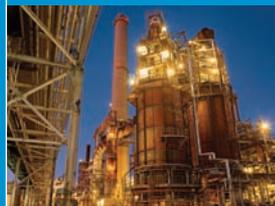


IN-DEPTH REVIEW OF ENERGY EFFICIENCY POLICIES AND PROGRAMMES



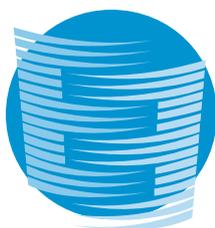
SWEDEN

2006



In-depth Review of Energy Efficiency Policies and Programmes of Sweden 2006

Energy Charter Protocol on Energy Efficiency and
Related Environmental Aspects (PEEREA)



The Energy Charter

The Energy Charter Treaty was signed in December 1994 and entered into legal force in April 1998. To date the Treaty has been signed or acceded to by fifty-one states¹. The Treaty was developed on the basis of the European Energy Charter of 1991. Whereas the latter document was drawn up as a declaration of political intent to promote East West energy co-operation, the Energy Charter Treaty is a legally binding multilateral instrument covering investment protection, liberalisation of trade, freedom of transit, dispute settlement and environmental aspects in the energy sector.

The Energy Charter Conference, the governing and decision making body for the Energy Charter Treaty, meets on a regular basis to discuss policy issues affecting East West energy co-operation, review implementation of the provisions of the Treaty, and consider possible new instruments and projects on energy issues. All states who have signed or acceded to the Treaty are members of the Conference. Regular meetings of the Conference's subsidiary groups on trade and transit, investment and energy efficiency and environment are held in between Conference meetings.

The Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects

The Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA) is a legally binding instrument that was signed together with the Energy Charter Treaty in December 1994 by the same fifty-one states that signed the Treaty itself. It requires its Signatories to formulate energy efficiency strategies and policy aims, to establish appropriate regulatory frameworks, and to develop specific programmes for the promotion of efficient energy usage and the reduction of harmful environmental practices in the energy sector.

Implementation of PEEREA is kept under review and discussion by the Energy Charter Working Group on Energy Efficiency and Related Environmental Aspects. A key feature of the Working Group's activities is the development of a series of in depth reviews of individual states' energy efficiency policies and programmes. Recommendations to the authorities of the states concerned resulting from these in depth reviews are presented to the Energy Charter Conference for discussion and endorsement.

For further information on PEEREA and the in-depth energy efficiency review series, contact Mr Tudorel Constantinescu Tel: +322 775 9854 or e-mail: Tudor.Constantinescu@encharter.org or Mrs Valya Peeva Tel: +322 775 9853 or e-mail: Valya.Peeva@encharter.org at the Energy Charter Secretariat in Brussels.

¹ Albania, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, European Communities, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Mongolia, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, The Former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Ukraine, United Kingdom, Uzbekistan.

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Executive summary

Background

After a relative decline in the economy in early 1990's Sweden has seen strong GDP growth in the past decade. Sweden has lower inflation, a higher employment rate, less unemployment and lower interest rates than the EU as a whole. Indicators point to a high quality of life and per capita incomes. Sweden has a large and decentralized public sector. During the last decade Sweden has strengthened competition legislation and deregulated a number of sectors, but the state remains the corporate sector's largest shareholder.

The green welfare state is a priority goal for the Government and is the basis for its sustainable development policy. Sweden's development priorities include modernization and innovation, reflected also in important investments in research.

Sweden's energy supply depends largely on nuclear power and oil products. Renewables have a relatively high share of about 26%. Hydro power production is substantial. Electricity from CHP plants and wind mills is increasing as is also heat produced from combustible renewables and waste.

The energy intensity of Sweden has been decreasing since 1996, but is higher than the average of the European OECD countries. This is reflecting the cold climate, but is also a result of the dominance of energy intensive industries. Consumption of electricity for space heating is high, although the contribution from district heating features a substantial increase since 1990.

Energy policy

The energy policy of Sweden is based on the 1997 and 2002 Energy Policy Agreements. Further steps in the nuclear power production phase out, approved by a referendum in 1980 and started in 1999, will amongst other depend on the rate of introduction of alternative energy generation and improvements in the efficiency of energy use.

The current government's energy policy aims at creating the conditions for efficient energy markets, security of supply and comprehensive consideration of the environment, health and the climate. In 2005 the Government set as a policy target to create the conditions necessary to break Sweden's dependence on fossil fuels by 2020 and a national programme against dependence on oil was initiated. Solutions are seen in replacing oil with biofuels, but also in measures to reduce energy use or to increase energy efficiency.

Sweden liberalised its energy markets in 1996. Integration of the Swedish and the other Nordic countries electricity markets organised in the Nord Pool have contributed to developing a competitive electricity market.

The Energy Markets Inspectorate (EMI), established in 2005 as the national regulatory authority, supervises the electricity and gas network companies and monitors the markets for electricity, natural gas and district heating. It is also actively engaged in strengthening the positions of energy customers on the deregulated energy markets.

Energy taxation has been a successful tool in Sweden to reduce consumption of oil and other fossil fuels and at the same time to promote renewable energy and increase energy efficiency. There is an energy tax on electricity and fossil fuels, a carbon dioxide tax on fossil fuels, and a sulphur tax is charged on all fossil fuels and peat. A green tax shift strategy has gradually been implemented in Sweden since 2001.

Energy efficiency policies and programmes

Energy efficiency has been long on the political agenda of Sweden and has been incorporated in the strategic energy and climate change decisions of the government. The energy efficiency policy of Sweden is also driven by the EU directives.

There are a number of energy efficiency programmes currently running in Sweden:

- The strategic 2002 Energy Policy Programme for Efficient Energy Use (2003-2007);
- The Energy Efficiency Investment Programme for Public Buildings (2005-2007);
- The Sustainable Municipality Programme (2003-2008);
- The Programme for Energy Efficiency in Energy Intensive Industry (2005-2009);
- Investment support for conversion from direct electricity and oil heating to district heating, bioenergy, heat pumps and solar heating (2006-2010);
- The National Programme for Energy Efficiency and "Energy Smart" Buildings, launched in 2006.

Energy taxes and tax rebates, subsidies and grants, technology and public procurement schemes, energy labelling, municipal and regional energy advice, information dissemination, and support for R&D are among the major policy instruments incorporated in the programmes.

Sweden allocates substantial budget funds for the promotion of energy efficiency and renewable energy. In many cases these funds are used to leverage funding by industry and consumers.

The Ministry of Sustainable Development is responsible for the energy efficiency and renewable energy policy of the government, supported by special commissions ("committees of inquiry"). The Swedish Energy Agency is responsible for the implementation of energy efficiency policy programmes and measures in the residential, services and industry sectors. The Swedish Environmental Protection Agency and the National Board of Housing, Building and Planning are also active contributors to sustainable energy policy implementation in their respective areas of responsibility.

Renewable energy policy

Renewable energy has gained substantial importance in Sweden. Sweden has operated different systems for supporting electricity production from renewable energy sources since the 1990s. Currently, the major types of economic incentives used in Sweden to promote renewable energy include: CO₂ tax and tax exemptions, green certificates, tax deductions, subsidies and grants, and support to R&D.

Carbon dioxide taxation resulted in a substantial increase in the share of renewable energy, primarily biomass and waste energy used in district heating and also stimulated combined heat and power production. The implementation of the green electricity certificate system introduced in 2003 led to increased production of "green" electricity followed by higher targets for renewable electricity production.

An active strategy for carbon dioxide-neutral transport biofuels and the introduction of green cars is increasingly influencing the transportation sector.

Overall assessment of progress

Sweden has taken ambitious legislative initiatives including programmes to promote and support energy efficiency and renewable energy with the objective to substantially reduce its dependence on fossil fuels and also to phase out nuclear power. The energy efficiency and renewable energy policy are implemented by successfully using a variety of policy instruments. Nevertheless, to reach the ambitious targets, further improvements need to be made, especially in the overall analysis and assessment of the economic potential of energy efficiency and renewables in the country, more effective regulation of the district heating sector and promotion of CHP, increased cooperation with municipal authorities and involvement of small and medium sized enterprises and services in energy efficiency programmes. The review team has formulated recommendations for improvements in these key areas.

1. Introduction to the PEEREA review

Sweden ratified the Energy Charter Treaty (ECT) and the Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA) in 1997. In fulfilling its commitments under PEEREA Sweden has presented regular reviews of its energy efficiency policies in June 2001 and November 2005. Sweden also volunteered to host the current PEEREA in-depth review of its energy efficiency policy. The purpose of the review is to assess the progress of the country in fulfilling its commitments under the Protocol, to enhance the level of co-operation among PEEREA Parties, and promote continuous dialogue and transfer of experience and information.

The in-depth review was carried out by a team, comprising officials from four countries parties to the Protocol: Mr. Tadeusz Skoczkowski from KAPE, Poland (team leader), Mrs. Alma Saraci from the National Energy Agency of Albania, Mr. Francesco Ciampa from ENEA, Italy, and Mr. Frank van Bussel from SENTER Novem, the Netherlands. The team also included Mr. Tudorel Constantinescu and Mrs. Valya Peeva from the Energy Charter Secretariat. The review team visited Sweden in the period 3-6 April 2006 and met with representatives of a number of organisations listed in Annex 4. The review team expresses its high appreciation to the Ministry of Sustainable Development and the Swedish Energy Agency for the organisation of the mission in Sweden and special thanks to all Swedish participants in the meetings.

A main source of information on the energy efficiency policies and programmes was the Regular Review, presented by Sweden to the PEEREA Working Group in 2005 and the information provided by Swedish institutions during the visit. Other sources of information were also used, e.g. publications of the Swedish government, IEA, OECD, EU, etc. The statistical information used in the report is primarily based on the IEA energy statistics, including data up to 2003. The review team notes the abundance of information provided by the Swedish governmental institutions to the national and international public through Internet and publications in Swedish and English languages.

2. General overview

Brief country presentation

Sweden is situated on the Scandinavian Peninsula, largely surrounded by sea and bordering Norway and Finland on land. The country has a total area of over 450 thousand square km, elongated at around 1560 km north/south, and over half covered by forests. The country has over 95000 lakes and a large number of rivers and streams with high hydropower potential, supported by the year-round precipitation. The island and coast line has a length of about 50000 km, providing good conditions for offshore wind farms. Most of the country has a cold temperate climate with winters bringing heavy snowfalls.

Sweden has a population of 9 million (2004) after a moderate increase since 1990. Regional differences of population density are substantial and are increasing. About one third of the population lives in one of the three metropolitan regions in the south of the country: Stockholm, Göteborg and Malmö with environment under heavy pressure, while in northern Sweden the population density is 3 inhabitants per sq. km.

Figure 2.1 Map of Sweden



Timber, hydropower, and iron ore constitute the resource base of the economy of the country. There are large areas of peat deposits all over Sweden, but not all are economically feasible to exploit.

After a relative decline in the economy in early 1990's Sweden has seen strong GDP growth in the past decade. GDP per capita has grown faster than the OECD and EU average in recent years. Sweden also has lower inflation, a higher employment rate, less unemployment and lower interest rates than the EU as a whole.¹

Sweden's economy is heavily oriented toward foreign trade with exports accounting for about 45% of GDP. The engineering industry with key products such as motor vehicles and telecom products is Sweden's largest sector, accounting for almost half the value of production and large share of exports.

Sweden has a large and decentralized public sector. During the last decade Sweden has strengthened competition legislation and deregulated a number of sectors, including

¹ From the Budget Bill for 2006: Budget Statement and Summary, Information material, Ministry of Finance, 20 September 2005.

electricity and part of transportation, but the state remains the corporate sector's largest shareholder with its owner share of business being the highest in the EU. The government is a major stakeholder in industries that many other countries have privatized, including mail service, telecommunications, electricity, airlines and retailing.²

The green welfare state is a priority goal for the Government and is the basis for its sustainable development policy. Indicators point to a high quality of life and per capita incomes, and Sweden is devoting substantial resources to preserving the environment and helping poorer nations.³ Sweden's development priorities include modernization and innovation, reflected also in important investments in research.

Sweden joined EU in 1995, but did not adopt the Euro. The national currency is the Swedish Crown (SEK).⁴

Sweden is a constitutional monarchy, with parliament (the Riksdag) elected every four years. The government implements parliamentary decisions, assisted by national agencies which act as the government's expert bodies. In addition to the central level, there are 21 regional county administrative boards and 290 municipal councils, elected in separate elections at the same time as the parliamentary (last elections were in September 2002). The county administrative boards represent the Riksdag and Government in the county. Swedish municipalities have far-reaching self governance and to a large degree receive their financing through municipal taxes that are decided locally.

Energy background

After substantial increases and structural changes in the 1980's, Sweden's energy supply has during the last 10 years been comparatively stable at around 50 Mtoe/year with an important share of nuclear power of around 35% and high share of oil products (31%). Renewable energy sources have a comparatively high total share at about 26%, dominated by hydropower, combustible renewables and waste, and some solar thermal and wind power. Coal and gas shares are limited to around 5% and 2% respectively (Fig. 2.2).

Sweden's energy import dependency amounted to 35 - 40% of Total Primary Energy Supply (TPES) during the last years, with a peak of 44% in 2003.

