Norde [

Annual Report
1994



Nordel's Annual Meeting 1994 was held in Helsinki Cathedral of Helsinki viewed from the harbour on an early morning

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Nordel

Nordel, established in 1963, is an association for Nordic electric power cooperation. It is composed of leading individuals within the power supply sector in Denmark, Finland, Iceland, Norway and Sweden. The association's by-laws and tasks were revised in 1993.

Nordel is an advisory and recommendatory body, whose prime task is to create criteria for efficient utilisation of the Nordic generating and transmission systems. Nordel plays a non-commercial role in connection with electricity exchanges.

Nordel's tasks include among other things:

- technical coordination of the Nordic generating and transmission systems
- formulation of technical framework conditions for the Nordic electricity cooperation
- international cooperation
- contact with other players, organisations and authorities in the electricity sector

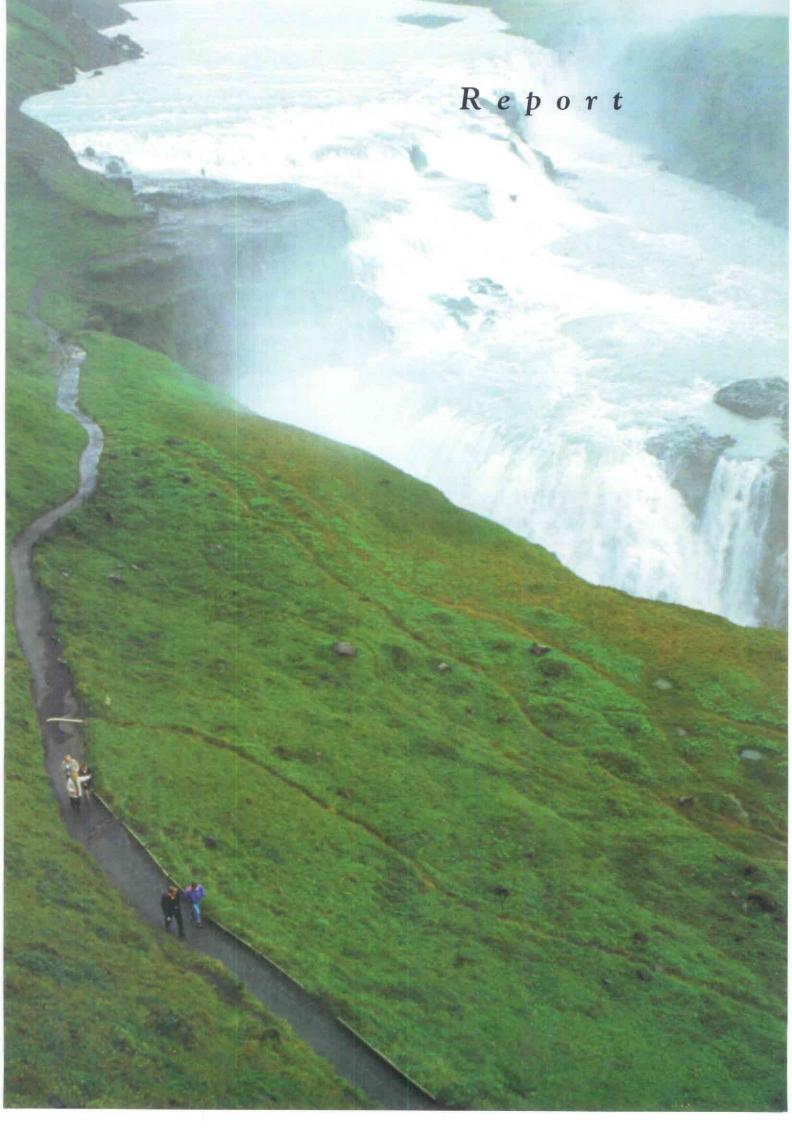
Nordel's chairman is elected for a three-year term. The chairmanship rotates between the member countries. The chairman appoints Nordel's secretary and is responsible for the secretariat.

Nordel has an Executive Board composed of one person from each of the Nordic countries. As Nordel's executive body, the board makes decisions on current matters and implements the decisions made at Nordel's annual meeting. The Executive Board also takes care of Nordel's external information activities.

Much of Nordel's work is carried out by committees and working groups, whose members include specialists on both the generating and the transmission side

Key figures 1994	Nordel	Denmark	Finland	Iceland	Norway	Sweden
Population Mill.inh	23.7	5.2	5.1	0.3	4.3	8.8
Electricity consumption (excl. electric boilers) TW	347.9	33.2	68.1	4.5	108.3	133.8
Max. load (measured 3rd Wedn. in January) GW	57.11)	5.6	10.7	0.6	18.0	23.2
Electricity generation TW	356.1	38.0	62.1	4.8	113.5	137.7
Distribution of electr. gen. in %:						
Hydro power	6 53	0	19	95	99	42
Nuclear power	6 25		30		*	51
Other thermal power	6 22	97	51	0	1	7
Other renewable power?	6 0	3	0	5	0	0

- . Data are nonexistent
- 0 Less than 0.5 of the given unit
- 1) Excl. Iceland



Nordel's activities 1994

Many European countries are in the process of making extensive structural changes in their electricity sectors. The Nordic countries are no exception, and Norway, Sweden and Finland have either established or are planning to establish national, market-based electricity markets. The interplay among these new national electricity markets will make substantial claims on Nordic electric power collaboration.

In 1994, Nordel's activities were influenced to a great extent by the continued adaptation of the work of the organisation to new, more competitive conditions, as well as by the reinforced cooperation with other European organisations in the power supply sector.

Nordel's Annual Meeting was held on 25 August 1994 in Helsinki. In addition to the presentation of the annual report for 1993, reports were made on the current power situation in the Nordic countries, the power situation for the next three years, and international contacts with UCPTE and CIS Electrical Power Council, among others. The Annual Meeting also approved a report containing recommendations about the future exchange of information within Nordel cooperation. The Director

General of Eesti Energia took part in the meeting as the representative of the electric power cooperation of the Baltic countries, thus confirming Nordel's interest in maintaining and strengthening collaboration with these countries.

At an extraordinary Nordel meeting held on 30 November 1994, it was decided to initiate a clarification of the preconditions for establishing a Nordic electricity pool comprising all four of the coordinating countries: Denmark, Finland, Norway and Sweden.

Development in Europe is influenced by increasing internationalisation, and to a far greater extent than previously, the Nordic countries will have to see their role defined within the framework set by the EU. EURELECTRIC, the cooperative body for the European power utilities, plays a key role in the debate on building up the EU in the energy area. Now that the Finns and the Swedes have voted "yes" to membership in the EU, the Finnish and Swedish electricity companies will be accepted as full members of EURELECTRIC. This turn of events provides the potential for a valuable Nordic dimension to be added to EURELECTRIC cooperation.

Increased internationalisation has also brought about the need for reinforced cooperation between cooperating European organisations in the power supply sector. Cooperation between Nordel, UCPTE and UNIPEDE was intensified in 1994, and is expected to be strengthened further in future. The closer cooperation between Nordel and UCPTE has already proved useful in several areas, such as in connection with deliberations about future electricity cooperation with Eastern Europe. Also in 1994, Nordel entered into an agreement with CIS Electrical Power Council on cooperation and exchanging experience, for instance on the operation of large interconnected electricity systems.

The decision to clarify the preconditions for establishing a Nordic electricity pool represents an important step towards the realisation of an open and flexible Nordic electricity market. In terms of supply, a Nordic market would comprise a wide spectrum of accessible energy sources: hydro power, nuclear power, coal, natural gas, oil, biofuels and wind power. Such an electricity pool, operating across national boundaries and comprising actors other than power generators, would be an innovation in international power supply, as well as a natural further development of the effective, unbureaucratic Nordic electricity collaboration that has now been in effect for more than 30 years.

Cooperation between UCPTE and Nordel was strengthened in 1994. Shown below: The Chairmen for the two organisations, Walter Fremuth (right) and John Hebo Nielsen (left)



Activities of the System Committee in 1994



Full-scale line span erected at the Swedish Transmission Research Institute (STRI) at Ludvika. Test results show that it is possible to develop new methods for separating and suspending wires in power lines that will make the magnetic field approx. 90% weaker

The System Committee is responsible for more longterm issues related to technical systems. Its work includes analyses of the technical collaboration between generators and grid operators, follow-up on generating and grid expansion in the interconnected Nordic system as well as studies of capacity requirements for transmission between the Nordel systems and between Nordel and other countries.

The major part of these tasks are handled by the two working groups appointed under the System Committee.

The Generating Group has analysed the power balance in the Nordel system. The basic scenario, depicting the situation in the year 2000, shows a reasonably strong energy balance in the Nordel system and a strong power balance in all sub-regions. The calculations include extensions already adopted and are also based on the assumption of optimal utilisation of the jointly operated links. Energy taxes have not been taken into account.

The basic scenario is designed to constitute the basis on which continued scenario studies will be carried out, including assessments of how energy taxation in the constituent countries will impact future conditions.

The Grid Group has studied new options as well as problems that may arise as a consequence of the substantial expansion of DC links within Nordel and between Nordel and other countries. The findings of the analyses show that these HVDC

links can enlarge the transmission capacity of the AC grid and improve the damping of the grid. If they are not coordinated, however, HVDC links may have the adverse effect that one counteracts the other, and faults in UCPTE can affect dimensioning in Nordel.

The grid group has also carried out analyses of bottlenecks in the transmission grid around the year 2000.

An ad-hoc group has revised the operational performance specifications for thermal power units. The report was discussed on a preliminary basis during the summer, and will be presented at the next annual meeting.

The System Committee reviewed the recommendations from the previous Planning Committee, and proposed that the recommended rules for grid dimensioning, common disturbance reserves and operational performance specifications for thermal power units should remain unchanged. The proposal was adopted by the Annual Meeting of Nordel.

An important part of the activities of the Committee was, and is continuously, concerned with efforts to eliminate restrictions on the most effective utilisation of the Nordic electricity generating and transmission system, for which purpose the Committee has developed an overall picture based on the outcome of various scenarios for the generating and transmission capacity in the Nordic countries and neighbouring regions.

Activities of the Operations Committee in 1994

ORIENTATION OF ACTIVITIES

The Operations Committee is responsible for technical system matters with a short time horizon, and for the technical framework for Nordic electric power interchanges and day-to-day operation.

The work of the Committee will have the following primary orientation.

- The Committee will establish the basis for the best collective utilisation of the complete Nordic electricity system.
- Particular attention will be devoted to the conditions for electricity exchange and improved framework conditions and administrative rules for the market contacts between the players involved.
- Open exchange of information within Nordel will be encouraged in order to ensure a high degree of operating stability and create motivation for increased power exchange.
- the Committee will be a forum for debate on operating collaboration in the Nordic electricity system.
- Environmental issues will have high priority and be handled as an integral part of activities.

Two permanent working groups have been appointed under the Operations Committee:

The working group for system operation (NOK-SY) will carry out analyses, prepare regulations and recommendations and coordinate technical issues related to power systems operation.

The working group has prepared a programme for its activities, which has been sanctioned by the Committee.

The working group for information technology in power systems operation (NORCON) will promote effective utilisation of information technology in operational management of power systems.

In its activities, the Committee is bound to respect the energy policies and electricity market structures of the respective countries. The Committee, therefore, keeps a close watch of developments in the electricity markets of the Nordic countries and the EU.

The Operations Committee has been responsible for the work of a sub-group with participants from the Operations Committee and the System Committee, which had been asked by the Executive Board to prepare an analysis of the scope for development of the Nordel collaboration in view of the new market situation, in order to

· guarantee that generators maintain a continu-

ed high level of supply security,

 facilitate efficient exchange of electricity between suppliers in the Nordic countries.

The group presented its final report at the end of 1994.

POWER COLLABORATION

The Operations Committee has handled current issues concerned with technical performance coordination, operational safety, conditions for power exchange as well as the power generating situation in the Nordic countries.

The power situation was affected by the extreme dryness of 1994, a radical change from 1993, which was a very wet year. In 1993, the water inflow to the Swedish hydro power system was 137 %, whereas in 1994 it was 90 % of the normal rate. The largest inflow deficit to the Nordic system was recorded in the late summer and autumn months.

The water levels in reservoirs at the end of the year were 10 and 20 %-units lower than normal in Norway and Sweden, respectively.

Nuclear power was utilised to the maximum extent apart from a 4 TWh output shortfall caused by extraordinary shutdowns in Sweden.

The use of fossil-fuel power was higher than normal during the dry-weather periods.

In 1994, the market for fossil fuels was strained because of restricted supplies in the coal market and rising prices.

The power situation in the Nordel system in late 1994 was the least favourable for several years.

During the year, permanent power was exported from Norway to Denmark and Sweden, and from Sweden to Finland and Germany via Jutland. The traditional import of occasional power by Denmark and Finland was heavily reduced because of the dryyear conditions in Norway and Sweden. Instead, Denmark exported power to these countries.

The power and energy balances compiled by the Operations Committee for the years 1995-97 are favourable, apart from the Norwegian energy balance which shows a deficit in dry as well as normal years.

An ad hoc group has proposed a structure for exchange of information between the parties to the Nordic power cooperation, taking account of the new market situation. The proposal was first considered by the Committee, and after its adoption by the Nordel Annual Meeting, the Committee is now working to adapt the collaboration to the structure proposed.

The Committee has co-organised a seminar



Power line through beautiful Norwegian scenery. Flisarvaten, Lesja in Oppland

between Nordel and the CIS Electrical Power Council (of the former Soviet states) with a view to breaking a path for future collaboration.

A joint meeting of UCPTE and the Operations Committee will be held in the spring of 1995 to consider developments in the electricity markets of UCPTE countries as well as the Nordic countries.

OPERATIONAL STABILITY

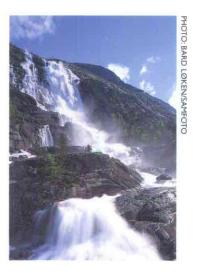
The Nordel system operated without serious outages in 1994.

The Operations Committee has considered a draft for new operational performance specifications for thermal power units, setting out requirements that have to be met before link-up to the Nordel grid.

NOKSY, the working group for systems operation under the Operations Committee, handling technical aspects and analyses for the Nordel system, has been asked by the Committee to focus on tasks such as:

- Analysing the new criteria for grid dimensioning and comparing the related safety requirements with those which are observed in practical operations.
- Reviewing existing recommendations for in-

Langfoss, Etne in Hordaland



stantaneous disturbance reserves and frequencycontrolled grid protection, and proposing necessary revisions and supplements.

