Annual Report
1999

Nordel

Contents

The participants of Nordel´s annual meeting 1999 had the opportunity of visiting Sveaborg fortress in Helsingfors. The fortress is popularly known as «The Nordic Eastern foothold» and was erected at the end of the 18th century by the Swedish admiral Augustin Ehrensvärd.

Photo: Juhani Eskelinen.

Nordel

Nordel is a body for co-operation between system operators in the Nordic countries. The association also serves as a forum for technical co-operation and co-ordination between system operators and actors who have technical facilities of importance for the operation and development of the electric power system.

Nordel´s primary goal is to create prerequisties for, and to develop further, an efficient Nordic electricity market. Nordel gives advice and recommendations. In August 1998, the association adopted new By-laws, which were accommodated to the new conditions that prevail on the joint Nordic market. Nordel´s revised structure also makes the association well suited to represent the Nordic system in international contexts. The results of Nordel´s work are public and its operations are neutral.

Nordel´s tasks fall mainly into the following categories:

- system development and rules for network dimensioning;
- system operation, reliability of operation and exchange of information;
- principles of pricing for network services;
- international co-operation;
- maintaining contacts with other actors, organisations and the authorities within the power sector.

Nordel´s highest decision-making body is the Annual Meeting, which encompasses leading individuals from the Nordic system operators as well as representatives of other participants in Nordel´s work. System operators cast half of the votes in Nordel and hold the chairmanship, which rotates between the Nordic countries at intervals of three years. The chairman appoints Nordel´s secretary and is responsible for the secretariat and for the related costs. The association has no budget.

Nordel´s executive body is the Executive Board, composed of one representative of the system operators in the Nordic countries, as well as two representatives of the other actors. The Executive Board makes initiatives and decisions on topical issues, and implements the decisions taken at Nordel´s Annual Meeting. The Board is also responsible for the association´s external information activities.

Much of Nordel´s work is carried out by committees and working groups made up of technical specialist from the various sectors involved in co-operation within Nordel.

Key Figures 1999

		Nordel	Denmark	Finland	Iceland	Norway	Sweden
Population	mill.	**24,1**	5,3	5,1	0,3	4,5	8,9
Total consumption	TWh	**383,8**	34,8	77,9	7,2	121,0	142,9
Maximum load (measured 3rd Wednesday in Jan.)	GW	**54,2**	4,7	10,2	0,7	17,6	21,0
Electricity generation	TWh	**384,3**	37,0	66,8	7,2	122,9	150,5
Breakdown of electricity generation							
Hydropower	%	**55**	0	19	84	99	47
Nuclear Power	%	**24**	.	33	.	.	47
Other thermal power	%	**20**	92	48	0	1	6
Other renewable power	%	1	8	0	16	0	0

. Data are nonexistent

0 Less than 0,5 %

Nordel's Activities in 1999

The continued development of the Nordic market and developments in Europe in particular dominated Nordel's work in 1999. The EU directive concerning the internal electricity market (IEM), 96/92/EC, formally came into effect on 19 February 1999, signifying that from this date onwards competition would be the norm, not the exception, for electricity trade and production in all the so-called IEM countries, i.e. the 15 EU countries together with Norway and Switzerland.

During the course of the autumn of 1998, it became clear that the EU Commission was in favour of an organisation that could represent transmission system operators (TSOs) in conjunction with the implementation of the electricity market directive. It did not recognise any of the electricity industry's existing organisations as representatives of the TSOs. At a meeting in Saariselkä in Northern Finland in early December 1998 between Nordel's Executive Board, UCPTE's Steering Committee and representatives from the British Grid System, it was therefore decided that work should be undertaken to establish an organisation for TSOs in the IEM countries, on the basis of the existing organisations. During the course of the first six months of 1999, considerable work was carried out by a number of working groups to pave the way for the formation of the envisaged organisation.

Thus on 1 July 1999 the new organisation, the Association of European Transmission System Operators (ETSO), was founded at a formal ceremony in Frankfurt in Germany. The four founders of ETSO were Nordel, the Union for the Co-ordination of Electricity Transmission (UCTE), the United Kingdom Transmission System Operators Association (UKTSOA) and the Association of Transmission System Operators in Ireland (ATSOI).

Nordel's new chairman, President and CEO of Statnett, Odd Håkon Hoelsæter was elected ETSO's first president.

Since the formation of ETSO, Nordel has played an active part in formulating and establishing solutions to promote the development and opening of the electricity market in Europe. In all, 10 people from the Nordel countries have participated in various working groups. With the exception of Iceland, all the countries are represented in ETSO's Steering Committee and Nordel is responsible for the management and secretarial functions of ETSO's Presidents´ Council.

At the annual meeting in Helsingfors on 20 May 1999, Nordel approved a recommendation regarding IT problems associated with the transition to the year 2000 (Y2K). We are pleased to note that the transition to the new millennium proceeded smoothly, without any negative consequences for the electricity supply in the Nordic countries.

The capacity situation in the Nordic electricity system has been reviewed. Consumption is rising, only marginal new production capacity is being added and older production facilities are being decommissioned resulting in a more tightly squeezed capacity balance. An ad hoc group under Nordel's Operations Committee has discussed issues surrounding delivery quality and reserves. As a result of this work, a new working group at Nordel was formed to take charge of dealing with power and energy balances.

At the Executive Board's meeting in August 1999, it was decided to look at Nordel's organisation in the light of the developments that had occurred after the electricity market directive became effective, including the formation of ETSO and the restructuring of UCPTE into an organisation for TSOs (UCTE). It is acknowledged that the developments observed have carried forward the trends that were outlined when Nordel's By-Laws was amended at the annual meeting in August 1998. In December 1999, the Executive Board resolved to take the assessment of changes to Nordel's organisation one step further and the following objectives were set:

- Refocusing of Nordel's management structure into a pure TSO structure
- Broader contact with market players
- Integration of the activities at the Grid Companies' meeting to avoid work being done twice

On the basis of this, proposed amendments to Nordel's By-Laws are being drawn up for the annual meeting in June 2000.

President and CEO of Statnett, Odd Håkon Hoelsæter, was elected new chairman of Nordel at the annual meeting in Helsinki.
Photo: Hoffmanns.

The Planning Committee's Activities in 1999

Goal and tasks

The Planning Committee is responsible for technical matters of a long-term nature concerning the transmission system and exchange of information concerning expansion of the system. The Planning Committee acts as a cooperation body for the Nordic transmission system operators and serves as a forum for debate on planning between the market players and the system operators. The Planning Committee helps to create the criteria for, and continue the development of, an efficient Nordic electricity market and takes the initiative for analyses of the technical interaction between electricity production and the transmission grid. The Planning Committee contributes to this by disseminating neutral analyses and reports.

The Planning Committee

- analyses the technical interaction between production and transmission grid at the planning stage
- follows up on the capacity situation and planning within both electricity production and transmission
- prepares recommendations for technical regulations for planning and expanding the Nordic electricity production system and transmission grid, including interconnection with neighbouring areas
- prepares recommendations for technical specifications for connection of production facilities to the grid
- analyses the need for transmission capacity between the different systems within Nordel and between Nordel and the rest of Europe
- analyses environmental issues and their importance to long-term system development.

The Planning Committee's activities

In 1999, the Planning Committee commenced discussions of the consequences on the planning side of the ongoing liberalisation and opening of the market. The discussions are expected to result in a study in the coming years. The main reasons for the discussions are as follows:

With the advent of liberalisation, earlier times' load dispatch has gradually been replaced by price-governed control and the system operators' signals to the market's players. An example is the earlier direct control of production for handling bottlenecks in the interchange – which are now handled by creating price regions, counter purchasing or special regulation.

The change from national planning to market-governed planning on the production side means that one can foresee bigger differences in the scenarios for the production plants of the future. This means new requirements concerning the robustness of the main grid. At the same time, the present decommissioning of back-up capacity is affecting the entire power situation, and the distribution of scarce reserves – including reactive reserves, may make new requirements concerning the main grid.

A study is therefore needed to clarify the consequences of such factors. The study is also expected to throw light on the need for coordinated planning in the market region and the use of new tools for the necessary analyses. At the beginning of the year, there were two permanent working groups under the Planning Committee: the Grid Group and the Production Group, but the latter was disbanded during the year.

The Grid Group

In 1999, the Grid Group continued its analyses of the consequences of large quantities of non-dispatchable production in the Nordic electricity system. The analysis was found necessary because of the prospect of a rapidly growing number of wind turbines and small CHP plants in the years ahead. These new types of production plant make demands on the regulating capacity of the system while at the same time to some extent displacing existing production plants with good regulating capacity. The purpose of the analysis is to illustrate the technical interaction between the non-dispatchable production, the other production and utilisation of the transmission grid. The result will be a common technical basis for negotiations between the market players.

In 1999, the Grid Group delivered a progress report on the subject to Nordel's Annual Meeting in 1999. In this, a number of technical needs are identified with respect to regulating capacity, voltage stability and power transports. It appears that, with the current rules and agreements, large quantities of non-dispatchable production may change the distribution of the financial burden between the Nordel partners. The Grid Group is now assessing the amount of regulating capacity. So far, this points in the direction of a need to review the concept for regulation and dispatch reserves in Nordel. The progress report also discusses the non-dispatchable production, seen in relation to any coming internal market for RE certificates. The Grid Group is now gathering the threads together in a final report that will be presented at the Annual Meeting in the year 2000.

A federation of European nuclear power companies has presented a paper setting out its views in preparation for European standardisation work on operating specifications and grid connection for power stations. It is important that a European standard has the right balance between the needs of the systems, power station interests and the possibilities of the suppliers. It is also important that the standard does not conflict with the existing system's design basis, which – in Nordel's case – is described in «Operating specifications for CHP plants» and «Rules for dimensioning of grids». The differences in system size between the Nordel grid and the UCTE grid may necessitate maintaining different requirements in some areas. For this reason, the Grid Group has commented on a number of points in the federation's paper: plant size in relation to system size, voltage curve after a short circuit, reactive power and breaker failure because there are critical differences here with respect to the requirements described in the federation's paper, The Grid Group will follow up on this in the year 2000.

The Grid Group has re-examined AC transmission capacities in the Nordel grid on the basis of the definition adopted in 1998. The definition of the AC transmission capacity is considerably more complex than the definition of the DC transmission capacity because the transmission capacity in a section of the AC grid is far more dependent on parameters in the system of which it is a part.

It is important to determine transmission capacities in sections within and between the Nordel countries and in links with the rest of Europe in connection with power and energy balance studies. The Grid Group has therefore followed the study concerning loss of load and contributed assumptions for analyses or interpretations of results concerning transmission conditions in the grid.

The Production Group

In 1999, the Production Group continued working on the new base scenario for the Nordel system in 2005 and also studied a number of alternative scenarios. These include an analysis of the importance of the interconnections with the Continent, CO_2 quotas and expansion of gas-fired production capacity.

The calculations for the base scenario show a relatively strong Nordic energy balance in 2005, with an average net export from Scandinavia to the Continent of around 5 TWh. It is mainly Denmark's energy balance that is strong, while the other countries have a certain net import. Calculations with decommissioning of back-up capacity show that the energy balance and the energy price are less affected in years with average precipitation. In dry years, on the other hand, the balance is weak, so some rationing is needed, which also results in a considerable increase in the energy price.

The problem with the energy balance in dry years is even greater in the scenario without the three cables between Norway and the Continent. Of the approx. 13 TWh assumed to be imported in dry years, only slightly less than 9 TWh is replaced by increased import via the interconnections with the rest of Scandinavia. The price thus goes up to around four times the average annual price in Norway. Sweden and Finland are also affected by the reduced import possibility, but the price rise is only about 2.5 times. Nor can the big export via cables in wet years be fully replaced by increased export to the rest of Scandinavia. However, the price reduction in wet years is not quite as dramatic. Calculations without the interconnections with the Continent show that a price rise of about 2 øre/kWh in Norway. However, the average value of the energy exchange between Scandinavia and the Continent is reduced only marginally.

In one scenario, the Production Group has studied the effect of the type of CO_2 quotas that the Danish government is planning to introduce in Denmark. The tax for exceeding the quota means an increase of 3-4 øre/kWh in the variable cost of condensing production. Production in Denmark is thereby reduced by around 6 TWh, which is partially compensated for by increased production in Finland, but mainly through increased production on the Continent. The net export to the Continent of 5 TWh is thus turned into a small import, and the average price rises somewhat. The CO_2 emission is reduced by 5 million tonnes/year in Denmark, but by just 4 million tonnes/year for the whole of Scandinavia. However, the increased production on the Continent results in a total increase in the emission of 0.7 million tonnes/year.

Lastly, the Production Group has studied expansion of gas-fired production capacity with two units in Norway and one in Finland. They are estimated to have a combined production of around 6 TWh/year. Net export to the Continent increases by about 3 TWh and coal-based condensing production goes down. The CO_2 emission in Scandinavia increases somewhat, but the total emission is reduced by around 2 million tonnes/year.

The strengthening of the energy balance in Norway considerably reduces the dry-year problem, but without the cables to the Continent, the price in dry years still rises to 2-3 times the average price.

Decommissioning of back-up capacity greatly affects the power balance. In 1999, the Production Group examined and updated the data for the model. The calculations show that the risk of loss of load in the Nordic system can no longer be regarded as negligible. The risk also depends greatly on how the possibility of power support from the interconnections with the Continent is assessed.

The Hengil area, Iceland, where Reykjavík Energy´s Nesjavellir geothermal heat and power station is located, has possibilities for more extensive exploitation.
Photo: Emil Thór Sigurdsson.

The Operations Committee's Activities in 1999

Objectives and tasks

The operations committee is responsible for issues concerning technical systems in the short-term and the technical framework for operations.

The objectives of the committee are:

- to contribute to creation of the best total utilisation of the Nordic power system
- to be a body for co-operation between the transmission system operators and the participating market players
- to create conditions for further developement of an efficient Nordic electricity market, taking into account the neighbouring systems
- to initiate technical investigations and co-ordination, compile preliminary recommendations, and to function as a body for referrals for issues relating to the utilisation and operation of the power system
- to promote international co-operation and exchange of information relating to the power system and the electricity market

The committee consists of representatives of both transmission system operators and market players.

There are three permanent working groups subordinated to the operations committee:

- The working group for power system operations, NOSY
- The working group for information technology issues, NORCON
- The working group for developing and standardising Electronic Data Interchange (EDI), Ediel Nordic Forum

The operations committee has continuously dealt with issues about operational technical co-ordination, operational reliability, and the power situation in the Nordic countries. The conditions for electricity trading have also been continuously studied.

Operations reporting

Consumption and power balances

In 1999 there was a slight positive trend in the total consumption in the Nordic countries with a total consumption of just below 384 TWh. The electricity consumption is expected to increase somewhat in all countries in the coming period and the power and energy balance forecasts compiled by the operations committee indicate continously smaller margins.. The power balance might in a dry year be poor because of discontinued thermal power. The energy balances show that Finland and Denmark have good reserves. Sweden's energy balance shows neither a surplus nor a shortage; the production capacity is, during normal years, 145 TWh whereas the temperature adjusted consumption was in 1999 144.5 TWh. The normal annual production of Norway is somewhat lower than its consumption. The transmission problems between the different systems and a correct allocation of existing capacity are still major challenges.

Power exchange

Examining the electricity exchanges in the Nordic area in 1999 shows that Sweden is still the big net exporter with 7.5 TWh. Denmark and Norway were also net exporter, the net export for both countries was approx. 2 TWh. Finland was a net importer of electricity, the net import for 1999 was just under 12 TWh. An increasing amount of the electricity used in Finland is imported. During the last three years the net import of electricity to Finland has tripled. The system price for Nord Pool's electricity spot trading was, on average during 1999, 13.46 EUR/MWh.

Production

In 1999 the spring floods started unusually early, then stopped for a month to resume without any high peaks well into the summer. The extended spring flood meant that the spill at the power stations along the river Kemi in Finland was unusually small. Towards the middle of the summer the water reservoirs in Sweden and Norway were a little less than 8 % over the ten year average due to the rain in the early summer. The early summer was unusually dry in Finland and the reservoirs did not fill up as much as normal. The weather at end of the summer and well into the autumn was warm and dry in the whole of Scandinavia. The lack of rain in the autumn led to the sparing use of hydro power and higher prices on the spot market. The increase in prices was obvious from the beginning of August, the prices reached a level that was twice as high as the previous year. In September-October the total Swedish

Svartsengi, Iceland, in autumn. Geothermal plant, 150 MW heat and 45 MW electric power. Photo: Oddgeir Karlsson.

and Norwegian reservoir contents fell to below the ten year average and the prices on the electricity market were still much higher than the previous two years. Cold peaks in November have led to increases in electricity prices in recent years. This time the initial spot price was high, but there were no cold peaks and the electricity price dropped in November-December to slightly below the prices of 1998. The new millennium began with the water reservoirs close to their average levels. In 1999 the total hydro power production in the Nordel area was 211 TWh.

1999 can be characterised as a good water year despite the dryness of the late summer and autumn. The price of electricity was slightly higher than the prices in 1998 but not so high that it would have been profitable to operate conventional thermal power plants over longer periods. The trend in recent years of decommissioning thermal power plants has continued. In some cases it is a question of mothballing, i.e. the vital part of the power plant (steam boiler etc.) are treated so that they will not be damaged while idle. Other times it is a question of complete demolition because future operations would involve such large investments in, for example, environmental protection that it is not considered profitable considering the prevailing price levels on the Nordic electricity market. There have been discussions, especially in Sweden, about whether the producers and system operators should jointly cover the costs for maintaining reserve power in power plants that would otherwise be decommissioned.

The nuclear power plant Barsebäck 1 in Sweden was according to a Governement decision from 1998 closed in November. The closure naturally increases the concern about the reliability of the electricity supply in case there is a cold winter in the south of Sweden.

Operational reliability

On the third of August the AC/DC substation in Viborg (Russia) failed causing a loss of 550 MW in the import to Finland. The loss led to emergency power functions being activated in Jutland. It was later stated that the regulating power was poor in the Nordel system at the time. The incident has carefully been analysed by the working group for power system operations, NOSY.

At the beginning of December a hurricane caused a lot of damage to the distribution grid in Denmark and southern Sweden. More than 40 000 houses were without electricity in Denmark, the longest power cuts lasted for several days. There were also problems with the transmission lines due to salt sticking to the lines. In Sweden three 400 kV lines were disconnected and Barsebäck 2 was closed down. The Baltic Cable between Sweden and Germany was also damaged by the storm and was taken out of operation for what would probably be the rest of the winter.

Co-operation with UCTE

The operations committee has participated in the activities of UCTE and has been continuously doing a follow-up of the deregulation within the UCTE area. The committee held a joint meeting with the corresponding group within UCTE (Verbundbetrieb). Issues relating to Nordel's recommendations about HVDC connections and information technology issues have been given special attention. European Transmission System Operators held their initial meeting in the summer of 1999 and the operations committee has continuously monitored its activities, especially with regard to operations and information technology issues.

The activities of the working groups

The ad-hoc working group's study on issues concerning reliability of delivery led, in 1998, to a report «Leveranskvalitet i Nordelsystemet" (Reliability of delivery in the Nordel system). The group continued working and produced a report "Effekt och Energibalanser» (Power and Energy balances). In the report it is recommended that Nordel defines what is meant by power reliability, energy reliability and reliability of delivery and makes recommendations for how the work on compiling power balances should be organised. The report suggests that deterministic power balance forecasts for the following winter should be made in the autumn and probability analyses covering several years should be made in the spring. The recommendations of the report led to the establishment of a special working group, the balance group.

A recommendation about preliminary measures to be taken before the change of the millennium had been compiled and accepted at the Nordel's annual meeting in May. Based on this recommendation the system operators within Nordel made an agreement which was valid till after the millennium shift.

Based on a report on the problems which can occur in the Nordic power system when the number of HVDC connections to neighbouring power systems increase, the working group for power system operations (NOSY) have continued to work on a recommendation about controlling and regulating HVDC connections. The intention is that the recommendation will be completed in co-operation with UCTE.

NOSY has also continued to work on issues related to quality of frequency, co-ordinating the criteria for operations and grid dimensioning and updating the requirements for reserves in the Nordic countries. NOSY's regular tasks include the follow-up and analyses of the quality of frequency and regulating power, analysing disturbances and exchanging experiences.

The working group for information technology issues, NORCON has, in close contact with Ediel Nordic Forum, functioned as a reference group in organising the future development of the information systems.

Ediel Nordic Forum was placed under the operation committee in the autumn 1999. The group works on developing and distributing the Ediel standard and supports Ediel users in their work.

The Transmission Pricing Committee's Activities in 1999

The newly formed transmission pricing committee set up at Nordel's annual meeting in 1998 is responsible for all matters relating to network tariffs and to terms and conditions governing network utilization in the joint Nordic power market.

The objectives of the committee are as follows:

- to serve as a discussion and cooperation forum for market players and companies with system responsibility
- to help develop the right conditions for an efficient Nordic power market
- to serve as Nordel's reference group for the European transmission pricing activities within ETSO
- to initiate studies of the development of tariffs and terms and conditions within the Nordic power market
- to participate in the work of international collaboration organizations
- to prepare information about network tariffs and other terms and conditions within the Nordic power market
- to coordinate this work with Nordel's other committees.

The committee actually started its work in 1999. Prior to this, introductory work was performed by a smaller project group whose members are now part of the transmission pricing committee. The committee is made up of representatives of system operators, regional network owners and market players.

The committee serves as a reference group for the following working groups:

- The price harmonization group, which focuses on harmonizing the Nordic transmission network tariffs so as to enhance the efficiency of the Nordic region's power market
- The transit group, whose task is to develop methods for estimating the power transit flows through a particular country, as well as transit costs.
- The bottleneck group, whose task is to make proposals for how to allocate the fees generated by Nordpool trading among the transmission network companies when transmission bottlenecks arise between the Nordic countries.

Work in progress

During the year, the committee has performed a study of international transmission network tariffs. This forms the basis for the price harmonization process in the Nordic region. Grid network tariffs in Spain, Argentina, Chile, Australia, California, and Canada have been analyzed with particular reference to such aspects as structure and level, etc.

The price harmonization work in the Nordic region is designed to enhance the efficiency of the Nordic power market and facilitate integration and cooperation between transmission network companies and market players.

The committee aims to have established a joint principal structure for transmission network pricing by the spring of 2000. In this context, the harmonization of input tariffs are the top priority. The changes are due to be implemented on 1 January 2002. The purpose of the committee's work is also to contribute to the network pricing activities within ETSO.

During the year, the transit group developed a number of methods for estimating transit though a particular country. The group is now pursuing its work on developing a method for continued testing. The method chosen should take into account possible application throughout the ETSO region. The goal is to start testing the method in 2000.

Based on the work of the bottleneck group, the allocation of bottleneck fees between the Nordic transmission network companies has been determined for a period up to and including 2000. Work is in progress to find a model that can be implemented in the longer term after 2000.

