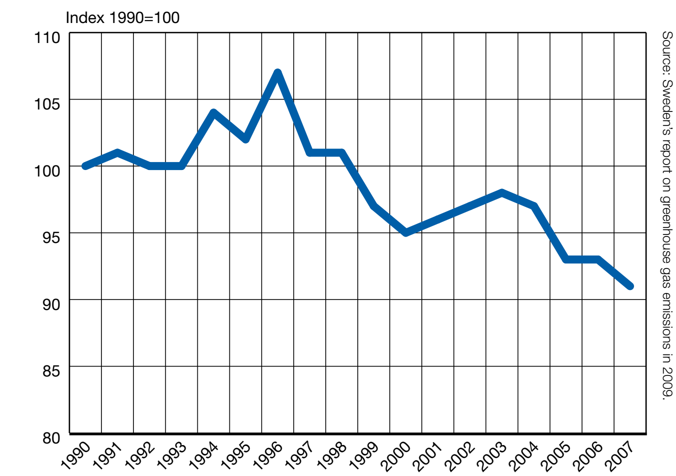


Figure 15:3 Carbon dioxide emissions by different sectors

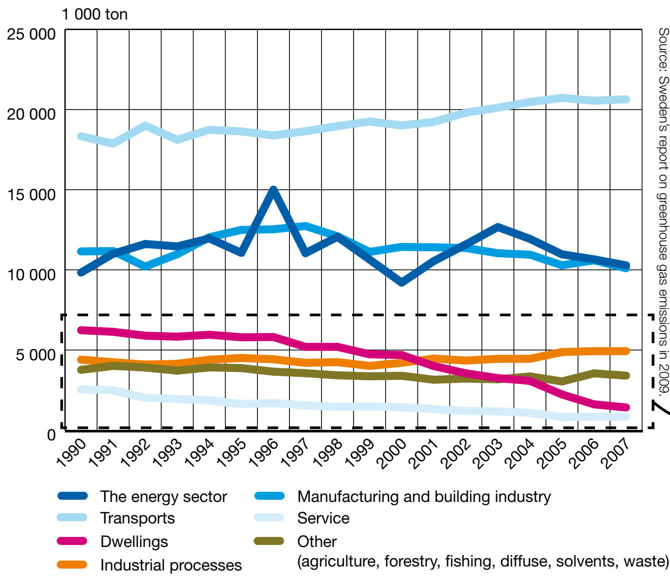


Figure 15:4 Details from Figure 15:3

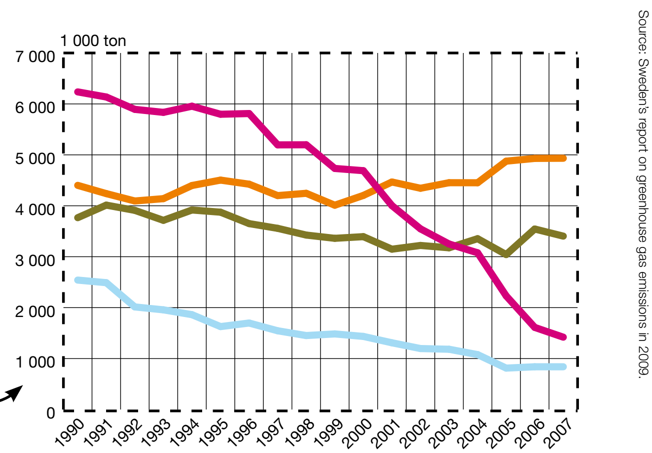
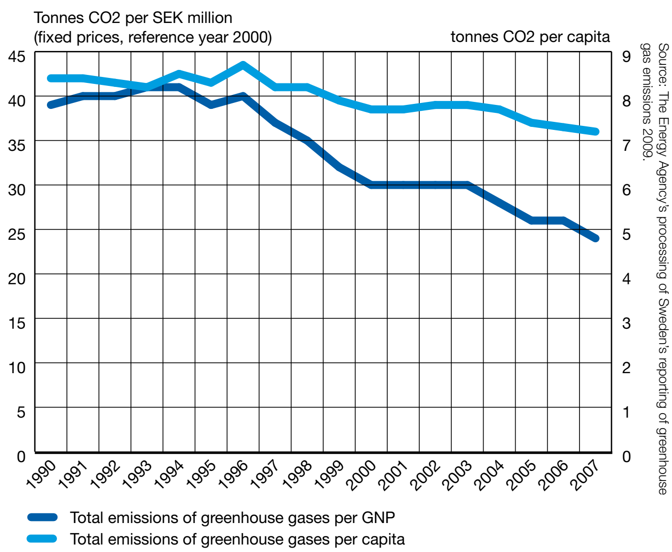


Figure 15:5 Total emissions of greenhouse gases per GNP and per capita



16 Sulphur dioxide emissions by sector

Sulphur dioxide emissions in 2007 were less than one third of the emissions in 1990. The industrial sector and the energy sector are the highest emission sources. The emissions from the residential, services and miscellaneous sectors and from transport are very low.

Energy and environmental policy objectives

According to the energy policy objectives, the energy supply should have a low negative impact on health, the environment and the climate. It is also emphasised that the Swedish environmental and climatic objectives will be taken into account. The Swedish environmental quality objectives were reported during 2005, and the target for emissions of sulphur dioxide were tightened up from 60,000 to 50,000 tonnes before 2010.

Trends

The emissions of sulphur dioxide have decreased continuously during the period studied. This applies to all sectors. In total, the emissions of sulphur dioxide in 2007 amounted to 33,523 tonnes, which is 31% of the emissions in 1990. The national environmental objective will have been met if the emissions are maintained at the present low level.

During most of the period, industrial processes have been the highest single source of sulphur dioxide emissions. The next emissions source was the manufacturing and building industries, followed by the energy sector (electricity and district heating generation and refineries).

For several years, sulphur dioxide emissions from the energy sector have been at a level which is roughly half of the 1990 level. The fluctuations in the emissions from the energy sector between different years are higher than in other sectors. As an example, the emissions from this sector, in 1996, were 40% higher than in adjoining years. The percentage reduction in emissions from the services sector is highest, followed by the residential sector and the transport sector.