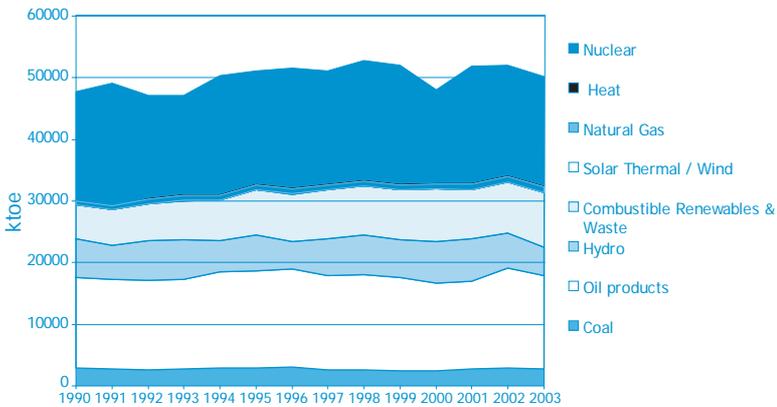
Electricity generation in Sweden is mainly based on nuclear energy (49.7%) and hydropower (39.3%). Nuclear power production phase out, approved by a referendum in 1980, started in 1999 with the closure of the first Barsebäck reactor. In October 2004 a political agreement was made on a strategy for continued phase out of nuclear power production. Under this strategy, the second Barsebäck reactor was closed in 2005. Today, Sweden has 10 nuclear power reactors in use. The further decommissioning has no fixed deadlines and will depend on the rate of introduction of alternative energy generation, improvements in the efficiency of energy use, energy research and technical development, as well as the effects of EU directives and incentives.

² OECD Economic Surveys, Sweden, Volume 2005, Issue 9.

³ OECD Economic Surveys, Sweden, Volume 2005, Issue 9.

⁴ One Swedish Crown (SEK) is exchanged at a rate of about 0.107 Euro (08/05/2006)

Figure 2.2 Total primary energy supply of Sweden



Source: IEA Energy Statistics, Electronic version 2005

Hydro power produces about 65 TWh of electricity in a statistically normal climatic year, but production varies widely, depending on the amount of precipitation during the year. There is a potential for more hydro production in the country, but many rivers are protected from hydroelectric power exploitation by the Environmental Code. These comprise the four national rivers: Torneälven, Kalixälven, Piteälven, and Vindelälven and a further 38 river basins with a total area of 153 000 km². Moreover, 10 river courses in 7 rivers are protected.⁵

Electricity produced by CHP plants has more than doubled since 1990, amounting to 13 TWh and has a share of nearly 10% of the total electricity produced (2003). Wind power production, which started in late 1980's, contributed 0.8 TWh of electricity in 2004. There are more than 700 wind mills in the country with an installed capacity of about 460 MW.

Combustible renewables and waste are steadily increasing their share in the energy supply of Sweden, based on the availability of raw materials (mainly wood) in the country and of industrial by-products, but also on the development of technologies for their utilisation and the incentives. They are mainly used for heat production, and less for electricity.

The energy intensity of Sweden (primary energy use per GDP) has been decreasing since 1996, but is higher than the average of the European OECD countries (Figure 2.3). This is reflecting the cold climate, but is also a result of the dominance of energy intensive industries. The number of heating degree days is high and varying between 3200 in the south and 6500 in the northern parts of the country.⁶

Sweden's Total Final Energy Consumption (TFC) has been increasing moderately during the period 1990-2003 and is dominated by oil products and electricity (Figure 2.4).

⁵ "Protected Nature" 2004, Statistical Report, Statistics Sweden, www.scb.se

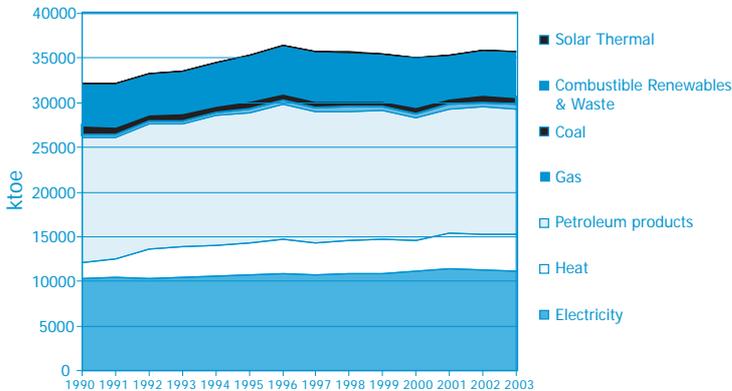
⁶ District Heat in Europe, Country by Country/2003 Survey, Euroheat & Power, 2003.

Figure 2.3 Primary Energy Intensity of Sweden



Source: IEA Energy Statistics, Electronic version 2005

Figure 2.4 Sweden: Total Final Consumption by Fuel 1990-2003



Source: IEA Energy Statistics, Electronic version 2005

Although Sweden has reduced substantially its consumption of oil products since the early 1980s, the consumption levels are still considered to be high amounting to about 14 Mtoe annually. The major part of it, about 60%, is used for transport.

Consumption of electricity has seen a slight increase during the period 1990-2003. It is the dominating energy source for the industrial sector, the residential sector and services. Space electric heating accounts for 22 TWh/year, or about 30% of the electricity use in the residential and services sectors.⁷

⁷ The Swedish Energy Market 2005, Swedish Energy Agency, Energy Markets Inspectorate.

Combustible renewables and waste have an important share in final consumption, especially in industry. The detached house sector is also an important consumer of biofuels and peat, especially in areas with easy access to forests.

Natural gas accounts for about less than 2% of the country's total energy consumption, although the distribution network has been progressively expanded after gas was introduced to Sweden in 1985 and now supplies about 30 municipalities in the south-west of the country.

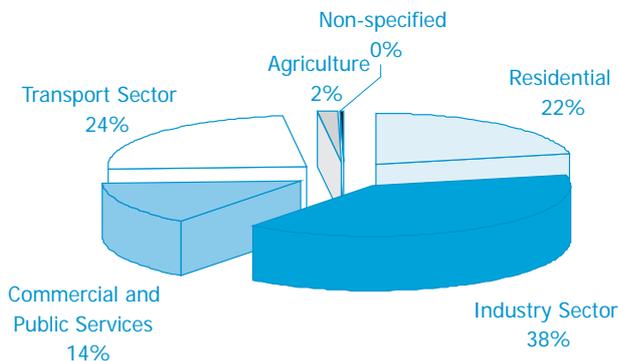
District heating features a substantial increase since 1990, supplying about 47 TWh of heat in 2004, or about half of the end-use heating in Sweden. It is the most common form of heat supply for apartment buildings and commercial premises and is also used for industrial purposes. More than 60% of the district heat production is based on biofuels, waste and peat. District heating produced in combined heat and power plants is about 40% of the total production. District heating losses, incl. in distribution and conversion, amount to about 11%. These comparatively low losses are due to a high technology level and high load factors.

District cooling appeared in Sweden in the early 1990s. Since then the market has expanded rapidly and today some 640 GWh of district cooling are supplied by 30 commercial district cooling companies. District cooling finds a market almost exclusively in the commercial sector for air conditioning of shops and offices, and in industry for process cooling and cooling of large computer centres.

End-use sectors

Industry is the sector with highest energy consumption in Sweden, mainly due to the paper and pulp industry. Transport is second in terms of energy consumption, followed by the residential sector (Fig. 2.5).

Figure 2.5 Sweden: Total Final Consumption by Sector in 2003



Source: IEA Energy Statistics, Electronic version 2005

Residential

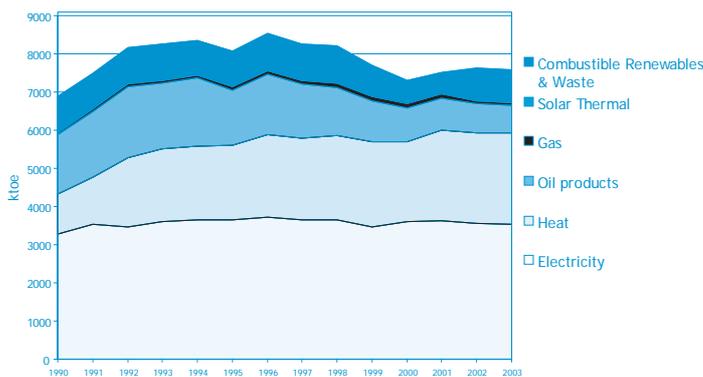
There are around 4.3 million dwellings in Sweden. Owner-occupied homes account for 37% of the housing stock, rented housing for 47% (half of which is owned by private landlords) and cooperative – tenant-owner – housing for 16%. Municipalities are responsible for housing provision at the local level. Municipally owned non-profit housing companies are implementing the housing policy.

Three of every four dwellings in Sweden were built after 1945 and almost half the flats in multi-dwelling buildings were built after 1965. It is the housing built in the period of strong growth in the 1960s and 1970s that is now beginning to need action on equipment and technical systems.

Dwellings are gradually increasing in number, but they are also becoming larger. The average residential floor space for newly-built detached and semi-detached houses increased about 12% in 10 years to reach 122 m² in 2003. The average residential floor space per capita rose during the 1990s from 41 m² to 43 m², or by 5%.⁸ All this, together with the increasing population, tends to drive up the energy requirement.

However, residential energy use has been relatively stable since 1990, and even went down after 1998, but the breakdown between different energy carriers has changed (Fig. 2.6). Use of oil products has declined and has been replaced by district heating, heat pumps, and biomass fuels. Household electricity use has slightly increased.

Figure 2.6 Sweden: Final Consumption of the Residential Sector by Energy Source



Source: IEA Energy Statistics, Electronic version 2005

The most common form of heating in detached houses is electric heating. The reason for the high share of electric heating is that it is cheap to install, simple to run and electricity prices were earlier attractive. Another common heating system in detached houses is electricity in combination with wood and/or oil firing. These heating systems

⁸ Sweden's Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change, Ministry of Sustainable Development, Sweden, 2005.

are relatively flexible, with the use of electricity being determined by the relative prices of the various energy carriers. District heating is the dominating form of heating in apartment buildings, supplying approximately 77% of the apartments. Oil is used as the sole or main heat source for only 5% of the apartments.

The use of electricity for non-heating purposes is significant and has increased since 1990 due to the increase in the number of households and more widespread ownership of domestic appliances. However, continued improvements in the efficiency of electric appliances have tended to offset this increase, as a result of more sophisticated operational control and correct sizing of systems at the time of installation. Electricity demand growth has also been dampened by new and improved light sources.

The average energy consumption (energy used per square meter for heating, hot water and electric appliances) in newly-built detached and semi-detached houses has decreased by around 20% over the past two decades to an average of 129 kWh/m². For comparison, houses built over the period 1990-95 consume 146 kWh/m² and those built in 1980-89 consume 159 kWh/m². Such differences in the heating consumption according to the time of construction are not apparent in apartment buildings.⁹

Industry

The Swedish manufacturing industry accounts for about 20% of GDP. The industrial structure is characterized by a large share of engineering industry (nearly half) and industries based on raw materials and energy like forestry and metal production. An increased degree of structural change towards more knowledge-intensive production has taken place since the mid-1990s.

In the energy intensive sectors - the pulp and paper industry and the iron and steel industry, production has been concentrated on fewer but larger and more efficient production units. A significant proportion of the production of the pulp and paper industry and the iron and steel industry is exported.

There was a significant increase in the productivity of the manufacturing industry in the 1990s, particularly for the engineering industry. The high rate of growth for engineering products compared with energy-intensive basic industry since the end of the 1990s, principally due to increased exports, has led to a structural change and somewhat reduced energy intensity in manufacturing.¹⁰

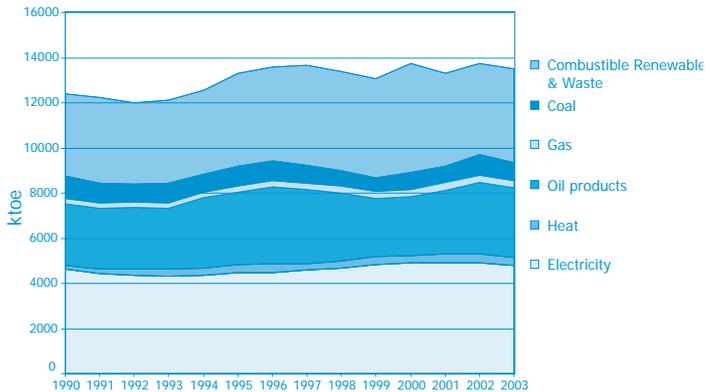
Still, industrial energy consumption is important accounting for nearly 40% of the total final energy use, and is increasing in absolute terms, although slowly (Fig. 2.7). The fuel mix has not changed much since 1990. Electricity and biomass fuels dominate the energy supply of the sector with around 35% each in 2003. Use of biomass fuels has slightly increased. The share of oil averaged 15% between 1990 and 2003.

⁹ Sweden's Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change, Ministry of Sustainable Development, Sweden, 2005.

¹⁰ Sweden's Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change, Ministry of Sustainable Development, Sweden, 2005.