Nordel's transmission pricing committee is also very active in European work relating to International Exchange of Electricity and Cross Border Tariffs. Since the Nordel countries have been forerunners in terms of the deregulation of the power market, many interesting comments and proposals have been presented by the Nordic countries.

Photo: Tor Oddvar Hansen.

Developments in 1999

The electricity market

Developments in the joint Nordic electricity market continued apace in 1999. The most significant change in the market was the integration of Jutland/ Funen in Nord Pool's electricity spot market as of 1 July 1999. Eastern Denmark is also expected to be fully integrated in the electricity spot market during the course of 2000.

The Elbas product was introduced to Finish and Swedish market players on 1 March 1999. With the Elbas product the market players can adjust their balance after the Elspot trade is cleared.

Day contracts and options were introduced in the financial market in autumn 1999. Nord Pool is thus able to offer a virtually complete product range for roughly three years into the future.

During the course of the year, there was considerable focus on the capacity situation in the Nordic system. The anticipated capacity shortfall in peak load situations and the interaction between system operators, the power exchange and authorities in handling capacity are issues that have been discussed.

The restructuring of the industry continued in 1999. Numerous mergers and acquisitions took place both in the production and the distribution sector. Facilities were acquired and exchanged at both main grid and regional grid level, driven by improved competitiveness and streamlined operations.

Developments in the small customer market continued. In Norway, small customers have been free to choose their supplier since deregulation began in 1992. Profile settlement or metering means that metering by the hour is not required for the smallest customers. Finland adopted this method in 1998 and Sweden on 1 November 1999, once again giving small customers a real opportunity to choose their supplier. Developments are currently underway in Denmark that will result in freedom of choice for all small customers by 2003.

On the whole, prices in the power market remained low throughout 1999.

The economies of the Nordic countries

The economies of the Nordic countries continued to prosper throughout 1999 and this trend is expected to continue in 2000. Prognoses suggest the same level of growth as in the other OECD countries.

The **Danish** economy is essentially sound with a surplus in public-sector finances and equilibrium in the balance of payments. Economic stability has also been achieved by curbing domestic demand through tax increases. Economic growth slowed down significantly in 1999 to 1.3%, against 2.7-3.1% in preceding years, largely attributable to a reduction in private consumption. Despite this slow-down, unemployment fell from 6.4% in 1998 to 5.6% in 1999. The balance of payments was virtually in equilibrium in 1999, making 1998 the only year in recent years to have suffered a deficit. Public-sector finances were showing a healthy surplus of DKK 35 billion and the trend in recent years towards growth in this surplus has therefore continued. Wage and price rises have been just above that of other countries, as wages have risen by 4.5% and prices by 2.5%, largely explained by the economic growth and the relatively hefty rises in Danish taxes.

Finland has undergone favourable economic growth since 1993. During the course of 1999, GDP rose by 3.8%. Prognoses suggest that there will be an even steeper rise in GDP in 2000. The increase in industrial production has primarily occurred in the electrical and electronic sector

Nord Pool has a busy exchange desk for spot market transactions. Photo: Nord Pool.

The total electricity volume traded on Nord Pool by financial contracts in 1999 was 215,9 TWh – amounting to NOK 27,6 billion. Photo: Nord Pool.

and the paper-making industry. Despite the favourable economic climate, unemployment has remained fairly high, at around 9.1% in the latter part of 1999. In 1999, mean inflation was 1.2%, rising towards the end of the year and ending at 2.0% in December. This was largely due to the price rises for petrol and light fuel oil.

Iceland's economic recovery continued, with GDP rising by 5% during the course of 1999. This is a slightly lower rate of growth than in previous years. There was no change in the real value of the country's most important export sector, fisheries products. Growth in the rest of the export industry stood at 21.5%, the largest share coming from aluminium exports. Unemployment fell by 1%-unit and throughout the year hovered at an average of 2.0%. Inflation was 3.4%, compared with 1.7% the year before.

In **Norway,** after marginal changes in economic activity in the second half of 1998 and the first half of 1999, there are several indications pointing to future growth. From a Norwegian perspective, the international economic forecasts look promising, although a further decline in oil investments will contribute to weak industrial development. The surplus in the current account balance with other countries totalled NOK 43.8 billion in 1999. GDP rose by 0.8%, against 2.0% in 1998 whilst inflation remained the same as in 1998 at 2.3%. Unemployment totalled 3.2%, against 3.0% in 1998.

The upturn in the **Swedish** economy continued in 1999. GDP increased in volume by 3.8% compared with the previous year. Production output in trade and industry rose by 4.4% and by 3.8% in the manufacturing industries. Exports of goods and services rose by 4.3% and total imports by 4.7%. Inflation was 1.2% in 1999. Unemployment was 5.6%, down by a mere percentage point compared with the previous year.

Electricity consumption and electricity generation

Electricity consumption (excluding deliveries to electric boilers) in the five Nordel countries totalled 377 TWh in 1999, which corresponds to a 0.7% increase compared with 1998. The increase was +1.7% in Finland, +14.5% in Iceland, +0.7% in Norway and +0,3% in Denmark whilst Sweden fell by -0.3% respectively.

Total electricity generation in the Nordel countries was 384 TWh in 1999, on a par with 1998.

- Hydropower was by far the largest production source with 211 TWh, corresponding to 55% of overall production.

- Nuclear power was the second largest production source, with an annual output of 92 TWh. Nuclear power's share of total production was thus on a par with the previous year (24%), whilst the volume of production rose by 1 TWh. As in previous years, the average efficiency in the nuclear power units, from an international perspective, was excellent.

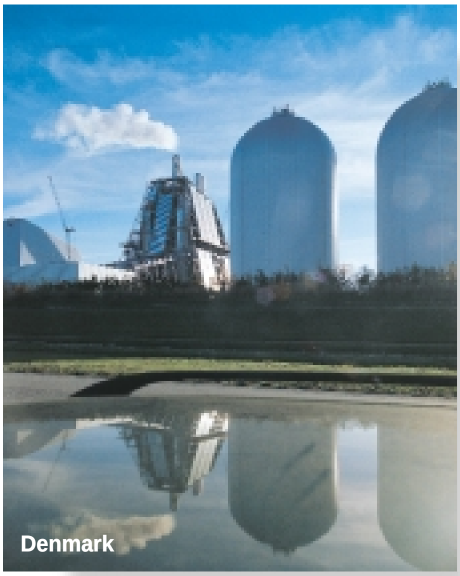
- Other thermal power had an output of 76 TWh and accounted for 20% of overall production - the same as in 1998.

- All other energy, e.g. wind power and geothermal power totalled 4.6 TWh, an increase of 1 TWh since 1998, accounting for 1% of total energy generation.

Power trading between the five Nordel countries totalled 27 TWh, against 23 TWh the year before. Added to this is trade with Germany and Russia of 13 TWh, which was the same as in 1998. During the course of the year, Sweden was the largest net exporter of power (8 TWh) whilst Finland was the largest net importer (11 TWh).

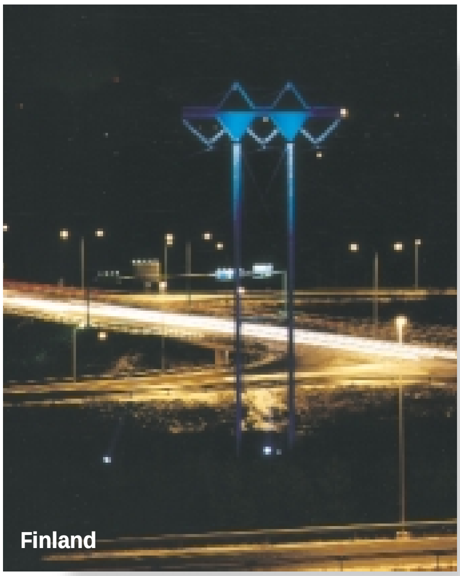
«Perlan» in Reykjavik, in special floodlight at the turn of the century. A restaurant owned by Reykjavík Energy. Revolving on top of warm water storage tanks. Photo: Emil Thór Sigurdsson.

Country Reviews



Denmark

Norway



Finland

Sweden

Iceland

Denmark

SK Power's new unit 2 at Avedøre Power Station is scheduled to go into operation in the autumn of 2001. Here it is shown with the chimney of unit 1 in the background and the two heat accumulators in the foreground.
Photo: Mogens Carrebye.

Energy policy

In 1999, energy policy in Denmark focused on the restructuring of the electricity sector. In March, a broad majority in the Danish Parliament agreed on an electricity reform. The main elements of the agreement are a time schedule for opening the market, a new corporate structure, establishment of an independent energy regulator, prioritisation of environment-friendly electricity production, CO_2 quotas for the generating companies, and establishment of the economic conditions for the main generating companies. On the basis of this agreement, a new electricity supply act was passed by the Danish Parliament in June 1999, together with an act on CO_2 quotas.

All in all, the electricity reform means that the EU directive on an internal market for electricity has been implemented in Danish legislation. The way has been paved for a speedy opening of the market, and a market scheme will encourage efficient production of renewable energy. The high level of Danish environmental ambitions is maintained through a quota scheme for CO_2 emissions. Consumer influence on the electricity sector is maintained, while electricity production and trade in electricity are coming under competitive pressure.

The Electricity Supply Act requires clear division between monopolistic and competitive activities. Production and trade in electricity are to be opened to competition, while grid operation and system operation must function as public infrastructure that is made available to all users of the system. In addition, special companies will be established with an obligation to supply electricity to all consumers in the supply region. Special requirements are made concerning consumer influence and public representation in grid, transmission and system operation companies and in companies with a supply obligation, and an independent energy regulator and an energy complaints board are being set up.

A separate act has been passed, introducing CO_2 quotas for electricity production. Every generator, with the exception of owners of renewable energy facilities, will receive a CO_2 emission permit. This applies to both present and future generators. CO_2 quotas have been set for the years 2000 – 2003 and political agreement has been reached on renegotiation of the scheme before the end of 2003. The limits for CO_2 emissions are 23 million tonnes in 2000, 22 million in 2001, 21 million in 2002 and 20 million in 2003. However, the act has not yet been put into effect because it is still awaiting approval by the EU Commission. CO_2 quotas will therefore not be in operation in the year 2000.

In the autumn of 1999, the parties behind the electricity reform entered into a supplementary agreement, this time concerning the economy of the generating companies, which, as regulated monopolies, have not been allowed to build up capital and are thus in a poor starting position under the new competitive market conditions. In December 1999, this agreement resulted in an amendment to the new Electricity Supply Act providing the generating companies with various possibilities for consolidation and capital injections.

The electricity market

The new Electricity Supply Act prescribes a phased but rapid opening of the market in Denmark. Today, all consumers with an annual electricity consumption of more than 100 GWh are free to choose their supplier. The consumption threshold will be reduced to 10 GWh on 1 April 2000 and to 1 GWh from 1 January 2001. From 1 January 2003, all consumers will have the right to choose their electricity supplier.

Since 1998, electricity production from natural gas-fired small-scale CHP plants, from wind power facilities and from other renewable energy plants has been given priority

In 1999, the 220 kV overhead line from Ensted Power Plant to the Danish-German border was regalvanised to extend its lifetime. Photo: Jørgen Schytte.

over other electricity production. All electricity users have to buy a pro rata share of the prioritised production. Similarly, all electricity users have to contribute to other public obligations, such as the cost of certain research activities, maintenance of fuel stocks, reserve capacity, etc. These provisions have been retained in the new Electricity Supply Act.

Under the new Electricity Supply Act, a special market is to be established to promote the use of renewable energy. This will be a market for green certificates, which will be issued to owners of renewable energy facilities. The electricity produced will be sold via the normal electricity market, while the market for green certificates is intended to produce the necessary extra earnings to enable renewable energy production to compete with other electricity production. Demand for green certificates will be ensured by means of quotas for all users. The aim is for renewable energy to cover 20 per cent of the demand for electricity from the year 2003. The act includes various transitional provisions that will ensure the economy of existing renewable energy facilities during the phasing-in of the market for green certificates. The market is expected to be in place from January 2002.

The so-called «CHP guarantee» in the present legislation will also continue unchanged. This means that the grid company and the system operator must accept, as prioritised production, electricity from the primary CHP plants supplying large urban areas. However, this obligation only applies if the electricity cannot be sold at prices that cover the relevant costs of the said electricity production. Since CHP is generally expected to be competitive, this provision is likely to remain unused or only to find limited use. The European Commission has approved the provision for a limited period - up to 2006 - in accordance with the rules on government subsidies.

On 1 July 1999, Western Denmark (Jutland and Funen) joined Nord Pool as a separate price region, thereby becoming an integral part of the Nordic electricity market. All the region's distribution companies and businesses with an annual electricity consumption of more than 100 GWh gained access to the market. The market's players showed great interest in the new trading opportunities from the very start and quickly covered around a quarter of the consumption via the market.

The epoch-making opening of the market had been carefully prepared in close cooperation with Nord Pool. Technically and administratively, everything functioned well from the start. However, problems arose in using the cable interconnections with Norway (Skagerrak) and Sweden (Konti-Skan), which are of importance to the functioning of the market. Bilateral negotiations are still going on to get old agreements from the monopoly period on the Skagerrak interconnection replaced by guaranteed price agreements and the border tariffs on Konti-Skan reduced to zero.

Energy interchange across the Danish-German border – i.e. between the Nordic electricity market and the Continent – is also impeded by old agreements from the monopoly period. The limited free capacity has been offered at monthly auctions and daily allocations among the market's players. Work is now going on to establish a separate price region at the border in association with Nord Pool. Such a price region would probably solve the border problems until an open, efficient German electricity market has been established.

Eastern Denmark is intended to become a separate price region in Nord Pool from October 2000.

Denmark's two system operators – Eltra and Elkraft System – are looking into the feasibility of a HVDC interconnection under the Great Belt, taking all aspects into account – supply security, environment, the national economy, the economy of the project, and market factors. The two operators expect to complete the study in the spring of 2000.

The structural analysis of the electricity sector in Eastern Denmark, which commenced in 1997, was completed in 1999 and resulted in the formation of two new companies, Elkraft System and Elkraft Transmission. Elkraft System will act as Eastern Denmark's system operator, while Elkraft Transmission will become the owner of Eastern Denmark's 400 kV transmission grid and Eastern Denmark's international interconnections. Elkraft's production-related activities are being continued under the name EK Energi.

Dismantling of high-voltage overhead lines.
Photo: Bo Tornvig/Sputnik©.

Electricity consumption

In 1999, electricity consumption in Denmark, including transmission losses, amounted to 34.8 TWh – a small rise in relation to 1998. The trend of the last ten years, with modest annual increases in electricity consumption thus seems to be continuing.

Industry, trade/service and residential customers each accounted for about 30 per cent of the total electricity consumption, and agriculture for the remaining 10 per cent.

Electricity production

Total electricity production in Denmark reached a figure of 37.0 TWh in 1999 – slightly less than in the previous year. The net export from Denmark amounted to around 2.2 TWh. In 1998, there was a net import of around 4.3 TWh.

Utility-owned power stations etc. accounted for 26.4 TWh of the total production and private and municipally owned CHP plants and wind turbines for the remaining 10.6 TWh.

On the production side, rationalisation measures continued in 1999. They included the decommissioning of old coal-fired units. A new biomass-fired CHP plant was inaugurated on Lolland and work continued on the construction of the 500 MW unit 2 at Avedøre Power Station. This unit is scheduled to go into operation in the autumn of 2001.

New wind turbines with a total capacity of 220 MW and small-scale CHP plants with a total capacity of 25 MW were connected to Western Denmark's grid during the year. Elsam decided to decommission a number of old units with effect from 1 January 2000. The units in question are five coal-fired units with a total capacity of 1,200 MW that were built at the end of the 1960s. At the same time, Elsam will mothball a 305 MW coal-fired unit at North Jutland Power Station.

In May, the Danish Energy Agency granted approval in principle for the construction of five offshore wind parks with a total capacity of 750 MW, which the electricity companies are required to build in the North Sea and Danish inland waters.

The transmission grid

In the Elkraft region, the restructuring of the main transmission grid in the north west part of Copenhagen continued, with the northern section of the 400 kV cable going into operation in 1999. The dismantling of 132 kV overhead lines in densely built-up areas is also proceeding according to plan. In addition, work is in progress on a 400 kV connection of the coming new unit 2 at Avedøre Power Station to the southern 400 kV cable in the Copenhagen region.

In the Eltra region, projects for three important enlargements of the 400 kV grid have suffered from very tardy processing by the county authorities of applications for approval. In the spring, the Danish Minister of Environment and Energy, Svend Auken, intervened, enabling work to commence on the Esbjerg-Vejen line. The official planning approval procedure for the Århus-Aalborg line also got going. This line would solve many of the bottle-neck problems plaguing the North Jutland grid.

In connection with the implementation plan for rehabilitating West Jutland's grid, overhead lines of 150 kV and less are being replaced by underground cables. On Djursland, for example, a new 150 kV cable is being laid on the 30-km section of line between Grenå and Mesballe. At the 60 kV level, 400 km of overhead lines will be removed before the end of the year 2000 or replaced by cables. 70 per cent of the grid at the 10-20 kV level is now underground and 85 per cent at the 400 volt level.

Electricity prices

At the beginning of 2000, the average price to users with an annual consumption of 3,500 kWh is DKK 0.53/kWh. Including taxes and VAT, the price is DKK 1.48/kWh. The corresponding prices with an annual consumption of 15,000 kWh are DKK 0.43/kWh and 1.29/kWh, respectively.

The prices for industrial customers with an annual consumption of 2.5 GWh are DKK 0.38/kWh and 0.44/kWh, respectively.

Particularly low combined 400/132 kV poles are used for conversion of the grid in the area around Copenhagen. Photo: Mogens Carrebye.

Finland

Fingrid wants at selected places to demonstrate industrial design to the public. Here is a «landscape pole - Antinportti» at Hämeenlinna. Design prof. Antti Nurmesniemi. Photo: Juhani Eskelinen.

Energy policy

The new government was formed after the general election of 1999 with the same party coalition as before. The government's programme commits it to, among other things, guaranteeing a stable economic development in Finland and maintaining a competitive environment for both Finnish and Foreign investment.

The programme's energy policy requires that following measures be taken:

- the promotion of the structure of energy production towards a less coal based balance
- the promotion of the energy market
- the promotion of biomass energy and other domestic energy sources
- the establishment of a high standard in energy technology
- the securing of a diversified and favourable energy supply
- the maintenance of the reliability of supply in the energy sector

A rapid increase in the use of natural gas is, in the governments programme, considered to be a prerequisite for Finland to fulfil its international obligations regarding the emission of greenhouse gasses.

The government has made a proposal to the parliament concerning the natural gas market in accordance to the directives issued by the EU. According to these directives, Finland cannot open the market until the Finnish gas network is connected to another EU country or the market share of an individual distributor is below 75 %. However, the demands for transparency and the separation of monopoly network activities and competitive functions must be met.

Inspection in Naantali Power Station.
Photo: Juhani Eskelinen.

A decision about the production of energy will be made as a part of an over-all strategy concerning both energy and environment policy. The decision will be made when the government has access to all the necessary investigations and a possible application for a decision in principle about expanding nuclear power. The energy strategy aims at reducing coal power production in the future, although this is a disadvantage with regard to preparedness. The demands for preparedness must also be considered from the point of view of competitiveness as the market is internationalising.

The government considers that the plans for the final storage of nuclear waste are progressing according to plan. This is in accordance with the decision made in principle by the government in 1983 which assumes that a place of deposit be chosen in 2000. In May Posiva Oy, owned by Teollisuuden Voima and Fortum, submitted an application for the final storage of nuclear waste. The Nuclear Energy Law assumes that the matter will be concluded in parliament. The matter has been under consideration and the opinions have, in general, been positive.

The ministry of trade and industry have established an ad-hoc working group to study how to maintain the reserve capacity especially with a view to the reliability of supply. The current competitive situation and environmental considerations appear to create a situation where there is a reduced readiness to maintain non-commercial reserve capacity.

Environment

During Finland's chairmanship of the EU several environmental directives concerning the energy sector were prepared. These included directives about combustion plants, national emission ceilings and refuse incineration, and a framework directive about water policy. The LCP directive is close to the position of the board, but it failed on the question of how old combustion plants should be treated by the directive.

Two national reforms took place in Finland: the Environmental Laws and the Building Laws were totally rewritten. The new Environment Protection Law incorporates the IPPC directive, which states that environmental permission should be part of an integrated process. The reform also changed the process for receiving environmental permits.

The central confederation of the energy sector, Finergy, has recommended that the companies publish an environmental declaration of their energy production. Finergy has also recommended a voluntary «future/environment penny» system, whereby the electricity companies offer their clients the possibility to pay a special fee which the companies will commit to spending on developing, for example, wind power, bioenergy, CO_2 reduction projects etc.

Electricity consumption

In 1999 the electricity consumption in Finland increased by 1.6 % or 1.4 TWh compared to the previous year. The total electricity consumption was 77.9 TWh. The seasonal and temperature adjusted increase was 2 %. The increase was distributed evenly between all consumer groups.

The industry used nearly 59 % of the electricity, households and agriculture 25 %, and services and the public sector together used c. 16 %. Electric heating, which is included in all consumer groups, consumed 11 % of the electricity and losses in transmission were 3 %. Approximately 12 000 households were connected to electric heating. At the turn of 1999/2000 there were 580 000 households with electric heating, with 1.6 million Finns living in them.

The electricity consumption of industry was 44.2 TWh. The forest industry used 26.1 TWh, the increase from the previous year was 1 %. The marginal increase was only because the forest industry's capacity utilisation was below average at the beginning of the year. The metal industry used 7.2 TWh, an increase of 5.8 % from the previous year. The chemical industry increased its electricity consumption by 2 % to 5.2 TWh. The capacity utilisation was good for both the metal and chemical industries throughout the year. The constructing indystry and the energy sector used together 1.9 TWh. The rest of industry used 3.8 TWh, an increase of 2.3 % from the previous year.

The net import of electricity increased to 14.3 % of the total consumption.

In right of ways you might often find biotopes differing from the surroundings. An entomologist at work under a power line. Photo: Tero Piirainen.

Electricity production

The domestic electricity production decreased by just under one percent because there was a supply of cheaper electricity especially from the other countries in the Nordic market. The net import of electricity increased by nearly 20 %. The previous record for importing set in 1990 was beaten. It was mainly imports from Sweden that increased but also the Russian imports increased. The export to the Nordic countries was marginal. Because of the low price level, Finnish electricity producers have had few possibilities of selling electricity the two last years.

37.6 % of the electricity production was from combined heat and power (CHP), 33.1 % from nuclear power, 18.9 from hydro power, and 10.3 % from coal and other conventional steam power. Wind power produced 0.1 %.

The good availability and the completed improvements in the effect increased the amount of electricity produced with nuclear power. The wind power production more than doubled due to the new wind power plants.