The total emissions of sulphur dioxide from the residential, services and transport sectors in 2007 were less than 8% of the total sulphur dioxide emissions in Sweden.

Reasons and relationships

The residential and services sectors display a substantial reduction in sulphur dioxide emissions. This can be explained both by falling oil use in favour of electricity and district heating and the use of more “sulphur-deficient” fuel oils. Sulphur-deficient oils also explain the reductions in the industrial and energy sectors. The sulphur tax has been a contributory factor to the substantial reduction in the sulphur content of the oils used in Sweden.

The fact that the emissions from the energy sector vary relatively widely between different years can mainly be explained by the influence of hydropower. As an example, 1996 was a dry year, and fuel-based electricity generation was, therefore, much higher than normal. The fuels that were used contained sulphur, which increased the emissions.

The reduction of emissions from the transport sector (domestic transport), from around 110,000 tonnes in 1990 to around 30,000 tonnes in 2006, cannot be explained by a reduction in the use of oil products. The reduction, in this case, is due, for example, to increased demand for tax-beneficial environmental class-1 diesel fuel with very low sulphur content.

Figure 16:1 Sulphur dioxide emissions

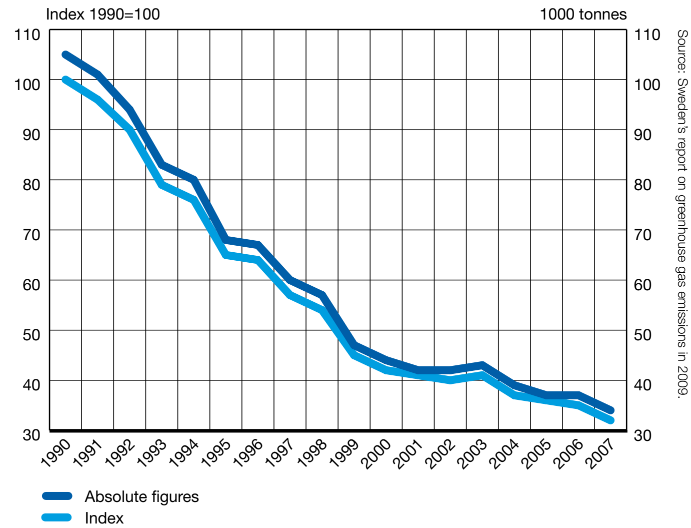


Figure 16:2 Sulphur dioxide emissions by different sectors

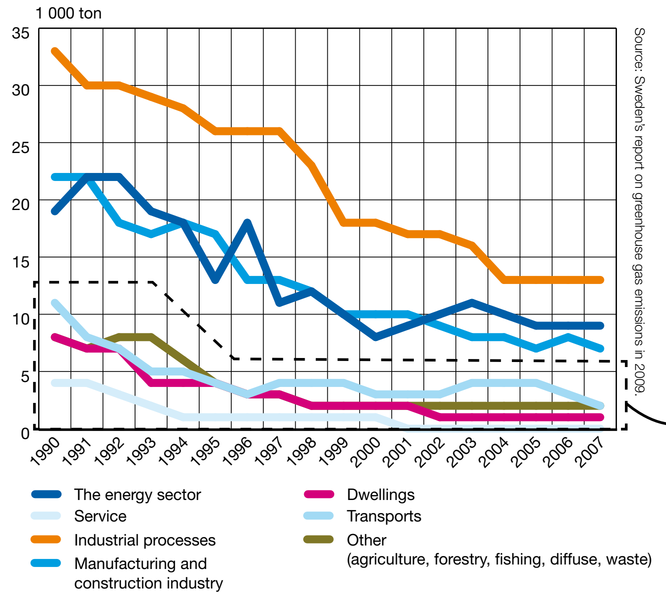
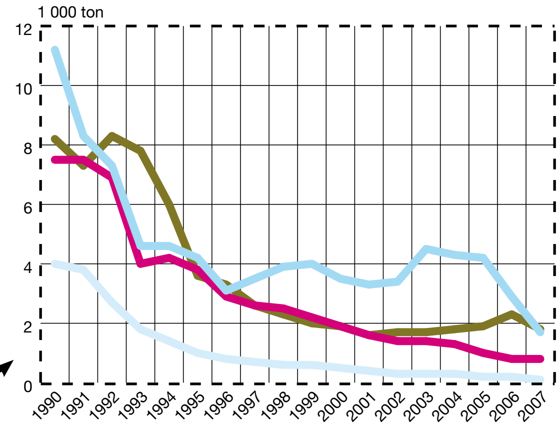


Figure 16:3 Details from Figure 16:2



17 Nitrogen oxide emissions by sector

Total nitrogen oxide emissions have dropped by around 45% between 1990 and 2007. The transport sector is the highest emissions source, followed by the manufacturing and building industries and by the miscellaneous sector (agriculture, fisheries, forestry, waste sector and diffuse emissions). The emissions from the residential, services and energy sectors are very low.

Energy policy objectives

According to the energy policy objectives, the energy supply should have a low negative impact on health, the environment and the climate. It is also emphasised that the Swedish environmental and climatic objectives will be taken into account. The Swedish environmental quality objectives specify that the annual emissions of nitrogen oxides will have been reduced to 148,000 tonnes before 2010.

Trends

Nitrogen oxide emissions have dropped at a relatively uniform rate during the whole of the 1990s. In total, the emissions have dropped by around 45% from 1990 to 2007.

The transport sector (domestic transport) is by far the highest source of nitrogen oxide emissions in Sweden. The manufacturing and building industries are the next highest emissions sources, but the emissions from these industries are much lower than those from the transport sector. In 1990, the transport sector accounted for around 62% of the total nitrogen oxide emissions. However, the emissions from the transport sector have dropped significantly and the proportion of emissions in 2007 had fallen to around 52%.

Emissions from the residential and services sectors have been decreasing slowly over the whole of the period. Viewed over the entire period, from 1990, the emissions from industrial processes have decreased, but they have then increased slightly from 2002. The nitrogen oxide emissions from the miscellaneous sector have decreased by 33% from 1990. The emissions from the energy sector vary from year to year, and were around 17% lower in 2007 than in 1990.