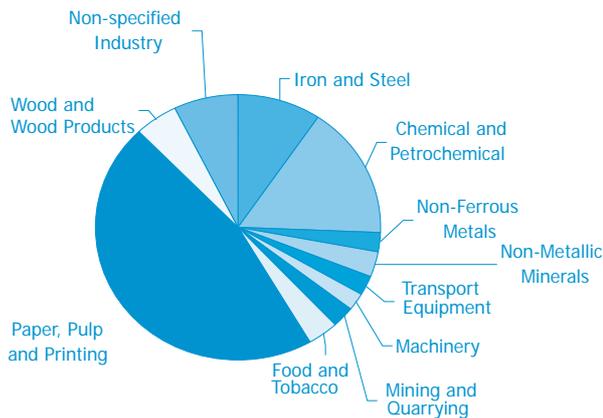
A small number of subsectors accounts for the bulk of energy use in industry (Fig. 2.8). The pulp and paper industry uses about 46%, the iron and steel industry about 15%, and the chemical industry about 7%. Together, these three energy-intensive sectors account for two-thirds of the total energy use in industry. The engineering industry, not being energy-intensive, accounts for almost 8% of the total energy use in industry. According to the Swedish Energy Agency the potential for improving the efficiency of energy use in industry is substantial and could be exploited by using available technologies.¹¹

Figure 2.7 Sweden: Final Consumption of Industry by Energy Source



Source: IEA Energy Statistics, Electronic version 2005

Figure 2.8 Structure of Energy Consumption in Industry by Subsectors, 2003



Source: IEA Energy Statistics, Electronic version 2005

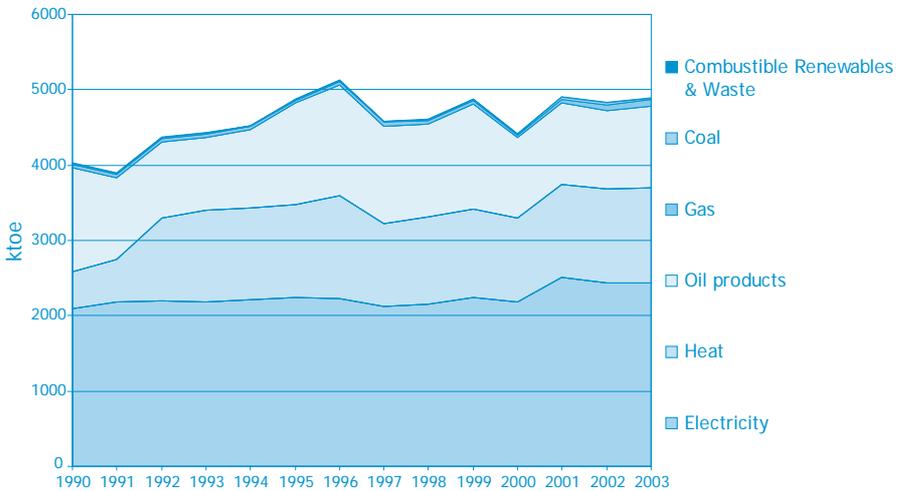
¹¹ Energy in Sweden 2005.

Services

The services sector has grown rapidly since 1990. The high growth rate of both private and public services has resulted in a substantial increase in the total floor area of offices and commercial premises, and in greater use of office machines.

The energy consumption of the sector has increased by 22% since 1990 (Fig. 2.9). District heating is the main source of heat in offices, commercial premises and public buildings. 58% of commercial premises were heated by district heating in 2002, but electric heating was also important. District cooling for commercial and administrative buildings, introduced in early 1990s, is increasing.

Figure 2.9 Sweden: Final Consumption of the Services Sector by Energy Source



Source: IEA Energy Statistics, Electronic version 2005

The use of electricity for public and commercial building services has increased. Electricity consumption for lighting, computers, cooling and ventilation has increased by 45% since 1990, despite of efficiency gains due to new and improved light sources, more sophisticated operational control, and correct sizing.

For ventilation Sweden has since 1992 a mandatory inspection system that includes most buildings. In spite of this system there are still ventilation deficiencies in around 60% of the buildings, where many are schools and day nurseries.¹²

Energy inspection of office buildings, completed under a project for improved buildings energy statistics, indicates that the electricity consumption in offices can be cut by 50%.

¹² The Regular National Report in Housing Development in Sweden 2005, Swedish National Board of Housing, Building and Planning, 2006, www.sweden.gov.se.

Transport

Sweden has a well developed road network of around 139 000 km of public roads and rail network of around 17 000 km. The volume of transport and the energy use of the transport sector are increasing continuously. Domestic passenger transport has increased by approximately 12% since 1990. Freight transport by railway and ship has declined. New transport flows principally go by truck and also to a small but rapidly increasing extent by air. Total freight transport activity in Sweden increased by just over 14% between 1990 and 2002, while the increase for freight carried by road is 25%. Transport activity by road accounts for around 90% of total transport activity.¹³

Domestic transport accounted for 24% of the country's total final energy use in 2003 (Table 10.4 in Annex 2). The energy consumption of this sector has increased steadily since 1990. Low admixture of ethanol in petrol has led to an increase in the use of ethanol as motor fuel of almost 600% between 2001 and 2004. However, in 2004, bioethanol still only accounted for 2% of the energy use of the transport.

Emissions from transport traffic are increasing. Carbon dioxide emissions from transportation rose by about 10% between 1990 and 2002 and amount to about 45% of the overall emissions in the country.

The energy efficiency of vehicles has been improving over a long period of time, but the weight and engine power of the Swedish vehicle population is steadily increasing. The total number of what are known as 'green cars', which are powered entirely or partially by electricity, biogas or ethanol, has increased in recent years.

¹³ Sweden's Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change, Ministry of Sustainable Development, Sweden, 2005.

3. Energy Policy

Institutions

The Ministry of Sustainable Development is responsible for the overall coordination of the government's work on sustainable development, including environmental policy, energy policy, housing policy, and climate policy. The Ministry was established in 2005 and took over the responsibilities of energy issues from the Ministry of Industry, Employment and Transport and of environment issues from the Ministry of Environment. The Ministry of Sustainable Development has a proactive role to reorient and modernise Sweden in order to obtain sustainable development and growth. To this end, it uses new technology, construction, planning and pursues an active energy and environmental policy.

The Ministry is a relatively small body having total staff of about 200, of which 25 comprise the energy division. The Ministry is supported in its activities by a number of executive agencies. The two main bodies responsible for the implementation of energy policy measures in Sweden are the Swedish Energy Agency and Svenska Kraftnät.

The Swedish Energy Agency, founded in 1998, works towards transforming the Swedish energy system into an ecological and economically sustainable system. This is done in collaboration with trade and industry, energy companies, municipalities and the research community.

The Energy Markets Inspectorate (EMI) was established in January 2005 within the Swedish Energy Agency as the Swedish national regulatory authority. EMI supervises the electricity and gas network companies in Sweden, and monitors the markets for electricity, natural gas and district heating, in order to ensure that they operate efficiently. It is also actively engaged in strengthening the positions of energy customers on the deregulated energy markets.

Swedish National Grid (Svenska Kraftnät) is a state owned utility which was established in 1992. The company administers and runs the national electrical grid which in total consists of approximately 15000 kilometres of 200 kV and 400 kV lines plus installations, interconnectors to neighbouring countries and IT systems. Operations are primarily financed by the network fees paid by power producers and suppliers to transmit power. Since July 2005, Svenska Kraftnät also has the system responsibility for the supply of natural gas. Svenska Kraftnät is consisting of three subsidiaries and six associated companies, the largest of which is the Nordic power exchange Nord Pool (50% stake in share-capital).

Strategic and legal basis

An energy policy agreement in 1997 set out a strategy for continued restructuring of the country's energy system driven by the principles of security of supply, competitiveness, health, environment and climate, and phasing-out nuclear. The short term energy policy programme (concerning primarily the replacement of the electricity production capacity of Barsebäck) and the long-term programme (mainly focused on research, development, demonstration and measures to address climate change) were concluded in 2002 and 2004 respectively.

The 2002 Energy Policy Agreement 'Working Together for Reliable, Efficient and Environmentally Aware Energy Supply' led to the introduction of the green electricity certificate system, and also included measures to improve the efficiency of energy use.

The current government's energy policy aims at creating the conditions for efficient energy markets, security of supply and comprehensive consideration of the environment, health and the climate.

In 2005 the Government has set a new policy target: to create the conditions necessary to break Sweden's dependence on fossil fuels by 2020. In October 2005 the Government presented a national programme against dependence on oil. The Programme is focusing greatly on renewables, transport and district heating and includes:¹⁴

- Tax relief for conversion from oil to encourage conversion from oil heating to renewable energy heating;
- More renewable energy with a target to base the entire energy supply on renewable fuels;
- Measures for renewable fuels in the transport sector;
- Research and new knowledge for a renewable society;
- Continued investment in district heating and clear financial incentives for biofuels and environmentally friendly heating where they will be economically advantageous.

A Commission on Oil Independence appointed in late 2005 is assigned to advise the Government in the work to significantly reduce Sweden's dependence on oil and other fossil raw materials by 2020. The Commission is to present a report in the summer of 2006 and to propose a set of priority measures. The Commission is a broad-based expert body, consisting of eight members from research, the business sector and public life, under the leadership of the Prime Minister.

Solutions are seen in replacing oil with biofuels, but also in measures to reduce energy use or to increase energy efficiency. The commission focuses on the transport sector as the greatest consumer of oil products in Sweden, heating of buildings and industry. The Commission's line of reasoning and its proposals are framed by four interacting approaches:

¹⁴ Mona Sahlin, Minister for Sustainable Development, Sweden first to break dependence on oil! New programme presented, Article, Dagens Nyheter, 01 October 2005.

- More resource-efficient technology combined with more sensible use of such technology (e.g. fuel-efficient cars and eco driving, properly adjusted heating boilers, etc.);
- Fuel conversion from oil and fossil fuels to renewable, non-fossil fuels (e.g. ethanol and biogas instead of petrol, wood pellets instead of heating oil);
- Infrastructure development (e.g. public transport, urban planning, system choice in energy policy, etc.).
- Change in behaviour (e.g. better/more careful use of family car journeys, more effective flow in handling of goods, energy awareness in consumption of food and electricity, etc.), including research, education, teaching, studies in popular movements, local energy advisory services.

Energy market liberalisation

Sweden liberalised its electricity market in 1996, opening both electricity supply and electricity production to competition. The Swedish electricity market today is largely integrated with electricity markets in the other Nordic countries, with electricity being traded on the Nord Pool exchange. Since deregulation, significant concentration in the ownership of generation capacity has been observed and in 2004 the three largest energy companies in Sweden accounted for 86% of the country's total electricity production. The network operation, i.e. the transmission of electricity, is a regulated monopoly and tariffs and other terms are monitored by the Energy Markets Inspectorate.

Natural gas trade was liberalised in Sweden with the 2000 Natural Gas Act. The network activities were operated as a legal monopoly with a requirement for third party access, and gas trading could be carried out under competitive conditions.

A new Natural Gas Act and amendment to the Electricity Act were introduced in 2005 in order to bring the legislation in line with EU's electricity and gas market directives. Among the changes are further liberalisation of the market and a requirement for legal separation between network activities and trading.

The electricity and natural gas markets are under the supervision of several regulatory authorities, each with its own sphere of responsibility. These authorities include, besides the Energy Markets Inspectorate, the Swedish Competition Authority, Svenska Kraftnät (the Swedish transmission operator) and the Swedish Consumer Agency. In addition to that, the Swedish Financial Supervisory Authority supervises the Swedish actors on the Nordic Power Exchange, Nord Pool.

Together with the liberalisation of the electricity market in 1996, there is a trend towards more commercial operation of district heating systems. It has contributed to a structural change, where the share of municipality-owned district heating utilities has fallen in relation to the number of privately- and state-owned utilities. The distribution networks are local monopolies. A District Heating Act was proposed in 2005 to improve surveillance of the district heating utilities' activities and to give customers the right to negotiate prices and delivery conditions.

A government bill aiming at strengthening the consumers' position on the energy market was presented in March 2006. The bill proposes changes in both electricity and natural gas legislation, with the aim to facilitate change of energy supplier and to force him to give better information about contracts, prices and other conditions to consumers.

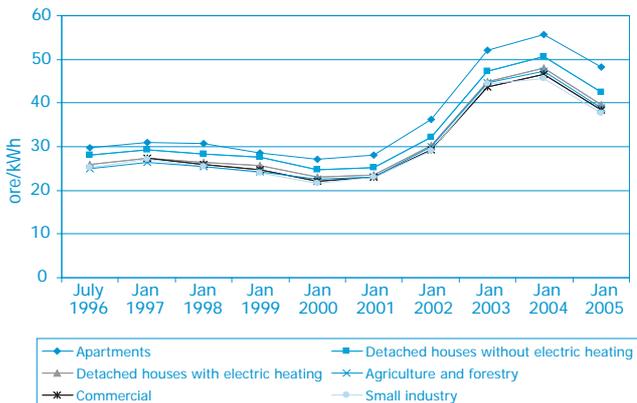
Energy pricing policy

The purpose of the electricity market reform was to introduce increased competition, provide the consumers with greater freedom of choice of supplier and, by open and increased trade in electricity, to create the conditions for efficient pricing. The Energy Markets Inspectorate does not exercise any supervision over electricity trading prices. Electricity is bought and sold on the Nordic electricity market on a competitive basis via bilateral agreements or via Nord Pool. The spot price of electricity varies widely, and is considerably affected by the amount of precipitation as the Nordic electricity supply system is very dependent on the hydro power production in Norway and Sweden.

The price at which electricity suppliers sell to the end-users consists of the price of the electrical energy, the price of green electricity certificates, the network charge and the taxes (energy tax and value-added tax). As of 1st January 2005, the price of the electricity accounted for 36%, the electricity certificate for 3%, the network charge for 19% and tax and value-added tax for 42% of the total electricity price paid by a customer having an electrically-heated house and an open-ended supply contract. The VAT is charged at 25% on the price of electricity, incl. taxes. The first two elements – the price of the electricity and the electricity certificates – can be influenced by the customer by making an active choice of supplier and/or renegotiating the contract.¹⁵

The price of electricity to end-users after 2000 has increased substantially (Figure 3.1 and Table 10.9 in Annex 3).

