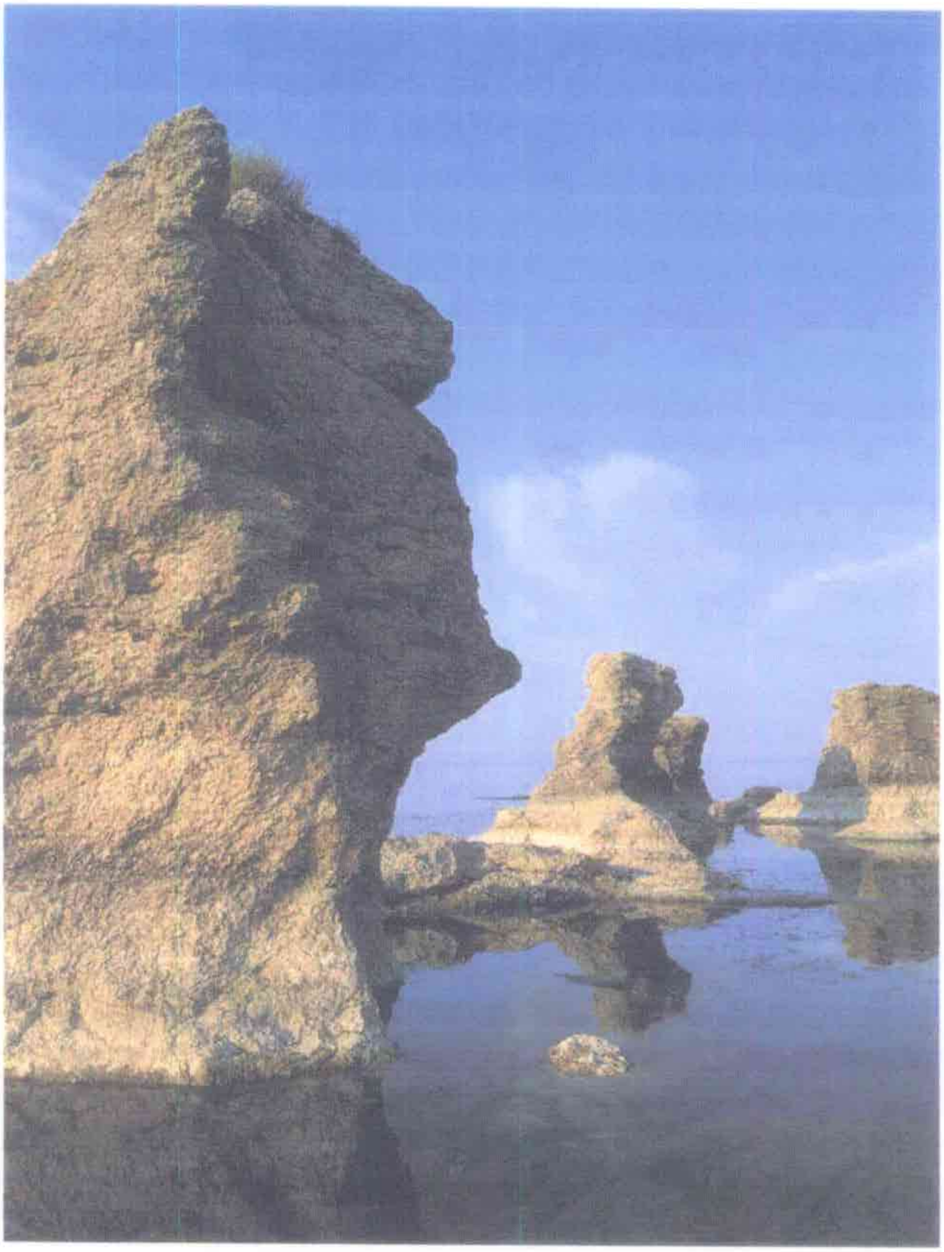
ANNUAL REPORT 1996



Nordel

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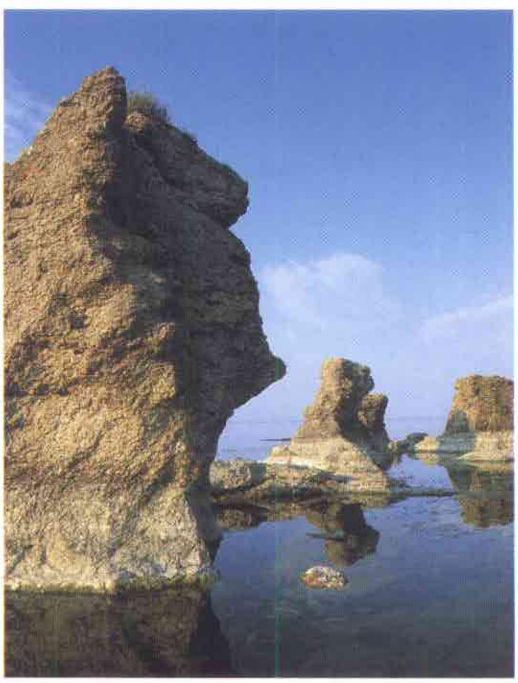


Nordel's Annual Meeting in 1996 was held in Visby, Gotland. Photo: Bildhuset/Bengt Olof Olofsson

Nordel is an association for electricity cooperation in the Nordic countries. Established in 1963, Nordel is an advisory and recommendatory body; its primary task is to create prerequisites for efficient utilisation of the Nordic electricity generation and transmission systems. Nordel has a non-commercial role in regard to electricity interchanges.

Nordel's tasks, which were revised together with the By-Laws in 1993, include:

- technical coordination of the Nordic electricity system;
- formulation of a technical framework for Nordic electricity cooperation;
- international cooperation;
- contacts with other players, organisations and authorities in the electricity sector.

Nordel is composed of leading individuals within the electricity generation and transmission sectors of Denmark, Finland, Iceland, Norway and Sweden. The Chairman is elected for a three-year term, and the chairmanship rotates between the member countries. The Chairman appoints Nordel's secretary and is responsible for the Secretariat.

Nordel's executive body is the Executive Board, composed of one person from each of the Nordic countries. The Executive Board presents initiatives and makes decisions on current matters, and implements the decisions made at Nordel's Annual Meeting. The Board is also responsible for the association's external information activities.

A large proportion of Nordel's work is carried out by committees and working groups made up of specialists in both electricity generation and transmission sectors.

Key figures 1996		Nordel	Denmark	Finland	Iceland	Norway	Sweden
Population	**mill.**	**23.9**	5.3	5.1	0.3	4.4	8.9
Electricity consumption (excl. electric boilers)	**TWh**	**360.7**	34.8	70.0	4.8	110.7	140.4
Maximum load (measured 3rd Wednesday in January)	**GW**	**56.9**	5.8	9.8	0.6	17.7	23.0
Electricity generation	**TWh**	**362.7**	50.4	66.4	5.1	104.9	136.0
Breakdown of electricity generation:							
Hydropower	%	**47**	0	18	93	99	37
Nuclear power	%	**25**	.	28	.	.	53
Other thermal power	%	**27**	97	54	0	1	10
Other renewable power	%	**1**	3	0	7	0	0

· Data are nonexistent
0 Less than 0.5%

Re-regulation of the Nordic electricity market reached a new phase in 1996. New electricity market legislation was introduced in Finland in June 1995 and in Sweden at the beginning of 1996. This enabled an open market for both producers and consumers in Norway, Finland and Sweden. Norway had already implemented reform of its electricity market in 1991. Discussions on re-regulation of the electricity market were also conducted in Denmark and Iceland, and a new law was enacted by the Danish Parliament.

A re-regulated market also enables new forms of trade. At the same time as the market was opened in Sweden, the border tariffs between Norway and Sweden were abolished and a joint electricity exchange began operations in these two countries. An electricity exchange was also set up in Finland during the year. A Nordic working group that had studied the potential of a joint electricity exchange issued its report in August 1996. The working group's study was based on Nordel's earlier analysis of the exchange and on the status report issued by the grid companies Statnett and Svenska Kraftnät in spring 1995. The working group concluded that there are sufficient prerequisites for establishing a Nordic exchange already in late 1997. A new management group was set up to act upon the proposals presented in the report and to work for the creation of a joint exchange, starting from the criteria that the group had defined.

Nordel's Annual Meeting, held on 22 August in Gotland, gave its support to the working group's report. Nordel continues to promote the prerequisites for a Nordic electricity exchange.

Besides the Annual Report for 1995 and the Committees' reports and plans, the Annual Meeting also discussed the current power situation in each Nordic country, and collectively for all the Nordic countries during the next three years. A recommendation for frequency maintenance, time deviation, regulating power and reserves was adopted. The Annual Meeting also approved a report concerning the power balance in the Nordel system in the year 2000 and a report on environmental aspects associated with transmission installations.

The power situation in 1996 was characterised by exceptionally low water reserves in Norway and Sweden, owing to an unusually dry year. This led to considerable power exports from Denmark and Finland, where thermal power production rose markedly. Prices on the Norwegian-Swedish electricity exchange varied sharply during the year.

Developments in Europe with respect to electricity supply have also involved a shift towards increased internationalisation and more open markets, which means that cooperation between Nordel and other organisations in the electricity sector is gaining more and more weight. Close cooperation with UCPTE was reinforced by a meeting between the leading bodies of the organisations in Helsinki in December. It is expected that cooperation between Nordel, UCPTE, UNIPEDE and Eurelectric will be intensified further in the coming years. The international contacts clearly show that the innovative work carried out in the electricity sector in the Nordic countries is valued highly and attracts great international interest.

A meeting between the leading bodies of Nordel and UCPTE was held in Helsinki in December 1996. Top row, from left: J.-Y. Delabre, J. Sereinig, J. Schwarz, J. Ingvaldsen, B. Jacob, O. Skak, H. Haavisto, A. Wickström, C-E. Nyquist. Sitting, from left: J. Allen Lima, M. Albert (Chairman of UCPTE), K. Nurmimäki (Chairman of Nordel), O.H. Hoelsæter. Photo: Juhani Eskelinen

The System Committee is responsible for long-range issues related to technical systems. The Committee's work includes:

- analyses of technical collaboration between generators and grid operators;
- follow-up on the capacity situation within Nordel in both the generation and transmission sectors; and
- analyses of the capacity requirements for transmission between the different systems within Nordel and between Nordel and other countries.

A major proportion of the work is done by the two working groups subordinate to the System Committee.

The Generating Group has studied the power balance within the Nordel system in 2005. The analyses consist of a base scenario and a number of alternative calculations that show how the outcome changes when different factors in the generation sector are varied.

The base scenario takes into account the expansions to production capacity that have been decided upon, as well as certain expansions that are being planned. It is assumed that optimum use is made of jointly operated interconnections without business-related, political or other limitations. It is also assumed that no fuel taxes are levied on power generation. The power and energy balances are analysed assuming that the connections to Continental Europe are utilised to the optimum extent. This means that the power systems in Northern Europe are also included in the model used in the calculations. It is further assumed that the new HVDC links increase the transmission capacity to the Continent by some 2,400 MW.

The alternative analyses study the effects of, e.g. the following situations; expansion of gas-fired power production in Norway and Finland, various models for determining the price of gas (fixed or volume-dependent price), a jointly set CO_2 tax in the whole area under study, a higher consumption level.

The preliminary results show that, in years with normal precipitation, the Nordic system is a net importer of power. Imports through cables from the Continent and from Russia amount to a good 2% of the total consumption. The difference between the variable marginal costs in the various countries is slight, which indicates that there is sufficient transmission capacity.

The scenario that includes expansion of gas-fired capacity, e.g. the power plants that have been planned in Norway, naturally strengthens the balance within the Nordel system. An increase in consumption in the Nordic countries is met for the most part by increased imports from the Continent.

Flisarvatn in Lesja, Oppland. Photo: Kim Hart

Environment-based fees mean that a considerable amount of coal-fired condensing power will be replaced by production based on natural gas and oil. Expansion of gas power results only in a marginal decrease in emissions (-1%), while the total reduction in emissions attributable to the CO_2 tax is -10%, despite an opposite effect locally in the Nordic countries (+1%).

The Grid Group has compiled a review of environmental aspects associated with transmission installations, the emphasis being on the requirements that the authorities have set in the various countries. The main trend shown by the report "Elektriske overføringsanlegg og miljøforhold i Norden" (Electric transmission installations and environmental considerations in the Nordic countries) is that environmental impact assessments and applications for permits take longer and longer to process in all countries.

In autumn, the Group began to compile the practices followed by the Nordel countries for setting design criteria; for instance, the definitions of concepts such as 'extreme situation' etc. This comparison will serve as a basis for an assessment to determine how differences affect the systems of neighbouring countries and whether there is any need for harmonisation.

One of the Grid Group's main tasks is to analyse the impact of the increasing number of HVDC links to the Continent. The work is carried out together with the NOKSY group of Nordel's Operations Committee. The joint HVDC working group studies a number of technical issues concerning, for instance, how these links affect the system in the event of faults.

Members of the System Committee participated in seminars and in working groups, both within Nordel and in association with other organisations.

An important aspect of the Committee's activities has consisted, and will continue to consist, of efforts to eliminate restrictions on the Nordic power generating and transmission system, in order to enable utilisation of the system that is as efficient as possible. To this end, the Committee studies different scenarios on the generating and transmission capacity and draws a comprehensive picture of the results. An example is the discussion conducted within the System Committee concerning the ability of the reorganised market to meet the requirements set for long-term supply security — an issue that has gained increasing weight because of the past dry year. No clear-cut solution models have been sought in this connection, but the discussion has shown how important it is for representatives of various interest groups to have the opportunity to ponder the issue together.

OBJECTIVES OF ACTIVITIES

The Operations Committee is responsible for technical system matters on a shorter term and for the technical framework of Nordic electric power interchange and day-to-day operation.

The primary objectives of the Committee are:

- To establish the preconditions for the optimum collective utilisation of the entire Nordic electric power system.
- To devote particular attention to the preconditions of electricity trading, including the establishment of framework conditions and administrative rules for the market contacts between the parties involved.
- To promote an open exchange of information between the parties in order both to ensure good reliability and to make it possible for the market to function efficiently.
- To serve as a forum for discussions about operational collaboration within the Nordic electric power system.
- To place high priority on environmental issues as an integral part of the activities, and to study the effects of operational collaboration on the environment.

Two permanent working groups have been set up under the Operations Committee:

- The working group for system operations (NOKSY) carries out analyses, prepares regulations and recommendations, and co-ordinates technical issues related to power system operation.
- The working group for information technology in power system operation (NORCON) promotes the effective utilisation of information technology in the operational management of power systems.

In its operations, the Committee strives to respect the energy policies and electricity market structures of the countries involved. The Nordel system will be connected to Europe more closely in the near future. Therefore, the Committee will closely follow the development of the electricity markets of the Nordic countries as well as developments in the EU.

POWER COLLABORATION

The Operative Committee has continuously dealt with issues concerning operational co-ordination, reliability, the power situation in the Nordic countries and the preconditions for electricity trading.

As to the power situation in the Nordic countries, while the year 1995 could be characterised as a normal year, a situation with extremely low water reservoir levels arose during the entire summer and in the early autumn of 1996, stemming from high consumption in the winter as a result of cold weather, a shortage of rainfall during the entire period and minor spring floods due to the extremely small snow reservoir.

In June, the reservoir levels in Norway and Sweden were the lowest for 15 years. In Norway, the reservoir level was about 45% as compared with the normal level of 70%, while the level in Sweden was about 20% as compared with 50% during normal years. The situation became even worse during the third quarter of the year, but heavier rains than usually improved the situation during the last quarter so that the reservoir situation at the end of the year was about 20% lower than the normal in both of these countries. In Finland, reservoir levels were almost normal.

The difficult water situation in Norway and Sweden in 1996 led to a considerably higher generation from fossil-fuel power than normally, which also led to greater emissions. The nuclear generating capacity was fully utilised apart from periods with reparation work. At year's end, Oskarshamn 1 was still out of use due to upgrading. The technical upgrading of nuclear power stations has increased the capacity by 5% to 6%.

Coal prices fell from the middle of 1995 to the middle of 1996, but started to rise again during the second half of 1996.

The poor water situation also led to changes in the normal interchange pattern. While there were net exports from Norway and net imports to Sweden during the first half of 1996, during the second half the situation changed so that there were extensive net imports to Norway and a balanced interchange in Sweden. If the whole year is taken into consideration, there were net imports to both Norway and Sweden. Denmark had considerable net exports to Norway, Sweden and Germany, while Finland had extensive imports from Russia and exports to the other Nordic countries.

The power situation in the Nordel system was difficult, owing to the unusual water conditions that prevailed for the major part of the year. This led to high market prices and a high utilisation of reserve energy, primarily in the form of fossil-fuel power in the Nordic countries and as imports from Germany.

The power balance during the peak load situation in the winter of 1996 was analysed for each of the systems. As compared with the very cold winter of 1987, peak consumption had increased by 15% in Jutland (Denmark), Finland and Norway, whereas the situation in Eastern Denmark and Sweden was unaltered. The power balances were good and the reserves could be utilised sufficiently.

The energy and power balances compiled by the Operations Committee for 1997 to 1999 show that the balances are good apart from Norway, where the energy balance shows that Norway is likely to be dependent on imports during both normal and dry years. From 1996 onwards, the balances have been compiled as pure balances per country, excluding both imports and exports. This is due to the new market structure in the Nordic region, which has a common market where agreements between generators and consumers in the different countries as well as between countries are confidential.

The interchange capacity in Southern Sweden increased considerably as the new 400 kV interconnection between Breared and Söderåsen was taken into use at the end of 1996.

In September 1996, the Operations Committee had a meeting with UCPTE, during which operational matters and issues related to the development of the electricity market in the UCPTE countries and in the Nordic region were discussed.

RELIABILITY

The Nordel system functioned without any serious operational disturbances in 1996. Two minor disturbances, one in Finland and the other in Eastern Denmark should, however, be mentioned. As a result of the disturbance in Finland in July, which was caused by a non-selective disconnection of a high-ohmic earth fault, both units of Olkiluoto power station stopped functioning, thus decreasing the frequency to 49.45 Hz. The operating personnel were able to prevent a serious collapse of the system.

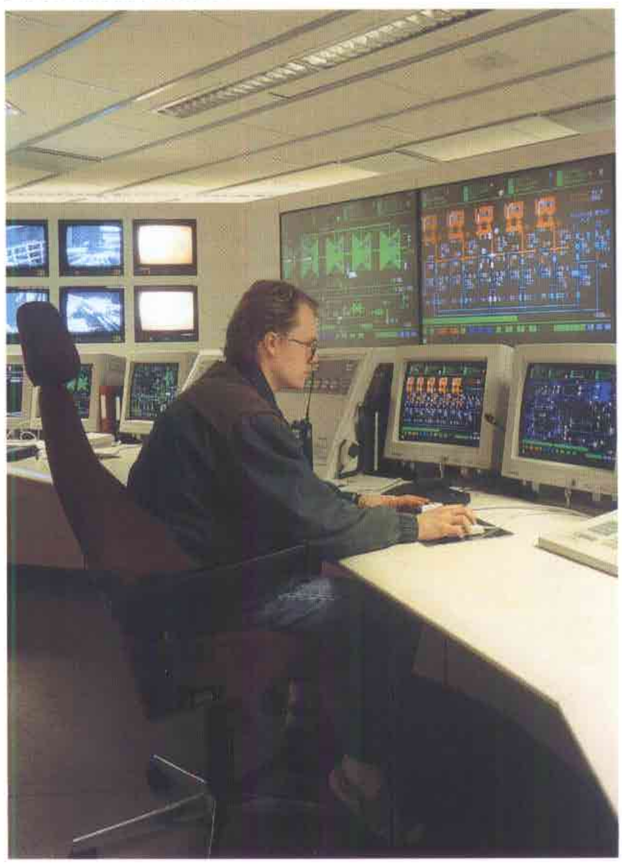
During a thunderstorm in Eastern Denmark, several single-phase faults took place in the 400 kV lines between Asnæsværket and Bjæverskov (Kontek). As a result of these faults, there was a simultaneous commutation deficiency in the Kontek and Baltic Cable interconnections. This disturbance showed that a fault in the alternating current system can lead to simultaneous commutation deficiencies in several HVDC interconnections that are situated close to one another in the network. This is why the Operations Committee asked NOKSY, in cooperation with the Net Group of the System Committee, to investigate the system criteria for designing HVDC interconnections. This work can give rise to a new recommendation for the design of these interconnections.

A new recommendation regarding frequency, time deviation, regulating power and reserves in the Nordel system was issued in 1996. This recommendation, which was drawn up by NOKSY by order of the Operations Committee, replaced four previous recommendations related to these matters. According to the recommendation, trade with regulating power and reserves can take place when there are no obstacles. In the autumn of 1996, an ad hoc group started to study the preconditions for such trade and its alternative forms. The work of the group can give rise to a revision of the above-mentioned recommendation. The group should have its report ready during the first half of 1997.

The NOKSY working group analysed the operating criteria in the different countries and found that there are differences in the criteria, and that they are partly inconsistent with the criteria in the new net work dimensioning criteria. According to the Committee, the countries should apply the same operating criteria based on the net dimensioning rules. NOKSY has also been asked by the Committee to focus on such tasks as:

- Comparing and assessing operational recommendations and rules applied by UCPTE and Nordel
- Monitoring the frequency quality of the Nordel system and analysing the interaction between the requirements for frequency quality and regulating power and the routines for the control of generation
- Establishing data for an operating grid for NOKSY's operational analyses
- Defining and documenting the transmission capacity of the interconnections
- Formulating an improved presentation of system operation with regard to frequency, utilisation of reserves, disturbances etc.
- Analysing disturbances in the Nordel system.

Operations centre at Meri-Pori Power Plant.
Photo: Juhani Eskelinen



Stable economic growth in the *Nordic countries* continued in 1996. Interest rates were low, and there are good grounds for believing that the favourable trend will continue. Yet, the heavy public debt constitutes a problem for Finland and Sweden, and a very strict fiscal policy has been pursued. The current account showed a positive balance in all countries.

Economic growth in *Denmark* in 1996 came to 2%, which is less than the year before. The explanation for this can be sought in the relatively weak growth in overall domestic demand, which was, however, partly offset by an increase in net exports. The number of people registered as being unemployed fell by 40,000, and the unemployment rate came to 9%.

The *Finnish* economy went through a period of slow growth during the first months of the year, but a marked upswing took place towards the end of the year. The GDP grew by 3.2%, compared with 4.2% the year before, and the current account showed a surplus of +8%. Demand by households was lively, and after its deep slump the building sector also showed some positive signs. However, the value of the most important sector, the paper and pulp industry, decreased by 7%. Unemployment fell somewhat and stood on average at 17%.

The positive economic cycle continued in *Iceland*, too. The GDP grew by 5.5%, compared with 2.1% the year before. The real value of the country's main export sector, fishery products, increased by 7.0%, while the growth in other sectors of industry amounted to 5.0%. Investments increased by 24%, compared with 2.2% in 1995. Unemployment fell somewhat and stood on average at 4.4%. From the end of 1995 to the end of 1996, the consumer price index rose by 2.1%. The corresponding figure the year before had been 2.0%.

The *Norwegian* economy has been improving steadily for the past three years. Demand by households, a marked increase in exports, and rapidly rising oil investments helped to trigger the economic upswing; thereafter, mainland investments have also increased. The GDP growth rate was 5.3% for the year, and the current account showed a surplus of NOK 66,000 million. The consumer price index rose by 1.25%. Unemployment stood at 4.25%.

In *Sweden*, the GDP growth rate was 1.5%, compared with 3.6% the year before. The current account stood at SEK 121,000 million, and inflation was -0.2% when measured from December 1995 to December 1996. Investment volume increased by 5.8%, compared with 10.9% the year before.

Total electricity consumption (excluding supply to electric boilers) for the five Nordel countries amounted to 361 TWh in 1996, or about 1% more than in 1995. However, the comparison with the previous year merely indicates a trend, since the bases for statistical calculations have changed.

Total electricity generation in the Nordel countries came to 363 TWh, or 1% less than in 1995.

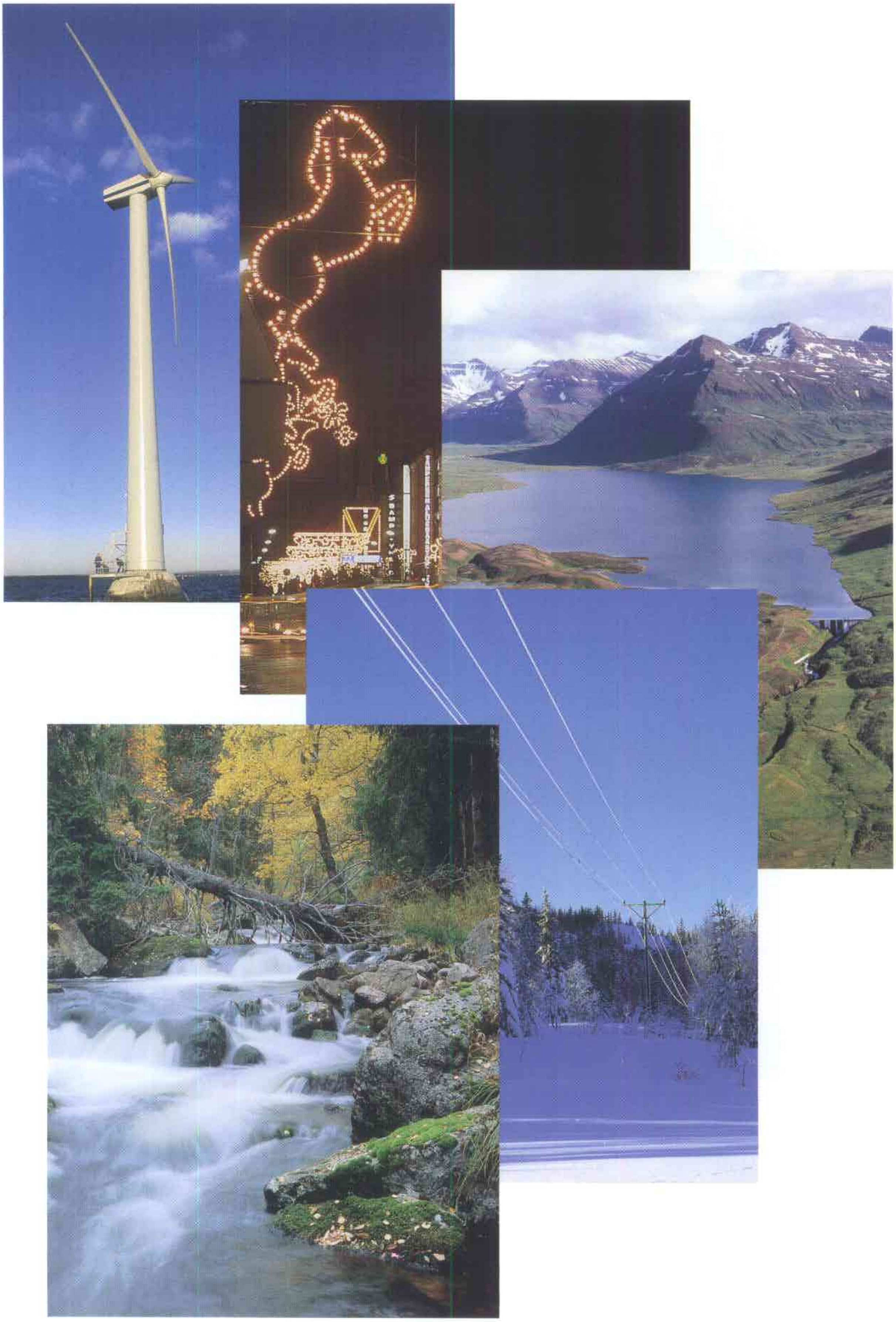
- Hydropower was the biggest generation source, accounting for 172 TWh, or 47%, of the total electricity output. The figure is 36 TWh less than in 1995, owing to the unusually dry year in Norway and Sweden, which rely heavily on hydropower.