The official Swedish emissions statistics have been revised since the 2008 indicator publication. This has meant that the emissions of nitrogen oxides have dropped by an average of 4.2% during the period 1990–2006 compared with last year's report. Revisions have been carried out in all sectors except for the energy and industrial sectors. The largest changes have taken place in the miscellaneous sector.

Reasons and relationships

The total nitrogen oxide emissions in 2007 amounted to around 167,000 tonnes. So there is some way to go to the target of 148,000 tonnes for 2010. Continued reduction in emissions is therefore necessary to achieve the target.

Reduced nitrogen oxide emissions in the transport sector are due to a gradual increase and more stringent emissions regulations for passenger vehicles and heavy vehicles. The trend has been counteracted by the fact that traffic is increasing.

The reduction in emissions from the energy sector (electricity and district heating generation and refineries) can largely be explained by the NOx charge system, introduced in 1992. This means that a charge of SEK 50 per kg of nitrogen oxide is imposed on emissions from large boilers, and the charge is then repaid in proportion to the utilised energy generated.

The emissions from the manufacturing and building industry sectors and from industrial processes can be related to the general economic climate and the turnover of the companies. The development in the miscellaneous sector mainly depends on emissions from contracting machinery.

Figure 17:1 Nitrogen oxide emissions and index

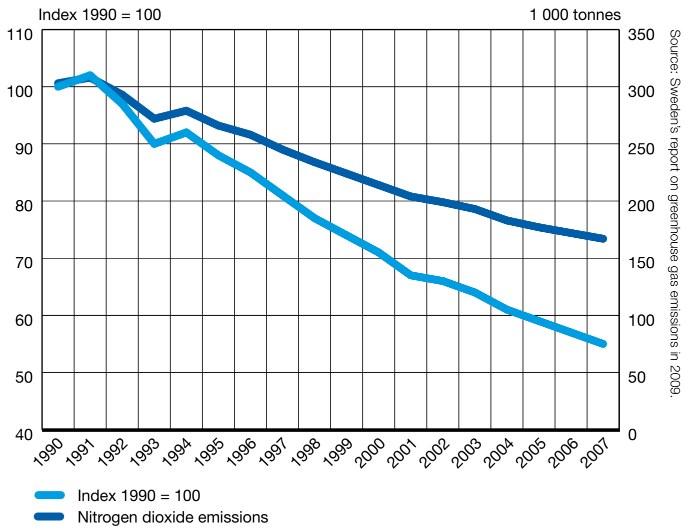


Figure 17:2 Nitrogen oxide emissions by different sectors

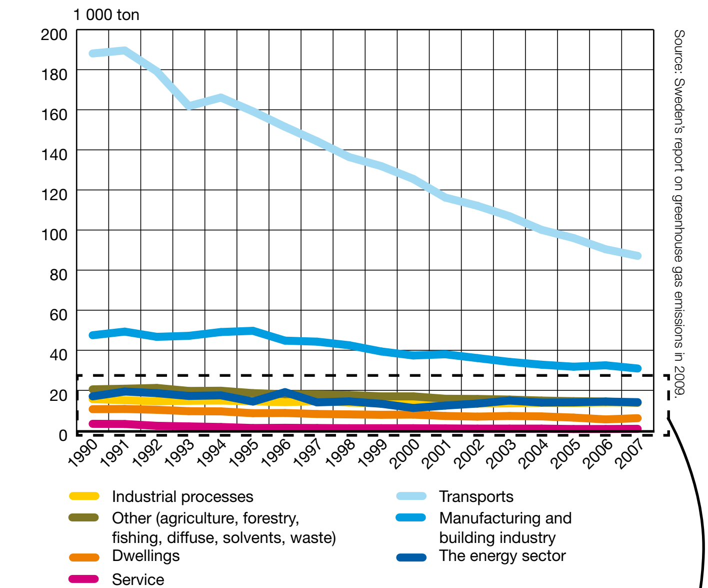
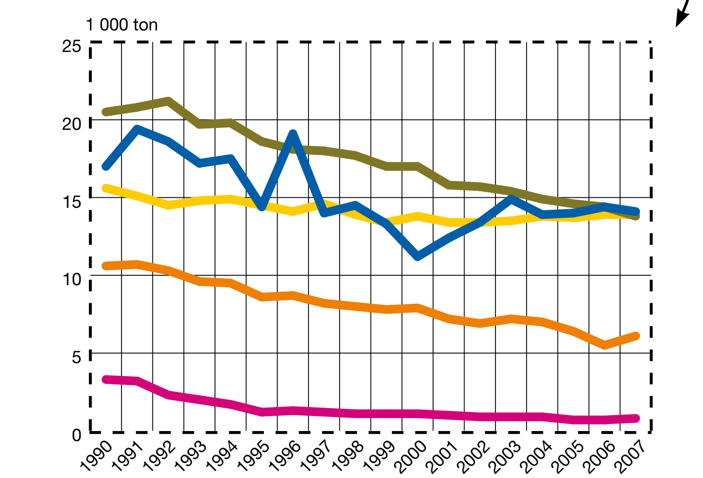


Figure 17:3 Details from Figure 17:2



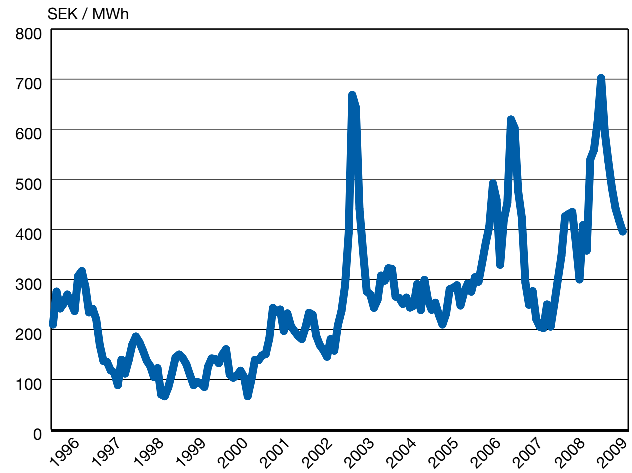
18 Price of electricity on the Nord Pool spot market

In order to achieve the objective of an efficient electricity market, it is important to have a competitive pricing structure that performs well. The spot price on the Nord Pool electricity exchange serves as a price reference for the Nordic electricity market. Since Swedish deregulation in 1996, the price on the electricity exchange has varied widely, both from year to year and within individual years. Since hydropower represents a large proportion of the Nordic electricity generation, the price on the electricity exchange is affected by the conditions for hydropower generation, e.g. the inflow of water and the reservoir levels.