Figure 3.1. Electricity prices to end users (excluding taxes and network charges)



Source: Based on data in *The Swedish Energy Market 2005*, Swedish Energy Agency, Energy Markets Inspectorate

15. *The Swedish Energy Market 2005*, Swedish Energy Agency, Energy Markets Inspectorate

Energy taxation

Sweden applies a relatively high and active taxation system of both fiscal and environmental character, directed at influencing energy demand and energy-related emissions. There is an energy tax on electricity and fossil fuels, a carbon dioxide tax on fossil fuels, and a sulphur tax is charged on all fossil fuels and peat (Table 10.11 in Annex 3). The total annual revenue from these taxes amounts to about 64.5 billion SEK (6.65 billion Euros). There is also a levy system on NOx emissions.

Figure 3.2 illustrates the taxation policy on energy consumption in Sweden. The energy tax can vary, depending on whether the fuel is being used for heating or as a motor fuel, whether it is being used by industry, domestic consumers or the energy conversion sector and, in the case of electricity, what it is being used for and whether it is being used in northern Sweden or in the rest of the country¹⁷(Table 3.1).

Tax levels for households, the public sector, and district heating are high and they are also providing the highest share of energy related tax revenues. Since the market reform in 1996 the rate of the energy tax for electricity for domestic users has increased with 140% for southern Sweden and 310% for northern Sweden¹⁸ (Table 10.10. in Annex 3).

Table 3.1 Energy taxes in Sweden, excl. VAT, April 2006

Petrol, environmental class 1	SEK 4.990/litre
Diesel, environmental class 1	SEK 3.665/litre
Residential heating oil	SEK 3.362/m ³
Electricity	
- households, services in Norrland	SEK 0.201/kWh
- households, services in the rest of Sweden	SEK 0.261/kWh
- industry, market gardening and agriculture	SEK 0.005/kWh

Source: Ministry of Finance, 14 April 2006, www.sweden.gov.se

The carbon dioxide tax was introduced in 1991 and has increased from the initial rate of 25 öre/kg carbon dioxide to 91 öre/kg carbon dioxide in 2005. This tax was intended particularly to reduce the use of fossil fuels for heat production. For CHP plants, the production of electricity is exempt from the tax, while heat production and heat supplied to manufacturing processes in industry receive a tax reduction of 79%.

Transport fuels petrol and diesel are subject to energy tax, carbon dioxide tax and value added tax (VAT). Based on environmental concerns, the tax rates are high, and taxes comprise more than a half of consumers' price. For petrol, tax (including value-added tax) accounted for 68% of the total price (see Figure 3.2 above).

¹⁷ Taxes and prices are higher in the south because electricity is mainly produced in the north, and the transmission costs are high.

¹⁸ The Swedish Energy market 2005, Swedish Energy Agency, Energy Markets Inspectorate, www.stem.be.

There are substantial tax reductions for industry, based on considerations for sustaining its international competitiveness. Manufacturing industry was excluded from paying energy tax until July 2004. After the implementation of the EU Energy Taxation Directive in Sweden, a minimum required tax rate of 0.5 öre/kWh was introduced on the electricity used in manufacturing, which is about 2% of the tax rate applied to households. Industry is paying only 21% of the carbon dioxide tax and in addition special rules exist for further reduction of the tax for energy intensive industries. The carbon dioxide tax was to be completely eliminated for industrial companies that trade in emission rights. However, the abolition of the tax was postponed until 1 January 2007.

A green tax shift strategy has gradually been implemented in Sweden since 2001. Environmental taxes have been raised while taxes on labour (employers' social security payments) have been lowered. The main aim of green taxation is to link the tax system more closely to environmental concerns and to lead to emission reductions and more efficient energy use. A green tax shift scheme is adopted every year with the Budget Bill. For the period 2001-2005 SEK 13.6 billion have been shifted. Higher energy costs, resulting from the additional tax burden, are neutralised by a decline in the income tax, which mainly benefits low and medium income households. An evaluation has shown that the shift towards green taxation has contributed to lower carbon dioxide emissions and that this has not created any imbalances between different types of households or between regions of the country.¹⁹

The Budget Bill for 2006 announced a tax shift of SEK 3.6 billion (Table 3.2).

Table 3.2 Green Tax Shift 2006 (SEK Million)

	Increase	Reduction
Income tax		-2 500
Payroll tax		-1 100
Vehicle tax on light buses and light lorries	+230	
Output tax on nuclear energy	+1 000	
Tax on electricity used by households and services	+400	
Tax on air tickets	+770	
Tax on gravel	+50	
Tax on landfill waste	+90	
New tax on waste incineration	+860	
Eliminated reduced tax rates for electricity, gas heating and water	+200	
Total	+3 600	+ 200

Source: Ministry for Sustainable Development

¹⁹ Ministry of Sustainable Development, www.sweden.gov.se

4. Environmental policy related to energy

Environmental concerns are traditionally the strong driving forces for the energy policy in Sweden. Fifteen environmental objectives were adopted in 1999 and were further developed with specific targets. Reduced climate impact and clean air are the objectives with most direct link with energy. Another one - a good built environment – includes targets for efficient energy use and energy conservation in local communities and buildings.

The environmental code

Legislation in the environmental field has since 1999 been compiled in the Environmental Code. The Code contains general rules that must be observed in all types of operations and measures. The Code stipulates, for example, that the best possible technology should be used in all industrial operations. It also states that anyone running an operation or implementing a measure should conserve raw materials and energy and that recovery and recycling should be conducted when possible. In the first instance, renewable sources of energy should be used. These regulations on environmental care apply to the extent that their application is reasonable and justifiable. The instruments under the Code include permits and environmental sanction charges. The Environmental Code has an important influence on industry.

Climate strategy

Sweden has developed an active policy to address climate change. Greenhouse gas emissions in Sweden are about 46% due to the energy sector, 30% due to transport, and to a smaller extent due to agriculture, industrial processes and waste. The Climate Policy Bill, approved by Parliament in March 2002, sets the objective of reducing the country's greenhouse gas emissions by 4% as a mean value over the period 2008–2012, in relation to the 1990 levels. This is a more ambitious objective than that required in accordance with the Kyoto Protocol, which in fact permits Sweden to increase its emissions by up to 4%. It was assumed that this emission reduction will be achieved by measures at national level, without having to credit measures carried out in other countries under the terms of the Kyoto Protocol flexible mechanisms or through the use of carbon sinks in the form of forests.

Recently, the Swedish government raised its aspirations in the area of climate change and proposed a medium-term emission reduction target of -25% by 2020, compared with emissions in 1990.²⁰

²⁰ Press release 30 March 2006, Ministry of Sustainable Development, www.sweden.gov.se.

In order to reach the objectives, Sweden's Climate Strategy relies on policy instruments and measures for reducing energy demand and greening energy supply, but also on some instruments more specifically oriented towards the climate in the form of funds to increase awareness of climate change and investment grants for climate measures. In recent years national climate-change policy has been increasingly influenced by the development of EU wide instruments, principally the emissions trading scheme.

Investment programmes

LIP (the local investment programme for ecologically sustainable development) and Klimp (local investment programmes for climate measures) are two government subsidy programmes for municipalities and companies that contribute to reducing greenhouse gas emissions. LIP grants, with up to one-third of the investment cost, and totalling SEK 6.2 billion were made over the period 1998-2002. Around a third of the total funds of LIP were allocated to investments in the energy sector, e.g. in the development of district heating, waste heat and local heating systems.

In 2002, the Local Investment Programme was replaced by the Climate Investment Programme (Klimp), providing grants for local authorities and other parties to make long-term investments in measures intended to reduce the emissions of greenhouse gases, assist restructuring of the energy system or demonstrate new technologies that can contribute towards these objectives. A total of SEK 810 million has been distributed to 47 climate investment programmes from 2003 to 2005. More than 50% has been directed to energy related projects, such as the extension of the district heating net and conversion to bio fuels. 10% has been directed to waste related projects, mainly to the production of biogas. The grants given are estimated to lower the emissions of GHG gases by approximately 365 000 tons of carbon dioxide equivalents per year and lower the use of energy by 570 000 MWh. The Klimp investment programme is to receive a boost of SEK 200 million in 2006 and SEK 320 million a year in 2007-2008.

Kyoto mechanisms

Sweden was very active in the pilot phase of activities implemented jointly (AIJ) in 1997-1999. Later the Swedish state has become a partner in the Testing Ground Facility, a regional fund for climate cooperation under the Kyoto Protocol, established within the framework of the Baltic Sea Region Energy Cooperation (BASREC) agreement. Sweden is also a member of the World Bank Prototype Carbon Fund. Sweden has signed bilateral agreements for JI projects with Romania, Estonia and Bulgaria, and is negotiating an agreement with Russia.

During 2003-2004, Sweden has signed agreements for four CDM projects (3 in Brazil and 1 in India), which are expected to produce emission reductions of 4.3 million tonnes/year of CO₂ equivalents, at a price of about 5 öre/kg of carbon dioxide. This can be compared with the marginal cost of CO₂ reductions in Sweden, in a range of 50-100 öre/kg of CO₂.

Sweden's national allocation plan for emission trading within the EU over the period 2005-2007 was presented in April 2004, and has been approved by the European Commission. The trading sector consists primarily of energy installations like power stations, heating plants, and oil refineries, and also of some energy-intensive industries: iron and steel works, glass works, glass fibre manufacture, cement works and ceramic industries, and pulp and paper mills. In total, nearly 600 Swedish plants participate in the system and this is expected to cover 30% of the total carbon dioxide emissions. This is less than within the EU, where the trading scheme is expected to cover installations equivalent to approximately 50% of emissions. The lower percentage in Sweden is mainly due to the absence of fossil electricity production.

Achievements

The evaluations presented in the 4th National Communication on Climate Change show that Sweden has succeeded to break the link between economic growth and greenhouse gas emissions. Emissions have been decreasing since 1990, while the economic growth has been relatively high, and this is greatly attached to the significant impact of policies and measures introduced.

The largest reductions in emissions were noted in the residential and service sector and in the agricultural and waste sectors, while increases primarily took place in the transport sector. However, the GHG emissions projections for up to 2020 expect that emissions will start to rise again unless more measures are taken.

5. Energy efficiency policies and programmes

Strategic and legal basis

Energy efficiency has been on the political agenda of Sweden for years and has been incorporated in the strategic energy and climate change decisions of the government.

The guidelines for the country's energy policy, set out in the 1997 energy policy agreement, put the efficient use of energy among the priorities of Sweden's energy policy. The 1997 energy policy decision also included support for more efficient use of energy through information, technical procurement, municipal energy advisers and the labelling of high-consumption equipment. In addition, the decision opened for grants for measures designed to reduce the use of electricity – for example for the expansion of district heating, the conversion of electrically-heated buildings and investments in solar energy.

The guidelines were confirmed in 2002, when the Parliament adopted a new strategic Energy Bill 'Working Together for Reliable, Efficient and Environmentally Aware Energy Supply'. The new Bill put a strong emphasis on measures to improve the efficiency of energy use, such as energy advisory services, technology procurement projects and market introduction of energy efficient technologies.

The key strategic decisions of Sweden's government which affect the country's energy efficiency policy are:

- The requirement for a certain, although not quantified, degree of self-sufficiency in power generation;
- The decision to phase out nuclear power and replace lost nuclear capacity with renewable energy and energy efficiency measures;
- The environmental limits to the further development of hydro power resources;
- The Climate Strategy, approved in 2002 and the commitment to reduce greenhouse gas emissions in line with the Kyoto Protocol strengthened with higher targets;
- The new 2005 programme for breaking Sweden's dependence on oil, where measures to increase energy efficiency and to promote the development of district heating are considered important tools.

However, there is no specific framework strategy or law on energy efficiency. The legal framework for energy efficiency is mainly defined by the Planning and Building Act (1987) and the Environmental Act (1998), respectively the Environmental Code. The Planning and Building Act provides the legal basis for the Building Code, which includes energy efficiency requirements for buildings. An ambitious code was implemented at the end of the 1970s and has since then gone through some revisions. At present, and in relation to the EU Directive on Energy Performance of Buildings, the Building Code is being revised. The Environmental Code contains some provisions which relate to energy management in industry.

The energy efficiency policy of Sweden is also driven by the EU. For example, the Framework Directive on the Energy Labelling of Household Products has been implemented through regulations of the Swedish Consumer Agency.

A new Government Bill of March 2006 proposed the necessary changes of the Swedish legislation for energy certification of buildings in order to fulfil the EU Directive on Energy Performance of Buildings. The Directive will be fully implemented by January 2009 and will be mainly administered by the National Board for Housing, Building and Planning.

The legislation for certification of origin in connection with the Cogeneration Directive will enter into force during 2006.

A Commission of Inquiry for implementation of the Energy Services Directive is planned to be set up. The Swedish Energy Agency is assigned to set the baseline for calculating the savings, calculate the national goal, suggest primary energy factors, and evaluate the quantitative effects of earlier measures.

The preparation for the implementation of the Ecodesign Directive is planned to start before the end of 2006.

Programmes

There are a number of energy efficiency programmes and projects currently running in Sweden, most of them focused on specific end-use subsectors. A programme with strategic character and wide scale is the [2002 Energy Policy Programme for Efficient Energy Use](#) (2003-2007), emerging from the 2002 energy policy bill and administered by the Swedish Energy Agency. The programme includes:

- Strengthening of the municipal energy advisory services to have municipal energy advisers in all 290 Swedish municipalities, complemented with 13 regional energy offices (about 100 MSEK/year);
- Information, education and methodology development (about 30 MSEK/year);
- Support for technology procurement and market introduction of energy efficient technology (about 60 MSEK/year);
- Testing, labelling and certification of energy using appliances (about 11 MSEK/year).