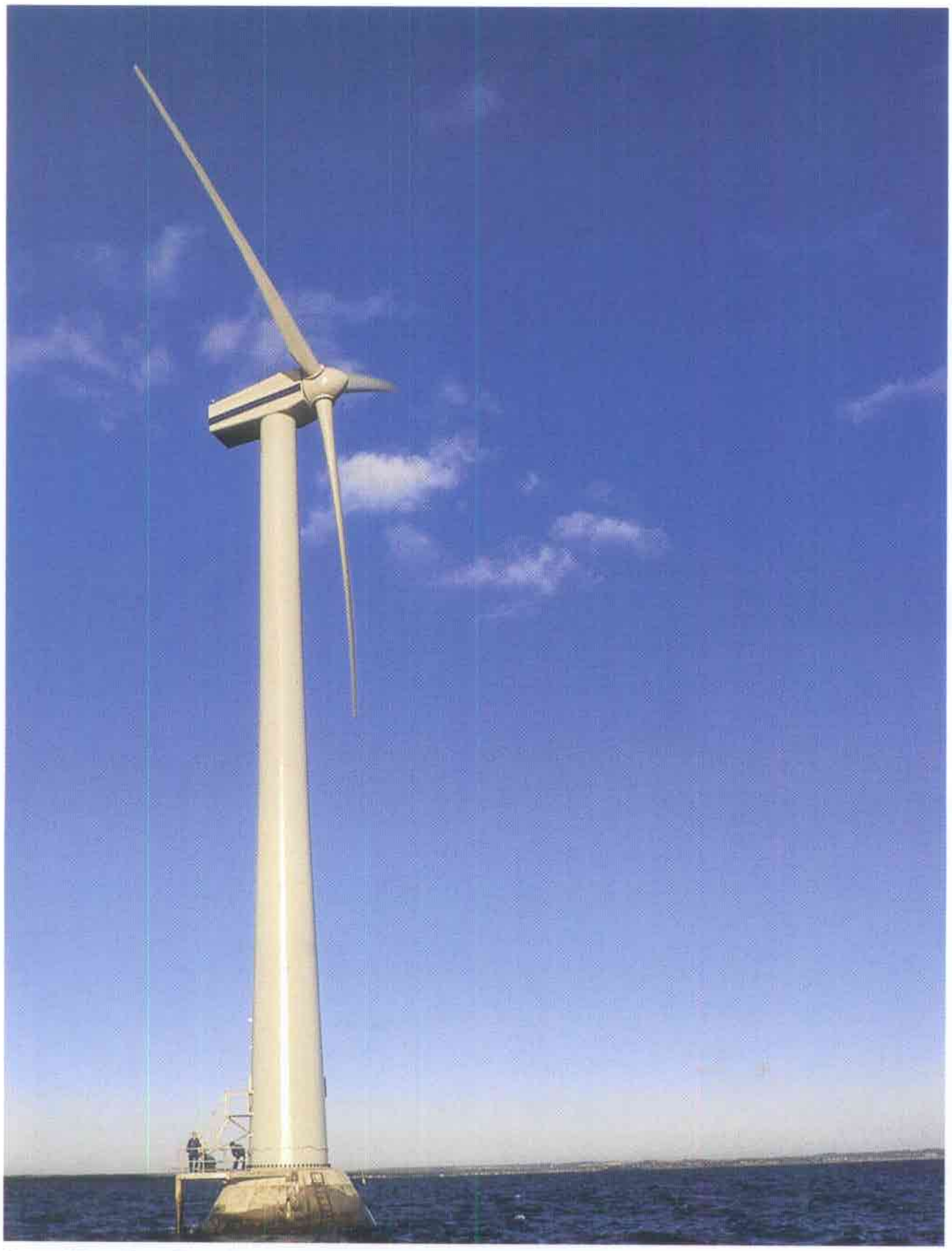
- Nuclear power was the second largest generation source, accounting for 90 TWh (25%) of the total output, or 5 TWh more than in 1995. The average availability rate of the nuclear power plant units was again on a very high level in international comparison.

- Output by conventional thermal power plants stood at 99 TWh, accounting for 27% of the total. The marked rise (+36%) is explained by the poor water situation, which led to increased thermal power production, in particular in Denmark and Finland.

- Other energy sources, e.g. wind power and geothermal power, accounted for 1.8 TWh, or 0.5%, of the total output.

Exchange of electricity between the five Nordel countries totalled 30 TWh. In addition, 11 TWh was interchanged with Germany and Russia. Norway was now the biggest importer of electricity, whereas in 1995 it had been the biggest net exporter. Denmark had the highest next exports in 1996.





Part of Tunø Seamill Park west of Samsø. Photo: Jørgen Schytte

ENERGY POLICY

ENERGY 21 — the Government's energy plan for sustainable energy development in Denmark — was published in April 1996. In its plan, the Government confirms the country's ambitious objective of achieving a 20% reduction in CO_2 emissions, calculated from the emission level of 1988, by the year 2005 . The new plan strives to ensure better utilisation of resources, a lesser environmental impact as well as more extensive incorporation of renewable energy forms in the Danish energy system.

Among its proposals, the plan includes sweeping requirements for saving electricity and heat, and it calls for a power system where the possibilities made available by cogeneration of electricity and heat are exploited as widely as possible. The plan also emphasises the opening of markets, which has already taken place in the Nordic region and which is being planned for the EU.

At the beginning of the year, the Ministry of Energy and Environment placed an order with the energy sector for building 200 MW of new wind power before the end of 1999. The overall target is to generate 1,500 MW of wind power, both privately and under power plant ownership, before the end of 2005. This amount would correspond to 10% of the total electricity consumption. Towards the end of the year, new regulations on connecting windmills to the electricity grid were issued. They will ease the requirements placed on ownership shares and local connections.

A more extensive reform of the energy sector was introduced in 1996, and the first steps for revising the laws regulating the sector were taken during the summer of 1996. The legislative amendments will define the terms of third party access, system responsibility in the Danish system and the securing of public obligations; for further information, see "Deregulation and electricity exchange in the Nordic countries" on page 32.

In consequence of the ENERGY 21 plan, before the end of the year the Government set up an Electricity Savings Fund, to be financed by raising the electricity tax on the price of electricity. The fund will subsidise energy saving measures made by households and in the public sector. Additional support will be directed to the transfer of buildings heated with electricity to collective heating.

In 1996, the Danish Parliament passed new regulations requiring the power utilities to purchase electricity produced at small-scale CHP plants. The Parliament also limited the increase inthe number of small-scale CHP plants, e.g. by reducing the fixed subsidy per produced kWh from DKK 0.10 to 0.07.

Just before the end of the year, the Government drafted a bill concerning the sale of municipal and provincial power supply operations. If municipalities or provinces sell their shares or ownership shares in power companies, the profits from such sales will be deducted from their state subsidy correspondingly. This will mean public savings.The State intends to invest any savings that occur in a fund to promote the interests of consumers and power supply.

ELECTRICITY CONSUMPTION

In 1996, total electricity consumption amounted to 34.8 TWh, which represents an increase of 3.7% on the previous year.

Industry, households, and the trade and service sector each accounted for about 30% of the total consumption, with agriculture etc. accounting for the remaining 10%.

In June 1996, the new 600 MW Kontek Link between Bjæverskov and Bentwisch was officially inaugurated by His Royal Highness Prince Joachim, who is seen here together with Birthe Philip, ELKRAFT's Chair, and Jürgen Stotz, Director of the VEAG Group. Photo: Mogens Carrebye

ELECTRICITY PRODUCTION

1996 was a record year for electricity production in Denmark. The amount generated totalled was 50.4 TWh, an increase of 47% on the previous year. In addition to the minor increase in domestic demand, this increased production stemmed from the hydropower situation in the Nordic region, resulting in considerable exports to Norway and Sweden.

Denmark exported no less than 17.5 TWh. The bulk of this amount, 13.5 TWh went to Norway and Sweden, partly through the Norwegian-Swedish electricity exchange Nord Pool. During the same period, imports — mostly from Germany — totalled 1.9 TWh. Denmark was consequently a net exporter in 1996, with exports amounting to 15.6 TWh.

Coal is still the main fuel used in Danish power plants, even though its share has decreased due to the increasing use of gas and biofuels and the efforts of SK Power to test-fire Orimulsion. In 1996, coal accounted for about 80% of total fuel consumption. Orimulsion and oil accounted for 11%, whereas the total share of gas, biofuels and wind power was 9%.

At the end of June, the Danish Energy Agency rejected SK Power's application for permission to establish a new multi-fueled CHP unit, with a proposed capacity of 460 MW_{el} and 480 MJ/s heat, at Avedøre Power Plant. The company filed a revised application at the beginning of 1997, and this was approved in March 1997. The new power plant is expected to be completed by the end of 2000 or the start of 2001.

The building of two 400 MW CHP units at Nordjylland Power Plant in Aalborg (coal-fired) and Skærbæk Power Plant in Fredericia (natural gas) advances according to schedule. Skærbæk Power Plant will take its new unit into use during the second half of 1997.

Completion of the small-scale CHP plants in Næstved and Masnedø, and the building of a new power plant in Ringsted, were the main steps in the incorporation of small-scale CHP units into the generation system of SK Power.

During the past few years, the number of small-scale CHP units has also increased considerably in the Jutland-Fuen district. At the year end, the small-scale units (decided upon, under construction or in operation) had a total power of 1,275 MW, which corresponds to 30% of the total capacity of the ELSAM power plants. The total installed capacity of small-scale CHP plants in Denmark is consequently 1,400 MW.

At the beginning of 1996, Østkraft's new CHP unit in Rønne was completed. The wood chips unit makes it possible to replace fossil fuels by a maximum of 10,000 tonnes of wood chips annually.

ELSAM is planning the construction of windmill parks in the Jutland-Fuen region. The parks, with a total capacity of 600 MW, are envisaged for completion before 2005. ELSAM's Board has, during the first stage, decided to build 120 MW of land-based wind power before 1999; this will more than double the windmill capacity owned by power plant in the Jutland-Fuen region. The total investment will come to about DKK 900 million. A decision has been made in the Elkraft region to increase the windmill capacity owned by power plants by 80 MW before the year 2000, which will mean an investment of DKK 600 million. In addition, both financial and technical studies are being conducted on the feasibility of establishing large-scale sea mill parks.

MAIN TRANSMISSION GRID

The authorities have yet to reach a final decision about ELSAM's application, filed five years ago, for building a 400 kV line between Århus (Trige) and Aalborg (Nordjylland Power Plant). The insufficient transmission capacity between the central and northern parts of Jutland meant several times during the year that it was not possible to

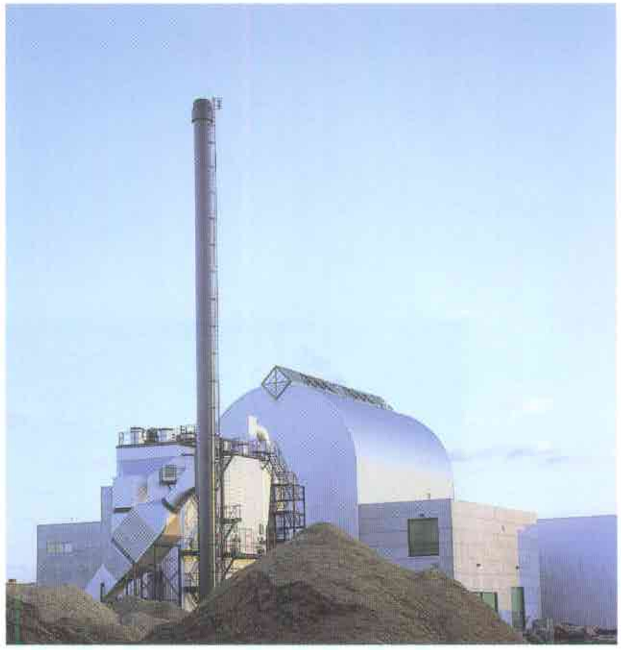
At the end of March 1997, the Danish Energy Agency approved SK Power's application for the construction of a multifuel CHP unit at Avedøre Power Plant. Photo: Mogens Carrebye

utilise the HVDC cables to Norway and Sweden in full. Consequently, the Norwegian-Swedish demand was several times greater than the capacity in ELSAM's alternating current grid.

The primary connections of Copenhagen with the remaining grid are being rebuilt. When this work has been completed, there will be a combined 400 kV aerial line and cable link of 7 and 12 km, respectively, a 400 kV cable link of 22 km, all leading to their own main stations, and local CHP production.

The reconstruction work, the total price of which will amount to more than DKK 1 thousand million, follows the new principles of the Ministry of Energy and Environment on the building and rebuilding of transmission facilities. The permits that must be obtained from authorities have delayed the project by about one year, and the work is expected to be ready by the end of the year 2000.

At the end of 1995, the two three-phase 400 kV submarine cable links between Zealand and Sweden were damaged by an anchor. As a result, all seven one-phase cables were damaged, some in several places. The Kontek DC cable link, which was then undergoing tests before its introduction to commercial use, became of vital importance to the reliability of supply in Zealand. One of the cable links was reintroduced to operation at the very beginning of 1996, and the second one first in the middle of April.



The decentralised CHP plant at Masnedø uses straw and wood chips as fuel. Photo: Mogens Carrebye

ELECTRICITY PRICES

From the beginning of 1996 to the beginning of 1997, electricity prices excluding taxes rose by DKK 0.001 to 0.003 per kWh. The average price for a user with an annual consumption of 3,500 kWh is DKK 0.475 per kWh. Including taxes and VAT, the price is DKK 1.231 per kWh. With an annual consumption of 15,000 kWh, the corresponding user prices are DKK 0.394 per kWh and DKK 1.096 per kWh.

The prices for industrial customers whose annual consumption amounts to 2.5 GWh average DKK 0.344 per kWh (excluding taxes) and DKK 0.403 per kWh (with taxes but excluding VAT).

RESTRUCTURING OF OPERATIONS

In order to be able to prepare itself for the new legislation and commercial market conditions, the Board of ELSAM decided in August 1996 to divide ELSAM's operations into two main sectors: ELSAM System and ELSAM Production. ELSAM System will take over the system responsibility; it will also own and operate the main transmission grid (including the HVDC interconnections to Norway and Sweden). ELSAM Production will coordinate the operation of the six regional power plans and will handle the joint commercial activities of the power plants, e.g. fuel purchases and electricity trading.

SK Power has continued test-firing of Orimulsion at Asnæs Power Plant unit 5.1. A total of 1.3 million tonnes of Orimulsion was consumed as fuel at the plant in 1996. Photo: Mogens Carrebye

Straw storage at Studstrup Power Plant, where the coal-fired unit 1 (152 MW) has been renovated to enable use of straw as supplementary fuel. The plant consumes 150,000 tonnes of straw per year. Photo: Jørgen Schytte

A CHP unit fired with refuse was commissioned at Fyns Power Plant in October 1996. The plant consumes 120,000 tonnes of refuse per year, collected from 17 municipalities. The combined generation of heat and electricity corresponds to consumption by 15,000 households. Photo: Jørgen Schytte

The Tampere Light Festival is arranged every autumn. Photo: IVO Photo

ENERGY POLICY

Energy strategy

The Ministry of Trade and Industry has launched preparations for Finland's new energy strategy up to the year 2020. The Energy Strategy Paper is expected to be completed during spring 1997, after which it will be presented to Parliament. The compilation of the strategy is coordinated by a ministerial task force on energy policy, which was appointed at the beginning of 1997.

The objective of the energy strategy is to define the main conditions for Finland's future energy policy, such as the alternatives for electricity supply in the long term, establishment of a national level for CO_2 emissions (in accordance with the Rio Convention), determination of goals for indigenous energy production (security of supply), and definition of other aims that will affect economy and employment, e.g. energy conservation and the competitiveness of industry. In the end, the energy strategy involves coordination of objectives concerning the environment, economy, employment and the security of supply.

Taxation of electricity

In 1996, energy taxes were imposed on the production stage, e.g. by levying a tax on the use of fuels. Fuel taxes were based on the energy content (FIM 3.50 per MWh) and on carbon dioxide emissions (FIM 38.30 per tonne of CO_2).

Before the onset of 1997, the energy tax system went through two major changes. Taxation was made stiffer and the structure was altered, shifting the emphasis from the taxation of electricity generation to consumption. In 1997, industry pays an electricity tax of 1.675 pennies per kWh, while other users pay 3.1 pennies per kWh. In addition, there is a supply security fee of 0.075 pennies per kWh. Fuels that are used for heat production are taxed only on the basis of carbon dioxide emissions (FIM 70 per tonne of CO_2).

ENVIRONMENT

The Finnish Parliament passed a new, and highly ambitious, Nature Conservation Act. The Act came into effect at the beginning of 1997.

The Environmental Permits Committee and the Environmental Law Committee issued their reports in June. The Committees propose that the provisions in various Acts concerning the prevention of environmental pollution be harmonised and that the system for decision-making be revised. The changes proposed are in agreement with the EU Directive on the integrated prevention and control of pollution (the IPPC Directive). It is also proposed that a new skeleton law, an Environmental Protection Act, be passed for the prevention of environmental pollution. Committees for environmental permit issues should be established in connection with the regional environment centres. Minor permit issues would still be handled within municipalities or within regional administration, but the Water Courts will be abolished.

The new Nature Conservation Act and the coming Environmental Protection Act will draw together the currently splintered and partly outdated statutes on nature conservation and environmental protection. The new Acts will also introduce much stricter requirements.

The Acidification Committee continued its work. Before the autumn of 1997, the Committee should complete a proposal for further measures to reduce SO_2 and NO_x emissions.

In June, the Ministry of the Environment prescribed new limit values and recommended values for air quality. Especially the strict recommended values for particle emissions (PM10) will cause difficulties when environmental permits are sought for power plant operation.

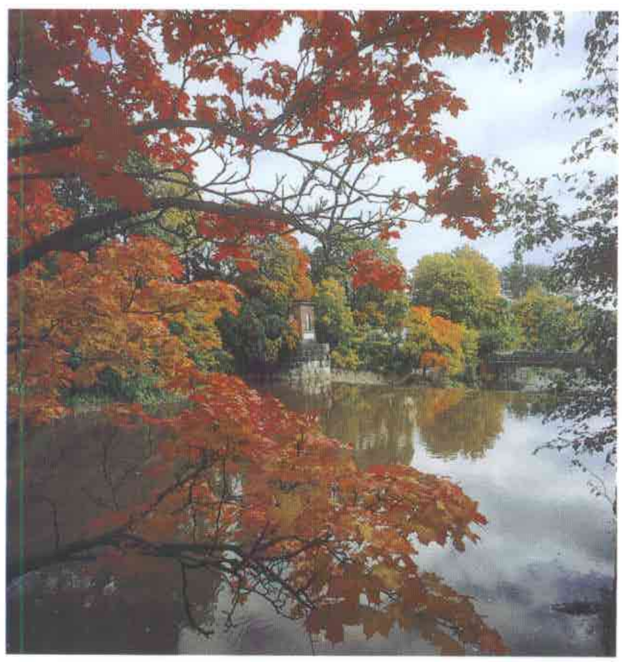
ELECTRICITY CONSUMPTION

Total consumption of electricity in Finland in 1996 amounted to 70.0 TWh, which included a statistical increase of 1.6%. The corresponding real change, adjusted for temperature and the calendar, was 0.4%. Thus, the adjusted consumption continued to rise slowly, at a rate of slightly over +1% per year. This is less than the official prognoses, and less than the growth in the GDP.

The main reason for the slow growth was stagnation within the forest industry; in consequence, consumption in the sector fell by a couple of percentage points. Moreover, less new housing was built during the year; the number of dwellings heated with electricity increased by some 7,000, which was one thousand fewer than in 1995 and only a quarter of the annual increase in the 1980s.

Consumption of electricity by industry remained on the same level as in the previous year, while the other branches continued their favourable trend. Industry accounted for 53%, households and agriculture for a good 25% and the

Vantaaankoski. Photo: Juhani Eskelinen



service sector for a good 17% of the total consumption of electricity.

The peak output for 1996 came to 11,200 MW, which was registered on 9 February when the temperature was -20°C. In 1995, the maximum loading had been about 200 MW lower.

ELECTRICITY PRODUCTION

The Finnish electricity supply amounted to 72.4 TWh. The measured, physical export from Finland to the Nordel area came to 2.4 TWh, while 1.4 TWh was imported during the year. Commercial exports and imports exceed the physical flow of electricity considerably. Owing to the unfavourable hydropower situation in Norway and Sweden, the net imports of 3.6 TWh from the rest of Nordel to Finland in 1995 were replaced by net exports of 1.0 TWh in 1996. In addition, 4.7 TWh, or 6% of the supply, was imported from Russia.

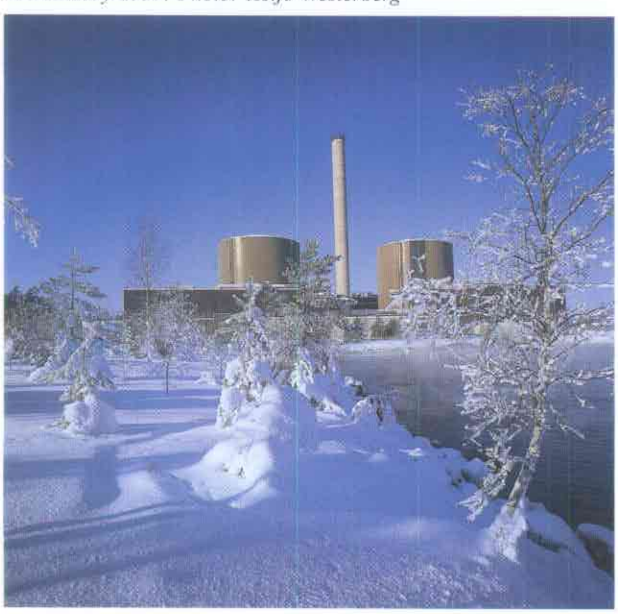
Hydropower generation was nearly 10% lower than the average. The annual energy figure amounted to 11.7 TWh, or to 16% of supply. During the year, 18.7 TWh was generated at nuclear power plants, which thereby covered 26% of the total demand.

The availability factors for the Loviisa units were 82.5% and 93.2%, being 92.4% and 95.1% for the Olkiluoto units. The availability of Loviisa I was lower because of a long annual maintenance, which also included annealing of the pressure vessel.

Generation of back-pressure power (22.5 TWh) was 8% higher than the year before. The need for separately generated condensing power (13.0 TWh) rose by more than 50% on the previous year, chiefly because of increased exports.

Generating capacity increased by a total of 290 MW. The new capacity consisted of hydropower, combined heat and power, industrial back-pressure power, and upgrading of the existing nuclear power plants. The power ratings of the Olkiluoto and Loviisa nuclear power plant units will be upgraded further in the coming years. Vaskiluodon Voima Oy intends to expand the power plant in Vasklot. This involves a power increase of about 230 MW; the investment is expected to be completed at the end of 1998.

Loviisa Power Plant celebrated its 20th anniversary in February 1997. Photo: Keijo Westerberg



At the end of 1996, a total of approximately 1,000 MW of new generating capacity was either under construction or at the stage where projects had been given the go-ahead. After the decommissioning of old power plants, the net increase is approximately 900 MW. About half of the increase is accounted for by the gas-fired CHP station at Vuosaari, Helsinki, which will be commissioned in 1997.

ELECTRICITY MARKET

In 1996, clients whose use of power exceeded 500 kW had the opportunity of purchasing electricity on a market subject to competition. Since the beginning of 1997, transmission services have had to be sold separately also to users whose need for power is under 500 kW, which means that all clients can freely choose their supplier. So far the change of supplier has required that clients purchase an electricity meter that registers consumption by the hour. However, a working group comprised of representatives of the authorities, the electricity sector and consumer organisations has proposed that a metering system based on type load curves be introduced for small-scale consumers in 1998.

Out of the roughly 1,500 electricity clients who, during 1996, had the opportunity to purchase electricity on the deregulated market, over 60% concluded a new or a re-negotiated electricity contract. According to surveys, however, less than one tenth of the clients had actually changed their supplier. Prices had fallen on average by about 7%.

At the beginning of 1997, the average consumer price of electricity, including the energy and value-added taxes, was FIM 0.59 per kWh in blocks of flats, FIM 0.51 per kWh in detached houses, FIM 0.39 per kWh in houses with direct electric heating, and FIM 0.33 per kWh in houses with electric storage heating. The prices rose by 1% in households without electric heating and by 3% in houses with electric heating.

The average taxed transmission price for medium-sized industry stood at FIM 0.091 per kWh. However, the price level varied sharply between areas, from FIM 0.053 per kWh to FIM 0.132 per kWh. The Electricity Market Authority supervises that the transmission rates follow the relevant guidelines.

An electricity exchange, EL-EX, commenced operations on 16 August 1996. In total 34 companies have registered for membership in the exchange. Among these companies, Imatran Voima Oy (IVO) serves as the market guarantor. Trading on the exchange is continuous and takes place with products on the hourly and weekly basis. The daily turnover on the exchange has been between 1 and 4 GWh, or about 1-2% of consumption in Finland.

The ownership structure of the distribution sector was subject to fewer changes than had been expected. Pohjolan Voima Oy (PVO) already relinquished its distribution operations at the beginning of 1996, when the electricity distribution operations of Etelä-Suomen Sähkö Oy were sold to various electricity companies. IVO increased its share in electricity distribution, mainly by acquiring a bigger holding in Länsivoima Oy.

