Publication Year 2005

The Swedish Energy Market

THEME: THE STORM GUDRUN

2005

Preface

The Swedish Energy Market, 2005 is an annual publication that presents information and statistics on the network based energy markets in Sweden, i.e. the markets for electricity, natural gas and district heating. It also provides an overview of the issues that have arisen on these markets during the second half of 2004 and the first half of 2005.

Considerable work is being carried out in the EU on creating a single market for electricity and natural gas. This publication therefore describes expansion of the Swedish market towards a Nordic and a European market.

The publication normally includes a theme chapter, describing some event of particular interest for the Swedish energy market during the year. This year, the theme chapter is devoted to the Storm Gudrun, which struck the south of the country at the beginning of January, and its effects on electricity supply throughout the country. The chapter is based on the report submitted to the Government by the Energy Markets Inspectorate in the spring of 2005, and also includes a summary of the Inspectorate's proposals for measures to improve the security of electricity transmission.

Energy in Sweden, which is another of the Swedish Energy Agency's annual publications, provides information and statistics on the development of the entire Swedish energy system.

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Books and reports published
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Order fax: +46 16-544 22 59
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ET: 2005:22

Translation: Neil Muir, Angloscan Manuscript Ltd.
Cover photo: Göran Gustafson/PRB
and Per Westergård
All other photos: Per Westergård
Layout and production: ETC
Print run: 1000 copies
Printer: Elanders Berlings Malmö 2005

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The Energy Markets Inspectorate

1st January 2005 saw the Energy Markets Inspectorate set up within the Swedish Energy Agency by the Government. The Inspectorate monitors the electricity, natural gas and district heating markets, in order to ensure that they are operating efficiently, and is the regulating authority for monitoring compliance with the Electricity and Natural Gas Acts. In addition, the Inspectorate is the authority having jurisdiction for matters concerned with electricity trading. It also monitors developments on the European electricity and gas markets and, in conjunction with other European energy regulators, assists development of the single electricity and natural gas markets within the Nordic countries and the EU. It is also actively engaged in strengthening the positions of energy customers on the deregulated energy markets. This is done in such ways as pressing for suitable regulatory frameworks and infrastructures, as well as providing information to consumers and small and medium size companies about their chances of acting on deregulated markets.

During 2005, the Inspectorate will be given increased resources in the interests of the well functioning of electricity and natural gas markets in Sweden and Europe. Surveillance of compliance with the Electricity and Natural Gas Acts will be strengthened, as will monitoring of the markets' functions, reporting and cooperation within the EU.

Swedish energy markets policy is intended to bring about efficient markets, incorporating a healthy element of competition, and assuring a reliable supply of energy at internationally competitive prices. This means that the target is to ensure that the markets make efficient use of resources and set realistic prices.

Starting from this energy policy objective, the Inspectorate has formulated the following working policy: "Sweden has effective and open markets for electricity, district heating and natural gas, delivering services that match their customers' needs."

The past year

Many changes in the electricity, natural gas and district heating sectors have occurred in Sweden within the EU during the past year. The following is a description of some of the more important changes and events that have occurred in the network based energy markets during the second half of 2004 and the first half of 2005.

Sweden

The Energy Markets Inspectorate is established
Although the restructuring of the electricity market have brought benefits to large customer groups, much remains to be done. Security of supply and the quality of transmission needs to be improved. The customers' situation on the electricity market need to be strengthened, through such means as improved surveillance of the grid companies' metering and reporting of electricity consumption, and through information to customers. The regulatory framework and institutional conditions that determine the factors governing competition on the electricity market need to be monitored and analysed.

The Energy Markets Inspectorate was established as part of the Swedish Energy Agency by the Government on 1st January 2005. This has brought together the duties of monitoring and analysing events on the market, as well as exercising supervision of the electricity, natural gas and district heating markets.

New legislation on the electricity and gas markets
In the beginning of 2005, the Government submitted a Bill to Parliament concerning a new Natural Gas Act and changes to the Electricity Act. The new and amended regulations were introduced in order to bring the acts into line with the EU's new electricity and gas market directives. Among the changes in the new Natural Gas Act are further liberalisation of the market, a requirement for legal separation between network activities and trading in natural gas, a requirement that the transmission companies may not apply their transmission tariffs before the regulating authority has approved the methods used for structuring the tariffs, and the introduction of requirements concerning system liability and liability for maintaining the balance on the natural gas market. The changes to the Electricity Act include requirements in respect of a functional separation between grid companies and trading companies, a reduced limit for hourly metering of electricity consumption and requirements that those selling electricity shall declare the mix of energy sources used to produce the electricity that they are selling. The Bill was passed by Parliament in May 2005, and came into force on 1st July 2005.

Phase-out of nuclear power production
During the autumn of 2004, the Government's negotiator for continued phase-out of nuclear power, Bo Bylund, stated that the negotiations with the nuclear power utilities had been put on hold. In his report, he pointed out that the country's present dependence on nuclear power is not sustainable in the long run, but that a change to a long-run-sustainable energy system would take time. The report pointed out that it is important that nuclear power should be progressively phased out, which means that the phase-out cannot be postponed indefinitely. Soon after the negotiations had been broken off, the Government presented its proposed strategy for continued phase-out of nuclear power generation. In accordance with this strategy, the second Barsebäck reactor was closed in May 2005.

Storm Gudrun
When the Storm Gudrun swept over southern Sweden on 8th-9th January 2005, it brought down over 20 000 km of electricity lines, resulting in loss of supply to over half a million households and thousands of businesses. Many of them had to wait for days, or even weeks, before their supply was restored. In addition, there was major damage to many other aspects of life, on social, cultural and economic levels.

As a result of the storm, the Government instructed the Inspectorate to put forward proposals for improving the reliability of electricity transmission. The terms of reference for the investigation, which were announced in April 2005, included the preparation of suggestions for requirements to ensure that electricity transmission grids were reliable, as well as proposals for regulations governing compensation for loss of power supplies to customers suffering long failures. The work also included consideration of, and proposals for, how the act concerning compulsory administration of grid companies could be tightened up. These proposals are described in more detail in the theme chapter of this report.

Tariff reviews using the Performance Assessment Model
Since 2003, the Electricity Act has required grid tariffs to be reasonable in relation to the added value delivered to their customers by the grid companies. The Inspectorate has developed a model, known as the Performance Assessment Model, which indicates whether local grid companies are charging excessive grid tariffs. The model was used by the Inspectorate for the first time in 2004, with the results indicating that the tariffs charged by 43 companies should be further investigated. In June 2005, the Inspectorate ordered 16 network companies to reduce their tariffs, by an average of 18 %. The investigation continues with 15 companies.

The Electricity and Gas Market Commission
The Electricity and Gas Market Commission was appointed in 2003, to put forward proposals for harmonising Swedish legislation with the requirements of the EU Electricity and Gas Market Directive, and to analyse the need for improvements in the Swedish electricity and natural gas markets. The Commission submitted its final report in December 2004, stating that, on the whole, electricity production and the bulk power markets are operating efficiently. The integrated Nordic market plays an important role in counteracting tendencies towards concentration of the electricity market. The Commission is therefore of the opinion that the Nordic market must be strengthened. In addition, it notes that there is a lack of competition on the natural gas market. The Commission notes that the prospects for establishing a competitive market in Sweden are improving as a result of a new regulatory framework coming into force.

New supply pipeline for natural gas
During the autumn of 2004, the Government gave permission for the construction of a new natural gas pipeline between Germany and Sweden. This will be the second supply point for natural gas to Sweden, which means that it will be important in improving security of supply and encouraging competition on the natural gas market. The pipeline is due for completion within five years, and must comply with a number of conditions, including environmental protection and protection of fisheries.

The Regulatory Reform Commission
In January 2005, the Regulatory Reform Commission, which had been asked to analyse the restructured markets, submitted its report to the Government. In its report, the Commission indicated that the changes in the market took insufficient account of consumers' interests, and that this was particularly the case for the electricity market. This means that there is a need to strengthen consumers' situations on these markets. In addition, the Commission is of the opinion that the surveillance of the electricity market should also be strengthened. It is of the opinion that it is important to create transparency and a clear indication of roles, and therefore suggests that the network regulator should be given greater independence and restructured into an authority in its own right.

The District Heating Commission
The District Heating Commission submitted its report to the Government in April 2005. In the report, the Commission proposes a District Heating Act to improve surveillance of the district heating utilities' activities, to give customers the right to negotiate prices and delivery conditions, and to establish a body, with members appointed by the parties concerned, to adjudicate on disputes. The Commission is now continuing its work, looking at the question of how continuity of district heating supplies could be maintained if a utility declares bankruptcy. This part of the Commission's work was presented in a report in June 2005.

International

The Gas Supply Directive
Work is in progress in the EU on establishing a single competitive market for electricity and natural gas. Correctly established, such a market would bring major benefits to electricity and natural gas customers in Sweden and in Europe, as well as to the energy utilities. In April 2004, Directive 2004/67/EC Concerning Measures to Safeguard Security of Natural Gas Supply was adopted. This means that the member states must prepare standards for safeguarding security of supply, and must define the division of responsibility between the various parties involved. The Directive establishes a crisis mechanism, operating at EU level, which is intended to come into force in the event of significant interruptions to supply. The Directive must be incorporated in Swedish legislation by 19th May 2006.

Meeting of Nordic energy ministers
The Nordic energy ministers met in Akureyri on Iceland in September 2004. Among other points, the meeting noted that the electricity supply situation during the winter of 2002/2003 showed that the market was operating satisfactorily, and was capable of handling difficult situations. As a result of the meeting, the Nordic transmission system operators were requested to prepare a common definition of what system responsibility should include.

PHOTO: SYDKRAFT

Theme: Storm Gudrun

When Storm Gudrun[1] swept over southern Sweden on 8th–9th January 2005, it brought down over 20 000 km of electricity lines, resulting in loss of supply to over half a million households and thousands of businesses. Many of them had to wait for days, or even weeks, before their supply was restored. In addition, there was major damage to many other aspects of life, on social, cultural and economic levels. Forests to a value of thousands of million SEK were blown down. Telecommunications failed, and many roads and railways were impassable.

The storm and its consequences in general terms

This chapter provides a brief description of the events during the storm, including such points as the variations and strength of the storm, the areas and distribution networks that were affected and estimates of the costs caused by the storm. A more detailed description can be found in the Swedish Energy Agency's and the Energy Markets Inspectorate's special reports on the storm.[2] The information has been provided by a selection of network operators and a number of public sources. It is estimated that about 80-90 % of electricity consumers affected by the storm were supplied by the network companies that provided information for the investigation.

In comparison with earlier severe storms, Storm Gudrun had considerably more serious consequences. Over 70 million m^3 of trees were blown down – equivalent to a year's felling. This can be compared with earlier storms: for example, the storm of November 1969 brought down 25 million m^3 of forest, while that of January 1954 brought down 18 million m^3.

Why did this storm have such extreme consequences? Despite what many claimed, it was not particularly exceptional when seen in the cold light of SMHI's statistics. However, what it did do was affect a larger area than most of the previous storms. Hurricane-strength winds (over 32.7 m/s) occurred over wide areas, although this, too, occurred in earlier storms. However, the damage was never so extensive as in January 2005.

The strongest winds during the storm were measured on Hanö, in southern Sweden (near Kristianstad), reaching an average speed of 33 m/s, with gusts of 42 m/s. Almost as strong winds were measured at several places along the west coast and on Gotland. The winds were strongest at sea and over the large lakes, as can be seen in Figure 1.

The storm followed essentially the same pattern as

[1] Named in accordance with the probably better-known convention for hurricanes: that is, the initial letter 'G' of the name indicates that this is the seventh storm of the 2004/2005 storm season.

[2] *Reliable electricity transmission,* Energy Markets Inspectorate 2005 and *The Gudrun storm – Consequences for grid operators and society,* Swedish Energy Agency 2005.2005.

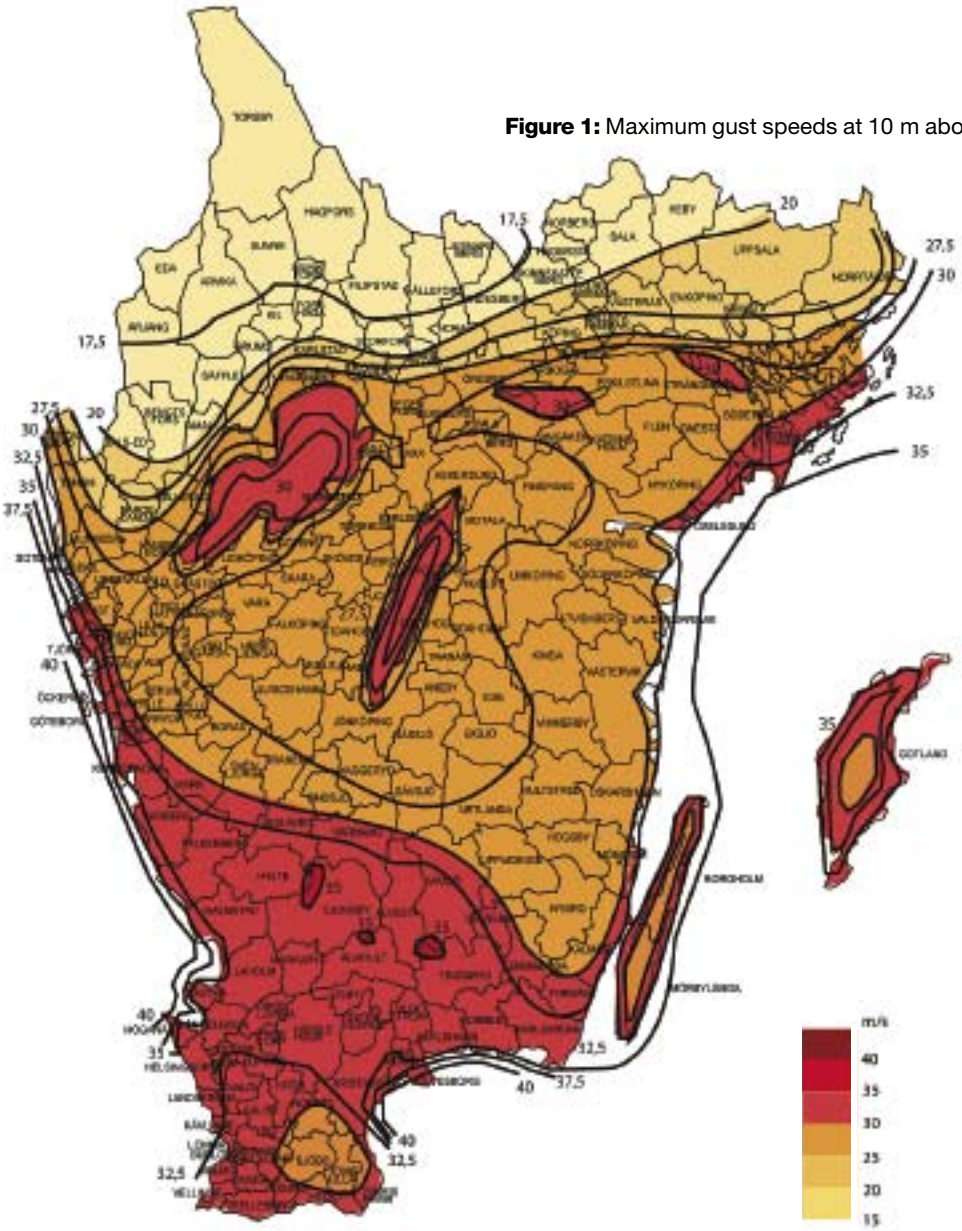


Figure 1: Maximum gust speeds at 10 m above ground

SOURCE: SWEDISH METEOROLOGICAL AND HYDROLOGICAL INSTITUTE (SMHI)

had occurred during previous strong depressions. The winds were at first south-westerly, gradually veering west: this, too, is nothing exceptional in terms of weather statistics. According to SMHI, it was unlikely that there were any tornados. The severe consequences must therefore probably be accounted for by certain conditions. One of these was that there was no frost in the ground: another was that plantations of spruce are possibly biotopically unsuitable in certain areas.

Consequences for electricity transmission

Regional networks

Although the regional networks consist mainly of uninsulated overhead cables, they suffered relatively lightly from the storm. One explanation for this is that regional networks tend to be built along broad rides, which considerably reduces their vulnerability to falling trees. The fact that, nevertheless, some regional networks suffered worse than others could be due to neglect of felling in, or widening of, rides. In some cases, too, the winds blew down power line poles directly.

Local networks

Buried cables were, of course, unaffected by the storm. However, there were many factors that affected how badly overhead lines in local networks were affected. Eye-witnesses have described how strong gusts toppled rows of trees, while nearby areas escaped relatively mildly. Several network companies describe how both insulated and uninsulated overhead lines, with ages ranging from zero to 60 years, were brought down by the storm.

Insulated lines are considerably more robust than bare wire lines. However, the storm showed that there was still a weakness for the double-insulated lines, in that the poles could be brought down. In some areas, the sheer numbers of trees that were blown down was so great that they either damaged the insulation, broke the poles or broke the lines. The network companies listed in Table 1 had a total of 663 000 customers whose power supplies were interrupted. Of them, 295 000 were supplied by Sydkraft. Other network companies with large numbers of affected customers included Vattenfall (260 000) and Fortum Distribution (50 000). However, it can be seen from the table that KREAB Öst suffered the worst in relative terms, with all of its customers losing their supplies.

Of the 663 000 customers who lost their supplies, 354 000 had the supplies restored within 24 hours. 159 000 customers remained without electricity for between one and three days; 82 000 customers between four and seven days; 56 000 customers between eight and twenty days, and 12 000 for more than twenty days. Sydkraft was the network company having the greatest problems in restoring supplies after the storm: 4% of its customers were without electricity for more than 20 days. On the other hand, all customers of KREAB Skåne, Ale Elförening and Habo Kraft had their supplies restored within three days.

Costs as a result of supply interruptions

Customers

The Inspectorate's investigation does not arrive at any figure for the costs caused to industry by the storm and resulting electricity failure. However, some estimates produced by individual companies hit by the storm indicate considerable costs. The examples quoted by the Confederation of Swedish Enterprise include Volvo Braås, which reported two days' shut-down, Beckers Färg which reported a three-day stop, and a number of other smaller companies, working in the plastics industry and other sectors.

The costs suffered by businesses can be of many different kinds, and can also vary between sectors. One cost item, for example, can be the loss of production. For a long time after the storm, several companies suffered from the fact that some of their staff had difficulty in even getting to work.

Local authorities suffered from the electricity failure in such ways as costs for standby power supplies, arrangement of emergency accommodation and other measures to help households and companies. Other authorities, such as county councils, the defence forces, the National Road Administration, the National Fire and Rescue Service, also suffered costs as a re-

Table 1: Storm-affected network companies and numbers of affected customers

Network companies	Total no. of customers	No. of customers affected	Proportion of customers affected
Ale Elförening	11 600	5 850	50 %
Alvesta Energi	4 769	1 612	34 %
Fortum Distribution	241 100	52 560	22 %
GENAB (Göteborg)	245 870	13 421	5 %
Habo Kraft	4 000	641	16 %
Härryda Energi	12 400	4 000	32 %
Jönköping Energi Nät	50 000	8 150	16 %
KEAB Skåne	17 000	6 480	38 %
KREAB Öst	7 200	7 200	100 %
Rödeby Elverk	4 100	2 150	52 %
Sydkraft	600 000	295 400	49 %
Vaggeryd Elverk	3 700	1 132	31 %
Vattenfall Eldistribution Mellan	450 000	111 430	25 %
Vattenfall Eldistribution Väst	167 200	107 240	64 %
Vattenfall Eldistribution Öst	119 200	45 000	38 %
Värnamo Kraft	10 366	934	9 %
Total	1 948 475	663 200	

SOURCE: EUROFUTURES

sult of the electricity failure.

For domestic consumers, the supply failure caused additional work in such ways as maintaining fires for heating, fetching water, additional transport and so on. In addition, they suffered from the loss of amenity, in that their day-to-day living patterns were interrupted. Property damage in the form of destroyed foodstuffs and damage to heating systems and pumps was also reported from domestic users.

Network companies

Much of the media's attention after the storm was concentrated on the damage to Sydkraft's network. Sydkraft was also the company whose customers were hit the hardest by the storm. It has a dominant position in southern Sweden, with more customers in this particularly affected area than other network operators.

Table 2 shows the network companies' estimated direct costs as a result of the storm. It can be seen, for example, that at SEK 11 900, Värnamo Elnät suffered the highest cost per customer affected. Apart from Sydkraft and KREAB Öst, no other network operator comes anywhere near these high costs. Värnamo Elnät's high costs per customer affected are due to the fact that the company's costs for clearance, repair and rebuilding were high, while relatively few of their customers were affected.

In addition to these three very severely affected companies, Vattenfall Öst and Väst, Fortum, Härryda and Vaggeryd Elverk incurred costs of between SEK 1 600 and SEK 3 200 per affected customer. Other network companies had relatively low costs, so that there is a significant difference between the highest and the lowest costs.

It can be seen from Table 2 that almost 80 % of the estimated costs were due to clearance, repair and rebuilding, with other cost items being less. The costs for loss of supply were low, despite the fact that large parts of the system were out of use for a week or more. This is due to the fact that it was the rural distribution networks, with relatively few major customers, that suffered worst. In total, it is estimated that the costs of the storm to the network companies amounted to over SEK 2 000 million.

Fault repairs and supply restoration in the short term

The large network companies and several of the smaller companies needed substantial resources, in the form of erectors, forest workers, helicopters, forest machinery and materials in order to restore their systems as quickly as possible. Sydkraft in particular states that it

Table 2: Network companies' estimated direct costs as a result of the storm, SEK

Network companies	Supply failure	Clearance, repair and reconstruction	Interruption compensation	Other costs	Total	Per affected customer
Ale Elförening	25 000	1 900 000	75 000	-	2 000 000	ca 300
Alvesta Energi	-	2 000 000	200 000	-	2 200 000	ca 1 400
Fortum Distribution	1 800 000	30 000 000	43 000 000	10 000 000	84 800 000	ca 1 600
GENAB (Göteborg)	-	-	5 500 000	-	11 600 000	ca 900
Habo Kraft	-	365 000	25 000	-	390 000	ca 600
Härryda Energi	70 000	4 850 000	3 300 000	-	8 250 000	ca 2 100
Jönköping Energi Nät	-	1 500 000	1 200 000	-	2 700 000	ca 300
KEAB Skåne	50 000	2 500 000	1 000 000	-	3 550 000	ca 500
KREAB Öst	500 000	30 000 000	9 500 000	5 000 000	45 000 000	ca 6 300
Rödeby Elverk	-	-	-	-	2 000 000	ca 900
Sydkraft	40 000 000	1 300 000 000	250 000 000	100 000 000	1 690 000 000	ca 5 700
Vaggeryd Elverk	-	1 700 000	670 000	-	2 370 000	ca 2 100
Vattenfall Eldistribution Mellan	2 660 000	20 500 000	25 000 000	5 050 000	53 210 000	ca 500
Vattenfall Eldistribution Väst	7 400 000	78 000 000	250 000 000	11 000 000	346 400 000	ca 3 200
Vattenfall Eldistribution Öst	1 100 000	57 200 000	25 000 000	1 000 000	84 300 000	ca 1 900
Värnamo Elnät	13 000	10 000 000	1 100 000	-	11 113 000	ca 11 900

SOURCE: EUROFUTURES

Note: The costs for supply failure are simply estimated losses of revenue. All costs in the table have been estimated by the network companies

had problems with obtaining materials and insufficient numbers of repair workers. Other companies, including Vattenfall, lent resources to Sydkraft and other companies after they had restored their own networks.