- Establishing data for an operating grid designed for the technical analyses carried out by NOKSY.
- Defining and documenting the transmission capacity of the jointly operated links.
- Analysing interruptions and interesting events occurring in the Nordel system.

Developments in 1994

The Nordic countries are in a period of respectable economic growth. Thus, in 1994, the Gross National Product (GNP) rose by 4.2 % in Denmark, 3.7 % in Finland, 2.1 % in Iceland, 4.5 % in Norway and 2.0 % in Sweden.

For Denmark, a fiscal policy relaxation led to a record increase in private spending, and is the main reason for the increase in production, investments and imports.

Finland's trade outlook took an upward turn the end of 1993 due to increased exports. The positive development in exports is due in part to good competitive ability, as well as to a strong upswing in the most significant markets. In spite of economic growth, the rise in domestic demand was modest.

The economic situation in Iceland in 1994 was characterised by a moderate economic upswing. The real value of fishery products, the country's most important product category, showed an increase of 2.5 %, while the value of the other industrial products grew by 7 %.

Norway is undergoing strong economic expansion that started in mid-1993. The upswing is driven first and foremost by domestic demand, with private spending playing a particularly significant role. Traditional exports have risen as well.

The economic outlook in Sweden turned at the end of 1993. Growth has taken place primarily through increased utilisation of capacity in industry and the export-related trades. This development is expected to result in a strong increase in invest-

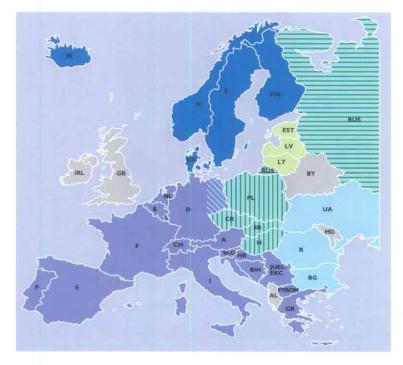
ments for new capacity. Domestic demand is expected to develop only weakly, mainly due to strict government finance policies.

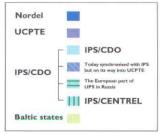
Total electricity consumption (excluding electric boilers) by the five Nordel countries rose by 2.3 % in comparison with 1993. The increase for the individual countries was as follows: Denmark 0.4 %, Finland 4.2 %, Iceland 0.8 %, Norway 4.0 % and Sweden 0.6 %.

Total electricity generation by the five Nordel countries was 356 TWh in 1994, which corresponds generally to the electricity generated in 1993.

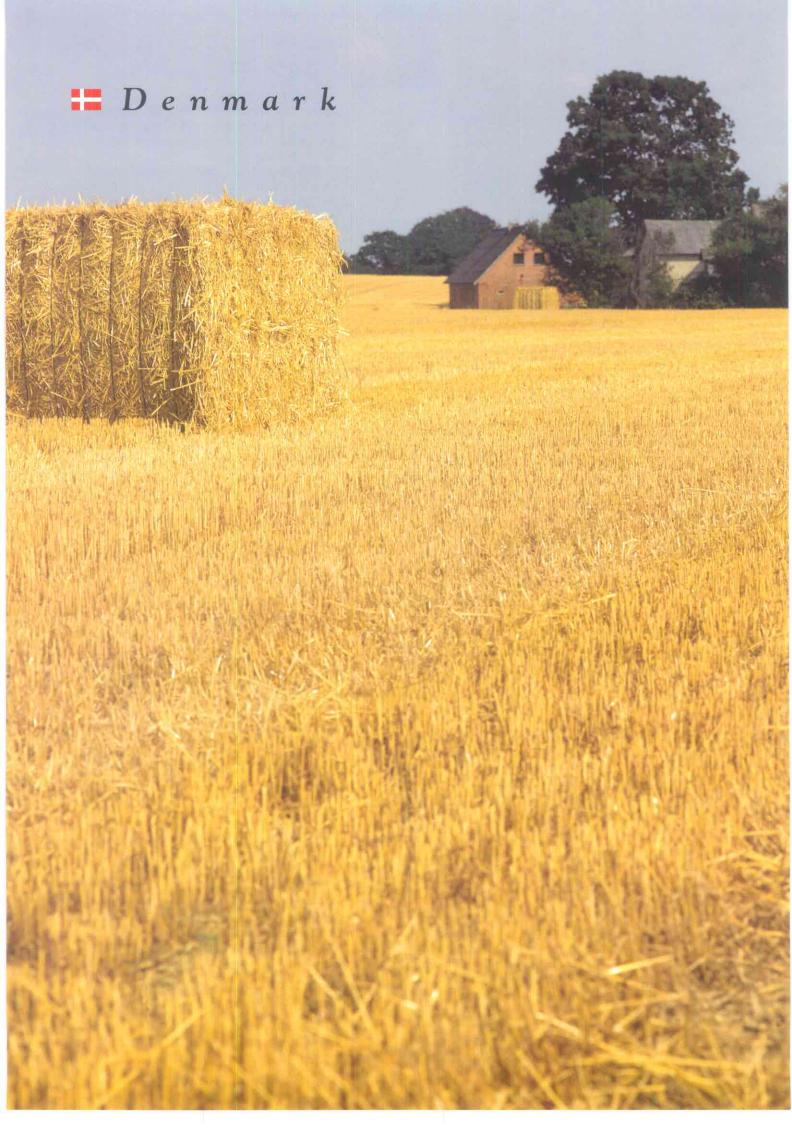
- Hydro power was the largest production source with 187 TWh, corresponding to 53 % of total electricity output. This is a decline of 13 % in relation to 1993, due to a diminished inflow of water to Swedish and Norwegian reservoirs during some of the year.
- Nuclear power was the second largest source of production with 88 TWh, corresponding to 25 % of combined electricity output. This is an increase of 14 % in comparison with 1993, as several Swedish nuclear power plants were shut down for longer periods that year.
- Other thermal power comprised 79 TWh, which corresponds to 22 % of total electricity output, an increase of 20 % in relation to 1993.
- Other renewable power, such as wind power and geothermal power, comprised 1.4 TWh, which is less than 1 % of total output.

Electricity exchange among the five Nordel countries comprised 15 TWh in 1994, plus 9 TWh of electricity exchange with Germany and Russia. Denmark was the largest net exporter with 5 TWh (of which 2 TWh were exported to Germany). Finland was the largest net importer with 6 TWh (of which 5 TWh were imported from Russia).





The organisations
Nordel, UCPTE and
IPS/CDO coordinate
electricity generation
and transmission in
the countries shown.
Interorganisational
collaboration was
strengthened in 1994.



Skærbæk Power Station's new unit 3, scheduled for commercial operation in 1997



ENERGY POLICY

Since the 1970s and with shifting priorities, the main objectives of Danish energy policy have been security of supply, the national economy, saving energy and concern for the environment. In recent years, concern for the environment has been increasingly incorporated into Danish energy policy, and in connection with national elections in September 1994, the Ministry of Energy was merged with the Ministry of the Environment to form the new Ministry of Environment and Energy.

In December 1994, the new Minister of Environment and Energy presented his first energy policy statement, emphasising that the government remains committed to the highly ambitious energy sector objectives set out in the energy action plan from 1990, "Energy 2000". The main thrust of the plan is to reduce CO₂ emissions by 20 % by the year 2005, relative to the 1988 level.

At the same time, the new energy policy statement indicates that the measures already adopted are not sufficient to meet the objectives for CO_2 reduction, and that new initiatives in the energy and transport areas will be forthcoming. The new initiatives are expected to include taxes on industrial energy consumption.

Effective as of 1 March 1994, provisions dealing with integrated resource planning (IRP) in the power supply sector were incorporated into the Danish Electricity Supply Act. The objective of IRP is to weigh consumer-related efforts against production-related action in order to meet top-level energy policy objectives in a way that is most cost-effective.

In 1993, the former Minister of Energy set up a working group to propose how to convert existing buildings in areas with collective heat supply from electric heat to natural gas or district heating. The results of this work were published in June 1994. The working group assessed that about 17,000

buildings currently heated by electricity could be converted to natural gas or district heating with direct benefits to the national economy. The report also indicated that financial benefits to users are questionable.

Folketinget (the Danish Parliament) adopted a proposed bill in June 1993, which opens the way for Danish power utilities to engage in energy supply projects abroad, to some extent. For more than a year, the proposed bill was blocked by the European Commission, which referred to the EU regulations on government subsidies, but the revised version of the bill is expected to be passed at the beginning of 1995.

As part of the realisation of the Single European Market, council directives have been proposed concerning a single market in the electricity and gas area. It is still uncertain how the future regulation of the Danish electricity and natural gas market will be designed, and the Danish government has acknowledged that environmental problems tied to the energy sector will make it necessary to follow up the realisation of a single energy market in the EU by several supplementary joint environmental measures.

ELECTRICITY CONSUMPTION

Total electricity consumption was 33.2 TWh in 1994, which corresponds generally to 1993 consumption levels.

Household and service sector consumption of electricity fell by 1 %, in part due to the savings campaigns carried on by the power utilities. However, the savings by households and the service sector were outweighed by the 5 % increase in industrial consumption.

ELECTRICITY GENERATION

In 1994, domestic output was 38.0 TWh, of which 89 % was generated at primary power stations. The remaining 11 % of production was generated at small-scale CHP plants and renewable energy plants, of which 25 % by wind turbines.

Denmark exported substantial amounts of electricity to both Sweden and Norway in 1994, as both countries had very low water inflow to reservoirs in late summer and autumn. For the year as a whole, Denmark was a net exporter with 4.8 TWh.

Coal continues to be the fuel used most widely by the Danish power stations, accounting for 89 % of their total fuel consumption in 1994.

In February 1994, ELSAM/ELKRAFT and Dansk Naturgas A/S signed an agreement on more natural gas supplies to the power stations. The new agreement comprises 350 million m³ annually to the new CHP unit at the Skærbæk Power Station, scheduled for operation in 1997. In June 1994, the parties also agreed on the supply of a further 300 million m³ of natural gas annually starting at the end of the 1990's.



The first shipload of orimulsion arrived at the Asnæs Power Station at the turn of the year 1994/95

The Danish power stations already have an agreement with Dansk Naturgas A/S to supply 300 million m³ annually, primarily for the Svanemølle and H.C. Ørsted Power Stations in Copenhagen. With the new agreements, total annual consumption of natural gas at the large Danish power stations will reach about one billion m³ by the end of the 1990's. If natural gas consumption by the industrial sector and district heating stations is added, about 25 % of Danish electricity output will be based on natural gas at the turn of the century.

In 1994, Sjællandske Kraftværker decided to file an application to the Energy Agency for setting up a new multi-fuel CHP unit at the Avedøre Power Station, with a capacity of 460 MW_{el} and 480 MJ/s heat. Plans for the new unit are based on

a highly sophisticated technical concept, which allows enormous flexibility as well as a very high efficiency.

In the ELSAM area, two new high-efficiency 400 MW convoy units are being built at the Skærbæk and North Jutland Power Stations. The Skærbæk unit, which will be gas-fuelled, is scheduled for operation at the end of 1997, and the new coalfuelled unit at the North Jutland Power Station will be operational a year later.

Increased use of biomass will be one of the means Danish power stations must adopt in order to reduce CO_2 emissions, and in 1993, the government entered into an agreement with several of the political parties about increased use of biomass. Under the agreement, the power generators must



I/S Vestkraft received the international "1994 Power Plant Award"

successively increase the use of biomass at their primary power stations to 1.2m tons of straw and 0.2m tons of wood chips by the year 2000. A final decision was made at the end of 1994 regarding strawfuelling at Studstrup Power Station's unit 1 (50,000 tons straw annually) and Masnedø Power Station (50,000 tons straw annually), and a separate strawfuelled boiler will be erected at Ensted Power Station's unit 3 (120,000 tons straw annually + wood chips). The biomass programme of the Danish power stations contains a wide range of activities that includes gasification, combined straw-/coalfuelling in traditional as well as fluid-bed boilers, and firing in separate straw-fuelled boilers.

At the turn of the year 1994/95, Asnæs Power Station began test-fuelling with orimulsion at the station's unit 5 (650 MW).

MAIN GRID

At the end of 1993, pole 3 in the DC link between Jutland and Norway became operative, increasing the transmission capacity of the Skagerrak link to about 1,000 MW. At the end of 1994, ELSAM and Statkraft reached agreement on adapting existing agreements concerning the use of the Skagerrak link to the new situation in Norway. The Norwe-

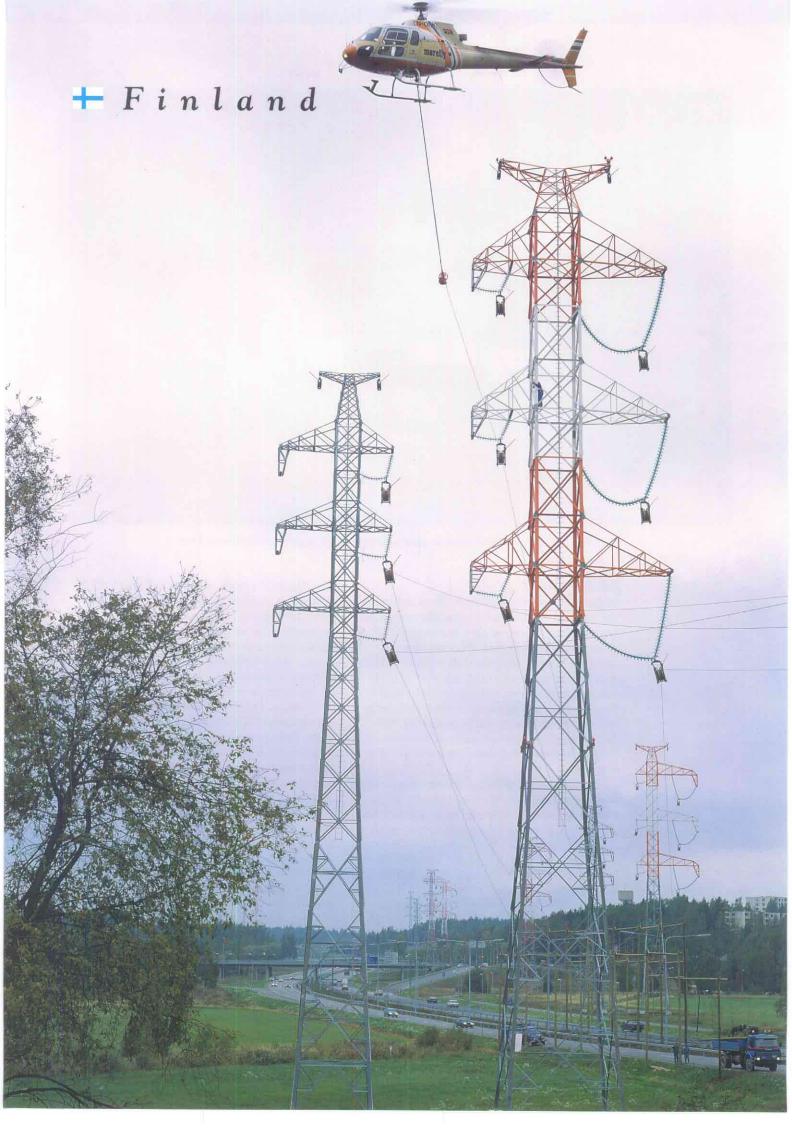
gian government has to approve the agreement before it can enter into force.