Energy policy objectives

Electricity is a very important element in the Swedish energy system. An efficient electricity market with competitive prices is, therefore, an important objective for the Swedish energy policy. Having a pricing system that performs well is emphasised in this policy.

Figure 18:1 Electricity price on Nord Pool's spot market for the Swedish price area, monthly average values January 1996–March 2009



Trends

In the Nordic electricity system, which is dominated by hydropower, the price of electricity is highly dependent on the availability of water. Since the introduction of trading in emissions on 1 January 2005, this has also affected the price of electricity during certain periods. The initially high prices of emission allowances dropped greatly at the end of April 2006. It transpired that emissions were almost 100 million tonnes lower than the allocation, which meant that the market had a substantial surplus of emission allowances. The price of an emission allowance more than halved in a matter of days, and in February 2007 it reached levels which were lower than 1 Euro per tonne. The prices of emission allowance in the second trading period of 2008–2012 have so far in 2009 remained at 8–15 Euro per tonne. Other factors that affect the price of electricity are the fuel prices for thermal power generation, temperature conditions and the operating status of the nuclear power plants in Sweden and Finland, as well as the available generation capacities. Because of the electricity interchange with the Continent, the prices of electricity abroad and the available transmission capacities have also affected the Nordic price.

The price of electricity on the spot market has varied widely since 1996, both from year to year and within individual years. The price difference between different years is mainly dependent on the hydropower generation conditions (wet year/dry year), although the temperature conditions also affect the price of electricity. The price of electricity is usually lowest in the summer and highest in the winter. The reason for this is that when the demand for electricity is high (high power demand/simultaneous demand) in the winter, plants with high generation costs must be taken into service. In principle, it is only during the spring floods and the summer that the demand can be met by plants with low generation costs. But the fact that much of the water can be stored in reservoirs along the rivers means that the adjustable water quantity is priced on the basis of a so-called water value instead of its low variable cost. The price of electricity is closely related to the hydrological balance, i.e. the availability of snow and surface water, and also water in the water reservoirs at a certain time in relation to the normal level at that time.

Figure 18:2 Price of electricity on the Nord Pool spot market for the Swedish price area, 24-hour average values and 24-hour minimum and maximum, 1 January 2006–23 April 2008

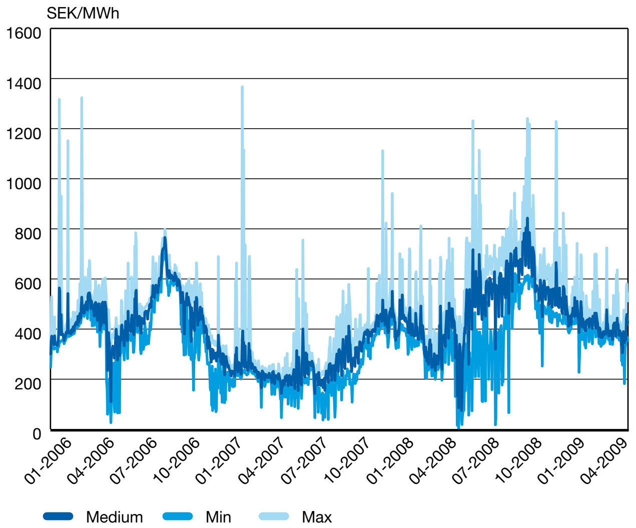
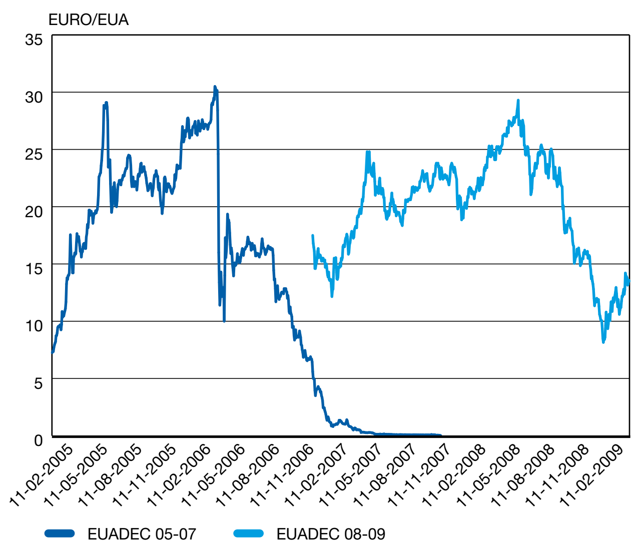


Figure 18:3 Development of prices for emission allowances, 24-hour average values (Nord Pool) 11 February 2005 –23 April 2008



The inflow to the Swedish water reservoirs varies over the year and between years. The inflow is usually low during the winter, since the precipitation is usually in the form of snow. The inflow increases drastically in conjunction with the melting of snow during the spring and early summer. To a certain extent, water also flows in during the autumn in the form of rain. The reservoir levels also vary widely. They are usually highest during the summer and autumn, decrease during the winter and early spring and rise rapidly in conjunction with the melting of snow.

Although the water reservoirs were at a higher level than normal in 2005, the price of electricity did not drop to earlier levels. This was mainly due to rising prices of emission allowance and the high fuel prices. In spite of the relatively normal inflow volume for the year as a whole, the price of electricity in 2006 reached the record high average level. However, at the end of the year, the price was down to the same level as in 2005. At the beginning of 2006, the increase in the price of electricity was mainly due to rising prices of emission allowance, but when prices fell at the end of April, the price of electricity followed suit. Nuclear power generation disturbances during the summer and autumn and the low water reservoir levels contributed to the year's highest 24-hour mean value, which was reached at the end of August. The situation changed in October, the water inflow increased and the Nuclear Power Inspectorate approved the restart of Forsmark 1 and 2, while the mild weather resulted in a low demand. In spite of a low average price of electricity in 2007, the highest spot price for one individual hour was recorded in February 2007 during the period 1 January 2006–23 April 2008, shown in Figure 18:2. Increased prices for both fuel and emission allowance, together with transmission problems caused by a broken cable in Norway, led to electricity prices increasing during the spring and summer of 2008. During the autumn, the trend changed because of the financial crisis. Reduced demand for electricity from industry led to declining prices, a trend which continued during the beginning of 2009.