In general, the companies gave priority to work which would restore supplies most quickly to the largest number of customers. This meant that regional networks and high-voltage networks (10-20 kV) were dealt with first.

Reserve power units were used primarily for waterworks and sewage treatment plants, as well as for particularly vulnerable groups, such as old people's homes, farmers and smaller industries. Sydkraft, for example, made its 1000 standby power units available to local authorities. Other network companies state that they liaised with local authorities to decide priorities for where standby power units should be used.

At first, the companies' repair work was made more difficult by blocked roads and failure of telephone and mobile radio networks. Customers, too, were unable to report faults if the telephone system did not work. As the network companies generally monitor their regional networks (40–130 kV) and high-voltage networks (10–20 kV) from control centres, they could see which lines were in service. However, as far as the low-voltage lines (400 V) were concerned – i.e. the networks closest to customers – the companies were dependent on customers themselves notifying supply failures.

After the storm, there was a considerable need for communication with those affected by the storm. Many customers contacted their local authorities or network companies in order to obtain information on the situation. The larger network companies often deployed extra resources in order to be able to answer all questions, but the picture given by the media is still that Sydkraft's customers felt that the information that they were given was poor. In general, the smaller network companies do not seem to have had the same problems in informing their customers.

Instructions to the Energy Markets Inspectorate from the Government after the storm

After the storm, the Government instructed the Inspectorate to put forward suggestions for measures to ensure more reliable transmission of electricity. This included not only suggestions for ensuring improved operational reliability of electricity transmission, but also suggesting rules for compensation for loss of supply to customers suffering long-duration failures. The work also included a review of, and suggestions for tightening up the Act Concerning Compulsory Administration of Electricity Network Companies. The Inspectorate's proposals (see the frame below) were reported to the Government on 30th April 2005.

FACTS: Security of supply

Requirements in respect of network function

The Inspectorate is of the opinion that, except in a few exception cases governed by what is known as control responsibility, no customer shall need to accept supply interruptions exceeding 24 hours. The Inspectorate proposes that this requirement should be incorporated in the Electricity Act. Those network companies that are at present unable to meet this requirement must comply with it by not later than January 2011.

Obligatory supply interruption compensation

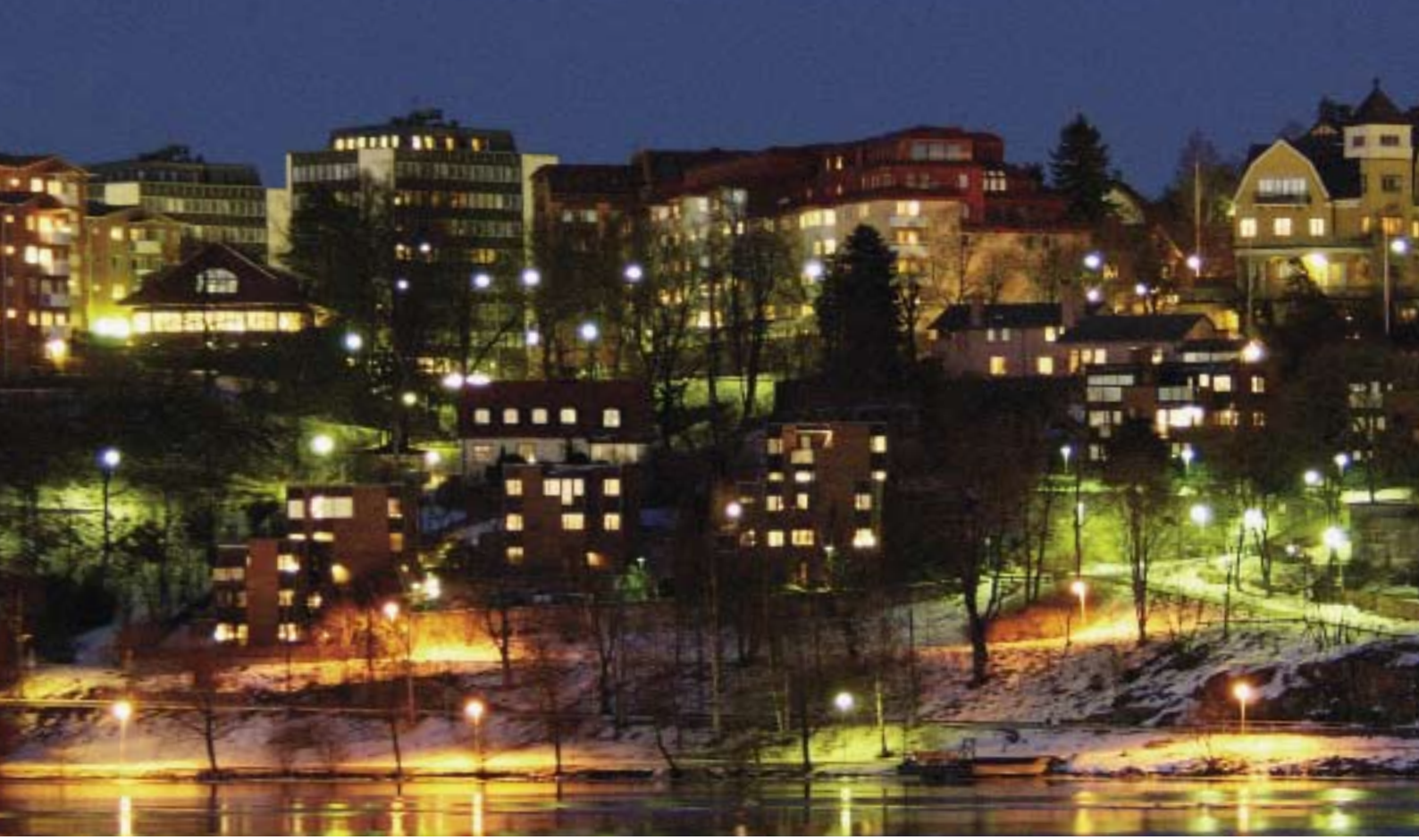
The Inspectorate proposes that all customers whose electricity supply has been interrupted for at least twelve hours shall be entitled to a flat rate compensation payment of 12.5 % of the customer's annual network cost. It is proposed that this compensation should be increased to 25 % of the customer's annual network cost for each interruption that lasts for at least 24 hours, and for each subsequent interruption period of 24 hours or part thereof. It is proposed that such payments should be subject to an upper limit amounting to three years' normal network costs. The purpose of an obligatory compensation payment is to provide a further incentive for limiting interruptions in the network supply and simultaneously to provide those suffering from the supply interruption with compensation over and above their right to damages.

Monitoring, surveillance and information

If the function requirement of a maximum supply interruption of 24 hours is to be achieved by 2011, the shortcomings in supply quality and work on strengthening networks must be monitored and reported effectively. Reporting must also be improved, in order to ensure that compensation for loss of supply is correctly applied. The Inspectorate therefore proposes that the network companies must prepare risk and vulnerability analyses for their networks, covering both the circumstances that could cause supply failures and the consequences of such failures. In addition, the Inspectorate proposes that the network companies must supply their customers once a year with written notice of their rights under the Electricity Act.

The Inspectorate also proposes measures intended to assist the network companies. These include allowing the companies to connect permanently installed standby power units to their networks, which would make it easier for the companies to meet the Act's requirements for good electricity quality. In addition, the Inspectorate intends to approve a wider voltage tolerance for area concessions using underground cables, which would simplify the processing of concession applications so that the companies can more quickly build robust network systems.

Further details of the Inspectorate's proposals can be found in the Inspectorate's report *En leveranssäker elöverföring [Reliable electricity transmission]*.



The electricity market

Since the introduction of electricity to Sweden over a hundred years ago, society has become dependent on it. In 2004, 146 TWh of electricity was consumed in Sweden, which is equivalent to over 16 000 kWh per person. Major changes have occurred to the electricity markets in the Nordic countries and in the EU in recent years. National markets are being opened to competition, and becoming increasingly integrated with each other.

Energy policy and the regulatory framework

Almost a decade has passed since the Swedish electricity market was opened to competition. Today, it is largely integrated with electricity markets in the other Nordic countries, with electricity being traded on the common Nord Pool exchange. In recent years, progress in the EU in creating a single market for electricity has also affected market conditions in Sweden.

The Nordic electricity market reform

The electricity markets in the Nordic countries have undergone major changes since the middle of the 1990s. Sweden liberalised its electricity market in 1996, opening both electricity trading and electricity production to competition. Similar reforms have been applied in all Nordic countries except Iceland. Norway liberalised its market in 1991, Finland in 1995 and Denmark in 1999. The purpose of the liberalisation was to improve competition, and thus to better utilise production resources.

With the change in the regulations governing the Swedish electricity market, the Norwegian electricity exchange became a joint Swedish/Norwegian exchange, Nord Pool. In 1998, Nord Pool was expanded to bring in Finland, and in 2000 it was further expanded to include Denmark. Nord Pool is a common market exchange for electricity trading, open to electricity producers, electricity traders and larger electricity users throughout the world. The purpose of an electricity exchange is to assist effective pricing with low transaction costs, thus facilitating trading in electricity and increasing competition between producers and traders from different countries.

A European market for electricity

In the wider EU arena, the objective is to create a sin-

gle market for electricity, operating under competitive conditions. The purpose of the single market is to facilitate trade in electricity between countries, thus contributing to growth and economic development within the EU.

In 2003, the European Parliament and Council adopted a new electricity market directive.[3] The directive aims to create equivalent competition and market conditions in the electricity sector between member states. According to the directive, the market for electricity must be open to commercial customers by 1st July 2004, and to domestic customers by 1st July 2007. This means that the Nordic electricity market is becoming increasingly affected by conditions on the European electricity market. At the beginning of 2005, electricity markets in seven of the EU's 25 member states were fully open to competition. Although Norway is not a member of the EU, it does have a fully competitive electricity market.

Greater harmonisation of the regulatory framework is very important if the European electricity market is to operate properly and if the market participants are to be able to compete on equal terms. Energy policy in Europe has therefore increasingly affected conditions in Sweden.

In connection with the adoption of the new electricity market directive, an ordinance concerning conditions for access to networks for cross-border trading was also adopted.[4] It includes rules concerning compensation between system managers in connection with cross-border trade in electricity, principles for harmonisation of national grid tariffs and guidelines for determining necessary capacities for cross-border connections. The purpose of the ordinance is to facilitate trading in electricity within Europe, and thus to encourage the growth of a functioning European market in electricity. EU ordinances are directly applicable in each member state, and have the force of law. The Swedish legislation does not conflict with the ordinance.

One of the prerequisites of a functioning electricity market is that the policy instruments used in the market should be harmonised. In the absence of such harmonisation, competition can be distorted and barriers to trade can arise. The EU took a step towards harmonised policy instruments when it adopted the new directive for greenhouse gas emission allowances trading in October 2003.[5] The purpose of this directive is to provide a cost-efficient way of assisting the EU's commitments under the Kyoto Protocol. In addition, the Energy Taxation Directive came into force on 1st January 2004.[6] This directive provides greater harmonisation of taxation of electricity, oils, coal and natural gas, and is intended to increase the competition neutrality of companies operating in the EU.

Implementing the new EU Directive into Swedish legislation

Swedish legislation needed to be amended in order to bring the Swedish regulatory framework into line with the requirements of the new Electricity Market Directive. The Government therefore submitted a Bill to Parliament, in which a number of amendments to the Electricity Act were proposed.[7, 8] Among the features of the Bill was a requirement for functional separation between electricity network activities and electricity trading activities, in order to reduce the possibility of cross-subsidisation between the two types of activities, and to ensure that the network companies act independently. In addition, the Bill proposed that electricity traders must provide information on their invoices and in advertising material on the mix of energy sources used for production of the electricity that they are selling.

The Bill also proposed that the lower limit for hourly metering of electricity consumption should be reduced from 200 ampere to 63 ampere. This will have the effect of allowing a greater number of customers to be offered differentiated electricity prices and network charges, thus creating the necessary conditions for pricing that provide an incentive for using electricity more efficiently.

In addition, the Bill proposed regulations for requiring costs and charges of district heating activities to be shown separately. The purpose of this proposal is to reduce the scope for transferring costs between district heating activities and electricity market activities. Preventing such cross-subsidisation is an important element in assuring efficient electricity and heat markets. The proposed changes to the law were passed by Parliament on 25th May, and came into force on 1st July 2005.

Nuclear power

Nuclear power is an important element of Swedish energy policy. No other country in the world produces as much electricity from nuclear power per capita as does Sweden. During a normal climatic year, nuclear power provides almost half of the country's total electricity production.

In 1980, after a referendum, Parliament decided that nuclear power production was to be phased out by not later than 2010. This was to be done with due allowance for future electricity demand and with maintenance of employment and welfare. It was agreed between the Centre Party, the Social Democrats and the Left Party that Barsebäck 1 and 2 should be closed in 1997. Barsebäck 1 was actually closed in 1999, at which time Parliament also laid down conditions for closing Barsebäck 2.

[3] The European Parliament's and the Council's Directive 2003/54/EC concerning common rules for the internal market in electricity and repealing Directive 96/92/EC.

[4] The European Parliament's and the Council's Ordinance 2003/1228/EC concerning conditions for access to networks for cross border exchanges in electricity.

[5] The European Parliament's and the Council's Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading and amending Council Directive 96/61/EC.

[6] The Council's Directive 2003/96/EC concerning restructuring the Community framework for the taxation of energy products and electricity.

[7] Bill No. 2004/05:62, Implementation of the EU Directive concerning common rules for the single markets in electricity and natural gas etc.

[8] The Electricity Act (1997:857).

In June 2002, the Government appointed an official negotiator to negotiate with the electricity industry with the aim of reaching an agreement concerning a sustainable energy policy for continued restructuring of the country's energy system. These negotiations were based on what is known as the German Model, which, briefly, gives the nuclear power industry a production cap for the total amount of electricity that may be produced in the country's nuclear power stations. The industry itself may then decide the order in which the reactors are to be closed. However, these negotiations were concluded in October 2004, without having been able to reach any agreement with the nuclear power companies.

In December 2004, the Government decided that Barsebäck 2 should be closed on 31st May 2005. Its contribution to the country's electricity requirement is between three and four TWh of electricity per year. In parallel with the ongoing intended phase-out of nuclear power production, the power companies are planning to increase production capacity from their remaining reactors. Increases in power output from the nuclear power plants require Government approval.

Policy instruments

Sweden has long employed economic instruments as part of its energy policy. Traditionally, taxes and investment subsidies have been the main instruments, although the country has started to move towards more market-based systems in recent years, as is well illustrated by the electricity certificate system that was introduced in 2003, and the emission allowances trading system that was introduced in 2005.

Taxes and levies

Initially, the prime purpose of energy taxes was to contribute to funding the public exchequer. Over the years, taxes have increasingly been employed in order to direct the use and production of energy towards energy and environmental policy objectives.

Taxes and levies at the production level in Sweden

Electricity production based on combustion processes pays sulphur tax and an NOX levy. Sulphur tax is charged on the sulphur content of the fuel, at present amounting to SEK 30/kg of sulphur emitted as sulphur dioxide, when burning solid fossil fuels and peat. The NOX charge, which is levied on boilers and gas turbines having a useful energy output of at least 25 GWh/year, amounts to SEK 40/kg of NOX and is repaid in proportion to the total useful energy production. This repayment provides an incentive to those affected by the levy to minimise their NOX emissions per unit of energy.

Electricity production does not pay energy or carbon dioxide tax. For taxation purposes, fuel used in CHP plants is apportioned between that part which is used for electricity production and that part which is used for heat production. The fuel used for heat production is then exempted from energy tax, and pays only 21 % of the carbon dioxide tax.

Electricity produced in nuclear power stations has been taxed since 1984. Originally, the tax was a production tax, but was changed in 2000 to a power tax which, at present, is charged at the rate of SEK 5 514/MW of reactor thermal output power. After allowance for the losses associated with conversion to electricity, this works out at about 2.7 öre/kWh of electricity. Electricity produced from nuclear power is also subject to a levy of 0.15 öre/kWh under what is known as the Studsvik Act.[9] In addition, each nuclear power station pays a levy intended to finance future costs for the disposal of spent nuclear fuel.[10] This charge is equivalent to a weighted average of 0.6 öre/kWh for Swedish nuclear power. In addition, the reactor owners are required to set aside capital each year for the disposal of nuclear waste and the decommissioning and demolition of nuclear power stations.

Taxes and levies at the consumer level in Sweden

Taxation of electricity consumption was introduced in 1951. Today, the tax is differentiated, depending on who the user is and where in the country the electricity is used.

The philosophy underlying the taxation was amended in 1990, in such a way as to increase taxation on the use of energy resources and on harmful environmental emissions, and using the resulting revenue to reduce other taxes, usually on income. Between 2001 and 2010, it is estimated that this change in the emphasis of taxation will have affected about SEK 30 000 million, of which SEK 9 000 million will be generated between 2004 and 2006. So far, this change has been implemented by raising the carbon dioxide tax in particular, the tax on diesel oil and electricity tax as paid by industry, coupled with reductions in income tax and employers' social security payments.

Table 3 shows the real development of taxation on electricity use in Sweden since 1996. With effect from 1st January 2005, the energy tax on electricity for domestic users is 25.4 öre/kWh in southern Sweden, and 19.4 öre/kWh in northern Sweden, equivalent to respective increases of 140 % and 310 % since the electricity market reform in 1996. Since 1994, the electricity tax has been adjusted in line with the consumer price index. Value-added tax on electricity is charged at 25 %, and applied to the price of the electricity (incl taxes).

[9] The Act (1988:1597) concerning financing of handling of certain radioactive waste etc.

[10] The Act (1992:1537) concerning financing of future expenditure for spent nuclear fuel etc.

Table 3: 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: NATIONAL TAX BOARD AND STATISTICS SWEDEN
Note: The values in the table are expressed in 2005 levels (January).

As a result of the EU Energy Taxation Directive, the zero tax rate for electricity used in industrial manufacturing processes was removed. In 2005, such electricity is taxed at 0.5 öre/kWh. The Act Concerning a Programme for Improving the Efficiency of Energy Use was introduced on 1st January 2005, in order to encourage efficient use of energy in energy-intensive industries (see the frame on the next page).[11] It enables energy-intensive companies to participate in five-year programmes for improving their efficiency of energy use, in exchange for exemption from energy tax on electricity. Up until 31st March 2005, 124 companies had signed up to the programme. The Swedish Energy Agency estimates that these companies, if they are approved for participation, will save a total of SEK 140 million/year in tax.

In 2004, taxes on electricity consumption generated SEK 17 100 million for the State. Taxes and levies on electricity production contributed a total of SEK 2 900 million. With a further SEK 9 800 million from value-added tax and public authority fees, the total tax take from the electricity sector amounted to SEK 29 800 million during the year.

Taxes and levies at the production level in the Nordic countries

In Denmark, fuels used for electricity production are subject to sulphur tax and carbon dioxide tax, with the latter tax becoming payable if the producer's assigned emission quota is exceeded. In Norway, hydro power production is taxed via a production-dependent concession charge, a production-dependent natural resource tax and other taxes. Finland has no production-related taxes for electricity. As opposed to the situation in Sweden, Finnish nuclear power reactors are not charged any power tax.

Electricity producers in all the Nordic countries pay property tax and corporate tax on electricity production. The corporate tax rate varies from 28 % to 32 % on the company's profit before tax. In Norway, the corporate tax can be reduced through deduction of the natural resource tax.

Taxes and levies at consumer level in the Nordic countries

All the Nordic countries levy tax on the use of electricity, either in the form of an electricity tax or of an electricity charge with value-added tax. Consumers in Denmark are also required to purchase a certain proportion of 'priority' electricity, which is electricity produced from wind power and decentralised waste-based or nat-

[11] The Act (2004:1196) Concerning a Programme for Improving the Efficiency of Energy Use.

FACTS: Energy efficiency programme

Since 1st January 2005, energy-intensive companies can apply to the Swedish Energy Agency to participate in the **Energy Efficiency Improvement Programme (PFE)**. To qualify for participation in the programme, companies must be operating an industrial activity, using electricity in their manufacturing processes, fulfil certain requirements in respect of energy intensity and be regarded as having prospects for completing the programme. Companies that are approved commit themselves to participate in a five-year programme of energy efficiency improvement in exchange for exemption from electricity tax. This exemption is limited to the electricity that is used in the part of the manufacturing process covered by the programme, and which is not already exempted from tax under any other regulations concerning tax exemption. If the commitment is not fulfilled, the Agency can rescind the approval. The company will then be required to pay all the tax on electricity that has been used within the framework of the programme.

ural gas-based CHP. This 'priority' electricity is more expensive than electricity from other sources, and its price is set by the authorities.

Emissions trading scheme

The EU emissions trading scheme (ETC) was introduced on 1st January 2005. Initially, the system covers only carbon dioxide, but it is the intention in due course to include other greenhouse gases in the system. The first trading period runs from 2005 to 2007, and represents an introductory phase prior to global emission trading, which is due to start in 2008 within the framework of the Kyoto Protocol's First Commitment Period.

The primary purpose of the trading scheme is to enable the EU and its member states to fulfil their Kyoto Protocol commitments in a cost-efficient and socio-economically efficient manner. For the 2008-2012 period, the EU has a commitment to reduce emissions of six greenhouse gases by an average of 8 % in relation to emission levels in 1990.

Initially, the EU emissions trading scheme covers only a limited number of industrial sectors, primarily energy production plants and certain energy-intensive industry sectors. In the longer term, it is planned that other sectors should be brought within the remit of the system. In the energy sector, it is combustion plants having an installed power capacity of 20 MW or more, and plants connected to district heating networks having a total power rating of over 20 MW, that are included.