The new KONTEK link, which will connect Eastern Denmark's electricity system with Germany, was finally approved by the authorities in 1994. The link will be established as an underground DC cable from Bjæverskov to Gedser (about 100 km), and from there as an approx. 45 km long submarine DC cable to Margrafenheide, north of Rostock. The KONTEK link will have a transmission capacity of about 600 MW and is expected to be commissioned at the end of 1995.

ELECTRICITY PRICES

Excluding taxes, electricity prices fell by about 0.015 DKK/kWh from the start of 1994 to the start of 1995. The average consumer price at an annual consumption of 3,500 kWh is now 0.455 DKK/kWh. Energy taxes and VAT bring the price up to 1.107 DKK/kWh. At an annual consumption of 15,000 kWh, corresponding prices are 0.374 DKK/kWh and 0.973 DKK/kWh.

An industrial customer with an annual consumption of 2.5 GWh pays an average of just under 0.325 DKK/kWh (excluding VAT), plus a CO₂ tax of 0.05 DKK/kWh.





Meri-Pori 565 MW coal-fired power station at Björneborg, inaugurated in February 1994

ENERGY POLICY

In early February, the Ministry of Trade and Industry finalised its proposal for a new electricity market act. The proposal was then fine-tuned by officials of the Ministry on the basis of the replies received in February, after the draft proposal had been submitted for hearing. The new draft proposal was completed in June and was then submitted to the Government. The Government passed on the document to the Parliament in September, and discussions of the proposed structure continued in the parliamentary Economic Committee into the new year.

The Parliament will adopt the new Electricity Market Act before the elections in March 1995, and the act is expected to take effect as from 1 June 1995. It will presumably be complemented by regulations protecting small consumers.

The Government's bill for an electricity market central, ancillary to the new Electricity Market Act, was adopted by the Parliament already in December 1994. The central will handle the tasks imposed on the electricity market authorities by the Act. In the longer term, the central will be funding its activities by means of control, licence and service charges.

The Carbon Dioxide Commission presented its report, according to which significant reductions in

the emission of greenhouse gases in Finland will be extremely difficult in the short term. The primary means for reducing emissions were seen to be energy savings and more extensive use of nuclear power. Finland ratified the Climate Convention in the summer of 1994, whereupon preparations for the national programme were commenced as well as the report for the meeting of the parties to the Convention. The goals can only be reached if the carbon fixation in the biosphere is taken into account. Detailed analyses of the programme have shown that it is uncertain how long the amounts of carbon retained in the biosphere will be sufficient to compensate for the growing emission of carbon dioxide.

Investments in the first desulphurisation and DeNox programmes were completed. In 1993, Finland's emission of sulphur was 120,000 tons, a reduction by almost 80% compared with the level in 1980. Since Finland's goal under Sulphur Protocol II is a 80% reduction before the year 2000, it will therefore be possible to reach this level without adopting all measures set out in the report of Sulphur Commission II. The expected development is, however, threatened by the rising share of fossil fuels used for the energy generated.

The present measures to cut nitrogen oxide emissions are also insufficient for attaining a 30 %

A helicopter helped out when the 400 kV TVS line near Helsinki was erected reduction from the level of 1987. Studies of technical and financial solutions that can help ensure adoption of the necessary measures have been initiated.

After the Government's adoption of amendments to the Nuclear Energy Act in late 1994, nuclear waste generated in Finland must be handled, stored and finally deposited there. At the same time, a prohibition was introduced against handling, storage and final deposit of nuclear waste generated outside Finland. Imatran Voima is allowed to continue transporting spent nuclear fuel to Russia until 1996, meaning another two transports. Imatran Voima has therefore commenced preparations for long-term intermediate storage and final deposit of spent nuclear fuel in Finland.

Following a Government decision in early April 1994, the use of bio-energy should be increased by at least one fourth relative to the present rate by the year 2005, or an energy volume equivalent to 1.5 Mtoe. The total amount of public subsidies to promote the use of bio-energy is FIM 500m a year.

New legislation concerned with mandatory storage of imported fuel will take effect from 1 January 1995. An important new feature, compared with previous storage requirements, is the inclusion of natural gas. Since storing natural gas is technically difficult, the supply security can be ensured by other types of fuel.

ELECTRICITY CONSUMPTION

In 1994, the electricity consumption in Finland rose to 68.2 TWh in total. Statistically, the consumption went up by 4.1 %, or 3.6 % in temperature-adjusted terms. Export industries had the most significant increase in their electricity requirements, in the light of rising demand for forestry and metal industry products. However, also manufacturers supplying the domestic market, the service trades and the housing sector demanded increasing electricity supplies.

The electricity consumption of manufacturing industries was 35.8 TWh, up 5.5 % compared with 6.3 % the previous year. The requirements of other sectors rose by 3 % on average, of which 1 % was the result of the weather conditions. Temperatures in 1994 were equal to the average, but lower than in 1993.

The year's peak output was registered in February, when the consumption reached 11,300 MW, corresponding to an outdoor temperature of -24°C.

Electricity accounted for 26.5% of the total energy requirements - a slight increase on the previous year.

In November 1994, the Ministry of Trade and Industry published a forecast for the electricity requirements until the year 2005, reflecting the trend of the next decade if the country's economic goals are achieved. According to the government

forecast the electricity requirements at the beginning of the 21st century will be higher than estimated by the electricity industry.

ELECTRICITY GENERATION

The electricity demand increased to 68.8 TWh in 1994, which was 4.4% more than the year before. Imports declined by 16%, totalling 6.7 TWh. Imports from Russia accounted for 5.0 TWh (+6%) and from Sweden 1.7 TWh (-47%).

Hydro power generated 11.7 TWh, or 12 % less than the previous year and 7 % less than the average volume. 18.3 TWh was generated by nuclear power, 2 % less than the previous year. The availability factors per unit were as follows:

- Loviisa I 90.3 %
- Loviisa II 80.9 %
- Olkiluoto I 96.4 %
- Olkiluoto II 92.4 %.

The upturn in the forest industry combined with colder weather increased back-pressure generation of power by 9 %. As a result of higher generation levels, lower hydro power output and declining imports, the necessary separate condense power generation went up by 63 % compared with the previous year.

Only minor interruptions occurred in the generating and transmission systems.

The generating capacity increased by a total output of 208 MW. The new capacity consisted of combined heat and power stations and industrial back-pressure plants.

By the end of 1994, new generating capacity of approx. 1000 MW in total was either under construction or at the stage where projects had been given the go-ahead. After decommissioning of old power plants, the net increase will be approx. 900 MW. About half the increase is accounted for by the gas-fired CHP station at Nordsjö, Helsinki, which will be ready for operation in 1997.

ELECTRICITY PRICES

The price of distributed electricity declined somewhat in 1994. The average taxed consumer price in September 1994 was 0.535 FIM/kWh in apartment buildings, 0.459 FIM/kWh in detached houses, 0.344 FIM/kWh in houses with direct electric heating and 0.286 FIM/kWh in houses with electric storage heating. Environmental taxes accounted for approx. 0.02 FIM/kWh.

In 1994, the greater part of the trade in crude power was based on the H/85 tariff system, which had been in use since 1985. The ten-year H/85 contracts will be replaced by new and more flexible products in 1995.

Energy taxation will be tightened in the 1995 Budget. The fuel tax based on energy content will be 3.5 FIM/MWh, whereas the tax based on carbon-dioxide emission will be 38.3 FIM per ton of carbon dioxide. In the same vein, the primary pro-



Waste fuel of the Lovisa nuclear power station is put on final deposit in the bedrock of the power station site. The bottom level, 100 metres down, was reached in April

duct allowance for peat was abolished as well as the import allowance for natural gas. To compensate for this change, the tax on peat and natural gas will be lower during the transition period.

In line with 1994, the taxes on coal and imported electricity will be raised by 70 %, the tax on electricity generated by nuclear power by approx. 15 % and the tax on hydro-power electricity by 50 %.

THE MAIN GRID

IVO Transmission Services Ltd (IVS) presented a proposal for new point tariffs for the main grid. This tariff system will give uniform terms for all those who link up with the grid. The new point tariff system incorporates grid services to generators, which replace the previous joint operation agreement. At the same time, IVS and TVS agreed to run their grids in parallel. The Nordic collaboration between grid operators was intensive, in particular in preparation for the electricity market of the future.

IVS invested significantly less in its grid than in previous years. Towards the end of the year, IVS commissioned a 400/110 kV transformer station at Vuolijoki in north-eastern Finland. No new 400 kV lines were completed. The feasibility of increasing the transmission capacity between Sweden and Finland was investigated. The integrated and versatile 400-110 kV grid database, ELNET, was put into operation. ELNET stores all technical data for lines and stations.

In December, Teollisuuden Voimansiirto Oy (TVS) commissioned the 400 kV Ulvila (Björneborg) - Rosendal - Länsisalmi (Helsinki) Line as well as a 400/110 kV transformer station at Länsisalmi. This link was the largest line investment in the Nordic region in the 1990's (235 km), amounting to FIM 250 million.

The operational reliability was high, and there were no serious interruptions in the main grid operation in 1994.

INTERCONNECTED OPERATION

In late 1994, the Electricity Delegation, a body representing generators and main grid operators, put forward recommendations for a contract system to be adopted in 1995 covering the technical side of interconnected operation. Beside the agreement between IVS and TVS on parallel operation of their main grids and grid services, the new system includes an agreement between main grid operators and generators on grid reserve capacity for disturbances and an agreement on maintenance of technical generating reserves.

The agreement system is exclusively based on the technical requirements for transmission grids and generating plants necessary to keep the electricity system running.

MISCELLANEOUS

Over the past decades, the energy-intensive industries have established several power generating companies. As a consequence, industrial companies have been able to be shareholders in several power generators. In order to strengthen the functional structure of their power generation, industrial companies have in recent years concentrated their power demands with Pohjolan Voima Oy and transferred their electricity purchasing resources to this company. Pohjolan Voima generates electricity for its owners based on their shareholdings.

In 1994, TVS entered into an agreement with the Russian export group of Technopromeksport for importation of electricity from Russia. This import will commence in 1997 and continue until 2004, when TVS's electricity import licence expires.

Ownership patterns in the distribution sector have changed recently. A new feature is the interest demonstrated by foreign enterprises. Previous acquisitions of power stations were primarily transactions between various local authorities or mergers between power stations located in the same region. In autumn 1994, however, Swedish Vattenfall acquired one third of Jyllinkosken Sähkö Oy, and also British Yorkshire Electricity has advanced propositions to Finnish electricity distributors.

Some of the Finnish distributors have also shown interest in stock exchange flotation. At present, two power generating companies are listed.



ENERGY POLICY

Negotiations with the "ATLANTAL" group on a new aluminium smelter in Iceland remained at a standstill in 1994, although the parties kept in contact with each other.

In May 1994, the Minister of Industry presented a report to Altinget, the Icelandic Parliament, entitled "Domestic energy sources for generating electricity". The report outlined the potential for generating electricity inherent in the country's deposits, in terms of exploiting the country's energy sources for energy-intensive industry, producing artificial fuel and possibly exporting power. With the same objective, the Minister of Industry published an information document about the hydro power projects in northeast and eastern Iceland, covering the technical and economic aspects of the projects, their influence on local industries as well as tourism, and environmental impact. He also held information meetings with local authorities and Members of Parliament in those regions expected to be particularly affected by these projects.

The Minister of Industry is now in the process of revising the Energy Act of 1967. At the 1994 annual meeting of the Iceland power station association, the Ministry brought up various points and questions in this connection, in order to get response from power utility people. The matter was discussed at the meeting, but no specific positions have been taken to date.

In December, Iceland signed the Treaty on the European Energy Charter, with the reservation that it is ratified by Altinget.

ELECTRICITY CONSUMPTION

Electricity consumption in Iceland was 4,774 GWh gross in 1994, that is, including transmission and

distribution losses and the power stations' own consumption. Compared with 4,721 GWh the year before, consumption grew by 1.1 % in 1994, divided as 3,905 GWh firm contract power and 869 GWh unguaranteed power.

Energy-intensive industry accounted for 50.3 % of total consumption (50.4 % in 1993). Private consumption increased by 1.5 %, without correction for temperature deviations from normal. With correction, growth was 1 %.

ELECTRICITY GENERATION

Electricity output, which is equal to gross consumption because no electrical energy is imported or exported, was 4,774 GWh, compared with 4,721 GWh in 1993. Of this amount, 4,510 GWh or 94.5 % was generated at hydro power station (unchanged in comparison with 1993), 260 GWh or 5.4 % at geothermal plants (also unchanged from 1993), and 4 GWh or 0.1 % by diesel and gas turbines.

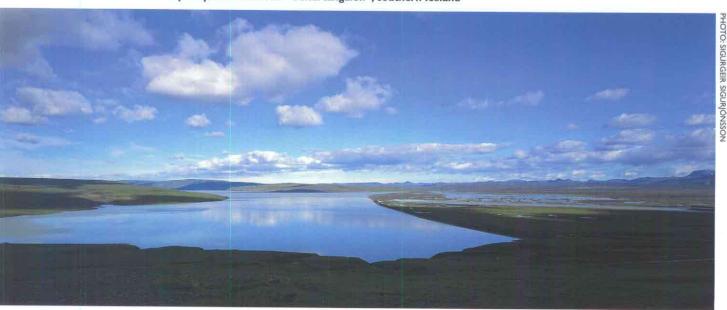
The installed capacity of public power plants was 1,045 MW at the end of 1994, largely the same as at the end of 1993.

ELECTRICITY PRICES

Landsvirkjun increased its bulk tariff to distributors by 3.0 % on 1 January 1994, the only increase during the year. The retail tariffs of the main distributors remained largely unchanged in 1994, falling rather than increasing, in fact. Certain internal adjustments were made between tariff groups.