Reasons and relationships

There is a clear link between the price of electricity and hydropower generation conditions: much hydropower gives a low price of electricity and vice versa. The increased demand for electricity in the Nordic countries, together with the very limited expansion of electricity generation capacity so far, has gradually raised the price of electricity in the Nordic countries. The links and trade with the Continent also increase the

Figure 18:4 Flow difference on a weekly basis compared with a median value for each week

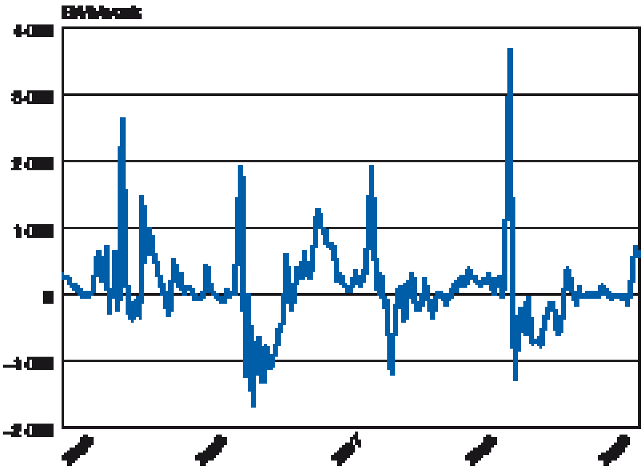
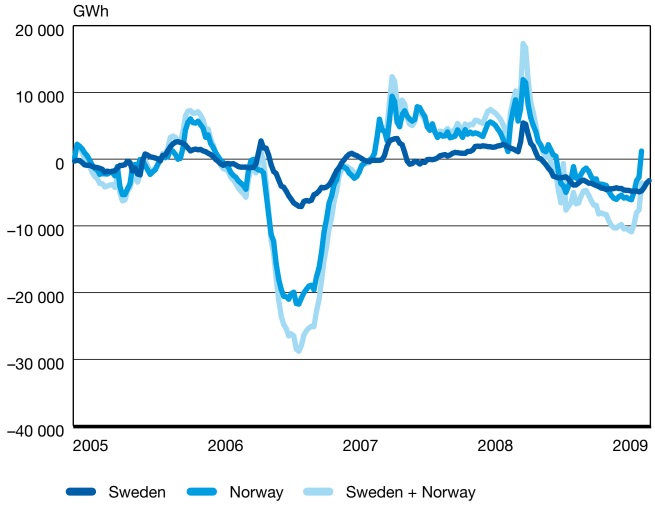


Figure 18:5 Storage content, on a weekly basis, deviations from normal



Source: Nord Pool, Svensk Energi, Norges vassdrags- og energidirektorat (Norwegian Water Resources and Energy Directorate).

price when the prices on the Continent are higher than in the Nordic countries, and electricity can therefore be exported. However, a long-term development is generally difficult to distinguish clearly, since the electricity price variation caused by the hydropower generation conditions and the effects of the varying climatic conditions are wide ranging.

Both the power balance and the energy balance are important from the aspect of security of supply, and both balances affect the pricing. In an energy-rated power system such as the Nordic system, the difference in the energy available between wet years and dry years may be very large, even though the installed power is the same.

Figure 18:2 gives examples of extremely high hourly prices. Spread over 24 hours, these peaks are evened out, and this becomes more apparent if they are spread out over weekly or monthly average values. To some extent, it can be said that a brief, high peak is linked to a temporary situation in which the power supply cannot, or cannot be expected to, meet demand, whereas a longer peak – which may be reflected in the average prices over several days in succession and therefore also in weekly average values – may be linked, to a greater extent, to an energy shortage situation.

FACTS Hydropower

In the Nordic countries, hydropower accounts for around half the electricity generated in a normal year. In Norway, generation by hydropower in a normal year amounts to 122 TWh, in Sweden it is 65 TWh and in Finland 13 TWh. Since the electricity market is Nordic, Sweden is largely affected by conditions in neighbouring countries. In the Nordic electricity market, it is actually the inflow to the hydropower plant reservoirs in all countries that is decisive, although the Swedish inflow of water still provides a good indication of the conditions. The inflow difference (for 2008) has been produced in relation to the median value for the period 1950–2006, and the median inflow of water in Sweden amounts to 62 TWh on an annual basis. The levels in the water reservoirs also play a role. The Norwegian reservoir capacity (82 TWh) is clearly larger than the Swedish capacity (34 TWh). For 2008, the reservoir level has been described as the deviation from the median value for the period 1990–2007 for Norway and as the deviation from the average value for the period 1950–2006 for Sweden.

19 Total market share for the three largest electricity generators

A larger number of operators can stimulate the competition which, in turn, contributes to an efficient and well-performing electricity market. In 2008, the market share of the three largest electricity generators in the Nordic electricity market was around 42%. Since 2002, this market share has increased somewhat.

Energy policy objectives

The electricity market is a central part of the Swedish energy policy. The importance of efficiency in the energy supply is emphasised in the energy policy objectives. An efficient electricity market is highlighted in particular. It is generally considered that a larger number of operators stimulate competition which, in turn, contributes to an efficient market that performs well.