The water year started off very well, the highest ever production record for the last 12 months was noted in the spring. The summer was, however, exceptionally dry and the over-all hydro power production remained at an ordinary level. Compared to the previous year the hydro power production decreased by 15 %.

The decrease in hydro power production was mainly compensated with increased electricity import, but the production of coal power and other steam power also increased by 10 %. The combined heat and power production decreased somewhat due to the warm weather. Finland is the leading country in combined heat and power production.

There was an exceptionally cold period at the end of January, which caused the load to reach just under 13 100 MW. 2300 MW were in reserve, excluding coal heated units not in operation.
At the end of 1999 c. 300 MW of new power station capacity was under construction.

Electricity market

The corporate acquisitions continued in the energy sector and foreign energy companies entered the Finnish market. Eastern (TXU Europe) became a part owner of Savon Voima Oy. The majority of the shares of Teollisuuden Sähkönmyynti Oy (now TXU Nordic Energy) were also bought by TXU Europe. TXU Nordic Energy became part owner of the PVO group. Graninge acquired the Ahlström group's energy activities and Stora Enso relinquished parts of its capacity for electricity supply.

At the beginning of the year 2000 there were 105 electricity distribution companies in Finland, this is three fewer than a year earlier. Some of the distribution companies have transferred the grid construction and maintenance to separate companies. The development of marketing alliances in the electricity industry continued and many changes took place in the ownership.

At the beginning of March trading with EL-EX Sähköpörssi's (EL-EX Electricity Exchange Ltd) new Elbas product began. Finnish and Swedish players can, through the Elbas; adjust their electricity balances after Nord Pool's Spot market has closed.

Electricity prices

At the beginning of the year 2000 the total price for household electricity was 50.4 p/kWh including tax. Compared to the previous year the reduction was 0.9 p/kWh or nearly 2 %. The cost of electricity for the medium sized industry was 30.6 p/kWh including tax. The price of electricity had decreased by 1.1 p/kWh or a bit more than 3 %. The price of electricity has continued to decrease steadily since the autumn 1998, when the electricity companies also started to compete in earnest for small customers. The new main grid transmission pricing, the favourable price level on the electricity exchange and the ample supply of electricity have also contributed to the reduced prices. There were no changes in the taxation of electricity during 1999.

In 1999 the development of the electricity transmission fees was dual. At the beginning of the year the electricity companies continued to increase their transmission fees because of changes to the main grid transmission pricing. Later in the year some companies reduced their electricity transmission fees or advertised reductions. In 1999 the electricity transmission fees for households and industry decreased by, on average, just under one percent. The transmission fees for district heating customers increased by the same amount.

The electricity market regularity board, which supervises the grid's activities, made a decision that set a precedent for the distribution companies' pricing. The decision, which is the first of its kind, assumes an adjustment in the companies grid pricing. The legislation assumes a reasonable profit. There have been appeals against the decision and the bases for it have been questioned by, for example, Finergy.

Main grid and cross-border connections

In 1999 Fingrid decided to reduce the prices for electricity transmission in the main grid as from the year 2000 by 7 % of the agreed price. This is possible as the effectiveness has been improved and the costs of financing and losses have been reduced considerably in comparison to the estimated costs.

This additional effectiveness is transferred to the customers through reduced prices.

As from 1 March 1999 Fingrid removed the boarder tariff from the Scandinavian transmission connections which had been affecting exchange and other trade. At the same time Svenska Kraftnät removed the boarder tariff from exchange trade for the connections to Finland.

As from the beginning of the year 2001 Fingrid is offering the opportunity to transfer 600 MW of electricity through its cross-border connections from Russia to all parties on the market. Fingrid offered the electricity market parties transmission capacity in two 300 MW lots; the first one in November 1999 and the other in March 2000. With continuous use, the total price for the transmission will be c. 2 euros per MWh. The world's largest power company, RAO ESS Rossii, will be responsible for the export and arranging the transmission opportunities on the Russian side.

Investments of 22 million euros were made in the Finnish main grid during the year. Compared to the last few years the investment level was quite low. This was mainly because no new 400 kV relay interlocking plants or grid line projects were completed. Work strengthening the 400 kV grid east of Helsinki towards the Russian border continued. The grid was at the same time strengthened on the Russian side.

In order to improve the transmission capacity between the north and south of Finland a decision was made for series compensation of three 400 kV connections. The series capacitors will be taken into use by the summer of 2001. These will also make it possible to make better use of the capacity between Sweden and Finland.

There were no disturbances in the main grid that would have jeopardised the operational reliability. There were altogether 288 minor disturbances, of which 29 were in the 400 kV grid. The most major disturbance happened at the end of January when a 220 kV junction pylon fell onto two crossing lines of 220 and 110 kV, which led to interruption of the electricity distribution in a wide area of Ostrobotnia. The cause of the accident was a fault in the quality of a high-tension electricity pylon which could not stand the severe cold of Northern Finland.

In August there were three separate instant re-connections on the 400 kV connection between Russia and Finland, these were all caused by a tree on the Russian side. The disturbance caused an interruption on the whole HVDC connection. Gas turbines were started, in order to stabilise the power system, and the capacity from Russia was reduced.

Iceland

Three 25 MW combined heat-exchanger columns at the geothermal heat and power station of Hitaveita Sudurnesja at Svartsengi.
Photo: Oddgeir Karlsson.

Energy politics

In the wake of the elections to the Althing (parliamentary elections) in May 1999, the same political parties continued to co-operate with each other. In the government's manifesto on energy matters the following is stated:

Competition in the field of energy:
«The organization of the energy sector must be changed so as to introduce competition for the purpose of increasing profitability and reducing energy costs. At the same time, we must work for the equalization of energy rates and the quality of the service.» It is expected that at the present sitting of the Althing a proposal will be presented for a new law on electricity in which the organization of the generation of electricity, and the way it is transmitted, distributed and sold, will be clarified. In the meantime a special committee has examined the operative range of the main transmission in preparation for the proposal for a new law on electricity. It is expected that the new organization can take effect in 2001-2002 and that an independent main transmission company will then start operating.

New environmentally-friendly energy carriers:
«It is necessary that work be done on the development and scientific research within environmentally-friendly energy sources, i.a. hydrogen and methanol.»

Energy-intensive industry:
«The development of energy-intensive industry will continue and financial co-operation is sought with foreign as well as domestic investors.» In this matter reference can be made to the current negotiations with Norsk Hydro in participating in the construction of a new aluminum smelter in eastern Iceland.

Environmental protection and the generation of power:
It is necessary to work for «a compromise between sensible exploitation of resources and views regarding environmental protection on the basis of sustainable development with a view to the interest of coming generations. It is necessary to develop a long-term framework programme on the exploitation of hydroelectric power and geothermal energy, taking into account the conservation value of individual territories.»

The Kyoto Protocol:
«Iceland will ratify the Kyoto Protocol when the acceptable results on this special matter of importance will be available.»

About 85% of Iceland's inhabitants use geothermal energy for heating purposes. The rest use heat generated by electricity. In general it is less expensive to use geothermal energy. Therefore, a study has been initiated to analyze the possibilities of utilizing geothermal energy to a much greater extent and to put greater emphasis on looking for geothermal energy in the so-called «cold» areas where people currently heat their houses with electricity. It is believed that it should be technically possible, and also profitable, to furnish geothermal heating to up to one half of the homes which now have no access to such energy.

The environment

Unusually heated discussions have been going on in connection with a 210 MW hydroelectric station at Fljótsdalur which Landsvirkjun, the National Power Company, has planned to construct to the northeast of the Vatnajökull glacier if the new aluminium smelter is to be constructed in eastern Iceland. The construction of this hydroelectric station was called for already nine years ago

The Iceland State Electricity's (RARIK's) high-voltage network (≥11 kV) is appx. 8,000 km long. This is equal to the distance between Reykjavík and Los Angeles! Photo: RARIK's Archives.

when the so-called Atlantal group had planned to build an aluminium smelter in south-western Iceland. Society's increased awareness of the environment has produced a new debate including the demand for a new analysis of the environmental impact. As Landsvirkjun was of the opinion that the authorization of 1991 was still valid, and it was thought that a new environmental analysis would take too much time, the government has taken the position that the Althing, i.a. with a view to the available recently-prepared environmental report, should conclude the matter. The Althing has now confirmed the authorization it had previously made.

A new company, Íslensk NýOrka (Icelandic NewEnergy), has been established. Its objective is to carry out research on, and prepare for the use of, hydrogen within the transportation sector. One half of the participants are Icelanders and, in addition, Daimler-Chrysler, Norsk Hydro and Shell Hydrogen are participating in the project. While the Icelandic government has expressed its interest, all this is in the initial stages.

A framework programme has been launched on the exploitation of hydroelectric energy and geothermal heat. Within the framework of the programme, the entire energy potential should be reassessed, both with respect to profitability and the expected effects on the environment, in the wake of which individual projects can be prioritized. This may be likened to the Norwegian Watercourse Master Plan.

Electricity consumption

In Iceland, electricity consumption in 1999 amounted to 7.2 TWh gross, i.e. including transmission and distribution losses and the power system's own use. The comparable use for 1998 amounted to 6.3 TWh. Thus, consumption rose by 14.4%, including 6.5 TWh of primary power and 0.7 TWh of non-guaranteed power.

Of the total consumption, 62.4% was used by energy-intensive industry (compared with 58.4% in 1998). General use rose by 3.5% without corrections being made for deviations in temperature from the average temperature. The temperature-corrected increase was 3.3%.

The proportion of electricity in total energy delivered to final users amounted to 26% in 1999.

A new and revised prognosis of electricity consumption in Iceland up to 2025, in addition to the consumption of new energy-intensive industry, was presented last October by the official committee for energy forecasts. In general, energy consumption is expected to rise by 1.6% annually up to 9.9 TWh in 2025. Comparable figures for general consumption amount to 2% and 4.4 TWh.

The generation of electricity

The generation of electricity covers total consumption, including transmission losses. Of the total production of 7.2 TWh, more than 6.0 TWh, or 84.1%, was generated by hydroelectric power (5.6 TWh, or 89.5% in 1998) more than 1.1 TWh, or 15.8%, was generated by geothermal energy (almost 0.7 TWh, or 10.4%, in 1998).

Total installed power in public power stations amounted to 1,304 MW at the end of 1999 (compared with 1,213 MW for the previous year). The first generator of two in Landsvirkjun's new hydroelectric station at Sultartangi, with an effect of 120 MW, was commissioned last November. The hydroelectric station will be fully operational in February 2000.

Hitaveita Sudurnesja commissioned a new 30 MW geothermal unit for the generation of electricity last November. Thereby, the company became the third largest producer of electricity in Iceland after Landsvirkjun and Reykjavík Energy.

During summer 1999, Landsvirkjun started the construction of a new 90 MW hydroelectric station, Vatnsfell, in southern Iceland which is to be operational in 2001.

Reykjavík Energy prepared for the enlargement of the Nesjavellir geothermal energy . This will result in a rise in the station's generation of electricity to 76 MW. This was effected, amongst other things, by entering into an agreement with a supplier regarding a third 30 MW unit. Whether, or when, energy production can be raised to 90 MW depends, amongst other things, on the geothermal resources available in the area.

Two new joint-stock companies, Sunnlensk orka (Southern Energy) and Nordlensk orka (Northern Energy) examined the possibility of constructing new power stations, one in southern Iceland and the other in northern Iceland. These companies are owned, 90% and 75% respectively, by the Iceland State Electricity (RARIK), along with, for the most part, communities in the respective districts.

Landsvirkjun's Vatnsfell site to the south of Thórisvatn in autumn 1999. Construction of this 90 MW hydroelectric station started in June 1999. Will be commissioned in autumn 2001. Photo: Emil Thór Sigurdsson.

Non-guaranteed power was rationed due to poor water supply to the hydroelectric works. This caused a reduction in generation for energy-intensive industry, and increased oil consumption by fish-meal factories and non-geothermal district-heating plants, the largest consumers of inexpensive non-guaranteed energy.

The electricity market

Energy-intensive industry experienced growth in 1999.

The third furnace at Icelandic Alloys' ferrosilicium plant at Grundartangi was commissioned last September. At the end of the year the furnace was up to full capacity.

In mid-year, Landsvirkjun signed an agreement with Nordic Aluminum for the enlargement of the smelter from a capacity of 60,000 to 90,000 tonnes of production per year. The enlargement will be commissioned in April 2001.

As mentioned above, Landsvirkjun continued with a preliminary study with Norsk Hydro regarding an aluminium smelter in eastern Iceland with the capacity of 120,000 tonnes production per year, with the possibility of an eventual enlargement to 480,000 tonnes per year.

Landsvirkjun is also participating in the previously-mentioned developmental project concerning the integration of hydrogen use in society, especially in traffic. The goal is to obtain electrically-manufactured and environmentally-friendly energy sources for use, amongst other things, in buses and other vehicles for which polluting energy sources are replaced by environmentally-friendly resources

The price of electricity

Landsvirkjun's wholesale tariff to distribution companies was raised by 3.0% on 1 July 1999. The tariffs charged by the main distributors were changed by -2% to +3%.

Nesjavellir in autumn 1999. Reykjavík Energy's geothermal heat and power station, producing 200 MW of heat and 60 MW of electricity. Enlargement to 76 MW of electricity is planned for June 2001. Photo: Emil Thór Sigurdsson.

There were no changes made to the tax or duties on electricity in 1999. The only duty on electricity is the value-added tax at the general rate of 24.5%, and 14% for the heating of residential buildings.

So as to equalize the price difference between those who are able to use geothermal energy for the heating of their houses and those who have to use electricity for this purpose, large subsidies are paid on electricity for the heating of residential quarters (not of businesses). Such subsidies have been rising, amounting to about ISK 760 million for the year 2000. This is by far the largest state appropriation within the energy sector. Furthermore, ad-hoc measures to support the establishment of new district-heating utilities will cost about ISK 85 million during this year. At the same time, plans are being prepared to make more efforts to equalize heating costs by rendering assistance concerning the most expensive district-heating utilities.

The main grid

During 1999, a committee has been examining how a main transmission network (the provisional name of which is «Íslandsnet») could be established. The committee's final report should be delivered in March 2000 at the latest.

A new high-voltage line, 12.5 km in length, between the Búrfell and Sultartangi power works, was commissioned at mid-year. While this line is constructed for a voltage of 400 kV, it will be operated on 220 kV for the time being.

The Búrfell switching station was renovated by the installation of new indoor 220 kV equipment. A new 220 kV transformer station was commissioned at Sultartangi where three 220 kV high-voltage lines are connected, thereby increasing considerably the reliability of the main transmission network in southern Iceland.

Other matters

In 1999, Reykjavík Energy established a new company, Lína.Net Ltd for the purpose of laying optical-fibre networks, thereby connecting electricity consumers to the Internet through the power grid. Lína.Net has entered a co-operative agreement with the telephone company Íslandssími, and at the end of 1999 some 40 km of the planned c. 125 km had been laid.

Due to the great extensions made to the power system, and the ensuing debate on energy-intensive industry, there has during the year not been any great emphasis put on the export and exchange of power through a direct-current connection with e.g. Scotland/England/Holland. This question will, however, become more actual in the coming years when the electricity industry will be deregulated and greater emphasis will be put on the exploitation of Iceland's natural energy sources for the purpose of reducing greenhouse gases in the atmosphere. While the so-called «Icenet» submarine-cable project is still under consideration, it seems as if the energy-political situation in Holland is perhaps the reason for this matter having been put on the afterburner during 1999.

Norway

A number of Statnett´s power lines are located in areas marked by severe topographic and climatic conditions. Shown here is the Høyanger line which was fortified in 1999 against avalanches. Photo: Tor Oddvar Hansen.

Energy policy

On 19 March 1999, the Norwegian Government presented White Paper no. 29 (1998-99) regarding Norway's energy policy. The White Paper deals with a number of energy policy issues without aiming to discuss all potentially relevant points. The principal focus has been to clarify:

- Energy policy objectives and strategies
- Prerequisites for domestic energy policy
- The policy for the reorganisation of energy consumption and energy generation
- Programme of new contracts between Statkraft SF and a number of companies

The Government's energy policy builds on the premise that environmental targets will determine production possibilities and that it is important to pursue an active policy in order to limit energy consumption. Increased production must to a greater extent be based on new, renewable energy sources.

The Government's energy strategy is based on the existence of a power market with power trading between the countries. The prerequisites for adapting conditions for power trading are that production and consumption fulfil environmental policy requirements. It is particularly important that energy prices reflect the costs to the environment to the greatest possible extent. Power trading and environmental challenges require close international collaboration. There is little point in setting targets for the amount of power that can pass between the borders.

In the next few years, the Government will encourage the development of renewable energy sources through an extensive development programme. The goal is an expansion of wind power, generating 3 TWh annually by 2010. Greater focus is also being placed on more water-borne heat based on new renewable energy sources, heat pumps and waste heat of 4 TWh/year by 2010.

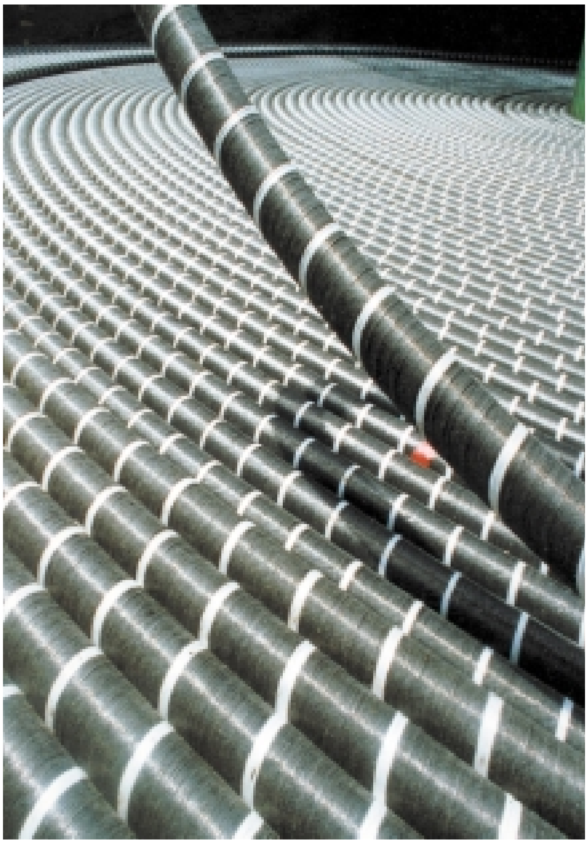
In the last ten years, investments in energy facilities have fallen substantially whilst consumption has continued to rise, resulting in a higher utilisation of the electricity system than in the past and a tendency towards more imported electricity. These factors mean that greater attention must be paid to security in the energy supply. The Government will work to maintain power supply security, both to cater for consumption peaks and to comfortably be able to meet the demand in years when there is a substantial decline in hydropower production due to insufficient precipitation. Statnett SF is responsible for system security in the Norwegian power system in the short and long-term and collaborates with the other Nordic grid companies. A well-dimensioned transmission network and a smooth-running power market are prerequisites for ensuring electricity supply security.

The Statkraft contracts, on terms determined by the Storting (Norwegian Parliament), for sections of the power-intensive industries and the wood processing industries expire between 2004 and 2011. The Government proposes new contracts and leasing agreements with a number of industrial companies on terms determined by the authorities as of 1 January 2001. New power supplies on terms set by the authorities must comply with the EEA agreement and an overall energy policy. The Government proposes that the requirements set in the new contracts and leasing agreements should contribute to strengthening supply security in the power system and streamline the use of energy.

In the 1999 spring parliamentary session, the Storting dealt with the appeal from Kraftlaget Opplandskraft, Tafjord Kraftselskap and Glommen og Laagens Brukseierforening against the Government's rejection of the licence application for the expansion of Øvre Otta. The companies' application was for an expansion entailing an overall production capacity of 992 GWh/year. During the parliamentary session, a majority voted in favour of a lesser expansion corresponding to around 50% of the original proposal.

Naturkraft has previously been awarded a licence for the construction of two gas-fired power plants, at Kårstø and Kollsnes respectively. The limits on maximum permissible emissions set by the Norwegian Pollution Control Authority for the two power plants require the elimination of 90% of CO_2 emissions from the power plants. Modern technology would not be able to meet these stringent requirements. In addition to Naturkraft's two planned gas-fired power plants, plans have also been put forward for gas-fired power plants at Skogn in Nord-Trøndelag and Tjeldbergodden in Møre og Romsdal. The gas power matter has become a key issue in the debate surrounding the government's energy white paper. During the Storting's consideration of the energy white paper in March 2000, a majority voted in favour of imposing requirements on gas

Photo: John Petter Reinertsen.



power station developers that would facilitate the realisation of the power stations using currently available technology. The Bondevik Government was unable to accept this and demanded a vote of confidence on the matter. The Government lost the vote and consequently resigned.

With regard to the DC interconnectors between Norway and the Continent, during the course of 1999 it became clear that Eurokabel would not be implemented. Work on the two other planned cables, Viking Cable and NorNed, continues. Due to the licence applications in Germany and the Netherlands taking longer to process than originally anticipated, the deadlines have been rescheduled.

Structural developments in the Norwegian power supply have continued and larger units are emerging as a result of amalgamations. Statkraft has injected assets in numerous regional companies and Vattenfall and Sydkraft have acquired shareholdings in Norway. Changes to the grid are moving towards larger, more rational units, through the exchange of grid facilities and direct acquisitions.

Electricity consumption

Gross total consumption in Norway was 121.0 TWh in 1999, 0.4 TWh (0.3%) higher than in 1998. Gross consumption in the ordinary supply totalled 82.6 TWh in 1999, 0.7 TWh higher than in 1998. Adjusted to normal temperature conditions, ordinary consumption was estimated at 85.1 TWh, an increase of 2.4 TWh (2.9%) compared with the same period of last year. Consumption in the power-intensive industries was 31.4 TWh, which is on a par with consumption in 1998. Overall power consumption for electric boilers and pumped storage power totalled 5.1 TWh, 0.6 TWh down on 1998.

The consumption of light heating products (light fuel oils and paraffin) equalled 953 million litres, which is 38 million litres (4.2%) more than in 1998. The consumption of heavy fuel oils was 330 million litres, which is a reduction of 30 million litres (8.3%). NVE estimates net domestic final consumption of energy in 1999 at 810 PJ, which is an increase of 11 PJ (1.4%) compared with 1998. Of this, electricity consumption accounts for 48.5%, which is 0.6 percentage points less than in 1998. Petroleum products account for 38.3% and solid fuels 12.5%. District heating accounted for around 0.7%.

The maximum load relating to domestic consumption including electric boilers and pumped storage power occurred at the ninth hour on 15 December 1999 and totalled 21,019 MW, which is an increase of 380 MW compared with 1998. 46 MW was exported in the maximum load hour at a system price of NOK 250 per MWh.