In May, PVO made a decision on electricity imports from Russia during the years 1997-2004. In order to secure the imports, a new 400 kV connection will be built from Vyborg to the main grid in Finland.

MAIN GRID AND BALANCING

The main grid functions, including system responsibility, were managed by the network companies IVO Transmission Services (IVO Voimansiirto OY, IVS) and Industrial Power Transmission Ltd (Teollisuuden Voimansiirto Oy, TVS). A new joint grid company, Suomen Kantaverkko Oy, was founded in late 1996, but is not expected to start its operations until August 1997. IVO and PVO each hold about 33% of the voting rights in the new company, while the State has about 16%. The rest of the shares (17%) are reserved for institutional investors.

The responsibility for frequency regulating reserves and for reserve power during temporary disturbances rests with the network company that has the system responsibility. The network company may agree with producers that the responsibility for these reserves is shifted to the producers.

A separate company, Suomen Voimatase Oy, has regulated the short-term and hourly balance and has had the responsibility for maintaining the national balance with the neighbouring countries since the beginning of 1997. The company is owned by the network companies and producers. Balancing is purchased from the network company IVS and the settling of the balance is purchased from PVO's subsidiary, Länsi-Suomen Yhteiskäyttö Oy.

The Ministry of Trade and Industry appointed two investigators to study the question of how to organise the balancing and the settling of the balance. In their report, the investigators propose elaboration of the definition of system responsibility in the Electricity Market Act so as to enhance interaction between system responsibility and balancing. Such an amendment to the Electricity Market Act may become topical during spring 1997.

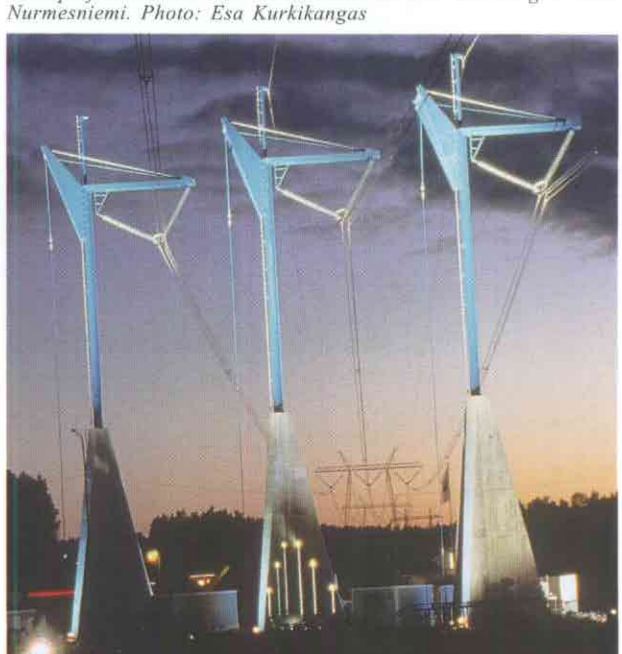
On 1 June 1996, the management of the northern links for interconnected operations to Sweden and Norway was transferred from IVO to IVS. Since the beginning of September 1996, all actors on the electricity market have, on equal terms, had access to the northern connections across the border between Sweden and Finland. In October, four Finnish parties had registered for trading on the daily market of the Norwegian-Swedish electricity exchange, Nord Pool. The intension is to abolish the energy-based border tariffs between Sweden and Finland during 1997, in order to make electricity trading more efficient.

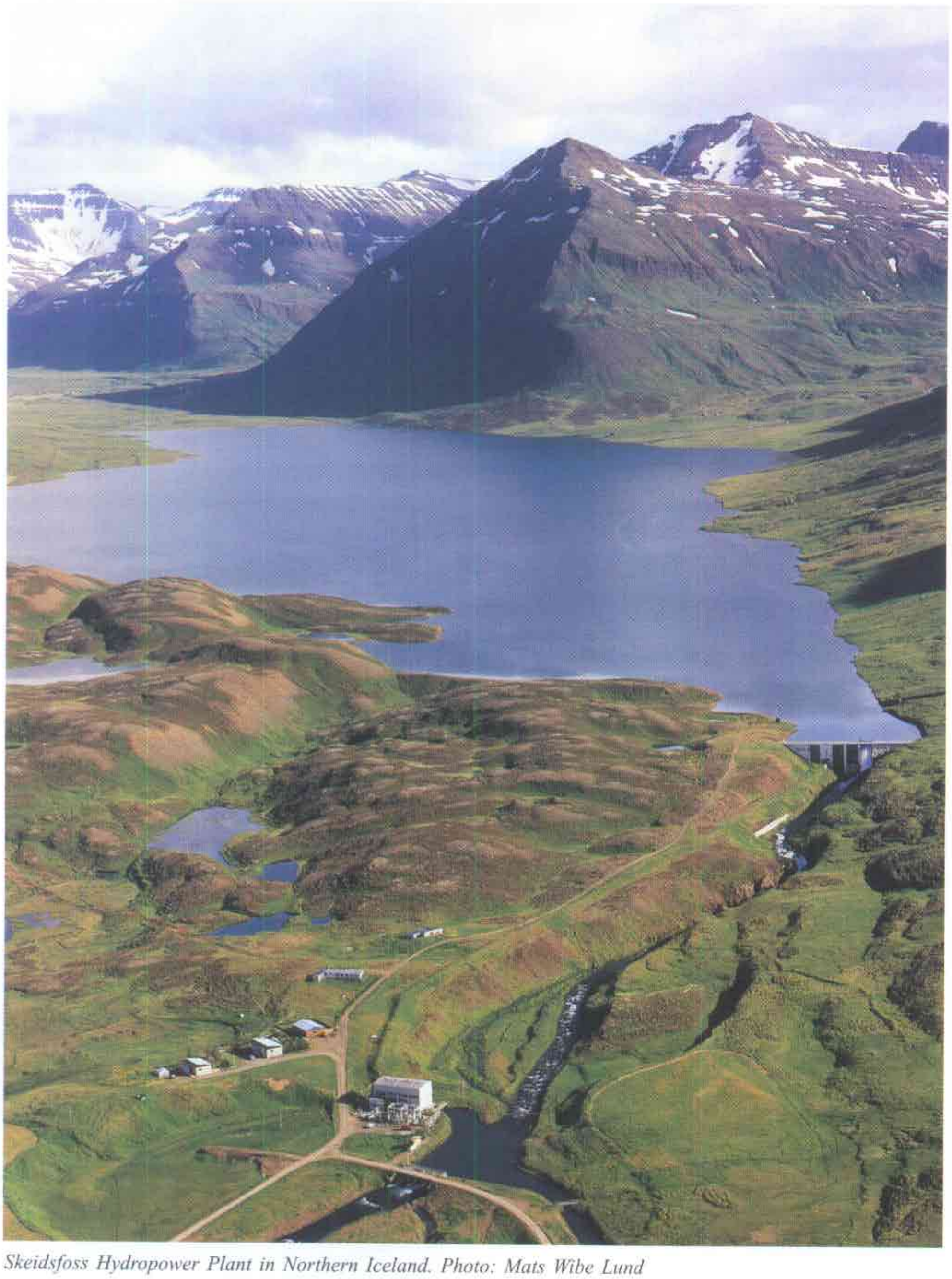
No major additions to the grid were taken into use during the year. The 400 kV line between Koria to Kymi (40 km) was completed and has been in use, initially carrying a voltage of 110 kV. In June, a decision was made to series-compensate both northern links for interconnected operations between Finland and Sweden. On the Petäjäskoski-Letsi line, one capacitor battery will be built in Swedish Isovaara, near the Finnish border; on the Keminmaa-Svartbyn and Keminmaa-Pikkarala lines, two batteries will be built at the Keminmaa station. The series compensation and the Pikkarala-Pyhänselkä line (20 km), as well as the Pyhänselkä transformer station, will increase the transmission capacity to Sweden by about 200 MW and from Sweden by 300-500 MW, depending on the network situation. Before the additions, the capacity for electricity importation from Sweden is 900 MW and for exportation 700 MW.

There were fewer disturbances in the main grid than the average for the last ten years. The amount of unsupplied energy was lower than ever before.

The most serious disturbance occurred on 24 July 1996. Both units of Olkiluoto power plant, in total 1,378 MW, were disconnected from the grid simultaneously, owing to a fault in the network. Design faults correspond to a situation in which the biggest plant unit trips; in Finland this would be one Olkiluoto unit. Transmission within Finland at the time was somewhat below the threshold value, whereas there was fairly little transit from Sweden. Voltage dropped and was at its lowest, 358 kV, in Central Finland; the network situation was critical. Regulation of the voltage and the reactive effect succeeded as planned.

Art and technology combined. "Blue cranes" in Espoo is a cooperation project between IVO Transmission Services and designer Antti Nurmesniemi. Photo: Esa Kurkikangas





Skeidsfoss Hydropower Plant in Northern Iceland. Photo: Mats Wibe Lund

ENERGY POLICY

The most important event in the field of energy policy in Iceland in 1996 was the appointment by the Minister for Industry and Energy of an Advisory Committee to advise him on revision of the Energy Act of 1967, which is still in force. The people appointed to the Committee work in the Ministry, the National Energy Authority, municipalities, the energy sector and in industry. The Committee presented its recommendations at the beginning of October. The matter is now under consideration both in the Ministry and in the political arena within the Government coalition. A Bill has not been introduced thus far.

The Committee consulted a number of experts, one of whom played a prominent role in reorganisation of the Norwegian power industry. The Committee's central findings may be summarised as follows:

1. The Committee recommended the introduction of competition in power production and possibly also in the sale of electricity to end users. Competition would be introduced gradually, over a span of several years. As a first step in the introduction of competition, an unbundling of the production and transmission functions in the accounts of the National Power Company (NPC) is recommended as from 1 January 1997. NPC is the largest power producer in Iceland, accounting for 93% of total power production in 1996. On NPC's own initiative, however, separation of these functions in the accounts was scheduled for that date in any case.

2. The Committee recommended that transmission of electricity be entrusted to a monopoly undertaking under government control. Various lines of demarcation between transmission and distribution were discussed in the Committee, but no definite recommendation was reached, since drawing any specific line of demarcation involves political considerations as well as technico-economic factors.

Although the Committee succeeded in arriving at unanimous conclusions, there emerged differences of opinion among its members. Some maintained, for instance, that the present organisation and structure of the Icelandic power industry had proved both efficient and well suited to Icelandic conditions, while others felt that, in spite of this, there was room for improvement in both efficiency and flexibility — improvement which competition might bring about.

Special difficulties facing deregulation of the Icelandic power industry are the small size of the country's power market and NPC's dominant position on this market, i.e. 93% of total production. This setting gives rise to goals that are not easy to accomodate. On the one hand are the economic and organisational advantages that competition might yield; but at the same time it is felt desirable to maintain the strength and credibility of NPC, not the least *vis-à-vis* foreign investors in Iceland's power-intensive industries. Irrespective of its strong position on the Icelandic power market, NPC is a small company by international standards. For both goals to be achievable, competition will have to come mainly from foreign sources investing in power production in Iceland, concurrent with growth of the market brought about by new power-intensive industries.

ENVIRONMENTAL ISSUES

No new laws or new regulations on environmental questions relating to the power industry were enacted or issued in 1996.

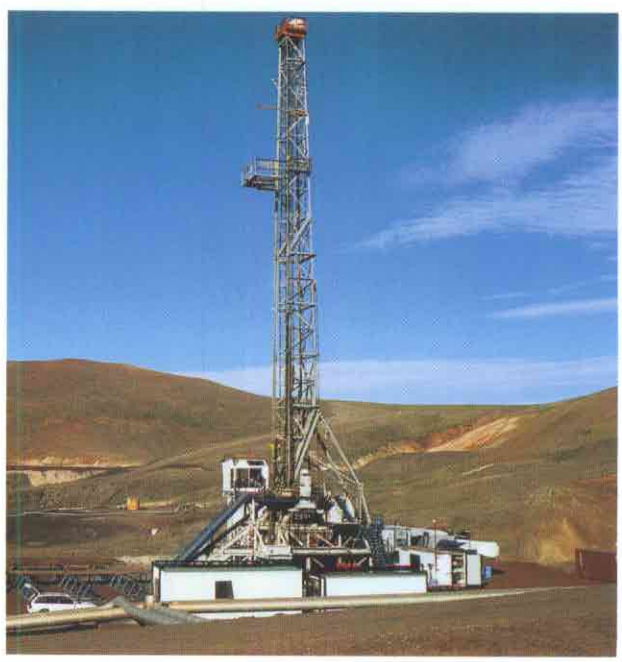
ELECTRICITY CONSUMPTION

The gross consumption of electricity in Iceland in 1996, including transmission and distribution losses and power plants' own consumption, amounted to 5,113 GWh, compared with 4,977 GWh in 1995; this corresponds to an increase of 2.7%. Of the total consumption, firm power accounted for 3,983 GWh and non-guaranteed power for 1,130 GWh.

Power-intensive industries accounted for 50.1% of the total consumption (50.1% also in 1995). General consumption increased by 2.7% without correction for the influence of outdoor temperature. When corrected for the difference in average temperature between the two years, general consumption grew by 4.2%.

In 1994, the last year for which the relevant data are available, electricity accounted for 20.5% of the total energy supply to end users.

A revised forecast of gross electricity consumption in Iceland up to 2020, exclusive of that of new power-intensive industries, was issued by the Energy Forecast Committee in October 1996. The revision shows only minor changes from the previous forecast presented in 1995, the prediction being 7,434 GWh in 2020 instead of 7,488 GWh. Gross consumption in 1996 was 5,113 GWh.



Drilling for steam at Krafla Geothermal Power plant in Northern Iceland. Photo: Hjalti Franzson

ELECTRICITY PRODUCTION

Electricity production in Iceland equals the gross consumption, mentioned above, since electric power is neither imported to nor exported from the country. Of the total production 4,764 GWh, or 93.2%, came from hydropower plants (94.0 in 1995), 346 GWh, or 6.7%. from geothermal plants (5.8% in 1995) and 3 GWh, or 0.1%, from fossil fuel (diesel) plants (0.2% in 1995).

Total installed capacity of public power plants in Iceland at the end of 1996 was 1,051 MW (1,049 MW at the end of 1995).

No major disturbances of the power supply system occurred in 1996.

In 1996 NPC completed extension of the reservoir of the Blanda hydropower plant in Northern Iceland, increasing it from 200 Gl (gigalitres = millions of cubic metres) of useful storage capacity to 400 Gl. NPC also commenced drilling for geothermal steam with a view to increasing the capacity of the Krafla geothermal power plant, also in Northern Iceland, from 30 to 45 MW; a further increase, to 60 MW, is envisaged in a few years. Further, in 1996 NPC began refurbishment of the Búrfell hydropower plant, Southern Iceland. Scheduled to extend over the next few years, the refurbishment project will ultimately increase the plant's capacity from the present 210 MW to 300 MW. Finally, NPC began construction in 1996 of diversion works to divert the uppermost part of Thjórsá River, Southern Iceland, into existing reservoirs, the aim being to increase the energy capability of downstream hydro stations.

Apart from the Blanda storage increase, the Thjórsá diversion and, in part, the Búrfell refurbishment, these capacity additions are pending new power sales negotiations.

NPC received permission in 1996 from the Minister for Environment to construct the Hágöngur storage reservoir and the 125 MW Sultartangi hydropower plant, both in Southern Iceland. Conversely, the Company's application for permission to construct a 40 MW geothermal plant at Bjarnarflag, near Lake Mývatn, Northern Iceland, was rejected by the National Physical Planning Agency. A revised application is being compiled.

The Reykjavík District Heating Service is now preparing power production of 60 MW at Nesjavellir, 30 km east of Reykjavík, entailing modification of its existing geothermal heat plant there into a CHP (combined heat and power) plant.

POWER PRICES AND TAXES

The wholesale price of electricity supplied by the National Power Company (NPC) to distribution utilities rose by 3% on 1 April 1996. The retail prices of the principal utilities, however, remained unchanged throughout 1996.

The market price of primary aluminium fell during 1996 and with it NPC's contract price for power supplied to the Icelandic Aluminium Company. The contract price amounted to USD 0.016/kWh in the first quarter of 1996 and USD 0.0145/kWh in the fourth quarter, or SEK 0.110/kWh and SEK 0.100/kWh, respectively, according to the exchange rate prevailing on 31 December 1996.

Inside Hrauneyjafoss Hydropower Plant, Southern Iceland. Photo: Sigurdour Stefán Jónsson

No changes in power taxes were made in 1996. The only tax now levied is VAT, which generally stands at 24.5% but is 14% on electricity used for space heating in apartments.

TRANSMISSION SYSTEM

No additions to the transmission system were made in 1996. A new transmission line between Búrfell and the Reykjavík area is being planned by NPC. It will be designed for 400 kV but operated initially at 220 kV.

MISCELLANEOUS

Extension of Power-intensive Industries

Extension of the capacity of the smelter of the Icelandic Aluminium Company at Straumsvík, a short distance south of Reykjavík, from 100,000 to 162,000 tonnes per year is proceeding on schedule and is expected to become operational in the autumn of 1997. This extension will absorb the present surplus capacity of the power system plus minor additions now under construction by NPC.

Negotiations held with the American Columbia Ventures Corporation, on construction of an aluminium smelter with an annual capacity of 60,000 tonnes in Grundartangi, on the west coast of Iceland a short distance north of Reykjavík, have now reached an advanced stage. Final decisions are expected in the first quarter of 1997. Construction of the smelter will necessitate additional power production facilities.

Icelandic Alloys Ltd is planning a 50% extension of the present capacity of 75,000 tonnes per annum at the company's ferrosilicon plant, located in Grundartangi. Final decisions are expected soon.

Power Export

The ICENET study group, made up of representatives from two Dutch power companies, a Dutch cable factory and the Municipality of Reykjavík and charged with investigating the feasibility of exporting power from Iceland to The Netherlands, presented its findings to representatives of its sponsors at a meeting that was held in Arnhem, The Netherlands, in the autumn of 1996. Among a number of alternatives studied, the group considers the following one to be the most promising, and it was decided at the meeting that further studies would concentrate on it.

This most promising alternative encompasses a 1,170 km long HVDC cable from Reydarfjördur on the east coast of Iceland to Peterhead in Scotland, rated 400 kV and 600 MW, plus two 250 km long HVDC cables, also rated 400 kV and 600 MW each, from Grain, south of the Thames estuary to Maasvlekte on the west coast of The Netherlands. Initially, the two last cables would be laid to transmit 300 MW of Scotch hydropower and 900 MW of thermally generated power in England, followed some years later by the cable from Iceland, which then would replace 600 MW of the thermal power with the same amount of hydropower originating in Iceland. Transmission of Scotch and Icelandic hydro-generated power to Grain would take place over the British National Grid.

The Icelandic Minister for Industry and Energy visited Hamburg in the autumn of 1996 to discuss power export possibilities with the Hamburg Senator for Energy and the Hamburgische Elektricitäts-Werke (HEW). It was decided to continue the present cooperation on pre-feasibility studies of such power transfers, and to establish a working group for the purpose. Other interested partners will be invited to participate in the working group.

Break-down of the 132 kV ring around Iceland caused by flood from a sub-glacial volcanic eruption, Southern Iceland.
Photo: Landsvirkjun

Power lines through Nordmarka. Photo: Bård Løken

ENERGY POLICY

In February 1996, a company called Naturkraft AS filed an application with the Norwegian Water Resources and Energy Administration (NVE) for permits to build and operate two gas-fired power plants, one in Kårstø and the other in Kollsnes and having a joint output of 700 MW. In April 1996, the Government presented a report on gas-fired power plants in Norway (White Paper no. 38 1995-96) to the Norwegian Parliament (the Storting). The report deals with the social impacts of building gas-fired power plants in Norway and the granting of permits for the two above-mentioned power plants.

In the Government's view, gas-fired power plants should meet the same requirements as any other industrial operations. The objective of these requirements is to ensure that the power plants can be operated profitably. The power from the gas-fired plants should thus be sold on normal business terms on the Nordic market. According to the plans, the power plants will be taken into use in 1999 and 2000.

In June 1996, the Storting approved the Government's proposal regarding the permits for the two gas-fired power plants. In the autumn of 1996, NVE made a decision on the building of these two power plants in accordance with Naturkraft's application. An appeal against the decision has, however, been lodged with the Ministry of Oil and Energy; the final decision on the matter is therefore expected during 1997.

In December 1995, the Government presented a proposal on revision of energy taxation. This proposal gave rise to extensive discussions within the energy sector and between the municipalities, counties and the State as to the effects of the proposed reform.

The Storting debated the Government's proposal in 1996 and made some changes to it. The energy tax now consists of the following elements:

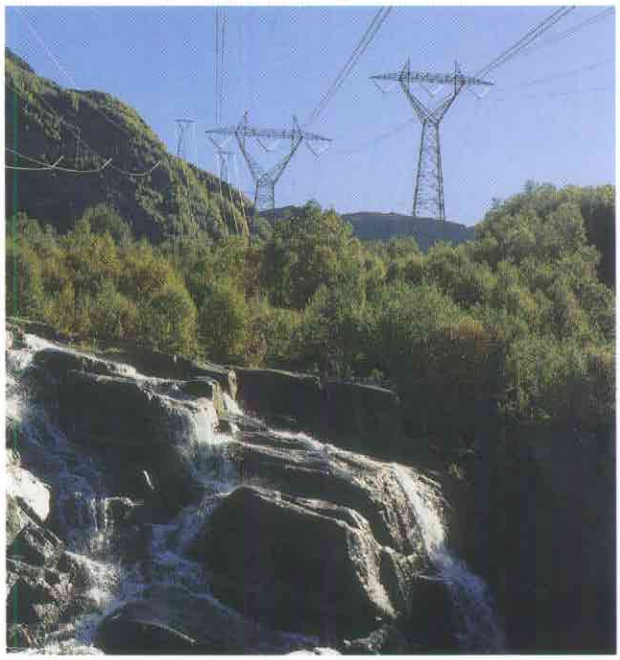
- Profit tax of 28%, paid by all companies. Some special provision are involved; e.g. straight-line depreciation on power plants.
- Base rate tax on the generation of hydropower; this amounts to 27% of the profit exceeding normal profit.
- Natural resource tax on the generation of hydropower, calculated on the basis of the amount of power actually generated during the past seven years. The natural resource tax can be deducted directly from the profit tax to the State.
- Property tax, calculated according to revised guidelines.

The generation tax will be abolished after 1997; in practice it will be replaced by the natural resource tax. The changes made will be applied starting from the financial year of 1997. Elements that are directly related to hydropower as a natural resource will not be applied to gas-fired power plants, which basically will be taxed as any other business operation. In the present system, gas-fired power plants in Norway are not subject to the CO_2 tax.

NVE has introduced a new model for regulating the monopoly of power companies in the central, regional and distribution grids. The purpose of the regulation measures is twofold: to motivate the grid owners to make permanent cost reductions by improving the efficiency of grid operations; and to introduce cooperation, mergers and acquisitions between grid owners.

As opposed to the cost-oriented regulation that is usually applied, various incentives are the key factors applied by NVE when defining the central preconditions for individual grid owners' profits, so that profits become dependent on efficient network operation. The regulation aims to improve the efficiency of network operation by 2% per annum. The decision of NVE became effective on 1 January 1997.

The Government has decided to conduct an energy study, which will outline the perspectives for the development of the Norwegian energy situation to the year 2020. The details of the study should be ready in 1997.



Aurlandsdalen. Photo: Helge Sunde

ENVIRONMENTAL ASPECTS

The Committee known as the green tax committee issued a report called "Grønne skatter - en politikk for bedre miljø og høy sysselsetting" (Green Taxes - A Policy for a Better Environment and High Employment) (NOU-96/9). The Committee proposes that the CO_2 tax be extended to include the domestic utilisation of natural gas. Up to now, the CO_2 tax has only been applied to the utilisation of natural gas on the Continental shelf and to the domestic use of oil products. The proposed level of the CO_2 tax is NOK 0.115 per Sm^3. The Storting is expected to deal with the proposal in the autumn of 1997.

ELECTRICITY CONSUMPTION

The total gross consumption in Norway was 113.9 TWh in 1996, representing a decrease of 3.1 TWh from the previous year.

The gross consumption in general distribution amounted to 80.5 TWh in 1996, which meant an increase of 2.5% on 1995. Adjusted for normal temperature conditions, the calculated general consumption was 79.2 TWh, an increase of only 0.3% on the previous year.

Consumption in energy-intensive industries totalled 28.5 TWh, a decrease of 0.1 TWh from 1995.

The total consumption of power for electric boilers and pumped storage power amounted to 3.6 TWh, which is 53% less than in 1995.

The consumption of light heating products (light fuel oils and paraffin) totalled 1,191 million litres. This represents an increase of 27.1% on the previous year. The consumption of heavy fuel oils amounted to 510 million litres, an increase of 48.3%.

Electricity consumption accounted for 48.3% of the energy content in energy carriers supplied to end users (net final consumption). This represents a decrease of 1.6 percentage points from 1995. Petroleum products accounted for 38.2% and solid fuels 13.0% of this, with district heating accounting for about 0.5%.

The peak load related to domestic consumption, including electric boilers and pumped storage, was recorded on 3 January 1996, when it reached 21,247 MW. This represents an increase of 1,756 MW on 1995, and is the highest consumption ever registered in Norway. At the peak-load hour, exports amounted to 534 MW.

ELECTRICITY PRODUCTION

The figure recorded for hydropower generation in 1996 was 104.1 TWh. With the addition of 0.8 TWh in thermal power, total generation amounted to 104.9 TWh. This is 18.0 TWh or 15.0% lower than the output figure of the previous year. The interchange of power with other countries resulted in net imports of 9.1 TWh. This represents a change from 1995, when net exports came to 6.5 TWh.

New generating capacity in 1996 totalled 74.3 MW, with an average annual output of 348.3 GWh. The additional capacity was provided by a total of 16 sources, mostly small-scale power plants. In 1996, Statoil took into operation a smaller thermal power plant in Tjeldbergodden. The capacity of the power plant is 28 MW, and the average annual output 200 GWh. The plant is an integral part of a methanol plant.

NVE estimated the average yearly output in the Norwegian hydropower system on 1 January 1997 as 112.7 TWh, based on data for the period 1931 to 1990. In addition, Norway has thermal power plants with an average annual output of 0.8 TWh. The total power output in Norway in 1996 was 8% lower than the calculated average annual figure. The installed capacity at hydropower plants on 31 December 1996 totalled 27,350 MW.

ELECTRICITY PRICES

NVE estimated the weighted average price for electricity paid by households on 1 January 1996 as NOK 0.277 per kWh, including electricity tax and VAT. The price on 1 January 1997 was calculated as NOK 0.364 per kWh, which means an increase of 31.6% during 1996. The average transmission price, excluding taxes, on 1 January 1996 was calculated as NOK 0.171 per kWh, the corresponding figure for 1 January 1997 being NOK 0.179 per kWh. The increase in transmission prices during 1996 was 4.7%.