Trends

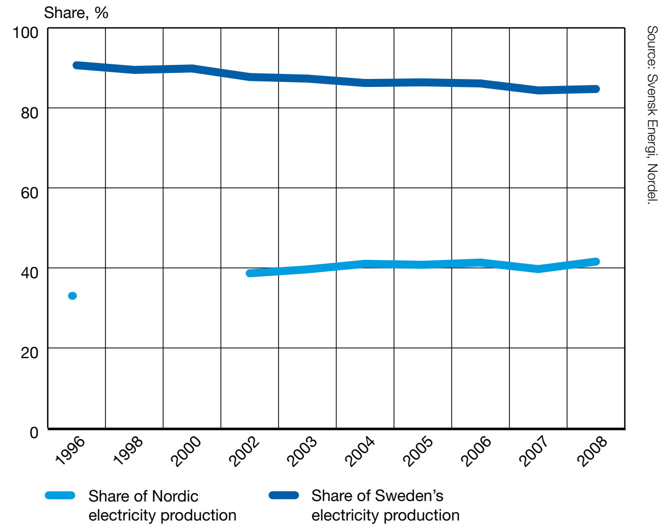
A common Nordic electricity market was established a number of years ago, which includes the Nord Pool electricity exchange. The electricity generated in the Nordic countries by the three largest electricity generating groups amounts to a market share of about 42%, if the total Nordic electricity generation is used to define the market size. In the report entitled "Pricing and competition in the electricity market",[65] the Energy Markets Inspectorate expresses concern that the increased concentration in the Nordic market by mergers and takeovers has reached a problematic level. The market share of the three largest electricity generators in Sweden in relation to the total Swedish electricity generation is around 85%.

Reasons and relationships

Svenska Kraftnät and other system operators in the Nordic countries are responsible for the transmission links and they ensure there is sufficient capacity for the electricity market to perform efficiently. How dominant the three largest electric-

65 The Swedisch Energy Agency and the Energy Markets Inspectorate, ER 2006:13.

Figure 19 Market share of the three largest electricity generators in relation to the total Swedish electricity generation and the total Nordic electricity generation



ity generation groups are depends on the geographic market being considered. In most cases, it is the Nordic market that is relevant to study.

As a consequence of the limitations of electricity transmission, the Nordic electricity market is divided into different sub-markets, known as price areas. This takes place when the market demand for electricity transmission for price equalisation is greater than that allowed by certain transmission links. This occurs fairly often, but, on such occasions, Sweden almost always forms a common price with other price areas, such as Finland and Denmark. It is rare that there is one price for Sweden only. This indicator includes wholly owned generation and partially owned generation, with deductions for minority owners and additions for replacement power. In addition to the parent company, an electricity generation group also includes subsidiaries in which the parent company has a holding of at least 50%. In this publication, the term Nordic electricity market refers to the Nordic countries excluding Iceland.

Among the electricity generators who have electricity generation in Sweden, Vattenfall, Fortum and E.ON are by far the largest. The largest electricity generators in the Nordic electricity market are Vattenfall, Fortum and Statkraft.[66]

66 Note that the indicator relates to the three largest electricity generators on the Swedish and Nordic markets. The three companies may differ from year to year.

20 The quantity of motor biofuel used and the number of biofuel-fuelled vehicles

The share of biofuels for transports amounted to 4.9% in 2008, which is an increase of 0.9 percentage points compared with 2007. Low-admixture ethanol accounts for the largest share of biofuel use, but use of highly concentrated ethanol is the fuel that has increased the most over the past year. The introduction of tax allowances and other benefits have contributed to an increase in the demand for this type of fuel. The number of passenger vehicles that can be run predominantly on renewable energy has increased greatly during 2008 and now makes up approximately 3.5% of the total passenger vehicle fleet compared with 2% in 2007.

Energy policy objectives

EC Directive 2003/30/EC, on the promotion of the use of motor biofuel or other renewable motor fuels, provides general guidelines for the introduction of motor biofuels and other renewable fuels. The targets shall be established by each member country based on reference values for the communities as a whole. The reference level were set at 2% for 2005 and 5.7% for 2010, and these levels relate to the energy content, on the market, of replaced petrol and diesel oil for transports.

In January 2008, the EC Commission presented its draft directive for renewable energy, which will supersede, among others, directive 2003/30/EC. The renewable energy directive was adopted by Parliament and the Council in December 2008. The directive includes binding requirements, on every country, for 10% renewable energy in the transport sector by 2020. Sustainability criteria are also set, and the criteria must be met if a motor biofuel is to be regarded as meeting the target.

The target of 10% renewable energy in the transport sector has not been delineated in terms of responsibility because it has been assessed that biofuels are products which can easily be traded across borders. The calculation of renewable energy in the transport sector in the renewable energy directive differs slightly from the calculation procedure in the directive from 2003. When calculating the share of renewable energy in the transport sector in accordance with the renewable energy directive, the use of petrol, diesel and biofuels for road transports and the use of electricity for all transports should be included in the denominator. In the numerator, the use of renewable energy for all types of transport should be included. The calculation of the addition from renewable electricity is either done in accordance with an EU mix or in accordance with a mix in the country in question, measured two years previously than the actual year. With regard to electricity use in electrical road vehicles, i.e. rechargeable hybrids or electric cars, use should be multiplied by a factor of 2.5 on compliance of the national transport target. Biofuels produced from waste and/or ligno-cellulose as a raw material can be multiplied by a factor of 2.[67]

Trends

The directive from 2003 is aimed at promoting the use of motor biofuel that can replace petrol and diesel fuel for transport applications. The share of motor biofuel calculated as energy content was 4.9% in 2008, which is the equivalent of 4.4 TWh.[68] This is an increase of 0.7 TWh since 2007. The renewable motor fuels used to any major extent in Sweden are ethanol, FAME[69] and biogas.

The use of motor biofuel in Sweden increased by more than 20% between 2007 and 2008. The use of highly concentrated ethanol (E85) has increased the most over the past year. But low-admixture ethanol, however, still accounts for the highest proportion of motor biofuel use. The total use of ethanol, both as admixture and highly concentrated ethanol, accounts for approx. 57% of biofuel use. FAME accounts for approx. 35% and biogas for the remaining 8% of biofuel use.

67 This means that in the numerator, in the quotient for the share of renewable energy, the quantity of energy can be multiplied by 2 for biogas from waste/ligno-cellulose and 2.5 for renewable electricity used for road vehicles. It should therefore be: the share of renewable energy = (quantity of energy biogas*2 + quantity of energy other biofuels + renewable electricity for road vehicles*2.5 + other renewable use of electricity for transport purposes)/(quantity of energy petrol, diesel, biofuels and electricity for transport purposes).