Electricity generation

Hydropower generation was measured at 122.1 TWh in 1999. An additional 0.8 TWh of thermal power brings total generation to 122.9 TWh, which is 5.9 TWh (5.1%) higher than last year. Power trading with other countries resulted in net exports of 1.9 TWh, whilst net imports in 1998 totalled 3.7 TWh.

New access to hydropower in 1999 totalled net 226 MW with a mean annual production of 423 GWh. The capacity is divided between a total of 11 installations.

NVE estimated mean annual production in the Norwegian hydropower system at 1 January 2000 to be 113.3 TWh, based on data collected between 1931 and 1991. Furthermore Norway's thermal power stations have a mean generation of 0.8 TWh, making overall power generation in Norway in 1999 7.7% higher than the anticipated mean production. The installed capacity in the hydropower stations at 1 January 2000 totalled 27,616 MW. On the same date, reservoir capacity totalled 84.1 TWh.

Electricity prices

The Norwegian Competition Authority has calculated that between 1 January 1999 and 1 January 2000, average weighted power prices for households rose by 12.8% to 31.78 øre/kWh, including VAT and consumption tax (electricity tax). The average weighted transmission price

Fortifying the Høyanger power line in order to minimize risk of damage due to avalanches. The job is conveniently done by heli-lift from Balestrand to the construction site - high up in the mountains. Photo: Tor Oddvar Hansen.

for households excluding VAT at 1 January 2000 has been estimated at 19.5 øre/kWh, compared with 19.4 øre/kWh at 1 January 1999.

Consumption tax (electricity tax) is levied on the consumption of power and is added to the power price (but not grid hire) before VAT is calculated. Industry, mining and labour market companies engaged in industrial production and greenhouse industries are exempt from electricity tax, as are consumers in Finnmark and Nord-Troms.

In 1999 the consumption tax was 5.94 øre/kWh, whilst for 2000 it has risen by 2.5 øre/kWh above inflation to 8.56 øre/kWh. The Government's reason for this is that the increase in the electricity tax will curb the growth in the consumption of electricity. To achieve good redistribution, three quarters of the revenues from the increase in the electricity tax will be used to increase the personal and basic tax allowances.

In common with all other goods and services that are liable for VAT, electricity is subject to VAT of 23%. The three northern-most counties are not liable for VAT.

The Main Grid

Once again in 1999, the Norwegian main grid experienced transmission restrictions. Based on calculated costs, the causes of these restrictions have varied between approximately 85% with an intact grid and approximately 15% due to grid maintenance.

A price area model is used to control production in the different areas in the event of transmission restrictions, whereby the country is divided into bid areas and a transmission capacity is defined between each area. Bottlenecks (transmission requirement - given capacity) arise when the transmission requirement between two areas exceeds the given capacity. The price difference between the two areas multiplied by the size of the bottleneck is known as a socio-economic cost. This cost is charged to the players in the relevant areas. In 1999, socio-economic costs arising from bottlenecks in the main grid rose by 50% compared with 1998. The costs are estimated to be in the region of NOK 62.2 million. The causes of the bottlenecks can be divided between maintenance (NOK 6 million) and intact grid (NOK 56 million).

Transmission capacity between Southern Norway and Sweden (via Hasle) has been subject to restrictions on import in periods of off-peak load and on export in periods of peak load. Problems with bottlenecks have also arisen between Central Norway and Sweden.

In addition to the costs associated with the market, the system operator incurs counter-trade costs (special regulations). In 1999, NOK 8.2 million was spent on counter-trading, NOK 5 million of which was due to bottlenecks arising from maintenance in the grid and NOK 1.9 million from bottlenecks with intact grid.

Disturbances and faults in the main grid incurred a number of costs for the system operator from counter-trading and capacity trading with neighbouring countries. Special regulations account for some NOK 0.8 million and capacity trading caused by system errors some NOK 0.8 million. The largest single events in this cost-estimate were disturbances to the following 420 kV lines: Kvilldal-Sylling on 28 January, Hasle-Tegneby on 24 June and Rød-Hasle on 29 August. The transmission capacity to Sweden via Hasle was substantially reduced following these operating disturbances. The disturbance of the Kvilldal-Sylling line also incurred a charge of around NOK 0.3 million to utilise spare capacity across Skagerrak and Kontiskan for delivery to Sweden.

On cold days, the system has only had marginal reserves and Statnett SF has, on several occasions, utilised the system service to reserve output. Producers are paid not to report production on the electricity spot market, but instead report the quantity in the regulating power market to ensure that the system has sufficient fast reserves.

Norway and Sweden are collaborating closely in balance regulation. The cheapest regulating object is to be regulated if there are no restrictions on the grid. In total, 848 GWh was traded for this purpose in 1999.

The 420 kV power line between Kristiansand and Evje was put into operation in April. Until further notice, the line will operate at voltages of 300 kV. System protection for the Sauda transfer corridor, which became operational in the latter part of 1998, increased the capacity above this bottleneck. As a result of an upgrade of the lines in autumn 1999, transmission capacity on the Sauda transfer corridor increased.

Photo: Tor Oddvar Hansen.

Sweden

The competition in the Swedish electricity market has brought a decrease in consumer electricity prices by 8-10 öre per kWh. Nordingrå, by Höga Kusten.
Photo: Alf Linderheim.

Energy policy

In line with the Swedish Government's energy policy guidelines, one Barsebäck reactor was due to be shut down by 1 July 1998. On 14 May 1998, the Swedish Supreme Administrative Court decided to postpone the execution of the government's decision to shut down the first reactor while awaiting a legal ruling. On 16 June 1999, the Swedish Supreme Administrative Court announced that the Government's initial decision would prevail.

Sydkraft AB shut down the Barsebäck 1 nuclear reactor on 30 November 1999 in accordance with the decision of the Swedish Supreme Administrative Court. The same day, groups representing the Government, Sydkraft and Vattenfall negotiated a compensation package with regard to Barsebäck's closure. The settlement covered the whole of Barsebäck 1 and part of Barsebäck 2. Basically, Sydkraft is compensated for the closure by an equivalent amount of electricity output from Ringhals - at the same cost and the same environmental impact - and Vattenfall sells output capacity from Ringhals to the Swedish Government on market terms.

The other Barsebäck reactor shall, in accordance with the Swedish Government's power policy guidelines, be shut down by 1 July 2001. Its closure is dependent on the electricity lost being replaced by new electricity output and reduced consumption.

An opto cable is fitted for broadband communication. Installation on a power transmission line near Sundsvall. Photo: Niklas Modig.

The Swedish Parliament decided to amend the Swedish Electricity Act in the autumn of 1999. The new regulations, which came into effect on 1 November 1999, allow households and other consumers with low consumption to enjoy deregulated power purchasing without any restrictions in the form of electricity meters that have an hourly registration of electricity consumption. Similar to Norway and Finland, these customers' electricity consumption is now calculated using so-called load profiles.

As a consequence of the Swedish Parliament's decision, the Swedish Electricity Concession Act was repealed, which included rules about purchasing obligation for small-scale electricity generation. In the autumn of 1999, Svenska Kraftnät reported the result of the procurement of small-scale electricity output for the year 2000, which indicated that its market price was in line with the power exchange price. In December, the Swedish Parliament decided to grant SEK 250 million as a temporary support for small-scale electricity production in 2000. The Swedish Government appointed a cross-departmental working group in December 1999 to come up with a proposal for a long-term solution for renewable electricity generation.

The Swedish Parliamentary Committee for Heating and the Gas Market submitted in October 1999 its final report (SOU 1999:115), «Trading while competing with gas». The report includes proposals for natural gas-related legislation that would satisfy EU directive 98/30/EU regarding the common rules for the internal natural gas market. A sub-report was submitted in February 2000 (SOU 1999:5), «Effective Heating and Environmental Solutions». It included proposals for measures to promote the construction of effective heat supply systems. In November, the Swedish Government's power entity presented a report on the heat market's structure and function, which was intended to form the basis of any governmental measures.

In November, the government commissioned a special inquiry to review certain network operations provisions of the Swedish Electricity Act. Its objective was to render network operations supervision more effective.

Electricity consumption

Total electricity consumption for 1999 was 142.9 TWh, a drop of 0.5 TWh compared with the previous year. This reduction is due to the fact that the autumn was very warm. Adjusted to a normal temperature, the figure would have been marginally higher than the previous year.

The transmission loss for the year was 10.6 TWh, of which 2.6 TWh was accounted for by national grid losses.

Electricity use in industry in 1999 was 55.0 TWh, which is more or less unchanged from the previous year. In the pulp and paper industry, which is the most power-intensive industrial sector in Sweden, consumption rose by 2% to 22.0 TWh. Electricity consumption for the housing and service sectors, etc. was 77.3 TWh, an upturn of 0.5 TWh compared with the previous year.

The exchange of power with neighbouring countries rose slightly in 1999. Sweden exported 16.1 TWh and imported 8.5 TWh. Net export was thus 7.5 TWh, most of which went to Finland. The net export for the previous year was 10.7 TWh.

Electricity supply

Electricity generation for 1999 was 150.5 TWh, a drop of 3.7 TWh compared with the previous year. Water levels in Swedish rivers was slightly above normal and hydropower output was 70.4 TWh, which is 6 TWh more than in a normal year but 3.2 TWh lower than hydropower output for 1998.

Water availability has been good after heavy rainfall during the year. The reservoir fullness factor at year-end was 62.4% which is 8.6% lower, however, than the end of 1998. The average value for the period 1950 - 1996 is 67.2%.

Nuclear power plant output in 1999 was 70.2 TWh, which is slightly lower than the previous year. Energy availability was very good at all reactors. Availability was 82.8%, which can be compared to the world average figure for 1998 of 79.2% (source: IAEA statistics). Of the Swedish reactors, Forsmark 1 recorded the highest availability of 96.8%, followed closely by Forsmark's other reactors in Ringhals, where availability exceeded 90%. As a result of the modernisation work at Oskarshamn 1, availability for the Oskarshamn blocks has improved strongly (87.6%) compared with previous year. As a result of the good availability of water, the output of nuclear power plants was reduced in favour of hydropower by around 3 TWh.

Kenneth Walve, Svenska Kraftnät, Bo Liwång, Statens Kärnkraftinspektion, Allan Lundberg and Folke Pärnerteg, Svenska Kraftnät, observing a successful millennium roll-over at midnight, 31st December 1999.
Photo: Mathias Landefjord.

Thermal heat and condensing power plants produced 9.5 TWh which is a drop of 0.3 TWh compared with 1998. Around 40% of thermal heat and condensing power output was based on biofuel (including waste liquor from the forestry industry).

The number of wind power plants continues to increase. There are now 480 in total which generated 0.4 TWh in the year, a rise of 0.1 TWh compared with the previous year.

Sweden's combined production capacity fell during the year, mainly due to the shutdown of a 600 MW reactor at Barsebäck. In recent years, stand-by power stations (condensing power plants and gas turbines) with a combined output of over 3000 MW have been shut down or «mothballed». The shutdowns correspond to around 10% of the country's total output.

The very strong storms that prevailed at the beginning of December with hurricane-strength winds caused extensive power cuts in western and southern Sweden. The problems mainly affected the distribution and regional networks. The storms caused damage to Baltic Cable AB ´s HVDC's 400 MW cable circuit between Sweden and Germany. Baltic Cable is co-owned by Sydkraft, Vattenfall and Preussen-Elektra. Sydkraft expects the connection to be back in operation at the end of April 2000.

The electricity market

The introduction of the rules about load-profile settlement in the autumn of 1999 have precipitated growing competition in the Swedish power market. Electricity prices for household customers have fallen by an average of SEK 0.08 - SEK 0.10 per kWh. Around 1% of the country's 5 million or so household customers changed supplier in conjunction with the reform coming into force. Around 20% of household customers have renegotiated their electricity rates with their existing supplier.

The price trend for business customers, especially in power-intensive industries, now follows power exchange trends. Although a significant part of energy trading is bilateral, the spot price at the power exchange is increasingly functioning as a reference point for bilateral business. The average price for the year on the Nordic power exchange’s spot market was 11.9 öre per kWh. The low price is due to the mild weather and ample water in the Nordic region's reservoirs.

During the years immediately following the electricity market reform, the standard rule applied whereby households' electricity bills could be divided up into three equal parts:

the electricity price, the network fees and tax. This ratio has changed during the year on the back of falling electricity prices and rising tax. The cost of electricity today constitutes around 20% of the combined costs for household customers, while network fees and tax account for around 40% each.

The matter of Swedish reserve power was also in focus in 1999 as production capacity continued to be reduced. The country experienced very cold weather for a few weeks in January and February 1999; consumption reached the previous peak of 26,000 MW and output balance was managed this time with sufficient margins. To counteract a situation where power consumption demand cannot be satisfied, Svenska Kraftnät introduced in the autumn of 1999 a high settlement price for companies with a deficit in their electricity balance in the event of an output shortage risk. The price for buying balancing power in such a situation is at least, SEK 3 per kWh. Svenska Kraftnät has also taken certain preparatory measures to withstand forthcoming winters. One emergency effort has been to guarantee continued operation of the Karlshamn Power Plant's third unit for a number of winters to come.

Svenska Kraftnät purchased gas turbines from Vattenfall to prepare for the eventuality of an immediate need for disturbance reserves (to manage network and balance disturbances). Furthermore, Svenska Kraftnät signed an agreement with Vargön Alloys about disconnecting the company's power consumption if required.

The Swedish electricity supply did not encounter any Y2K related problems.

Tax

Energy tax on electricity was reduced on 1 January 1999 due the change in the consumer price index, by 0.1 öre/kWh to 9.5 öre /kWh in parts of Norrland and by 15.1 öre/kWh in the rest of the country. At the same time, the tax on hydropower plant premises was lowered by 1.71 percentage points to 0.5%. Remaining tax is equivalent to the tax that applies to all industrial properties.

On 1 January 2000, tax on nuclear power was raised by 0.5 öre per kWh to 2.7 öre per kWh.

National grid and international interconnections

The year saw a thermal reinforcement on the west coast of Sweden to increase the transmission capacity north wards with export to Norway. The measure involves boosting transmission capacity by 400 MW during most of the year. Furthermore a network safeguard has been built for Kontiskan which, in the event of the reduction of a number of lines, will allow for imports to Sweden to be regulated accordingly.

A new 400 kV cable has been built on a 14 km-long stretch between Rätan and Tandö. The existing cable was underdimensioned with regard to ice loads.

The substation in Karlshamn has been extended for the purpose of connecting the SwePol Link to the 400 kV system. In conjunction with the extension the control unit has been renewed.

A new technology for transmitting telecoms has been installed in a large number of stations in southern and central Sweden. The old technologies, power line carrier and radio links have been replaced by optical fibre links. Communication is enabled via optic fibre cables installed in the power lines darth wires. So far the optic fibre networks has been used for Svenska Kraftnäts own communication needs, but they have also been rented to external customers.

The work with building a new 400 kV line between Alvesta and Hemsjö in the counties of Kronoberg and Blekinge got under way in mid-November 1999. The new line is being built to strengthen the existing power supply from the production point in the north to consumers in the south, and is scheduled to start operating in December 2000. The Alvesta-Hemsjö line will be 66 km long and is largely built on the same route as an existing 130 kV line owned by Sydkraft. To reduce land encroachment and to be as environmentally-friendly as possible, a solution has been identified whereby both the lines will be connected together. Investment costs are calculated at around SEK 240 million.

The 400 kV national grid station in Borgvik is undergoing rebuilding and expansion work. Operation is scheduled to start in 2001. The project entails a 350 MW capacity increase from Sweden to Norway. The investment is calculated at around SEK 80 million.

The main part of Swe Pol Link AB's work with constructing a DC line between Sweden and Poland was completed in 1999. Instalment of the cable commenced in the spring but a decision by the Swedish Environment Court of Appeal on 2 June meant that the activities in Swedish territorial waters had to be stopped. The matter was referred to the Swedish Environment Court.

In November the Swedish Environment Court announced that work could resume, and the installation could be completed in 1999. The ruling of the Swedish Environment Court was appealed, however, and the matter is now back in the hands of the Swedish Environment Court of Appeal, which is as yet undecided.

Test operation of the line will start at the beginning of 2000 and commercial operation is planned to start in May 2000. The total investment at the turn of 1999/2000 was SEK 2157 million.

A free Electricity Market

The Nordic countries have led the way in the deregulation of the electricity markets, setting an example for other countries to follow. Last year's report described developments in the Nordic electricity market and some of the history behind the deregulation of the electricity market in this region. In the following, we will explore this further, and outline the basic requirements for a fully functioning free electricity market in general, and more specifically in the Nordic region.

Fundamental requirements for a fully functioning electricity market

There are several models for a fully functioning free electricity market. However, a number of fundamental requirements need to be fulfilled in order for a free electricity market to function well.

The three basic requirements are as follows:

- All players must be treated equally and impartially and be allowed equal access to the grid
- Trade-stimulating tariffs and efficient management of limited transmission capacity are essential
- Operations must ensure instantaneous balance and maintain satisfactory operational security

Equality and impartiality

The most basic requirement is a proper body of laws that sets the necessary framework conditions. Activities exposed to competition are distinguished from monopolistic activities. The legislation should ensure that an independent system operator secures the operations and provides an impartial balancing service for all players on the market. In all the Nordic countries, this task is the responsibility of the transmission system operators. All players must also be guaranteed access to the grid, which is the physical marketplace, to ensure that each player has an equal opportunity to offer its products or to trade in a neutral, common marketplace.

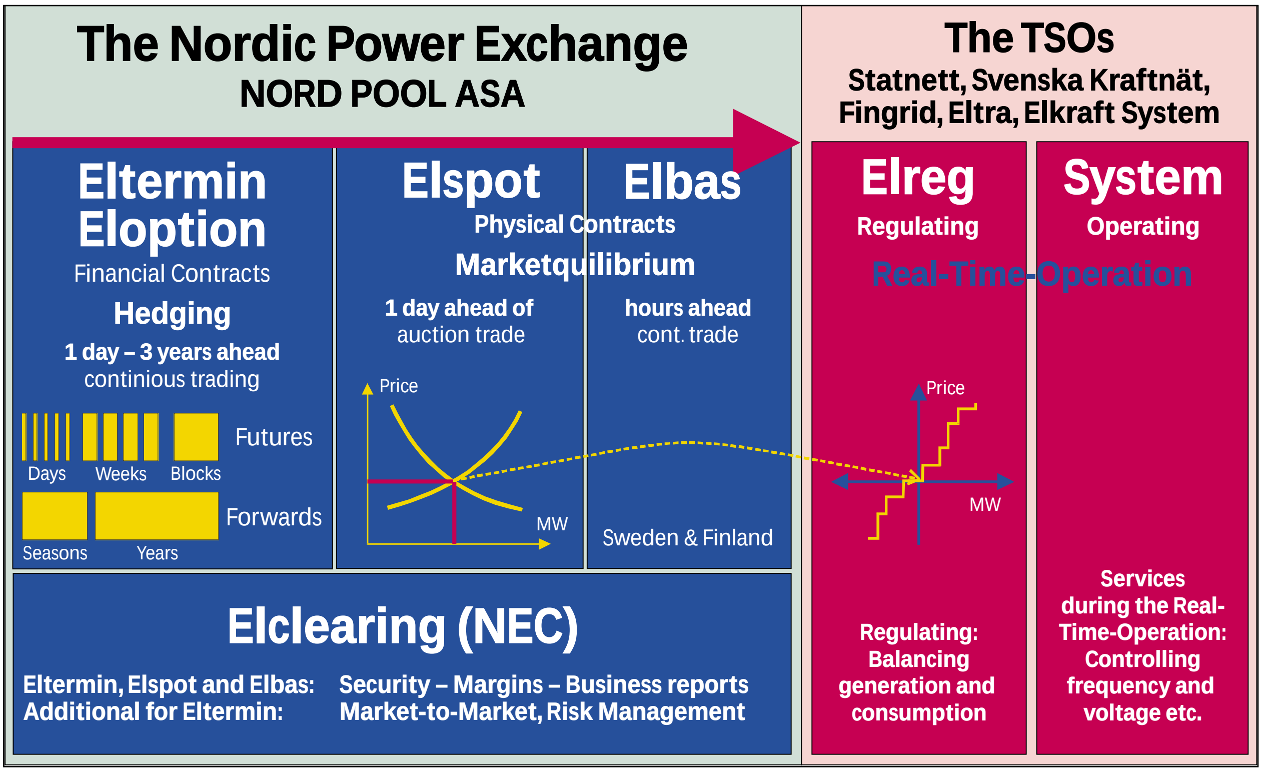
Players must be provided with information on equal terms and, to this end, the revolutionary developments in information technology provide superb opportunities. All information regarding bottlenecks and other factors that may influence the actions of the market players, and hence the prices, can be published on the system operator's home pages, making it accessible to all those interested without any form of discrimination.

Tariffs and transmission capacity

A fully functioning power market requires market players, without which, there would be no brisk trade providing a point of reference. Access to a transmission system, i.e. the grid, is required to bring producers and consumers of power to the marketplace to offer their products, submit bids and to trade.

Although the grid must be accessible to all, it does not have unlimited capacity and bottlenecks may therefore arise when the demand for the transmission of power exceeds the capacity in the grid. Transmission system operators are responsible for ensuring that transmission bottlenecks are avoided or minimised. It is important for the players that the principles governing the way in which transmission system operators manage bottlenecks are market-based and published. Long-term bottlenecks are dealt with by dividing

Figure 1: Trading in the Nordic Electricity Market. Source: Nord Pool Consulting ASA.



the market into price areas (market splitting), while short-term bottlenecks are relieved through counter-trading. Auction principles of trading can also be used for dealing with bottlenecks.

Unambiguous and non-discriminatory tariffs for use of the grid are crucial. The connection point tariff system has proven to be an appropriate system. The consumer and the producer both pay a tariff for connection to the grid as well as a tariff for use of the grid. The tariff, which is paid to the grid owner, entitles them to transmission within a single trading area, which can encompass several sub-systems or countries.

The operations

In order for the operations to function, satisfactory operational security must be maintained. A continuous balance between production and consumption is also necessary, as is comprehensive exchange of information between the players.

Operational security
As their title suggests, independent system operators are responsible for the operational security and reliability of their systems as well as other technical matters relating to the system, such as frequency, voltage, stability, the management of operating disturbances and bottlenecks. The transmission system operators are responsible for ensuring the availability of ancillary services that contribute to maintaining operational security. This include frequency response and reserves among others.