The market price of crude aluminium improved somewhat in 1994, relative to its low level the year before. Consequently, the price for power charged by Landsvirkjun to Det Islandske Aluminiumselskab, ISAL, also rose. The price was 12.5 mUSD/kWh in the first quarter of 1994, but 14.176







Ploughing down three single-phase 33 kV cables for distribution to rural districts in northern Iceland

PHOTO: THORDUR ANDRÉSSON



Geothermal ORC (Organic Ranking Cycle) unit of 1.2 MW using isobutane as working fluid in Svartsengi CHP plant, southwestern Iceland

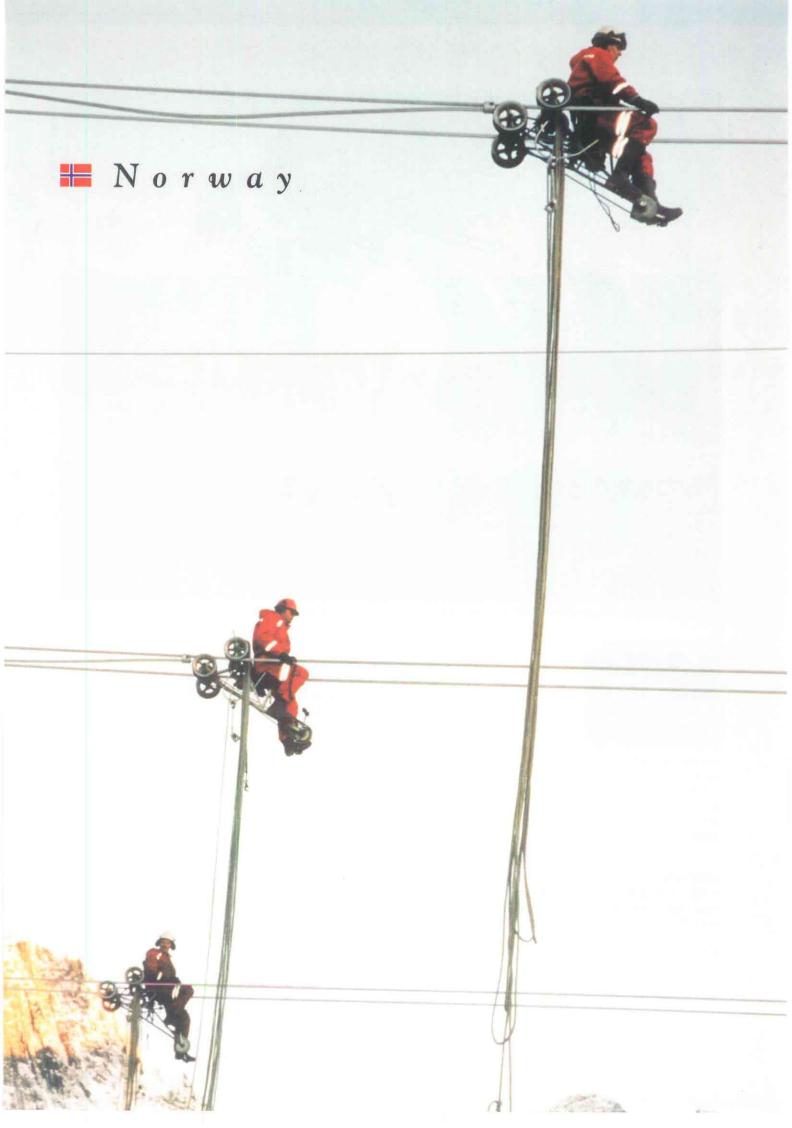
mUSD/kWh in the fourth quarter, corresponding to 0.0929 SEK/kWh and 0.1053 SEK/kwH, respectively, based on the rate of the dollar on 31 December 1994.

MISCELLANEOUS

ICENET, a study team with representatives from two Dutch power utilities, a Dutch cable manufacturer and Reykjavik Municipality, continued the second phase of the feasibility study on exporting power from Iceland to the Netherlands. At the request of ICENET, Landsvirkjun will also take part in the last part of the study. Other export possibilities are being kept in sight. Landsvirkjun's cooperation with Scottish Hydro on studies of a cable connection between Iceland and Scotland continued during the year, and representatives from Hamburgische Elektricitätswerke AG paid the Ministry of Industry and Landsvirkjun a visit in the summer of 1994.

Towards the end of the year, information meetings between an American zinc manufacturer and its Icelandic counterparts were held in Reykjavik, about building a zinc factory in southwest Iceland. Landsvirkjun and a Reykjavik manufacturer of artificial fertiliser were present at the meetings.

At extraordinary meetings in December, the associations of the Icelandic power stations and heating stations decided to merge, a process that has been underway for a long time. No decision has yet been made on what to call the new national association, which will also encompass waterworks.



ENERGY POLICY

The Ministry of Industry and Energy has granted Norsk Krafteksport AS a concession for a power exchange agreement with SEP, a Dutch power generator. The exchange will be realised via a new cable between Norway and the Netherlands. It is intended to have a capacity of 600 MW and will be operational in the year 2001. The agreement has been concluded for a term of 25 years. Stattnet SF will be owning the northern and SEP the southern half of the cable. Stattkraft SF is the Norwegian party to the agreement, but will make agreements with the other shareholders in Norsk Krafteksport AS, who are seven of the major Norwegian power generators.

Norsk Krafteksport AS will be supplying a maximum power volume of 2.16 TWh a year, whereas SEP has been granted an option for exporting 0.6 TWh annually at an agreed price. In addition, the entire capacity of the cable is intended to be available for short-term exchange of power, to take advantage of differentials between marginal costs in the Netherlands and prices in the Norwegian power market. If a pool is established in the Netherlands, the prices will be based on the prices quoted for this pool.

A public committee has presented a proposal to amend the act on water utilisation and ground water (the Water Resources Act). The new act will replace the existing Water Utilisation Act from 1940. The basic idea of the proposal is to ensure that environmental concerns are reflected more distinctly in the new Bill, at the same time as the public interest in the management of water resources will be reinforced. The Bill has been submitted for hearing to a broad range of interested parties, and the Ministry of Industry and Energy is aiming at presenting the Bill to the Parliament in the spring of 1996.

The compilation and publication of data on water reserves stored in the reservoirs of the power generators began on 1 August 1994, after such data had not been available to the public for almost two years. The Norwegian Water Resources and Energy Administration (NVE) collects data from the power generators as a routine procedure, and processes and compiles them into total figures for three national sections as well as for the country as a whole. The Central Statistical Office publishes the total figures once a month in line with its publication of other economic statistics.

The Water Resources and Energy Administration (NVE) has drafted new guidelines for metering and paying for power consumption, which makes it more simple to switch to another power supplier also for customers with low requirements. These guidelines specify the distribution of liabilities between power suppliers and grid operators in a region. The authorities have forbidden the power generators to demand fitting of new meters, if small customers want to switch to another power suppli-

er. NVE has also prepared new guidelines for system liabilities in the power system. The system liability concept makes generators, grid operators and major end users liable to coordinate their actions to the necessary extent, where such actions will impact the power system. The purpose is to protect operational stability. National system liability has been imposed on Stattnet SF, based on guidelines that set out more specific definitions of Stattnet SF's practical responsibilities and methods. The guidelines will come into force from 1 January 1995.

The Competition Supervisory Authority is responsible for ensuring conditions that permit effective competition in the power trade. The Authority has to make sure that the power generating and distributing sectors are subject to the same rules for competition and information to the market and the public as operators in other market-oriented activities. In December 1994, the Competition Authority turned down an application from three major Norwegian power generators (the OBT Group) and another application from six large power generators (Sørkraft AS), who had requested exemption from the provisions of the Competition Act that prohibit cooperation on sale of electric power, market sharing and agreements on inter-company water exchange.

ELECTRICITY CONSUMPTION

The total gross consumption in Norway was 113.5 TWh in 1994, representing an increase of 1.1 TWh from 1993.

The gross consumption in general distribution was 77.0 TWh, 4.2 % up from 1993. Adjusted to normal temperature conditions, the general consumption was calculated at 77.5 TWh, an increase by as much as 4.4 % compared with the same period last year. This is a far higher growth rate than in the last half of the 1980s and the beginning of the 90s, when the temperature-adjusted growth rate was about 1.5 - 2.0 %.

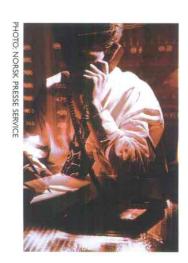
The consumption in energy-intensive industries was 28.0 TWh, up 1.5 % compared to 1993.

The total demand for power for electric boilers and pumped storage power was 6.8 TWh, a decline by 23.1 % relative to 1993.

The consumption of light heating products (light fuel oils and paraffin) was 970 million litres. This represents an increase of 6.8 % compared with 1993. For heavy fuel oils, the consumption was 393 million litres, a surge by as much as 52.3%.

The electricity consumption was about 50.4 % of the energy content in energy carriers supplied to end users (net final consumption). Petroleum products covered 37.4 % and solid fuels 11.7 %. District heating accounted for approx. 0.5 %. Thus, the electricity share of the total consumption declined by approx. two percentage points from 1993 to 1994.

The power line Salten-Svartisen, commissioned in November, greatly expands the transmission capacity between northern and central Norway



Statnett Marked recorded a steep increase in turnover in 1994, particularly in the weekly market

The peak load related to domestic consumption, including electric boilers and pumped storage power, was recorded on 14 February, when it reached 19,786 MW, an increase on 1993 of 499 MW or 2.6 % and a new peak load record. At the peakload hour, exports amounted to 348 MW.

ELECTRICITY GENERATION

The generation of hydro power was registered at 112.9 TWh in 1994. Including 0.6 TWh thermal power, the total output reached 113.5 TWh. This was 6.7 TWh or 5.6 % less than the 1993 output.

The exchange of power with other countries resulted in net imports of 0.1 TWh, a change relative to 1993, when net exports totalled 7.8 TWh. Exports to Sweden accounted for 4.4 TWh, whereas imports were 2.9 TWh. Exports to Denmark amounted to 0.9 TWh and imports 2.3 TWh. Imports from Finland amounted to 0.3 TWh. There was no exchange of power with Russia.

New generating capacity in 1994 totalled 133.5 MW, with an average annual output of 514.2 GWh. The additional capacity was provided by 11 projects, most of them small-scale power plants. The largest project was the Meråker/Tevla power station with a capacity of 108 MW and 409.1 GWh.

NVE has estimated the mean yearly output in the Norwegian hydro power system at 111.7 TWh, using data returned for the period 1931-1990. In addition, Norway has thermal power stations with a mean annual output of 0.6 TWh. The total Norwegian power output in 1994 was thus 1.1 % higher than the mean annual figure. In hydro power stations, the installed capacity totalled 27.144 MW on 31 December 1994.

ELECTRICITY PRICES

The average price (quantity weighted) for power distributed through Statnett Marked AS was 177 NOK/MWh for 1994. This is an increase by as much as 116% compared with 1993. The average price of power distributed through the daily market

was 185 NOK/MWh. The highest price in this market was 481 NOK/MWh (on 28 February) and the lowest was 60 NOK/MWh (on 14 May). The average price of regulating power was 176 NOK/MWh, whereas it was 162 NOK/MWh for the weekly market.

The average 1994 price for households was 0.489 NOK/KWh including taxes, a reduction by 3.1 % from 1993. The average 1994 price covers a power price of 0.157 NOK/kWh, a transmission price of 0.193 NOK/kWh and total taxes of 0.139 NOK/kWh. Analyses have revealed a tendency towards price equalisation of total prices charged for the various regions of the country. The transmission price tends to vary a good deal, whereas the competitive power price is subject to considerable equalisation.

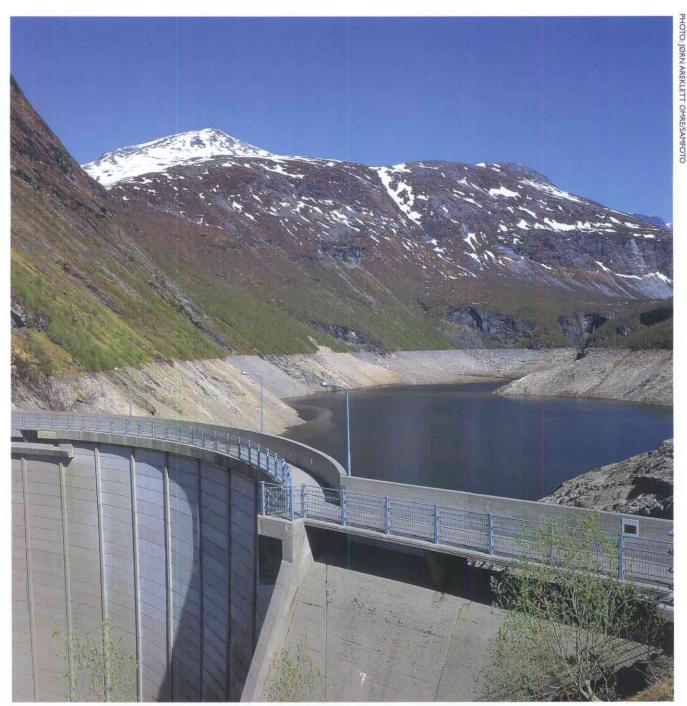
An electricity tax is levied on power supplied, though manufacturing industry, mining, greenhouses and electric boilers have been exempted from this tax from 1994. Consumers in Nord-Troms and Finnmark are also exempted from the tax. In 1994, the tax was levied at a rate of 0.051 NOK/ kWh, but it has been raised to 0.052 NOK/kWh for 1995. In addition, there is a generating tax on all electricity generated. Until 1 July 1994, the rate was 0.0122 NOK/kWh, whereas it was raised to 0.015 NOK/kWh for the rest of the year and to 0.0152 NOK/kWh for 1995. The tax base is 1/15 of the total output generated during the past 15 years (the period 1978-1992). Like all other goods and services liable to VAT, electricity was subject to VAT at the rate of 22 per cent. The VAT rate has been raised to 23 % for 1995. However, the three northern counties are exempt from VAT.

Statnett Marked AS, the organiser of the Norwegian marketplace for trade in physical power, took over Norsk Kraftmarked AS as at 5 October 1994. This acquisition was part of the development of a new financial power market. Statnett Marked is aiming at harmonising the offers in the traditional weekly market with new financial products. From 1 January 1995 Statnett Marked has been given a more free position in relation to its parent, Statnett SF, and on that occasion the company was relocated to new premises.

MAIN GRID

On 11 August, a new 132 kV line from Mestervik to Hungeren (line 2) was put into operation. This new line has helped ensure a more reliable power supply to Tromsø city.