All EU member states are covered by the system. Those countries covered by the EEA Agreement (Iceland, Norway and Liechtenstein) can decide if they wish to join the system. In total, it is calculated that plants producing half of the total EU carbon dioxide emissions will be included in the trading scheme.

Each unit of emission allowances allows its holder to emit one tonne of carbon dioxide during the specified trading period. For the 2005-2007 period, at least 95 % of the emission allowances in the EU trading scheme have been issued at no charge to the plants concerned, as required in the directive. In Sweden, all emission allowances have been issued by the State without charge. The starting point for assigning emission allowances in Sweden is that the quantity of allowances for each plant should be determined on the basis of emissions from the plant over the period from 1998 to 2001. Other rules are used for determining emission allowances for plants started up in 2002 or later.

Emission allowances equivalent to 67,3 million tonnes of carbon dioxide were issued for the 2005-2007 period. In addition, a reserve allocation of 2,1 million tonnes was held back for issue to new participants. This latter group consists of new plants entering the market during the trading period, together with increases in capacity in existing plants. It is estimated that, in total, one-third of total Swedish carbon dioxide emissions are covered by the trading scheme in 2005-2007.

Nord Pool opened for trading of emission allowances in February 2005. By May 2005, 45 trading parties from ten countries had joined the Nord Pool trading exchange.

As with carbon dioxide taxation, the objective of emissions trading is to reduce carbon dioxide emissions, which means that there are at present two policy instruments targeting carbon dioxide emissions. The Government has promised to provide further information on the future of carbon dioxide taxation during 2005.

Support schemes

Both Sweden and the EU encourage expansion of electricity production based on renewable energy sources. In some cases, economic support is needed in order to make electricity from renewable energy sources competitive.

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, one of which is the Swedish Society for Conservation of Nature's 'Bra miljöval' ['Good environmental choice'] for electricity, which was introduced after the 1996 electricity

FACTS: The Emissions Trading Scheme

The purpose of emissions trading is to provide a cost-efficient way of reducing greenhouse gas emissions. Its effect is intended to be that reduction measures should be undertaken where the cost of reducing emissions is the lowest. Companies which would incur high costs to reduce their emissions can purchase emission allowances from companies having lower reduction costs. Companies emitting less carbon dioxide than the quantity for which they hold emission allowances can save the allowances for the rest of the trading period or sell the surplus to other companies. As the emissions trading scheme within the EU does not yet cover all emission sources for carbon dioxide, the cost-efficiency is limited.

Trading is determined by setting a cap for the amount of emissions allowed during a trading period. Each plant covered by the scheme then receives a number of emission allowances, which can be bought and sold. The price of the allowances is not set in advance, but is determined on the market for emission allowances. In addition to companies operating plants covered by the Emissions Trading Directive, individual persons and organisations may also participate in emission trading.

market reform. However, the Swedish Energy Agency has established that the voluntary systems have not succeeded in encouraging an expansion of renewable electricity production to the extent that would be desirable.[12] The various investment and operational subsidies are being progressively phased out and replaced by market-based systems.

The environmental bonus for wind power production remains, but will be progressively reduced, to be replaced in 2009 by support from the electricity certificate system. In 2005, this subsidy amounted to 9 öre/kWh of electricity produced in onshore wind power plants, and 16 öre/kWh of electricity produced in offshore wind power plants. The subsidy is payable to electricity producers selling electricity from wind power plants in Sweden.

Economic support systems in the other Nordic countries

Subsidies differ from one Nordic country to another, and also vary from one technology to another. In Denmark, consumers are required to purchase a certain proportion of 'priority' electricity, which is electricity produced by wind power or by decentralised waste-based or natural gas-based CHP. Priority electricity is more expensive than other electricity, and the price is determined by the authorities, which means that producers receive more for such electricity. Denmark also provides investment grants, amounting to 50 % of the capital cost, for converting coal-fired hot water boiler plants for district heating to natural gas-fired CHP plants. Finland provides an operational subsidy for small hydro power plants, wind power plants and biofuel-based electricity production, varying between 2 and 4 öre/kWh, depending on the type of production technology. Finland also provides investment grants for renewable energy sources and for energy efficiency improvement measures. Norway provides subsidies for wind power production, both for capital investment and for operational support. In addition, Norway is currently discussing implementing a green certificate system with a common market with Sweden.

The electricity certificate system

As part of the process of transferring support schemes from the State to the market, Sweden introduced a system of electricity certificates in May 2003. The purpose of the system is to increase the amount of electricity supplied by renewable energy sources by 10 TWh/year between 2001 and 2010. Electricity produced from wind power, solar energy, geothermal energy, wave energy, peat, certain biofuels and certain hydro power is entitled to certificates.

The system works by providing producers of electricity from renewable energy sources with certificates from the State, in proportion to the amount of electricity produced. Each MWh of such electricity is entitled to one certificate, which the producer can sell in parallel with the electricity that is produced. The effect is therefore that electricity production based on renewable energy sources becomes more profitable for the producers.

In order to create the necessary conditions for a trade in electricity certificates, electricity users are required to purchase a certain quantity of electricity certificates in proportion to the amount of electricity that they use, referred to as their quota obligation. In 2005, the quota obligation is 10.4 %, and this proportion will be progressively increased, reaching 16.9 % per year in 2010. The quota period is the same as the calendar year, and those required to purchase certificates must return them to the Swedish Energy Agency for redemption by 31st March each year. Electricity-intensive industries are exempted from having a quota obligation. In 2004, the quota-obligated electricity use was 95.2 TWh.

Parties failing to meet the obligation must pay a penalty charge to the State, calculated as 150 % of the

Table 4: Market statistics for the electricity certificate system, 2003–2004

	2003	2004
Quota obligation (number of certificates)	4,4 million	7,9 million
Number of certificates redeemed	3,5 million	7,8 million
Weighted average price	SEK 216	SEK 231
Quota obligation fulfilment	79 %	99 %
The state's revenue from penalty charges	SEK 181 million	SEK 17 million

SOURCE: SVENSKA KRAFTNÄT

[12] *The consumer and renewable electricity,* Swedish Energy Agency, 2004. [In Swedish.]

FACTS: Electricity certificate

The electricity certificate system is a market-based support system, with the purpose of increasing the proportion of electricity produced from renewable energy sources. Producers of electricity from renewable energy sources receive electricity certificates from the State, in proportion to the quantity of electricity that they produce. Each MWh of such electricity entitles the producer to one certificate, which can be sold by the producer in parallel with the electricity, thus generating revenue both from the sale of the electricity and from the sale of certificates. In order to create a demand for the certificates, electricity users are required to purchase a certain number of certificates in proportion to their electricity use, referred to as their quota obligation.

Electricity produced from wind power, solar energy, geothermal energy, wave energy, peat, certain biofuels and certain hydro power is entitled to certificates.

volume-weighted average price of electricity certificates during the previous year. During an initial period of 2003 and 2004, the penalty charges was capped at SEK 175 and SEK 240 respectively. In 2004, the average price of a certificate was SEK 231. Certificates have no expiry date, and may, thus, be saved between quota periods.

In 2004, the total quota obligation amounted to about 7.9 million certificates. About 7.8 million certificates were redeemed, giving a quota fulfilment of about 99 %, which can be compared with 77 % in 2003. The increase was partly due to the fact that the penalty charge was higher than the average price of certificates. Penalties levied in 2004 generated SEK 17 million, as against SEK 181 million in 2003. Table 4 shows market statistics of the electricity certificate system in 2003 and 2004.

The electricity suppliers are required to handle the quota obligations of their end-users, unless the end-user explicitly choses to manage his/her own obligation. The suppliers are entitled to charge customers for this service, and the price set for this service must be separately reported on the electricity bill. The price depends on the purchase price of certificates, the expected future price and the administrative costs involved in dealing with them.

Certificates equivalent to production of 11 TWh from renewable sources were issued in 2004. 8.1 TWh of this quantity was supplied by biofuels, 2 TWh by small-scale hydro power and 0.9 TWh by wind power.

Similar systems are in operation in other countries, such as Belgium, the UK, Italy, Australia and the USA. At present, Sweden is the only Nordic country that is operating an electricity certificate system. However, the Government and the EU have expressed their intention that electricity certificates should be internationally tradable in the future. In a report to the Government in December 2004, the Agency discussed expansion of the Swedish electricity certificate to include Norway.[13] The Agency is of the opinion that a joint Swedish/Norwegian market would enable the production targets to be achieved with greater cost-efficiency.

The Swedish Energy Agency and Svenska Kraftnät are responsible for administration and operation of the Swedish electricity certificate system.

[13] The consequences of an expanded electricity certificate market, Swedish Energy Agency 2005.

The electricity system

Electricity, as opposed to many other products, cannot be stored, and must therefore be consumed as it is produced, which means that production and consumption must always be in balance.

Electricity production

Swedish electricity production is based mainly on nuclear power and hydro power. In 2004, these two power sources provided over 90 % of the country's total electricity production, with the remaining 10 % being supplied by fossil-fuel and biofuel production and a small quantity of wind power. Total electricity production amounted to 148.2 TWh, which was an increase of 15.5 TWh over 2003. Hydro power supplied 59 TWh during 2004, which, although 10 % less than in a statis-

Table 5: Electricity production in Sweden, TWh

	1990	1997	1998	1999	2000	2001	2002	2003[2]	2004[2]
Production[1]	141,7	145,3	154,7	151,0	142,0	157,7	143,2	132,3	148,2
Hydro power	71,4	68,2	73,8	70,9	77,8	78,4	65,8	52,8	59,5
Wind power	0,0	0,2	0,3	0,4	0,5	0,5	0,6	0,6	0,8
Nuclear power	65,2	66,9	70,5	70,2	54,8	69,2	65,6	65,5	75,0
Conv. thermal power	5,1	10,0	10,1	9,4	8,9	9,6	11,3	13,2	12,9
Industrial CHP	2,6	4,2	4,0	3,9	4,2	3,9	4,6	4,7	5,4
CHP in district heating systems	2,4	5,6	6,0	5,6	4,7	5,6	6,3	7,9	7,5
Cold condensing, including gas turbines	0,0	0,2	0,1	0,0	0,1	0,1	0,4	0,6	0,0
Consumption	139,9	142,6	144,0	143,5	146,6	150,4	148,6	145,1	146,1
Of which distribution losses	9,1	10,7	10,9	10,6	11,1	11,9	11,8	10,6	11,2
Import-export	-1,8	-2,7	-10,7	-7,5	4,7	-7,3	5,4	12,8	-2,1

SOURCE: STATISTICS SWEDEN

[1] Net production, excluding own use.
[2] Figures for 2003 and 2004 are based on preliminary statistics.

Table 6: Available installed capacity in Sweden, MW

	1996 31 Dec	1997 31 Dec	1998 31 Dec	1999 31 Dec	2000 31 Dec	2001 31 Dec	2002 31 Dec	2003 31 Dec
Total installed capacity[1]	34 158	34 044	31 994	30 885	30 894	31 721	32 234	33 361
Hydro power[2]	16 203	16 246	16 204	16 192	16 229	16 239	16 097	16 143
Nuclear power	10 055	10 056	10 052	9 452	9 439	9 436	9 424	9 441
Conventional thermal power	7 795	7 620	5 564	5 026	4 985	5 753	6 374	7 378
Cold condensing	2 842	2 777	846	452	448	1 023[3]	1 356[3]	2 108[3]
CHP, district heating	2 464	2 354	2 246	2 248	2 264	2 340	2 462	2 572
Industrial CHP	776	776	841	841	932	929	957	979
Industrial CHP.	1 713	1 713	1 631	1 485	1 341	1 461[3]	1 599[3]	1 719[3]
Wind power	105	122	174	215	241	293	339	399

SOURCE: NORDEL, WITH FURTHER PROCESSING BY THE ENERGY MARKETS INSPECTORATE

[1] Installed capacity represents the simple arithmetical total of all individual units' net power available to the grid, and is not the same as the total available capacity at any particular point in time.
[2] Including the Norwegian proportion of Linnvasselv (25 MW).
[3] Including capacity in stations in Sweden covered by standby power capacity agreements. Sverige.

tically average year, was 11 % higher than in 2003. The eleven Swedish nuclear power reactors produced 75 TWh in 2004, which is the highest annual nuclear production so far in Sweden. Wind power increased by a third from 2003, rising to 0.8 TWh. Conventional thermal power production provided 12.9 TWh. Table 5 shows the details of the Swedish electricity production, broken down by energy source.

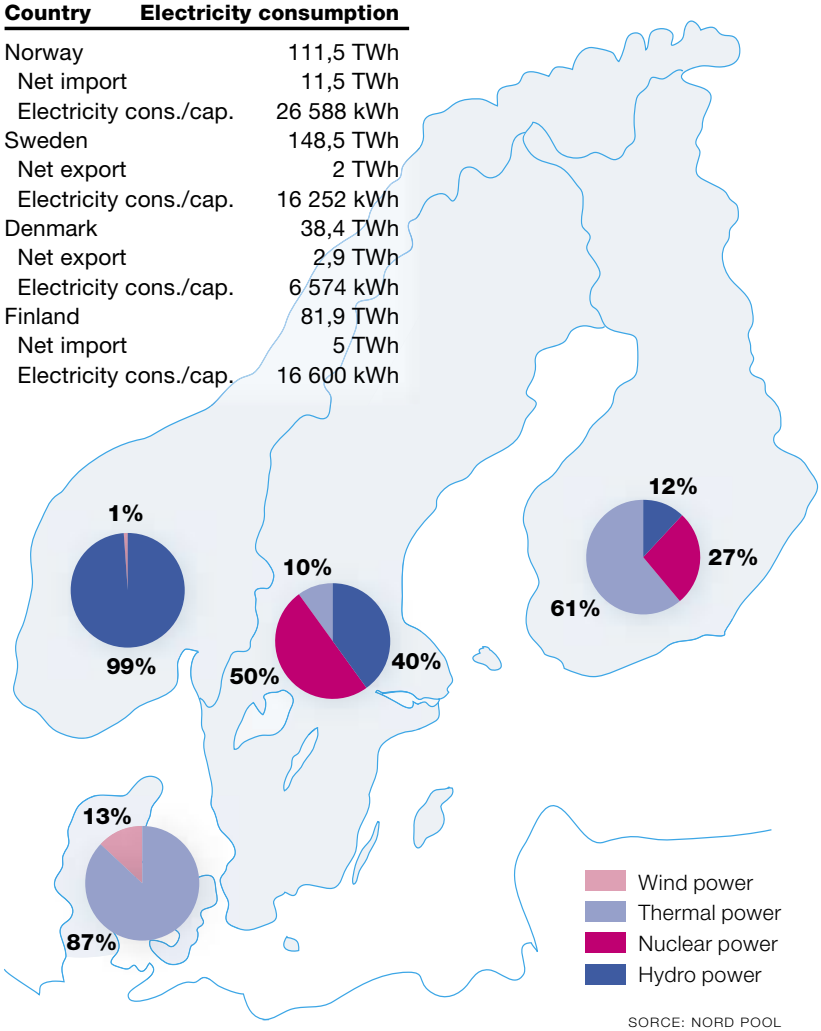
Electricity production varies in parallel with electricity consumption, which means that production and consumption is higher during the winter than during the summer. Maintenance of the nuclear power stations is therefore normally scheduled for the summer, when the demand for electricity is at its lowest. The reservoirs for hydro power production fill during the spring and summer, with the stored water then being used during the winter until the next spring flood from melting snow occurs.

Installed capacity

Table 6 shows the changes in installed capacity in Sweden since 1996. It can be seen that it has fallen considerably since the deregulation of the market, with most of the reduction occurring in conventional thermal power production capacity. Bearing in mind that, over the same period, electricity production has increased, the reduction in installed capacity means that there is less standby capacity in the Swedish electricity production system. Since the winter of 2000/2001, available installed capacity in cold condensing power stations and gas turbine power stations has increased as result of Svenska Kraftnät purchasing standby capacity. (See page 33 for further details.)

Figure 2: Electricity production and consumption in the Nordic countries 2004

Country	Electricity consumption
Norway	111,5 TWh
Net import	11,5 TWh
Electricity cons./cap.	26 588 kWh
Sweden	148,5 TWh
Net export	2 TWh
Electricity cons./cap.	16 252 kWh
Denmark	38,4 TWh
Net export	2,9 TWh
Electricity cons./cap.	6 574 kWh
Finland	81,9 TWh
Net import	5 TWh
Electricity cons./cap.	16 600 kWh



SORCE: NORD POOL

Table 7: Electricity consumption in Sweden, TWh

	1990	1997	1998	1999	2000	2001	2002	2003[1]	2004[1]
Industry	53	52,7	53,9	54,5	56,9	56,2	55,7	54,5	56
Residential, service etc.	65	69,6	69,9	69,1	69	73,1	72,5	72,1	72,3
of which electric heating	25,8	26,1	23,9	21,5	21,4	22,2	22,1	21,8	21,8
domestic electricity	17,9	18,6	19,4	16,9	17,7	19,2	19,5	20,1	20,1
building services systems	21,3	24,9	26,6	30,7	29,9	31,7	31	30,2	30,4
Transport	2,5	3	2,8	3	3,2	2,9	2,9	2,8	2,8
District heating, refineries	10,3	6,8	6,6	6,3	6,5	6,3	5,7	5,1	3,8
Distribution losses	9,1	10,7	10,9	10,6	11,1	11,9	11,8	10,6	11,2
Total consumption	139,9	142,6	144	143,5	146,6	150,4	148,6	145,1	146,1
Total consumption, temperature-corrected	143,1	143,3	145	144,8	149,5	151,3	149,7	145,6	146,1

SOURCE: SCB

[1] Figures for 2003 and 2004 are based on preliminary statistics.
Note: Domestic electricity and electric heating in 2004 have been assumed to be the same as for 2003, as statistics for detached houses, apartment buildings and commercial premises will not be available until the summer of 2005.

Electricity production in Denmark, Norway and Finland

Almost all electricity production in Norway is based on hydro power, with only about 1 % of supply coming from wind power. Electricity production in Denmark is based mainly on the use of coal and natural gas in CHP plants and cold condensing power plants. In addition, Denmark has a relatively high proportion of wind power production. Finland's electricity production is based on hydro power, conventional thermal power and nuclear power. Figure 2 shows electricity production in the Nordic countries, by power source.

Electricity consumption

Electricity consumption in Sweden varies with the ambient temperature, as space heating of residential buildings and commercial premises accounts for a considerable proportion of electricity use. In 2004, total electricity consumption in Sweden amounted to 146.1 TWh, with the residential and service sector accounting for about half of this, and industry for about 40 %. Table 7 shows the changes in the pattern of electricity consumption from 1990. During the 1970s and 1980s, electricity consumption in Sweden increased at a rate of over 4 % per year: over the period from 1990 to 2004, this annual increase had fallen to less than 0.5 %. After correction for a normal climate year, the annual increase drops still further, to about 0.15 %.

Electricity consumption in Denmark, Norway and Finland

Total electricity consumption in the Nordic countries in 2004 amounted to about 380 TWh, of which 146 TWh were in Sweden, 115 TWh in Norway, 85 TWh in Finland and 35 TWh in Denmark. Industry accounts for a considerable proportion of electricity consumption in Norway and Finland, amounting to 40 % and 54 % respectively in the two countries. This is because both countries have a high proportion of electricity-intensive industries, as does Sweden. In Denmark, which has a different industrial structure, industry accounts for only 27 % of electricity consumption. Instead, a greater proportion of the country's electricity is used in agriculture, as well as in the residential and service sector. All the Nordic countries apart from Denmark have high electricity consumption per capita in comparison with other countries.

The peak load problem in Sweden

The power balance of an electricity system describes its ability to balance demand (consumption) with supply (production). In recent years, demand in Sweden has reached very high levels, with maximum demand occurring during severe winter weather. Maximum demand hitherto in Sweden occurred in February 2001, amounting to about 27 000 MW.

During the years before reform of the electricity market in 1996, the major power utilities had reached agreement on the amount of peak load capacity each would hold. However, as a result of the reform of the market, these agreements ceased to apply, leading to the producers decommissioning a considerable amount of their peak load capacity, as the plants were seldom used and did not therefore justify their costs. However, electricity demand has continued to increase, with the result that there is a risk of insufficient generating ca-

pacity being available. If this occurs, it is necessary to temporarily disconnect supplies to parts of the country.

The Act Concerning Standby Power Capacity came into force on 1st July 2003. Under the Act, the Swedish transmission system operator, Svenska Kraftnät, is responsible for purchasing standby power capacity not exceeding 2 000 MW per year until 2008.[14] This is done by Svenska Kraftnät reaching agreements with producers to make additional production capacity available, or with users to reduce their demand. The Act applies until the end of February 2008, at which time Svenska Kraftnät's responsibility for standby power capacity will cease and be replaced by a market-based arrangement. In 2004, the negotiated standby capacity amounted to 1970 MW.

Transmission of electricity

Electricity is transmitted from power stations to users over transmission and distribution networks. In Sweden, these are divided into three levels: the national grid, regional networks and local networks (distribution networks). The national grid consists of 220 kV and 400 kV lines, and is owned by Svenska Kraftnät. The regional networks connect to the national grid, and operate at a lower voltage, usually 70-130 kV. They carry electricity from the national grid to the local networks, and in some cases directly to larger electricity users. Most of the regional networks are owned by the large electricity producers. The local networks connect to the regional networks, and supply electricity to domestic users and to most industries. These networks normally operate at 20 kV, with power being transformed down to the normal domestic voltage of 400/230 V. The local networks are owned primarily by the major electricity producers and by local municipalities.

Security of supply in transmission and distribution

Security of supply has become increasingly important in Sweden. One way of obtaining an overview of security of supply is to look at the relationship between the length of overhead lines and the length of underground cables. Table 8 shows how this proportion has changed over the period 2000–2003. It can be seen from the table that it is mainly in the local networks that the proportion of underground cable has increased. However, it should be pointed out that underground cables is not done only in order to increase the security of supply, but also for environmental, space or aesthetic reasons.

Another way of obtaining a picture of security of supply and efficiency of electricity transmission and distribution is to look at developments in interruptions to supply. Table 9 shows statistics for supply failures and their average durations over the period 1999–2003.

Table 8: Lengths of overhead lines and underground cables in the Swedish electricity system, km

	2000	2001	2002	2003
Regional networks				
Overhead lines	30 519	30 229	30 026	30 638
Underground cables	478	396	473	691
Proportion of cables in proportion to total network length	1,5 %	1,3 %	1,6 %	2,2 %
Local networks				
Overhead lines[1]	225 267	227 698	217 933	211 153
Underground cables[1]	249 500	255 597	259 285	263 803
Proportion of cables in proportion to total network length	53 %	53 %	54 %	56 %

SOURCE: THE ENERGY MARKETS INSPECTORATE AND SVENSKA KRAFTNÄT

[1] HV and LV cables.