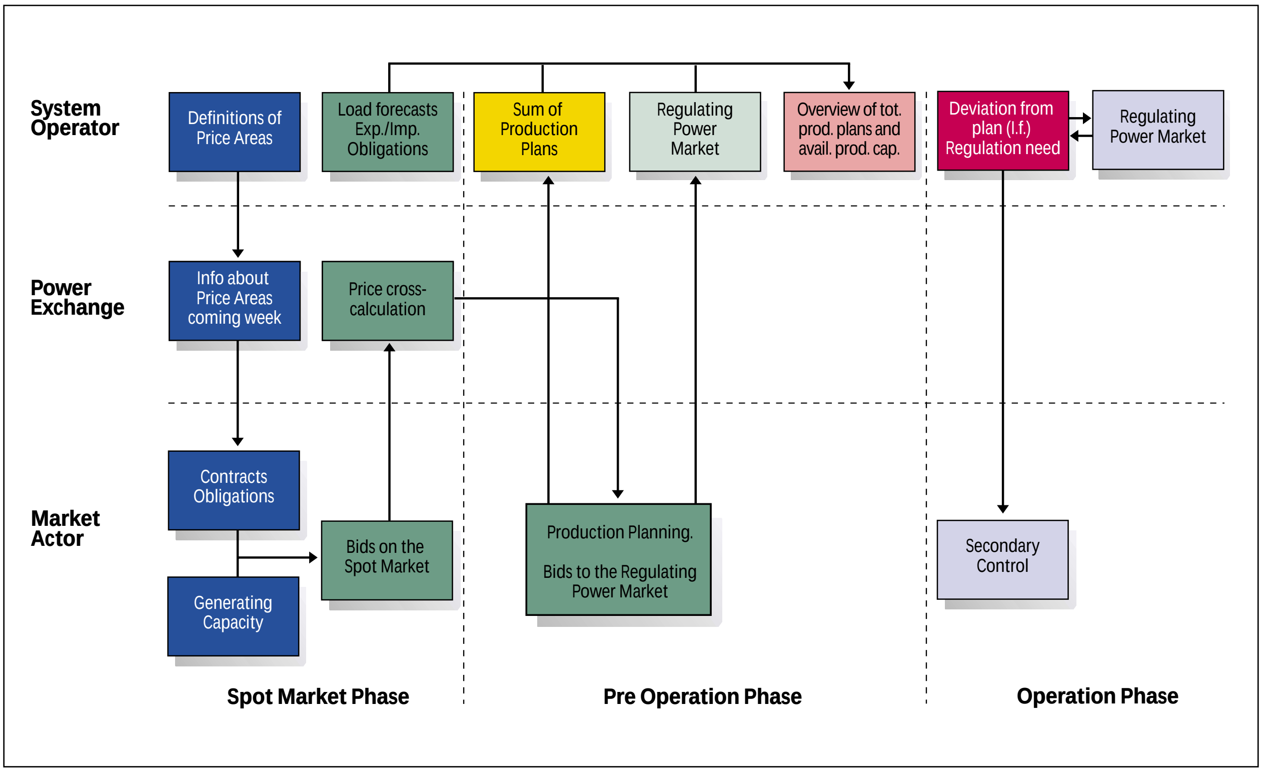
Balancing service
An important task for the system operator is to offer the market players an impartial balancing service and balance settlement. The objective is to perform a control action where it is most effective. When power is traded – either via the exchange or bilaterally – sooner or later the situation will arise whereby the agreed delivery is deviated from. Imbalances between agreed and physical deliveries can easily arise and are handled by the system operator in a way that is impartial for all parties.

The system operator is also responsible for covering losses in the transmission grid. This is purchased in the market.

Exchange of information
The transmission system operators must have access to information from all market players. This can be secured through agreements or legislation. Furthermore, there must be a mutual exchange of information between these companies and all non-sensitive information should be available to all market players.

As shown, system operators have numerous important tasks in a deregulated market. The activities of transmission system operators are regulated by laws and regulations. A number of countries also have a regulator to monitor that the operations are conducted within the permitted frameworks. The players on the market play a vital role in pushing for the further development of practices and regulations.

Activities in balancing the Nordic power system in different time phases.



A neutral market operator

So far we have looked at the fundamental requirements for a free electricity market in general terms. These requirements are also fundamental to the Nordic region, even if at a more detailed level there are differences between the individual countries. We will now look more closely at a number of factors in the Nordic electricity market.

Electricity exchange and OTC market

Prior to the deregulation of the electricity markets in the Nordic region, there was active bilateral trade between producers within each country and between the countries themselves, and also between producers and distributors in each country. Norway has had an organised spot market for trading occasional power between producers since 1971, which meant that a trading culture already existed and trading systems were in place that paved the way for the opening of the electricity market based on existing expertise, rules and systems. Following deregulation, several new players have entered the market, in the form of traders, brokers and portfolio managers. More and more international companies based outside the Nordic region have also begun trading in the Nordic market.

The organised Nordic market has evolved gradually, from the introduction of Norway's Energy Act in 1991 to the integration of Western Denmark in Nord Pool on 1 July 1999. Today the Nordic market comprises Norway, Sweden, Finland and Western Denmark. Current plans suggest an integration of East Denmark in the Nordic electricity market as from 1st October 2000. Nord Pool's current product structure has been gradually expanded to cater for the requirements of the market participants and in close collaboration with the transmission system operators in the exchange area. Figure 1, Electricity trading in the Nordic electricity market, shows the structure at the beginning of the year 2000.

The physical products Elspot and Elbas

The mainstay of physical trade is the spot market, Elspot, which is used by the market participants to balance contractual obligations and access, either in the form of their own production or contracts. The trend is towards replacing long-term contracts, which previously resulted in the physical delivery of power, with insurance through financial contracts and the delivery of physical power through the spot market. The spot market offers trade in individual hours or in blocks of hours. Trade is organised as an auction and is by the hour for a day at a time. Another key function of the spot market is that it utilises the price area mechanism to balance grid restrictions between the Nordic countries and also internally in Norway.

The varying costs of imbalances in the Nordic countries have meant that the requirements for products with which to handle deviations have also varied. In Sweden and Finland, deviations can currently be traded up to two hours prior to delivery, through the Elbas product, which is open for continuous trading between 00.00 and 18.00 every day. A new day is added after Elspot has closed for the corresponding day.

The financial products Eltermin and Eloption

A liquid spot market that has the confidence of market players has proven to form the basis for the development of new products. The futures markets originally traded physical contracts with delivery at specified points on the Nordic grid. As of the autumn of 1995, Nord Pool switched its contracts to financial contracts and today this is the dominant type of contract also in the OTC market (over the counter trading). The product structure has gradually evolved to cater for the requirements in the market, and today futures contracts can be traded through Nord Pool with a trading horizon of up to three years. As of the autumn of 1999, it also became possible to trade options contracts, which means that the range of products available is now fairly comprehensive and that most of the contracts are extremely liquid.

The OTC market

Direct trade between players in the market continues to be the most common form of trade. Following deregulation, new companies quickly emerged that wished to broker contracts. This has become an important part of the market, and the competition between brokers and the exchange has been instrumental in the success of the Nordic market. The contracts that are traded OTC are largely the same contracts that are traded via the exchange. In addition, the presence of brokers stimulates the introduction of new products. Brokers were trading options, for instance, long before they were being traded on the exchange.

Clearing financial contracts

The need for a clearing function that went beyond clearing contracts on the electricity exchange became apparent at a fairly early stage, following the establishment of both physical and financial trading. Radical changes in the corporate structure of those trading meant that far greater attention was given to credit rating and risk management than in a system in which producers and distributors were the only ones trading with each other. Currently, all contracts that are traded on the electricity exchange, or OTC contracts that correspond to the exchange contracts, can be cleared. The exchange contracts and other contracts are integrated in a net portfolio. Today, approximately 90 per cent of all bilateral contracts in the Nordic market are cleared.

The physical market

The annual production in the Nordic region in 1999 totaled 384,3 TWh, while net exports totalled 0,5 TWh. Of this production, hydropower accounted for 55 per cent, nuclear power 24 per cent, conventional thermal power 20 per cent and other sources of power 1 per cent. However, there are major variations between the countries regarding type of power production.

Production planning unchanged

Surprisingly, operational production planning has remained virtually unchanged following deregulation. The reason for this is that external factors such as hydrological/meteorological variations and random technical faults impose greater requirements on production planning than the new free power market. Hydropower and thermal power planning have remained largely the same as before deregulation. The difference is primarily linked to greater uncertainty surrounding future opportunities to make provisions, as flexibility is now valued higher than in the past.

The formation of a free electricity market resulted in mounting pressure on prices, in turn resulting in a negligible increase in the number of power plants and the postponement of a number of new investments. These decisions have been socio-economically correct. However, a number of questions remain regarding how to finance reserve power plants.

Separation of production and sales

Prior to deregulation, the primary aim of production planning was to cover your own customers' requirements. Once this had been achieved, short-term bilateral power agreements were entered into to improve financial performance. The state of the market eventually became such that no-one was interested in selling below the electricity spot price and no-one wanted to purchase above the electricity spot price.

Consequently, the production and consumption sides have become increasingly independent of each other, causing a number of the integrated companies to specialise in one of these functions, whilst others continue to operate as before. However, all players use the electricity spot price as a reference for their production planning and power trading.

Mounting pressure on prices

The economic pressure on prices has resulted in a far greater focus on costs and in a higher priority being given to flexibility due to greater uncertainty surrounding revenues.

Contracts with end customers

The free electricity market has undoubtedly created greater changes on the consumer/sales side than on the production side. End users still have the opportunity to enter into agreements at a pre-determined price and with the opportunity to consume power according to need without placing advance orders, and this remains the most common form of agreement for small and medium-sized customers. In addition to fixed price agreements, most vendors of power also offer their customers various forms of floating prices, which are linked to the electricity spot price or futures price or a combination of these with some form of price ceiling.

Alternatively, major consumers in particular are able to take responsibility for maintaining the balance (regardless of whether or not they themselves produce power) and to purchase contracts for a fixed volume bilaterally and/or on the electricity spot market, thereby actively managing a portfolio of contracts. End consumers naturally have the option of joining forces and forming joint purchasing/sales enterprises with responsibility for balance.

Operational phase

The planning of the actual physical operation of the power system begins «in earnest» the day before the operational phase when players bid to the spot market (see figure 2). A number of parameters are set in advance by the transmission system operators, such as plans for the maintenance of power lines and power stations and analysis of the relevant physical system in terms of capacity. However, the concrete physical plans do not begin to take shape until the players bid to the electricity spot market.

Elspot (the day before)

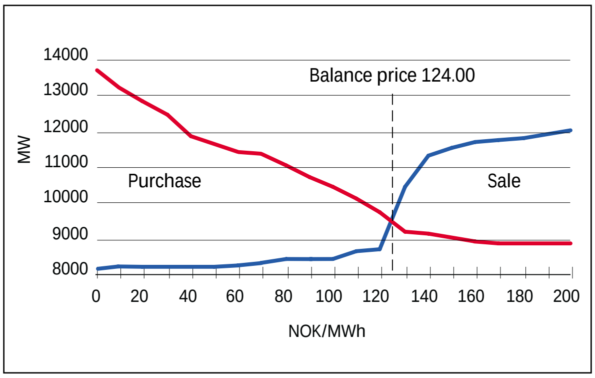
As shown above, prices at Nord Pool are determined by summarising all purchases into a purchase curve and all sales into a sales curve. A full set of reports is produced for each hour the following day. Purchases are high when prices are low and lower when prices are high, whilst the opposite is true of the sales curve (see figure 2).

Bids in the electricity spot market are given in the same way regardless of player. A bid that applies to the following day is given before 12.00 noon every day indicating the amount you wish to purchase/sell at the relevant hour at different price levels. The possibility of placing block bids has been introduced to supplement the hourly bids. Block bids are a form of sales/purchase bid whereby the bid only applies if the lowest/highest average price is achieved for a number of hours in the form of a block.

The day is divided into three blocks corresponding to the hours 00-07, 07-18 and 18-24. Block bids are principally used by thermal power producers as they cannot risk a situation in which they sell between 08.00 and 09.00 and between 10.00 and 11.00, but not between 09.00 and 10.00.

All power on Nord Pool is thus sold at the price at which the purchase and sale bids intersect. Once the price has been determined, this also determines the individual player's sale and purchase. Prices are calculated at around 13.30 every day. Once the players have received the next day's prices, the producers determine the final physical operation.

Figure 2: The Elspot Market, bids and calculation of balance price.



Planning (the evening before)

The purely physical planning of the system is executed partly by producers who determine how much each power station is to generate as a result of the market price that has been calculated, and partly by consumers who determine the amount of electricity they will be using as a result of the prices. The latter will generally apply to those who have alternative energy sources, e.g. oil heating. The consumption side is largely «insensitive» to price fluctuations in normal situations, i.e. when the prices are not too extreme.

The national grid companies in the Nordic countries are system operators, which means that they must co-ordinate groups of players in order to ensure the smooth functioning of the power system as a whole. A crucial aspect of this co-ordination is ensuring that total consumption and total production correspond at all times. Setting the electricity spot prices is the first important step towards this, since the price agreed upon is the basis for balance between consumption and production. The production plans laid must ensure that each player fulfils his obligations. A producer must thus draw up a production plan that enables him to deliver his contracts, meet his own consumption needs (where applicable) and fulfil any sales he may have in the electricity spot market. Once all production plans have been determined in accordance with the above, they are submitted to the system operator.

The system operators summarise all planned production in an overall production plan, as well as obtaining an overview of anticipated total consumption, either by calculating this themselves or by collecting summaries from the consumption side. The production plan is then compared with anticipated (forecasted) consumption to ensure that the figures correspond (see figure 3). If, for instance, this comparison shows that the production for the next day is slightly too low in relation to consumption, this indicates that additional production is required.

Elbas (no later than two hours prior to the operating hour)

In the event that the players still need to trade in order to achieve the required balance, they can trade on the Elbas market. The Elbas market is an exchange on which it is possible to trade physical hourly contracts up to two hours prior to the operating hour. Players can thus also utilise Elbas to adjust their plans in the event of load discrepancies and any disruptions to production that have arisen throughout the operating day. Elbas is currently only available to Finish and Swedish players.

The regulating market

The next step is to obtain bids from producers and consumers for the regulating market, in which market players quote a price and quantity for upward or downward adjustment. The system operator sorts the bids for upward adjustments with the lowest price first and the bids for downward adjustments with the highest price first. The resultant price/quantity list is the system operator's instrument for achieving equilibrium between consumption and production from one minute to the next.

The operating hour (from one minute to the next)

Once the operating hour (operational phase) is reached, the system operator monitors the power system and checks that production and consumption are in balance. In the event that production needs to be increased or decreased, the regulating power are activated wherever it is most expedient. The objective is to utilse regulating capacity from the entire Nordic system when there is vacant transmission capacity.

As well as monitoring the balance between consumption and production, the system operator is also responsible for ensuring that the system is operated safely. Line loads and voltages in the power grid are monitored, and the system operator ensures that the system as a whole operates within approved quality standards. Should faults arise, the system operator is responsible for implementing the measures necessary to return the system to a normal situation as quickly as possible.

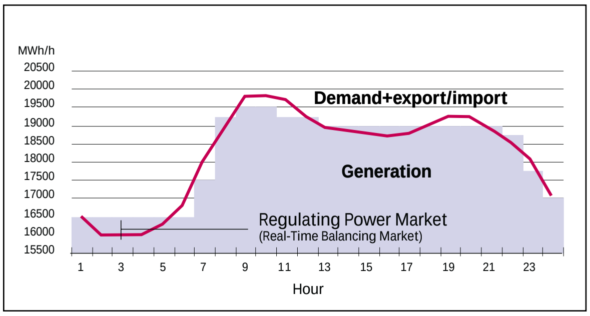
This regulation and monitoring is closely co-ordinated throughout the Nordic region and the transmission system operators work closely together to ensure co-ordinated measures throughout the entire system.

Exchange of information

The exchange of information is a key aspect of a smooth-running market. In its start-up phase, the Nordic market has focused particularly on the physical framework conditions. The system operators within the exchange area have agreed that all market information must be distributed to the market players first through Nord Pool. This applies to plan values relating to transmission capacity and maintenance plans as well as historical values for the flow of power between countries and areas, production and consumption as well as faults in the individual transmission grids.

Similarly, Nord Pool has an agreement with all players whereby the maintenance of production and consumption facilities and faults or incidents on installations must be reported. In addition, Nord Pool obtains weekly information regarding the reservoir situation in all countries. All this information is available on Nord Pool's web site (http://www.nordpool.com).

Figure 3: Planned generation and forcasted consumption.



Settlement (control and deferred settlement)

Balance settlement entails a comparison of planned and actual production, consumption and trade. Any imbalances result in the purchase and/or sale of balancing power.

All market players' trading – both bilateral trade and exchange trade – should be reported to the system operator's balance settlement in the relevant country. A number of market players can assign this reporting responsibility to players who are responsible for balance. The grid owners are responsible for submitting information on the physical withdrawal of power (metering values) to the settlement centre. Settlement information comprises the plans and actual hourly power trading in the grid company's power grid of all those responsible for balance.

In the settlement process, exchange trade and bilateral contracts are compared with the physical withdrawal and input of power of each balancing operator and the variance is calculated. The variance is corrected using balancing power, which is priced using the price on the regulating power market.

This means that a player who has reported greater consumption than that which has been physically withdrawn through the player's physical contracts is invoiced for the cost of having to correct the imbalance in the regulating power market.

The financial market

The cost situation for producers varies depending on the type of power station owned. Nevertheless, on the whole, the fixed costs are relatively high, particularly for hydropower and nuclear power. The revenues in the regulated market were also fairly fixed as the prices were usually fixed and volumes were largely predictable. In a free power market, both volumes and prices are unpredictable, which means that the company's financial performance may vary unacceptably for the owners. One way of hedging production prices is for the producer to sell bilaterally to the end customer via a sales organisation. Another way is to sell the power on the electricity spot market and to hedge the price and volume on the financial market. Regardless of the method chosen, it is imperative that the company formulates a risk policy that regulates the proportion of future revenues that is to be hedged. Although by hedging prices in this manner the opportunities of making a profit are naturally limited, it does ensure a minimum level of profit. The counter-parties to this price hedging are end customers, brokers or traders.

Nordel and its neighbours

The Nordic electricity system is connected to the systems in Russia and Germany and during the course of 2000 will also be connected to Poland. The non-Nordic power market players are showing mounting interest in joining the Nordic power market.

As a result of this, the framework of EU's market directive will be used to regulate access to the market from these countries to the Nordic region. The requirements for reciprocity, transparency and non-discrimination in particular set the spotlight on the existing long-term agreements, which are often 25-year agreements. The opening of the market across the border with Germany is constantly progressing. So far, it has been possible to carry out auctions for transmission capacity and to a certain extent employ the «use it or loose it» principle. Assessments are currently underway to see whether the existing long-term agreements can be replaced by financial contracts, or whether other solutions can be found for liberalising border transmission.

By opening the borders, it should be possible to prepare for the highly likely situation that a number of exchange areas will be set up outside the Nordic region. In future, the question will be how trading will occur in the market between exchange areas.

Whilst the market conditions are being clarified, the system collaboration between the system operators on both sides of the Western Danish-German border must be determined. Close collaboration is therefore required between the system operators and the exchanges in question.

A virtual price area is expected to be set up for traders north of the Western Danish-German border in 2000. Border capacity will consequently be utilised on the basis of the value of MWh/h in the daily spot market and not on the basis of a monthly auction for MW as at present.

In the future, Nordel's relationship with its neighbours will be influenced by developments in Europe as a result of the introduction of the internal electricity market. This work took off when the electricity market directive, which covers the 15 EU countries together with Norway and Switzerland, came into effect on 19 February 1999. The Association of European Transmission System Operators (ETSO), of which Nordel was one of the founders, will play a key role in this respect.

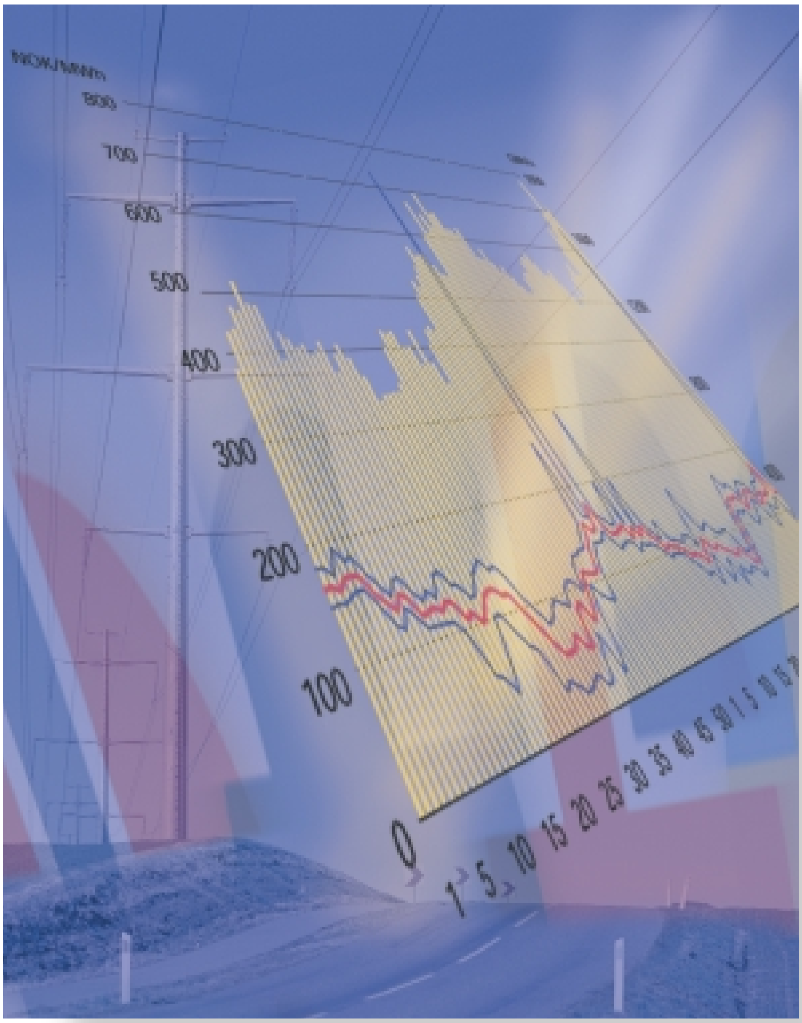
Key issues that are under discussion and for which solutions must be found are:

- Border tariffs for trade between the countries mentioned above
- The management of bottlenecks
- The exchange of information for the secure operation of the power systems

All these issues are being discussed by ETSO, the EU Commission, the regulators and organisations representing market players. Solutions are expected to be ready for implementation 1 October 2000. These will then form the basis for the future development of the European electricity market and, through this, the relationship between Nordel and its neighbours.

This article was written by freelance journalist Aksel Tonjer in association with an editorial group consisting of *Egil Eriksson*, Fortum Power and Heat Oy, *Ole Gjerde*, Statnett SF, *Carl Hilger*, Eltra amba, *Kurt Lindström*, Fingrid Oyj, *Set Persson*, Vattenfall AB, *Hans Randen*, Nord Pool AS, *Torbjørn Sletten*, Statnett SF.