An electricity tax is levied on consumption. Manufacturing industries, mining, greenhouses and electric boilers have been exempt from this tax since 1995. Consumers in the counties of Nord-Troms and Finnmark are also exempt from the electricity tax. In 1996, the tax amounted to NOK 0.0530

The power line over Sandviksfjellet in Bergen. Photo: Helge Sunde

per kWh; it rose to NOK 0.0562 per kWh in 1997. A generating tax is levied on all electricity generated. In 1996, this tax stood at NOK 0.0155 per kWh, the corresponding figure for 1997 being NOK 0.0139 per kWh. The tax base is 1/15 of the total output generated during the past 15 years. As with other goods and services liable to VAT, electricity was subject to a value-added tax of 23% in 1996, and this rate remains unchanged in 1997. The three northernmost counties are exempt from VAT.

The power situation in Norway in 1996 was characterised by the reduced availability of hydropower, an outcome of the low snow reservoir in the winter of 1995/96 and the scarce rainfall during the first half of the year. The reservoir situation on 10 June 1996 was 27.9 TWh, i.e. 35.7% of the total reservoir capacity. The heavier rains than usually in September and October improved the situation considerably, and the high imports and low consumption also contributed to the improvement. On 30 December 1996, the reservoir level was 41.8 TWh (53.5%), which is 22.6 percentage points lower than the average reservoir level during the period 1982 to 1991.

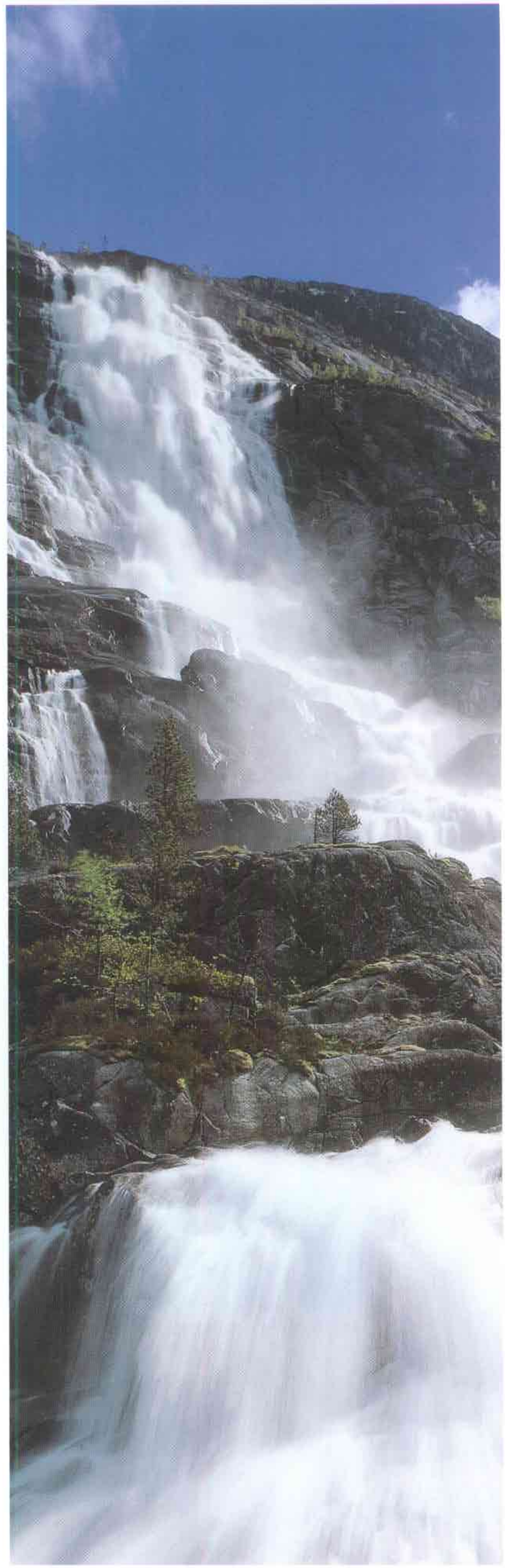
MAIN GRID

The year 1996 as a whole was rather uneventful with regard to the operation of the main grid. During the year, there were no considerable disturbances in operation concerning the Nordic joint use of the main grid.

Statnett and Svenska Kraftnät in Sweden have cooperated in order to increase the transmission capacity of the existing grid. During the year, the transmission limit for power imports to Norway was increased from 1,500 to 1,650 MW for the Sweden-Hasle/Halden interconnection.

Plans for further expansion of the main grid are closely related to the three cable links decided upon between Norway and Germany and The Netherlands, and the planned gas-fired power plants in Norway. Statnett has applied for a permit from NVE for the construction of a new 420 kV line between Kristiansand and the Evje region, which would later be expanded to Holen in Bykle in order to increase the north-south transmission capacity in Southern Norway. Statnett SF and the cable companies Viking Cable AS and EuroKabel AS have also applied for permits regarding the necessary direct current facilities in Norway. Additional permit applications regarding the necessary domestic grid expansions are expected during 1997.

In 1996, Statnett and Norsk Hydro introduced cooperation in order to investigate the possibilities of connecting England and Norway with a cable for the transmission of power. The companies wish to start a project the aim of which is to have such a cable in operation after the year 2000. If the cable is built, it will be the longest cable connection between Norway and any another country so far.



Langfoss. Etne, Hordaland. Photo: Bard Løken

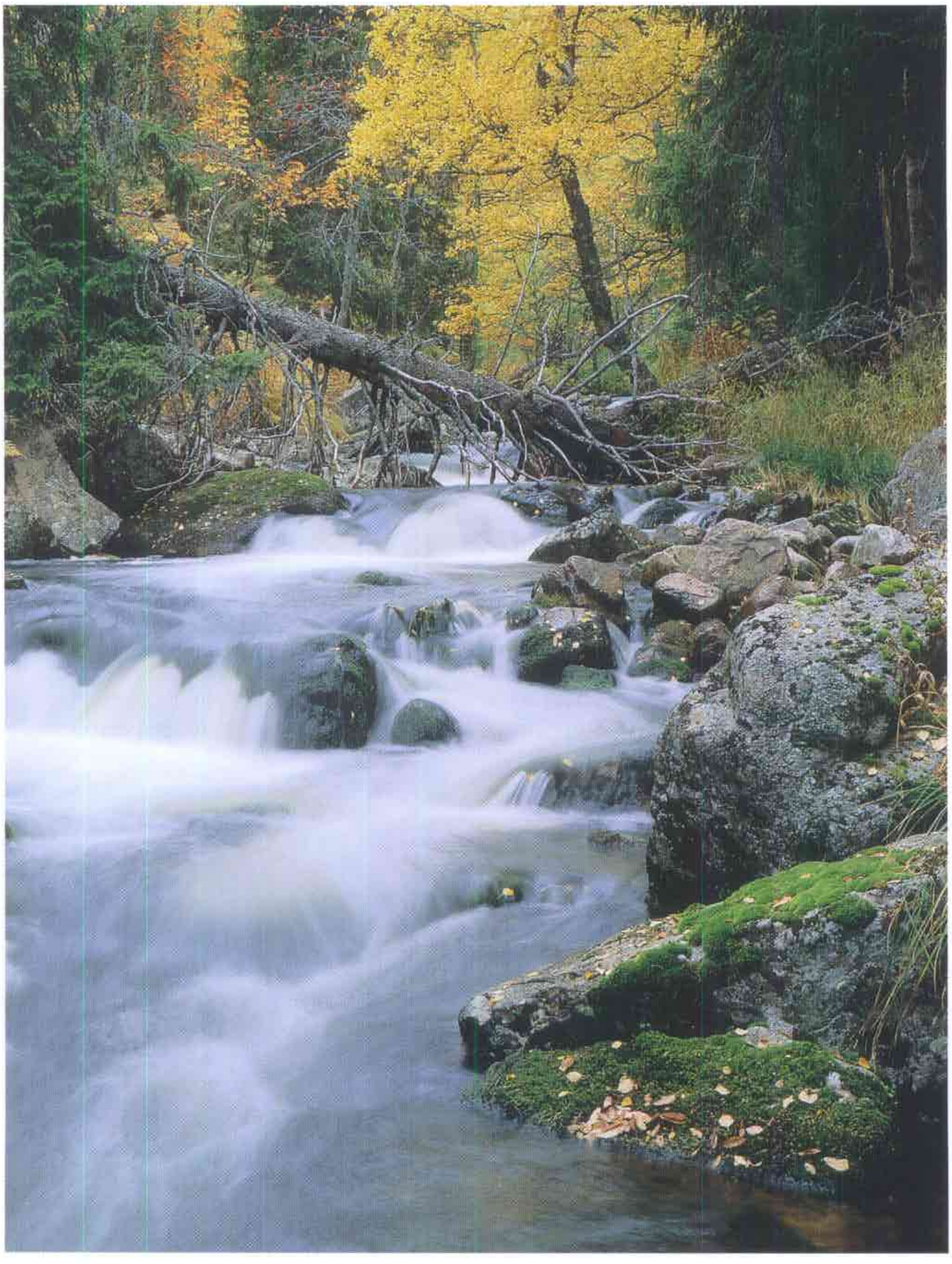


Photo: Torbjörn Arvidson

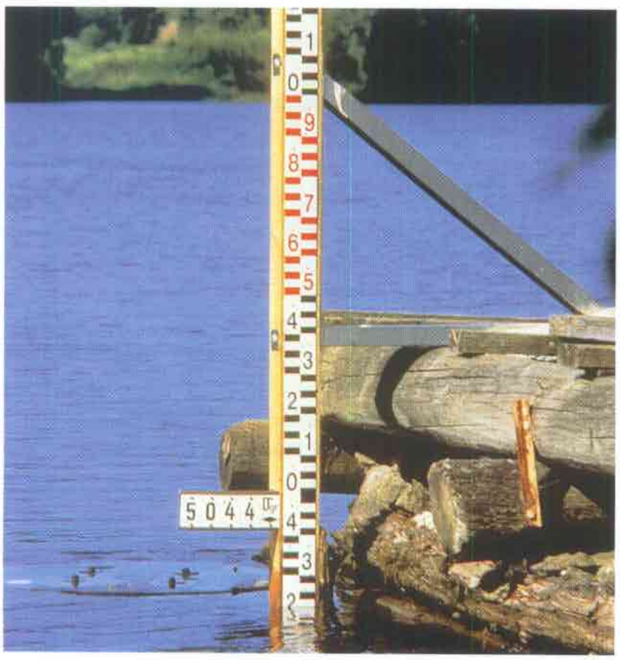
ENERGY POLICY

The reform of the Swedish electricity market came into effect at the turn of the year, enabling all clients to benefit from the competition on the open market. The reform has been followed by discussion on how to strengthen the position of small-scale consumers of electricity so as to make it possible for them, too, to take advantage of the new market situation. Many have considered that the metering devices needed for the hourly registration of small-scale consumers' electricity consumption are too expensive. At the request of the Government, the Grid Authority and Svenska Kraftnät studied the question and proposed rules for metering based on type load curves; these rules would be applied to consumers whose electrical systems have at most 25 A fuses. On 14 March 1997, the Government submitted its own proposal in the issue to Parliament. However, Parliament decided not to adopt the principle of metering based on type load curves. Instead, it was proposed that a ceiling should be set for the price of the metering device, including installation. This maximum price would be SEK 2,500 per client.

The committee that had been appointed to study the possibilities of shifting the emphasis of taxation from taxation of work to environment and energy taxes did not publish its report by the end of the year, as had originally been planned. However, before Christmas the majority of the committee members presented their general conclusions that such a shift should be possible. A shift of approximately SEK 25,000 million within a period of 15 years was mentioned.

The principal energy policy issues during the year were nuclear power and preparation of the long-term energy policy. All political parties represented in Parliament have conducted negotiations, led by Energy Minister Anders Sundström, in order to find a solution that can gain support from a broad majority in Parliament. Several parties left the negotiations in late autumn, and at the turn of the year the negotiation group consisted of the Social Democrats, the Centre Party, the Christian Democrats and the Left. An agreement was reached on 2 February 1997 between the Social Democrats, the Centre Party and the Left. On the basis of this agreement, the Government drew up its proposal on energy policy, which was presented on 14 March 1997.

Owing to the dry summer, the level of water reservoirs fell.
Photo: Gunnar Almberg



One of the decisions made in the proposal is that the decommissioning of the Swedish nuclear power plants will commence on 1 July 1998 by closing down one unit in Barsebäck. This decision is based on a Bill, which — if adopted by Parliament — will grant the Government the right to close down nuclear power plants. The Government, without delay, shall launch negotiations with Sydkraft on how to replace the production capacity in Barsebäck with other electricity generation. If it is shown that sufficient supply can be ensured, e.g. by economising on electricity use and by converting from electric heating to other forms of heating, the second unit in Barsebäck will also be closed down by 1 July 2001. Thereafter, the energy policy programmes on conservation and supply — which are now being proposed — will be assessed before any further decisions are made on decommissioning. The proposal does not name any point in time when the last reactor would be shut down.

ELECTRICITY CONSUMPTION

Electricity consumption in 1996 amounted to 142.1 TWh, which is 0.5 TWh more than in the previous year. Transmission losses accounted for 9.7 TWh of the total.

Weather conditions during the past year were slightly under the normal in terms of temperature. Adjusted for temperature, electricity consumption is thus corrected by -1.6 TWh, to 140.5 TWh.

The machine room in Harsprånget, by the Lule river. This power plant has the highest capacity in Sweden (max. power 940 MW).
Photo: Hans Blomberg

Use of electricity by industry remained on the same level as in 1995. Total consumption of electricity by industry came to 51.8 TWh. The food and timber processing industries used 2.4 and 2.0 TWh of electricity, respectively.

The pulp and paper industry, which is the most intensive industrial user of electricity in Sweden, increased its consumption by 0.6 TWh, to 19.7 TWh. Consumption by the rail and tramway sector was 2.5 TWh, or the same as the year before.

Consumption of electricity in the sector of housing, services, heating plants, etc. came to 78.2 TWh, or 5.6 TWh more than in the previous year. The principal reason for the increase is higher consumption during the first half of the year, which was considerably colder than the year before.

The interchange of power with neighbouring countries rose markedly during 1996. Sweden exported 9.8 TWh and imported 15.9 TWh, which gives a surplus of imports over exports amounting to 6.1 TWh.

The peak figure for hourly electricity consumption during the year was 26.3 GWh/h, which was recorded on 7 February, between 8 and 9 a.m. This is a new all-time high for electricity consumption. The old record, 26.2 GWh/h, was registered on 12 January 1987.

ELECTRICITY SUPPLY

Electricity output totalled 136.0 TWh, or 7.3 TWh less than in the previous year.

Hydropower plants generated 50.9 TWh, or 10.7 TWh less than the mean annual output and 16.1 TWh less than in 1995. Availability of water was considerably poorer than in the previous year, especially in late summer and in autumn. Reservoirs were 52.5% full at the end of the year, equivalent to an energy value of 17.6 TWh.

Barsebäck Kraft and Oskarsham Power Plant together accounted for 16.5 TWh. Photo: Pierre Mens (top), OKG AB (bottom)

Electricity generated by the nuclear power plants in 1996 came to 71.4 TWh, or 4.4 TWh more than the year before. Considering how restricted the availability of water was in 1996, the high output generated by the nuclear power plants was very valuable for the Swedish electricity supply.

The Oskarshamn I nuclear reactor was shut down for part of the year because of measures taken to prevent certain crack formation. Otherwise, there were few unplanned outages.

The energy availability rate was 84.1%, which can be compared to the world average of 76.3% for light-water reactors during the three-year period of 1993-1995 (the latest total figures available for the world — reactors in the former Soviet Union are not included in the weighted world figure). Of the Swedish reactors, Forsmark 1 achieved the highest availability rate at 94.8%, followed closely by Ringhals 3 at 92.8% and Forsmark 2 at 91.4%.

Back-pressure generation amounted to 13.5 TWh, or 3.9 TWh more than in 1995. Output from condensing power plants, gas turbines, etc. stood at 3.6 TWh, or as much as 3.1 TWh higher than the year before.

ENVIRONMENTAL ISSUES

The Swedish electricity generation system centres on hydropower and nuclear power. This means that the emissions of harmful substances from the Swedish electricity generation are very low in international comparison. The pivotal and difficult question that arises from the world's overall use of energy is the issue of greenhouse gases, which, among other things, is associated with the carbon dioxide emissions of electricity generation plants.

A new climate conference was held in Geneva in July 1996. At the conference, the signatories of the UN Climate Convention of Rio in 1992 undertook to reach an agreement on legally binding goals for achieving a considerable reduction in the emissions of greenhouse gases. The reductions in emissions are to be specified for the years 2005, 2010 and 2020.

The negotiations will continue until the meeting in Kyoto in December 1997, by which time industrial countries are expected to have made binding commitments for the reduction of greenhouse gas emissions. This also concerns Sweden, which in international negotiations acts through the EU. Together with the other EU Member States, Sweden must determine how much it is possible to cut carbon dioxide emissions. These commitments may gain major importance for the formulation of Sweden's future energy systems.

MAIN GRID AND INTERNATIONAL LINKS

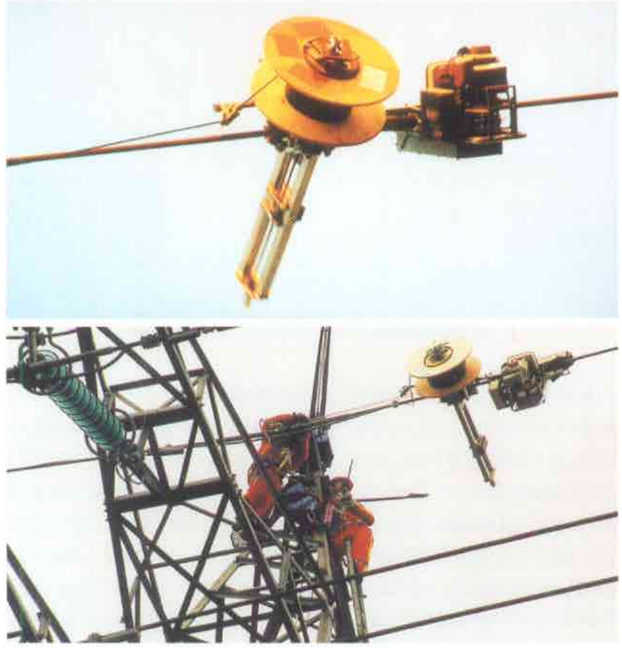
A new system transformation station of 400/220 kV was built in Betåsen to replace the system transformation that used to be in Lasele. The voltage of the line between Lasele and Betåsen was reduced to 220 kV. The new system transformation station was commissioned on 28 April.

The 220 kV switching station in Danderyd was supplemented with a B bus. A new 400 kV 150 Mvar reactor was installed in Lindbacka and commissioned on 14 June. A new 400 kV line was built on the west coast, between Breared and Söderåsen. The line is 87 km long and in some places it was linked with the existing lines. The Breared and Söderåsen stations were rebuilt in order to accommodate the new line. The line was commissioned on 19 December.

The lines between Vittersjö and Hamra, Söderala and Untra, and Hallsberg and Stenkullen have been upgraded. Optical-fibre links have been installed along existing lines between Stockholm and Malmö, a total of 740 km.

ELECTRICITY PRICES

Now that Sweden has deregulated the electricity market, the price of electricity has become an issue for negotiation between the buyer and the supplier, at least as concerns supplies to major clients.



In cooperation with the communications company Tele2, Svenska Kraftnät is building an optical fibre network, first between the major cities of Stockholm, Göteborg and Malmö. Photo: Eri Focas

At the beginning of October, the Grid Authority published an evaluation of the outcome of the electricity market reform. It was found that the costs for household clients had increased by a total of 5.1 to 8.1%. In its report, the Grid Authority comments on this by saying that "price increases depend mainly on changes in taxation". The total cost payable by the client for electricity, i.e. energy cost + grid cost + tax, is on average SEK 0.974 per kWh for people living in blocks of flats, while the corresponding cost in a detached house heated by electricity is SEK 0.674 per kWh. Much of the difference can be explained by the fact that the fixed portion of the grid cost per kWh of electricity supplied becomes higher for a household whose consumption of electricity is low. On average, the grid cost per kWh comes to SEK 0.409 for people living in blocks of flats as opposed to SEK 0.198 for clients who live in detached houses heated by electricity.

In 1996, the Swedish Parliament decided to raise the energy tax on electricity as of 1 September 1996 to two different levels, SEK 0.113 or SEK 0.058 per kWh. The lower tax is payable in some areas of Norrland, while the higher tax is levied elsewhere in the country. During the year, Parliament also raised the production tax on electricity generated at nuclear power plants to SEK 0.022 per kWh. Likewise, the tax on hydropower production was raised according to a differentiated scale, depending on the age of the power plant. At its highest, the tax stood at SEK 0.05 per kWh after 1 September 1996. As of 1 January 1997, this tax was replaced by a tax on premises.

In 1996, Sydkraft commissioned 12 wind power plants on Gipsön island, off Landskrona. Each plant has a power rating of 600 kW. Photo: Perry Nordeng

A MARKET IN TRANSITION

A long tradition of Nordic cooperation

In the power sector, cooperation between the Nordic countries goes back a long time. Nordel was established in 1963 as a cooperation forum for the big, mostly State-owned power companies that were responsible for electricity supply in their respective areas. Among its activities, the organisation drew up design criteria for high-voltage networks and prepared rules for operating the joint Nordic power system, which formed the basis for comprehensive trade in power. Exchange of electricity was carried out by the companies responsible for maintaining the balance in each country's power system, enabling optimisation of operation on the Nordic level. Variable costs were minimised and major advantages were achieved in the fields of economy, environment and system security.

The European perspective

The issue of a more open power market in Europe became topical in the late 1980s. The objective was to improve efficiency in the power sector, for instance, by increasing power trading on the European internal market. The 'Transit Directive', which stipulated a certain transmission obligation between the owners of the main grid systems in the EU Member States, became effective in 1992 at the same time as requirements were made for transparent pricing for major consumers.

The first proposal for the IEM (Internal Energy Market) Directive was presented in 1992. After a number of changes, the Directive was approved in December 1996 and came into force at the beginning of 1997. The IEM Directive opens up the market for all end users whose need for power exceeds 100 GWh, as well as for some other customers who are chosen by the Member States according to certain criteria. In the first phase, from 1999 onwards, this will subject some 20-30% of the end-user market to competition within the EU and within each individual country. The criteria will be tightened later so that the percentage will rise. The Member States have the option of deregulating the market more at a faster pace and to a greater extent.

Rapid development in the Nordic countries in the '90s

From the Nordic perspective, liberalisation of the electricity sector within the EU has progressed slowly. Deregulation of the power market has been considerably more rapid in the Nordic countries. In the early '90s, the individual Nordic countries discussed reorganisation of their national electricity supply, and the Nordic Council of Ministers recommended the establishment of a deregulated Nordic market. In 1991, Norway passed a new Energy Act, which required power companies to divide their operations between a grid sector and a production sector. More or less corresponding electricity legislation was drafted in Sweden and Finland a few years later. Transmission fees between Norway and Sweden were abolished at the beginning of 1996, and a joint electricity exchange — Nord Pool ASA — began operations in this market area. With respect to legislation, Denmark has opted for a concept that follows the outlines drawn up within the European Union. Apart from that, measures have been taken in the electricity sector to promote more rapid development. In Iceland, a committee made up of representatives of the authorities and various interest groups has issued its report on revision of the Energy Act. The ideas presented in the report follow roughly the same lines as elsewhere in the Nordic countries, and the report is now being discussed on the political level.

The starting point in these electricity market laws is that grid operations are conducted as a monopoly and that grid operators are required to transmit power at reasonable costs and on equal terms, whereas electricity generation and electricity sales are subject to competition to a greater extent than before. These two types of operations are separated; for instance, to prevent cross subsidies. The pricing of transmission services in the whole network is based on a 'point tariff system', which means that the choice of supplier does not affect the costs payable by the customer for grid services. This promotes a more liberal power market and gives the customer more opportunities to choose the power supplier on terms determined by the market.

THE SAME DIRECTION WITH ROOM FOR INDIVIDUAL CHARACTERISTICS

Denmark

Electricity supply in Denmark is mainly regulated by the Power Supply Act, but other laws — in particular those on the environment and competition — are also relevant in this respect.

The latest amendment (May 1996) makes provision for the fact that the electricity market in the Nordic countries and within the EU is becoming increasingly open for competition. The law ensures a comprehensive framework for competition, in harmony with the power sector's public obligations. The market in the sector will be opened up gradually, and the public duties included in electricity supply will prevail in the competition situation.

The amendment to the Power Supply Act specifies that electricity distributors whose volume of operations exceeds 100 GWh per year, and end users whose annual consumption of electricity per site is at least 100 GWh, may conclude agreements on direct supply of electricity with Danish or foreign suppliers.

The new Act also contains provisions on transmission enterprises that have the system responsibility. Those with system responsibility are required to maintain secure and efficient electricity supply on the main grid level within an interconnected supply area. In addition, they must complete the tasks set forth in law, irrespective of commercial interests and taking into account the confidential nature of commercial information. As a result of the law, ELSAM's Board of Directors has decided to split the company into two parts: ELSAM System and ELSAM Production.

Prices and conditions will still be reported to the Electricity Price Committee, and the Committee may require that changes be made in prices or in terms of trade.

The agreements on access to the network shall be reasonable and the prices shall also include the costs incurred in meeting the legal obligations concerning supply security, consumer protection and environmentally benign electricity generation.

Under certain conditions, the law also gives priority to electricity generated at combined heat and power plants and at electricity generation plants that use renewable fuels and renewable energy.

The new Act is expected to come into effect after it has been approved by the European Commission during 1997.