A supply failure is defined as partial or total loss of supply to a subscriber for more than three minutes. However, on the basis of the material available to the Inspectorate, it is difficult to draw any detailed conclusions concerning trends in security of supply in respect of transmission and distribution of electricity.

Svenska Kraftnät maintains the country's system balance

Svenska Kraftnät is responsible for maintaining the balance between the production and consumption of electricity in Sweden. This task is performed by the Operating Balance Service, which monitors the electricity balance in the short-term and keeps the frequency of the networks at 50 Hz. Deviations in frequency occur when the planned production of electricity does not correspond with the actual consumption.

Svenska Kraftnät collaborates with thirty or so players, known as balance providers. Through agreements with Svenska Kraftnät, these have assumed the balance

[14] The Act Concerning Standby Power Capacity (2003:436).

Table 9: Interruptions to supply at local network level in Sweden

	1999	2000	2001	2002	2003
No. of interruptions per customer					
Notified	0,47	0,26	0,24	0,26	0,21
Not notified	1,43	0,93	1,13	0,92	0,93
Average duration of interruption, minutes					
Notified	64	37	34	37	25
Not notified	142	81	143	86	98

SOURCE: STATISTICS SWEDEN AND THE ENERGY MARKETS INSPECTORATE

Note: The values for the number and duration of interruptions are average values for all local networks throughout the country.

FACTS: Congestion Management

Market splitting is used to deal with bottlenecks that occur or are foreseen in the planning phase. On the Nordic electricity market, this is done via Nord Pool. When calculating Nord Pool's equilibrium price for electricity (the system price), no allowance is made for grid transmission capacity. If the capacity is sufficient to achieve equal prices within the trading area, then the system price will apply in all areas. However, if the quantity of power that the market wishes to transfer between areas at the current system price exceeds the actual physical capacity, then the market is divided up into two or more price areas. This means that there will be a higher price of electricity in deficit areas, and a lower price in surplus areas. In the long term, the price indicates a need for investments and to locate production in deficit areas and use in low-price areas.

Counter trading is used to deal with bottlenecks that arise in real-time operation. If the flow of electricity anywhere in the grid exceeds the permissible amount, the system operator orders an increase of production in the deficit area and/or a reduction of production in the surplus area. The resulting costs for such trading fall upon the system operator, and provide a signal that the capacity of the grid needs to be increased.

A third method of dealing with bottlenecks is to **limit imports and/or exports**. This means that the system operator deals with an internal bottleneck by limiting available grid transmission capacity between his area and other price areas.

responsibility for one or more electricity consumers. Balance responsibility entails assuming the financial responsibility for Sweden's electricity system, hour by hour, being supplied with the same amount of power that is being used by the electricity consumers for whom the balance responsibility has been assumed.

The balance provider creates a balance between his supply and consumption by planning his production, if he engages in this, and by buying and selling power through trade with other balance providers, and on the power exchange Nord Pool.

Deviations in frequency arising during the operating phase, due to balance providers not being able, in most cases, to create a perfect balance, are corrected by Svenska Kraftnät's Balance Service during the hour of delivery itself (balance regulation). The price of regulation is set for each hour of delivery and the cost of each balance provider's imbalance between supply and consumption is later calculated in the balance settlement..

Bottlenecks

Demand for cross-border transfer of electricity within the Nordic electricity market varies, depending on such factors as the weather and variations in production and use. The transmission grid does not have the capacity to deal with all possible variations, and so restrictions on capacity, known as bottlenecks, can occur. Various methods are used on the Nordic electricity market to deal with bottlenecks (see the panel). Bottlenecks that occur during the planning phase are dealt with by splitting the market into different geographical areas, so-called price areas. This is employed internally in Norway, and also between the Nordic countries. Import and export capacity limitations are applied to varying extents in order to deal with foreseen bottlenecks within or between the Nordic countries, while bottlenecks that occur during operation in real time are dealt with by counter trading.

In a report to the Government in November 2004, the Swedish Energy Agency has described the effects of present methods of dealing with transmission limitations in Sweden and the Nordic countries.[15]

One way of reducing the risk of bottlenecks occurring is to increase the transmission capacity. In general, this is expensive, and cannot always be justified from a socio-economic point of view. Nordel, the joint association of transmission system operators in the Nordic countries, has identified five areas where grid capacity should be increased. The objective of these investments is to prevent grid overloads and to improve the Nordic security of supply of electricity.

The other Nordic countries

85 % of the national grid in Norway is owned by Statnett, which is the Norwegian system operator. Statnett is responsible for operation and expansion of the entire grid, as well as for maintaining network balance. In Denmark, EnergiNet Danmark is the system operator. EnergiNet Danmark owns the national grid and cross-border connections to Sweden and Germany. Prior to 2005, the grid was operated by two companies, Eltra and Elkraft. In Finland, Fingrid is the system operator, and owns the country's national grid as well as the cross-border connections. Fingrid is responsible for operational security in the Finnish electricity system, and also maintains system balance and assigns costs for imbalances.

The market

The price of electricity on the competitive Nordic electricity market is determined by supply and demand. The parties involved in the market are electricity producers, electricity traders, network utilites and end users.

The electricity market in Sweden is characterised by vertically integrated companies, i.e. companies that control activities in electricity production, distribution, and electricity trading. Vattenfall, Fortum and Sydkraft are major parties in Sweden and the Nordic

[15] *Hantering av begränsningar i det svenska överföringssystemet för el – Ett nordiskt perspektiv [Handling of limitations in the Swedish electricity transmission system – A Nordic perspective],* Swedish Energy Agency 2004.

countries in terms of electricity production, electricity distrubution and electricity trading.

The bulk power market

An electricity producer owns a production plant and sells electricity to electricity trading companies, the electricity exchange or directly to end users.

The structure of the bulk power market

Electricity production in Sweden is dominated by a small number of companies. In 2004, the three largest companies – Vattenfall, Fortum and Sydkraft – accounted for 86 % of the country's total electricity production, with Vattenfall alone supplying 47 % of the country's electricity. From a Swedish perspective, the bulk power market is highly concentrated. From a Nordic perspective, the three largest electricity producers had about 40 % of the total Nordic electricity production. Tables 10 and 11 show the largest electricity producers in Sweden and the Nordic countries.

Vattenfall AB is owned by the Swedish State, and is the largest producer of electricity in the Nordic countries. Its main operating activities are in Sweden and Germany, although it also has activities in Norway, Finland, Denmark, Poland, South America and south-east Asia. In 2004, it produced over 70 TWh of electricity in the Nordic countries. Its production in the Nordic countries is based primarily on hydro power (41 % of total electricity production) and nuclear power (58 %). Its production mix in Germany is different, with 73 % of production based on fossil fuels. In May 2005, Vattenfall entered into an agreement with the Danish company, Dong, to take over about 24 % of the production capacity in Danish E2/Elsam. In addition, during the year, Vattenfall bought the Örestad wind power farm. Through these actions, Vattenfall reinforced its position as the largest producer of electricity in the Nordic countries in 2004. In addition, during the year, it increased its ownership proportion in the Polish GZE electricity trading and distribution company from 54 % to 75 %.

The majority owner of Fortum is the Finnish State. In 2004, the company produced more than 51 TWh of electricity in Nordic countries. It has exercised a purchase option on E.ON Finland, which gives it 65.6 % of the share capital. In addition, Fortum has increased its proportion of ownership in the Russian OAO Lenenergo power company, acquired 85 % of the shares in the Polish PESC Czestochowa district heating company and increased its ownership proportion in the Finnish Gasum Oy.

The major shareholders in Sydkraft AB are the German E.ON, with 55 %, and the State-owned Norwegian Statkraft, with 44 %. Sydkraft is planning to change its name at the end of the summer 2005 to E.ON Sweden AB. In 2004, Sydkraft produced 34 TWh of electricity in the Nordic countries. In October 2004, Sydkraft's majority owner, E.ON, reached an agreement in principle with Statkraft concerning the sale of production capacity. Under the agreement, Sydkraft will sell 1.6 TWh of hydro power production

Table 10: Sweden's largest electricity producers and their production in Sweden, TWh

	2002	2003	2004	Proportion in Sweden
Vattenfall	70,3	61,5	70	47,2 %
Sydkraft	28,5	27,1	33,9	22,9 %
Fortum	24,5	24,7	24	16,2 %
Skellefteå	3,4	2,4	3,1	2,1 %
Others	16,6	16,6	17,2	11,6 %
Total in Sweden	143,3	132,3	148,2	100 %

SOURCE: SVENSK ENERGI

Note: The figures relate only to production in the respective companies´ own wholly-owned plants.

Table 11: The Nordic countries'[1] largest electricity producers and their production in the Nordic countries, TWh

	2002	2003	2004	Proportion in the Nordic countries
Vattenfall	70,6	61,8	70,5	18,6 %
Fortum	46,5	51,2	50,7	13,4 %
Statkraft SF	34	32,5	34,3	9,1 %
Sydkraft	28,5	27,1	34	9 %
Pohjolan Voima OY	16,6	18	17,7	4,7 %
Teolisuuden Voima	14,9	15,7	15,9	4,2 %
Elsam	16,2	18,	14,6	3,9 %
E2	12,5	14,1	10,8	2,8 %
Others	143,3	124,9	130,5	34,4 %
Total, Nordic countries	383,1	363,3	379	100 %

SOURCE: SVENSK ENERGI AND COMPANIES' ANNUAL REPORTS

[1] Exkluding Iceland

Note: The figures relate only to production in the respective companies' own wholly-owned power plants.

Table 12: Percentage of the year for which price areas have been isolated from other areas

	1998	1999	2000	2001	2002	2003	2004
Stockholm	3,2	0,6	5,5	0	0,1	0	0,1
Oslo	22,9	33,2	55	8,9	25,4	23,8	24,2
Tromsö	23,1	36,6	41,7	23,8	21,9	10,9	26,8
Helsinki	-	4	15,8	0,9	5	29,2	23,9
Jylland/Fyn	-	33,8	44,8	19,1	40,1	48,9	30,5
Zealand	-	-	7,2	5,4	9,3	2	6

SOURCE: NORD POOL

capacity to Statkraft, which is equivalent to about 5 % of the company's total production capacity.

The Swedish bulk power market is part of a larger common Nordic market, which includes all the Nordic countries apart from Iceland. Electricity is bought and sold on the market via the Nordic power exchange, Nord Pool. For parts of the year, the price of electricity on Nord Pool's electricity spot market is the same in all countries. During these periods, the high concentration of companies on the Swedish bulk power market does not distort competition as, in a Nordic perspective, the companies do not have sufficient market power to upset competition.

However, the bulk power transmission grids in the Nordic countries have some limitations in terms of transmission capacity, known as bottlenecks. As described above, internal bottlenecks in Norway, together with those between the Nordic countries, are dealt with by splitting the market. This means that the market in the Nordic countries is divided up into a number of price areas at times when the transmission capacity is insufficient to meet all demands in respect of cross-border transmission of electricity.

Bottlenecks in the grid result in the formation of smaller sub-markets within the larger Nordic market. As a result, at times, individual power producers may be able to influence the market price, and therefore push prices up above their marginal costs.

The price areas most generally formed within Nord Pool are Sweden, Finland, Jutland/Fyn, Zealand, Oslo and Tromsø. During periods of extensive bottlenecks, the Norwegian electricity market may be divided up into further sub-areas. Table 12 shows the percentage number of hours when the price in a given electricity spot area is isolated from all other price areas. It can be seen that Sweden (Stockholm) is the price area that has been the least isolated from other price areas. This is due partly to Sweden's central position in the Nordic electricity system, and partly to the many connections from Sweden to other countries.

The Swedish price area often constitutes a common price area with eastern Denmark and/or Finland, although it can also form combinations with other price areas. For over 25 % of 2004, there was a common price for electricity throughout the Nordic countries.

FACTS: Nord Pool

Nord Pool organises physical and financial trading in electricity, and also provides clearing services.

The physical market is served by Elspot and Elbas. Elspot is a day-ahead market for short-term trading in physical electricity contracts. The system price of electricity (the spot price) on the Elspot market is determined one day in advance for every hour of the day. This price is an equilibrium price, based on the sum of all buying and selling bids. Elbas is a physical adjustment market for trading in electricity in hourly contracts in Sweden and Finland, with trading available up to one hour before delivery of the power at any time during the day.

Traders on the financial market can buy futures to protect the price of electricity against changes in the spot price up to four years ahead, which is done through the Eltermin and Eloption products. Traded units can be for 24-hour, weekly, block, seasonal or yearly contracts. Eloption is a financial instrument for risk management and price setting of future revenues and costs associated with trading in electricity contracts.

Nord Pool's clearing service means that Nord Pool Clearing participates in power contracts as a party to the contract. This reduces the financial risk for those who have negotiated the contract. Nord Pool Clearing charges a clearing fee, and requires the companies involved to deposit a security based on their portfolio in order to cover the risk taken by Nord Pool.

Electricity trading on the bulk power market

Electricity is bought and sold on the Nordic electricity market on a competitive basis via bilateral agreements or via Nord Pool. In 2004, over 40 % of the electricity traded in the Nordic countries was traded via Nord Pool.

Bilateral trading

Bilateral agreements are not traded on an organised market, but are arranged by brokers. In addition to arrangement via brokers, contracts may also be entered into directly between the parties concerned. Contract prices agreed in bilateral trades are confidential, and the parties concerned are under no obligation to publish the information.

Nord Pool

The Nord Pool price is published daily, and forms a reference for bilateral trade. Prices are established both for the following day and for longer periods. The daily prices are decided on the spot market. Nord Pool also provides a financial market, where parties can trade in standardised financial contracts up to four years ahead. By setting a desired price for electricity in advance, all parties involved can more easily plan their economics, i.e. future revenues and costs.

The advantage of a Nordic electricity exchange is that the Nordic power plants can be operated in an economically optimum manner. First in the order of merit are those plants that have the lowest marginal costs, i.e. hydro power plants and nuclear power plants. As demand increases, more expensive plants are brought on line, i.e. those burning fossil fuels. Another advantage of trading via an exchange is that the transaction costs are lower than

they would be in connection with bilateral agreements.

Nord Pool ASA is owned in equal parts by the system operators in Norway (Statnett) and Sweden (Svenska Kraftnät). Nord Pool Spot, which organises the physical trade in electricity, is owned as follows: 20 % each by Nord Pool ASA, Svenska Kraftnät, Statnett and Fingrid, with the Danish system operators Elkraft and Eltra each owning 10 %.

The parties trading on Nord Pool consist of power producers, distributors, industrial companies and other end users, as well as investment companies. On 1st January 2005, there were 397 registered parties on Nord Pool, representing an increase of 13 % over the previous year. Most of those active in Nord Pool are registered in the Nordic countries, although the proportion of those from other countries has increased in recent years. In 2004, about 90 % of the parties in Nord Pool were registered in the Nordic countries, with the remainder from seven non-Nordic countries.

In 2004, the Nord Pool physical market turned over 167 TWh of electricity, which is an increase of over 40 % in comparison with the previous year. Nord Pool's explanation for this is that there was a substantial reduction in the charge paid by companies having both purchase and selling portfolios on the spot market with effect from 1st January 2004. The transparency of the electricity market improves as a greater proportion of electricity is traded via the exchange.

Trade in the financial market increased by 8 % in comparison with 2003, and amounted to 590 TWh. In addition, 1 207 TWh were cleared in bilateral standardised contracts during 2004.

The Nord Pool market is in a state of constant development: it has been possible to trade in electricity certificates since the spring of 2004, and in emission allowences since February 2005.

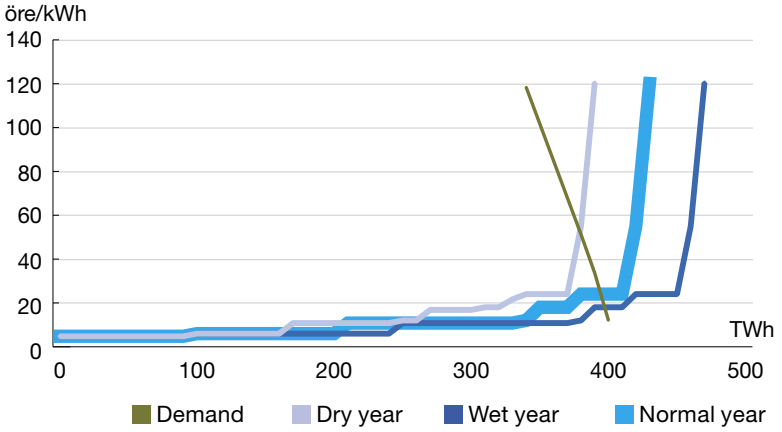
The price of electricity varies with the availability of water

The spot price of electricity on the Nordic market varies widely, both within and between years. In the short term, the price is considerably affected by the amount of precipitation.

The spot market price of electricity on the Nord Pool exchange is set hourly, with producers and consumers making sale and purchase bids, after which the price is set as a balance between supply and demand. The supply curve for the Nordic production system can be illustrated by a stepwise diagram of the variable costs for the different types of production. These variable costs include operation and maintenance costs, fuel costs and taxation. In the case of combustion-based power production, it is the fuel cost that constitutes the largest element. Wind and hydro power have the lowest variable production costs in the Nordic electricity supply system, and are therefore first in order of merit. They are followed by nuclear power, CHP, and oil- and coal-fired cold condensing power. Gas turbines have the highest variable costs in the system.

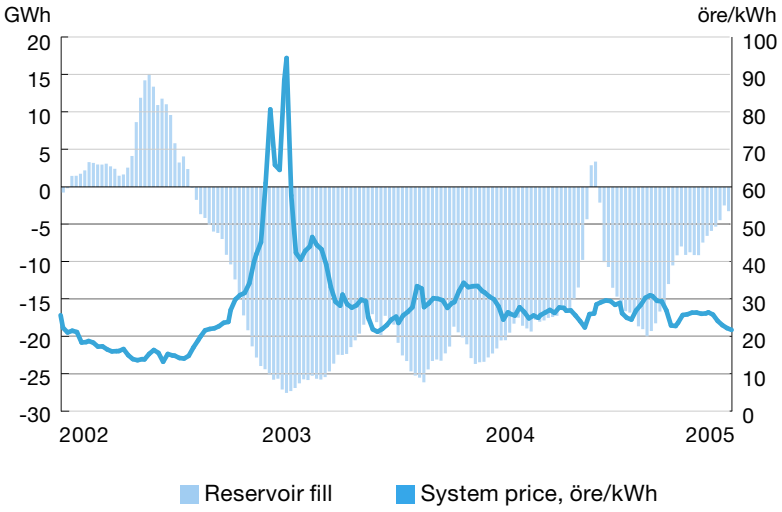
The Nordic electricity supply system is very dependent on the hydro power systems in Norway and Sweden. Inflow to reservoirs in the two countries is generally fairly similar, thus if inflow is low in Norway, it is likely also to be low in Sweden. On a Nordic basis, this means that hydro power production varies considerably between dry years and wet years.

Figure 3: The electricity system in the Nordic countries, showing availability in normal, dry and wet years



SOURCE: THE ENERGY MARKETS INSPECTORATE

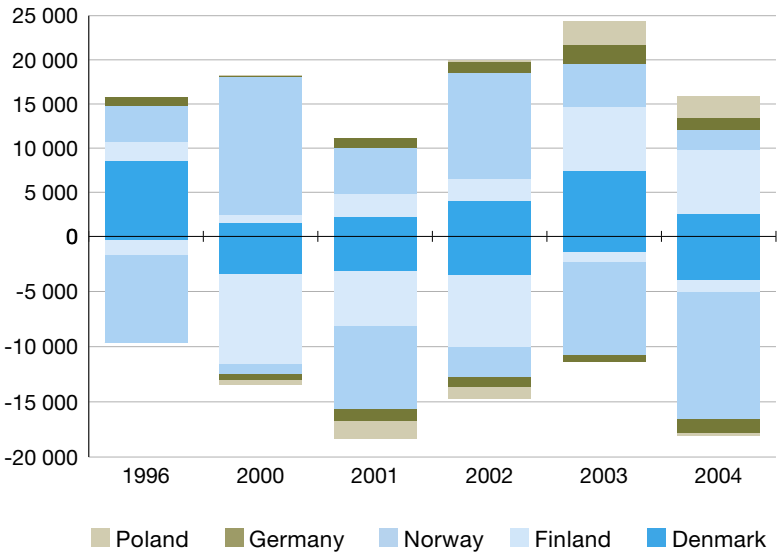
Figur 4: The relationship between Nord Pool's system price and the degree of reservoir fill in the Nordic reservoirs.



SOURCE: NORD POOL

Note: The prices shown in the diagram are expressed in nominal values, i.e. without allowance for inflation.

Figure 5: Sweden's import and export of electricity, GWh



SOURCE: SWEDENERGY

Although, in the long run, the amount of precipitation is relatively stable, the short-run variations, both between years and within years, can be considerable. The amount of hydro power available determines the need for other forms of production. Figure 3 shows how the varying availability of hydro power affects the supply curve on the Nord Pool spot market. It can be seen that the availability of hydro power has a considerable effect on the price level of electricity on the exchange.

Figure 4 shows the relationship between the system price and the levels in the Nordic hydro power reservoirs over the period 2002–2004. 2002 was an extremely dry year in the Nordic countries, which meant that it was necessary to bring more expensive forms of electricity production on line in order to meet the demand for electricity, which therefore pushed up the system price on Nord Pool. The system price remained at a high level in 2003, and it was not until the end of March that it fell below 30 öre/kWh. This can be compared with earlier years, during which the price exceeded 30 öre/kWh on only a few occasions. At the beginning of 2004, the reservoirs were only 53 % full. However, as a result of considerable precipitation, particularly during the autumn, this had risen to 70 % by the end of the year, which helped to bring down the system price. The average Nord Pool system price in 2004 was 26.4 öre/kWh, or 20 % lower than in 2003.

Sweden's import and export of electricity, 2004

In 2004, Sweden had a net export of 2 TWh of electricity, which can be compared with a net import of 12.8 TWh in 2003. This net export was due mainly to high output from the nuclear power stations, in combination with an only slightly rising demand for electricity. Figure 5 shows Sweden's imports and exports of electricity since 1996. In 2004, the Nordic countries as a whole had a net import of about 12 TWh, supplied mainly by Russia, Germany and Poland

The trade flows of electricity between the Nordic countries are determined largely by the levels for Nordic water reservoirs. During the winter, when inflow to the reservoirs is low and the demand for electricity is high, both Sweden and Norway have a greater need of imports. The two countries therefore import electricity from a number of countries, including Denmark and Finland, which have a high proportion of cold condensing power production. During the spring and summer, the Swedish and Norwegian reservoirs are generally well-filled, and electricity use is low. During these periods of the year, the two countries therefore normally become net exporters of electricity.