On 10 November, the 420 kV line from Salten to Svartisen was operational, providing a 420 kV through-link in a region where the exchange in the Norwegian grid was previously carried by a single 132 kV line. Analyses completed in 1994 showed that it will be possible to operate the lines of Nord-kalotten as one grid (ring operation Norway-Finland-Sweden). After the restructuring of operations



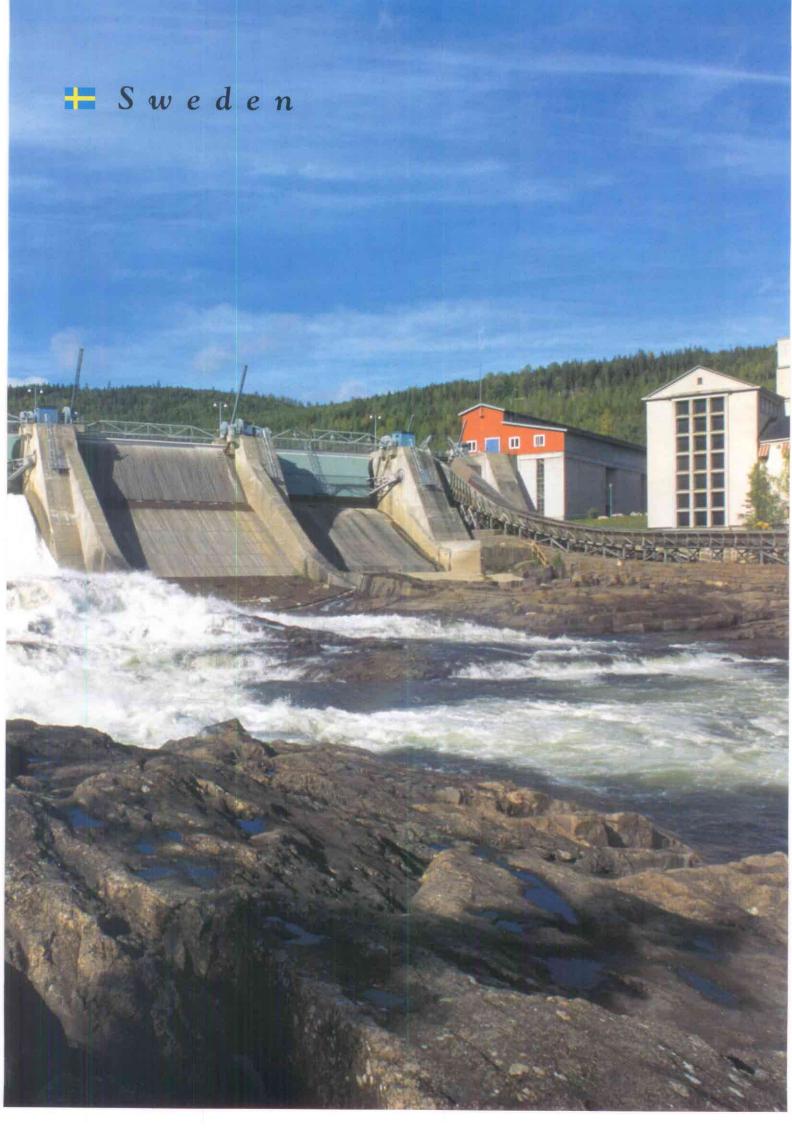
The Sakarias Dam, Møre and Romsdal. Collection and publication of data on water levels in power station reservoirs have been resumed

(January 1995), consumers in Finnmark will have instantaneous reserve capacity in case of outage of a single line in the main grid.

The Norwegian main grid had no operating interruptions affecting large areas in 1994.

Statnett has given advance notice of comprehensive plans to reinforce the main grid in southern Norway in the period from 1997 to 2003, to provide capacity for the planned and adopted cable links between Norway and the continent. The investments required for the domestic main grid are estimated to total up to NOK 2 billion. The advan-

ce notice is based on plans including three new cable links to the continent before 2003 - 2005, of which the first link cannot be established earlier than in 1999. Otherwise, the planning foresees a maximum capacity of 800 MW for each cable. The advance notice proposes location of the current-converting stations at either Lista/Feda, Tonstad or Kvilldal in the Ullaførre region. Specific proposals for new transmission systems include a 420 kV line between Holen-Evje and Kristiansand. Other major projects to rebuild the existing main grid may also become necessary.



ENERGY POLICY

In 1994, energy policy discussions were centred on two main issues, deregulation of the electricity market and the question of carrying into effect the phasing-out of nuclear power by the year 2010. The first deregulation measure taken by the Parliament was a resolution, passed in late May, to lift all restrictions on the electricity market in order to introduce free market conditions in Sweden from 1 January 1995. This action was accompanied by a decision to appoint a parliamentary energi commission, designed to analyse issues related to the electricity market reform, and to revise the energy policy with special reference to the question of nuclear power. According to its mandate, the commision should present its report by 30 November 1995.

After the parliamentary elections in the autumn, a new government took office in Sweden. Its first action in the energy policy area was postponement of the electricity market reform. The new government issued an additional directive to the energy commision to further analyse certain effects of the electricity market reform. Among the issues were the situation of the customers living in sparesely populated parts of the country, and foreign trade with electricity. By the directive the commision was given the possibility of giving precedence to these questions by treating them together in a separate report. Thereby, the deregulation of the Swedish electricity market can be implemented by 1 January 1996 provided that the commissions' analyses support the reform.

In mid-year, NUTEK, the industrial and technology development body, presented its annual evaluation of Sweden's energy situation commissioned by the Parliament. The evaluation was carried out in extension of the three-party statement on energy policy drafted in 1991.

The NUTEK report includes an assessment of Sweden's electricity requirements by the year 2005. The total energy consumption is expected to grow by barely one per cent a year, to approx. 158 TWh in 2005. The forecast is based on the assumption of an average increase in manufacturing output of 2.6 per cent per year and average annual GNP growth of 1.8 per cent.

According to NUTEK's assessment of nuclear power generation, the generating capacity will be about 72 TWh in 2005. In its Budget for 1994/1995, the Government uses NUTEK's assessments of electricity consumption and generation without further comments.

ELECTRICITY CONSUMPTION

The 1994 electricity consumption, excluding electric boilers, rose to 125.6 TWh, an increase of 2.3 TWh compared with the previous year. In addition to the direct electricity consumption, the transmission loss was estimated to be 8.3 TWh against 9.5 TWh in 1993.



Turbine, Porjus Power Station

The weather conditions in the past year were largely normal in temperature terms. Thus, for conversion to average temperature terms, the electricity consumption needs adjustment by only +0.6 TWh, to 126.2 TWh.

The power supplied to disconnectable electricity boilers in 1994 was 4.1 TWh, representing a decline by 3.3 TWh relative to the previous year. Thus, the total electricity consumption in Sweden for 1994 was 129.7 TWh, a decline by 1.1 TWh.

Industry used 49.5 TWh, or 2.0 TWh more than the previous year. In the food and timber processing industries, the consumption fell by approx. 2.3 %.

The pulp and paper manufacturers, the most energy-intensive industry in Sweden, increased their annual consumption by 2.7 % to 19.1 TWh.

The rail and tramway sector increased its electricity requirements by 4.2 % to 2.6 TWh.

The electricity consumption in the housing, service and heating station sectors rose to 73.5 TWh, which is 0.1 TWh less than the previous year.

The extent of power exchange with neighbouring countries was less than in 1993. Sweden exported 6.4 TWh and imported 6.7 TWh, producing an import surplus of 0.3 TWh.

The year's single-hour peak was 24.4 GWh/h, which was recorded on 14 February between 8 and 9 a.m.

Thus, the all-time-high (26.2 GWh/h) recorded on the extremely cold day on 12 January 1987 remained unchallenged.

◀ Krångede
Power Station

Reactor I at Oskarshamn had a major overhaul in 1994 and is expected back in operation in spring 1995



ELECTRICITY SUPPLY

The total electricity output declined to 137.7 TWh, or 3.4 TWh less than the previous year.

Hydro power stations generated 57.9 TWh, 5.6 TWh below the mean annual output level, and 15.4 TWh less than the 1993 output. The water inflow, in particular in the late months of the year, was far more limited than in 1993. The annual inflow rate was 90 % of the mean annual flow level. The reservoir rate at the end of the year was 51 per cent, equivalent to an energy value of 17.2 TWh.

The output generated by nuclear power stations rose to 70.2 TWh in 1994, an increase by as much as 11.3 TWh compared with the year before. In view of the relatively limited water inflow to hydro power stations in 1994, the higher nuclear power output was invaluable for Sweden's electricity supply.

The Oskarshamn 1 nuclear reactor was shut down for continued overhaul in 1994. Otherwise, there were few unplanned stoppages.

The energy availability rate was 79.9 %, which compares favourably with a world average of 69.8 - 74.5 % during the past 10 years for light-water reactors (the reactors of the former Soviet Union are not included in the weighted world tariff). Of the Swedish reactors, Forsmark 3 recorded the highest availability rate at 93.5 %, followed closely by Forsmark 1 at 92.6 % and Ringhals 3 at 91.7 %, helping the Forsmark Power Group as well as Ringhals Power Station break their annual output records in 1994.

Back-pressure generation rose to 8.6 TWh, an increase of 0.6 TWH compared with 1993. The output from condense plants, gas turbines, etc. rose 0.5 TWh to 0.9 TWh.

Klippens hydro power station was completed in 1994 (27 MW), and a capacity improvement was commissioned at Ringhals 1 (40 MW).

Five combined heat and power stations were also completed in 1994, including Linköping (50 MW), Enköping (22.5 MW) and Kristianstad (15 MW). All new CHP plants can be fuelled by wood.

The wind power output was expanded by means of new turbines generating 9 MW.

In 1994, the total growth in generating capacity was 203 MW.

MAIN GRID AND INTERNATIONAL LINKS

The line section between Horred and Breared, the first stage of the new 400 kV west-coast line, was put into service on 16 November. The project included renovation and capacity extension at the switchgear stations at Horred and Breared. The second stage, including continuation of the line to Söderåsen, is in the process of construction.

The Kilanda 400 kV transformer station was extended with capacity for two new lines; two reactors with a total capacity of 125 Mvar were commissioned at Lasele; and, at Kolbotten, the renovation works continued during the year.

The last station with serial capacitors, which contain the eco-toxic substance PCB, was renovated. The station, located at Stöde, was back in operation on 1 November. The project to renovate the switchgear and monitoring systems at Grundfors was completed, and the new monitoring system at Stadsforsen was commissioned in December.

The renovation project at the 400 kV switchgear station at Kilforsen was completed. The upgrading included installation of a new monitoring

Baltic Cable, the 600 MW power link between Southern Sweden and Germany was completed in 1994 and opened for commercial operation on 1 January 1995

system, and, as the last station in the 400 kV grid, Kilfors was equipped with double line protection.

The central previously located at Hamra, which monitored several of the 400 kV stations in eastern Svealand as well as the Fennoskan HVDC cable, was moved to Råcksta and is now operated by Svenska Kraftnät.

The Baltic Cable for transmission between southern Sweden and northern Germany was completed and inaugurated on 1 December. The cable, having a transmission capacity of 600 MW, is owned jointly by PreussenElektra, Sydkraft and Vattenfall.

ELECTRICITY PRICES

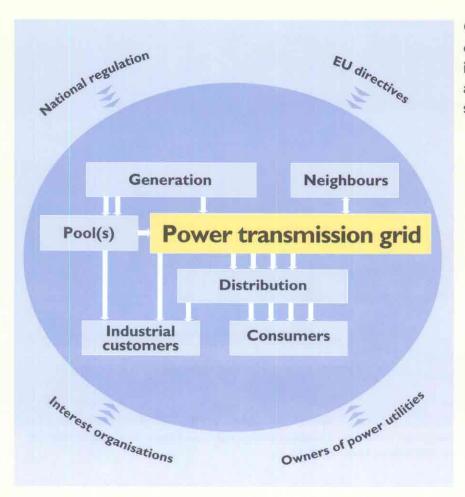
In view of developments in the Swedish electricity market during the past few years, a uniform electri-

city price cannot be reported. Already before the deregulation has been formally implemented, the suppliers have commenced adjustment to the expected market reform. Therefore, all contracts for electricity supplies are preceded by negotiations on prices and other supply conditions, thus creating a highly fragmented pricing picture.

In the tax area, the Parliament decided in 1993 to raise energy taxes according to an index based on the general trend of prices in the twelve-month period October-October. Within this framework, the Parliament has raised the energy tax on electricity to 0.09 and 0.037 SEK/kWh from 1 January 1995. The low rate will be charged in Norrland, whereas the high rate will be payable in the rest of the country.

Nordic Main Grid

The backbone of Nordic electricity collaboration



Growing competition in international electricity supply.

INTRODUCTION

Smooth operation of the Nordic main grid is the technical precondition for the reliable supply of electricity and a high standard of supply quality. The expanding scope for free competition in electricity exchange and generation has increased demands on the main grid.

The Nordic main grid is comprised by the national transmission systems of Denmark, Finland, Norway and Sweden and several interconnecting links, which bind the grids into one continuous system. The main grid is operated at high voltage levels, mainly 400 kV and 300 kV, and the voltage range between 220 kV and 110 kV to some extent.

The main grid integrates electricity generation and consumption. At the same time, the interconnected Nordic grid enables operators to take advantage of the economic, supply security and en-

vironmental benefits offered by cooperation between the different generating plant systems in the Nordic power sector.

Until recently, the main grid was considered an integral part of the power generating system. In the past few years, however, new trends such as those inspired by the EU proposal for a single energy market have induced changes in the electricity supply structure in many countries. Electricity trading and generation are increasingly based on free competition as well as the separation of generating, transmission and distributing functions. Combined with the rising public interest in electricity supply issues and their environmental impact, this has led to organisational changes and motivated new legislation in several Nordic countries.

Growing internationalisation as well as new developments in HVDC transmission technology have

also boosted interest in establishing new cable links between Nordic countries and other parts of Europe.

These patterns of change are accompanied by new and important challenges for future planning and utilisation of the Nordic main grid.

THE MAIN GRID: TECHNICAL DESIGN

The current Nordic main grid consists of approx. 75,000 km of line sections. About 17,000 km are 400 kV lines, about 13,000 km are 220-300 kV lines and about 45,000 km are 110-150 kV lines.

The Nordic main grid and collaboration have been developed steadily ever since 1914, when the first transmission link between Sweden and Denmark was put into operation. The present structure of the main grid is indicated by the map on page 42.