68 According to preliminary statistics of fuels for transport purposes: Quarterly fuel statistics, Statistics Sweden.

69 FAME stands for Fatty Acid Methyl Ester. RME (Rape Methyl Ester) is most common in Sweden.

According to the directive 2003/30/EC, all member countries have submitted an annual report of their shares of renewable energy in the transport sector. Because directive 2003/30/EC has been replaced by the renewable energy directive, in the near future the report will be made in accordance with the renewable energy directive's regulations. The model used to calculate the share of renewable energy in the renewable energy directive differs significantly from the 2003 directive. For 2008, the share of renewable energy in the transport sector in Sweden amounted to 4.9% according to the directive from 2003. If this share is instead recalculated in accordance with the renewable energy directive's calculation model, the share of renewable energy for 2008 amounts to 6.8%.[70]

Another directive which has great significance for the use of biofuels is the EU's fuel quality directive, which encompasses requirements regarding the quality of fuels for road vehicles, working machinery and inland vessels. A new fuel quality directive was adopted in December 2008 which, among other things, means that the permitted level of admixture ethanol in petrol increased from 5% to 10%. For FAME in diesel, the permitted admixture level is set at 7%. Implementation in the member countries' legislation must be completed by 31 December 2010.

At the beginning of 2009, there were approx. 4.3 million passenger vehicles in Sweden. Of these vehicles, approx. 149,000 were passenger vehicles which could be run predominantly on renewable energy, which equates to approx. 3.5% of the passenger vehicle fleet.[71] This is an increase from 2007, when the number of vehicles amounted to 92,000.

During 2008, the average fuel use for a petrol-driven car was 7.5 l/100 km while the average fuel use for ethanol vehicles run on petrol was 8.0 l/100km. Compared with 2007, fuel use for petrol-driven vehicles dropped by 3.6% while use for ethanol vehicles remained unchanged from 2007.[72]

Of the country's 3,250 filling stations, a little more than 45% supplied an alternative fuel as of January 2009. This may be compared with the equivalent figure for the previous year, which was 29%. Of the filling stations with alternative fuels, more than 90% of them supply E85.

Reasons and relationships

Factors that have contributed to the increase in the number of motor biofuel vehicles are that the availability of vehicles run on renewable fuels has increased in recent years and the interest of consumers for this type of vehicle has grown. There are also a number of government instruments which affect consumers' choice of vehicle. For instance, a carbon dioxide differentiated road tax was introduced in 2006, which is based on the vehicle's carbon dioxide emissions instead of on the vehicle's weight. The regulations for the taxation of company cars have also influenced the number of biofuel-fuelled vehicles.

During the period 1 April 2007–30 June 2009, private persons who purchased an environmental car receive a premium of SEK 10,000. The purpose of the premium was to encourage more people to purchase fuel-efficient passenger cars or, alternatively, cars which run on eco-friendly fuels.

It should also be noted that a prerequisite for these control measures increasing the sale of biofuels is that the price of the biofuel is lower than the price of petrol and diesel, in terms of quantity of energy. As of today, biofuels are exempt from energy and carbon dioxide taxes. The purpose of tax exemptions is to promote the introduction of new biofuels and to contribute to the energy policy objectives regarding security of supply by supporting the use and domestic production of biofuels. Despite tax exemptions, there are times when biofuel is more expensive than petrol and diesel, which has a large impact on

70 This is based on 52% of the electricity being renewable (the measured amount is for 2006, i.e. two years prior to the year in question) and that all biogas for transport purposes is produced from waste.

71 Vehicles referred to here are those that can be run on ethanol, gas or electricity. Source: The Swedish Road Administration.

72 Naturvårdsverket (The National [Swedish] Environment Protection Board), Index of new vehicles' climate impact 2008, report 5946, 2009.

Figure 20:1 Total number of registered passenger vehicles that can be run predominantly on electricity, ethanol and biogas

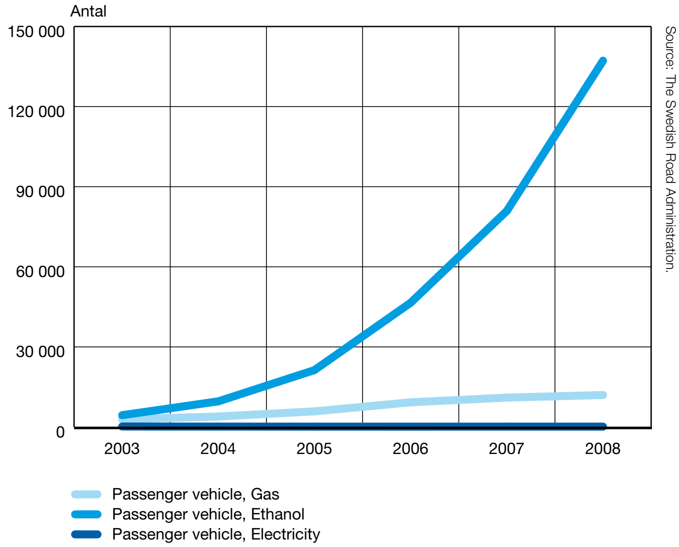
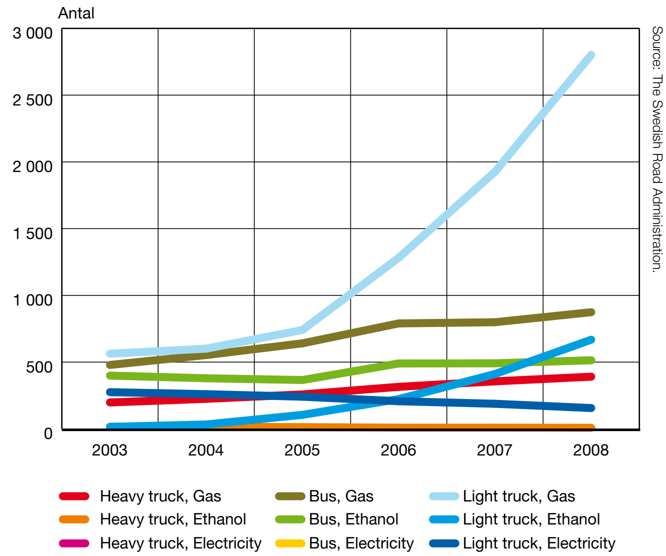