The end-user market

Trading in electricity is exposed to competition. As opposed to the bulk power market, electricity trading on the end-user market is mainly restricted to national boundaries. This is because customers purchasing electricity from other countries have to be responsible for the effects of their own consumption on system energy balance, which involves considerable costs and is technically complicated. Swedish end users therefore normally buy electricity from retailers that are established in Sweden, and which have agreements concerning responsibility for maintenance of system balance with Svenska Kraftnät.

The electricity supplier purchases electricity from a producer and resells it to electricity users. The compa-

FACTS: Consumer's Electricity Bureau

The Consumers' Electricity Advisory Bureau is an independent bureau which provides cost-free advice and guidance on various aspects of the electricity market to consumers. It provides information, for example, on applicable legislation and other rules, and explains how they are normally applied by companies in the electricity sector. Consumers can contact the Bureau when they want to know how the electricity market works in respect of matters such as types of contract and prices, comparisons of electricity suppliers, change of suppliers and legislation and other regulations. The Bureau's duties also include identification of consumer problems as experienced in the electricity market. These problems are then presented to concerned public authorities and companies in the electricity sector.

ny may also produce electricity, in which case it acts as both producer and supplier. Customers are free to choose from which electricity supplier they want to purchase their electricity.

The number of electricity suppliers on the Swedish end-user market has fallen since the market was restructured. At that time, there were over 220 electricity suppliers in Sweden: by 2004, this number had fallen to about 150 suppliers registered with Svenska Kraftnät. According to the final report of the Electricity and Gas Market Commission, about a hundred of the suppliers were actively selling electricity to end users, and with about 20 of them (i.e. of the hundred active suppliers) operating throughout the country. The substantial fall in the number of suppliers can be essentially explained by two factors: several electricity suppliers have been sold, often to one of the larger power-producers, and a number of other trading companies have merged.

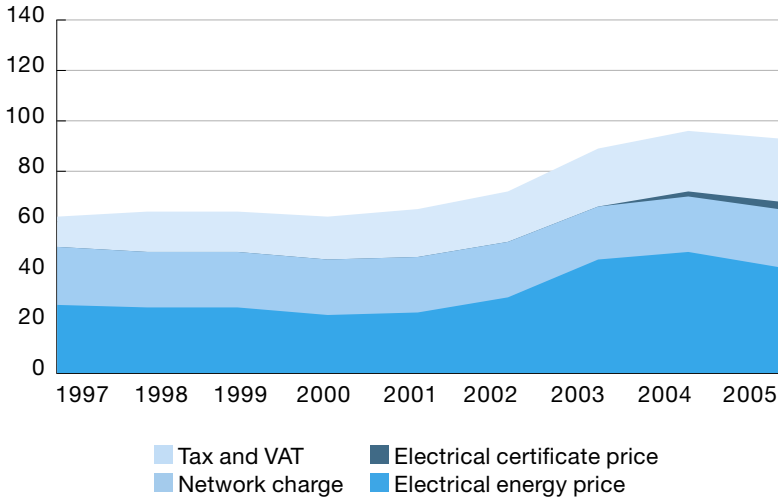
In 1996, the three largest electricity suppliers had a market share of over 30 %. By 2004, the three largest suppliers – Vattenfall, Sydkraft and Fortum – had a market share approaching 50 %, which is equivalent to about 2.5 million customers. If these suppliers' affiliated companies are included, this market share rises to almost 60 %. In addition, it can be noted that foreign ownership of electricity suppliers in Sweden has increased from about 10 % in 1996 to about 40 % in 2004.

According to Svenskt Kvalitetsindex, 43 % of Swedes were dissatisfied with their electricity supplier in 2004[16]. Although aware of the efforts that the electricity suppliers were making in the fields of service and information, customers did not feel that they had actually seen any results. In order to improve customer service and to strengthen consumer protection, the electricity sector (Swedenergy) has joined together with the Swedish Energy Agency and the National Consumer Agency to establish a service bureau under the name of the Consumers' Electricity Advisory Bureau (see below).

A prerequisite for a working and effective electricity market is the presence of active customers. Changing electricity suppliers, or renegotiating a contract with the present supplier, are the ways in which customers can act on the market. Customers making active choices provide a driving force for electricity suppliers to compete through low prices, attractive contract terms and good service. If customers are to be active, they need information on operation of the electricity market, on choices open to them and how to change supplier. Such information must be easily available and easy to understand. The National Consumer Agency (www.konsumentverket.se) has been displaying a purchasing guide, with price comparisons, since 2001.

On behalf of Swedenergy, Temo has carried out surveys to investigate the pattern of behaviour of domestic users on the electricity market. 54 % of those interviewed had changed their electricity suppliers or renegotiated their contracts with their existing supplier between 1996 and the autumn of 2004. This represents an increase of almost 10 % in comparison with the autumn of 2003. The number of changes of supplier is greatest

Figure 6: Composition of the electricity price for a typical domestic customer[1], öre/kWh



SOURCE: STATISTICS SWEDEN AND THE ENERGY MARKETS INSPECTORATE

1 Detached house with electric heating in southern Sweden

Note: The electrical energy price is based on an open-ended contract.

Note: The values in the figure are expressed in 2005 price levels (January). The price of the electrical energy has been deflated using a consumer price index excluding energy raw materials..

16 Svenskt Kvalitetsindex (SKI) is a system for collecting, analysing and disseminating information on customers' expectations, views on quality and evaluations of goods and services. The system has been initiated by a consortium consisting of SIQ (Swedish Institute of Quality Development), Statistics Sweden, the Stockholm School of Economics and the Centre for Service Research at the University of Karlstad.

Table 13: Electricity trading companies' customers by types of contract, per cent

	Open-ended contracts	1-year contract	Fixed price contract 2-year contract	3-year contract	Variable-price contract
2002	63,7	16,6	10,4	7,2	2,2
2003	65,2	11,4	9,2	11,4	2,8
2004	58,1	13,7	8,5	15,7	4
2005	52,5	17,6	9,6	16,9	3,7

KÄLLA: SCB

in the major urban regions, while the number of renegotiated contracts is greatest in sparsely populated areas. According to Temo's survey, almost 90 % of the customers who had changed their electricity suppliers during the period were pleased with the results.

In order to receive a supply of electricity, the customer must have an agreement with his local network company utility (distribution company). For this, the customer pays a fee known as the network fee. The network company is responsible for metering and reporting the customer's electricity consumption to the electricity supplier. As the network activity – i.e. operation and maintenance of the local distribution network and transport of electricity over it – is operated as a monopoly, customers are not free to choose their network companies.

There are over 180 network companies in Sweden, with over five million customers connected to their networks. The largest network companies – Vattenfall Eldistribution, Fortum Distribution and Sydkraft Nät – each have over 900 000 customers spread over several network areas. The smallest network companies have less than 1 000 customers. Electricity distribution in urban areas is often provided by local authority-owned companies, while the large power companies by tradition have a strong position in urban areas.

FACTS: Electricity Market Contracts

Customers have to sign two contracts in order to obtain a supply of electricity. One provides connection to the electricity distribution system, by signing a network contract with the local network company. The second agreement relates to the supply of the electricity itself, and for this customers may sign up with any electricity supplier of their choice. There are various forms of supply contracts: the three most common forms for consumers are open-ended contracts, fixed price contracts and variable price contracts.

Customers will have an **open-ended contract** if they have not actively signed a contract with a supplier concerning the price of electricity. The open-ended price of electricity is generally higher than the price under other alternatives. The price can also be changed during the year, but is less likely to change than the price under a formal variable-priced contract.

Fixed price contracts agree a fixed price for a defined period. The usual length of such contracts are one, two or three years, and the prices are determined by current trading exchange prices.

Variable price contracts link the price directly to events on the Nordic electricity market. Under them, the customer experiences the effects of market price fluctuations, receiving a lower price of electricity when the market prices are low, and vice versa. Variable electricity prices often rise during the winter, when the Nord Pool spot price is generally higher than during the summer. The price is set monthly by the electricity supplier, and represents an average of Nord Pool's spot price during the month, together with a profit mark-up and possibly a fixed charge element.

End-user prices

The total price of electricity paid by an end-user consists of:

- the price of the electrical energy
- the price of electricity certificates
- the network charge
- taxes (energy tax and value-added tax)

As of 1st January 2005, the price of the electricity accounted for 36 %, that of 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 first two elements – the price of the electricity and that of the electricity certificates – can be influenced by the customer by making an active choice of supplier and/or renegotiating the contract.

Figure 6 shows the development of the total price of electricity paid since 1997 for a typical customer in

Table 14: Prices of electrical energy to various types of customers with open-ended contracts, excluding taxes and network charges

	1996 July	1997 Jan	1998 Jan	1999 Jan	2000 Jan	2001 Jan	2002 Jan	2003 Jan	2004 Jan	2005 Jan
Apartment	29,7	30,9	30,6	28,6	27,2	28,2	36,3	52,1	55,7	48,2
Det. house without electric heating	28,1	29,2	28,3	27,7	24,7	25,3	32,2	47,3	50,6	42,5
Det. 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: STATISTICS SWEDEN

Note: Price statistics from 2000 differ from those for earlier years. The earlier year figures are based on supplier's concessions: from 2000, prices shown are for open-ended contracts.
Note: The prices in the table are expressed in 2005 price levels (January).

Sweden having an electrically heated house, broken down by the price of the electricity, the network charge, the electricity certificate price and taxes and value-added tax. It can be seen, for example, that the proportion of the price made up of the electricity itself has remained essentially unchanged since 1997. Over the same period, the proportion of the total cost accounted for by tax rose from 35 % to 41 %. It should also be noted that the proportion of the total cost accounted for by the network charge has fallen significantly since 1997. The electricity certificate system was introduced in the spring of 2003.

The price of electricity

After restructuring of the electricity market, customers have been able to sign different types of contract for the supply of electrical energy. Those who have neither changed their supplier nor renegotiated their contract with their present supplier generally have what is known as an open-ended contract. Several forms of contract (see the frame on Page 47) are available to customers who are active on the market. Table 13 shows the proportions of the types of contract available. It can be seen from the table, for example, that the number of customers with open-ended contracts has fallen in recent years, although they still constitute a majority.

Table 14 shows the prices of electricity for customers having open-ended contracts over the period 1996-2005. It can be seen that, in comparison with the Nord Pool spot price, the price of electricity to end users has remained relatively stable over the years.

As a result of the competition that arose after restructuring of the electricity market, electricity suppliers were forced to adjust their prices, with the result that prices have fallen since 1996. However, this trend was broken in 2001, with prices rising as a result of relatively low precipitation and resulting price rises on the spot market. With an improvement in the water situation in the Nordic countries, which has had a downward effect on the spot market prices, prices have started to fall over the period 2004–2005.

FACTS: Typical customers

Apartment	2 MWh/year, 16 A main fuse.
Det. house, not el. heated	5 MWh/year, 16 A main fuse.
Det. house, electrically heated	20 MWh/year, 20 A main fuse.
Forestry or agriculture	30 MWh/year, 35 A main fuse.
Commercial	100 MWh/year, 50 A main fuse.
Light industry	350 MWh/year, 100 kW power demand or 160 A main fuse.

FACTS: Performance Assessment Model

The performance assessment model is an IT-based model that the Energy Markets Inspectorate has developed in order to provide a transparent and effective means of assessing the reasonability of network charges. Each year, the network companies are required to send in data from their activities to the Inspectorate. This data is fed into the performance assessment model, which creates a reference network. The model then calculates an economic value for the services provided by each network company, referred to as the value of network performance. The factors that are assessed include operation and administration of electricity supply and the quality of the supply, e.g. in the form of the number and duration of interruptions during the year. This network benefit is then compared with what the company has invoiced its customers, to create a debiting rate. If the value of the debiting rate exceeds 1.0, the company has invoiced more than its services were worth, which may indicate that its charges have been too high.

Table 15: Development of network charges, öre/kWh

	UPPER QUARTILE			MEDIAN			LOWER QUARTILE		
	1997	**2005**	**%**	**1997**	**2005**	**%**	**1997**	**2005**	**%**
Apartment	51,5	52,2	1	45,1	47,0	4	36,1	39,2	8
Det. house, not elec. heated	45,8	45,6	-1	39,3	40,6	3	32,4	34,7	7
Det. house, with el. heating	26,9	25,4	-5	23,2	22,7	-2	20,3	19,9	-2
Agriculture or forestry	28,8	27,1	-6	24,2	23,8	-2	21,1	21,4	2
Commercial	19,2	19,3	0	16,8	17,1	2	14,4	15,2	5
Light industry	20,3	19,7	-3	18,2	16,9	-7	15,5	15,1	-3
Medium industry	11,6	11,6	0	10,2	10,3	1	8,7	9,2	5
Elec.-intensive industry	7,5	7,5	0	5,9	6,3	7	4,7	4,6	-2

SOURCE: SCB

Note: All the values shown include mandatory charges but exclude value-added tax.
Note: The prices in the table are expressed as 2005 price levels (January).

Table 16: Taxes and VAT for typical domestic users[1], öre/kWh

	1980	1990	2000	2001	2002	2003	2004	2005
Tax and VAT, öre/kWh	11,7	19,7	33,3	35,6	38,9	45,8	47,7	47, 4
Tax as proportion of the total price	16,9 %	34,1 %	42,0 %	43,6 %	46,3 %	40,0 %	40,4 %	43,1 %

SOURCE: THE ENERGY MARKETS INSPECTORATE AND STATISTICS SWEDEN

[1] Detached house with electric heating.

Note: The prices in the table are expressed as 2005 price levels (January).

Table 17: Electricity prices in the Nordic countries as of 1 July 2004, including taxes and network charges[1], öre/kWh

	Domestic, 3 500 kWh	Domestic 20 000 kWh	Light industry[2]	Medium industry[3]	Heavy industry[4]
Sweden	126	108	56	47	42
Norway	111	63	51	41	30
Finland	97	63	56	52	42
Denmark	207	189	67	-	-

SOURCE: EUROSTAT

[1] Prices for industrial customers exclude VAT: for domestic customers, VAT is included.

[2] 1,25 GWh per year, 0,5 MW, 2 500 hours.

[3] 10 GWh, 2,5 MW, 4 000 hours.

[4] 70 GWh, 10 MW, 7 000 hours.

Note: Average exchange rates (July 2004) have been used to convert prices to SEK.

Table 18: Gross electricity production, TWh, and per-capita electricity consumption, kWh/year, 2002

	Hydro power, wind power m.m[1]	Nuclear power	Fossil power	Biomass and waste	Total production, gross	Import / export	Per-capita use[2]
Belgium	2	47	32	2	82	8	8 315
Denmark	5	0	32	3	39	-2	6 500
Finland	11	22	32	10	75	12	16 131
France	67	437	53	4	560	-77	7 366
Greece	4	0	50	0	55	3	4 256
Ireland	2	0	23	0	25	1	6 069
Italy	53	0	228	4	285	51	5 447
Holland	1	4	87	4	96	16	6 696
Spain	35	63	143	5	246	5	5 725
UK	9	88	285	5	387	8	6 158
Sweden	67	72	7	4	146	5	15 656
Germany	44	165	350	13	572	10	6 742
Austria	42	0	18	2	62	1	7 456
USA	284	805	2858	70	4018	22	13 228
Japan	96	295	681	26	1097	0	8 220
China	288	25	1325	2	1640	-7	1 184
Canada	351	76	167	8	602	-20	16 941
Norway	130	0	0	0	131	-10	20 094
Switzerland	37	27	1	2	67	-5	7 990
Iceland	8	0	0	0	8	0	27 586

SOURCE: IEA

[1] Also includes solar and geothermal electricity.

[2] Electricity consumption represents gross electricity production plus imports minus exports and distribution losses.

The price of electricity for apartment customers on 1st January 2005 was on average 13 % lower than at the same time in 2004. Detached house customers, with and without electric heating, saw price falls of 17 % and 16 % respectively. It is worth noting that two-thirds of the electricity suppliers reduced the price of electricity to customers with open-ended contracts. Larger customers, too, such as industry and agriculture, received lower prices in 2004. However, it is important to note that, on the whole, larger customers tend to negotiate prices based on long-term bilateral contracts. This means that they are not affected to the same degree by short-term variations in the spot price of electricity. Electricity prices for large customers are not shown in the table.

2005 price levels (January). The price of the electrical energy has been index-corrected, using a consumer price index excluding energy raw materials.

The price of the electrical energy consists of the price that the electricity supplier pays plus a trading margin. This margin represents the average revenue from electricity sales, minus the average cost of purchasing the electricity. Over the period 1996-2002, the trading margins of electricity suppliers in Sweden fell.[17] One reason for this reduction can be greater market competition.

The price of electricity certificates

From 1st May 2003, households have paid an additional price to their electricity suppliers for electricity certificates. The certificate price is not regulated, and is determined by each supplier. During 2004, the average certificate price for domestic users was about 3 öre/kWh, and was somewhat lower during 2003. Surveys carried out by the Energy Markets Inspectorate show that there are major price differences between the suppliers on the market.[18] In a report to the Government, the Energy Agency has suggested that the price of certificates should be included in the price of electricity as set by the electricity suppliers.[19] This would make it easier for consumers to compare prices and contract conditions between suppliers.

Network charges

It was decided, when the electricity market was opened to competition in 1996, that network activities (as opposed to the production of and trading in electricity) should continue in the form of a legal monopoly. Operating networks as a monopoly is natural and logical from a socio-economic point of view, as it would be very uneconomic to have several parallel distribution networks.

The Electricity Act defines network charges as the fees and other conditions for transporting electricity and for connection to a distribution network. The network charges that the customer pays to his local network company for the transport of electricity is made up of the costs incurred in the national grid, in regional networks and in local distribution networks, together with a mark-up for profit. The Act specifies that the network charges must be reasonable in relation to the service supplied by the network company. It must also be objective, non-discriminatory and constructed to reflect actual conditions. The network charges are public, and are monitored by the Energy Markets Inspectorate. The performance assessment model is one of the tools that the Inspectorate uses in its supervision in order to assess the reasonability of the network companies' charges (see below).

Table 15 shows how network charges have varied between 1997 and 2005.[20] Between 1997 and 2005, the median value of network charges increased by 4 % for apartment customers, and by 3 % for those in detached houses without electric heating. For detached house customers with electric heating, the network charges fell by 2 % over the same period. The greatest change in network tariffs occurred for electrically intensive industry, for which it increased by 7 %.

Most network operators employ a charge consisting of a fixed element and a variable element. The fixed tariff varies with the supply capacity rating, i.e. the size of the main fuse. The variable charge varies depending on the amount of energy supplied. Since 1997, the structure of network charges has tended to change from a high variable component to a larger fixed component. The proportions between the two elements varies from one network operator to another.

Electricity tax and VAT

Table 16 shows how taxes have changed since 1980 for a typical domestic customer. It can be seen from the table that the proportion of the customer's total electricity price has increased from about 17 % in 1980 to about 43 % in 2005. During the period 2000-2005 the proportion of the price accounted for by tax has remained more or less unchanged.

Electricity prices in the other Nordic countries

As can be seen from Table 17, Denmark has the highest prices of electricity for all typical customers in the Nordic countries. This can be largely accounted for by the high taxes on electricity use. Norway has the lowest prices of electricity, not only for domestic customers but also for industrial customers. However, prices in Sweden, Norway and Finland are relatively similar.

All of the Nordic countries monitor and supervise the network monopolies and their tariffs. In Norway, this is done by the Norwegian Water Resources and Energy Directorate, NVE. In Finland it is done by the

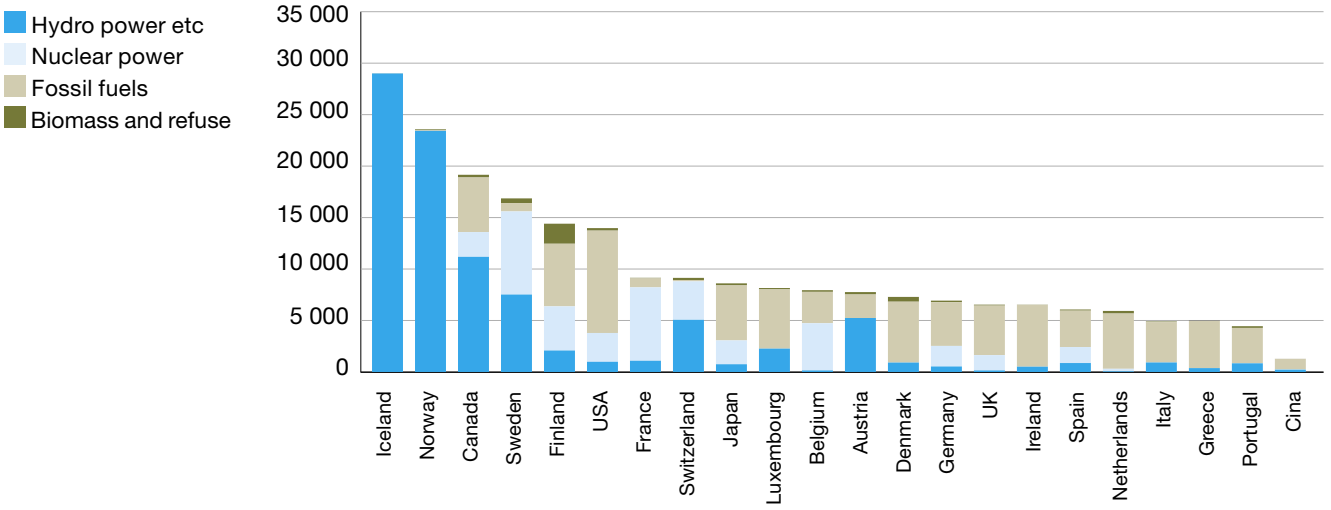
17 *Energy indicators 2004 – for monitoring Sweden's energy policy objectives,* Swedish Energy Agency, 2004. [In Swedish.]

18 *Priser och kostnader i elcertifikatsystemet / Prices and costs in the electricity certificate system,* Swedish Energy Agency 2005. [In Swedish.]

19 *Review of the electricity certificate system – Interim report, Stage 2,* Swedish Energy Agency 2005. [In Swedish.]

20 *Development of network charges,* Swedish Energy Agency 2005. [In Swedish.]