The national transmission grids and interconnecting links between them make up the electricity sector infrastructure, which plays a key role in the power supply system. Since 1972, the transmission grid has been designed according to common Nordel dimensioning rules, which ensure sufficient grid strength under normal operating conditions, as well as in rare cases when adverse combinations of events place system security at risk. The common Nordel rules help ensure that systems are restored quickly when faults occur.

The total transmission capacity of the interconnecting links between the countries is approx. 6,000 MW, equivalent to approx. 7 % of the rated generating capacity of the Nordic countries. The total transmission capacity between the Nordel region and neighbouring countries is currently approx. 3,000 MW, but considerable expansion is on the way. The figure below illustrates developments and variations in the exchange of electricity over a span of about 20 years.

Interconnecting different systems provides

several advantages, but also means inter-dependency. System reliability is regulated by technical recommendations, and a reasonable distribution of the burden is taken into account.

The technical requirements defined for the design of power stations are based on system-related conditions as well as local needs. The requirements are set out in Nordel's technical performance specifications for thermal power stations. These specifications can be considered a "non-discriminatory" requirement for the connection of power stations. The system-related part of the requirements is closely correlated with the frequency-induced disconnection of consumers at distribution level and the protective systems of the transmission grid. The requirements are also closely tied to the possibilities of frequency-induced power regulation for HVDC links to neighbouring regions.

Coordinated adjustment of the power regulation of the many existing and planned HVDC links ensures that they do not counteract each other, and that faults in neighbouring regions do not influence the dimensions of the Nordel system.

Hydro power and thermal power stations have highly different regulating properties and opportunities for output change with different timing requirements. The favourable properties of hydro power stations have helped bring about substantial savings in thermal power systems over the years. Conversely, the energy potential of thermal power stations has provided substantial savings on dryvear protection for hydro power systems. The variations in the mean annual output of hydro power systems are considerable from one year to another.

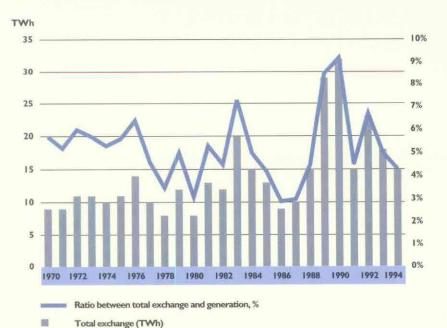
The necessary reserves are split between the Nordic countries in such a way that the costs to each subsystem are limited.

The generating systems of the Nordic countries

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Smooth operation of the Nordic main grid is the technical precondition for maintaining reliable Nordic electricity supply with high standards of supply quality, even if legislation and other terms are changing

77



The figure illustrates development and variation in electricity exchange over about 20 years.

have traditionally been developed to provide the capacity necessary for their own consumption, and to provide some degree of supply reliability. However, the new market-orientation may have the consequence that as measured by traditional standards, there will not be sufficient equilibrium between output and consumption in the Nordic countries at any time. The reason is that generators are not likely to invest in new generating capacity until prices have reached a level high enough to cover their investments and a certain rate of profit via long-term contracts.

In the traditional system, an imaginary interruption of the links to neighbouring regions would not lead to an immediate breakdown in supplies, but "only" to more expensive electricity, reduced reliability of supply and inferior standards of supply quality. Acquiring generating plants in neighbouring regions would, however, make new demands on the transmission grid in order to maintain the same availability of capacity to the generating plants, irrespective of their geographical location. Like dams and power station sites, overhead line tracks are a resource in scarce supply.

THE MAIN GRID: ORGANISATION, OWNER-SHIP, EXCHANGE AND TARIFF CONDITIONS

The European energy sector is currently undergoing a process of rapid change. Two of the underlying factors are the liberalisation measures contemplated by the EU and the deregulation which has already started in some countries.

In the Nordic region, Norway liberalised the electricity sector with effect from 1 January 1991, and Sweden and Finland have proposed new electricity legislation, similar in many ways to the Norwegian reform.

In the transmission sector, there are still vast differences between the countries as shown by the table below.

The table demonstrates that ownership structure and organisation vary widely from country to country; the national legal frameworks, including concession issues, are also different.

Nordic electricity collaboration is based on a framework in which the Parliaments have sovereign authority, whereas generators and other operators have decision powers in relation to their owners.

The following pages give a more specific review of conditions in each of the Nordic countries. The feature article in the 1993 annual report presented a detailed account of ownership and organisational structure in the respective countries. The following review is a supplement to that report.

DENMARK

Generators (above 25 MW) and grid operators (above 100 kV) are subject to 20-year concessions. International links and distribution are covered by other parts of the Electricity Supply Act. Concession holders are subject to supply obligations.

System liability, including power transmission functions, are handled by the planning, operating and coordinating utilities ELKRAFT and ELSAM,

Subject	Owne	ership	Optimising	System liability	
	Transmission grid	Collaborative links	generation/ Trading system		
Denmark	Elkraft/Elsam *)	Elkraft/Elsam *)	Centralised generating optimisation	Elkraft/Elsam*)	
Finland	IVS/TVS **)	Generators	National generating optimisation ***)	IVO (present) IVS / TVS **) (Bill)***)	
Iceland	Landsvirkjun	Landsvirkjun	Centralised generating optimisation	Landsvirkjun	
Norway	Statnett (approx. 80%)	Statnett (major links)	Pool	Statnett	
Sweden	Svenska Kraftnät	Svenska Kraftnät and generators	National generating optimisation (will be replaced)	Svenska Kraftnät	

which are owned by the generators. Distributors have direct influence on the control of the EL-KRAFT transmission grid.

The transmission grids, including interconnecting links, are owned by ELKRAFT and ELSAM. The 132 kV grid is owned by the distributors on Zealand, whereas the 150 kV grid is owned by the generators on Funen and in Jutland. ELKRAFT and ELSAM are in charge of load dispatch, with considerable respect paid to supplies of cogenerated heat and power, as well as power sourced from small-scale plants and wind turbines. ELSAM's grid is synchronously linked with the continental UCPTE-grid.

Denmark has no pool functions or public transit tariffs for the transmission grid, nor published conditions for connection to the grid. However, sales tariffs are public. The authorities have the right to insight into the matter, and the price formation process is partially public. Generators can be ordered to use special fuels or technology (for example cogeneration of heat and power). There are no restrictions on trading with foreign partners.

Bottlenecks in the transmission grid are eliminated by the decision of the Boards of ELKRAFT and ELSAM, respectively.

In February 1995, the Ministry of Energy and Environment issued new rules, according to which a number of the existing 132 - 150 kV transmission lines will be dismantled and incorporated in fewer 400 kV line avenues. The rules are also expected to result in the replacement of the existing 50 and 60 kV overhead lines by underground cables. The principal aim of the new rules is to reduce the impact of overhead lines on the natural environment.

FINLAND

Today, all sales of electricity must be based on concessions.

A new Electricity Act, expected to come into force on 1 June 1995, will incorporate rules for third-party access to the grid for consumers requiring more than 0.5 MW during a transition period as well as free choice of supplier. Concessions will be required for grid operators, but no longer for distributors. Generating plants will be subject to approval according to environmental and other legislation, but not based on assessments of electricity demand. Distributors will be granted concessions for a limited geographical area and be subject to obligations of supply. Distributors must make a supply offer to all customers in a neighbouring area. Sales tariffs must be published.

In 1992, transmission activities were separated from the state-owned IVO group of companies into an independent subsidiary, IVS, which manages more than half the transmission grid above 100 kV (90 % of 400 kV, 75 % of 220 kV and 35 % of 110 kV). About 20 % (of which 10 % is 400 kV) of the grid is administered (owned) by the industrial

company, TVS, whereas the remaining 30 % is owned by approx. 50 other operators. The existing international links are owned by the IVO generating company.

According to the new Electricity Act, transmission tariffs and terms must be available to the public. Pricing and marketing agreements in restraint of trade and abuse of a dominant position are prohibited under the Competition Act. Pricing must be transparent, but regulation of generation, distribution and international trade will be reduced.

The new act will impose system liability on the central transmission companies. The transmission grid must provide access for third parties against reasonable compensation. The two transmission companies with system liability will be responsible for eliminating bottlenecks in the grid.

A pool system is not incorporated in the Bill.

ICELAND

Concessions are issued for generation, transmission and distribution.

The greater part of generating activities are handled by the Landsvirkjun utility, owned by the state and two large municipalities. Landsvirkjun is also responsible for supplying large industrial customers, and selling electricity wholesale to the large distributors according to public tariffs. In addition, Landsvirkjun operates the main transmission grid and is thus holder of the system liability.

The distributing companies in Iceland are either owned by the state or municipalities or by a combination of both. Each company has a monopoly right of distribution in its region, and the sales tariffs are public.

Iceland is without electricity links to other countries, but despite the long distance to Europe, plans are being prepared for HVDC cables to Scotland or the Netherlands. The attraction of these projects is derived from Iceland's relatively large and cheap hydro power projects. It is estimated that only 13 % of the country's hydro power potential and geothermal resources are developed today. Future plans for a larger electricity market in Iceland include new markets such as more large industrial plants.

NORWAY

Since the new Electricity Act came into force in 1991, the Norwegian electricity sector is among the most liberal in the world. However, the ownership structure has not changed very much, and there has been no privatisation of either generators or grid operators, which remain in public hands primarily. The organisational structure was changed, as the government split the state-run company, Statkraftverkene, into a generating entity, Statkraft SF, and a grid operator, Statnett SF. Statkraft is the largest generator, accounting for approx. 30 % of Norwegian electricity generation. Statnett is responsible

77

Separation of generating, transmission and distributing functions. Growing international contact between the Nordic region and other countries. Clashing interests and ideologies. Necessity of finding a new balance between Nordel collaboration, bilateral coordination and commercial contracts between companies 77

for the central grid scheme (the transmission grid) including system liability, and is also responsible for planning, expanding and operating the state-owned part of the grid. Through the central grid scheme, Statnett rents capacity on the approx. 20 % of the transmission grid which is owned by a total of 33 other operators. Statnett is also responsible for the administration of short-term international electricity exchange. Pool trading is handled by its subsidiary Statnett Marked AS.

Very few of the other electricity companies have been split into separate entities for grid and generation/distribution. However, the authorities demand that accounts be kept separately.

Norway has had pool trading in electricity since 1971, but trading was reserved exclusively for generators until 1992. Today, the pool is open to all participants in the electricity sector, and operates on three markets: a daily market, weekly market and regulating power market. The regulating power market is an instrument available to holders of system liability to ensure balance between supply and demand.

All players have unrestricted third-party access to the grids. Distributors are liable to connect consumers, but they have no obligation to supply them. Competition in the end-user market was sharpened as from 1 January 1995. There is no longer an hourly metering requirement for subscribers who want supplies from a source other than their local distributing company, and the charge for switching to an alternative power supplier has been reduced to NOK 200.

Transmission services are paid for by means of a point tariff system. Tariffs are not based on the distance between supplier and consumer, but depend on the marginal loss related to feeding and takeout. Bottlenecks in the grid are handled by creating a separate price area behind a bottleneck. The electricity price of such an area will be different from that of the rest of the country, and market forces will control the production behind the bottleneck.

International electricity exchange is subject to regulation. Long-term contracts (for more than six months) have to be sanctioned by the Ministry of Industry and Energy. Short-term trading is given special concession and have to take place on the daily and weekly markets. Agreements have been entered into for direct HVDC cables to Germany and the Netherlands, with attached supply agreements. In addition, negotiations are being conducted for further cable agreements. These agreements will require substantial reinforcement of the grid in southern Norway.

The Norwegian Water Resources and Energy Administration (NVE) plays a major role as the authority which grants concessions, defines the premises and controls the grid monopoly. In addition, power generation and sale are monitored through the general competition legislation.

SWEDEN

Sweden has regional concessions with supply obligations (distribution) and line concessions (transmission).

Power transmission is handled by Svenska Kraftnät, which has been separated from Vattenfall into an independent company as a restructuring measure. The company holds the system liability, and has an obligation to make transmission capacity available on non-discriminatory terms. The concept of system liability embodies management of the short-term power balance, comprising all generation and consumption, independent of voltage levels, and safe and reliable transmission of power on the main grid as well as the international links.

Svenska Kraftnät has therefore been given the right to define specified requirements for electricity systems, where this is considered necessary. For example, the technical conditions for connection include specifications for all systems connected to the main grid. Bottlenecks are eliminated through counter-purchase, which gives virtually endless grid strength.

Svenska Kraftnät owns all of the 400 kV grid and almost the entire 220 kV transmission grid, as well as the majority of the international links. It has a right of access to the remaining parts of the transmission grid. Vattenfall and Sydkraft have a right of access to a couple of the interconnecting links with other countries. Transit and connection tariffs must be published. Electricity is traded by agreements between generators, distributors and large customers.

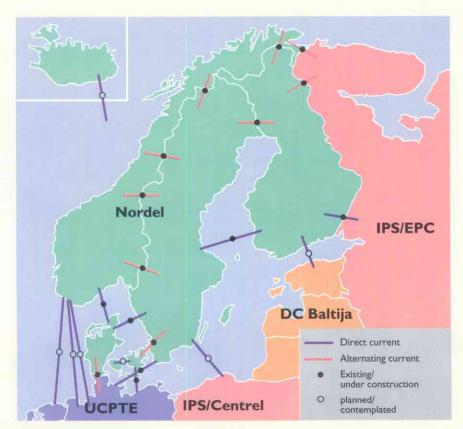
The new Electricity Act, which was intended to come into force on 1 January 1995, has been postponed pending new fact-finding reports. The goal is to create a more competition-driven electricity market like the Norwegian system, for example. This means that the Act will include elements such as third-party access and free supplier choice. The feasibility of establishing a pool in Sweden, or possibly a joint pool with Norway, is being studied.

In connection with the new Electricity Act, it is the intention to introduce a new tariff for main grid transmission. It will probably be a point tariff, with rates based on distance and favourable terms for feeding in Southern Sweden and take-out in the North.

Svenska Kraftnät's system liability and the new tariff became effective on 1 January 1995, and are thus not affected by the postponement of the new Act.

THE MAIN GRID: NEW OPERATING CONDITIONS, DEVELOPMENT TRENDS AND SCOPE FOR ACTION

The challenge in coordinating development is closely related to the conditions under which the main grid, as well as the whole generating sector, operate.



Existing and planned interconnecting links in the Nordic region

In addition to the separation of generating, transmission and distributing functions, the trend is moving towards increased international contact and trade between the Nordel region and other countries.