Finland

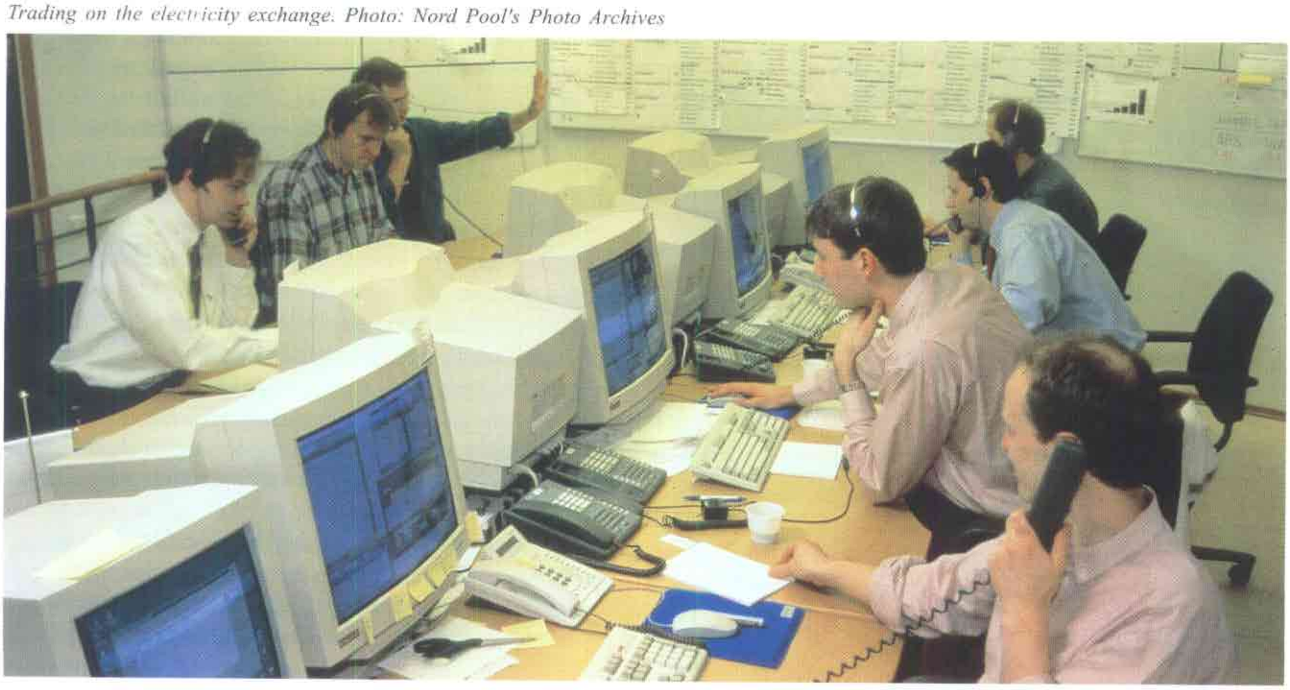
The Finnish electricity market is chiefly regulated by the Electricity Market Act, which came into effect in summer 1995. The network, generation and sales functions must be accounted for separately, but the Act does not require the operations to be placed in separate companies. In the first phase, point tariffs were to be applied in all networks for customers whose consumption exceeded 500 kW. A newly formed official body, the Electricity Market Authority, supervises transmission tariffs to ensure that they comply with the instructions issued. The supplier who has the dominant position in an individual network area also has the obligation to supply power to customers.

The requirement to apply the point tariff encompassed small-scale consumers at the beginning of 1997; in consequence, all consumers can choose their supplier freely. So far, in order to change supplier, it has been necessary to install a meter registering consumption by the hour, but it has been proposed that billing for small-scale consumers could be based on type load curves as of 1998.

The Finnish main grid is owned by several network companies, which have applied a uniform point tariff. Now a new jointly-owned grid company, Finnish Power Grid Ltd, has been established; according to plans, the company will start operations in autumn 1997. The company will control the entire Finnish transmission grid, including the Finnish sections of all connections across borders. Finnish Power Grid is owned by power generators, the State and, at a later stage, probably also by some institutional investors.

The responsibility for frequency regulating reserves and for reserve power during temporary disturbances rests with the network company that has the system responsibility. The network company may agree with producers that the responsibility for these reserves is shifted to the producers. The network company eliminates any bottlenecks that may occur in the Finnish grid; this is done without any direct economic consequences for the customers, i.e. the whole of Finland forms a uniform price area.

Trading on the electricity exchange. Photo: Nord Pool's Photo Archives



A separate company owned by producers and by grid companies, Suomen Voimatase Oy, regulates the short-term and hourly balance and has the responsibility for maintaining the national balance with other countries.

Norway

The most important law governing the Norwegian power market is the Energy Act. The Norwegian Water Resources and Energy Administration is the regulatory authority supervising compliance with most of the provisions in the Energy Act.

According to the Act, it is sufficient if electricity companies give separate accounts of their grid and generation activities. When a transmission installation changes ownership between electricity companies, the regulatory body has in recent times begun to require that companies be split in accordance with the business group model, in order to prevent further vertical integration. Grid operations conducted on a regular basis must be organised in a subsidiary of their own.

The Act promotes opening of the power market so as to encompass, in principle, all electricity customers. It is a general demand that customers who wish to purchase power on the Nordic electricity exchange, Nord Pool ASA, should have their consumption determined on an hourly basis, but small-scale customers linked to the distribution network may also require a simplified metering system based on the network owner's adjusted input profile.

The State-owned grid company Statnett SF is responsible for the Norwegian main grid, both as the grid operator and as the owner of the State-owned transmission installations, which account for about 80% of all transmission installations. Statnett SF also has the system responsibility, which involves the principal responsibility for coordinated operation of the power system. Those with system responsibility use the regulating power system for balance corrections in the Norwegian power system. Regulating power is a price list of the costs incurred in the event of regulation up or down by the body responsible for the system at the time of operation.

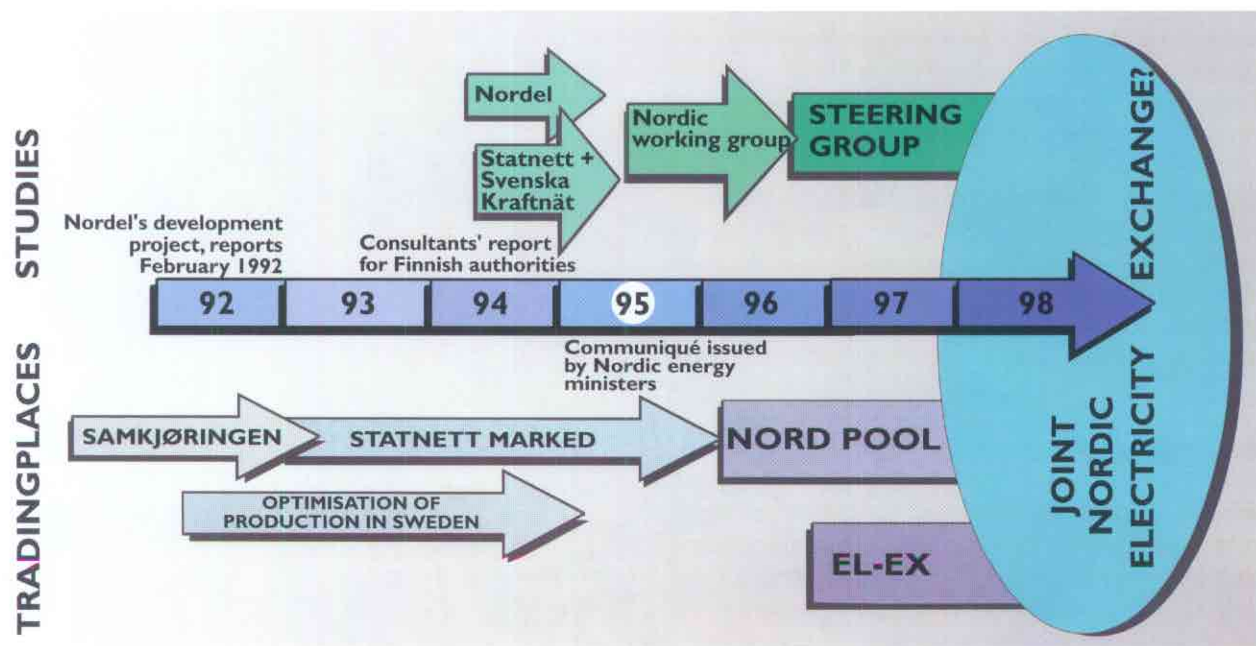
The transmission tariffs have been calculated according to the regulatory authorities' guidelines. The tariff system is based on the principle of point tariffs, with fees set for the various parties' use of the grid system for feeding or taking power. The traditional approach in Norway has been to apply different price areas within the country, to clear up bottlenecks. Recently, the principle of counter-purchases has gradually been used more, especially during internal short-term bottlenecks.

Sweden

New regulations for the Swedish electricity market came into force on 1 January 1996, following amendments to the Electricity Act and introduction of a new law concerning trade in electricity. The most important change was that all power networks on all voltage levels were opened up. All electricity customers were thereby given the opportunity to choose their supplier freely, on the condition that power consumption is measured by the hour. During a transitional period of at least five years, holders of a supply concession for an area must supply electricity to all customers who have not chosen to change their supplier within the area covered by the concession.

Grid operations must be conducted in a unit that is legally and organisationally separated from the generation and sales of electricity, which are subject to competition. Network customers pay a point tariff to the network owner at the connection point and are thereby granted access to the whole grid system.

The publicly-owned utility Svenska Kraftnät has the system responsibility for the Swedish power system. This includes responsibility for the main grid and for connections abroad, as well as for the national short-term power balance (frequency regulation). In addition, Svenska Kraftnät



clears up any bottlenecks in its network through counter-purchases, i.e. upward regulation of generation is purchased in an area where there is a generation deficit and corresponding downward regulation is purchased on the other side of the bottleneck.

A new function — Balance Service — has been established to enable Svenska Kraftnät to acquire regulating power in competition from several producers. Each network owner must, in its own area, measure and report the data that are needed, e.g. for settlement of the balances.

A new grid authority — within NUTEK — regulates and supervises monopoly operations — i.e. network services and concessions — in order to guarantee equality among all parties.

THE NORDIC ELECTRICITY EXCHANGE

Many milestones en route

At the beginning of the 1990s, Nordel found it necessary to study the structures of Nordic power cooperation and to discuss ways of improving these matters. A number of working groups was set up within the framework of a project named Nordel's Development Project. Project reports were presented in February 1992. Nordel's new by-laws from 1993 emphasise the association's role as a non-commercial organisation that works to promote the prerequisites for a well-functioning market. In connection with the discussion on the deregulation of electricity supply in the Nordic countries, the issue of the electricity exchange was reanalysed from several perspectives.

Norway has had a power market organised according to the exchange principle in operation since 1971. Sweden had investigated the possibilities of establishing an electricity exchange. In July 1994, the grid companies Svenska Kraftnät and Statnett signed an agreement in principle for studying the development of a joint electricity exchange that would encompass Sweden and Norway. A working group was appointed to investigate this issue, and the group gave its report in March 1995.

At the initiative of Nordel's extraordinary meeting held on 30 November 1994, a study was conducted on the prerequisites for a joint Nordic electricity exchange that would encompass Denmark, Finland, Norway and Sweden. The report was published in April 1995.

The meeting of Nordel's Executive Board on 28 April 1995 recommended that a joint Nordic working group be appointed to study the unclear questions that still existed in regard to the Nordic exchange. Finland, Sweden, Denmark and Norway each had two representatives in this group, the Nordic Exchange Study Group. The work was completed and a report was issued in August 1996.

At their meeting on 27 June 1995, the Nordic energy ministers issued a communiqué, stressing the importance of further development of Nordic cooperation.

Various trading places in the Nordic countries over the years

Norway was the first Nordic country to organise electricity trading according to the exchange principle, i.e. bids for purchasing and selling power were received, and prices were determined so that a balance between supply and demand was achieved. This market began operations in July 1971, and only the members of "Samkjøringen av krafverkene" in Norway had access to the trading place. In consequence, the market was a market for optimising production.

The first market was very simple in form, and prices were initially determined only for three periods per week: day, night and holiday.

A project was launched in the early '90s to study modernisation of the market. As a result, it was proposed that the price should be determined for one day at a time, at a certain fixed time. In order to clear up balance problems in a way that suited the nature of the market, a system was devised for regulating power that enabled economic agreements for the imbalances that occurred in the operating phase. In addition, a market was established for standardised weekly agreements on physical supply.

Sweden had also established a market for production optimisation. Trading on this market took place by the hour, just before the hour of operation.

At the request of the Swedish Government, Svenska Kraftnät had studied the issue of a Swedish electricity exchange and concluded in its report that the greatest need in Sweden was the need for balance services. Thereafter, Svenska Kraftnät established its balance service in 1995. It was recommended in the report that development of an electricity exchange should be seen in relation to the other Nordic countries, especially Norway. As a result, a joint Norwegian-Swedish electricity exchange was founded.

The electricity exchange established in Norway in 1993 was formed as a joint-stock company under the name of Statnett Marked AS, which was owned 100% by Statnett SF. In 1996, half of the shares of Statnett Marked AS were acquired by Svenska Kraftnät, and the jointly owned company changed its name to Nord Pool ASA. At the same time, fees on exchange trade across the border between Norway and Sweden were abolished and the two countries were integrated as one common trade area. The products that can be traded on Nord Pool are hourly agreements for physical supply on the next day (spot market) or agreements lasting for a week and including a financial deal (financial futures market). The financial agreements can be traded up to three years before the supply date.

The idea of a trading place for electricity had also come up in Finland. Consultants commissioned by the Finnish Ministry of Trade and Industry presented their report at the end of 1994. The report recommended establishment of an electricity exchange in Finland, but certain doubts were expressed concerning liquidity and price stability in a

Finnish national electricity exchange. The report pointed out that a better liquidity on the market and better price stability could be achieved by means of a joint Nordic electricity exchange.

In 1995, the Finnish joint-stock company EL-EX, which was mostly owned by financial institutions, presented plans to establish an electronic transaction exchange in Finland, provided that a sufficient number of parties showed interest and became registered on the exchange. The exchange was opened for trading on 16 August 1996. Like Nord Pool, EL-EX is an alternative to bilateral contract trading and other spot trading in Finland.

The products offered for trading by EL-EX correspond to those of Nord Pool, i.e. hourly and weekly agreements, but all products are traded by means of an electronic system designed for continuous trading. All agreements result in physical supply of electricity.

The Nordic exchange model and other concepts

The principles that have been chosen for electricity trading in the Nordic countries are described in international contexts as the Nordic model. A characteristic feature of this model is that access is granted to an electricity exchange where the players can voluntarily decide whether they wish to trade. Starting from simple purchase and sale bids, the exchange determines prices that create a balance on the market. The prices on the spot market can also be utilised as reference prices for making financial agreements.

The Nordic model thus allows trading by means of both bilateral agreements and trading on the exchange. In consequence, the parties to the Nordic market have great flexibility when choosing the way of trading in electricity.

An exchange model that differs from the Nordic one is the UK model (The Pool in England and Wales). In this model, all physical exchange of power is channelled through the market place. It is mainly the producers who submit bids to The Pool, and these bids contain several components that describe characteristic prices in the production system. Certain costs incurred in the elimination of bottlenecks, extra payments to producers calculated according to the probability of power failure, etc. are added to the prices determined by The Pool. This means that the purchase prices are not set finally until about a month after the supply date. In this way, production is determined centrally, starting from the bids that have been submitted to The Pool.

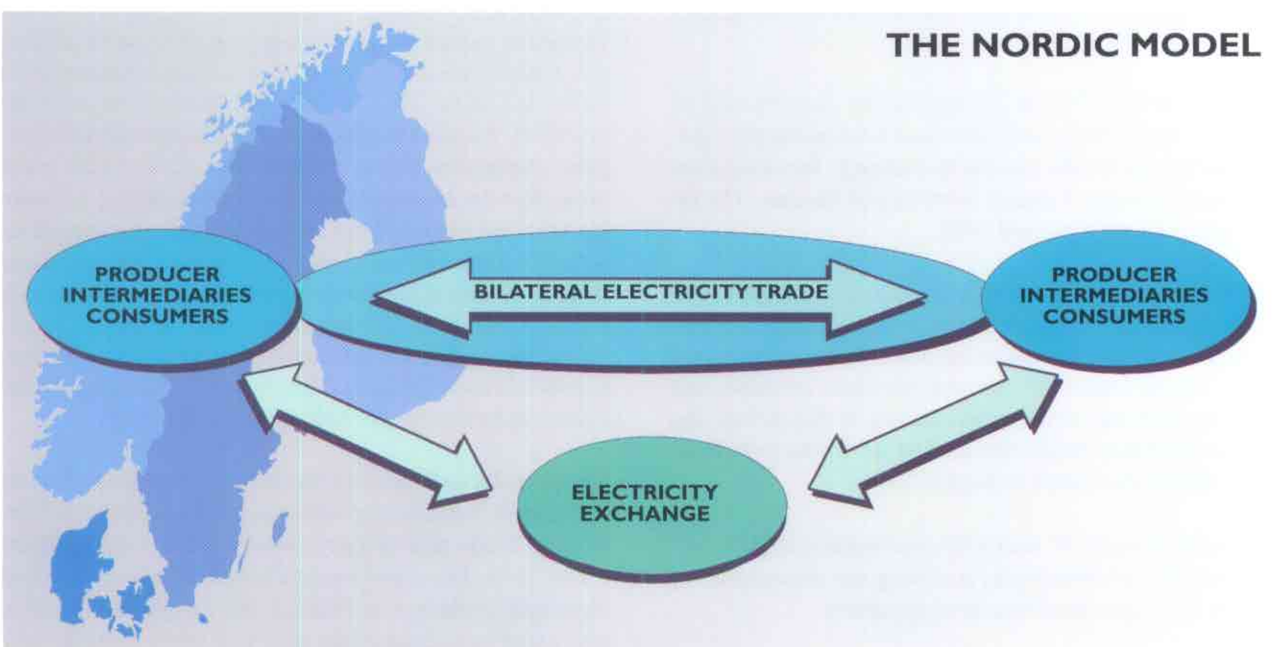
Countries that are considering deregulation of the electricity market in various parts of the world focus their discussion of the principles involved mainly on the two models described above. New Zealand, Australia, Chile, Argentina and the USA participated in the discussion on liberalisation of the power market at an early stage, but in the flexibility of electricity trading, no country has proceeded as far as the Nordic countries have. The different market concepts are being compared in South Africa, The Netherlands and Spain, and the Nordic model is viewed with great interest in these areas.

California has chosen a market model that in principle resembles the Nordic one. The Nordic model is generally considered to be more market-oriented than the UK model.

It has also been noted with great interest that the Nordic countries have established a market-based exchange system without simultaneously privatising the electricity sector. The fact that it is possible to achieve substantial improvement of efficiency using a system that has both privately-owned and State-owned participants has attracted considerable attention, e.g. in Eastern Europe.

Work by the Nordic Exchange Study Group

The Nordic Exchange Study Group commenced its work in summer 1995 by outlining the conditions that apply to electricity supply in the individual countries. The Group dis-



covered some differences that can make it more difficult to create a joint electricity market. In this connection, the Group found it necessary to define certain criteria that should be met before success can be ensured.

The criteria apply to the following areas:

- Frame conditions
  These concern the competition environment and access to trading. The individual countries should have laws that create equal (acceptable) conditions for players in the area covered by the electricity exchange. Parties who wish to trade on the electricity exchange should be given the right to do so. The rules regulating access may not discriminate against individual players or groups of players.

- Access to the network
  This involves access to the AC and DC links in the electricity exchange area and to neighbouring areas. All networks in the area, including AC links between the countries, must be open for all parties. Unused capacity on the DC links must be free for the market to utilise. Parties outside the electricity exchange area are to be offered access within the framework of reciprocity.

- Transmission tariffs
  This concerns the necessary harmonisation of tariffs. The point tariff must be chosen, and there may be no thresholds in the form of fees for power transmission between countries. Differences in tariff systems can be allowed, but harmonisation is desirable.

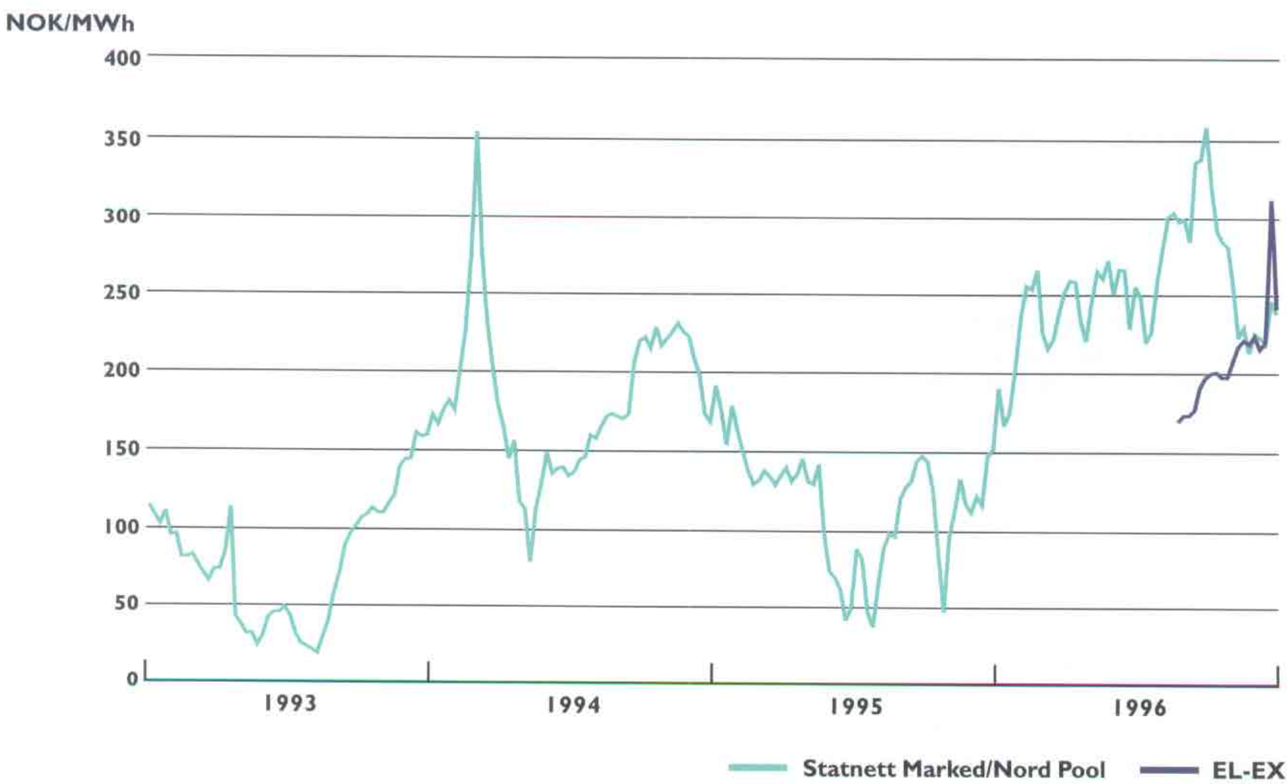
- Handling of bottlenecks
  This concerns the necessity of agreements that regulate the economic circumstances and secure coordinated reinforcement of the network. When bottlenecks appear in the network, power transmission must be changed in relation to the demand on the market. The system managers may take the necessary measures, which in turn lead to redistribution of revenues and costs. Those having the system responsibility must agree on how such situations are to be resolved.

- Settlement of balances
  This refers to the need for balance services on the national level. However, the services must be organised so that they do not discriminate against individual players or so that they do not provide certain groups with advantages over others. Those responsible for balance services in each country must work in close cooperation that involves certain obligations to each other.

- Requirements on the electricity exchange
  This refers to the fact that the national authorities set requirements that must be met, but for the electricity exchange to operate satisfactorily, it is also required that the players in the individual countries contribute to secured liquidity.

- Taxes and fees
  Different national taxes and fees may have a distorting effect on competition and they may become a hindrance for a joint exchange concept.

SPOT PRICES ON THE ELECTRICITY EXCHANGES
STATNETT MARKED /NORD POOL AND EL-EX



In its report of August 1996, the Nordic Exchange Study Group concludes that an open Nordic electricity market and a joint electricity exchange involve major advantages. The Group recommends that work to even out differences between countries be continued and that a steering group be appointed for ensuring continued development.

The Nordic Exchange Study Group has worked out the above criteria in view of the goal that an electricity exchange will be established during 1997. The exchange will encompass Norway, Sweden, Denmark and Finland. The Nordic Exchange Study Group recommends that, for practical reasons, the exchange should initially be based on today's concept, with Nord Pool as the trading place.

The Nordic Exchange Study Group's report was distributed to the authorities, Nordel, the electricity sector and to other interest groups. At its 1996 Annual Meeting, Nordel discussed the report and supported the recommendations.

The steering group has now been appointed; it comprises two members from each country and one representative from Nord Pool. Among other things, this group will ensure that the viewpoints of all countries are taken into account when proceeding with the development.

Development will continue

Running an effective electricity market requires that the system operation, including settlement of balances and maintenance of reserves, is managed in the proper way. Those responsible for the system must go through these problems and they must make the necessary bilateral agreements in this area. A Norwegian-Swedish working group has been appointed to study the possibilities of closer cooperation between Norway and Sweden in balance maintenance. The solutions proposed also need to be evaluated in relation to Denmark and Finland.

Once the conditions for balance maintenance have been described, the intention is to develop trading on the exchange, enabling it in the best possible way to meet the needs of the participants in the countries concerned.

On 1 September 1996, it became possible to utilise free capacity on the AC links between Finland and Sweden for transmission of power that was exchanged over Nord Pool, or for short-term hourly reservation for other power trading. This meant that new Finnish participants joined Nord Pool. The new network Finnish Power Grid Ltd will start operations in Finland in autumn 1997. The goal is also to abolish border tariffs between Sweden and Finland, to further facilitate short-term power trading between the two countries.

Future challenges

Increased international trade in electricity presents the parties to the market with advantages but also with considerable challenges. New technology for DC transmissions has made it possible to establish electric connections over much longer distances than what used to be considered economically appealing. As a result, strong connections have been constructed, or are under planning, with Russia, Germany, Poland and the Netherlands. Further, the potential of establishing connections to the Baltic States and to the UK are being studied. Nordel's international contacts with other organisations are taking on increasing importance, and cooperation will be strengthened.

The new connections bind together countries differing as to their history, experiences and traditions. Various production systems are linked together, opening up interesting opportunities for collaboration and optimisation. Cooperation within the Nordic countries, and the products that a Nordic electricity exchange offers for trading, must take this situation into account.