Figure 7: Per-capita electricity production, by power source, kWh/year, 2002



SOURCE: IEA

Energy Market Authority while the Danish Energy Regulatory Authority is responsible for supervising the network monopoly in Denmark. Norway and Denmark have price controls, which mean that the regulating authorities determine the total revenues from network tariffs in advance (ex-ante control). In Sweden and Finland, the network tariffs are regulated retrospectively (ex-post control).

An international perspective

The electricity industry is at present undergoing major changes in many parts of the world. This is due partly to changing market conditions, and also due to growing environmental pressure.

Electricity production

A total of over 16 000 TWh of electricity were produced worldwide in 2002, with North America accounting for over 30 % of this and Europe and Asia for about 20 % each. The USA was the single largest producer of electricity in the world, with an output amounting to about 4 000 TWh.

Of world electricity production in 2002, 65 % was based on fossil fuels, 17 % on hydro power and 17 % on nuclear power. The rest was based on biomass and waste, as well as contributions from wind energy, solar energy and geothermal energy. Over half of electricity production in the EU was based on fossil fuels, with one-third on nuclear power and a little over 10 % on hydro power. Biomass and waste provided 2 % of production. In comparison with typical EU and world values, Sweden produces a relatively small proportion of its electricity from fossil fuels (about 5 % in 2002), with a very high proportion of hydro power and nuclear power, amounting to over 90 %.

Figure 7 shows per-capita electricity production statistics for a selection of countries, broken down by power source. It can be seen that only three countries produce more electricity per-capita than Sweden. A common feature of countries with high per-capita electricity production is that they have good availability of hydro power.

Electricity consumption

In comparison with other countries, Sweden is a major electricity user. Table 18 shows the per-capita electricity consumption in a number of countries. Among the OECD states, Iceland, Norway and Canada have the highest per-capita electricity consumption. Sweden comes in at fourth place, with a per-capita consumption of over 16 000 kWh/year. The world average is about 2 400 kWh/year. A common feature of countries having high per-capita electricity consumption is that they have a high heating requirement due to a cold climate. In Sweden, the high per-capita electricity consumption is due primarily to the amount of electricity used by the country's electricity-intensive industries.

The Natural Gas Market

Natural gas was introduced to Sweden in 1985, since when the distribution network has been progressively expanded, so that it now supplies gas to about 30 municipalities in the south-west of the country. 2004 saw a consumption of about 10 TWh of natural gas in Sweden, or somewhat less than 2 % of the country's total energy consumption. In those areas covered by the gas distribution network, gas accounts for over 20 % of energy consumption, which corresponds to the market share in the rest of the EU.

Energy policy and the regulatory framework

One of the objectives of EU energy policy is to create a common competitive market for natural gas in Europe. The publication of the EU's natural gas market directives have introduced several changes to the Swedish and the European natural gas markets.

The objective of Swedish policy on the natural gas market is to continue the changes in the gas market in order to introduce an efficient competitive market. Increased competition can benefit consumers through lower prices, improved service and a greater range of services.

Under the guidelines published by Parliament in 1988, the State must not provide economic support for natural gas projects. Investments in pipelines and purchases of gas must be based on strictly commercial bases.[21] At the same time, another objective states that natural gas is the least harmful fossil fuel, and that its use should be encouraged via the existing natural gas network.[22]

A single European market for gas

The first step towards a single market for natural gas within the EU was taken in 1998, when the European Parliament and the Commission adopted the first natural Gas Market Directive.[23] The directive resulted in Sweden's first Natural Gas Act, which came into force on 1st August 2000.[24] The purpose of the Act was to establish competition in the Swedish natural gas market. Figure 8 illustrates the various steps in progress towards opening the Swedish natural gas market to competition.

Under the terms of the Natural Gas Act, eligible customers can freely choose their gas suppliers. Customers' eligibility to do so has been determined by the

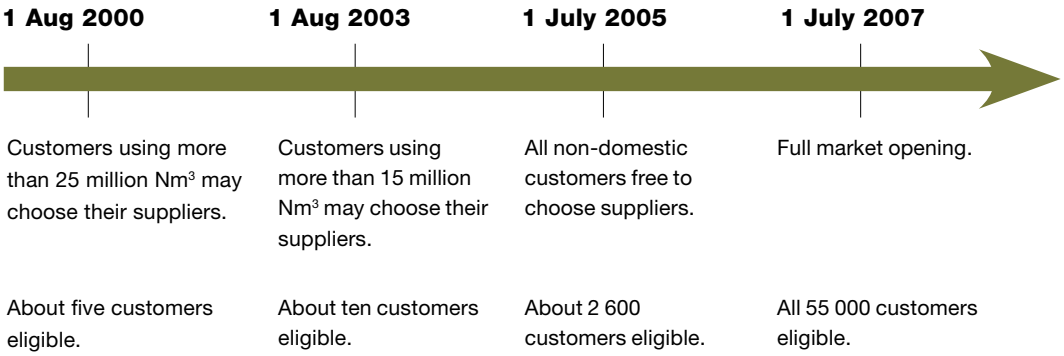
[21] Bill no. 1987/88:90, Energy Policy for the 1990s.

[22] Bill no. 2001/02:143 Cooperation for a Secure, Effective and Environmentally Benign Energy Supply.

[23] The European Parliament's and the Commission's Directive 1998/30/EC of 22nd June 1998 concerning common rules for the internal market for gas.

[24] Natural Gas Act (2000:599).

Figure 8: The gradual opening of the Swedish natural gas market to competition



amount of their annual consumption. In 2000, only customers with an annual consumption exceeding 25 million Nm^3 per year could choose their suppliers. In August 2003, this limit was reduced to 15 million Nm^3.[25]

The European Parliament and the Commission adopted a new Gas Market Directive in June 2003.[26] The directive includes requirements relating to further relaxation of the market and expanded application, as well as calling for legal separation between transmission and distribution companies, backed up by rules governing access to the transmission and distribution systems and gas storages. The overall purpose of the new directive is to create a common European market for natural gas, subject to competition.

Implementing the new directive in Swedish legislation

The new EU Gas Market Directive required substantial changes to Swedish legislation. In February 2005, the Government submitted a Bill to Parliament, proposing replacement of the previous natural gas act by the new act.[27] The new act was approved by Parliament during the spring, and came into force on 1st July 2005.[28]

Under the terms of the new act, all non-domestic customers can choose their gas supplier. This increased the number of eligible customers from less than a dozen to about 2 600, accounting for almost 95 % of the country's total consumption of natural gas. From 1st July 2007, all customers will be entitled to choose their gas supplier.

The Act also includes a provision that the transmission companies may not apply their transmission tariffs until the regulating authority has approved the methods used for setting the tariff (a priori). The reasonability of the tariff will be retroactively inspected by the regulating authority (ex post).

In accordance with the requirements of the Directive, the new Natural Gas Act states that a legal person may not operate both a trading company and a network company. Network activities are defined as the transmission of natural gas and the possession of natural gas stores or facilities for condensed natural gas. The separation between trading activities and network activities is essential in order to prevent cross-subsidisation. Cross-subsidisation is forbidden if revenues from the monopoly network activity are used to subsidise the competitive trading activity, as this would have the effect of distorting competition at the trading level.

In addition, the new Act includes requirements relating to system responsibility and balance responsibility. This is in order to ensure that the conditions for providing system balancing services shall be determined on objective and non-discriminatory grounds.

In order to ensure that the application area of the Act is in accordance with the requirements of the Gas Market Directive, it has been written to apply also to liquefied natural gas (LNG), biogas and gas from biomass and other gases if it is technically possible to use these gases in the natural gas system.

Further harmonisation within the EU

Creation of a single natural gas market within the EU requires further additions to the new Gas Market Directive. The Commission has therefore presented a proposal for an ordinance concerning conditions for access to the gas network.[29] The Ordinance, which is expected to come into force in July 2006, includes regulations relating to fees and services for third-party access, balancing fees and mechanisms for assignment of capacity.

Security of Supply Directive

The EU's Security of Supply Directive came into force in May 2004, setting out measures to ensure a suitable level of security of supply.[30] These measures also contribute towards a well-functioning single

[25] 1 Nm^3 equals 1 m^3 of natural gas at a pressure of 1.01325 bar and a temperature of 0 oC.

[26] The European Parliament's and the Commission's Directive 2003/55/EC concerning common rules for the internal market in natural gas and repealing Directive 1998/30/EC.

[27] Bill no. 2004/05:62 Implementation of the EU Directive for common rules for the single markets in electricity, natural gas etc.

[28] Natural Gas Act (2005:403).

[29] Proposal to the European Parliament's and the Commission's Ordinance concerning conditions for access to the gas network (COM/2003/0741)

[30] The Commission's Directive 2004/67/EC of 26th April 2004 concerning measures to safeguard security of natural gas supply.

Table 19: Tax rates for natural gas, as of 1 January 2005, SEK/1000 m^3

	Energy tax	CO^2 tax	Total
Motor vehicles, ships, aircraft	0	1 110	1 110
Manufacturing industry, agriculture, forestry, aquaculture and CHP production	0	410	410
Other	238	1 954	2 192

SOURCE: NATIONAL TAX BOARD AND THE ENERGY MARKETS INSPECTORATE

market for gas. The directive includes requirements for a common framework within which the member states must define general, open and non-discriminatory strategies for safeguarding the supply of gas.

Policy instruments

The introduction of natural gas to Sweden was to a considerable extent the result of a political wish to replace oil and coal. Natural gas has therefore served as a replacement raw material, with its price being set on the basis of its use as an alternative to other energy raw materials. Changes in taxation and fees etc. have therefore had a considerable effect on development of the gas market in Sweden.

Taxes

Natural gas is taxed in accordance with the Act Concerning Taxation of Energy.[31] This is a purchase tax which, for natural gas, covers both energy and carbon dioxide taxation. The carbon dioxide tax is levied on the amount of carbon dioxide emissions, while energy tax is payable independently of the energy content. Table 19 shows the tax rates for natural gas with effect from 1st January 2005.

The tax rate for natural gas depends on the end-user category. For industry, the tax is reduced by the entire amount of the energy tax element and by 79 % of the carbon dioxide tax element. From 1st January 2004, the taxation of CHP production was changed so that cogeneration plants pay the same tax rates as industry for that portion of fuels used for heat production. Previously, CHP plants were exempted from half of the energy tax, and had to pay the full carbon dioxide tax rate. Gas that is used for electricity production is free of tax. The change in the structure of cogeneration tax has resulted in greater interest in CHP production in Sweden based on natural gas. When used in vehicles, natural gas pays no energy tax and a little over half the carbon dioxide tax rate.

In comparison with oil, natural gas enjoys a taxation advantage of 1.7 öre/kWh for industry and CHP production, and of 12.8 öre/kWh for other users.[32] The tax difference between oil and gas is important in determining the competitiveness of natural gas on the market. Of the total price of natural gas, taxation accounts for about 30 % for industrial customers (carbon dioxide tax), and for about 50 % for domestic customers (energy and carbon dioxide tax, as well as VAT).

Emissions trading

The EU emissions trading scheme (see the panel on page 26) also affects the natural gas market. The trading scheme started on 1st January 2005, initially applying to large parts of the energy-intensive industry and to power and heating plants.

The emissions trading scheme has the effect of increasing the competitiveness of natural gas against coal and oil, due to the fact that, when natural gas is burnt, it produces 40 % less carbon dioxide emissions than does burning a corresponding quantity of coal, and 25 % less emissions than when burning a corresponding quantity of oil. Plants that previously used coal or oil can therefore change to natural gas and sell their unused emission allowances, thus increasing their revenues. On the other hand, emissions trading reduces the competitiveness of gas for those industrial sectors that can use biofuels, due to the fact that emission allowances are not needed in order to compensate for the carbon dioxide emissions from biofuels.

[31] The Act (1994:1776) Concerning Taxation of Energy.

[32] The electricity and gas markets – energy markets in development, SOU 2004:129.

FACTS: Market liberalisation

Liberalisation of the natural gas market means that gas is traded on a competitive market. However, the network activity, which consists of the construction, operation and management of natural gas networks and the transmission of gas, is still operated as a legal monopoly. This is because it would not be in the public interest for competing network operators to build parallel networks. As the network owners are required to make their gas networks available on equal terms to gas suppliers and end users, known as third party access, gas trading can be carried out under competitive conditions.

Greater competition on the gas market can increase the benefit to customers through greater efficiency, lower prices and better service.

Natural gas in Sweden

Natural gas was first used in Sweden in 1985. Consumption increased rapidly until the beginning of the 1990s, after which the rate of increase declined somewhat. Over 9 TWh of natural gas were imported in 2004, equivalent to almost 2 % of the country's total energy consumption. In those areas where natural gas is available, the gas supplies over 20 % of energy demand. Figure 9 shows the growth in natural gas consumption over the period 1985–2004.

In a report to the Government in June 2004, the Swedish Energy Agency and the Environment Protection Agency estimated the future consumption of natural gas in Sweden.[33] According to the report, the consumption of natural gas is expected to increase from 10 TWh/year to 15 TWh/year in 2010 and to 50 TWh/year in 2020. This assessment is based on several assumptions, one of which is the closure of Sweden's nuclear power reactors after 40 years' operation.

Sweden has no natural gas of its own. All natural gas is imported via the pipeline between Denmark and Sweden. Regardless of its country of origin, the gas has to transit the Danish natural gas system.

Infrastructure

Natural gas is conveyed primarily in pipes and can, as opposed to other network based energy carriers, be transported over long distances with low energy losses. The transmission network starts at the gas fields and finishes at the end-user's combustion equipment.

All natural gas to Sweden enters the country via a pipeline from Denmark. From Denmark, there are connections to the rest of Europe, which means that Sweden is linked with the continental system. The Swedish market is concentrated along the west coast; from Trelleborg in the south to Stenungsund in the north, and with a branch towards Småland. At present, about 30 municipalities use the gas. Figure 10 shows the natural gas system in Sweden.

The distribution network can be divided into transmission networks and distribution networks. Gas in the long-distance transmission mains is contained under high pressure, normally in the range 50-65 bar. This pressure is reduced in a number of metering and control stations before being supplied to local distribution networks for onward delivery to customers. The pressure in the distribution network is usually 4 bar. Some customers require a higher pressure than is available from the distribution network, and are therefore connected directly to the transmission network. In 2005, the Swedish natural gas system consisted of about 540 km of transmission pipelines and about 3 000 km of distribution pipelines.

The existing transmission pipeline between Malmö and Gothenburg has a potential annual capacity of 2 000 million Nm^3 of gas per year, which is equivalent to about 22 TWh. With the addition of more compressors, this capacity could be increased to about 30 TWh. During high load periods, the possible transmission capacity is limited to about 15 TWh without compressors, or 20 TWh with compressors. There are at present no compressors in the Swedish system.

There are plans for greater use of the existing natural gas system. The two most important features of this are two natural gas fired cogeneration plants in Gothenburg and Malmö, with planned start ups in 2006 and 2009 respectively. It is calculated that these two plants would use about 8.5 TWh/year at full load.

LNG

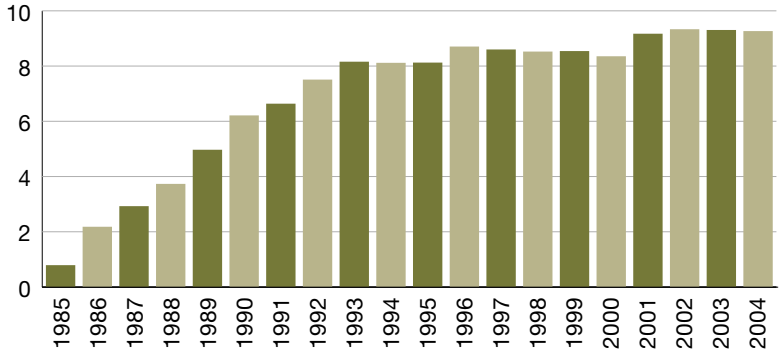
Natural gas liquefies when cooled to -162 ºC, and occupies only 1/600 of its volume at normal temperature. This reduced volume means that liquefied natural gas (LNG) can be transported over long distances without using the pipeline network. LNG is usually transported with specially built gas carrier ships. At the destination harbour, the LNG is transferred to a terminal in which it is gasified and then fed into the distribution network. In recent years, as a result of technical development and reduced costs, the use of LNG has expanded considerably within the international natural gas industry. It can result in greater global competition on the natural gas market, by giving more countries access to the natural gas fields.

Sweden does not yet have any reception terminal for re-gasification of LNG. However, several companies are investigating the feasibility of importing LNG to Sweden, which would improve Swedish security of supply of natural gas.[34]

[33] *Forecasts of emissions of greenhouse gases,* Interim report no. 1 in the Swedish Energy Agency's and Environmental Protection Agency's information for Checkpoint 2004. [In Swedish.].

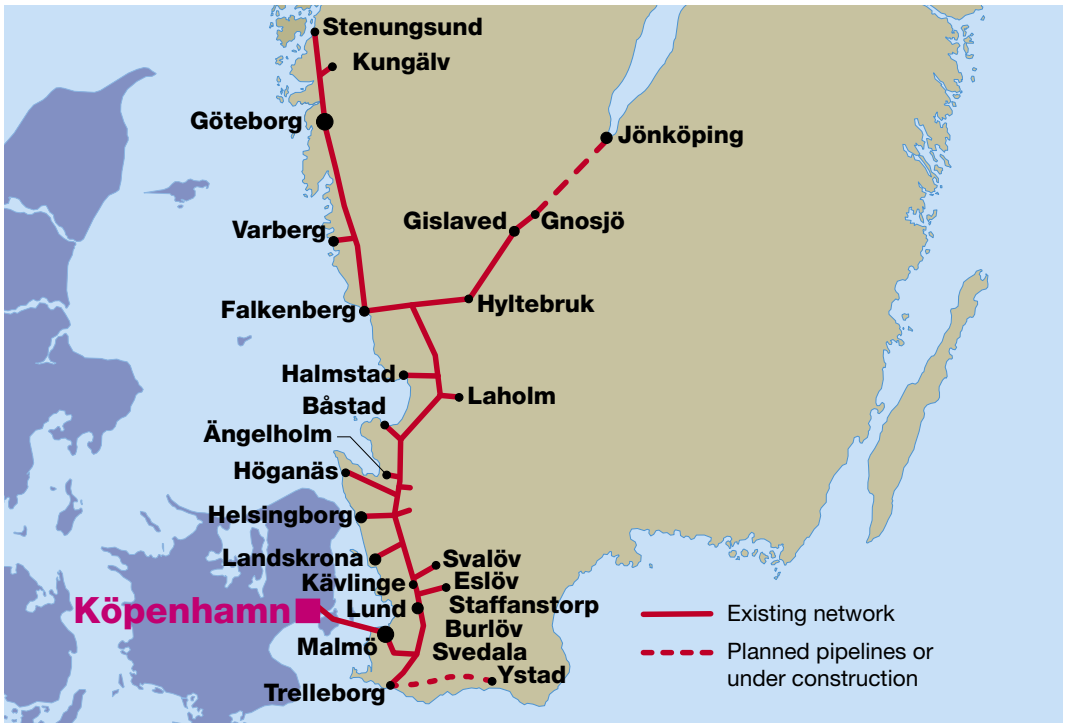
[34] For further details, see *LNG in Sweden – An explorative socio-economic investigation,* Energy Markets Inspectorate, 2005. [In Swedish.]

Figure 8: Growth in natural gas consumption in Sweden, 1985–2004, TWh



SOURCE: STATISTICS SWEDEN

Figure 10: The Swedish natural gas network



SOURCE: SWEDISH GAS ASSOCIATION

Storage

Consumption varies during the year as a result of temperature changes, seasonal variations in process industries and variations in the prices of other energy raw materials, all of which create a need for storage.

Natural gas can be stored either in special storage facilities or by increasing the pressure in the transmission networks, referred to as line-packing. There is at present only one storage facility in Sweden: it is sited in southern Halland, and is intended primarily as a demonstration facility. In the spring of 2005, it had not yet been taken into commercial use. For the foreseeable future, Sweden will have to rely on stores in other countries, or on delivery rates that accommodate the market fluctuations.

Under the terms of the new Natural Gas Act, the operators of storage facilities are obliged to allow customers to load natural gas into and out of the store on reasonable terms. These terms are supervised ex-post by the Energy Markets Inspectorate in order to ensure that they are reasonable, objective and non-discriminatory.

System balance

As of 1st July 2005, Svenska Kraftnät is the transmission system operator (TSO) for the Swedish natural gas market. This means that Svenska Kraftnät has the overall responsibility for maintaining the short-term balance between delivery of natural gas to the national system and the extraction of gas from it. This authority is exercised by signing agreements with companies concerning their liability for maintaining system balance. Under the terms of these contracts, each company undertakes to maintain the balance at the company's own input and extraction points. Gas suppliers can choose either to be responsible for their own balance undertakings, or to purchase the service from another supplier. Those having responsibility for maintaining system balance buy or sell gas in order to adjust for system imbalances. The cost of maintaining system balance is then apportioned between the companies that have caused the imbalance.

FACTS: Natural Gas

Natural gas is a flammable mixture of gaseous hydrocarbons, consisting mainly of methane. Its composition varies somewhat, depending on the source of the gas. As with coal and oil, natural gas is a fossil fuel, and has been formed by bacterial breakdown of organic materials from animals and plants laid down hundreds of millions of years ago. The resulting gas has then been trapped in fissures in the rock and subjected to high pressure. It is from these fissures that the gas is recovered today.

Natural gas is non-toxic and odour-free. It is lighter than air, and therefore rises in the event of a leak. An artificial odour is added to the gas in order to facilitate leak-tracing.

As opposed to the combustion of coal or oil, combustion of natural gas does not give rise to any emissions of sulphur or heavy metals, nor does it leave any solid residues such as ash or soot. For the same amount of energy released, carbon dioxide emissions from the combustion of natural gas are 40 % less than from combustion of coal and 20 % less than from combustion of oil.

The market

Since its introduction, the Swedish natural gas market has been characterised by a small number of companies and a high degree of vertical integration. Vertical integration means that companies operate in both network activities and trading activities. Under the terms of the new Natural Gas Act, vertically integrated companies must split these activities into two distinct companies; a network company and a trading company.

The Swedish natural gas market has three sales stages: import, wholesale trading and retail trading. Wholesale trading companies sell gas to other companies who in turn intend to sell on the gas. Retail trading companies are those that sell to end-users. Figure 11 shows the parties engaged in sales as in the spring of 2005, while Table 20 shows the companies' proportion of retail trade in 2004.