Statistics



Definitions, units and symbols

Gross consumption
The sum of domestic generation and imports minus exports and occasional power to electric boilers; usually expressed in GWh.

Electricity generation (net generation)
The output of a power plant, excluding the plant's own consumption; usually expressed in GWh. Registration of generation is referred to where the power plant is physically located.

Imports/exports
The monthly sums (in GWh) of the physically registered MWh values for each connection between the individual countries, per hour of exchange. Net imports is the difference between imports and exports.

Installed capacity (net capacity)
The sum of the rated capacities of the individual power plant units (expressed in MW), excluding the power plant's own consumption of electricity.

Generation of condensing power
Generation at a conventional steam power plant where the energy of the steam is used solely for electricity generation and where the steam is condensed to water after the turbine.

Net consumption
The sum of the energy used by consumers of electricity; usually expressed in GWh.

Transmission capacity
The power (in MW) that a high-voltage line can transmit under normal conditions, taking into account any limitations that may be imposed on the rated capacity.

Pumped storage power
The electricity used for pumping water up to a reservoir, for the generation of electricity on a later occasion; expressed in GWh.

Losses
The difference between gross consumption and net consumption plus pumped storage power; usually expressed in GWh.

Occasional power to electric boilers
Expressed in GWh, this refers to the supply of electricity to electric boilers on special conditions for the generation of steam or hot water, which may alternatively be generated using oil or some other fuel.

Total consumption
The sum of electricity generation and net imports, expressed in GWh.

Combined heat and power (CHP) generation:
Generation at a steam power plant where some of the energy of the steam is used for electricity generation and some for another purpose, e.g. for district heating or as process steam for industry. Previously known as back-pressure generation.

Units and symbols

kW	kilowatt
MW	megawatt = 1000 kW
GW	gigawatt = 1000 MW
J	joule
kJ	kilojoule
PJ	petajoule = 10^{15} J
kWh	kilowatt-hour = 3600 kJ
MWh	megawatt-hour = 1000 kWh
GWh	gigawatt-hour = 1000 MWh
TWh	terawatt-hour = 1000 GWh
~	Alternating current (AC)
=	Direct current (DC)
.	Data are nonexistent
..	Data are too uncertain
0	Less than 0.5 of the unit given
-	No value

Calculation of electricity consumption

Electricity generation
\+ Imports
\- Exports

= Total consumption
\- Occasional power to electric boilers

= Gross consumption
\- Losses, pumped storage power, etc.

= Net consumption

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Responsible for processing of the statistics:
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The present statistics were prepared before the 1999 official statistics for the individual countries had become available. Certain figures in the Annual Report may thus differ from the official statistics.

The statistical data and selected sections of the rest of the Annual Report can also be read on Nordel's Internet pages at www.nordel.org

Installed capacity

S1 Installed capacity on 31 Dec. 1999, MW

	Denmark [5]	Finland	Iceland	Norway	Sweden	Nordel
Installed capacity, total [1]	10 934	16 458	1 304	27 934	30 885	**87 515**
Hydropower	11	2 937	1014	27 616	16 192 [2]	**47 770**
Nuclear power	.	2 640	.	.	9 452	**12 092**
Other thermal power	9 156	10 843	120	305	5 026	**25 450**
- condensing power [3]	2 228 [4]	3 912	.	73	452	**6 665**
- CHP, district heating	6 310	3 617	.	12	2 248	**12 187**
- CHP, industry	330	2 436	.	185	841	**3 792**
- gas turbines, etc.	288	878	120	35	1 485	**2 806**
Other renewable power	1 767	38	170	13	215	**2 203**
- wind power	1 767	38	.	13	215	**2 033**
- geothermal power	.	.	170	.	.	**170**
Commissioned in 1999	534	46	92	271	46	**989**
Decommissioned in 1999	1 055	46	3	29	1 155	**2 288**

[1] Refers to the sum of the rated net capacities of the individual power plant units in the power system, and should not be considered to represent the total capacity available at any single time.
[2] Includes the Norwegian share of Linnvasselv (25 MW).
[3] Includes capacity conserved for an extended period, Finland (700 MW)
[4] Includes the German share of Enstedværket (316 MW).
[5] New routine of reporting makes the installed capacity lower then the year before.

S2 Average-year generation of hydropower in 1999, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Average-year generation 1999	-	12 716	5 940	113 300	64 000	**195 956**
Average-year generation 1998	-	12 716	5 500	112 900	64 000	**195 116**
Change	-	0	440	400	0	**840**

S3 Changes in installed capacity in 1999

Power category	Power plant	Commiss-ioned MW	Decommiss-ioned MW	Change in average-year generation (hydropower) GWh	Type of fuel
Denmark					
Condensing power	Skærbækværket blok2		269		Coal / oil
	Ålborgværket blok2		269		Coal / oil
	Esbjergværket blok2		245		Coal / oil
	Studstrupværket blok2		262		Oil
CHP, district heating	Skærbækværket blok1	100			Coal / oil
	Others	11			Various
	Others	49			Biofuel, waste
	Others	11			Natural gas
CHP, industry	Others	2			Various
Wind power	Others	361	10		
Finland					
CHP, district heating	Valkeakoski	11			Natural gas
CHP, industry	Kajaani		41		Wood chips, peat
Condensing power	Koverhar	14	5		Waste
Wind power		21			
Iceland					
Hydropower	Sultartangi	62		440	
Geothermal power	Svartsengi	30	2		
Diesel	Varous engines for stand by		1		Oil
Norway					
Hydropower	Matre	35		20	
	Skagen	55		50	
	Berlid	11		46	
	Grøa	35		91	
	Lakshola	30		108	
	Fløyrli	80	29	82	
	Others	9		26	
Wind power	Harøy	4			
CHP, district heating	Fana varmekraftverk	12			
Sweden					
Hydropower	Various changes	3	15		
Nuclear power	Barsebäck 1		600		
CHP, district heating	Rya	2			Natural gas
Condensing power	Hässelby G4		154		Oil
	Bråvalla		240		Oil
Gas turbines, diesel power	Stallbacka G3		86		
	Arendal		60		
Wind power	Approx. 55 new aggregates..	41			

S4 Power plants (larger than 10 MW): decisions taken

Power category	Power plant	Capacity MW	Estimated start-up Year	Average-year generation (hydropower) GWh	Type of fuel
Denmark					
CHP, district heating	Avedøreværket 2	570	2001		Natural gas / Straw / Wood chips / (Oil)
FInland					
CHP, district heating	Naistenlahti	80	2000		Natural gas
	Pietarsaari	240	2001		Peat, waste wood
CHP, industry	Anjalankoski	33	2001		Natural gas
Hydropower	Kelukoski	10	2001		
Iceland					
Geothermal power	Nejavellir II	16	2001		
Hydropower	Sultartangi	60	2000	440	
	Vatnsfell	90	2001	430	
Norway					
Hydropower	Eid	10	2000	53	
Sweden					
CHP, district heating	Helsingborg	60	2000		Biofuel / Natural gas
	Eskilstuna	35	2000		Biofuel
	Umeå / Dåva	10	2000		Biofuel
	Sala - Heby	10	2000		Biofuel
	Lycksele	14	2000		Biofuel
	Mariestad	10	2001		Biofuel

System load

S5 Maximum system load for each country in 1999[1)]

	MWh/h	Date/time
Denmark	6471	[2)]
Finland	13080	29th January 1999 08:00 - 09:00 AM
Iceland	905	9th December 1999 08:00 - 10:00 AM
Norway	21019	15th December 1999 08:00 - 09:00 AM
Sweden	25800	29th January 1999 08:00 - 09:00 AM

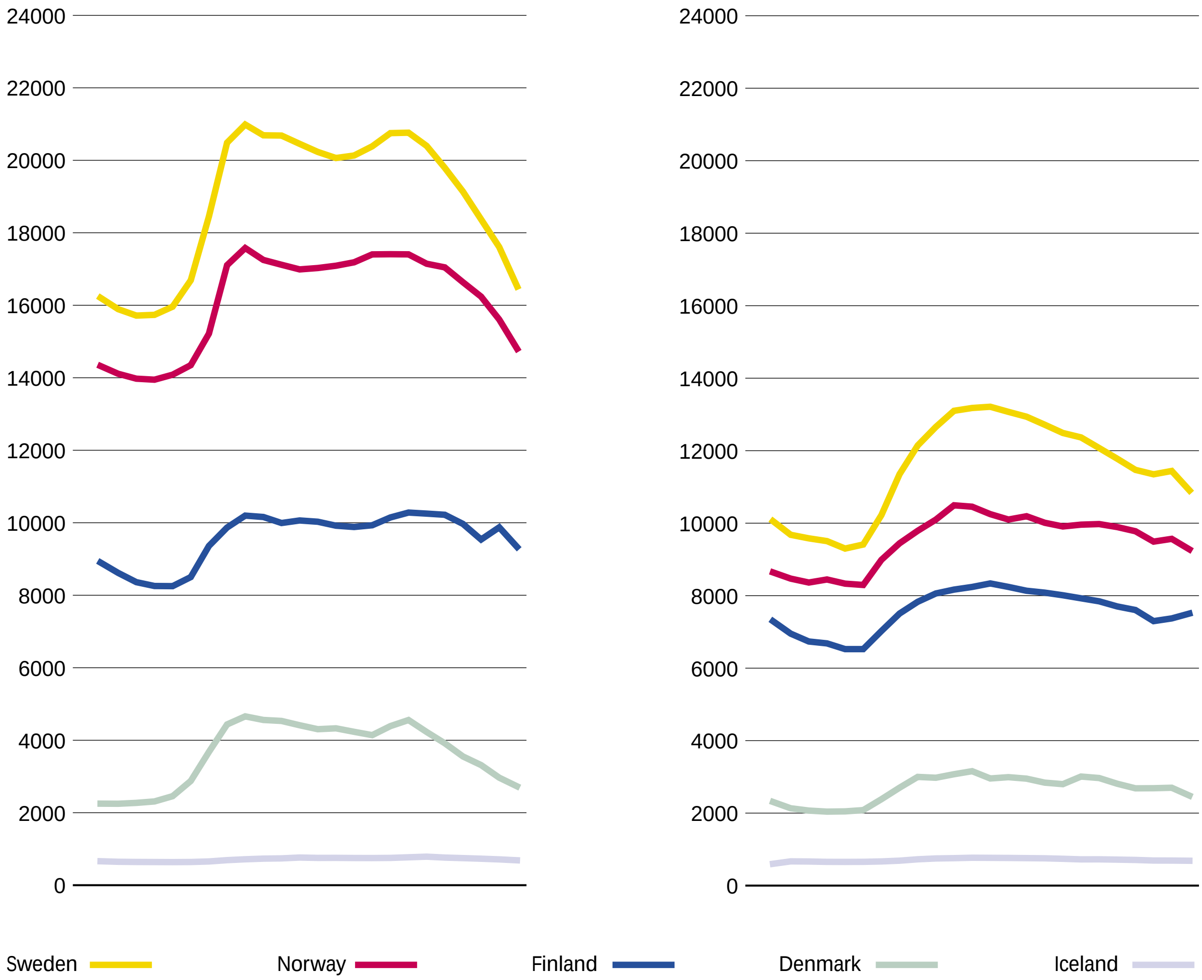
[1)] The system load is not corrected vs. temperatures.

[2)] Denmark-East: 2698 at 12th January 1999 05:40 - 05:45 PM,
Denmark-West: 3773 at 21st December 1999 08:15 - 08:30 AM.

System load 3rd Wednesday in January and 3rd Wednesday in July 1999

Average 24-hour load 3rd Wednesday in January (20-1-1999) MWh / h

Average 24-hour load 3rd Wednesday in July (21-7-1999) MWh / h



All hours are local time.

	Installed net capacity [1] 31.12.99 GW	Maximum system load 3rd Wednesday in Jan 1999 8:00-9:00 AM (CET) GWh / h	Minimum system load 3rd Wednesday in July 1999 4:00-5:00 AM (CET) GWh / h
Denmark	10,9	4,7	2,0
Finland	16,5	10,2	6,5
Iceland	1,3	0,7	0,7
Norway	27,9	17,6	8,3
Sweden	30,9	21,0	9,3
Nordel	**87,5**	**54,2**	**26,8**

[1] Refers to the sum of the rated net capacities of the individual power plant units in the power system, and should not be considered to represent the total capacity available at any single time.

The grid system in the Nordic countries

Interconnections

S6 Existing interconnections between the Nordel countries

Countries Stations	Rated voltage kV	Transmission capacity as per design rules[1] MW		Total length of line km	Of which cable km
Denmark - Norway		**From Danmark**	**To Danmark**		
Tjele-Kristiansand	250/350=	1040	1040	240/pol	127/pol
Denmark - Sweden		**From Sweden**	**To Sweden**		
Teglstrupgård - Mörarp 1 and 2	132~	350 [2]	350 [2]	23	10
Hovegård - Söderåsen 1	400~	800 [2]	800 [2]	91	8
Hovegård - Söderåsen 2	400~	800 [2]	800 [2]	91	8
Vester Hassing - Göteborg	250=	290	270	176	88
Vester Hassing - Lindome	285=	380	360	149	87
Hasle (Bornholm) - Borrby	60~	60	60	48	43
Finland - Norway		**From Finland**	**To Finland**		
Ivalo - Varangerbotn	220~	70	70	228	.
Finland - Sweden		**From Sweden**	**To Sweden**		
Ossauskoski - Kalix	220~			93	.
Petäjäskoski - Letsi	400~	1500 [3]	900 [3]	230	.
Keminmaa - Svartbyn	400~			134	.
Hellesby (Åland) - Skattbol	70~	35	35	77	56
Raumo - Forsmark	400=	550	550	235	198
Norway - Sweden		**From Sweden**	**To Sweden**		
Sildvik - Tornehamn	132~	50	120	39	.
Ofoten - Ritsem	400~	1350	1350 [4]	58	.
Røssåga - Ajaure	220~	310 [5]	310 [4,5]	117	.
Linnvasselv, transformer	220/66~	50	50	.	.
Nea - Järpströmmen	275~	450 [5]	450 [5]	100	.
Lutufallet - Höljes	132~	40	20	18	.
Eidskog - Charlottenberg	132~	100	100	13	.
Hasle - Borgvik	400~	1650 [5]	1800 [5,6]	106	.
Halden - Skogssäter	400~			135	.

[1] Maximum permissible transmission.

[2] Thermal limit. The total transmission capacity is 1775 MW to Denmark and 1700 MW to Sweden.

[3] In certain situations, the transmission capacity can be lower than the limit given here.

[4] Thermal limit. Stability problems and generation in nearby power plants may lower the limit.

[5] The transmission capacity can in certain situations be lower, owing to bottlenecks in the Norwegian network.

[6] Requires a network protection system during operation (production disconnection).

S7 Existing interconnections between the Nordel countries and other countries

Countries Stations	Rated voltage kV	Transmission capacity MW		Total length of line km	Of which cable km
Denmark - Germany		**From Nordel**	**To Nordel**		
Kassø - Audorf	2 x 400~	1200	800	107	.
Kassø - Flensburg	220~			40	.
Ensted - Flensburg	220~			34	.
Bjæverskov - Rostock	400=	600	600	166	166
Finland - Russia		**From Nordel**	**To Nordel**		
Imatra - GES 10	110~	.	100	20	.
Yllikkälä - Viborg	±85=	.	1000	.	.
Nellimö - Kaitakoski	110~	60	60	20	.
Norway - Russia		**From Nordel**	**To Nordel**		
Kirkenes - Boris Gleb	154~	50	50	10	.
Sweden - Germany		**From Nordel**	**To Nordel**		
Västra Kärrstorp - Herrenwyk	450=	600 [1]	600 [1]	250	220

[1] Owing to restrictions in the German network, transmission capacity is currently limited to 450 MW from Nordel and 400 MW to Nordel.

S8 Interconnections: decisions taken

Countries Stations	Rated voltage kV	Transmission capacity as per design rules MW	Total length of line km	Of which cable km	Estimated commissioning Year
Denmark - Denmark (Storebælt/The Great Belt) Eltra - Elkraft System	400=	500-600	ca 70	ca 70	[1]
Finland - Sweden Senneby (Väddö) - Tingsbacka (Åland)	110~	80 [2]	81	60	2000
Finland - Russia Yllikkälä - Viborg [3]	±85=	300			2000
Norway - The Netherlands (NorNed Kabel) Feda - Eemshaven	±450=	min 600	ca 570	ca 570	2002
Norway - Germany (Viking Cable) Feda - Brunsbüttel	500=	min 600	580	580	2004
Sweden - Poland (SwePol Link) Stärnö - Slupsk	450=	600	252	237	2000

[1] According to plans, the Great Belt connection will be in operation in 2003. The capacity can be less than 500-600 MW. The Minister of the Environment and Energy has the authority to decide on the connection.

[2] At present 63 MW.

[3] Increase of station capacity.

Line lenghts

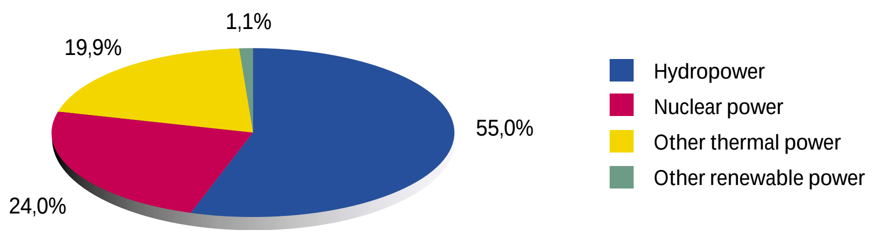
S9 Transmission lines of 110-400 kV in service on 31 Dec. 1999

	400 kV, AC and DC km	220-300 kV, AC and DC km	110, 132, 150 kV km
Denmark	1 318 [1]	504 [2]	3 922 [3]
Finland	3 777 [4]	2 510	15 000
Iceand	94 [5]	508	1 315
Norway	2 144	5 639 [2]	10 429
Sweden	10 807 [4]	4 602 [2]	15 000

[1] Of which 2 km in service with 150 kV and 53 km with 132 kV.
[2] Of which 80 km in Denmark and 96 km in Sweden (KontiSkan), 89 km in Denmark and 382 km in Norway (Skagerrak) in service with 250 kV DC, and 75 km in Denmark and 74 km in Sweden (KontiSkan 2) in service with 285 kV DC.
[3] Of which 13 km in service with 60 kV and 118 km with 50 kV.
[4] Consisting of submarine cable (DC), 99 km in Finland and 99 km in Sweden; and land cable (DC), 34 km in Finland and 2 km in Sweden (Fenno-Skan).
[5] At present in service with 220 kV.

Electricity generation

S10 Total electricity generation within Nordel 1999

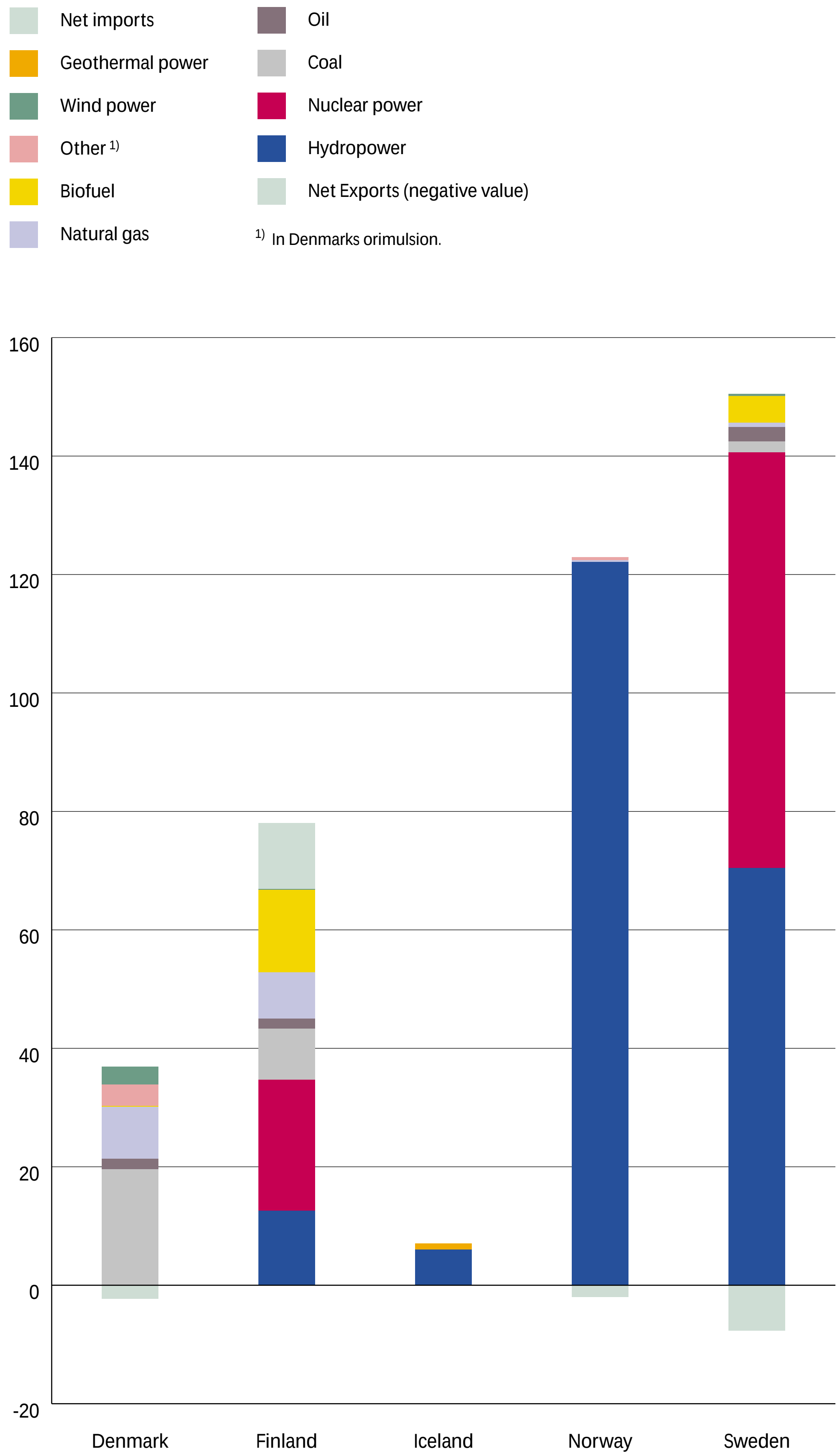


S11 Electricity generation 1999, GWh

Total generation	Denmark 37 009	Finland 66 766	Iceland 7 184	Norway 122 874	Sweden 150 510	Nordel 384 343
Hydropower	31	12 606	6 043	122 095	70 423	**211 198**
Nuclear power	.	22 067	.	.	70 171	**92 238**
Other thermal power	33 949	32 043	3	766	9 547	**76 308**
- condensing power	32 266 [1]	6 922	.	119	281	**39 588**
- CHP, district heating	..	12 941	.	.	4 770	**17 711**
- CHP, industry	1 683	12 178	.	370	4 486	**18 717**
- gas turbines, etc.	-	2	3	277	10	**292**
Other renewable power [2]	3 029	50	1 138	13	369	**4 599**
Total generation 1998	39 040	67 324	6 277	116 953	154 340	**383 934**
Change as against 1998	-5,2%	-0,8%	14,4%	5,1%	-2,5%	**0,1 %**

[1] Includes generation in combined heat and power stations.
[2] Wind power and, for Iceland, geothermal power.