The [Energy Efficiency Investment Programme for Public Buildings](#) (2005-2007) is administered by the counties' administrative boards and the National Board of Housing, Building and Planning (Boverket). This programme has a budget of 2 billion SEK and approximately 600 MSEK were granted the first year. Under the programme, 30% support is provided to public buildings for "energy mapping", energy saving measures and conversion from electricity or fossil fuelled heating to renewable energy sources and district heating. There is a limit of maximum 10 MSEK per building. The programme also provides 70% support for installation of PV systems (maximum 5 MSEK per building).

The [Sustainable Municipality Programme](#) is a five-year programme, which was launched in 2003 with the objective to support the energy restructuring and to build sustainable and effective energy systems on the local level. Five municipalities, representing different

“type municipalities” and having suitable conditions for good co-operation with local business and industry, participate in the programme. More efficient use of energy is also included among other development objectives. The Swedish Energy Agency contributes with research grants, environmental scanning, basic data and method support, as well as participating in the municipalities’ efforts in the area of energy. Apart from these contributions no other particular economic support is given. The objective is to be in a position to replicate the programme in the rest of the municipalities in Sweden without being dependent on state grants.

The [Programme for Energy Efficiency in Energy Intensive Industry](#) (PFE) is a five-year voluntary programme, which started in January 2005 and is supervised by the Swedish Energy Agency in cooperation with the Swedish Tax Agency and a programme council, representing the industries. The programme is based on the voluntary participation of companies, who have the financial resources to implement the measures required by the programme. By joining the programme companies commit themselves to:

- Implement energy management systems;
- Make a profound analysis of their energy use;
- Make investments in energy efficiency, related to their electricity use, with a payback period of maximum 3 years.

Participating companies, which implement these requirements, get exempted from the electricity tax, introduced in 2004. The Programme is aimed at manufacturing industries, which use electricity in their processes and are energy intensive according to an adopted definition.

The Programme has attracted a large number of applicant companies (126), mainly from the most energy consuming industry, pulp and paper (47 companies), but also from the mineral industry and steel and other metals, food industry and wood products. These companies consume more than a half of the energy used in the industrial sector.²¹ The energy audits and management systems required in the programme provide good opportunities to identify and implement measures that improve energy efficiency. Participating companies, which fail to fulfil the commitments, should pay back the tax reductions received.

The programme [Investment support for conversion from direct electricity and oil heating to district heating, bioenergy, heat pumps and solar heating](#) is a five-year programme started in 2006. It has a budget of SEK 2 billion and support is provided as a subsidy. The programme is implemented by the counties’ administrative boards and the National Board of Housing, Building and Planning (Boverket).

A Government Bill for a [National Programme for Energy Efficiency and “Energy Smart” Buildings](#) was presented for approval by Parliament in March 2006. The Programme focuses on energy efficiency in buildings and complements existing energy efficiency measures. A new ambitious quantitative target for reduction of the total specific energy use per heated area is proposed for existing residential buildings and other premises: 20% by 2020 and 50% by 2050, compared with 1995. By 2020 the dependency on fossil fuels should be broken and the share of renewable energy should increase continuously.

²¹ *The first year with PFE, 2005 Report on the Programme for improving energy efficiency in industry, Swedish Energy Agency.*

The Programme requires governmental agencies and property companies to act as “good examples”. Governmental agencies should also choose energy efficient alternatives when purchasing energy using appliances. The National Board of Housing, Building and Planning is assigned to strengthen the Building Code regarding energy use and in particular when electricity is used for heating. Energy efficiency requirements should be applied to larger renovation of buildings. The programme also includes requirements for combining the existing mandatory control of ventilation systems in buildings with advice on energy efficiency measures; for studying the feasibility of individual measurements of electricity and domestic hot water consumption in multifamily buildings; and for more intensified effort for R&D for buildings. The programme also includes an energy efficiency campaign coordinated with the implementation of the European Directive on Energy Performance of Buildings.

Policy instruments and measures

Energy taxation

The taxation policy in force in Sweden is considered to be one of the most important instruments for improving energy efficiency. Tax rates are high and widely differentiated (see section Energy Taxation). Taxes are mainly applied at the point of consumption. The effect of energy taxation can be seen in the reduced consumption of the residential sector although the floor area and the population are rising.

There are also some programmes that apply tax reduction incentives, e.g. the tax reduction, introduced for 2004–2006 to house owners to fit high-performance windows in existing houses or to install a biofuel-fired heating system in new houses.

Exemption from the energy tax on electricity is the main instrument in the Programme for Energy Efficiency in Energy Intensive Industry. Although the tax rate for industry is not high, it is a heavy burden for the energy intensive manufacturing industries, and this justifies the interest of many companies in the programme.

Technology procurement

Sweden is a pioneer in designing and implementing technology procurement to support the market penetration of new energy efficient technologies. This has been a widely applied measure in Sweden in the fields of heating and control systems, domestic hot water and sanitary systems, ventilation, white goods, and lighting. Since the 1990s, 55 technology procurement projects have been initiated and partly (50%) financed by the state. SEK 377 million was paid out over the period 1998-2002 for energy technology procurements.

The 2002 energy policy programme emphasised the significance of technology procurement for market opening and dissemination of energy efficient technologies. Current technology procurements include demand-controlled ventilation in new

apartment buildings, control and monitoring systems for properties, climate screen-integrated systems for solar shading and daylight penetration, industry-standardised information in the sawmill industry, and biogas-powered and hybrid vehicles.

A typical example is the development through technology procurement of new energy-efficient water mixers, jointly conducted by the Swedish Energy Agency and the City of Stockholm's Office for the Local Investment Programmes (LIP). The technology procurement began in 2000, and the winning mixer was announced in 2003. A purchasers' group of organizations and companies was involved in the procurement, and will be using the new mixers for domestic hot water.

Public procurement

The 2002 energy policy programme included public procurement as an instrument to increase energy efficiency in the public sector. Specific requirements and tools for energy efficient procurement were developed, along with dissemination of information. Efforts were made to strengthen public purchasers' competence with regard to energy efficient procurement. The review of the programme indicated that energy efficiency criteria still has not been given sufficient priority in public procurement, although the potential for increased energy efficiency is high. In addition, further direct efforts in this field are needed in the context of the EU directives on public procurement, on energy end-use efficiency and energy services, and also the ecodesign directive.

Mandatory energy labeling

Mandatory energy labelling of domestic appliances in Sweden was introduced following the EU directives. The labelling covers lamps, ovens, refrigerators, freezers, washing machines, tumble-dryers and dishwashers. The Swedish Consumer Agency estimates that this labelling has contributed to a 25-35% drop in the average energy consumption of new domestic appliances since it was introduced. The labelling has also contributed towards the disappearance from the market of the appliances having worst energy performance.²²

Recent developments of testing, labelling and certification aim to include other energy using equipment than household appliances and to facilitate the implementation of the EU ecodesign directive.

Requirement for information about fuel consumption, carbon dioxide emissions, and environmental classification of new cars was introduced to implement the automotive industry's voluntary agreement on lower fuel consumption in new cars.

²² Sweden's Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change, Ministry of Sustainable Development, Sweden 2005..

Subsidies and grants

Governmental support in the form of subsidies and grants has been widely used in Sweden. A limited-time investment subsidy for certain environmental and energy investments in public buildings was introduced with the Energy Efficiency Programme for Public Buildings. The programme is providing support in the form of a grant.

Various forms of public subsidies have been provided for the expansion of district heating for many years. Grants have, for example, been given for linking smaller networks together, for investments in bio-fuelled CHP or for the connection of detached houses to district heating systems. A substantial part of the funding under the Climate Investment Programme public subsidy scheme was granted for investment projects in the field of district heating and local area heating (e.g. 30% of SEK 500 million that were granted under the scheme in 2004).²³ This support influenced the substantial expansion of DH in the country. The 2006 programme managed by Boverket also provides investment support for conversion to district and green heating and reduction of electricity and oil use for heating.

The on-going Sustainable Municipality five-year programme for local energy measures, launched in 2003, provides support to five pilot municipalities with research grants, in addition to environmental scanning, basic data and methodological support.

Information and advice

Information and creating awareness are elements of all programmes and are also applied in specific campaigns. The Swedish Energy Agency is a central provider of energy information using many different channels and working with a large number of different parties in order to ensure that information reaches the target groups. An important tool is the Agency's website. Some larger, special-themed campaigns are also run, e.g. the 'Domestic heating' travelling information campaign.

Information activities aimed at improving awareness of energy efficiency improvements in industry are implemented through such ways as the development of energy auditing systems and environmental management systems. For example, through the energy management systems and energy audits that make up the PFE programme, companies are improving their awareness of their potential for cost-efficient energy efficiency improvements.

A running project on improving the information and statistics of energy use in the built environment aims to improve knowledge of this area. The project initiated in 2003 includes energy inspection of 1000 non-residential buildings (offices, schools, shops, hospitals, hotels, etc.) and monitoring of electricity use in 400 households in 6 years.

²³ *The Swedish Energy Market 2005, Swedish Energy Agency, Energy Markets Inspectorate, www.stem.se.*

At local level, the energy advisers created in 1998 play an important part in bringing information to the general public and businesses, including small and medium companies and industries. The consultancy provided to consumers involves areas such as energy, technology and consumer guidance. Priority is given to efforts to make the use of energy more efficient. The consumers do not pay for the services received.

The competence of the energy advisers has been achieved by in-service training and exchange of experience, supported by the Swedish Energy Agency and the regional energy agencies. Funding for energy advisory services is provided from the state budget channelled through the Swedish Energy Agency. The funding is made to municipalities where the size of the funding and the number of energy advisers depend on the number of inhabitants. The energy advisers are selected and employed by the municipalities, but they cannot provide services to the municipal departments or companies. There are about 250 energy advisors currently in Sweden, not all of them working full time. The local advisers provide desk advice only and do not do inspections.

The municipal energy advisory service has evolved in a constructive way. The follow-ups indicate that more and more people are aware of the advisory service and that people also know that they can make use of the advisory service to obtain information about investments in energy consuming equipment and appliances.²⁴ Local energy advisers collaborate in a common network and have an Association of Energy Advisers.

R&D

Energy research is considered a vital part of the transformation of the Swedish energy system into an ecological and economically sustainable system. A long-term energy research programme has been running for a period of seven years up to the end of 2004.

In 2005, the Parliament decided on the new long-term programme concentrating on research, development and demonstration activities. The new programme expanded the objectives of the previous programme, and put increased emphasis on efforts intended to convert the results of energy related research and development activities to commercial products.

The research is grouped in six theme areas: Energy System Studies, Fuel-based Energy Systems, Transport, the Power System, Energy-intensive Industry and the Built Environment. Three of these theme areas refer to energy efficiency.

The energy use in the built environment research theme aims at achieving substantial improvements in the efficiency of specific energy use for heating, domestic hot water and building services systems. Work in the field of building services systems is concentrated on several different technology areas, such as small-scale combustion of biomass fuels, district heating and district cooling, heat pumps, solar heating and buildings as energy

²⁴ *Review of the activities for efficient use of energy within the National Energy Policy Programme 2002, A summary of the report by Carl Bro Energy Consultants on assignment by the Ministry of Sustainable Development, February 2006*

systems. The objectives in this area of research are by 2020 to have reduced energy consumption in new buildings by 25%, in old buildings by 10%, to replace 60% of the oil used in buildings by renewables, and to reduce electricity use by 15%.

The Swedish Energy Agency has the principal and coordinating responsibility for energy-related building research. The Agency finances projects in this sector together with the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning. The Swedish Consumer Agency, the Swedish National Board of Housing, Building and Planning and the Swedish Environmental Protection Agency also have energy-related undertakings in the building sector.

The energy-intensive industry theme area gives priority to improvements in the efficiency of energy use, particularly for energy-intensive process stages in the pulp and paper and the steel industries. The Swedish Energy Agency seeks to improve cooperation between the research sector and industry. Industrial organisations and research institutes have an important role in this context.

The transport theme area includes research and development of biobased motor fuels, combustion engines and electrical drive systems. In the longer term, improvements in combustion engines and electrical drive systems should result in substantial reductions in the fuel consumption of cars and of heavier vehicles.

In spring 2006 the Government presented a bill with long-term guidelines for the continuing energy RD&D program. The focus of the bill is on research, development, demonstration and commercialization activities to develop technologies and processes needed for the long-term transition to a sustainable energy system. The program is to be evaluated after 4 years.

Energy efficiency financing

Funding of energy efficiency programs in Sweden is mostly by government grants. Recently tax rebates for specific energy related measures have been adopted.

Sweden allocates substantial budget funds for the promotion of energy efficiency and renewable energy. Table 5.1 below indicates the state funding of some of the most important programmes, including the proposed increase in the funding for the Climate investment programme and the resources earmarked for energy research.

In many cases these funds are used to leverage financial sources from the consumers. Under the programme for public buildings the funds provide only 30% of the total cost of approved energy saving projects, whereas they cover 70% of the cost of installation of solar cells. The funding for research is matched with equal amounts of resources from industry.

Funding for research is greatly concentrated in industry, bioenergy/CHP and electricity generation, while the resources for building research seem not to be corresponding to the importance attached to improving energy efficiency in this area.