The Swedish natural gas companies

Under the terms of the new Natural Gas Act, natural gas companies are defined as those that carry or trade in natural gas, or which operate storage facilities or gasification plants. In May 2005 there were eight natural gas companies in Sweden, of which seven sold natural gas to end users

Nova Naturgas AB owns large portions of the Swedish transmission network. Up until the end of 2004, the company sold almost all the natural gas that was consumed in Sweden. However, on 1st November 2004, the company sold its trading business (Nova Supply) to Dong Naturgas A/S, since when it operates only its network business. The sale included Nova Naturgas' customer contracts and its distribution networks to several large customers. The sale was reviewed by the Swedish Competition Authority during the autumn of 2004. In connection with the review, the Swedish Energy Agency pointed out the risk of the market becoming further concentrated as a result of sale of the company. The takeover was approved by the Competition Authority on 6th October 2004 after Dong voluntarily undertook to offer Nova Supply's customers an opportunity to terminate their contracts in advance if they so wished. As a result, the Competition Authority was of the opinion that this will improve the opportunities for potential competitors to enter the market.[35]

The Danish company, Dong Naturgas A/S delivers all the natural gas consumed in Sweden, supplying it both to wholesale trading companies, retail traders and end users on the Swedish market. The company has signed a delivery agreement with Öresundskraft and Lunds Energi for supplies starting 1st October 2005, which considerably reinforces Dong's position in the Swedish wholesale market. Dong also supplies natural gas to Denmark, Germany and the Netherlands.

Sydkraft Gas AB carries and sells natural gas to end users and to other retail suppliers on the Swedish natural gas market, and also uses some of the gas for its own production of electricity and heat. In 2004, Sydkraft accounted for almost half of retail sales, and for two-thirds of sales on the wholesale market. From 1st October 2005, Sydkraft will import all its natural gas from its German associate company E.ON Ruhrgas.

Other natural gas companies on the Swedish market are Göteborg Energi, Lunds Energi, Varberg Energi, Ängelholms Energi and Öresundskraft, all of which

[35] Decision 556/2004, National Price and Competition Board.

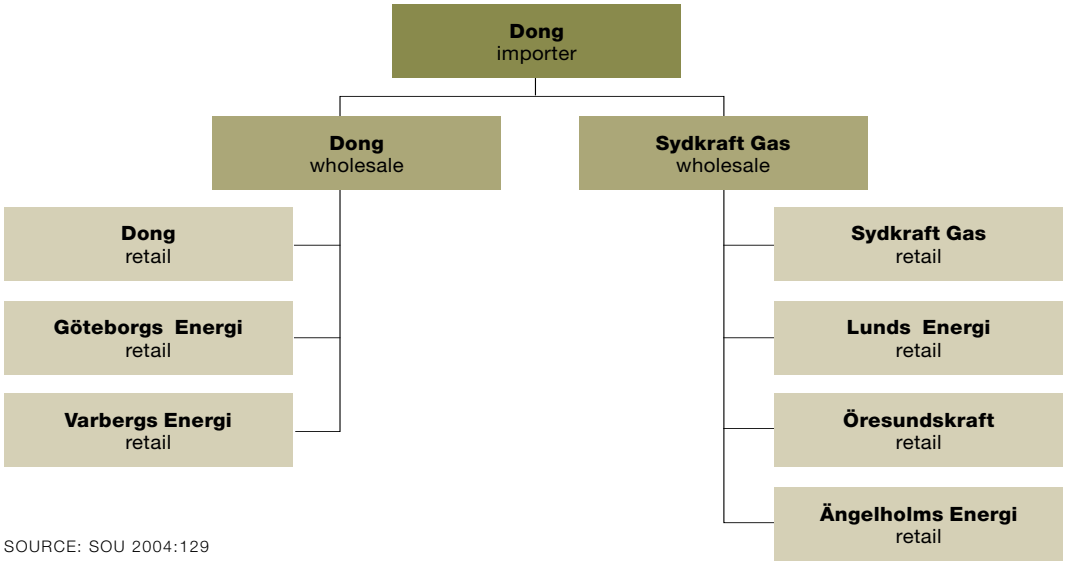
Table 20: Market shares of retail companies, 2004

	Volyme, GWh	Market share
Sydkraft Gas	4 918	49 %
Göteborg Energi	1 697	17 %
Nova Naturgas[1]	1 221	12 %
Öresundskraft	897	9 %
Lunds Energi	750	7 %
Dong Sweden[2]	275	3 %
Ängelholms Energi	267	3 %
Varberg Energi	72	1 %
Total sales	10 097	100 %

SOURCE: THE NATURAL GAS COMPANIES

Note: Volumes consist of the combination of sales to end users and the companies' own use.
[1] Nova Naturgas sold its trading business on 1st November 2004, and is therefore no longer active as a retail supplier
[2] These figures apply only for sales during November and December.
They do not include sales to other retail suppliers, even if these suppliers have their own consumption of natural gas.

Figure 11: Natural gas companies' market structure in Sweden, spring 2005



SOURCE: SOU 2004:129

purchase gas partly for their own use, and partly for onward sales to other end users. In addition, all the companies own distribution networks for natural gas.

Apart from Nova Naturgas and Dong, all the gas companies belong to energy companies having other activities in the electricity and/or district heating markets in Sweden. In addition, Dong, Nova Naturgas and Sydkraft Gas are owned by private or state energy companies in foreign countries, while the other companies are owned by Swedish local municipalities. E.ON is the majority owner of Sydkraft and, through its ownership of Ruhrgas, owns a proportion of Nova Naturgas.

FACTS: Use of Natural Gas

Natural gas is used in district heating plants to produce hot water which in turn supplies space heating and domestic hot water to customers. Combined heat and power plants use natural gas for simultaneous production of electricity and heat. Industry uses natural gas for several applications, including hot water and steam production, heat treatment of materials and direct use in processes. The major users of natural gas are in the chemical, pulp, food, and iron and steel industries. Natural gas is used in the residential and service sector mainly for space heating and domestic hot water production. The gas is used as fuel in boilers, both in detached houses and in larger properties. Kitchen stoves, sauna units and radiant heaters can also be fuelled by natural gas. The gas can also replace petrol and diesel oil as a vehicle fuel

An expanding market

There have been several plans for expansion of the Swedish natural gas system in recent years: the following plans are at present under consideration.

In October 2004, Sydkraft Gas was given permission by the Government to construct a pipeline between Germany and Sweden via Denmark. The project, which is referred to as the Baltic Gas Interconnector (BGI), involves Swedish, Danish and German energy utilities. At present, no investment decision has been taken.

In addition, Sydkraft is planning an extension of the existing transmission pipeline northwards and eastwards to central Sweden. According to an approximate time plan, the pipeline should reach Oxelösund, on the east coast, in 2010. As a complement to piped gas, Sydkraft is also planning to construct an LNG terminal in Oxelösund, with a planned commissioning date of not later than 2010.

The Fortum Group is involved in the Swedish natural gas market via Svensk Naturgas AB and AB Fortum Värme. The former company is investigating the prospects for extending the natural gas system to cover Stockholm, the Lake Mälaren region and Bergslagen, and is also investigating the possibility of con-

Table 21: Natural gas prices in Sweden, including taxes and VAT, öre/kWh

	2003 1 Jan	2004 1 Jan
Domestic		
Domestic gas	85,8	79,3
Heating and domestic gas	70,6	71,1
Central heating for at least 10 households	61,4	66,1
Industry		
Industry (less than 15 million Nm^3)	39,1	42,4
Industry (more than 15 million Nm^3)	-	29,7
CHP plants/cold condensing power plants	27,9	27,9

SOURCE: STATISTICS SWEDEN

Note: Industrial customers do not pay VAT
Note: Prices in the table are nominal prices, i.e. they include allowance for inflation.

structing an LNG terminal in Gävle. Fortum Värme is investigating the possibility of importing LNG to replace its present production of town gas in Stockholm with natural gas. At present, there are somewhat less than 100 000 users of town gas in Stockholm, using a total of about 0.5 TWh/year.

In March 2005, the Norwegian Parliament decided that the State should encourage construction of an off-shore gas pipeline from Stavanger to Grenland, south-west of Oslo. This would make it possible to connect the Swedish gas network directly to the large Norwegian natural gas fields. Under the working name of NGAS (Norwegian Gas Connected to Sweden), a number of large gas consumers along the Swedish west coast have started work to show the Swedish potential for use for which the Norwegian pipeline should be designed.

The addition of further supply alternatives for natural gas to Sweden would probably improve the competition situation on the Swedish gas market, as the opportunities for buying natural gas from several directions could create a pressure on prices. Further supply alternatives would also improve the security of supply of natural gas in Sweden.

The end-user market

There are at present about 55 000 users of natural gas in Sweden, of which about 2 600 are commercial customers and the rest are domestic customers. The number of customers has remained relatively stable in recent years.

In 2004, industry and power/heating plants each took about 40 % of natural gas supplies in Sweden, with the remaining 20 % being consumed by residential customers, commercial premises and a few smaller industries. A small amount was also used as vehicle fuel.

A prerequisite for an efficient market is the presence of active customers. Customers making active choices of their suppliers intensify competition between suppliers, and are therefore important for the growth of competition on the market. No statistics are at present available concerning change of suppliers on the Swedish natural gas market. According to an investigation carried out by the Inspectorate in December 2004, only a few customers have changed their supplier or renegotiated their contract with existing suppliers.[36] This low incidence of change of supplier can partly be the result of long contracts which prevent customers from changing suppliers, or it can also to some extent be due to the lack of competition on the supply side. A further explanatory factor can be that customers have little awareness of either the organisation of the market or of their own opportunities for acting. The Inspectorate has therefore launched a number of information campaigns in connection with the 2005 liberalisation of the market, so that the customers affected by the changes will have sufficient information to allow them to make best use of the market.

End-user prices

The total price paid by an end-user for natural gas consists of:

- the price of the gas
- the price for its delivery
- taxes (energy taxes and VAT).

As, until 2005, network activities had been integrated with trading activities, there are no official statistics available to show the proportions of the two cost elements. However, according to information from several parties involved in the market, the price of delivery probably makes up 20-30 % of the total

36 *The natural gas market report, 2005:1 – Market liberalisation,* The Energy Markets Inspectorate 2005. [In Swedish.]

price paid by the customer. As for the electricity market, the Energy Markets Inspectorate supervises the tariffs charged by the network companies. From 2006, companies will have to obtain advance approval from the Inspectorate of the methods used in setting, and of the structure of, their transmission and distribution tariffs.

The prices shown in Table 21 include both the price of the gas itself and that of its delivery. It can be seen that prices generally increased slightly between 2003 and 2004, although prices for domestic customers using natural gas only for cooking (domestic gas) fell by 8 %. Prices for other categories rose somewhat or remained stable during the period.

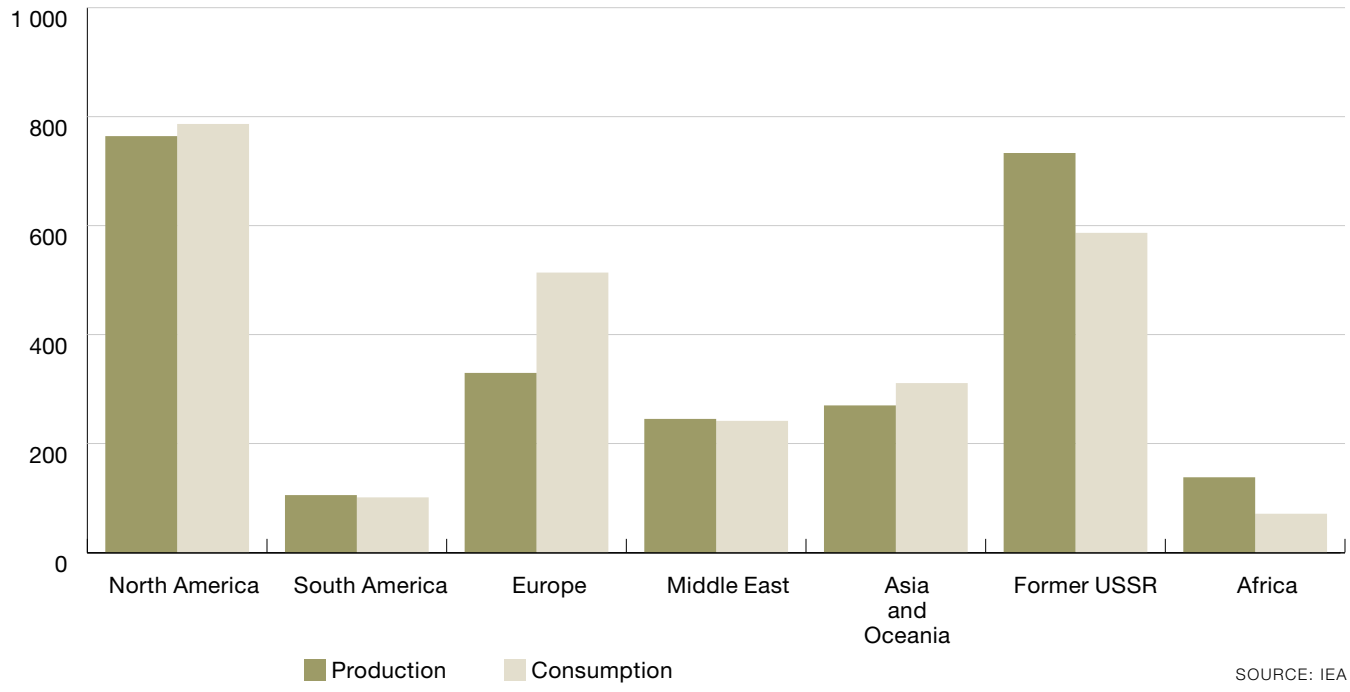
Contracts and pricing

Contracts for the supply of natural gas have traditionally been very long-term, both in Sweden and internationally, in order to guarantee a return on substantial investments in production and transmission. Agreements between importers and trading companies in Sweden generally run for 20 years. Agreements between suppliers and larger end users usually run for five years, after which they can be extended one year at a time. The long-term supply contracts usually include what are known as take or pay clauses, which means that the purchaser undertakes to pay for a contracted volume of natural gas, regardless of whether or not he actually does use it. The supplier undertakes to provide up to a certain volume of gas. In countries with a well developed infrastructure, the trend is towards shorter contract periods, without take or pay clauses.

Both in Sweden and internationally, the price of natural gas is generally based on the price that customers pay for alternative energy carriers, i.e., opportunity cost pricing. This principle is applied between all parties in the chain, from the original producer to the end-user. In most cases, the price of natural gas is indexed against the price of oil. The restructuring of the market that is in progress in Sweden has resulted in corresponding changes in supply contracts. An example of this is presented by Dong's contract with Göteborg Energi concerning the supply of gas to the Rya CHP plant. Under the terms of the contract, the price tracks the price of electricity for that part of the gas that is used for electricity production, with the remaining portion of the gas (used for heat production) being priced in accordance with a more traditional model.

Trading markets have been established in the UK, Germany, Holland and Belgium, on which gas suppliers can offer gas in competition. This has had the effect of making the opportunity cost pricing system less important, and replacing it by competition between suppliers. In Sweden, natural gas is traded under bilateral contracts.

Figure 12: World production and consumption of natural gas in 2003, 1 000 million Nm^3



SOURCE: IEA

An international perspective

The proportion of world energy supply met by natural gas has steadily increased. Good availability of gas, competitive pricing and good environmental properties mean that natural gas is preferred over other fossil fuels in many parts of the world.

Production and reserves

Production of natural gas is concentrated to the former USSR and to the USA, which together account for about half of total world production, as shown in Figure 12. In Europe, it is the UK, Norway and the Netherlands that are the largest producers of natural gas.

At present, reserves of natural gas are increasing at about the same rate as the gas is used. The biggest known reserves are in Russia and the Middle East: only 5 % of reserves are in Europe. In total, commercially recoverable reserves could be expected to last for over 60 years at the present rate of consumption. Most of the known natural gas resources have been found in connection with prospecting for oil. As natural gas has become increasingly commercially important, interest has grown in prospecting in areas looking only for natural gas.

Consumption

World natural gas consumption increased by about 25 % between 1993 and 2003. At present, total global consumption of natural gas amounts to about 26 000 TWh, or about a quarter of total world energy supply.

Europe consumed about 5 000 TWh of natural gas in 2004, representing an increase of over 3 % since 2003. Natural gas supplies over 20 % of total energy needs in the EU member states, although the proportion varies widely between countries, from about 2 % in Sweden to almost 40 % in the UK.

The Nordic countries consumed about 110 TWh of natural gas in 2004, of which 10 TWh were in Sweden, 50 TWh in Denmark and 45 TWh in Finland. Norway, although one of Europe's largest natural gas producers, consumed only about 4 TWh/year.

The District Heating Market

District heating is the most common form of heat supply for residential buildings and commercial premises in Sweden, supplying about 47 TWh/year of heat. It is reckoned that more than every third Swede comes into daily contact with district heating through heating in the home, at work or at school. District heating is an important part of the long-term restructuring of the Swedish energy system through its ability to use fuels that have no other alternative use, and as a basis for the production of electricity in CHP plants.

Energy policy and the regulatory framework

District heating has been used as part of the country's energy policy for many years. After the oil crises of the 1970s and 1980s, its role in energy policy was to reduce the national dependence on oil. A few years later, in connection with the nuclear power debate, a new energy policy emerged with the aim of encouraging greater use of indigenous and renewable fuels.

At present, the strongest energy policy driving forces on district heating are those related to the environment and climate. District heating is flexible in terms of its ability to use different fuels, and is therefore an effective way of reducing carbon dioxide emissions. Depending on their availability, everything from waste to forest felling residues and waste heat can be used as alternatives to traditional fossil heating fuels. The Swedish District Heating Association has estimated that carbon dioxide emissions from Swedish district heating production have fallen by 20 % since 1981. The local environment and air quality in urban areas can also be improved when older, scattered small heating boilers are replaced by central district heating plants.

The part played by district heating in restructuring the country's energy system can be summarised as follows:

- Changing from the use of fossil fuels to renewable fuels.
- Reducing the use of electricity for heating.
- Creating opportunities for greater CHP production.

District heating is affected not only by Swedish energy policy, but also by EU work towards a single market for energy. The EU Cogeneration Directive sets out guidelines for how cogeneration should be promoted throughout the EU, with the objective of in-

creasing the proportion of electricity produced by co-generation in Europe from 9 % in 2002 to 18 % in 2010.[37] The advantage of cogeneration in comparison with other forms of electricity production is a high overall efficiency as a result of the waste heat from electricity production being used as district heating. However, if this high potential efficiency is to be realised, there must also be possible to sell the heat in a distribution network with customers. Expansion of CHP production can therefore be very important for expansion of district heating distribution systems.

New conditions

The district heating market was covered by the liberalisation of the electricity market that was carried out in 1996. Prior to this, local authority district heating utilities were governed by the Local Authority Act Concerning the self-cost and quality principle. This meant that prices had to be set to reflect costs, and that all customers in any given category (e.g. domestic customers) should pay the same price as long as the utilities' costs for the service were the same. This was then amended by the Electricity Act such that district heating activities had to be '... operated on a commercial basis'.[38] The objective of this amendment was to create competition neutrality between different energy carriers. The trend towards more commercial operation of district heating systems has contributed to a structural change, in which the proportion of municipality-owned district heating utilities has fallen in relation to the number of privately- and state-owned energy utilities.

The distribution network that carries the hot water from the heating plant to customers is a natural/legal monopoly. In each local district heating market, there is room for only one distributor of district heating: it would not be socio-economically viable to have several parallel heat distribution systems. Generally, a customer wishing to change from district heating to some other form of heating will have to invest in new equipment, such as a new boiler for biofuels. This has the effect of reducing customer mobility. 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 lead to the government questioning whether the market is well-functioning. The district heating industry's view is that district heating is exposed to competition in the heating market, and that the relatively low mobility is something that affects the market for heating in general. The spread in prices is explained by different conditions between companies, including factors such as the number of customers, the availability of fuel and investment costs.

In December 2002, the Government appointed a District Heating Commission. The Commission has now published three reports.[39] The Commission suggests the following measures to be undertaken in order to improve the situation for district heating customers:

- that companies providing district heating services should be required to show separate accounts for their district heating activity and other activities, and that district heating activities and electricity market activities may not be carried out by the same legal entity (legal unbundling),
- a requirement for yearly reporting of a number of key indicators, facilitating external inspection and comparison of the companies' costs and revenues,
- that the Swedish Consumer Agency and the Swedish Energy Agency prepare a model form of contract for the supply of district heating,
- that customers should be entitled to negotiate the terms of their contracts with the supplier, and that a Board should be appointed to resolve any disputes.

The Commission has also put forward a proposal for a special District Heating Act which would bring the customer protection measures together with regulations concerning supervision of the district heating market.

Policy instruments

The role of district heating in liberalisation of the energy system is mainly to contribute to a reduction in Sweden's use of electricity and fossil fuels for heating purposes, and to provide a basis for electricity production in cogeneration plants. Several policy instruments influence the conditions and the situation for district heating in Sweden.

Taxes and fees

A green tax reform was introduced in Sweden in 2001, with the aim of transferring some SEK 30 000 million in tax burden by 2010. Until 2004, the emphasis of the programme was on higher taxes for electricity and fossil fuels: district heating taxation was affected primarily through the carbon dioxide tax and the energy tax.

The carbon dioxide tax was introduced in 1991, intended particularly to reduce the use of fossil fuels for heat production. The production of electricity is exempt from the tax, while heat production in CHP plants and heat supplied to manufacturing processes in industry receive a tax reduction of 79 %. As of 1st January 2005, carbon dioxide tax was levied at the rate of 91 öre/kg of emitted carbon dioxide.