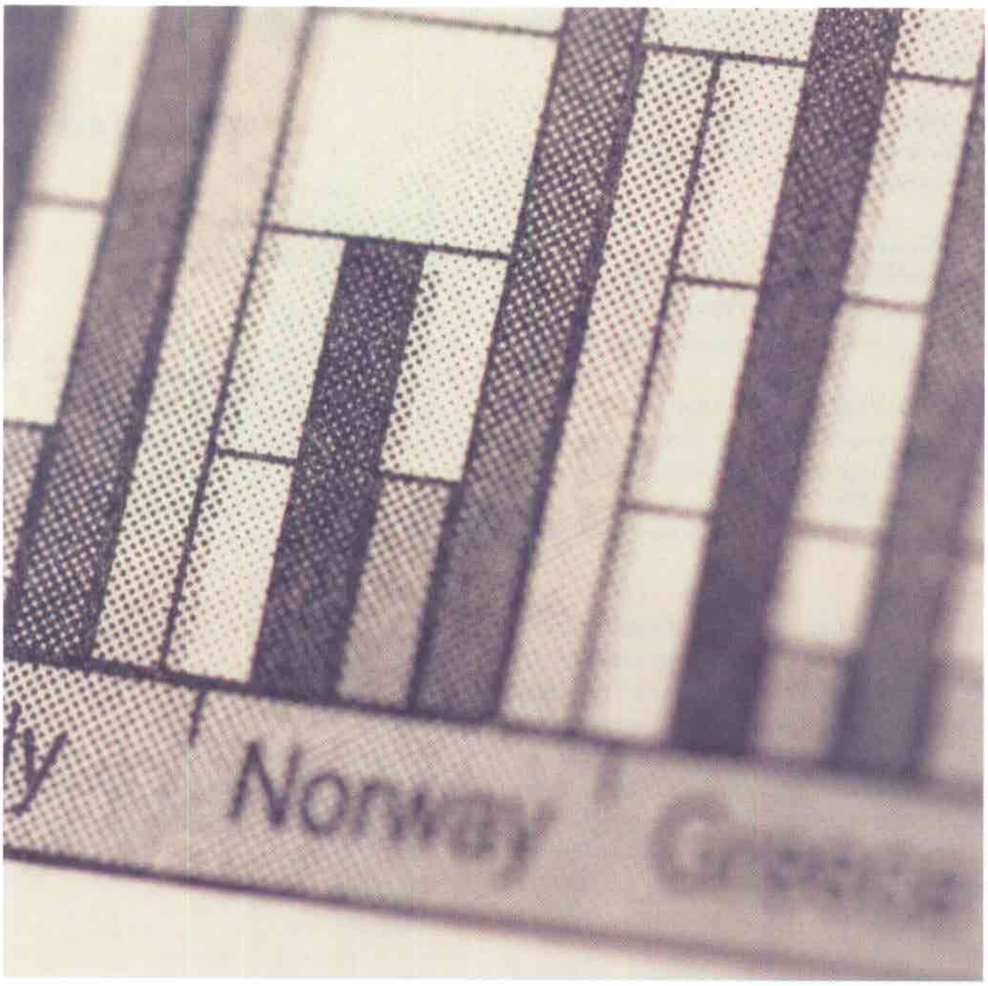
A natural development for promoting international trade is to establish international electricity exchanges that cover wider areas. The electricity exchange should be a trading place with a high degree of liquidity, where parties to the market can sell or buy power at short notice, if the situation so requires.

The prices on the exchange give signals to all players on the electricity market and can act as references for other trade in electricity. The electricity exchange and other players can thus offer varying products for risk management, which will gain an increasingly important role in the operations of enterprises. It can be assumed that international brokerage and trading companies will participate in the trade in electricity contracts, in addition to trading in oil, gas, etc. Such development will be able to improve liquidity and reduce volatility on the electricity exchange.

In a deregulated power system, construction of new generating capacity involves more risks than before. Investments must be assessed starting from anticipated future market situations. There will be a need to develop the electricity market so that it also gives price signals to planners and investors.

The forms of electricity trading in the Nordel area and with the surrounding systems have been under continuous development for decades. Establishment of a joint Nordic electricity exchange can be seen as a natural continuation of this development. In the future, too, one of Nordel's most important tasks will be to contribute to the advancement of this process and to the elimination of any barriers to development.

The article has been prepared by Nordel's Liaison Group and Knut Fossdal, Nord Pool ASA.


Norway

DEFINITIONS, UNITS AND SYMBOLS

DEFINITIONS

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.

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.

Electricity generation (net generation):
The output of a power plant, excluding the plant's own consumption; usually expressed in GWh.

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.

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.

Imports/exports:
Since 1 January 1996, the sum (in GWh) of the physically registered MWh values for each connection between the individual countries, per hour of exchange. Until 31 December 1995, imports and exports referred to the quantities of energy recorded as purchases and sales between the respective countries when accounts were settled. Net imports is the difference between imports and exports. *The Norwegian share of Linnvasselv is recorded as imports to Norway and the German share of Enstedværket as exports to Germany.*

Total consumption:
The sum of electricity generation and net imports, 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 are alternatively generated using oil or some other fuel. *As of 1 January 1996, Sweden can no longer determine monthly values for occasional power to electric boilers. Thus the values for gross consumption in Sweden for 1996 also include occasional power to electric boilers.*

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

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

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.

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

UNITS AND SYMBOLS

kW	kilowatt
MW	megawatt = 1,000 kW
GW	gigawatt = 1,000 MW
J	joule
kJ	kilojoule
PJ	petajoule = 10^{15} J
kWh	kilowatt-hour = 3,600 kJ
MWh	megawatt-hour = 1,000 kWh
GWh	gigawatt-hour = 1,000 MWh
TWh	terawatt-hour = 1,000 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

Responsible for statistical data on the individual countries:
Lisbeth Petersson - Association of Danish Electric Utilities, Denmark
Terho Savolainen - Finnish Electricity Association, Finland
Ólafur Pálsson - Iceland Energy Agency, Iceland
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Lars Nilsson - Swedish Power Association, Sweden

Responsible for processing of the statistics:
Laura Karjalainen - Imatran Voima Oy, Finland

The present statistics were prepared before the 1996 official statistics for the individual countries had become available. Certain figures in the Annual Report may thus differ from the official statistics.

INSTALLED CAPACITY

S1 INSTALLED CAPACITY ON 31 DEC. 1996, MW

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Installed capacity, total	10 937	14 963	1 049	27 631	34 158	**88 738**
Hydropower	10	2 850	880	27 334	16 203 [1]	**47 277**
Nuclear power	.	2 350	.	.	10 055	**12 405**
Other thermal power	10 141	9 756	119	293	7 795 [2]	**28 104**
- condensing power	4 910 [3]	3 673	.	73	2 842	**11 498**
- CHP, district heating	4 757	3 037	.	.	2 464	**10 258**
- CHP, industry	187	2 168	.	185	776	**3 316**
- gas turbines, etc.	287	878	119	35	1 713	**3 032**
Other renewable power	786	7	50	4	105	**952**
- wind power	786	7	.	4	105	**902**
- geothermal power	.	.	50	.	.	**50**
Commissioned in 1996	323	290	0	429	135	**1 177**
Decommissioned in 1996	70	73	0	355	-	**498**

[1] Includes the Norwegian share of Linnvasselv (25 MW)
[2] Thermal power has been subject to an inventory, which has altered the previous data
[3] Includes the German share of Enstedværket (300 MW)

S2 AVERAGE-YEAR GENERATION OF HYDROPOWER IN 1996, GWH

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Average-year generation 1996	-	12 608	4 950	112 597	63 645	**193 800**
Average-year generation 1995	-	12 600	4 950	112 249	63 645	**193 444**
Change	-	8	0	348	0	**356**

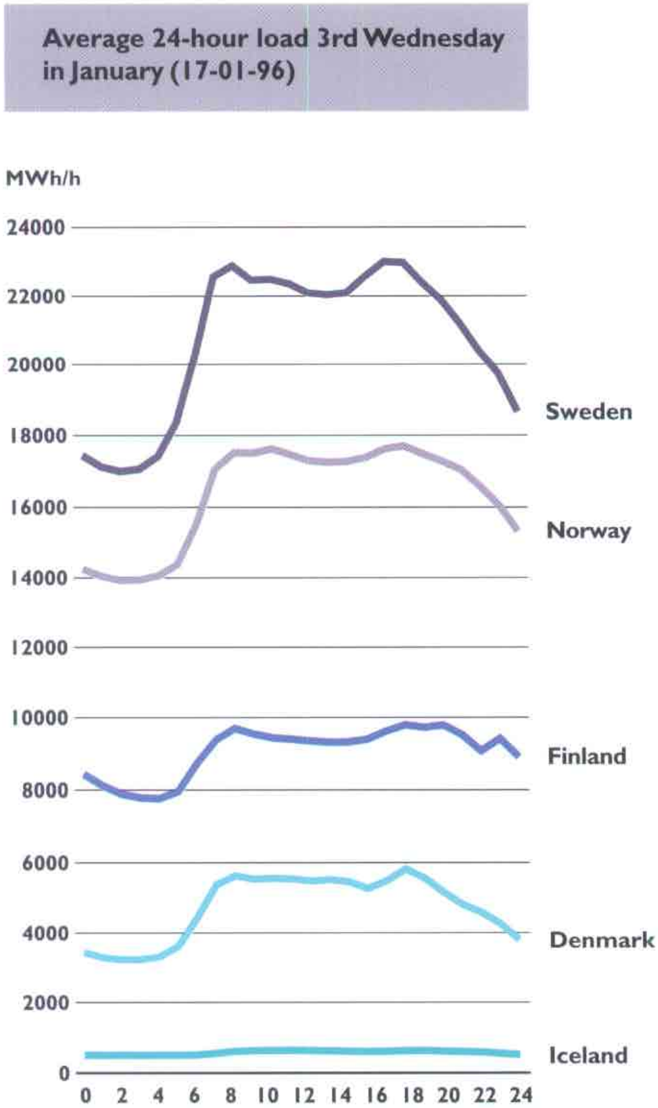
S3 CHANGES IN INSTALLED CAPACITY IN 1996

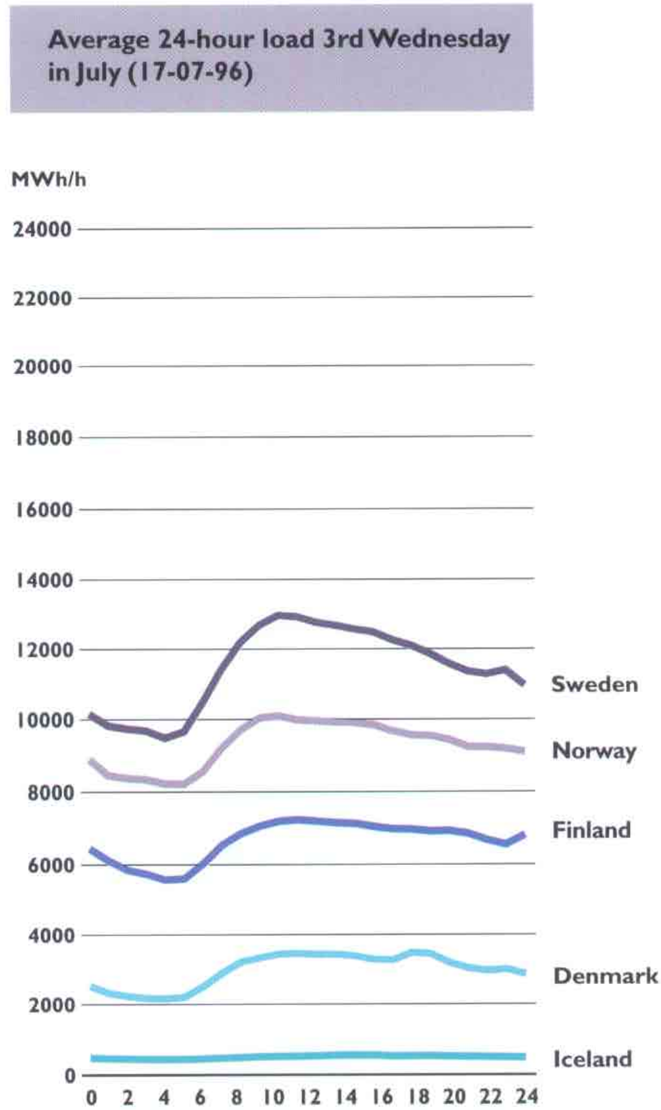
Power category	Power plant	Commissioned	Decommissioned	Change in average-year generation (hydropower)	Type of fuel
		MW	MW	GWh	
Denmark					
CHP, district heating	FVA I	11			Waste, refuse
	Hjørring	60			Natural gas
	LKV anlæg	45			Natural gas
	Sønderborg	56			Natural gas
	Viborg	57			Natural gas
	Århusværket		70		Coal/Oil
CHP, industry	Fiskernes Fiskeindustri	21			Natural gas
Wind power	Several small plants	169			
Finland					
Hydropower	Petäjäskoski I	8		8	
Nuclear power	Loviisa	30			
	Olkiluoto	10			
CHP, district heating	Forssa	15			Wood chips/Bark
	Others	15			
CHP, industry	MB Kemi	30			Internal fuel
	Metsä-Rauma	85			Internal fuel
	VTS Kemi	93	73		Internal fuel/Peat
	Others	3			
Wind power	Lammasoaivi	1			
Norway					
Hydropower	Gravfoss II	30	19	52	
	Svartisen	340	310	172	
	Others	59	26	125	
Sweden					
Hydropower	Juktan	26		-	
CHP, district heating	Skellefteå	34			Wood chips
	Växjö	37			Wood chips
Wind power	Several small plants	38			

S4 POWER PLANTS (LARGER THAN 10 MW): DECISIONS TAKEN

Power category	Power plant	Capacity	Estimated start-up	Average-year generation (hydropower)	Type of fuel
		MW	Year	GWh	
Denmark					
CHP, district heating	Ringsted	12	1997		Natural gas
	Skærbækværket 3	394	1997		Natural gas
	DTU 2	33	1998		Natural gas
	Maribo / Sakskøbing	10	1998		Biofuel
	Nordjyllandsværket 3	385	1998		Coal/Oil
	Århusværket	88	1999		Coal/Oil/Biofuel
	Avedøreværket 2	500	2001		Natural gas/Straw/ Wood chips/(Oil)
Finland					
Hydropower	Pamilo	26	1997	0	
	Raasakka	20	1997	25	
	Vuotos	37	2004	430	
Nuclear power	Olkiluoto	20	1997		
CHP, district heating	Kotka	49	1997		Natural gas
	Vuosaari B	450	1997		Natural gas
CHP, industry	Kirkniemi	70	1997		Natural gas
	Neste POVO	70	1997		Natural gas
	PVO Nokia	45	1997		Natural gas
	VTS/Oulu	70	1997		Internal fuel
Condensing power	Vaskiluoto	230	1998		Coal/Oil
Iceland					
Geothermal power	Krafla	30	1997		
	Nesjavellir	60	1998		
Norway					
Hydropower	Skjerka	95	1997	80	
	Svartisen II	10	1998	79	
Condensing power	Kårstø	350	1999		Natural gas
	Kollsnes	350	2000		Natural gas
Sweden					
CHP, district heating	Brista	41	1997		Wood chips

S5 SYSTEM LOAD 3RD WEDNESDAY IN JANUARY AND 3RD WEDNESDAY IN JULY 1996





	Installed net capacity	Maximum system load	Minimum system load
	31 Dec. 1996 GW	3rd Wednesday in Jan. 1996, 5:00-6:00 p.m. GWh/h	3rd Wednesday in July 1996, 4:00-5:00 a.m. GWh/h
Denmark	10.9	5.8	2.1
Finland	15.0	9.8	5.5
Iceland	1.0	0.6	0.4
Norway	27.6	17.7	8.2
Sweden	34.2	23.0	9.5
Nordel	**88.7**	**56.9**	**25.7**

All hours are local time

THE GRID SYSTEM IN THE NORDIC COUNTRIES

S6 EXISTING INTERCONNECTIONS BETWEEN THE NORDEL COUNTRIES

Countries Stations	Rated voltage	Transmission capacity as per design rules [1]		Total length of line	Of which cable
	kV	MW		km	km
Denmark - Norway		From Denmark	To Denmark		
Tjele-Kristiansand	250/350	1040	1040	240/pol	127/pol
Denmark - Sweden		From Sweden	To Sweden		
Teglstrupgård - Mörarp 1 och 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~	900 [3] (Ossauskoski–Keminmaa)	700 (Ossauskoski–Keminmaa)	93	.
Petäjäskoski - Letsi	400~			230	.
Keminmaa - Svartbyn	400~			134	.
Hellesby (Åland) - Skattbol	70~	35	35	77	56
Raumo - Forsmark	400=	500	500	235	198
Norway - Sweden		From Sweden	To Sweden		
Sildvik - Tornehamn	132~	50	120	39	.
Ofoten - Ritsem	400~	750	750	58	.
Rossåga - Ajaure	220~	285 [4]	250 [4]	117	.
Linnvasselv, transformer	220/66~	50	50	.	.
Nea - Järpströmmen	275~	450 [4]	450 [4]	100	.
Lutufallet - Höljes	132~	40	20	18	.
Eidskog - Charlottenberg	132~	100	100	13	.
Hasle - Borgvik	400~	1650 [4] (Hasle–Halden)	1800 [4] (Hasle–Halden)	106	.
Halden - Skogssäter	400~			135	.

[1] Maximum permissible transmission.
[2] Thermal limit. The total transmission capacity is ± 1,600 MW. It can be higher if no restrictions have been imposed on imports/exports in the Danish or Swedish network.
[3] Further 100 MW for power balance deviation.
[4] The transmission capacity can in certain situations be lower, owing to bottlenecks in the Norwegian network. 1,800 MW requires a network protection system during operation (production disconnection).

S7 EXISTING INTERCONNECTIONS BETWEEN THE NORDEL COUNTRIES AND OTHER COUNTRIES

Countries Stations	Rated voltage	Transmission capacity		Total length of line	Of which cable
	kV	MW		km	km
Denmark - Germany		From Nordel	To Nordel		
Kassø - Audorf	2 x 400~	1400 [1] (Kassø–Ensted)	1400 [1] (Kassø–Ensted)	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=	.	900	.	.
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 [2]	600 [2]	250	220

[1] Transmission capacity varies between 1,200 and 1,500 MW, depending on operating conditions.
[2] Owing to restrictions in the German network, transmission capacity is currently limited to 450 MW from Nordel and 370 MW to Nordel.

S8 INTERCONNECTIONS: DECISIONS TAKEN

Countries Stations	Rated voltage	Transmission capacity as per design rules	Total length of line	Of which cable	Estimated commis-sioning
	kV	MW	km	km	Year
Denmark - Denmark (Storebælt / The Great Belt) Elsam - Elkraft	400=	500 - 600	ca 70	ca 70	1)
Finland - Russia Kymi - Viborg	±85=	300 2)			1997
Norway - The Netherlands (NorNed Kabel) Feda - Eemshaven	400-600=	min 600	ca 550	ca 550	2001
Norway - Germany (Euro Cable) Øksendal (Tonstad) 3)- Brunsbüttel	400-600=	min 600	ca 550	ca 550	2002
Norway - Germany (Viking Cable) Øksendal (Tonstad) 3)- Wilhelmshaven	400-600=	min 600	ca 550	ca 550	2003

1) According to plans, the Great Belt connection will be in operation in 2003. The Minister of the Environment and Energy has the authority to decide on the connection.
2) Transmission capacity initially 150 MW to Nordel.
3) Cable to Lista, overhead line to Tonstad.

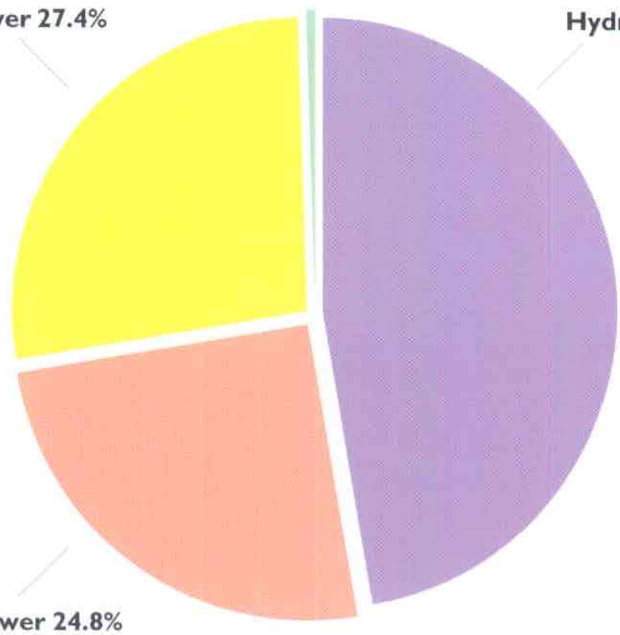
LINE LENGTHS

S9 TRANSMISSION LINES OF 110-400 KV IN SERVICE ON 31 DEC. 1996

	400 kV, AC and DC	220-300 kV, AC and DC	110, 132, 150 kV
	km	km	km
Denmark	1 285 1)	435 2)	3 949 3)
Finland	3 821 4)	2 660	14 850
Iceland	.	492	1 315
Norway	2 110	5 782 2)	10 300
Sweden	10 954 4)	4 389 2)	15 000

1) Of which 2 km in service with 150 kV and 46 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 105 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).

S10 TOTAL ELECTRICITY GENERATION WITHIN NORDEL 1996

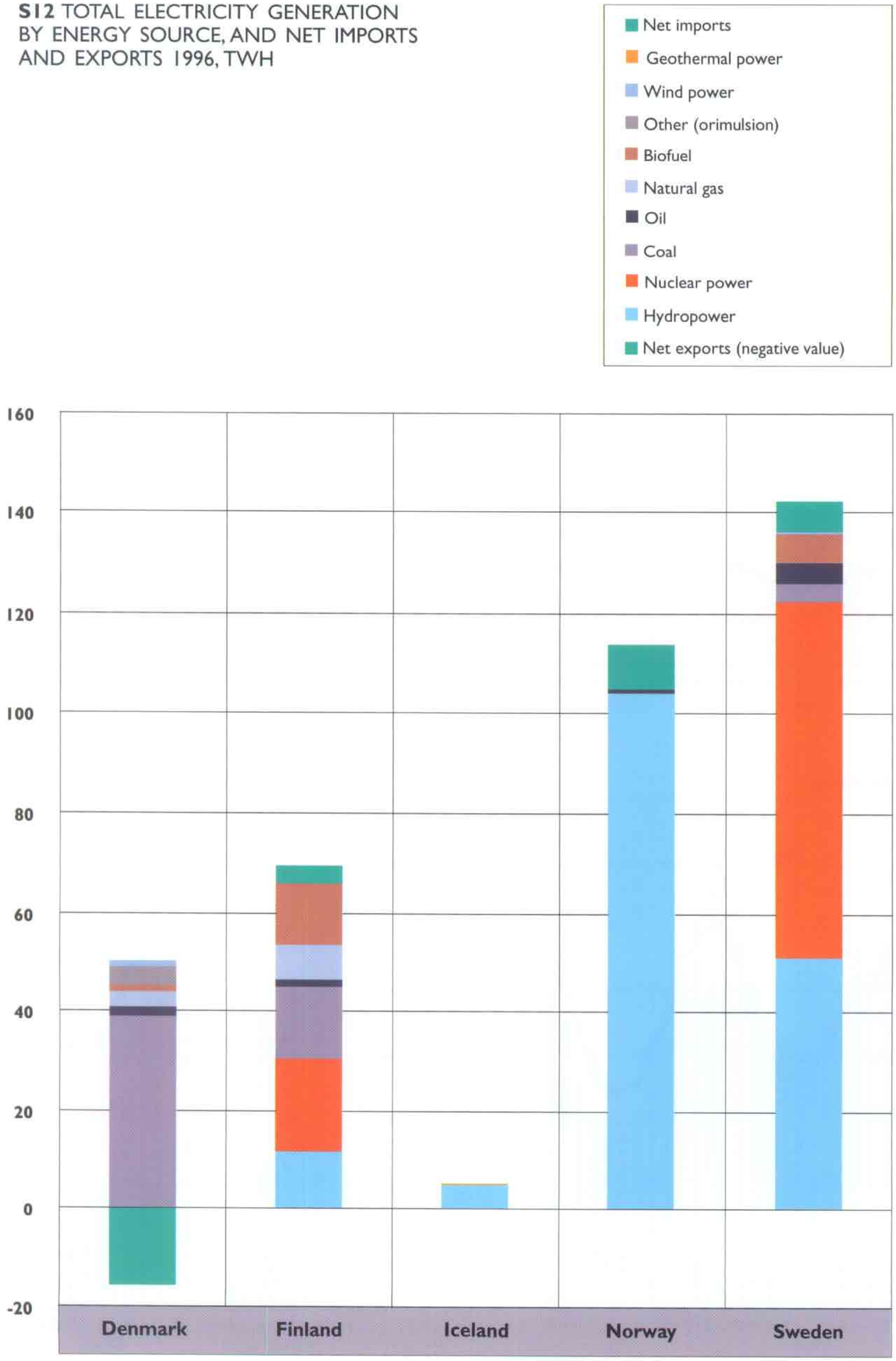


S11 ELECTRICITY GENERATION 1996, GWH

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total generation 1996	50 367	66 367	5 113	104 878	136 011	**362 736**
Hydropower	19	11 713	4 765	104 091	50 951	**171 539**
Nuclear power	.	18 662	.	.	71 385	**90 047**
Other thermal power	49 098	35 981	3	781	13 530	**99 393**
- condensing power	48 250 [1]	13 496	.	119	3 547	**65 412**
- CHP, district heating	..	12 660	.	.	5 434	**18 094**
- CHP, industry	848	9 800	.	382	4 530	**15 560**
- gas turbines, etc.	-	25	3	280	19	**327**
Other renewable power [2]	1 250	11	345	6	145	**1 757**
Total generation 1995	34 339	60 541	4 975	123 499	143 700	**367 054**
Change as against 1995	46.7%	9.6%	2.8%	-15.1%	-5.4%	**-1.2%**

[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 1996, TWH

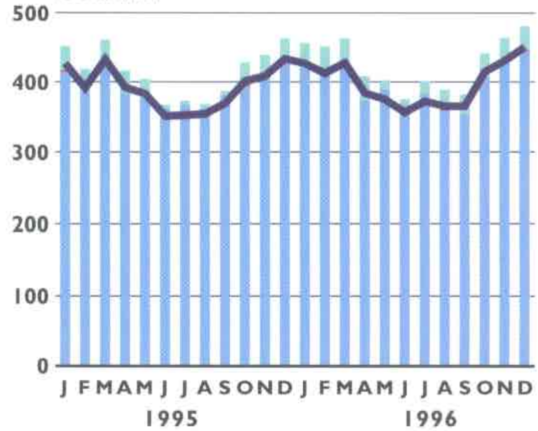


S13 MONTHLY GENERATION AND GROSS CONSUMPTION OF ELECTRICITY 1995-1996, GWH

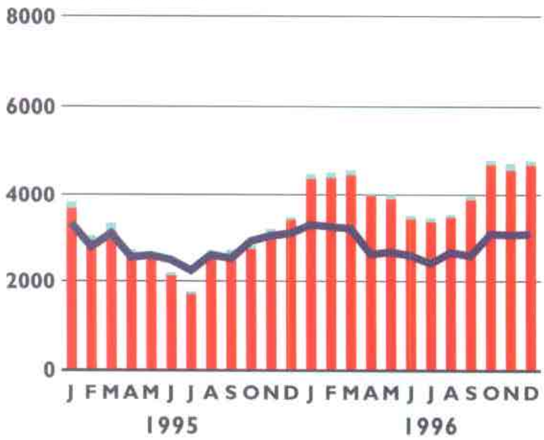
- Gross consumption
- Wind power or geothermal power
- Nuclear power and other thermal power
- Hydropower

N.B. Consumption in Sweden in 1996 also includes supply to electric boilers. It is therefore not directly comparable with consumption in 1995.