Table 5.1 State funding for some of the energy efficiency and renewable energy programmes

Programmes	Timeframe	Budget
2002 Energy policy programme for efficient energy use	2003-2007	1 billion SEK
Energy efficiency investment programme for public buildings	2005-2007	2 billion SEK
Investment support for conversion from direct electricity and oil heating, bioenergy, heat pumps and solar heating	2006-2010	2 billion SEK
Energy Research & Development	2004-2008	5.3 billion SEK
Local Investment programme (LIP) ²⁵	1998-2002	6.2 billion SEK
Climate Investmet programme (Klimp) ²⁶	2003-2008	1.3 billion SEK
Energy technology procurements	1998-2002	0.4 billion SEK

Source: Ministry of Sustainable Development

An example of funding through tax reductions and exemptions are the tax deductions on installation of energy efficient windows in small dwellings, provided in 2004-2006 and amounting to approximately 50 MSEK/year. Another example is the Programme for Energy Efficiency in Energy Intensive Industry. This programme requires that participating companies invest at least the amount of the tax reduction they receive. In this way, company investments in measures to reduce energy use are stimulated. The tax reduction for the currently participating 126 companies totals SEK 147 million per year.

Monitoring and evaluation

Monitoring and evaluation of energy efficiency programmes are important for both timely alterations, and also for further follow-up. Although there is no established system, such practice already exists in Sweden.

In 2003 an evaluation of the 1997 energy strategy was held, on the basis of which the government proposed that a broader long-term energy policy programme should be run for seven years, from 2005 to 2011. The evaluation was done a year after the start of the 2002 Energy Policy Programme for Efficient Energy Use.

The 2002 Programme passed through a mid-term evaluation in December 2005 - February 2006, i.e. two years before completion. The evaluation was done by external consultants appointed by the Ministry of Sustainable Development. The review aimed at providing a basis for possible changes for the remainder of the programme period and

²⁵ As was mentioned before, only about a third of the funding under this programme was directed to investments in the energy sector.

²⁶ More than 50% of the funds so far were directed to energy related projects.

for decisions concerning a new programme period. However timely this review was, it was done after the government adopted new policy targets in the energy area relying on energy efficiency and renewables.

A similar external evaluation of the Energy Efficiency Investment Programme for Public Buildings will be done in 2006.

Yearly general energy indicators reports are prepared and presented by the Swedish Energy Agency. The Agency also reports to the government on activities in various areas in collaboration with the regional energy offices and the local energy advisers.

Periodical and structured evaluation of energy related policies is done in connection with the National Communications under the climate convention. The latest communication was published recently, together with the Swedish report on demonstrable progress under the Kyoto Protocol.

The regular reviews of energy efficiency policies Sweden presented under PEEREA can also be considered an important monitoring and evaluation effort.

6. Organisation of energy efficiency activities

In line with its overall tasks and objectives on sustainable development and the energy and climate change policy, the Ministry of Sustainable Development is responsible for the energy efficiency and renewable energy policy of the government.

A practice in the country is to appoint special commissions ("committees of inquiry") to analyse specific issues and put forward proposals for decisions to the government. A number of such commissions were established in 2003: Electricity and Gas Market Commission, District Heating Commission, Renewable Motor Fuels Commission, Energy Performance of Building Commission, Building Declaration Commission, Commission on Energy Research, Development and Demonstration.

The Energy Performance of Building Commission was charged with putting forward proposals for implementation of the Energy Performance of Buildings Directive in Sweden. Building Declaration Commission was to produce a proposal for the methods and the organisation of the energy declarations of buildings.

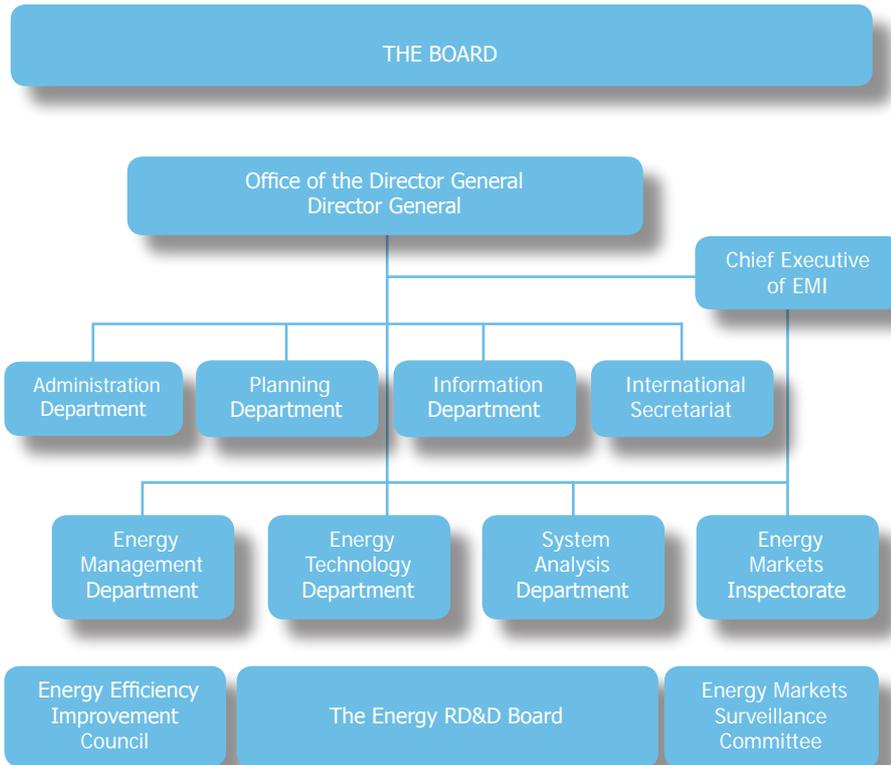
The Commission on Oil Independence appointed lately and earlier mentioned is assigned to provide the government with advice on the priority measures to significantly reduce Sweden's dependence on oil and other fossil raw materials by 2020.

The Commissions are broad-based expert bodies, working in a transparent way, using a number of different methods: public hearings, public website, specific inquiries, meetings with interested parties, and internal discussions.

The Swedish Energy Agency is responsible for the implementation of energy efficiency policy programmes and measures in the residential, services and industry sectors. The Agency maintains comprehensive research funding for raising the efficiency of energy use in Sweden. It is responsible for the implementation of a number of ongoing programmes, e.g. the programme for improving energy efficiency in energy-intensive industries (PFE) and the Sustainable Municipality programme. The Agency supports local energy advisers and the regional energy agencies with information and financial assistance, and also contributes to their networking. Under the Local Authority Energy Planning Act, the Energy Agency is the supervisory body for local energy planning. The Agency also provides support for technology procurement and market introductions of energy efficient technologies, and support for market introductions of wind energy. The green certificates program is also managed by the Agency as well as reports and advice to the ministry. In addition, the Energy Agency shares responsibility with the Swedish Environmental Protection Agency on climate related programmes, particularly the implementation of the European Emissions Trading Scheme.

The Agency has a staff of 250, including 60 positions in the Energy Market Inspectorate.

Figure 6.1 Organisational chart of the Swedish Energy Agency



The Swedish Environmental Protection Agency (EPA) is a central environmental authority under the Ministry of Sustainable Development with main tasks to co-ordinate and to promote environmental work on both national and international level. EPA's work includes pursuing development towards more sustainable patterns of production and consumption and more efficient energy use and transport. The Agency is responsible for state support of local investment programmes (LIP) and climate investment programmes (Klimp).

The National Board of Housing, Building and Planning (Boverkett) is the central government authority for planning, management of land and water resources, urban development, building and housing under the Ministry of Sustainable Development. Boverkett is responsible for the building code and financial instruments in relation to buildings. It also provides information to those engaged in planning, housing, construction and building inspection activities. Boverkett is coordinating some of the energy efficiency programmes and projects in the building sector, and is the main agency responsible for the implementation of the European Directive on Energy Performance of Buildings.

Other agencies with roles in the national energy efficiency policy implementation are:

- The Swedish Consumer Agency, responsible for some information measures regarding house-hold-equipment etc.
- The Swedish Governmental Agency for Innovation Systems is responsible for energy-related transport research. The transport authorities (Vägverket, Sjöfartsverket, Luftfartsverket, Banverket) have responsibilities within their sectors to promote efficient use of energy.

Local authorities have an important role in energy efficiency policy, as they are taking care of many day-to-day aspects of life, including energy, environment, housing and transport. All local authorities must ensure their energy supplies at the same time as promoting energy conservation. Since 1977 they are legally obliged to promote the efficient use of energy in their planning. There are municipal authorities with ambitious activities in energy efficiency and renewable energy.

Regional energy agencies have been formed by means of collaboration between county administrative boards, local authorities and their associations, and business. Most energy agencies were set up under the EU SAVE Programme and received financial contributions from the EU for the first three years, but following this their activities were financed from membership fees paid by municipalities and project financing by the Swedish Energy Agency and EU programmes. There are at present 13 regional energy agencies in Sweden. Their activities aim at increasing the use of renewable energy and to promote more efficient use of energy within the region. They also act as hubs for the municipal energy advisors. The energy agencies are part of a European network and have associated offices in other EU countries. The Swedish energy agencies have a joint association, the Association of Swedish Regional Energy Agencies.

A number of professional and trade associations are carrying out activities for energy efficiency and renewable energy, most important among them are the following:

- Swedenergy, the Swedish Association of Electricity companies carries out programmes and projects for utilisation of renewables and for efficient electricity end use through its R&D company Elforsk.
- The Swedish District Heating Association, founded in 1949 and having 167 members, is promoting district heating, district cooling and cogeneration for the benefit of Swedish district heating companies and their customers.
- SweHeat, the Swedish Council for District Heating, is established by leading companies and organizations for international cooperation in the district heating sector. Members of SweHeat are owners and operators of district heating systems, R&D organisations, consultants, and suppliers of equipment covering the whole range of district heating technology. SweHeat works for promoting district heating and CHP, and using renewable energy sources for their operation. SweHeat members have completed a large number of energy efficiency projects in Sweden and internationally.
- SABO - the Swedish Association of Municipal Housing Companies - is the biggest organization on the Swedish housing market. The approximately 300 member companies manage some 830 000 dwelling units. This is 20% of the total housing stock in Sweden and about one third of all dwelling units in multi-storey houses.

- The Swedish Property Federation is an interest organisation and trade association of Sweden's 7 regional property associations. The associations are owners of apartment rental buildings, industrial properties and tenant owners' associations. The association takes care of management of properties, provides advice, and offers favourable terms in connection with the purchase of oil, white consumer goods, etc.
- The Eco-Cycle Council, a NGO of the Swedish building sector (a network consisting of some forty branch organisations within the field of building and property) has developed "The Environmental Programme for the Building Sector". The programme contains environmental goals for energy conservation, economising with building materials, gradual decrease of hazardous substances, and encouragement of sound indoor environments.
- Swedish Wind Energy Technology Group, Swedish Bioenergy association, Swedish Bioenergy Group and others are specialised in promoting different types of renewable energy.

7. Renewable energy policy

Since the 1990s, Sweden has operated several systems for supporting electricity production from renewable energy sources. Investment grants have been provided, for example, for electricity production from biomass, wind power and small-scale hydro power, while production subsidies have been paid for electricity from wind power plants. The country also has a number of voluntary systems, but the Swedish Energy Agency has established that the voluntary systems have not succeeded in encouraging an expansion of renewable electricity production to the extent desirable. The various investment and operational subsidies are being progressively phased out and replaced by market-based systems.²⁷

Currently, different types of economic incentives are used in Sweden to promote renewable energy: CO₂ tax and tax exemptions, green certificates, tax deductions, and subsidies and grants.

Green certificates system

The system of electricity certificates was introduced in Sweden in May 2003 as part of the process of transferring support schemes from the State to the market. The purpose of the system was to increase the amount of electricity supplied by renewable energy sources by 10 TWh/year between 2001 and 2010, excluding existing large scale hydro power. Electricity produced from wind power, solar energy, geothermal energy, wave energy, peat, certain biofuels and certain hydro power is entitled to certificates. All electricity users are required to buy certificates corresponding to a certain share of their electricity use, starting with 8.1% in 2004. This share will be increased every year to reach 16.9% in 2010. In practice, the obligation is assumed by the energy supplier. Electricity-intensive industries are exempted from the quota obligation under the electricity certificate system.

The Swedish Energy Agency and Svenska Kraftnät are responsible for administration and operation of the electricity certificate system. 10 million electricity certificates have been sold in 2004, the first year of the system. Biofuel-fired electricity generation accounted for approximately 73% of the electricity certificates issued, hydro power for approximately 19% and wind power for just over 8%. The aggregated number of green certificates reached 30 million in January 2006 and the green electricity produced in 2005, excluding big hydro, amounted to 11.3 TWh.

During 2004 a review of the electricity certificate system was carried out, on the basis of which the Ministry of Sustainable Development in spring 2006 issued a proposal for extension of the timeframe for green certificates until 2030 and a higher target share of renewables in electricity generation. The government is targeting at 17 TWh by 2016, which means a stronger ambition compared to the former target of 10 TWh by 2010. The new legislation should be applied from January 2007.

²⁷ *The Swedish Energy Market 2005, Swedish Energy Agency, Energy Markets Inspectorate.*

An expansion of the electricity certificate trading system to incorporate Norway has been discussed as leading to more economically efficient renewables support, but the discussions have not yet been concluded.

Environmental subsidies and grants

Wind energy is a priority for Sweden's government and a targeted support in the form of an environmental subsidy for wind power generation is complementing the green certificates system. The subsidy is highest for offshore wind power production. It was intended to progressively phase out the subsidy by 2009, but a later decision extended it by five years from 2008. The amount allocated is SEK 70 million a year.²⁸ Additional SEK 30 million per year will be allocated to expanding wind power in 2007 and 2008.²⁹

In a government bill presented in March 2006, the Swedish government is proposing the following actions to promote wind power, offshore and onshore:

- Tax reduction for wind power plants (real estate tax);
- Establishment of a national center for wind power;
- A pilot project support of 37 million Euros for areas with good wind power capacity;
- A new planning target;
- Grid inquiry to find actions to promote wind power.