The Nordic countries have different legislative frameworks, reflecting a variety of development trends, but the systems are tied by the same physical laws of nature. Agreements can be made on payment conditions, but no one can agree to decide how electricity runs in an AC grid. The parliaments have sovereign authority in their countries, whereas operators in the electricity sector have decision-making power within their own entities. The participants depend on their neighbours, decisions have impact on them, and, frequently, the whole Nordic system is affected directly or indirectly. This inter-dependence necessitates a constant dialogue between generators, grid operators and consumers.

Strong, contradictory interests are involved: Society, power sector and manufacturing industry (prices and price stability), consumers (prices, reliability and quality of supply) and environmental bodies (air and countryside). Ideologies may clash as well: collaboration vs competition, with or without regulation or central control, for instance, by means of Integrated Resource Planning.

Changes are introduced frequently in all countries, at organisational and regulatory level. Competition is growing on national and international

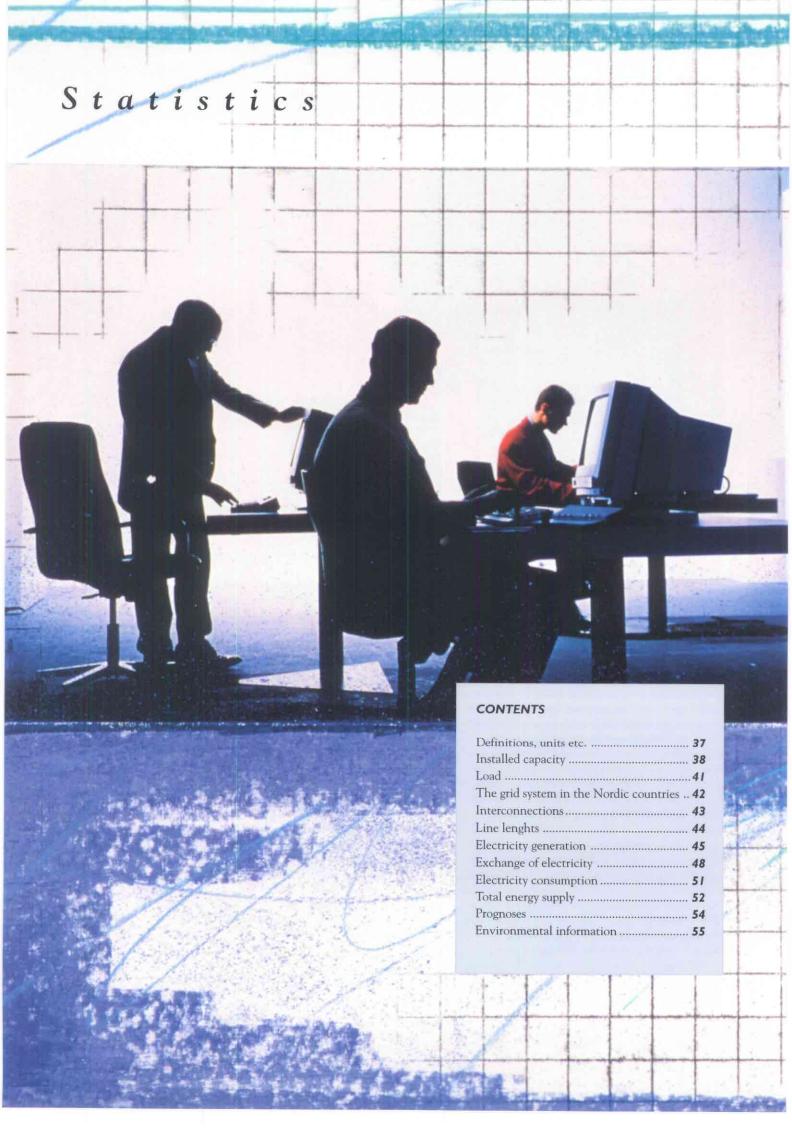
markets, also due to new cross-border ownership constellations.

Public interest in electricity issues and their environmental impact is growing, but there is also a more responsive dialogue between electricity suppliers and authorities. The authorities' demand for "insight into price formation" is constantly increasing.

The outcome of this process has been different ways of allocating responsibility for system stability and supply security in the respective countries. The basic prerequisite is a developed and relatively strong transmission grid, which provides scope for collaboration and trade.

Trading patterns are changing; for example, part of the bilateral exchange of occasional power is being replaced by pool trading complemented by long-term contracts. Bilateral trade is replaced by trade between more parties, who are not necessarily neighbours. A larger number of permanent contracts are cutting into the amount of power available for occasional power exchange. Thus, the increasing amount of trade has emphasised the importance of expanding the main grids of the respective countries, as well as the interconnecting links between them.

The article has been written by Ole Graabæk in cooperation with Nordel's System Committee and Network Group



DEFINITIONS

Installed capacity (net capacity): Is given in MW and constitutes the arithmetric sum of the rated capacity of the unit installed, but excluding own consumption.

Transmission capacity: Is the rated capacity in MW of a line with due regard taken to the limits imposed by the transformers connected to it.

Electricity generation (net generation): Is usually given in GWh and represents the output ex works, i.e. excluding own production at power station.

Condense: Is defined as the output from a turbogenerator set operated by steam that is expanded in a cooling water condenser to enable the steam to be utilised exclusively for electric power genera-

Combined heat and power (CHP): Is the generation of electric energy by a generator set driven by steam which, when discharged from the turbine, is applied for a purpose irrelevant to power generation such as district heating (CHP District heating) or process steam for industry (CHP Industry). Previously designated Back-pressure generation.

Imports/Exports: Is given in GWh and represents the settled values which (inclusive of compensation of loss) are registered as purchases and sales of electricity between the individual countries. Net imports: Is the difference between imports and exports.

Notes: The Norwegian share of Linnvassely is considered as exports from Sweden to Norway. The German share of Enstedyærket is considered as exports from Denmark to Germany.

Total consumption: Is given in GWh and is the sum of electricity generation and net imports.

Occasional power to electric boilers: Is given in GWh and is the supply of electricity to electric boilers on special conditions for the generation of steam or hot water, which is alternatively generated by firing with oil or other fuels.

Gross consumption (electricity available): Is usually given in GWh and is the calculated electricity consumption: the sum of domestic electricity generation and imports deducting exports and occasional power to electric boilers.

Losses: Are usually given in GWh and is the calculated expression of the difference between gross consumption and net consumption.

Pumped storage power: Is given in GWh and is the electrical energy consumed by the pumps in raising the water into the upper reservoir.

Net consumption: Is usually given in GWh and is the sum of power consumed by the consumers.

UNITS AND SYMBOLS

kW kilowatt

MW megawatt = 1,000 kW

joule

kI kilojoule

PI petajoule = 1015 J

kWh kilowatt-hour = 3,600 kJ

MWh megawatt-hour = 1,000 kWh

GWh gigawatt-hour = 1,000,000 kWh

TWh terawatt-hour = 1,000 GWh

Alternating curent (AC)

Direct current (DC)

Data are nonexistent

Data are too uncertain

Less than 0.5 of the given unit 0

No value

EXAMPLE OF CALCULATION:

Electricity generation

+ Imports

- Exports

Total consumption

Occasional power to electric boilers

Gross consumption

Losses, pumped storage power etc.

Net consumption

Responsible for statistics processing: Anne-Marie Volt - SK Power Company, Denmark

Responsible for the individual countries' statistical information: Lisbeth Petersson - The Association of Danish Electric Utilities, Denmark Terho Savolainen - The Association of Finnish Electric Utilities, Finland Rutúr Halldórsson - The Iceland Energy Agency, Iceland Arne Hjelle - Statnett Market, Norway Gunilla Kierkegaard and Yngve Wending - Vattenfall AB, Sweden

The present statistics were prepared before the 1994 official statistics for the individual countries have become available. Certain figures in the Annual Report may thus differ from the official statistics.

SI Installed capacity 31.12.1994, MW

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total installed capacity 1994	10 342	14 525	1 046	27 426	35 037	88 376
Commissioned in 1994	92	209	2	202	203	708
Decommissioned in 1994	76	- m	-	68		144
Hydro power	10	2 802	875	27 144	16 502 1)	47 333
Nuclear power		2 310			10 040	12 350
Other thermal power Of which:	9 794	9 408	121	278	8 457	28 058
Condense	8 339 2)	3 673		78	2 740	14 830
CHP District heating	701	2 867		- I.	3 143	6 711
CHP Industry	195	1 990		165	636	2 986
Gasturbine etc.	559	878	121	35	1 938	3 53 1
Other renewable power Of which:	538	5	50	4	38	635
Wind power	538	5		4	38	585
Geothermal power			50			50

i) Incl Norwegian share of Linnvasselv (25 MW)

S2 Average-year generation of hydro power 1994, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Average-year generation 1994		12 530	4 950	111 697	63 600	192 777
Average-year generation 1993		12 530	4 950	111 183	63 500	192 163
Change	-	-	_	514	100	614

²⁾ Incl. German share of Enstedværket (300 MW)

S3 Changes in installed capacity 1994

Power category	Power plant	Commissioned	Decommissioned	Change in average-year generation (Hydro power)	Type of fuel
		MW	MW	GWh	
Denmark					
Condense	Masnedøværket		75		Coal/Oil
	Asnæsværket		1		Coal/Oil
CHP District heating	Hanstholm	5			Natural gas
Wind power	ELSAM	12			
Finland					
Condense	Mussalo	91			Natural gas
CHP District heating	Martinlaakso	8			Natural gas
Namuou					
Norway Hydro power	Fossheimfoss	2		12	
- riyaro power	Nomeland		177	12	
	Ottedal	29	17	35	
		9	6	7	
	Fosse	18	18	3	
	Leinafoss	5		15	
	Meråker	87	20	295	
	Terla	41		114	
	Byafossen	3		25	
	Scheldefoss	1		6	
	Kongsmarka	3		1	
	Skarsfjord	4	4	2	
Sweden					
 Hydro power 	Klippen	27		97	
	Munkfors	11			
	Alfta	10			
	Div. ændringer	3			
Nuclear power	Ringhals I	40			∫ Wood waste
 CHP District heating 	Linköping	50			Waste, refus
	Enköping	23			Wood waste
	Falun	9			Wood waste
	Kristianstad	15			Wood waste
	Värnamo	6			Wood waste
 Wind power 	Div. vindkraftv.	9			

S4 Decided power plants (larger than 10 MW)

Power category	Power plant	Capacity	Estimated commission.	Average-year generation	Type of fuel
		MW	Year	GWh	
Denmark					
CHP District heating	Skærbækværket 3	394	1997		Natural gas
	Nordjyllandsværket 3	385	1998		Coal/Oil
	Silkeborg	102	1995		Natural gas
	Sønderborg	52	1996		Waste, refuse/Natural gas
	Avedøreværket	498	1999		Coal/Oil/Natural gas/Bioma
	Svanemølleværket	80	1995		Natural gas
	Næstved	38	1995		Waste, refuse/Natural gas
	Østkraft	37	1995		Coal
	Ringsted	12	1995		Natural gas
	Masnedøværket	10	1996		Straw
Finland					
Hydro power	Koivukoski	25	1995	20	
	Matarakoski	11	1995	32	
	Vuotos	37	2001	430	
CHP Industry	Kyro	40	1995		Natural gas
	MB/Rauma	50	1996		
	Veitsiluoto	30	1996		
	Kirkniemi	80	1997		Natural gas
CHP District heating	Toppila 2	105	1995		Peat
	Rovaniemi	30	1995		Peat
	Vuosaari B	450	1997		Natural gas
Norway					
Hydro power	Frøystul	19	1995	74	
STATE RESIDEN	Hekni	56	1995	230	
	Åsebotn	15	1995	85	
	Gravfoss	34	1996	78	
	Svartisen II	40	1998	251	
Sweden					
CHP District heating	Nyköping	34	1995		Wood waste

\$5 Maximum and minimum load on 3rd Wednesday in January and in July 1994

	Installed		Maximum and minimum system load 1994								
	net capacity	3rd Wedr	nesday in Ja	nuary		3rd Wedn					
	31.12.94, MW	Local time	Max MW	Local time	Min MW	Local time	Max MW	Local time	Min MW		
Denmark	10 342										
West of t	he Great Belt	17-18	3 325	03-04	1 822	10-11	2312	04-05	1 446		
East of th	ne Great Belt	17-18	2 282	02-03	1 276	11-12	1 376	04-05	775		
Finland	14 525	19-20	10 704	03-04	8 869	12-13	6 721	05-06	5 296		
Iceland	1 046	10-11	602	03-04	480	11-12	472	05-06	374		
Norway	27 426	08-09	18 045	02-03	14 798	10-11	9 135	04-05	7 193		
Sweden	35 037	08-09	23 248	23-24	17 401	11-12	11 591	04-05	8 135		
Nordel 1)	87 330	08-09	57 124	02-03	44 367	11-12	31 059	04-05	22 845		



S6 Existing interconnections between the Nordel countries

1) Maximum permissible exchange

Thermal limit. The total transmission capacity is +/- 1300 MW. It can be higher, however, if the practical possibilities of supply are limited, it is most

often due to the import/export capacity of the Swedish or the Danish system

3) The transmission capacity can in certain operating situations be lower due to bottlenecks in the Norwegian network. 1800 MW implies a network protection system during operation (PDC = Production disconnection)

\$7 Existing interconnections between the Nordel countries and other countries

Countries Stations	Rated voltage	Transmissi	on capacity	Total lines	Of which cable
	kV	М	w	km	km
Denmark-Germany Kassø-Audorf Kassø-Flensburg Ensted-Flensburg	2 × 400 ~ 220 ~ 220 ~	From Nordel	To Nordel	107 40 34	
Finland-Russia Imatra-GES 10 Yllikkälä-Viborg Nellimö-Kaitakoski	110 ~ ±85 = 110 ~	From Nordel	To Nordel 100 900 60	20	*
Norway-Russia Kirkenes-Boris Gleb	154 ~	From Nordel 50	To Nordel 50	10	
Sweden-Germany Västra Kärrstorp - Herrenwyk	450 =	From Nordel 600 ²⁾	To Nordel 600 ²⁾	250	220

1) Transmission capacity alters between 1200 and 1500 MW due to operating conditions
2) Due to limitations in the German network, the transmission capacity is limited to 250 MW from Nordel and 200 MW to Nordel for the present

S8 Decided interconnections

Countries Stations	Rated voltage	Transmission capacity as per design rules	Total lines	Of which cable	Brought into service
	kV .	MW	km	km	Year
Denmark-Germany Bjæverskov - Rostock	400 =	600	181	166	1995
Denmark-Denmark Elsam-Elkraft	400 =	500-600	approx 70	approx 70	1998
Norway ¹⁾ -The Netherlands ²⁾	400 - 500 =	min 600	approx 550	approx 550	2001
Norway ¹⁾ -Germany ³⁾	400 - 500 =	min 600	approx 550	approx 550	2003