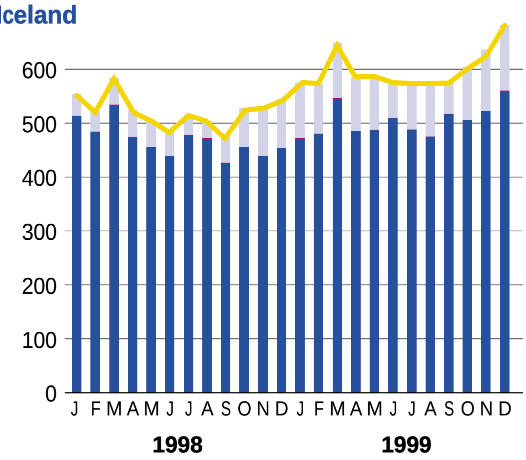
S12 Total electricity generation by energy source, and net imports and exports 1999, TWh



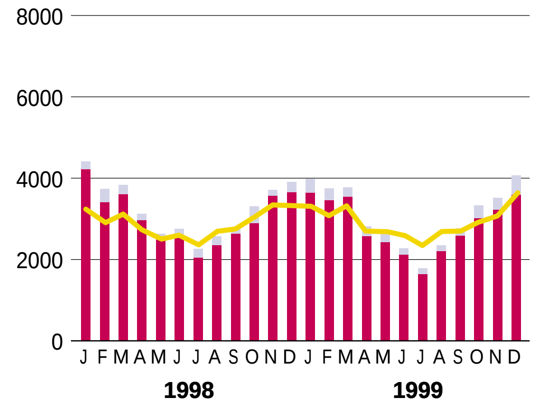
S13 Monthly generation and total consumption of electricity 1998-1999, GWh

- Total consumption
- Wind power or geothermal power
- Nuclear power and other thermal power
- Hydropower

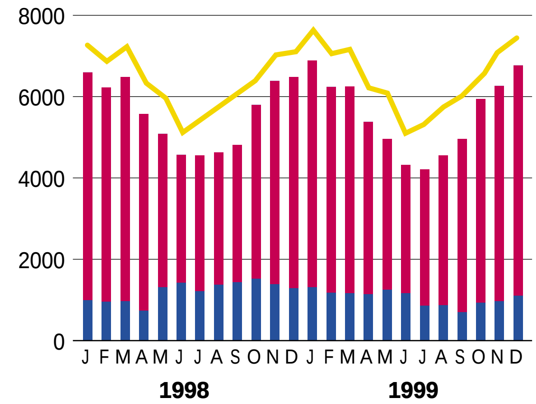
Iceland



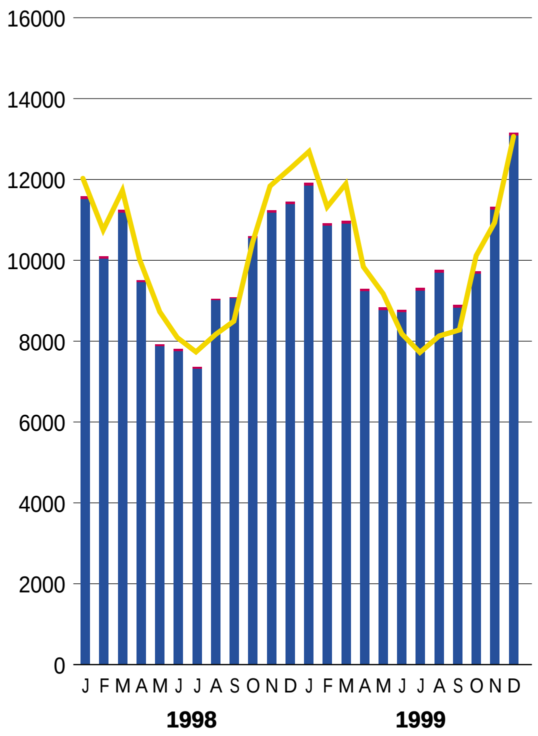
Denmark



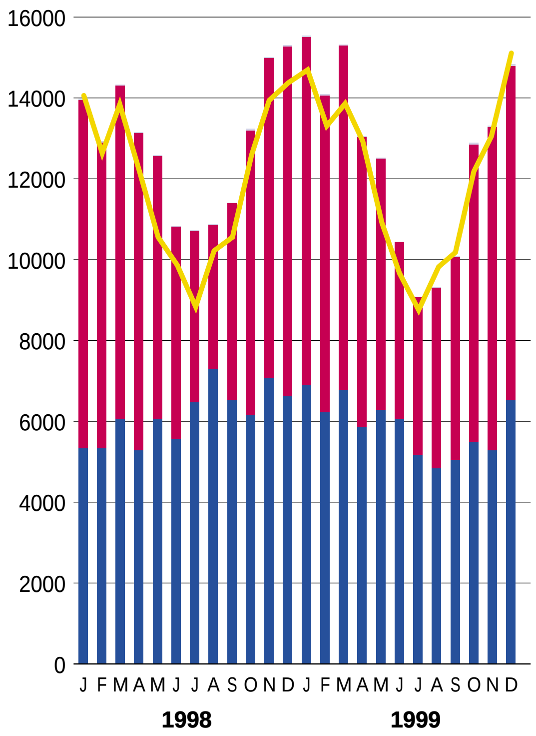
Finland



Norway



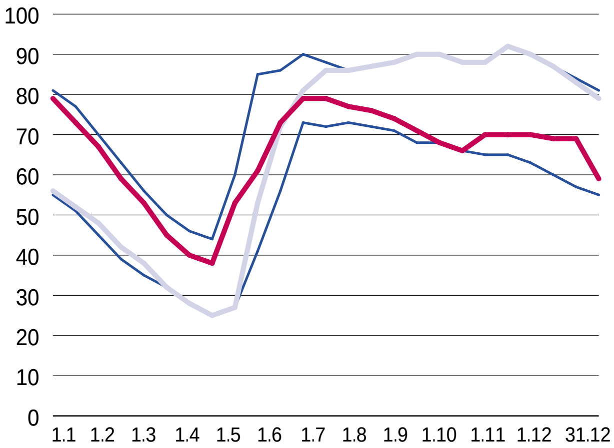
Sweden



Water reservoirs

S14 Water reservoirs 1999

Finland

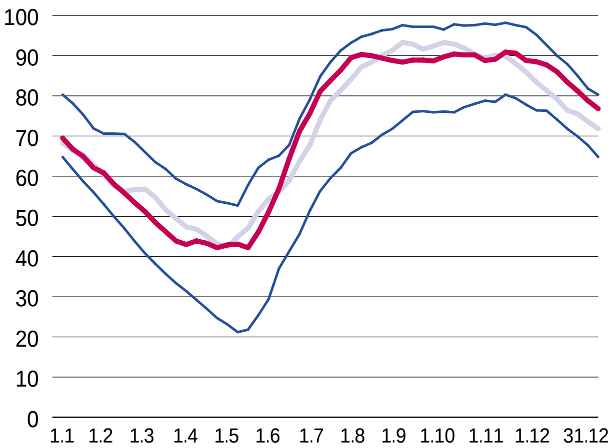


Water reservoirs 1999 expressed in %
Water reservoirs 1998 expressed in %
Minimum- and maximum values in %

Reservoir capacity 4900 GWh

Minimum and maximum limits are based on values for the years 1989-1998.

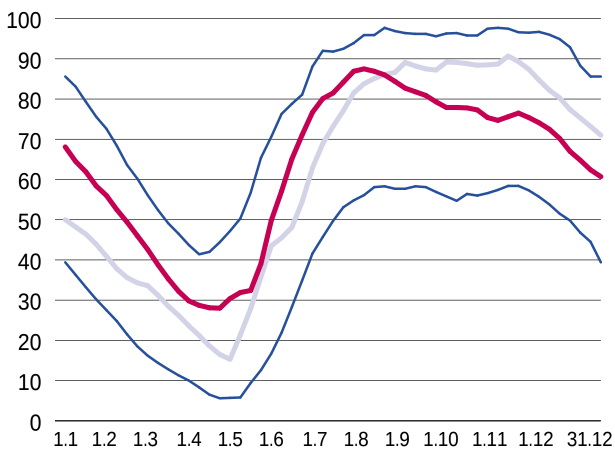
Norway



Reservoir capacity
1.1.1999 **81 489 GWh**
31.12.1999 **81 893 GWh**

Minimum and maximum limits are based on values for the years 1982-1991.

Sweden

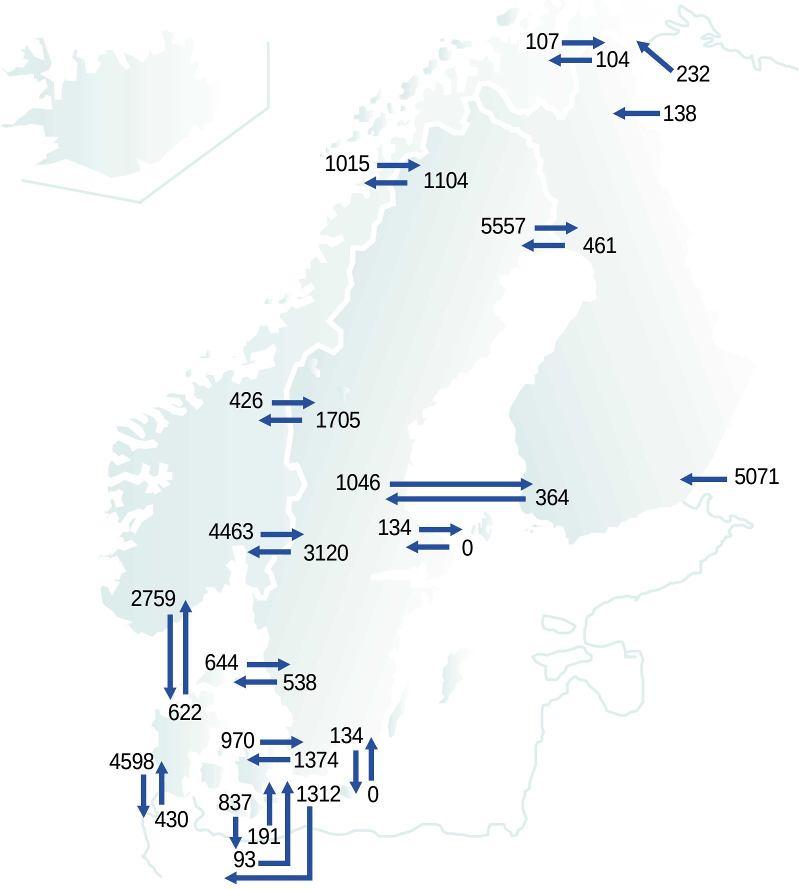


Reservoir capacity 33 748 GWh

Minimum and maximum limits are based on values for the years 1950-1998.

Exchange of electricity

S15 Exchange of electricity 1999, GWh



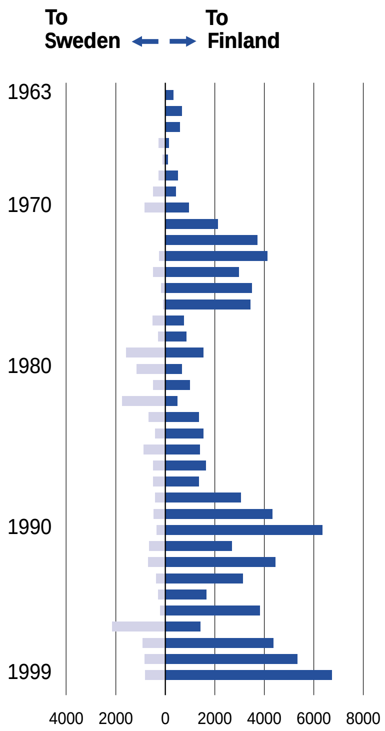
S16 Imports and exports 1999, GWh

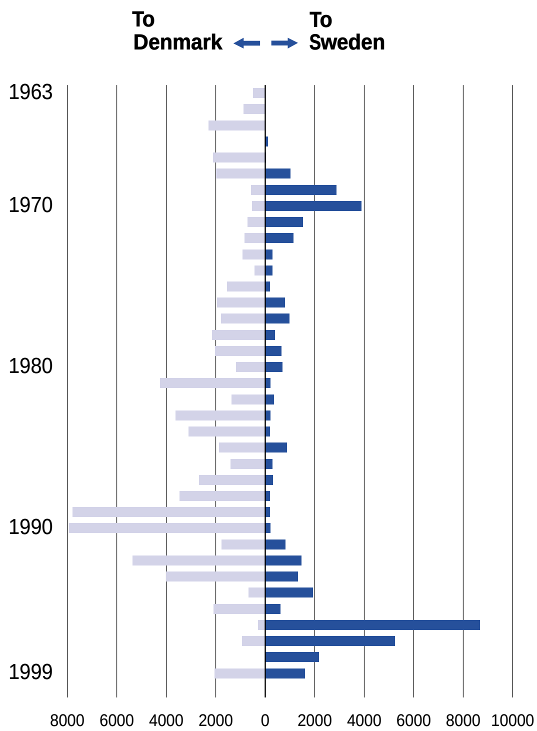
Exports from	Imports to Denmark	Finland	Norway	Sweden	Other countries[1]	S Exports
Denmark	.	.	622	1 614	5 356	**7 592**
Finland	.	.	104	825	.	**929**
Norway	2 759	107	.	5 904	.	**8 770**
Sweden	2 046	6 737	5 929	.	1 312	**16 024**
Other countries[1]	622	5 209	232	93	.	**6 156**
S Imports	**5 427**	**12 053**	**6 887**	**8 436**	**6 668**	**39 471**

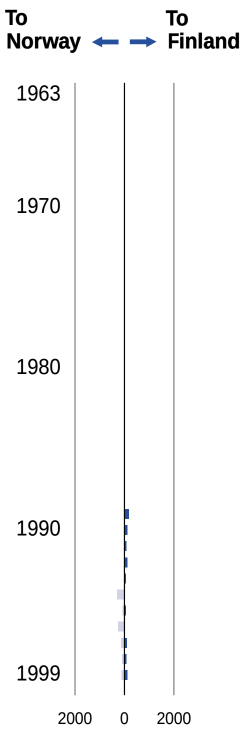
	Denmark	Finland	Norway	Sweden	Nordel
Total imports	5 427	12 053	6 887	8 436	**32 803**
Total exports	7 592	929	8 770	16 024	**33 315**
Net imports	-2 165	11 124	-1 883	-7 588	**-512**
Net imports / total consumption	**-6,2 %**	**14,3 %**	**-1,6 %**	**-5,3 %**	**-0,1 %**

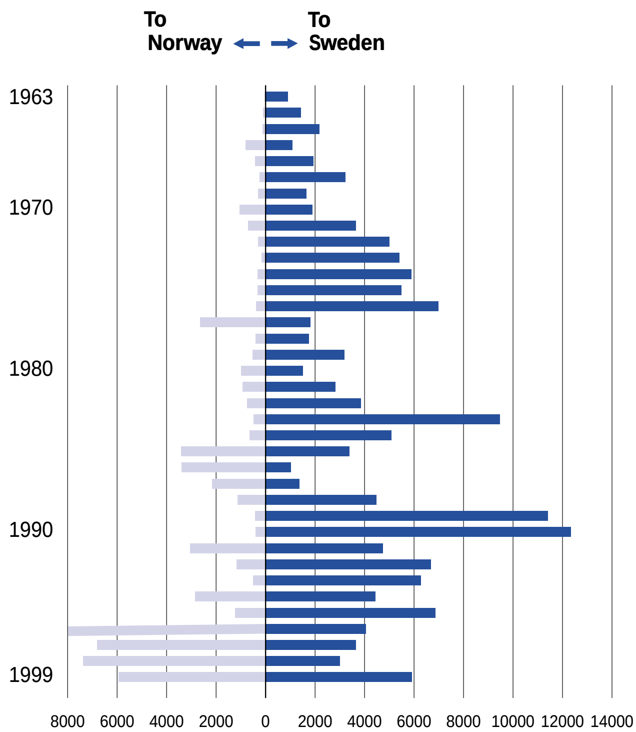
[1] Germany and Russia.

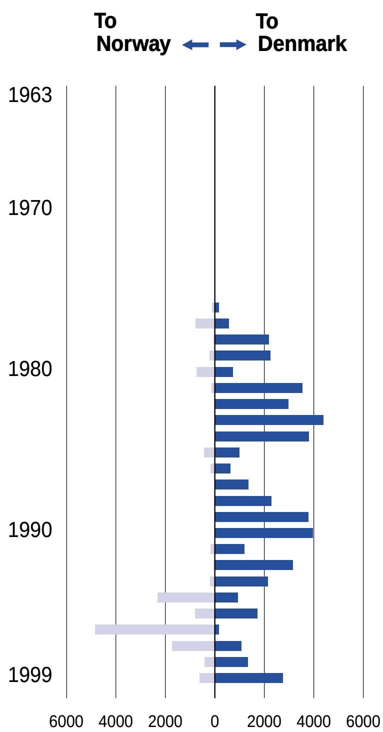
S17 Exchange of electricity between the Nordel countries 1963 - 1999, GWh