Funding support for promoting renewable energy is provided by the Climate Investment Programme. Also, for some time special funding support has been available to libraries, public swimming baths and hospitals that become more fuel efficient by converting to renewable energy. An investment support scheme for solar heating is available for homeowners since 2000.

Programmes providing subsidies and grants to end-users for promotion of renewable energy are very often integrated with energy efficiency measures. These programmes were discussed in Chapter 5.

Tax reduction for transport biofuels

The Climate Bill of 2002 included a strategy for carbon dioxide-neutral transport biofuels and the introduction of green cars with the main aim of increasing the use of transport biofuels. The strategy was based on tax relief for biofuels, combined with governmental procurement and municipal incentive programmes for environmental friendly vehicles. The strategy was a means of implementing the EU directive on the use of biofuels or other renewable fuels for transport, although in Sweden policy instruments designed to encourage the introduction of biofuels were partly in place before the directive was adopted.

²⁸ *Energy in Sweden 2005, Swedish Energy Agency, 2006.*

²⁹ *The 2006 Spring Budget: Focusing on the elderly, young people, new jobs and integration, Press release, 18 April 2006, Ministry of Finance.*

Since 2004, carbon dioxide-neutral transport biofuels have been exempt from taxation in Sweden. This exemption will apply, under the current decision, until the end of 2008.

A target was adopted that 3% of the energy used in transport in 2005 should consist of biofuels, and the 5.75% target stipulated in the EU's directive on the promotion of biofuels should be achieved by 2010. In 2003, the oil companies began to mix ethanol into petrol on a large scale, which has quickly led to a situation where almost all petrol sold in Sweden now contains 5% ethanol and the share of biofuels in total transportation fuel use has increased from 0.7% in 2002 to 2% in 2004. There was a further increase in 2005.³⁰

The policy incentives have brought a rapid increase of the number of so-called green cars. The number of new green cars in 2004 amounted to 7 000, i.e. approximately 2.5% of all the new cars.

A government bill from March 2006 proposes tax reductions for environmental-friendly vehicles to be introduced in 2006 for both light and heavy vehicles. It is also planned to introduce a carbon dioxide-related vehicle tax during 2006.

Taxation of heating fuels

The increased energy tax in the 1970s led to a reduction in the use of oil for heating. However, it was the introduction of the CO₂ tax in 1991 that has resulted in a substantial increase in the share of renewable energy, primarily biomass and waste energy used in district heating systems (Fig. 7.1). These changes have resulted in 2-3% annual reductions of emissions, although heating demand has increased.³¹ Carbon dioxide taxation also stimulated combined heat and power production.

Taxation on consumption is also giving incentives for using renewables. In 2004, the taxes on gas oil for house heating accounted for 62% of the total cost, compared to only 20% of the cost of heating with wood.³²

Cogeneration and district heating

Sweden has a long standing policy favouring district heating opening possibilities to use energy which otherwise would have been wasted. Support has in recent years been given to connecting buildings to district heating and to interconnecting small district heating networks. District heating by covering 50% of the heat market has a dominant position in Swedish space heating. It is the main form of heating in the urban centres of 232 of the country's 290 municipalities. The number of district heating companies is around 200, 67% being owned by municipalities. District heating companies are increasingly being privatised, often by being sold to power utilities.

³⁰ *The Swedish Report on Demonstrable Progress under the Kyoto Protocol, Ministry of Sustainable Development, Sweden, 2005.*

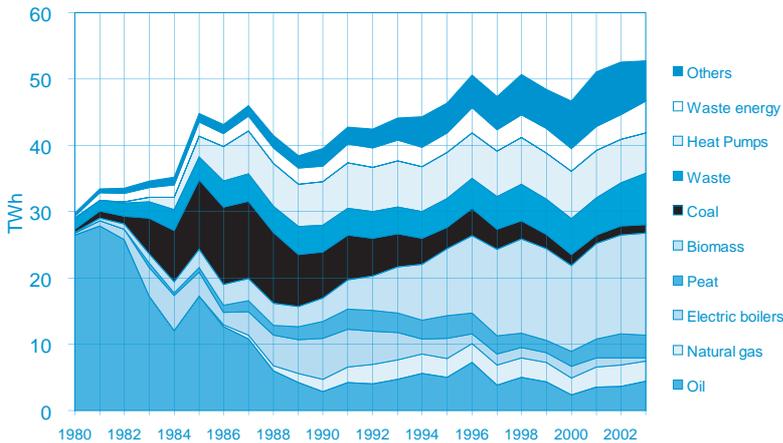
³¹ *Sweden's fourth national communication on climate change, Ministry of Sustainable Development, Sweden, 2005.*

³² *Energy in Sweden 2005, Swedish Energy Agency.*

Combined heat and power (CHP) is supplying less than 40% of the district heating systems, being below the average in other countries with well developed district heating systems. The introduction of green certificates, as well as the implementation of the EU CHP Directive is expected to increase the share of CHP in district heating.

One of the successes of the district heating sector is related to the use of biomass fuels and waste in the energy mix (Fig. 7.1), due to the taxation policy described above.

Figure 7.1 Fuel/energy used for District Heating in Sweden 1980 to 2003



Source: Swedish District Heating Association

Until now the district heating sector was not covered by regulatory provisions. However, increases in district heating prices over the last five years with an average of 30%, have triggered a new District Heating Act which will regulate the sector. The Energy Market Inspectorate is envisaged to introduce benchmarking of prices and better information of customers.

Research and development

The new long-term programme for research, development and demonstration activities, introduced in the 2005 Budget Bill (see Chapter 5), gives a prominent role to renewable energy. Three of its five theme areas refer entirely to renewables.

The fuel-based energy systems research theme area concentrates on research and development of sustainable biomass fuel production and energy conversion, with the main emphasis on biomass-based systems. Research in this area is intended to result in reduced production costs and to utilising a greater proportion of the overall production potential. Sweden is one of the world's leading countries in the production and use of forest-based fuels, such as wood pellets.

The transport theme area includes research and development of biobased motor fuels. Prioritised work includes pilot plants for making ethanol from forestry raw materials, black liquor gasification and biomass gasification.

The power system theme area includes hydro power, wind power, solar cells, wave power, power transmission and energy storage. For hydro power, the goal is to accumulate and maintain the expertise necessary to ensure that an efficient and reliable hydro power remains an important part of Sweden's energy supply, and also to secure future modernisation of existing hydro power plants. Research into wind power is aimed at increasing wind power production, and for reducing its cost. Research and development in the field of solar cells are concentrated on thin film solar cells and nano-structured cells, as well as on integration, installation and use in buildings. There is also research in the area of power transmission and energy storage systems.

8. Assessment of Progress

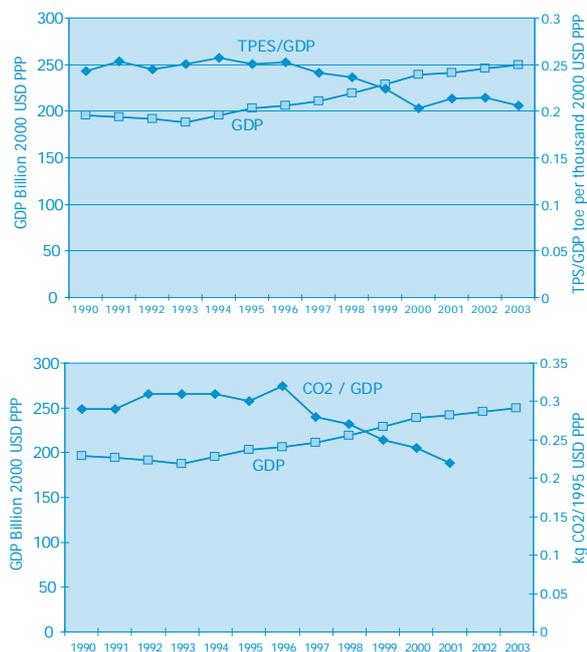
Energy efficiency legislation, policies, and programmes

Sweden has identified energy efficiency and renewable energy as national priorities and has integrated them into its energy and environmental policies, driven by the vision for sustainable development of the country as a green welfare state.

The energy intensity during the last decade is declining on the background of a steady GDP growth and moderate rise of energy consumption in part because of the national energy efficiency policies (Figure 8.1).

Sweden has also achieved substantial progress in decoupling carbon dioxide emissions from economic growth which is to a large extent caused by the impact of implemented policies and measures.

Figure 8.1 GDP Growth, Energy Intensity and CO₂ emissions



The ambition of the Government of Sweden is to substantially reduce fossil fuel use and also to phase out nuclear power, currently accounting for an important share of the country's electricity production. A number of legislative initiatives and programmes have been started:

- A national programme aiming at reducing oil dependence to the maximum extent possible;
- Legislation in progress on energy efficiency and implementation of related EU directives;
- Governmental decision on high voluntary target for reducing emissions of GHG gases (-25%);
- Draft legislation on renewables, setting a high target share of green electricity.

These ambitious government policies aims at exploiting the existing potential for increasing energy efficiency in all sectors and the potential for increased use of renewable energy. Still, there is a need for careful analysis of the economic costs of the achieving the objectives and the compatibility of the quantitative targets. There are also political and environmental constraints on increasing small scale hydro power.

Monitoring and evaluation of the programmes are undertaken by the government, but it seems that a better coordination of the evaluation efforts could be beneficial. The experience and lessons learnt can support the setting of feasible new targets and contribute to the structuring and successful implementation of new programmes.

Energy markets and pricing

Sweden liberalised its energy markets in 1996. A success is the integration of the Swedish electricity market with the electricity markets in the other Nordic countries and the functioning of the Nord Pool. Electricity consumers are making use of the market liberalisation and more than 50% of them have changed supplier or re-negotiated their contracts.

The conditions on the district heating market, with local distribution monopolies and limited customer mobility, together with a relatively wide spread of prices between companies, has questioned the well-functioning of this market. The proposed District Heating Act should improve the customer protection together with regulations concerning supervision of the district heating market. Improved regulation, together with improved metering for district heating customers may bring additional efficiency gains.

The Energy Market Inspectorate is playing an important role in regulating the electricity network operators and in informing consumers to how to make choices in the market. However, the Inspectorate's regulatory role needs strengthening, including its role in the district heating sector. The government has identified a number of issues related to the position of the consumers on the energy market and has started to address them. Strengthening of the Energy Market Inspectorate could support these efforts.

Energy efficiency funding and fiscal policies

Sweden has a long tradition for using economic instruments in its energy policy. Taxes and investment subsidies have been the main instruments, although the country has started to move towards more market-based systems in recent years.

Energy taxation has been a successful tool in Sweden to reduce consumption of oil and other fossil fuels, and at the same time to promote renewable energy and increase energy efficiency. The taxation system is used as a stick and a carrot. It includes:

- High energy and emission taxes;
- Tax exemptions conditioned on meeting environmental and energy efficiency goals;
- Support of investment programmes through tax reductions.

Changes in energy and carbon dioxide tax levels since 1990 have provided strong financial incentives for a substantial expansion in the use of biomass in district heating as well as replacement of oil in individual heating with biomass, district heating and heat pumps.

The high energy and carbon dioxide taxes on transport fuels have also influenced the consumption in this sector. Analysis shows that carbon dioxide emissions from cars in 2005 would have been 1.5-3.2 million tonnes/year higher if the taxes had remained at the nominal level that applied in 1990.³³

However, in the current situation of substantial increases in market energy prices, the effects of the energy and environmental taxation policy need to be carefully monitored and evaluated in order to secure that the industrial competitiveness and overall economic development are not jeopardised.

It is a long established government policy to provide financial support for investment in energy efficiency and renewable energy. Support in the form of tax rebates is increasingly being used. Also, leverage funding by the industry and consumers is used with success although still to a limited extent.

Institutional framework

Sweden has developed a well functioning system of governmental institutions in the area of energy and environment. The activities of the new Ministry of Sustainable Development incorporate the vision of the government about exploiting synergies between economy, social welfare and the environment.

The government agencies dealing with energy and environment are well staffed with highly qualified personnel and have good resources at their disposal. Sector orientation and theme focus of the agencies are quite clear, although there is a room for improvement, especially when cross-sectoral topics and shared responsibilities are concerned.

³³ *The Swedish Report on Demonstrable Progress under the Kyoto Protocol, Ministry of Sustainable Development, Sweden, 2005.*

Municipal energy advisory services were introduced to reach a wide section of consumers with independent energy advice and information, in order to stimulate interest in energy efficiency and renewable energy on the local level. The substantial efforts and resources involved have brought important results. Municipal advisory services are available in nearly all municipalities and the professional competence of municipal energy advisers has been improved. The cooperation between the Energy Agency, the municipal energy advisers, and the regional energy agencies has established a good network for the exchange of experience and support.

However, some possibilities for improvements are identified. Municipal energy advisory services are not self-sustainable. Municipalities, while they appoint the advisers, cannot use the advisory services for their own facilities. The selection procedure for energy advisers is not based on specified professional requirements. Improved tools for following-up on the advisors' activities are needed.

More generally, the cooperation between the Swedish Energy Agency and the municipal authorities is concentrated on the energy advisory services. The other running programme - Sustainable Municipality - involves a very limited number of municipalities (only five). There is a room for more active cooperation in order to stimulate local energy efficiency and renewable energy initiatives.