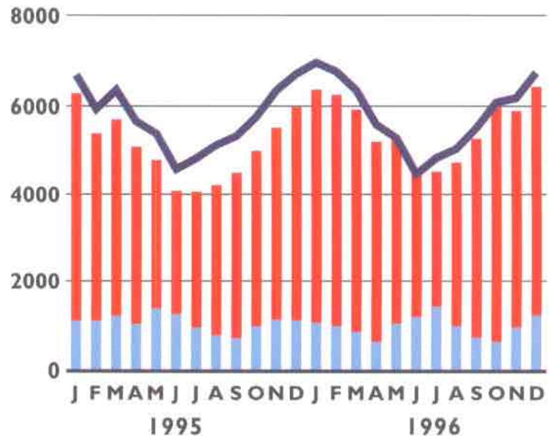
Iceland



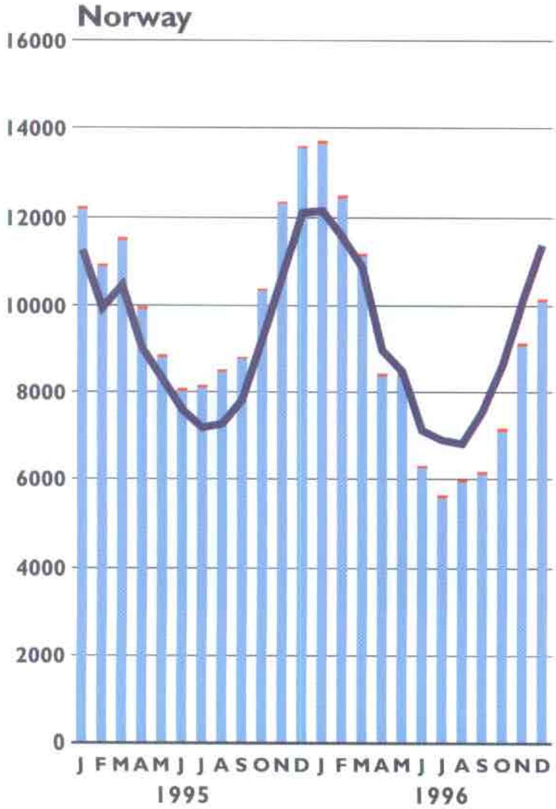
Denmark



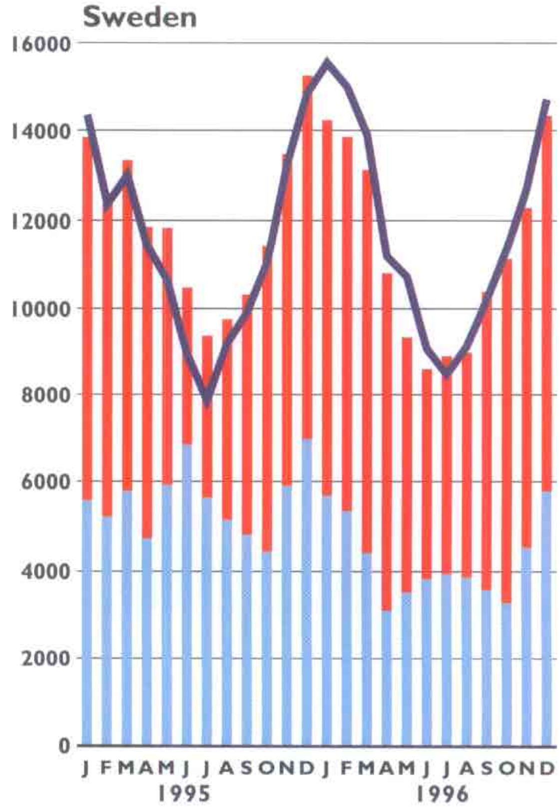
Finland



Norway



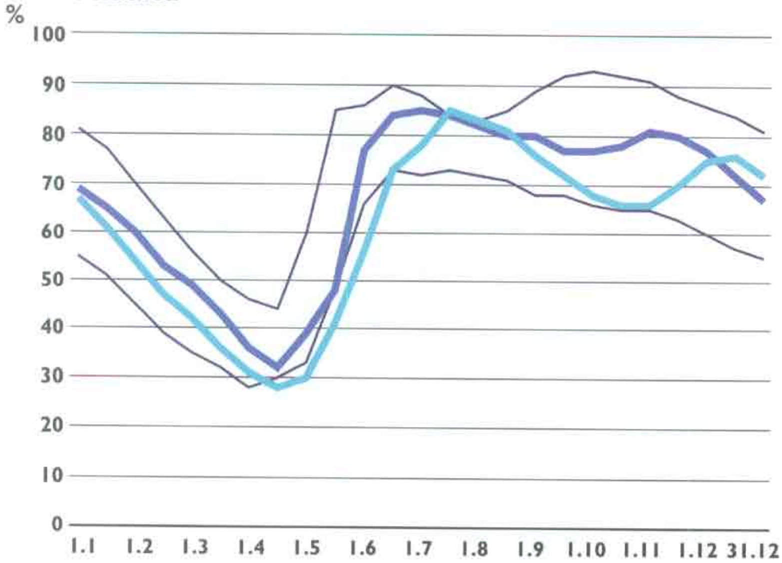
Sweden



S14 WATER RESERVOIRS 1996

- Water reservoirs 1996 expressed in %
- Water reservoirs 1995 expressed in %
- Minimum and maximum values in %

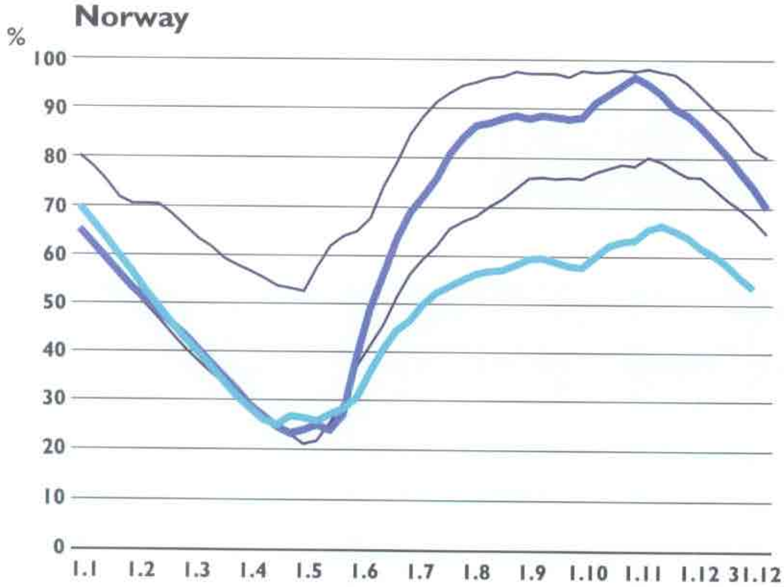
Finland



Reservoir capacity 4 900 GWh

Minimum and maximum limits are based on values for the years 1986-1995

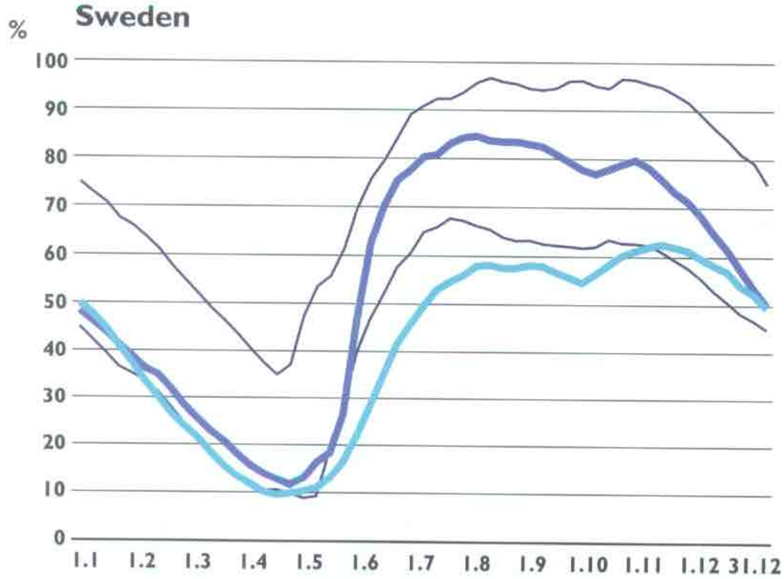
Norway



Reservoir capacity
1.1.1996 77 888 GWh
31.12.1996 78 121 GWh

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

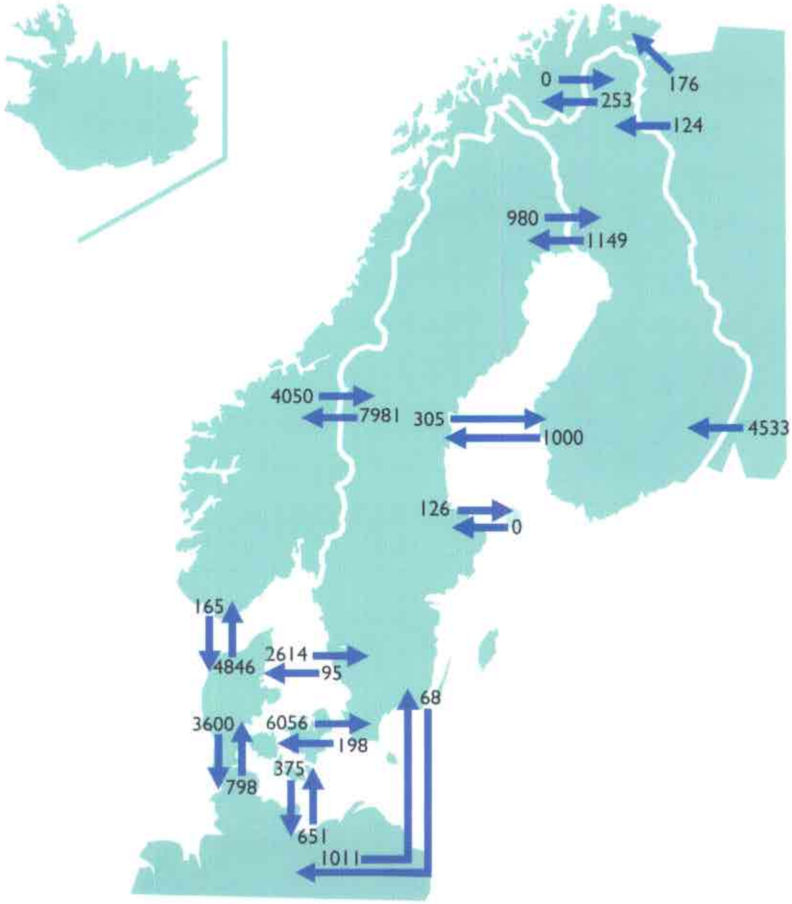
Sweden



Reservoir capacity 33 550 GWh

Minimum and maximum limits are based on values for the years 1980-1994

S15 EXCHANGE OF ELECTRICITY 1996, GWH



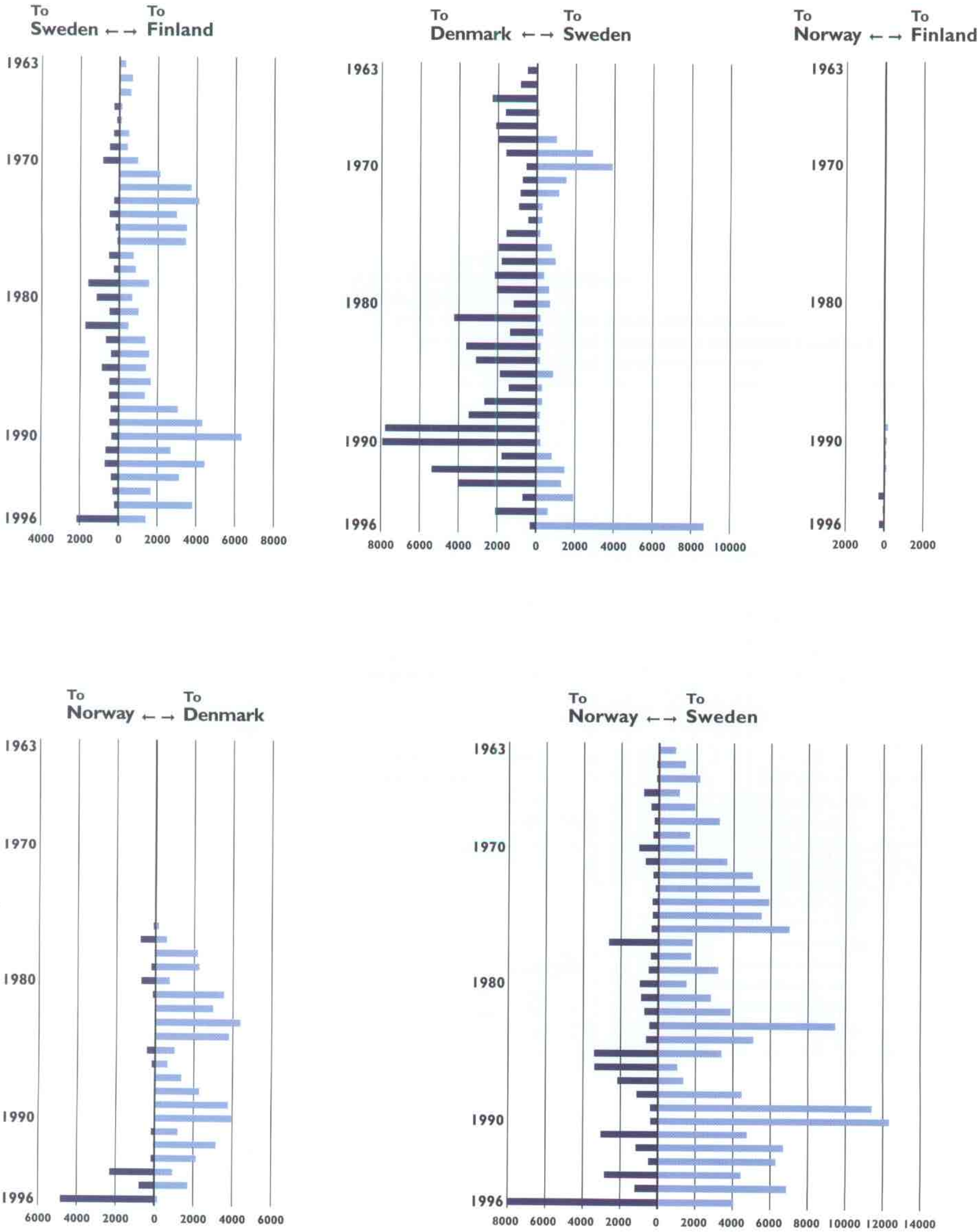
S16 IMPORTS AND EXPORTS 1996, GWH

	Imports to: Denmark	Finland	Norway	Sweden	Other countries [1]	Σ Exports
Exports from:						
Denmark	.	.	4 846	8 670	3 975	**17 491**
Finland	.	.	253	2 149	.	**2 402**
Norway	165	0	.	4 050	.	**4 215**
Sweden	293	1 411	7 981	.	68	**9 753**
Other countries [1]	1 449	4 657	176	1 011	.	**7 293**
Σ Imports	**1 907**	**6 068**	**13 256**	**15 880**	**4 043**	**41 154**

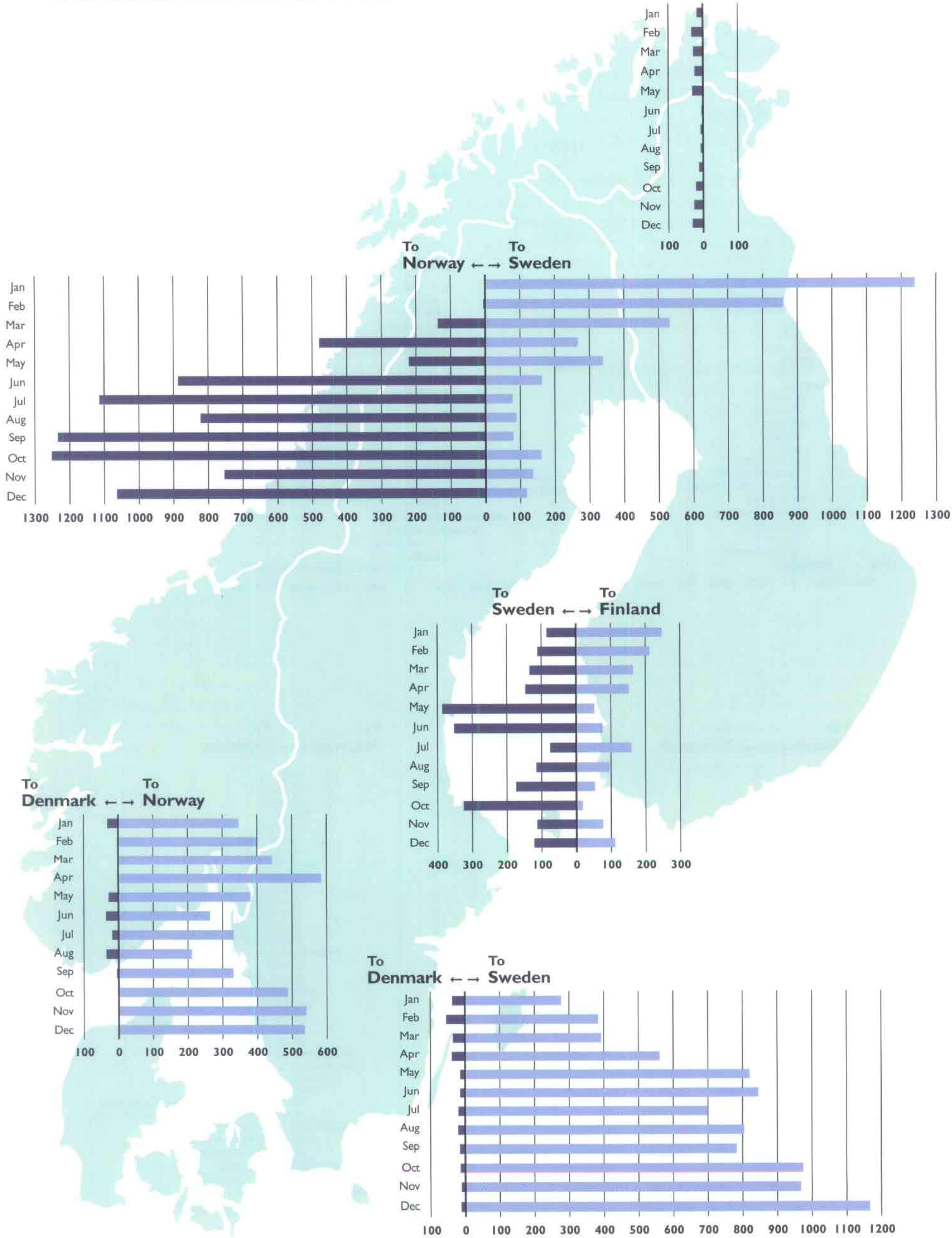
	Denmark	Finland	Norway	Sweden	Nordel
Total imports	1 907	6 068	13 256	15 880	**37 111**
Total exports	17 491	2 402	4 215	9 753	**33 861**
Net imports	-15 584	3 666	9 041	6 127	**3 250**
Net imports / gross consumption	**-44.8%**	**5.2%**	**8.2%**	**4.4%**	**0.9%**

[1] Germany and Russia

S17 EXCHANGE OF ELECTRICITY BETWEEN THE NORDEL COUNTRIES 1963 - 1996, GWH

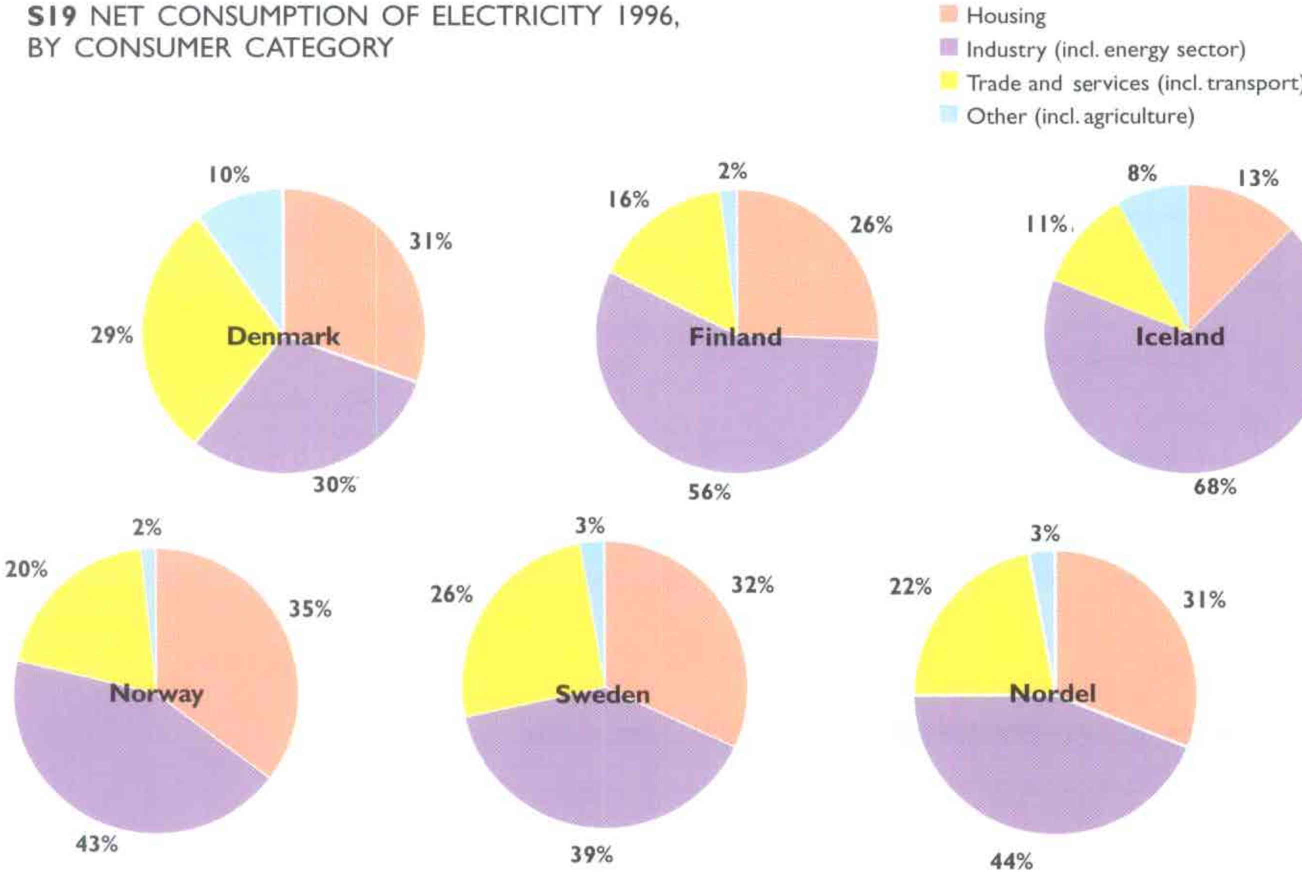


S18 MONTHLY EXCHANGE OF ELECTRICITY BETWEEN THE NORDEL COUNTRIES 1996, GWH



ELECTRICITY CONSUMPTION

S19 NET CONSUMPTION OF ELECTRICITY 1996, BY CONSUMER CATEGORY



S20 ELECTRICITY CONSUMPTION 1996, GWH

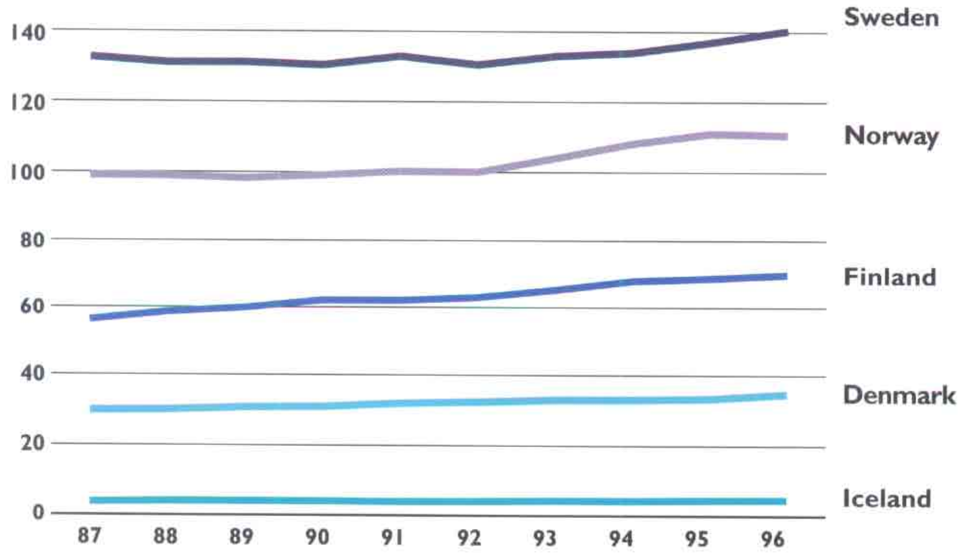
	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total consumption	34 783	70 033	5 113	113 919	142 138	**365 986**
Occasional power to electric boilers	.	54	325	3 222	1 700 [1]	**5 301**
Gross consumption	34 783	69 979	4 788	110 697	140 438	**360 685**
Losses, pumped storage power	2 617	2 959	312	9 105 [2]	9 738	**24 731**
Net consumption	32 166	67 020	4 476	101 592	130 700	**335 954**
- housing	9 833	17 200	570	35 760	41 700	**105 063**
- industry (incl. energy sector)	9 775	37 880	3 044	44 091	51 800	**146 590**
- trade and service (incl. transport)	9 223	10 590	501	20 141	33 700	**74 155**
- other (incl. agriculture)	3 335	1 350	361	1 600	3 500	**10 146**
Population (million)	5.3	5.1	0.3	4.4	8.9	**23.9**
Gross consumption per capita, kWh	6 563	13 654	17 733	25 268	15 867	**15 074**

N.B. Consumption in 1996 is not directly comparable with consumption in the previous years, owing to different principles in recording the exchange of electricity.