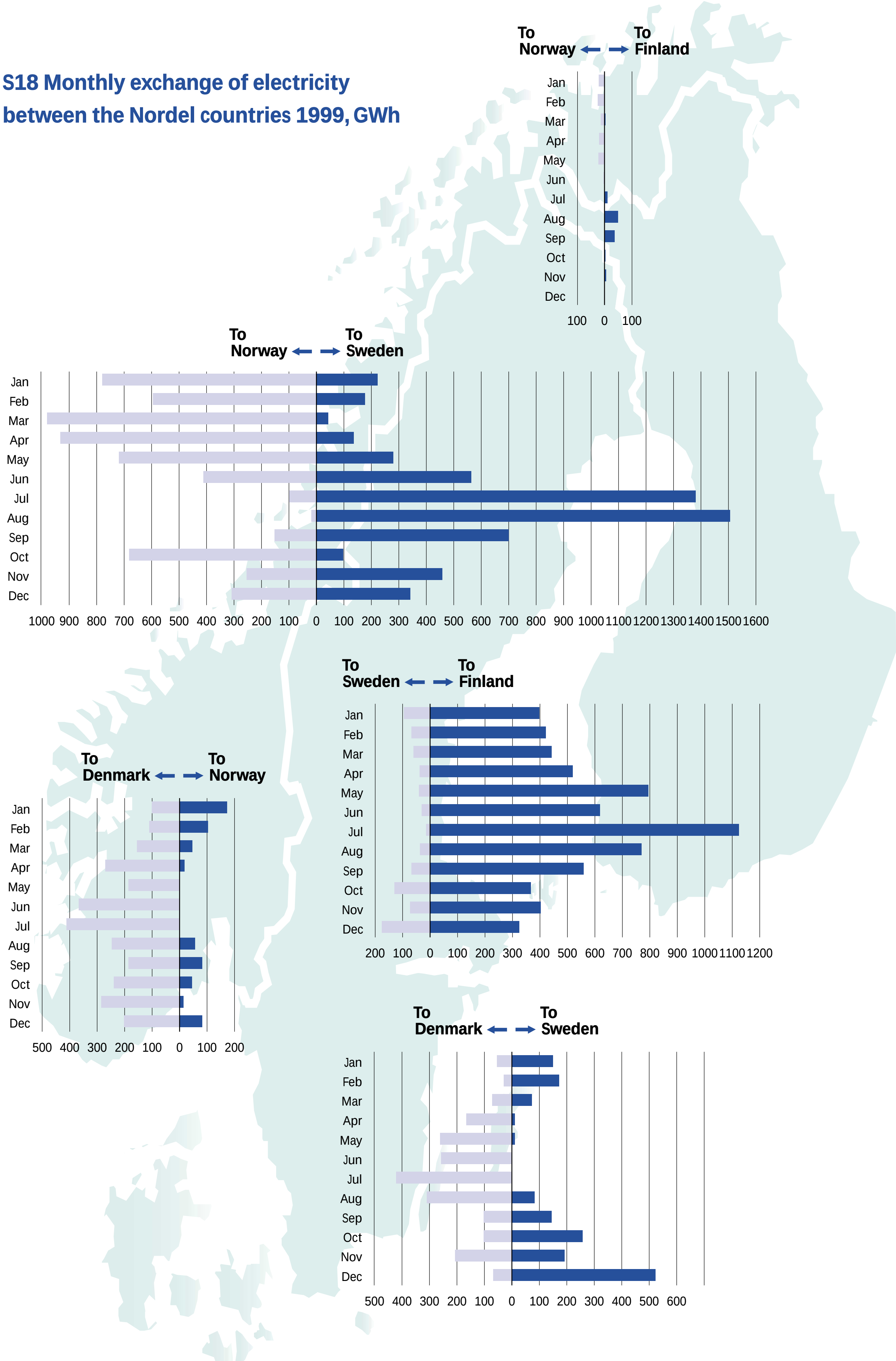






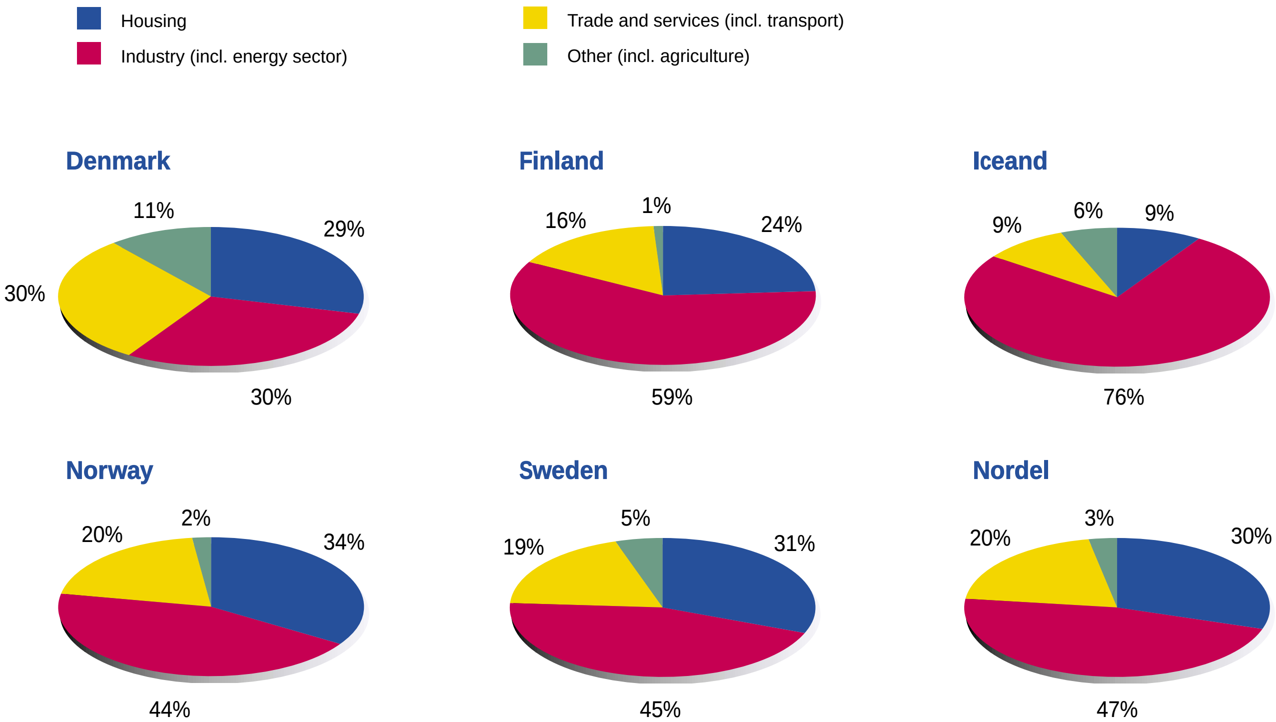


S18 Monthly exchange of electricity between the Nordel countries 1999, GWh



Electricity consumption

S19 Net consumption of electricity 1999, by consumer category

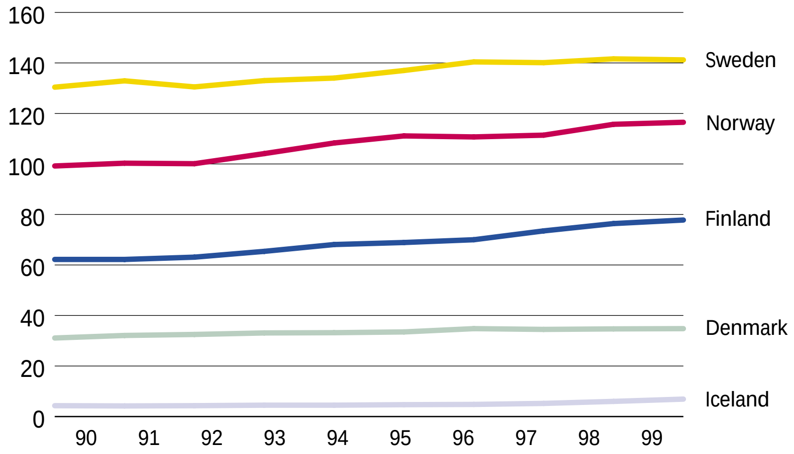


S20 Electricity consumption 1999, GWh

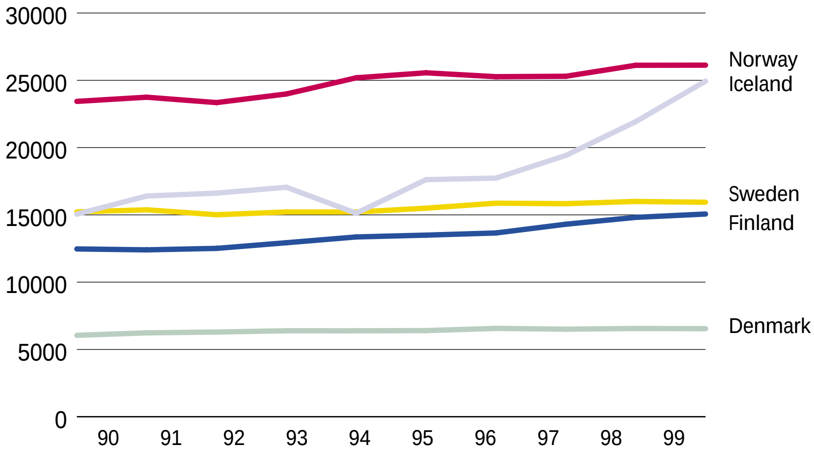
	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total consumption	34 844	77 890	7 184	120 991	142 922	**383 831**
Occasional power to electric boilers	.	80	276	4 475	1 700 [1)]	**6 531**
Gross consumption	34 844	77 810	6 908	116 516	141 222	**377 300**
Losses, pumped storage power	2 300	2 700	465	10 084	10 550	**26 099**
Net consumption	32 544	75 110	6 443	106 432	130 672	**351 201**
- housing	9 600	18 670	602	36 395	40 100	**105 367**
- industry (incl. energy sector)	9 800	44 168	4 894	46 937	59 200	**164 999**
- trade and services (incl. transport)	9 700	11 672	582	21 500	25 200	**68 654**
- other (incl. agriculture)	3 444	600	365	1 600	6 172	**12 181**
Population (million)	5,327	5,166	0,277	4,460	8,861	**24,091**
Gross consumption per capita, kWh	6 541	15 062	24 939	26 125	15 937	**15 661**
Gross consumption 1998	34 747	76 504	6 029	115 715	141 630	**374 625**
Change as against 1998, %	0,3 %	1,7 %	14,6 %	0,7 %	-0,3 %	**0,7 %**

[1)] Only electric boilers at district heating plants shown.

S21 Gross consumption 1990 - 1999, TWh



S22 Gross consumption per capita 1990 -1999, kWh

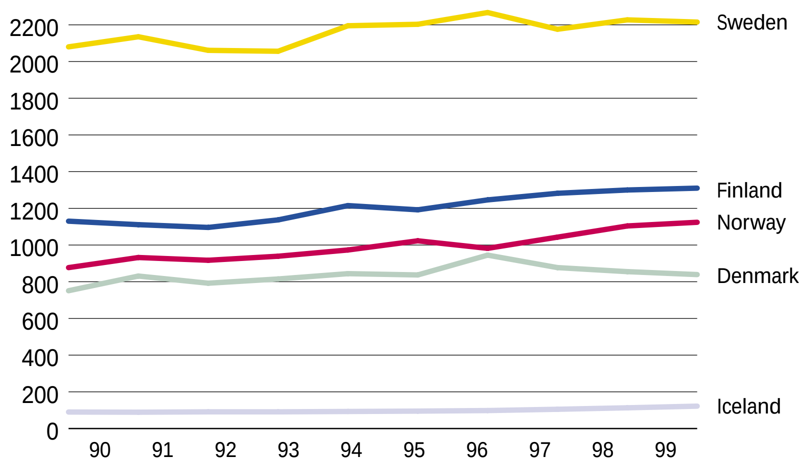


S23 Total consumption 1999, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Generation 1999	37 009	66 766	7 184	122 874	150 510	**384 343**
Net imports 1999	-2 165	11 124		-1 883	-7 588	**-512**
Total consumption 1999	34 844	77 890	7 184	120 991	142 922	**383 831**
Generation 1998	39 040	67 324	6 277	116 953	154 340	**383 934**
Net imports 1998	-4 293	9 307		3 678	-10 810	**-2 118**
Total consumption 1998	34 747	76 631	6 277	120 631	143 530	**381 816**

Total energy supply

S24 Total energy supply 1990 - 1999, PJ



Prognoses

S25 Gross consumption of electricity 1999 and prognoses for 2000 and 2005, TWh

	Denmark	Finland	Iceland	Norway [1]	Sweden
1999 [3]	35	78	6,9	117	141
2000	36	80	7,5	117	144 [2]
2005	37	85	8,1	124	149 [2]

[1] Excl. pumped storage power.
[2] Prognoses based on data from Statens Energimyndighet.
[3] The consumption is not corrected vs. temperatures.

S26 Maximum system load 1999 and prognoses for 2000 and 2005, MW

	Denmark	Finland	Iceland	Norway	Sweden
1999 [4]	6 471	13 080	1 080	21 019	25 805
2000 [1]	6 600	13 700	1 100	22 600 [2]	27 200 [3]
2005 [1]	6 900	15 000	1 180	24 100 [2]	28 100 [3]

[1] Includes supply to electric boilers only for Iceland.
[2] Consumption during a cold winterday.
[3] Prognoses based on data from Statens Energimyndighet.
[4] The consumption is not corrected vs. temperatures.

S27 Installed capacity [1] 1999 and prognoses for 2000 and 2005, MW

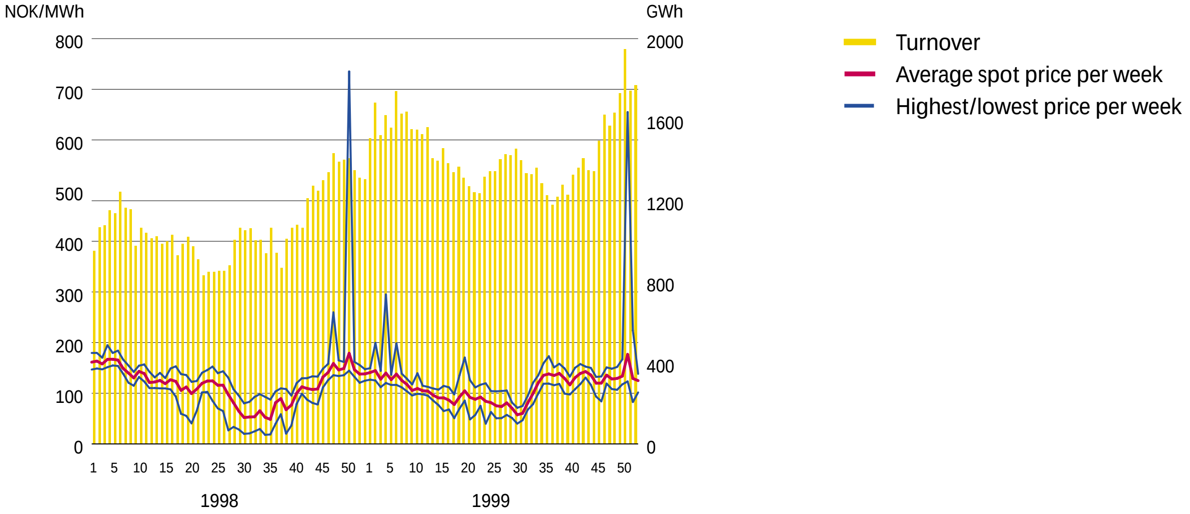
	Denmark	Finland	Iceland	Norway	Sweden
1999	10 934	16 458	1 304	27 934	30 885
2000	11 780	16 550	1 380	27 934	31 000
2005	11 650	[2]	1 470	29 146	31 100

[1] Refers to the sum of the rated net capacities of the individual power plant units in the power system, and should not be considered to represent the total capacity available at any single time.
[2] Prognoses not available.

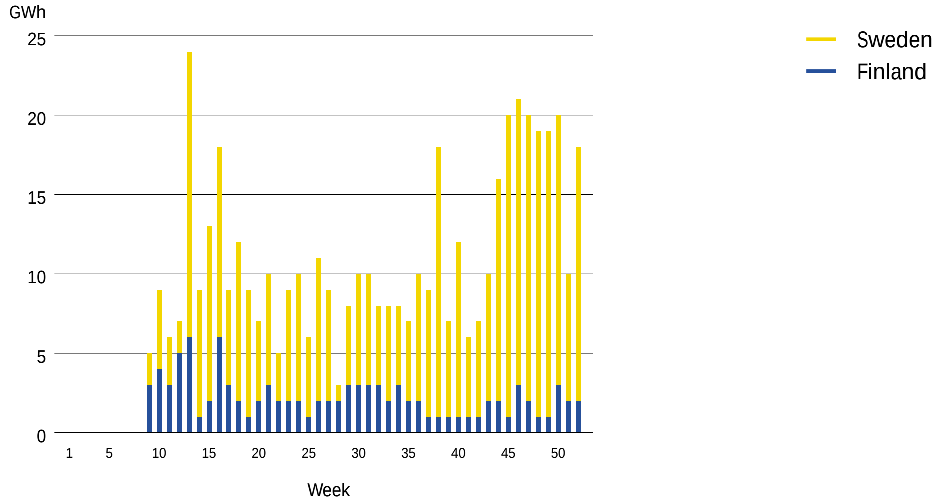
Spot prices

S28 Spot prices and turnover on the Nordic electricity exchanges 1998-1999

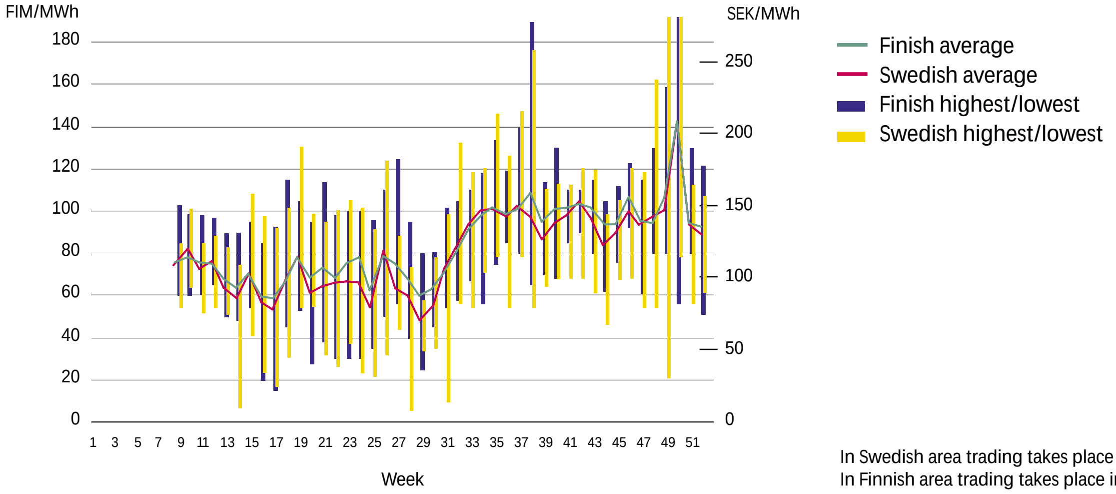
Nord Pool ASA spot market - average systemprice and turnover per week



ELBAS market - turnover per week 1999



ELBAS market - price per week 1999



In Swedish area trading takes place in SEK.
In Finnish area trading takes place in FIM.

Information on the environment

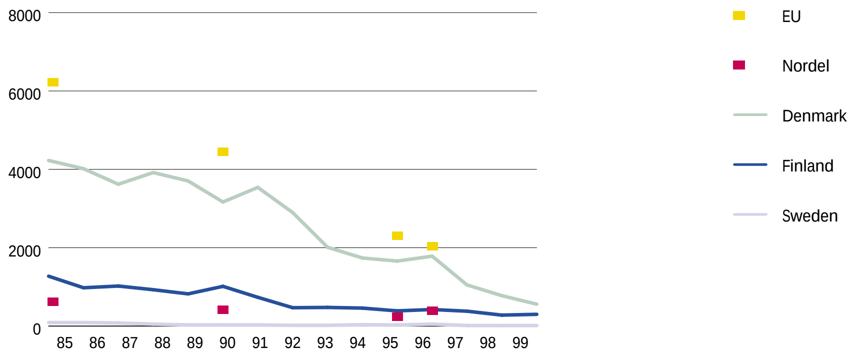
Environmental aspects play a central role in the electricity sector. Actors in this sector take an active part in the work under way within the European Union for development of programmes and rules in order to limit emissions harmful for the environment. Similarly, long-range measures have been taken to reduce emissions from power generation by introducing new combustion and purification techniques and by utilising CHP plants of high efficiency. The active trade in power between the Nordel countries has also helped reduce environmental impacts by ensuring that effective use is made of production resources.

The diagrams below show the emissions of SO_2, NO_2 and CO_2 in relation to total electricity generation in each country. The high proportion of thermal power in the Danish and Finnish systems increases the emission figures in these countries. The Norwegian and Icelandic emissions are negligible because virtually all electricity generation is based on hydropower and geothermal power.

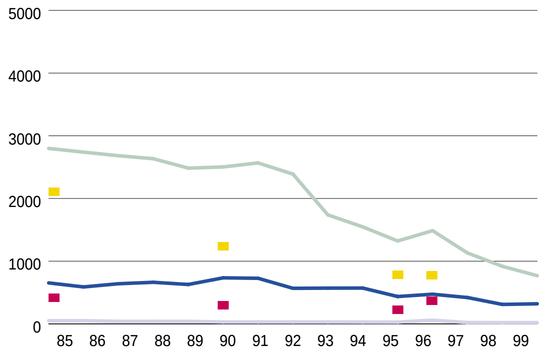
The emissions show a steady downward trend in the long term. The year 1996 was an exception because the unusually dry weather conditions led to a sharp increase in the consumption of fossil fuels. However, the data for 1997 to 1999 show that the general trend follows the previous pattern.

Average emissions within the EU and within Nordel are given for some reference years. On the whole, emissions from the Nordel countries seem to be somewhat lower. However, the diagrams should merely be considered as indicating a trend because, for instance, the exact proportions of emissions from combined heat and power generation cannot be defined without ambiguity.

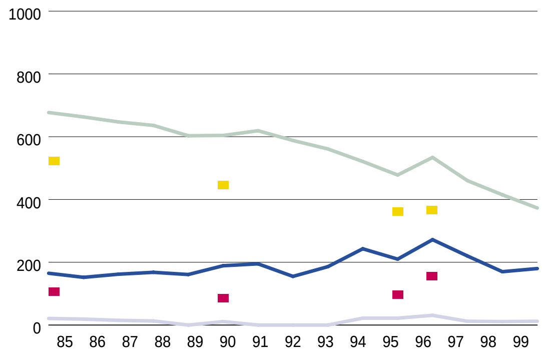
SO_2 - mg/kWh



NO_2 - mg/kWh



CO_2 - g/kWh



Current Nordel recommendations

Availability Concepts for Thermal Power
September 1977

Localisation of System Oscillations Equipment
August 1992

Network Dimensioning Criteria
August 1992

Common Disturbance Reserve
August 1992

Operational Performance Specifications for Thermal Power Units Larger Than 100 MW
August 1995

Operational Performance Specifications for Small Thermal Power Units
August 1995

Standardised Communication Procedure
August 1995

Recommendations for Frequency, Time Deviation, Regulating Power and Reserves
August 1996

Summery of recommendation
May 1997

Trade with Reserves within the Nordic Countries
August 1998

Recommendation on changeover to year 2000
May 1999

Symbols:

Nordic version

English version

Electronic version

Members of Nordel and Organization

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Bent Agerholm, Managing Director, CEO, Elkraft System a.m.b.a.
Mogens Arndt, Commercial Director, i/s Sjællandske Kraftværker
Niels Bergh-Hansen, Managing Director, SH Energi A/S
Georg Styrbro, Managing Director, Eltra amba

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Juha Kekkonen, President and CEO, Fingrid System Oy (as of 20.05.99)
Kalervo Nurmimäki, President, Fortum Power and Heat Oy (President until 20.05.99)
Timo Rajala, President and CEO, PVO-Group
Timo Toivonen, President and CEO, Fingrid Oyj
Harry Viheriävaara, Deputy Managing Director,
Energibranschens Centralförbund r.f Finergy (until 20.5.99)

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Thorkell Helgason, Director General, Statens Energistyrelse
Halldór Jónatansson, Managing Director, Landsvirkjun (until 20.05.99)
Kristján Jónsson, Managing Director, Statens Elverker
Fridrik Sophusson, Managing Director, Landsvirkjun (as of 20.05.99)

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Odd Håkon Hoelsæter, President CEO, Statnett SF (President from 20.05.99)
Jens Musum, Managing Director, Nord-Trøndelag Elektrisitetsverk (as of 20.05.99)
Atle Neteland, Managing Director, BKK A/S
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Jan Magnusson, Director General, Svenska Kraftnät
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Bent Agerholm, Managing Director, CEO, Elkraft System a.m.b.a., Denmark
Timo Toivonen, President and CEO, Fingrid Oyj, Finland
Adalsteinn Gudjohnsen, Energy Advisor to the Mayor of Reykjavík, Iceland
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Cecilia Hellner, Chief of Staff, Svenska Kraftnät, Sweden

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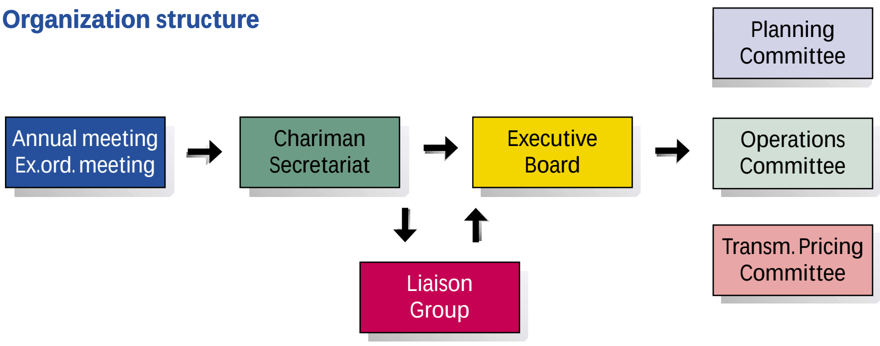
Organization structure



Operations Committee

Hans-Henrik Clod-Svensson, Director, System Operation Department,
Elkraft System a.m.b.a., Denmark
Carl Hilger, Manager of System Operation Department, Eltra amba, Denmark
Egil Eriksson, Control Engineer, Fortum Power and Heat Oy, Finland (Secretary)
Matti Kaisjoki, Managing Director, PVO-Group, Finland
Kurt Lindström, Director, Fingrid Oyj, Finland (Chairman)
Örlygur Jónasson, Regional Manager, Statens Elværker, Iceland (observer)
Jon Ingvaldsen, Director, Statkraft SF, Norway
Torbjørn Sletten, Head of Department, Statnett SF, Norway
Karl-Axel Karlsson, Group Manager, Svenska Kraftnät, Sweden
Set Persson, Chief Process Line, Vattenfall AB, Sweden

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Edvard Gudnason, Senior Engineer, Landsvirkjun, Iceland
Agnar Olsen, Director, Landsvirkjun, Iceland
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Curt Lindquist, Head of Department, Sydkraft Elnät Syd AB, Sweden

Committee members as per ultimo 1999.

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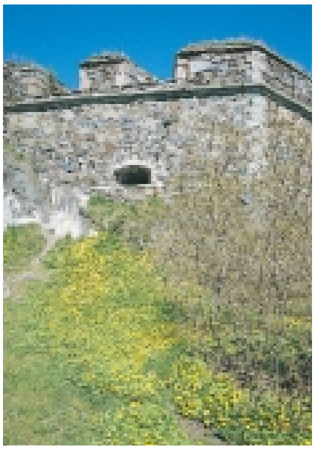

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