Figure 20:2 The total number of registered lorries and buses that can be run predominantly on electricity, ethanol and biogas



the sale of biofuels. A clear example of this was during autumn 2008, when the price of E85 (in petrol equivalents) was higher than the price of petrol. This resulted in the sales of E85 dropping by 70% between September and December 2008.[73]

A further factor which influences the use of biofuels is the availability of biofuel filling stations. A law regarding the obligation to supply renewable fuels came into force on 1 April 2006. The law means that the country's major filling stations must provide one of the renewable fuels besides petrol and diesel. The law initially covers filling stations that have a sales volume in excess of 3,000 m^3 of petrol or diesel fuel. In 2009 the law was extended so that it applies to sales outlets that have an annual sales volume of 1,000 m^3 or more of conventional fuels. Because investments have mainly been made in fuel pumps supplying E85, the law has been supplemented with a special allowance for other renewable fuels (excluding ethanol). The number of filling stations supplying vehicle gas[74] amounted, at the beginning of 2009, to 89, while the equivalent amount for E85 was 1,372.[75]

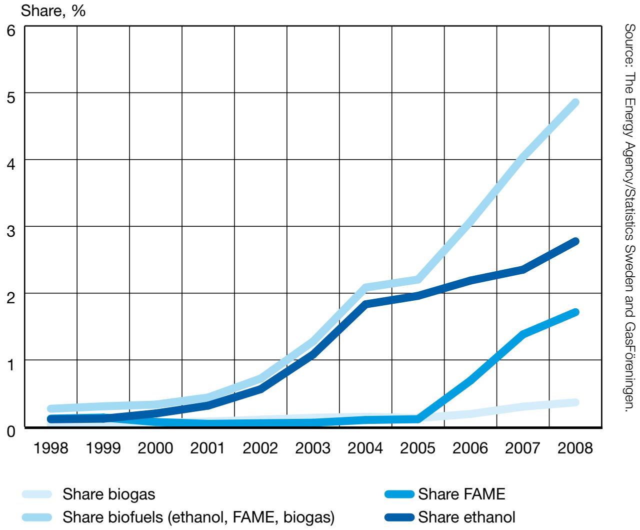
Several Swedish cities have chosen to use biogas as the fuel for local buses. In conjunction with this trend, filling stations have also been created for passenger cars and the increased availability of vehicle gas filling stations has led to an increase in the number of these vehicles. Another positive effect of the investments in biogas-fuelled local buses is that the number of heavy vehicles that run on gas is increasing, such as, for example, refuse collection vehicles.

73 SPI, Press release 15 January 2009.

74 Vehicle gas consists of biogas, natural gas or a combination of the two.

75 SPI, 2009.

Figure 20:3 Share of biofuels in relation to the total amount of petrol, diesel and biofuels, based on energy content



FACTS Fuel prices

On 29 April 2009, 1 litre of petrol (lead-free 95 octane) cost approx. SEK 11.6. The equivalent price for 1 litre of E85 fuel (which consists of 85% ethanol and 15% petrol) was approx. SEK 9.60. Because ethanol has a lower energy value than petrol, 25–35% more E85 is required compared with petrol.

Correspondingly, the cost of using E85 at this point in time was approx. SEK 0.90 higher compared with the cost of petrol. Vehicle gas was cheaper than petrol, with a price difference of approx. SEK 2.0–2.50 per litre (petrol equivalents), depending on where in Sweden the gas was purchased.

Sources and quality

The source information for the indicators in this publication has predominantly been obtained from Swedish official statistics (SOS). If statistics other than SOS have been used, this is given under the corresponding graph. If comments need to be made concerning individual sources of statistics or source information, this is also given under a corresponding indicator. Several indicators in the theme sections have been taken from the EU's environmental bureau: www.eea.europa.eu , from the ODYSSEE database (http://www.odyssee-indicators.org/ and from EU's statistics bureau Eurostat.

The quality of a product, or a statistic, is determined by the user's perception of the product and its usability. To enable the user to assess or value the quality of a product, a number of aspects of a product are listed, which users take into account when they assess how well it meets their needs and expectations.

A description of the quality of statistics contains the following five main components: (1) Contents, that mainly relate to statistical target characteristics; (2) Reliability that relates to uncertainty sources and their effects on the statistics; (3) Topicality that comprises time aspects that play a role in how well the statistics describe the current situation; (4) Comparability and usability that refer to the possibility of making comparisons, over time ad between groups, and for use in combination with other statistics; (5) Accessibility and intelligibility, which concern the physical accessibility of the statistics and its intelligibility.

A description of the quality in statistical sources from the SOS system can be obtained from the Statistics Sweden homepage (www.scb.se). The statistics used here that are not included in the SOS system have been based on the same quality aspects as for SOS statistics, in order to guarantee a high level of quality.

With regard to indicators, a further dimension in the quality description is required. Firstly, the underlying statistics, with regard to the above components must maintain a high level of quality, and secondly, the indicator, as such, must also maintain a good quality for the purpose intended.

The quality of the indicator is determined by the comparability of detailed series with regard to matters such as population, variables and quantities, and their definitions. In this publication, the statistical data for the indicators has been selected to meet quality requirements in the indicator. Good quality for this purpose therefore means that the underlying statistics can be combined in one indicator, and also that both the statistics and the indicator as such are suitable for the purpose. In cases where one of the quality aspects for the indicator could not be fully met, these requirements have been noted under the corresponding indicator.

With regard to the quality of the indicator and with regard to what it measures, a number of factors must be assessed. The indicators should also be relevant, i.e. linked to the objectives that are to be followed up, they should be easy to understand, and should be meaningful in the sense that they should show what they intend to show. They must also be comprehensive and well substantiated, and the parameters in the source information must be well defined. The source information for the indicator should be based on available statistics of an official nature, which is reported and well described.

Our objectives – smarter energy use

The Swedish Energy Agency is a state authority working to achieve a secure, environmentally friendly, and efficient energy system.

We can help achieve the climate objectives through international cooperation and involvement.

The Agency finances research and development of new energy technology. We actively support business concepts and innovations that can lead to establishment of new companies.

We also show Swedish households and companies the way to accomplishing smarter energy use.

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