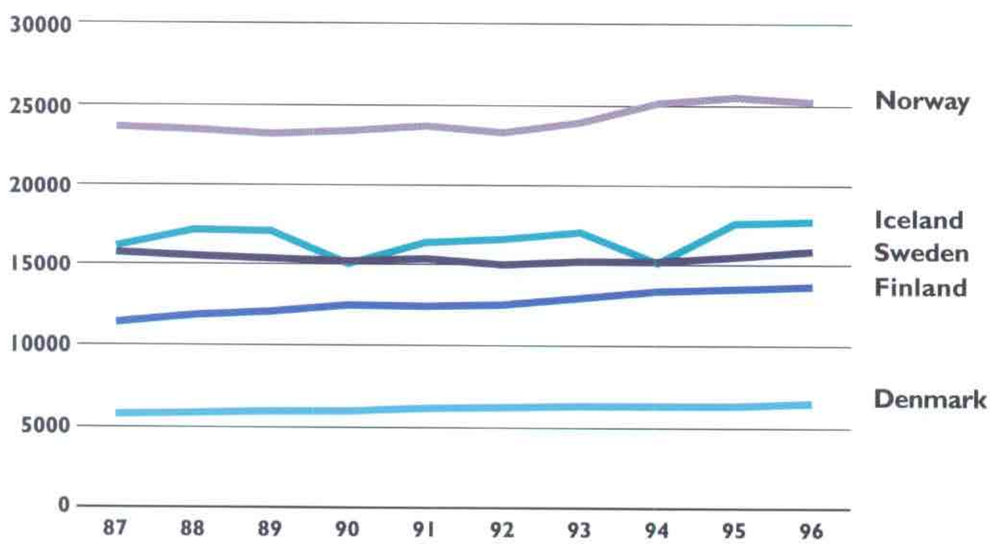
[1] Only electric boilers at district heating plants (the corresponding value 1995 was 3,300 GWh out of a total of 4,500 GWh).

[2] Pumped storage power accounts for 415 GWh.

S21 GROSS CONSUMPTION 1987 - 1996, TWH



S22 GROSS CONSUMPTION PER CAPITA 1987 - 1996, KWH



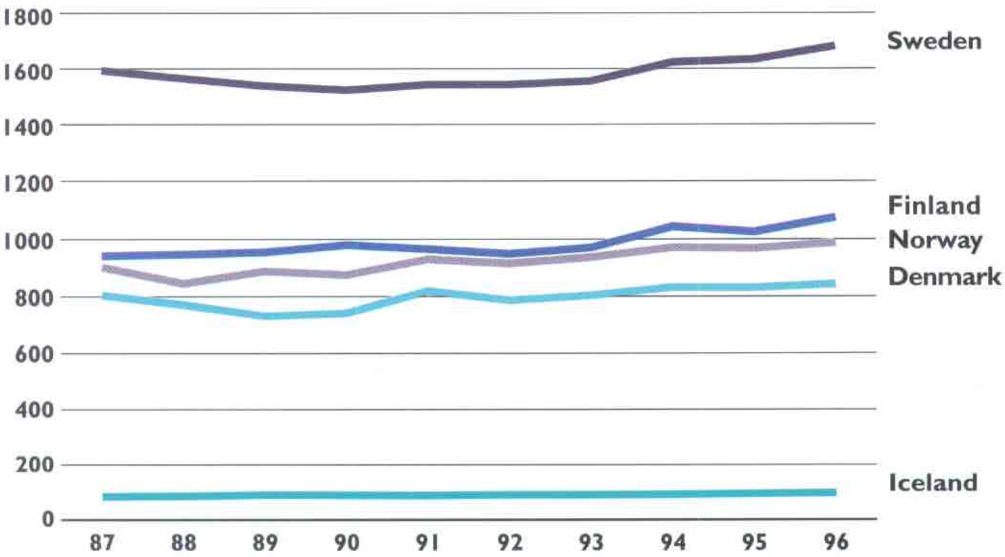
S23 TOTAL CONSUMPTION 1996, GWH

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Generation 1996	50 367	66 367	5 113	104 878	136 011	**362 736**
Net imports 1996	-15 584	3 666	.	9 041	6 127	**3 250**
Total consumption 1996	34 783	70 033	5 113	113 919	142 138	**365 986**
Generation 1995	34 339	60 541	4 975	123 499	143 700	**367 054**
Net imports 1995	-795	8 411	.	-6 491	-1 700	**-575**
Total consumption 1995	33 544	68 952	4 975	117 008	142 000	**366 479**

N.B. Consumption in 1996 is not directly comparable with consumption in the previous years, owing to different principles in recording the exchange of electricity.

TOTAL ENERGY SUPPLY

S24 TOTAL ENERGY SUPPLY 1987 - 1996, PJ



PROGNOSES

S25 GROSS CONSUMPTION OF ELECTRICITY 1996 AND PROGNOSES FOR 2000 AND 2005, TWH

Year	Denmark	Finland	Iceland	Norway	Sweden
1996	35	70	4.8	111	140
2000	36	81	6.2	117	146 [1]
2005	38	89	6.5	125	148 [1]

[1] Net consumption, prognoses based on the Climate Report issued by NUTEK

S26 PEAK LOAD DEMAND 1996 AND PROGNOSES FOR 2000 AND 2005, MW

Year	Denmark	Finland	Iceland	Norway [1]	Sweden
1996	7 410	11 200	750	22 200	26 300
2000	7 753 [2]	14 200	900	22 900	27 450 [3]
2005	8 262 [2]	15 600	950	25 000	27 890 [3]

[1] Excl. reserve requirements
[2] VEAG's share accounts for 350 MW
[3] Prognose based on the Climate Report issued by NUTEK

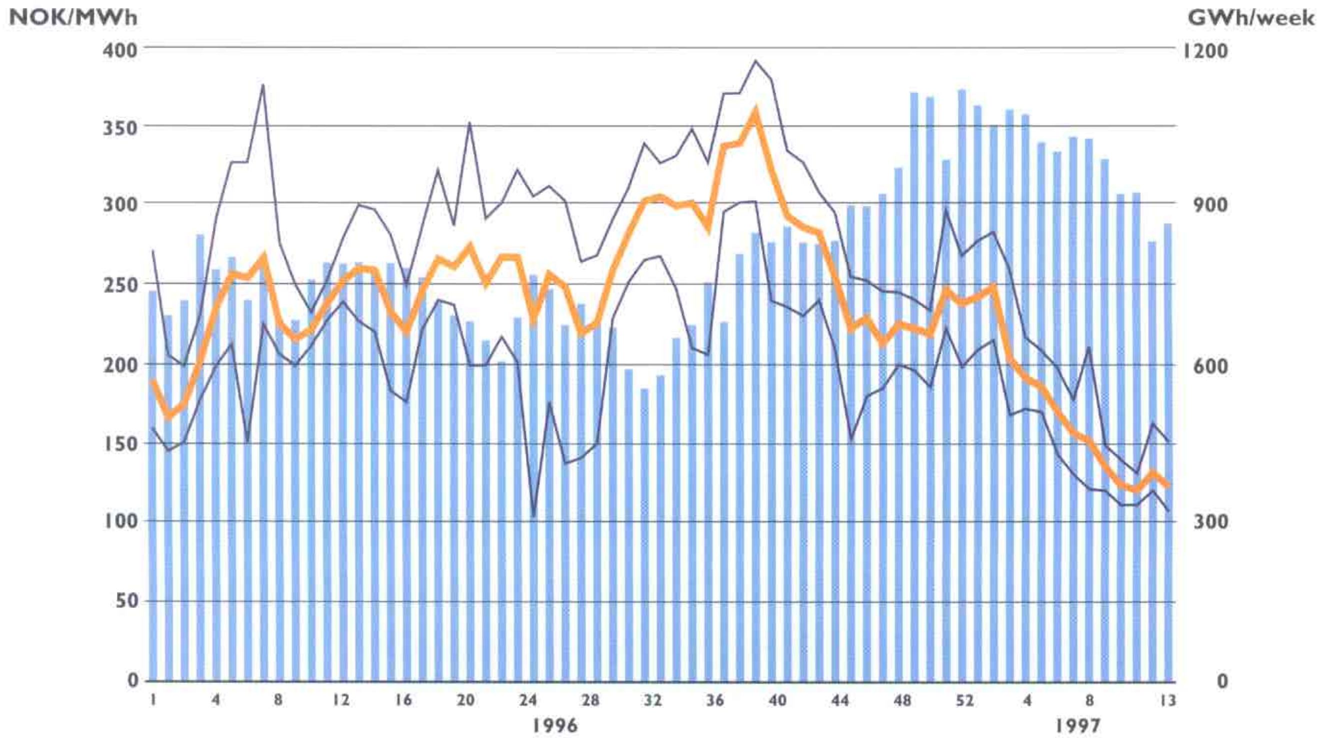
S27 INSTALLED CAPACITY 1996 AND PROGNOSES FOR 2000 AND 2005, MW

Year	Denmark	Finland	Iceland	Norway [1]	Sweden
1996	10 937 [2]	14 963	1 049	27 631	34 158
2000	9 561 [3]	16 000	1 174	28 700	[4]
2005	9 024 [3]	[4]	1 174	30 000	[4]

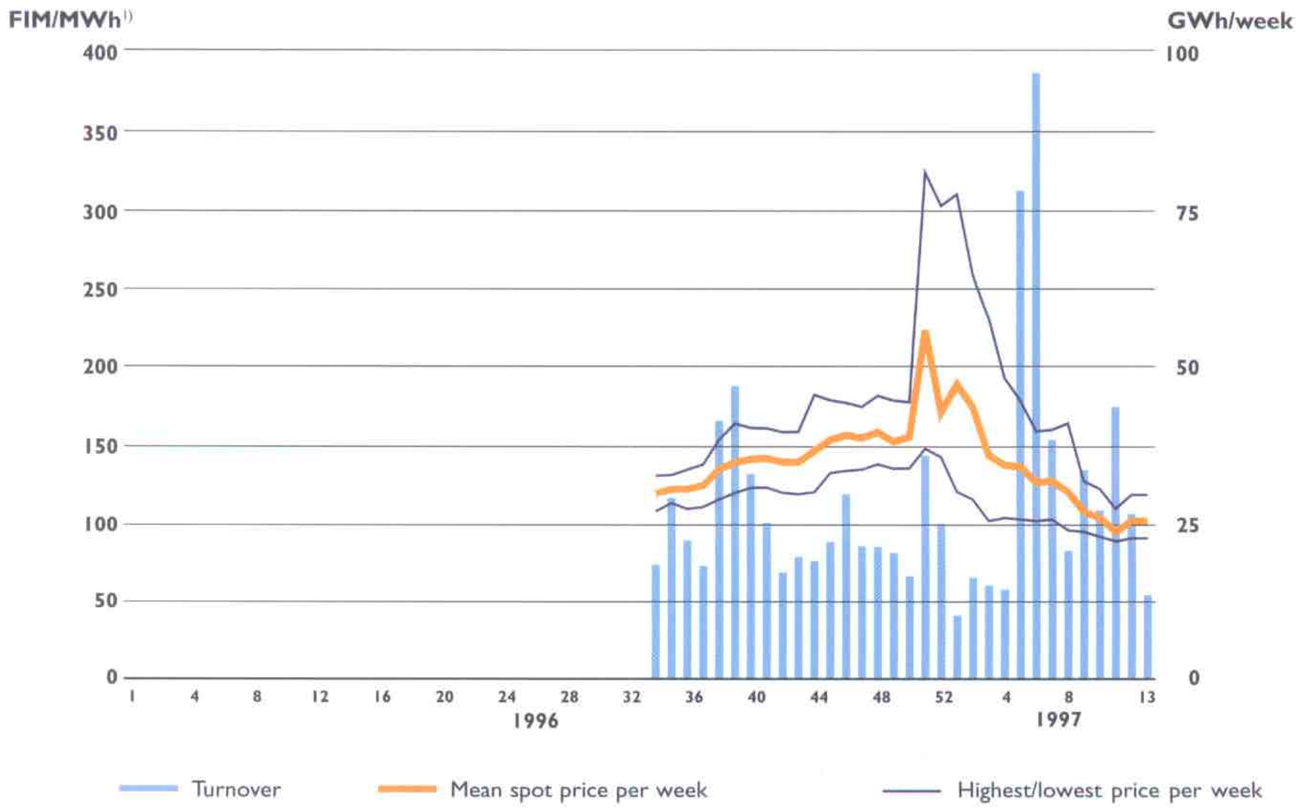
[1] Prognoses are based on report 96/16 issued by the Central Statistical Office in Norway: "Det norske kraftmarkedet til år 2020 Nasjonale og regionale framskrivninger"
[2] The capacity of autoproducers comes to 1,587 MW
[3] Excl. capacity of autoproducers
[4] N.A.

S28 SPOT PRICES AND TURNOVER ON THE NORDIC ELECTRICITY EXCHANGES

Nord Pool ASA's spot market: Mean price (system price) and turnover per week



EL-EX's spot market: Mean price and turnover[2] per week



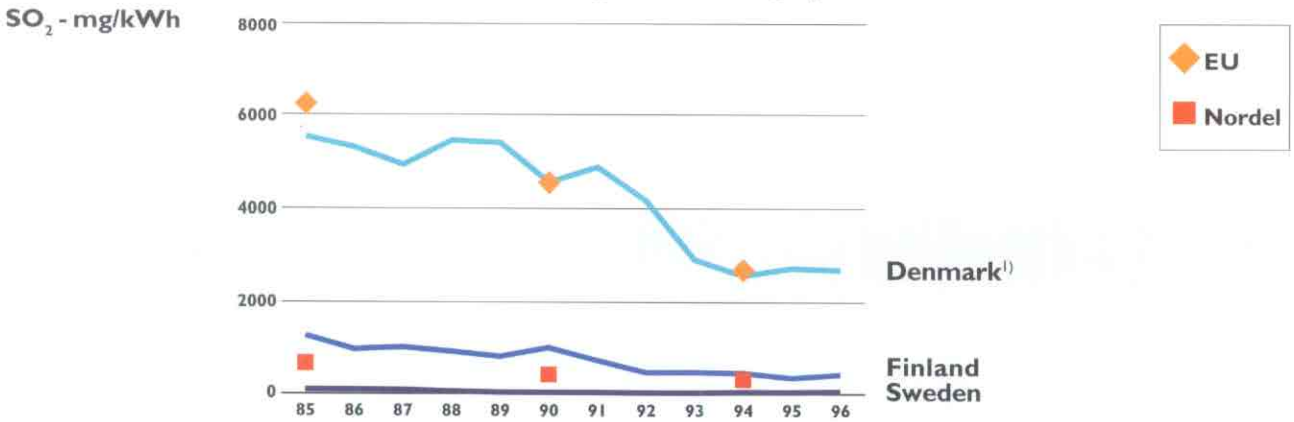
[1] The average NOK/FIM currency exchange rate in 1996 was 0.7111.
[2] Trading on EL-EX is based on the principle of continuous trading, which means that the turnover may be greater than the physical supply.

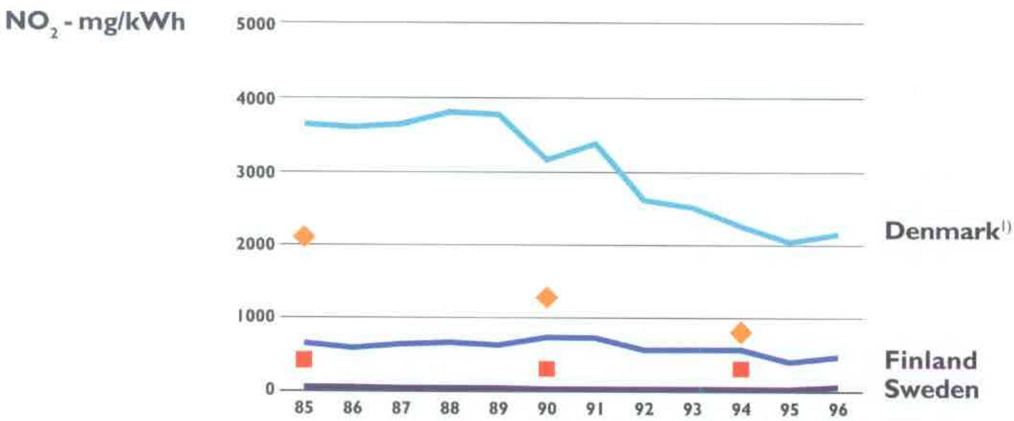
Environmental aspects play a central role in the electricity sector. The Nordic countries have taken long-range measures to reduce emissions from power generation, e.g. by utilising new combustion and purification techniques and by utilising combined heat and power plants of high efficiency. The active trade in power between the Nordel countries has also helped reduce environmental effects by ensuring that effective use has been made of the hydropower resources.

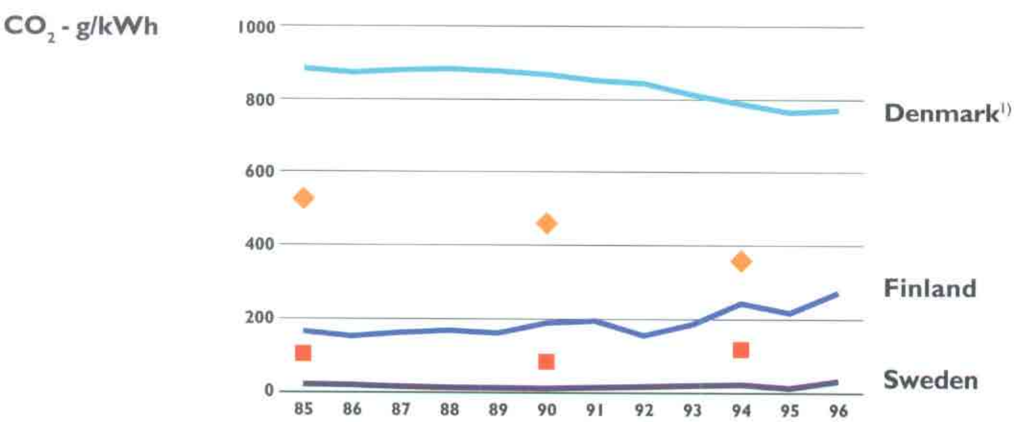
The diagrams below show the emissions of SO_2, NO_2 and CO_2 in relation to total electricity generation in each country. The high proportion of thermal power in the Danish and Finnish systems increases the emission figures in these countries. The Norwegian and Icelandic emissions are negligible because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

In the long term, the emissions show a steady downward trend. However, the year 1996 differs somewhat from the general trend because the exceptionally dry year led to a sharp increase in the consumption of fossil fuels.

Average emissions within the EU and within Nordel are given for some reference years. Emissions from the Nordel countries are on a considerably lower level. 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.







1) For Denmark's part only power production owned by power utilities is shown, representing about 90% of the total production.

ELECTRICITY TAXES IN THE NORDIC COUNTRIES IN 1996 AND 1997

Taxation of electrical energy in the Nordic countries varies with respect to both structure and level. The taxes have been raised substantially in most countries during the '90s, and considerable structural changes have also been introduced.

Long-range planning in these questions is of great importance in the capital-intensive power industry, for instance, when companies make decisions about investments. If electricity taxes imposed on power generation vary from country to country within the same market area, a serious problem arises because enterprises in the individual countries are denied the opportunity to compete with each other on equal terms. In consequence, Nordel has called attention to this drawback and has recommended harmonisation of electricity taxes. The need for more uniform electricity taxation has also been stressed in connection with the development of a Nordic electricity exchange.

The table below shows the electricity taxes that have been imposed on power generation and consumption in the Nordic countries in 1996 and 1997. To enable comparison between the countries, the taxes have also been converted to pennies/kWh. Some assumptions have been made, for instance, with respect to currency exchange rates and the characteristics of power plants; therefore the table should only be seen as indicative.

TAXES ON ELECTRICITY GENERATION & CONSUMPTION IN THE NORDIC COUNTRIES, 1996 & 1997

	Year	Finland	Sweden	Norway	Denmark	Iceland
Generation						
Hydropower	96	0.4	0-5	1.55	-	0
(pennies, öre/kWh)	97	0	0 [1]	1.39	-	0
Nuclear power	96	2.4	1.2	-	-	-
(pennies, öre/kWh)	97	0	2.2	-	-	-
Coal	96	116.1	0 [2]	0	0	0
(FIM, SEK, NOK, DKK/t)	97	0	0 [2]	0	0	0
Gas	96	5.6	0 [2]	0	0	0
(pennies, öre/m^3)	97	0	0 [2]	0	0	0
Peat	96	0.35	0	-	-	-
(pennies, öre/kWh, fuel)	97	0	0	-	-	-
Heavy fuel oil	96	18.55	0 [2]	0	0	0
(pennies, öre/kWh)	97	0	0 [2]	0	0	0
Biofuel	96	0	0	-	0	0
(pennies, öre/kWh)	97	0	0	-	0	0
Imports						
(pennies, öre/kWh)	96	2.2	0	0	0	-
	97	0	0	0	0	-
Consumption						
Industry/Energy	96	0 / 0	0 / 7.3 (4.2)	0 / 0	1.2-21.7 / 1.2-21.7	0 / 0 [3]
Private elec. heating/Private		0 / 0	9.5 (4.2) / 9.5 (4.2)	5.3 (0) / 5.3 (0)	43.4 / 46.9	0 / 0
Industry/Energy	97	1.675 / 3.1	0 / 9.1 (5.8)	0 / 0	1.2-36.9 / 1.2-36.9	0 / 0
Private elec. heating/Private		3.1 / 3.1	11.3 (5.8) / 11.3 (5.8)	5.62 (0) / 5.62 (0)	47.4 / 50.9	0 / 0
(penni, S/N/D öre/kWh)						

The taxes on consumption have been divided into the following categories:
Finland: Industry / Other consumers
Sweden: Industry / Supply of electricity, gas, heat and water / Other consumers (Municipalities in Northern Sweden)
Norway: Industry / Other consumers (Consumers in Finnmark and Northern Tromssa are exempted from taxes)
Denmark: Industry and enterprises / Consumers of electricity from heating / Other consumers

[1] The tax on hydropower has been replaced by a tax on premises (including hydropower plant premises)
[2] Energy and CO_2 taxes are paid for the plant's own use of fuel, i.e. 3-5% of the total volume
[3] The VAT in Iceland is determined so that the tax percentage is 24.5% except for houses heated by electricity (14%) and power-intensive industry (0%)
- Not applicable

TAXES ON ELECTRICITY GENERATION AND CONSUMPTION, CONVERTED TO PENNIES/KWH

	Year	Finland	Sweden	Norway	Denmark	Iceland
	Year	pennies/kWh	pennies/kWh	pennies/kWh	pennies/kWh	pennies/kWh
Generation						
Hydropower	96	0.4	0-5	1.1	-	0
	97	0	0	1.0	-	0
Nuclear power	96	2.4	0.8	-	-	-
	97	0	1.5	-	-	-
Coal	96	4.3	1.4	0	0	0
	97	0	1.5	0	0	0
Gas	96	1.4	0.8	0	0	0
	97	0	0.8	0	0	0
Peat	96	0.9	0	-	-	-
	97	0	0	-	-	-
Heavy fuel oil	96	4.6	1.3	0	0	0
	97	0	1.4	0	0	0
Biofuel	96	0	0	-	0	0
	97	0	0	-	0	0
Imports						
	96	2.2	0	0	0	-
	97	0	0	0	0	-
Consumption						
Industry/Energy	96	0 / 0	0 / 4.9 (2.8)	0 / 0	0.9-16.9 / 0.9-16.9	0 / 0
Private elec. heating/Private		0 / 0	6.4 (2.8) / 6.4 (2.8)	3.7 (0) / 3.7(0)	33.9 / 36.6	0 / 0
Industry/Energy	97	1.75 / 3.175	0 / 6.1 (3.9)	0 / 0	0.9-28.8 / 0.9-28.8	0 / 0
Private elec. heating/Private		3.175 / 3.175	7.6 (3.9) / 7.6 (3.9)	3.9 (0) / 3.9(0)	37.0 / 39.7	0 / 0

Assumptions:

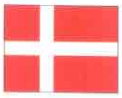
Currency exchange rates: SEK 1 = FIM 0.67 , NOK 1 = FIM 0.70, DKK 1 = FIM 0.78 FIM, ISK 1 = FIM 0.07

Fuel	Energy	Efficiency (Thermal power)
Coal	7.09 kWh/kg	0.38
Gas	10.00 kWh/m3	0.4
Peat	11.28 kWh/kg	0.38
Heavy fuel oil	10.77 kWh/l	0.36

Consumption taxes in Finland include a fee for supply security (0.075 pennies/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



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Bendt Jørgensen, Director, Københavns Belysningsvæsen
Preben Schou, Managing Director, i/s Sjællandske Kraftværker
Georg Styrbro, Managing Director, ELSAM

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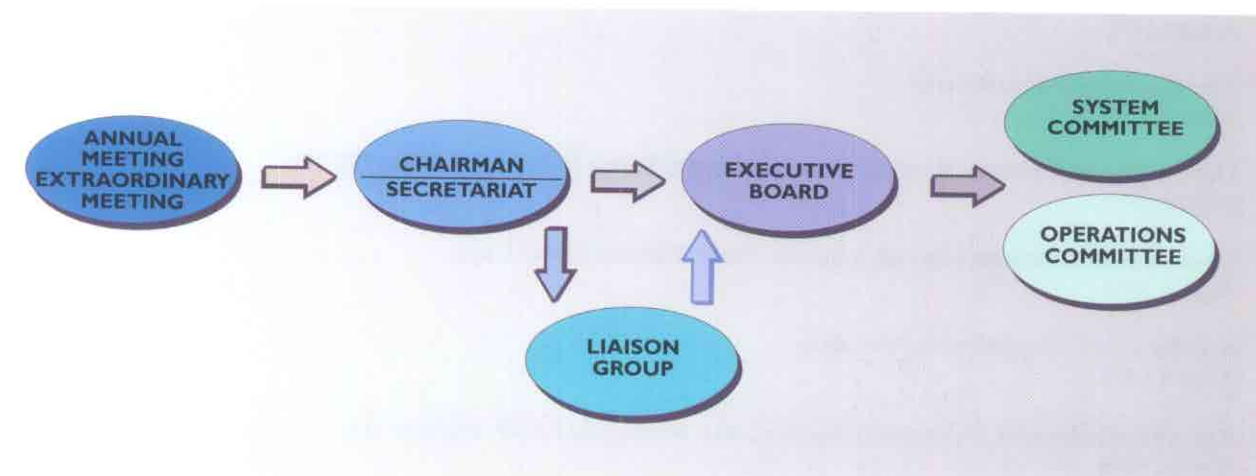

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