Renewable energy, district heating and cogeneration

Renewable energy has gained substantial importance in Sweden actively supported by policy measures.

The green electricity certificate system is a success story by its stimulation of the electricity production from renewable sources. Some problems have been identified. The certificate system has become rather expensive for the consumers and transaction costs are high. The role of small scale hydro in the system is being discussed at the political level.

A system similar to green certificates, but for energy efficiency gains, is under discussion in Sweden as it is in some IEA and EU countries.

District heating has an important role in the restructuring of the Swedish energy system through its ability to use fuels that have no other alternative use, and as a basis for cogeneration of electricity. In early 1990s the production of district heat increased substantially, but it has in recent years been rather stable. Interest in CHP, mainly biofuel-fired, has increased recently driven by the changed taxation regime for CHP, the green electricity certificate system and carbon dioxide taxation.

9. Recommendations

General

- The government should undertake more analyses of long term demand and supply with a view to better assess the potential contribution of energy efficiency and renewables in the energy balance of the country.
- In implementing the relevant EU directives, the government should adopt a higher level of commitment, reflecting the importance given to energy efficiency in the overall energy policy in the country.

Energy efficiency legislation, policies, and programmes

- The government should ensure that the proposed National Programme for Energy Efficiency and Energy Smart Buildings covers all the key areas for improving energy efficiency and includes clearly defined objectives and implementation mechanisms.
- The government should further promote public awareness on the benefits of improving energy efficiency and secure more public involvement in the policy making in this area.
- The government should further strengthen the monitoring and evaluation of the energy efficiency programmes.
- Synergies between energy efficiency and climate change mitigation measures should be further explored in the implementation of environmental policies and programmes.
- The government should undertake additional measures to improve energy efficiency and renewables implementation in small- and medium- size enterprises (SMEs), especially in the services sector.
- The government should ensure that the cost for obtaining energy certificates for buildings is not creating a barrier for public acceptance.

Institutional framework

- The government should ensure that the growing policy requirements in the area of energy efficiency and renewables are matched with adequate capacity in the responsible implementing institutions.
- Given the high number of organisations with responsibilities in the energy efficiency and renewables areas, the government should make efforts to secure continuous good coordination between them.
- Municipalities should be encouraged to make wider use of available instruments for improving energy efficiency at community level.

- Building on the experience gained so far, the government should further support the development and improve the effectiveness of the local energy advisors network in cooperation with municipal authorities.

Energy markets and pricing

- The government should further strengthen the role of the Energy Market Inspectorate with a view to ensure that market liberalisation and competition benefits are transferred to the energy consumers.
- The government should consider introduction of effective regulation of the district heating sector.
- The government should assess the benefits of introducing individual heat metering in centrally heated buildings.

Energy efficiency funding and fiscal policies

- The government should further develop the energy taxation system in a way to encourage energy efficiency improvements while not constraining economic development, social welfare, and competitiveness of the national industry.
- Considering the existing potential and the declared targets for energy efficiency improvements in buildings in the country, the government should provide greater support for R&D in this area.
- The government should further encourage the private sector to invest in energy efficiency, including through the use of ESCOs and performance contracting.
- The property tax system should be further developed in a way to secure incentives for energy efficiency measures in buildings.
- The government should consider more energy efficiency oriented tax system for cars, accompanied by other measures such as energy labelling.

Renewable energy and cogeneration

- Building up on the experience gained with the electricity “green” certificate system, the government should develop similar market mechanism for the promotion of energy efficiency projects.
- The government should analyse the potential for CHP and promote measures, including market based mechanisms, supporting its development.
- The government should map the economic potential for RES, including small hydropower, with a view to increase their contribution to the energy mix of the country.
- Programmes for developing the market for alternative fuels in the transport sector should be continued and coordinated with the car and automotive industry.

10. Annexes

Annex 1: Energy Situation in Sweden

Table 10.1 Energy Balance for Sweden (Ktoe)

Indicators	1990	1995	2000	2001	2002	2003
Total Primary Energy Production	29754	32005	30830	34290	32457	31664
Net imports	18286	19334	19216	19178	19842	22716
Total Primary Energy Supply (TPES)	47566	50996	48453	51511	52835	51532
Total Final Consumption (TFC)	32146	35339	35112	35325	35905	35800

Source: IEA Energy Statistics, Electronic Version 2005

Table 10.2 Total Primary Energy Supply (TPES) (Ktoe)

	1990	1995	2000	2001	2002	2003
Coal	2955	2879	2448	2755	2840	2685
Oil Products	14673	15814	14227	14490	16531	15548
Hydro	6235	5857	6758	6799	5707	4576
Combustible Renewables & Waste	5506	7278	8502	8016	8223	8790
Solar Thermal/Wind	4	14	44	45	56	59
Natural Gas	577	754	776	875	891	888
Heat	0	317	357	365	377	314
Nuclear	17769	18225	14937	18792	17750	17569
Electricity	-152	-145	402	-627	462	1103
Total Primary Energy Supply	47567	50993	48451	51510	52836	51532

Source: IEA Energy Statistics, Electronic Version 2005

Table 10.3 Total Final Energy Consumption (TFC) (Ktoe)

	1990	1995	2000	2001	2002	2003
Electricity	10350	10713	11070	11410	11290	11160
Heat	1705	3539	3549	3986	4012	4062
Petroleum Products	14037	14634	13683	13866	14184	14105
Gas	364	404	477	529	495	532
Coal	1052	900	800	762	942	795
Combustible Renewables and Waste	4635	5144	5528	4768	4978	5141
Solar Thermal	3	5	5	4	4	5
Total Final Consumption	32146	35339	35112	35325	35905	35800

Source: IEA Energy Statistics, Electronic Version 2005

Annex 2: Selected end-use data tables

Table 10.4 Total Final Energy Consumption by Sector (Ktoe)

Sectors	1990	1995	2000	2001	2002	2003
Residential	6875	8064	7305	7516	7619	7589
Industry Sector	12415	13310	13757	13288	13735	13517
Commercial and Public Services	4024	4869	4416	4901	4822	4890
Transport Sector	7417	7829	8244	8227	8139	8275
Agriculture	571	536	445	468	531	591
Non-specified Other	0	83	112	117	138	127
Total Final Consumption	32146	35339	35112	35325	35905	35800

Source: IEA Energy Statistics, Electronic Version 2005

Table 10.5 Final Energy Consumption of the Residential Sector (Ktoe)

Energy Type	1990	1995	2000	2001	2002	2003
Electricity	3276	3645	3614	3627	3567	3530
Heat	1043	1951	2080	2362	2371	2408
Oil Products	1562	1445	891	849	756	718
Gas	51	88	103	120	76	69
Solar Thermal	3	5	5	3	4	4
Combustible Renewables and Waste	940	930	612	555	845	860
Total Residential sector	6875	8064	7305	7516	7619	7589

Source: IEA Energy Statistics, Electronic Version 2005

Table 10.6 Final Energy Consumption of the Industry Sector (Ktoe)

Energy Type	1990	1995	2000	2001	2002	2003
Electricity	4640	4473	4897	4912	4925	4783
Heat	167	348	344	385	391	381
Oil Products	2711	3231	2592	2816	3159	3069
Gas	257	257	306	344	320	334
Coall	966	876	786	748	927	782
Combustible Renewables and Waste	3674	4125	4832	4083	4013	4168
Total Industry Sector	12415	13310	13757	13288	13735	13517

Source: IEA Energy Statistics, Electronic Version 2005

Table 10.7 Final Energy Consumption of the Services Sector (Ktoe)

Energy Type	1990	1995	2000	2001	2002	2003
Electricity	2095	2242	2183	2511	2438	2435
Heat	495	1234	1118	1233	1242	1266
Oil Products	1375	1347	1066	1090	1050	1076
Gas	42	35	36	33	66	89
Coal	-	-	-	-	-	-
Combustible Renewables and Waste	17	11	13	34	26	24
Total services sector	4024	4869	4416	4901	4822	4890

Source: IEA Energy Statistics, Electronic Version 2005

Table 10.8 Use of electricity in the residential and services sectors (TWh)

	1990	1995	2000	2001	2002	2003	2004
Electric heating	29.0	25.6	24.3	23.1	23.2	22.3	23.6
Electricity for household purposes	17.9	19.7	17.7	19.2	19.5	20.1	19.5
Electricity for common purposes	21.3	25.4	29.9	31.8	31.0	30.2	30.0
Total	68.2	70.7	71.8	74.0	73.6	72.6	73.1

Source: Energy in Sweden 2005, Facts and Figures

Annex 3: Energy Prices and Taxes

Table 10.9 Electricity prices to end users (excluding taxes and network charges) öre/kWh

Consumer types	July 1996	Jan 1997	Jan 1998	Jan 1999	Jan 2000	Jan 2001	Jan 2002	Jan 2003	Jan 2004	Jan 2005
Apartments	29.7	30.9	30.6	28.6	27.2	28.2	36.3	52.1	55.7	48.2
Detached house without electric heating	28.1	29.2	28.3	27.7	24.7	25.3	32.2	47.3	50.6	42.5
Detached house with electric heating	26.0	27.4	26.5	25.7	23.0	23.5	30.2	44.9	47.9	39.7
Agriculture and forestry	25.0	26.4	25.4	24.3	22.6	23.1	29.9	44.6	47.4	39.0
Commercial	-	27.3	25.8	24.6	22.1	23.1	29.4	43.7	46.6	38.3
Small industry	25.3	27.1	25.4	24.0	21.5	23.0	29.1	44.4	45.6	37.8

Source: The Swedish Energy Market 2005, from Statistics Sweden

Note: 1) Prices are for open-ended contracts 2) The values in the table are expressed in 2005 levels (January).

Table 10.10 Electricity taxes at consumer level in Sweden öre/kWh

	1996 1 Jan	1997 1 Jan	1998 1 Jan	1999 1 Jan	2000 1 Jan	2001 1 Jan	2002 1 Jan	2003 1 Jan	2004 1 Jan	2005 1 Jan
Northern Sweden										
Electricity, gas heat and water supply	4.7	9.0	10.4	10.3	11.4	13.3	14.5	16.9	18.1	19.4
Industrial activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Other users	4.7	9.0	10.4	10.3	11.4	13.3	14.5	16.9	18.1	19.4
Rest of Sweden										
Electricity, gas heat and water supply	8.2	12.6	14.0	13.9	15.0	16.8	18.0	20.3	21.5	22.8
Industrial activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Other users	10.5	15.1	16.4	16.4	17.5	19.2	20.5	22.9	24.1	25.4

Source: The Swedish Energy Market 2005, from National Tax Board and Statistics Sweden

Note: The values in the table are expressed in 2005 levels (January).

Table 10.11 General energy and environmental taxes as of 1st January 2005, excluding VAT

	Energy Tax	CO2 tax	Sulphur tax	Total tax	Tax
Fuels					
Gas oil, SEK/m3, (<0.05% sulphur)	735	2 609	-	3 344	33.6
Bunker oil, SEK/m3, (0.4% sulphur)	735	2 609	108	3 452	32.6
Coal, SEK/tonne, (0.5% sulphur)	313	2 270	150	2 733	36.2
LPG, SEK/tonne	144	2 744	-	2 888	22.6
Natural gas, SEK/1000m3	238	1 954	-	2 192	21.9
Unrefined tall oil, SEK, m3	3 344	-	-	3 344	34.1
Peat, SEK/tonne, 45% moisture (0.3% sulphur)	-	-	50	50	1.84
Motor fuels					
Petrol, unleaded, env. class 1, SEK/l	2.8	2.1	-	5.0	54.8
Diesel fuel, env. class 1, SEK/l	1.0	2.6	-	3.6	36.6
Natural gas/methane, SEK m3	-	1.1	-	1.1	11.1
LPG, SEK/kg	-	1.4	-	1.4	10.6
Electricity Use					
Electricity, northern Sweden, öre/kWh	19.4	-	-	19.4	19.4
Electricity, rest of Sweden, öre/kWh	25.4	-	-	25.4	25.4
Electricity, Gas, Heat or water Supply					
Northern Sweden, öre/kWh	19.4	-	-	19.4	19.4
Rest of Sweden, öre/kWh	22.8	-	-	22.8	22.8
Electric Boilers, >2MW, 1/11-31/3					
Electricity, northern Sweden, öre/kWh	21.8	-	-	21.8	21.8
Electricity, rest of Sweden, öre/kWh	25.4	-	-	25.4	25.4
Industry					
Electricity, industrial processes, öre/kWh	0.5	-	-	0.5	0.5

Source: Energy in Sweden 2005, from National Tax Board

Annex 4: Organisations contacted by the Review Team

Ministry of Sustainable Development

Ministry of Industry, Employment and Communications

Ministry of Finance

Swedish Energy Agency (STEM)

Swedish Environmental Protection Agency

National Board of Housing, Building and Planning

Energy Markets Inspectorate

Svenska Kraftnät (Swedish Transmission System Operator)

Swedish Commission on Oil Independence

SwedEnergy (The Swedish Utilities Organisation)

ELFORSK AB, Swedish Electrical Utilities R&D Company

Swedish District Heating Association

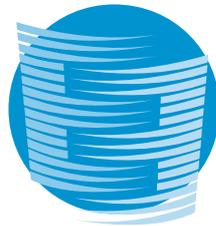
Swedish Property Federation

Regional Energy Agency South East Sweden

Swedish Energy Advisors Association

Annex 5: Information Sources

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Energy Charter Secretariat
Boulevard de la Woluwe, 56
B-1200 Brussels, Belgium

Tel: +32 2 775 98 00
Fax: +32 2 775 98 01
E-mail: info@encharter.org

www.encharter.org