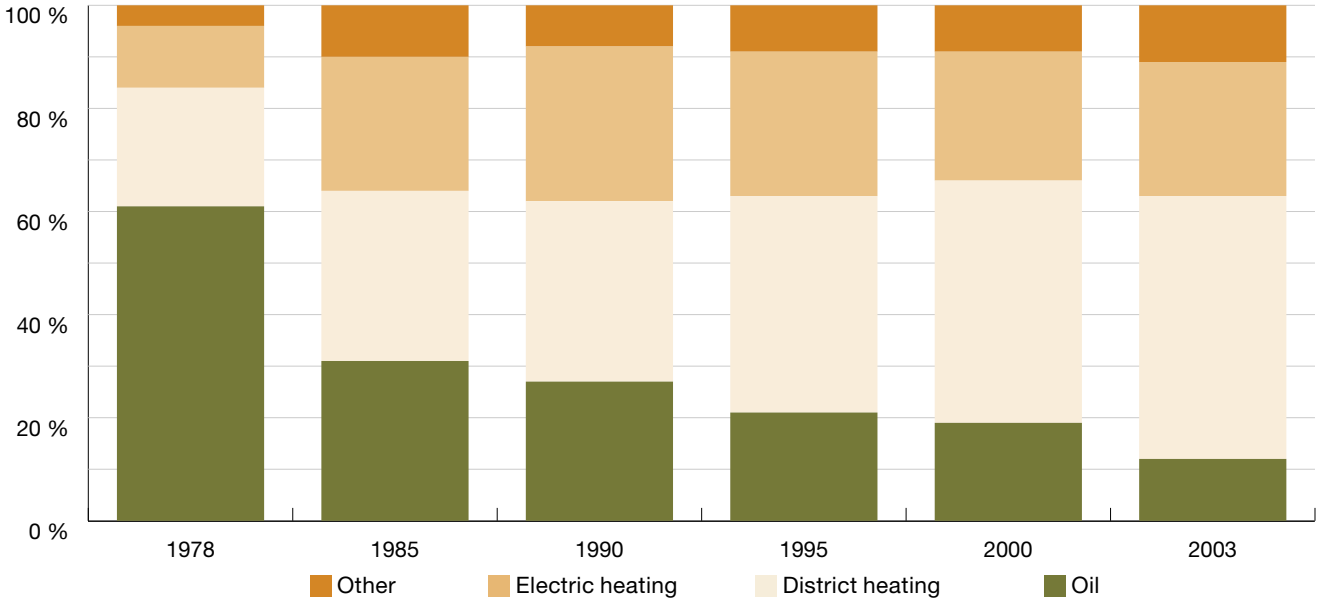
Since 1st January 2005, Sweden participates in the European emission trading scheme. All production

[37] The European Parliament's and the Council's Directive of 11th February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EC.

[38] Electricity Act (1997:857).

[39] Improved security for district heating customers and greater transparency of, and separation between, electricity and district heating activities, SOU 2003:115; Reasonable prices for district heating, SOU 2004:136; and District heating and cogeneration in the future, SOU 2005:33. [In Swedish.]

Figure 13: Market shares of Sweden's heating market for residential and commercial buildings



SOURCE: THE DISTRICT HEATING BUREAU AND FVB SWEDEN AB

plants connected to Swedish district heating networks are included in the system. This means that the companies concerned must obtain emission allowances in order to emit carbon dioxide formed by combustion of fossil fuels. The panel on page 16 describes how trading in emission allowances works.

FACTS: District Heating

District heating is the generation and distribution of hot water in a pipeline system for the collective heating of buildings. The heat is generated in boiler stations or in CHP plants. Hot water distribution is carried out through a network of pipes.

A district heating network consists of two pipelines – a supply pipe and a return pipe for returning the cooled water to the district heating plant. The following four criteria are generally said to determine whether a system is a district heating system:

- that there is an agreement between the customer and the supplier,
- that the customer pays for the delivery,
- that more than one property is connected
- that the deliveries are distributed onto several customers and that heat is supplied on commercial terms.

The energy tax affects district heating producers via their choice of fuel. The fuel categories subject to the tax are oil, coal, LPG, natural gas and – as the only taxed biofuel – crude tall oil. Electricity and heat production in CHP plants are exempt from the energy tax, as are supplies of heat to industrial manufacturing processes.

Subsidies and grants etc.

For many years, expansion of district heating has been encouraged by various forms of public subsidies. 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. The Climate Investment Programme (KLIMP) is a public subsidy scheme for measures intended to reduce climatic impacts. Of the over SEK 500 million that was granted under the scheme in 2004, 30 % went to investment projects in the field of district heating and local area heating.

District heating in Sweden

Sweden's first municipality-owned heating plant was opened in Karlstad in 1948. It was followed during the 1950s by larger municipalities such as Stockholm, Gothenburg, Malmö, Linköping and Örebro. The demand for electricity at that time meant that many of these plants were built as CHP plants.

Figure 13 shows the market shares of various forms

Table 22: Fuels used for district heating production in Sweden, TWh/year

	1981	1992	2003
Coal	1,2	5,7	1,2
Peat	0,0	3,2	3,6
Wood fuels	0,6	5,6	17,7
Oil	29,5	4,8	4,7
Natural gas	0,0	2,9	3,3
Biogas	0,0	0,0	0,4
Other gas	0,4	0,8	1,0
Tall oil	0,0	0,0	1,7
LPG	0,0	0,8	0,3
Waste	2,1	4,1	6,5
Other	0,0	0,4	1,6
Electricity[1] GWh	1,5	9,3	4,3
Supplies to end users	28,4	37,5	46,9
Distribution system length[2] (km)	4 573	8 952	14 200

SOURCE: STATISTICS SWEDEN

[1] Electricity is used for heat pumps, electric boilers and for operation of the plants.
[2] Information provided by the Swedish District Heating Association.

of heating systems for residential and commercial buildings since the end of the 1970s. Since the middle of the 1980s, district heating has been the most common form of heating, exhibiting an average annual growth rate of over 2 %. It can be seen that the use of oil as a heating fuel has decreased considerably during the same time period.

Initially, most district heating was produced by oil-fired boilers. At the beginning of the 1980s, oil still accounted for about 90 % of the fuel input. However, the oil crises in the 1970s had motivated both the industry and politicians to prioritise alternative fuels. During a transition period, coal was used instead of oil, but coal has gradually been replaced by increasing proportions of biofuels, waste, heat pumps and natural gas.

Table 22 shows how the fuel mix used for district heating production has changed between 1981 and 2003. In 2003, fossil fuels (oil, coal, natural gas and peat), together with electricity, supplied 27 % of the total fuel consumption. In 1981, the corresponding figure was 87 %. The 10 % proportion of fuel input provided by oil has remained essentially unchanged over the last 15 years. Today, oil is used primarily in peak load boilers to meet high demand levels during particularly cold periods in the winter.

The suppy of district heating has increased by about 70 % between 1981 and 2003. According to the District Heating Association, it is expected that supply will increase by 2-3 % per year until 2010, which is equivalent to an increase of 10 TWh and a total delivery of about 60 TWh by 2010. In the longer term, the potential is estimated at 75 % of the heating market, or about 20 TWh more than the present-day supply.

The market

According to Avgiftsgruppen, district heating is the most common form of heating in apartment buildings in 232 of the country's 290 municipalities.[40] In addition, district heating supplies about half of the heating energy for residential buildings and commercial premises in Sweden.

Producers of district heating

According to Statistics Sweden's (SCB) company register, there were 208 district heating companies in the country in March 2005, operating about 570 separate district heating systems in total. For more than half of these companies, district heating was their only activity: most of the remaining companies supplied district heating in conjunction with some form of activity on the electricity market.

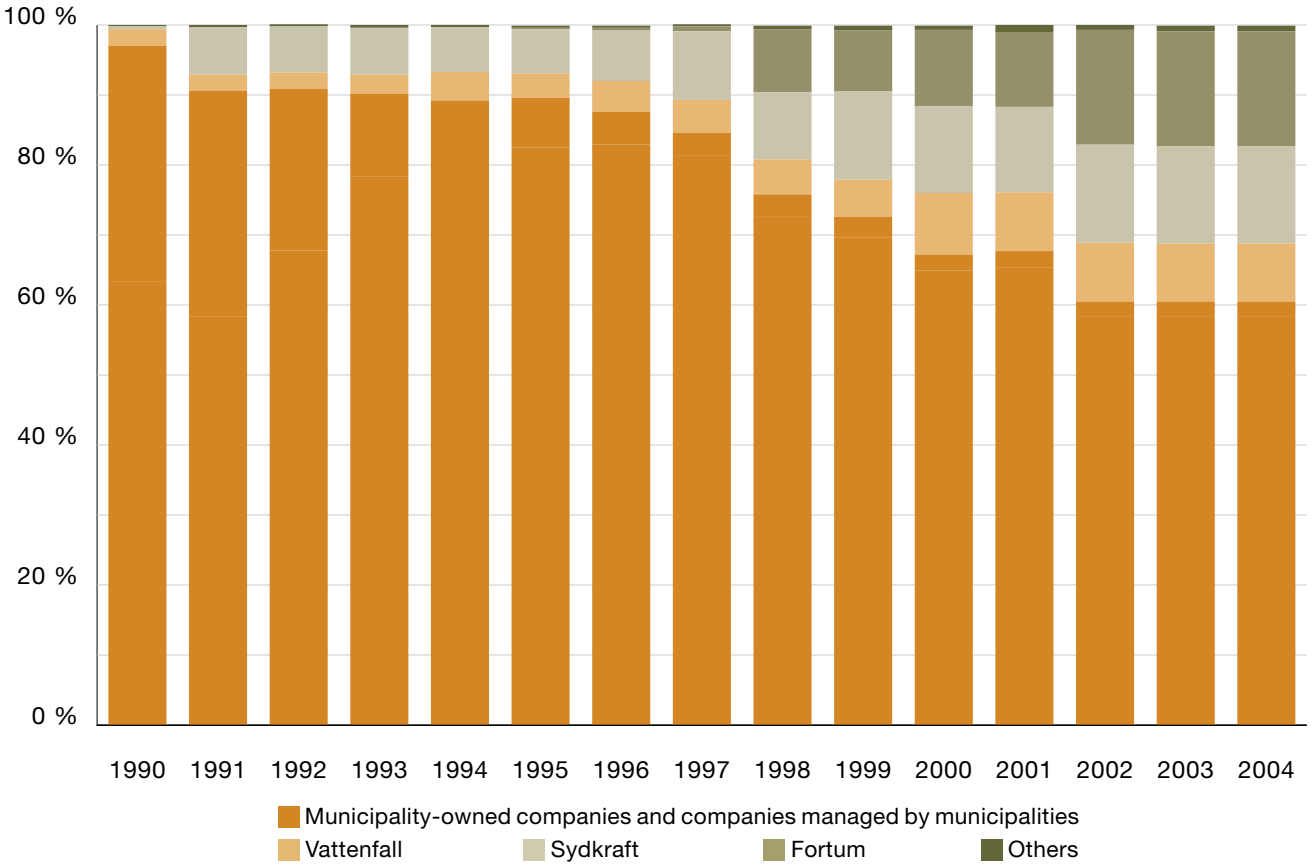
According to the Swedish District Heating Association, its members' total revenue in 2003 amounted to SEK 21 300 million, an increase of over 7 % compared with the previous year. 87 % of revenues derived from variable energy charges, with the remainder coming from fixed charges. Members' average revenue per kWh delivered was 44.6 öre. According to SCB, the average cost of district heating fuel during 2003 was 13.9 öre/kWh. To this must be added fixed costs for production. Investments in production and distribution facilities amounted to SEK 4 800 million. Investments therefore amounted to 22.5 % of revenue, which was an increase of 1.3 percentage points over the previous year.

An investigation of the ownership of district heating companies was carried out on behalf of the District Heating Commission and Avgiftsgruppen in 2003. The results showed that:

- 59 % of district heating supplies come from companies owned by municipalities,
- 32 % of supplies were controlled by three large groups, with foreign ownership,
- the 35 largest companies account for 85 % of sales, and
- private and state-owned companies have prices that are 5-20 % higher than prices from companies owned by municipalities.

[40] This group consists of HSB Riksförbund, Hyresgästföreningen, Riksbyggen, SABO and Fastighetsägarna Sweden, all large housing companies.

Figure 14: Ownership shares of Swedish district heating supplies



SOURCE: THE DISTRICT HEATING BUREAU AND FVB SWEDEN AB

After the liberalisation in 1996, there has been a structural change from municipality ownership of energy utilities towards ownership by large energy groups. Between 1996 and 2002, the proportion of utilities owned by municipalities fell by over 25 %. Examples of municipality-owned energy companies bought up by private companies in recent years include Lidingö, Upplands Väsby, Sigtuna, Mora, Norrköping, Järfälla and Kalmar. Other major ownership changes that have occurred in recent years include E.ON's acquisition of Sydkraft, Fortum's purchase of Birka Värme and Sydkraft's acquisition of Graninge. Figure 14 shows the effects of the current ownership readjustments.

The end-user market

At the end of 2003, there were 250 000 district heating supply contracts in Sweden. Table 24 shows statistics for energy consumption, market shares and num-

Table 23: District heating customer categories and supplies, 2003

Category	Energy consumption, TWh	Proportion of district heating, total	Proportion of respective heating market[1]	No. of subscribers
Det. houses	3,7	7,9 %	9 %	169 000
Ap't buildings	24,2	51,7 %	83 %	49 000
Commercial[2]	14,5	31,0 %	66 %	26 000
Industry	4,4	9,4 %	-	4 000

SOURCE: STATISTICS SWEDEN

[1] Indicates the proportion of the total heated area. The figures also include buildings using a combination of district heating and an alternative form of heating
[2] The Commercial buildings category includes public buildings and other buildings

Table 24: Prices of district heating[1], gas oil[2] and biofuels, including tax and VAT, öre/kWh

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fjärrvärme[1]	55,9	55,5	56,0	55,5	55,3	55,8	56,2	57,4	61,1
Villaolja[2]	56,7	46,4	43,3	44,5	58,1	61,8	63,9	68,4	79,2
Biobränslen	11,9	12,0	12,2	12,1	11,8	11,3	12,5	12,6	13,8

SOURCE: SWEDISH ENERGY AGENCY, AVGIFTSGRUPPEN, SWEDISH PETROLEUM INSTITUTE AND STATISTICS SWEDEN

1. The price of district heating applies for a typical apartment building of 1000 m3, 15 apartments and with an annual heating requirement of 193 MWh.
Note: The prices shown in the table are expressed in 2004 price levels. Earlier prices have been deflated using the consumer price index, exclusive of energy raw materials.

bers of subscribers for the customer groups of detached house, apartment buildings, commercial premises and industry.

Total district heating supplies in 2003 amounted to 47.5 TWh. In general, district heating has a dominating position on the heating markets for apartment buildings and commercial buildings. In the central parts of towns and urban areas, the dominance of district heating is often higher than is shown in Table 23. Although the proportion of detached houses connected to a district heating system amounts to less than 10 %, numbers are increasing steadily. At present, about 10 000 detached houses are connected each year.

Avgiftsgruppen's comparison of Sweden's municipalities from 2004 shows a relatively wide spread of district heating prices, from 30 öre/kWh up to 70 öre/kWh. Municipalities with extensive district heating networks, and systems supplied by companies using waste heat, have the lowest prices. The highest prices occur in areas having district heating systems that expanded rapidly over the last decade. An important comparison factor that affects the companies' revenues, and thus also their ability to keep prices down, is the density of customers. District heating companies in large urban areas have lower investment costs per unit of heat supplied, and can generally be expected to have lower prices than companies supplying district heating in sparsely populated areas.

Price development and competition

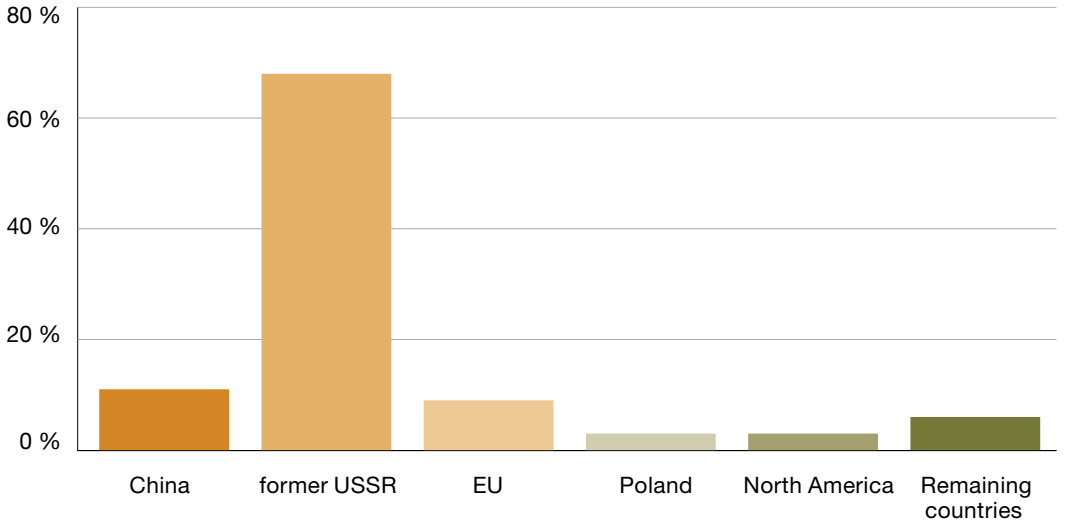
District heating distribution in densely populated areas has cost advantages in comparison with distribution in sparsely populated areas. In places where the distribution network covers most of the area, district heating generally supplies a significant proportion of the heat market. Local domination, together with a natural monopoly in the form of the physical distribution system, and high costs for customers attempting to change heating systems, means that the customer is

Table 25: Heating systems and energy carriers, numbers of customers

	DETACHED HOUSES		APARTMENTS		COMMERCIAL PREMISES	
Category	**2003**	**Change since 2002**	**2003**	**Change since 2002**	**2003**	**Change since 2002**
Electric heating (el)	500 000	-14 000	92 000	5 000	15 400	-100
Oil	93 000	4 000	123 000	4 000	7 700	-270
Biofuels (bio)	53 000	14 000	-	-	-	-
Heat pumps (hp)	63 000	28 000	64 000	1 000	4 900	0
District heating (dh)	132 000	14 000	1 853 000	20 000	20 500	500
Dh + oil, el, hp	-	-	108 000	1 000	1 450	350
Oil + bio, el, hp	250 000	-53 000	55 000	-9 000	3 100	-200
Bio + el	350 000	35 000	7 000	3 000	700	100
Gas	-	-	24 000	-3 000	800	-200
Other	142 000	-12 000	80 000	10 000	100	80
Total	1 583 000	16 000	2 406 000	32 000	54 650	260

SOURCE: STATISTICS SWEDEN

Figure 15: World use of district heating in 2002



SOURCE: IEA

in a weak position in relation to the district heating company. The Government has interpreted the relatively wide spread of the price of district heating supplies as an indication of lack of competition.

In order to decide what the competitive status of district heating is, it is of vital importance to decide whether district heating should be regarded as a separate market, or if it should be regarded as part of a larger heating market. In its report, the District Heating Commission notes that district heating should be regarded as a market of its own as far as existing customers and properties are concerned, but should be regarded as one alternative on a larger heating market for customers considering a new investment in some form of heating. In the case of properties that were connected to systems during the earlier years when they were operated under the municipality actual cost rules, but for which prices were raised after liberalisation, this represents a difficult and expensive situation, with a customer being locked into his choice of district heating.

Prior to 1996, municipality-owned district heating companies (limited liability companies) operated under the actual cost principle and the equal terms principle. The principle now applied by the sector for determining prices is the opportunity cost principle, i.e. how the cost relates to those of competing alternatives. This means that the price of district heating has followed price variations in that of the closest alternative, such as oil, electricity or biofuels. The opportunity cost pricing principle benefits the customer if the competing alternatives drop their prices. However, the increases in energy and carbon dioxide taxes in recent years have created conditions favourable to increasing the price of district heating. Table 24 shows prices since 1996 in a reference model property, used by Avgiftsgruppen for its annual price investigations, and consisting of a typical apartment building with a heated area of 1 000 m^2, 15 apartments and an annual heating requirement of 193 MWh.

Since 2000, the price of district heating has risen by 3–6 % per year. Over the whole period, prices have risen by about 10 %, with the increase being particularly marked between 2003 and 2004. Over the period 1996–2004, the price of oil rose by about 40 %. Since 1996, the total tax on oil has been increased by 77 %, which is the main explanation for the rise in the price of oil. The increased cost of oil, and a rising price of electricity, has created a gap between prices of the different energy carriers, allowing the price of district heating to be increased at a higher rate than the general inflation rate. That this opportunity to raise the prices of district heating has been taken can also be due to the fact that many companies have been required to increase their rates of return.[41]

Customer mobility of district heating customers is low, in that very few owners of connected properties choose to disconnect their district heating systems. The changes in the numbers of district heating customers that have been noted have all represented an increased number of properties connected to district heating systems. Each year, SCB investigates the proportions of energy carriers used in the district heating market for residential buildings and commercial premises. Table 25 shows the numbers of customers for different types heating or energy carriers in 2003, together with details of changes since the previous

41 The EKAN Group. District heating companies and ownership. A report for the District Heating Commission and Avgiftsgruppen. [In Swedish.]

year. It can be seen that the market share of district heating is increasing in all categories. This is particularly clear for apartment buildings and commercial buildings, where district heating has a high proportion of the market. On the other hand, in the detached house market, district heating's growth is weaker than that of both heat pumps and biofuels.

Since 2001, the Swedish Energy Agency has monitored competition on the heating market each year. The resulting report shows district heating prices and what various other forms of heating cost for property owners. The alternatives are compared on the basis of both investment costs and variable costs for fuel or electricity.[42]

An international perspective

District heating is used in Eastern and Central Europe, China, Japan, Korea, Mongolia and the former USSR. In 1998, 80 % of the world's district heating was produced in the former USSR and in China, as shown in Figure 15. China is the country where district heating is growing most rapidly in the world. More than 40 million people in eastern and central Europe are connected to district heating: for the domestic sector, this represents a weighted average market share of 37 %, which can be compared with a corresponding figure of 7 % for EU-15.[43] According to the European industry organisation for district heating, Euroheat and Power, district heating is supplied to more than 100 million people in 27 countries in Europe.

The extent of development of district heating in western Europe varies widely. In Sweden, Denmark, Finland and Iceland, district heating is a very common form of heating. Austria and Germany have market shares of 12–15 %, while in other countries the market shares are lower, at just a few per cent.

In most countries, district heating is regarded as a natural monopoly, due to the fact that distribution is a natural monopoly and because the production of hot water is predominantly integrated with distribution. Denmark has special legislation governing pricing, as well as requiring property owners in areas in which district heating is available to connect their buildings to the system. Price control and vertical separation of production and distribution were common in the earlier planned economies. Other countries rely on national antitrust or competition legislation.

A clear difference in the use of district heating appears in a comparison between the Nordic countries. In Sweden, about a quarter of the thermal energy is supplied by CHP plants, while the corresponding figure in Denmark and Finland is three-quarters. Further extension of district heating in Sweden has been restrained by a low price of electricity, which has meant that investment in CHP production is not as profitable as investment in a plain heating plant.

[42] *Heating in Sweden, 2005 – Monitoring the heating markets, with the emphasis on district heating,* The Energy Markets Inspectorate 2005. [In Swedish.]

[43] Gochenour, C (2001), District Energy Trends, Issues, and Opportunities: The Role of the World Bank, World Bank Technical Paper no. 493.

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