¹¹ Not decided: Lista, Feda or Tonstad

59 Transmission lines 110 - 400 kV in service Dec. 31, 1994

	400 kV, AC and DC	220-300 kV, AC and DC	110, 132, 150 kV
	km	km	km
Denmark	1 109 19	540 ²⁾	3 890 3)
Finland	3 821 4	2 660	14 600
Iceland		492	1 315
Norway	2 110	5 782 ²⁾	10 300
Sweden	10 657 4)	4 621 2)	15 000

¹⁾ Of which 129 km in service with 150 kV and 46 km with 132 kV

²⁾ Probably Eemshaven

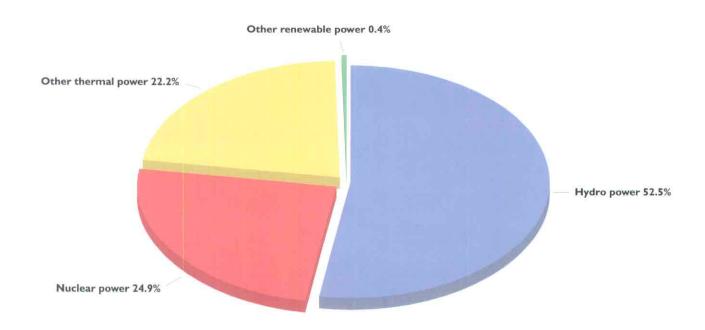
³⁾ Probably Wilhelmshaven

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 in service with 50 kV

⁴ Of which 99 km in Finland and 99 km in Sweden DC submarine cable and 34 km in Finland and 2 km in Sweden DC land cable (Fenno-Skan)

\$10 Total electricity generation within Nordel 1994



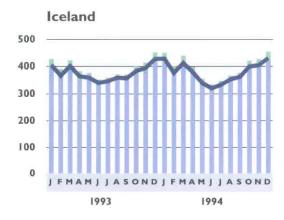
SII Electricity generation 1994, GWh

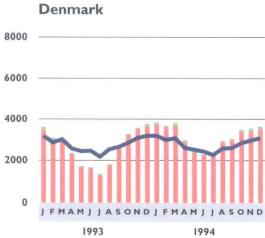
	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total generation 1994	38 044	62 108	4 774	113 528	137 656	356 110
Hydro power	28	11 669	4510	112 908	57 883	186 998
Nuclear power		18 337		+	70 151	88 488
Other thermal power Of which:	36 933	32 095	4	613	9 547	79 192
Condense	36 332 1)	12 010		119	850	49 311
CPH District heating		10 461		+ 1-1-	4 608	15 069
CPH Industry	601	9 615		341	4 007	14 564
Gasturbine etc.	-	9	4	153	82	248
Other renewable power 2)	1 083	7	260	7	75	1 432
Total generation 1993	31 882	58 005	4 720	120 205	141 062	355 874
Change as against 1993	19.3 %	7.1%	1.1%	-5.6%	-2.4%	0.19

³⁾ Wind power Iceland: Geothermal power

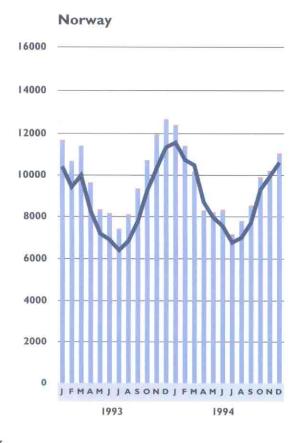
\$12 Monthly electricity generation and gross consumption 1993 -1994, GWh

- Gross consumption
 - Generation by hydro power
 - Generation by nuclear and other thermal power
 - Generation by wind power or by geothermal power (Iceland)

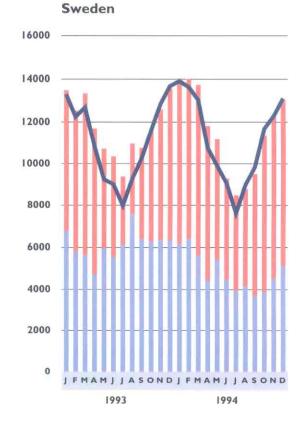




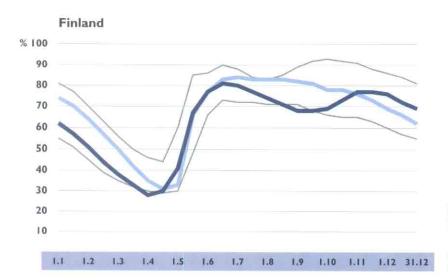








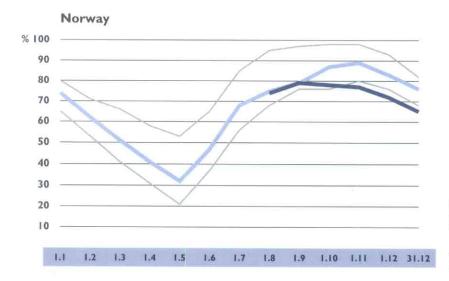
\$13 Water reservoirs 1994



- Water resevoirs 1994 shown in % Norwegian data given from 31.7.1994
- Water resevoirs 1993 shown in % Norway: Average 1982-1991
- Minimum and maximum in % The values are given by data which have been recorded the past 10-14 years

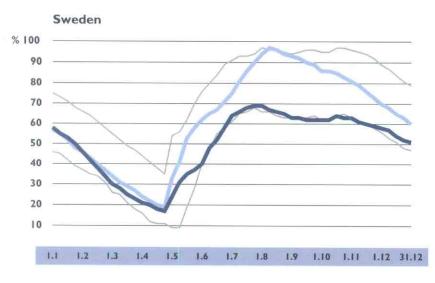
Resevoir capacity 01.01.1994: 4 900 GWh 31.12.1994: 4 900 GWh

Minimum and maximum values from data which have been recorded 1984-1993



Resevoir capacity 31.07.1994: 77 032 GWh 31.12.1994: 77 073 GWh

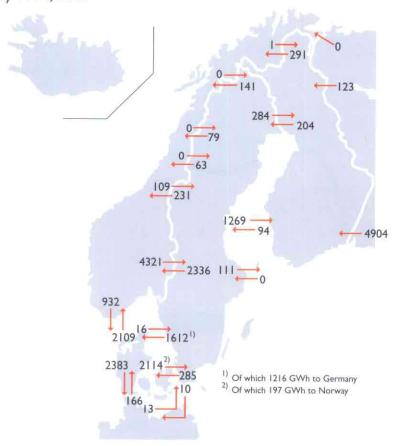
Minimum and maximum values from data which have been recorded 1982-1991



Resevoir capacity 01.01.1994: 33 550 GWh 31.12.1994: 33 550 GWh

Minimum and maximum values from data which have been recorded 1980-1993

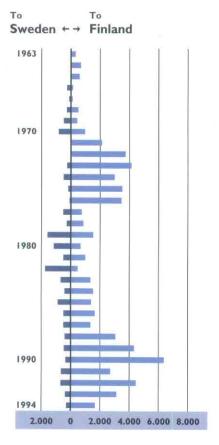
\$14 Exchange of electricity 1994, GWh

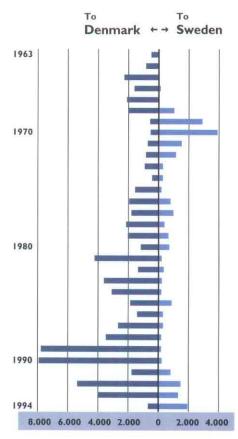


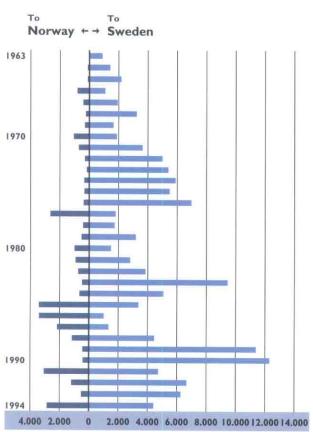
S15 Imports/Exports 1994, GWh

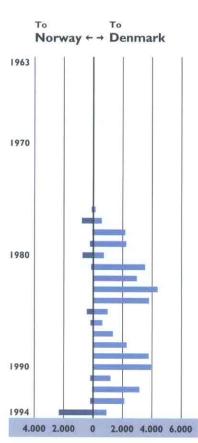
	Imports to:				Other	
Exports from:	Denmark	Finland	Norway	Sweden	countries 1)	∑ Exports
Denmark	N		2 306	1 933	2 383	6 622
Finland			291	298		589
Norway	932	T		4 430		5 363
Sweden	681	1 664	2 850	4	1 226	6 421
Other countries 1)	166	5 027	0	13	1	5 206
∑ Imports	1 779	6 692	5 447	6 674	3 609	24 201
	Denmark	Finland	Norway	Sweden	Nordel	
Total imports 1994	1 779	6 692	5 447	6 674	20 592	
Total exports 1994	6 622	589	5 363	6 421	18 995	
Net imports	-4 843	6 103	84	253	1 597	
Net imports/ Gross consumption	-14.6%	9.0%	0.1%	0.2%	0.5%	
¹⁾ Russia and Germany						

S16 Exchange of electricity 1963 - 1994, GWh

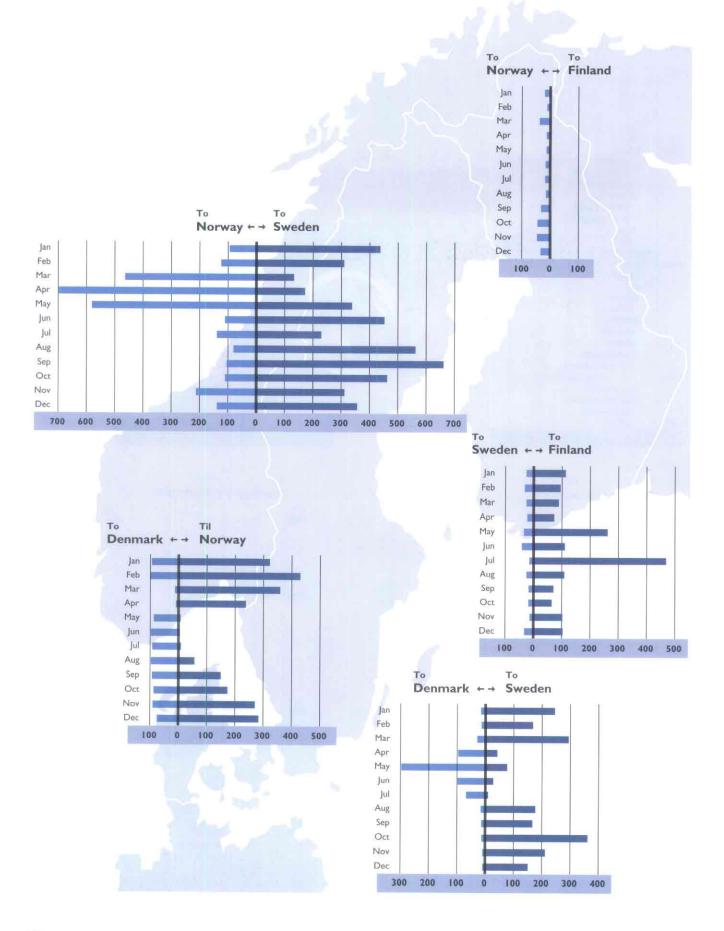


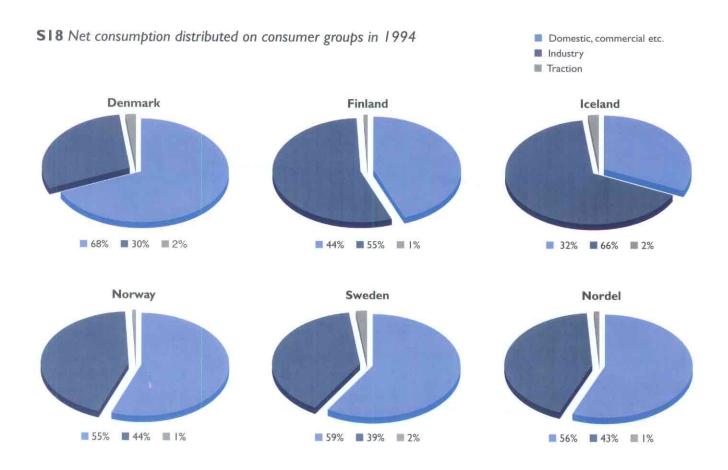






\$17 Monthly exchange of electricity between the Nordel countries 1994, GWh

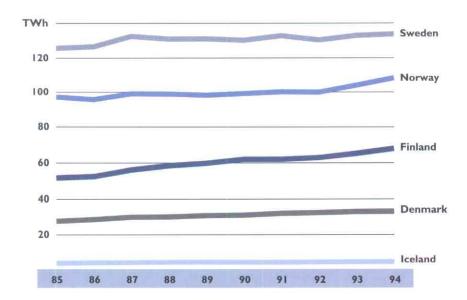




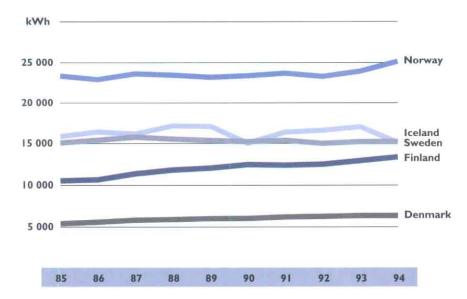
\$19 Electricity consumption 1994, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total consumption	33 201	68 211	4 774	113 612	137 909	357 707
Occasional power to electric boilers		82	237	5 3 1 5	4 081	9 715
Gross consumption	33 201	68 129	4 537	108 297	133 828	347 992
Losses, pumped storage power etc.	2 329	2 789	484	10 407 1)	8 248	24 257
Net consumption Of which:	30 872	65 340	4 053	97 890	125 580	323 735
Domestic, commercial etc.	21 069	28 870	1 296	54 377	73 490	179 102
Industry	9 206	35 990	2 677	42 853	49 513	140 239
Traction	597	480	80	660	2 577	4 394
Average population 1994, mill. inh.	5.2	5.1	0.3	4.3	8.8	23.7
Gross consumption per inh., kWh	6 385	13 359	15 123	25 185	15 208	14 683
Gross consumption 1993	33 071	65 398	4 501	104 103	133 017	340 090
Change in gross consumption as against 1993	0.4%	4.2%	0.8%	4.0%	0.6%	2.39

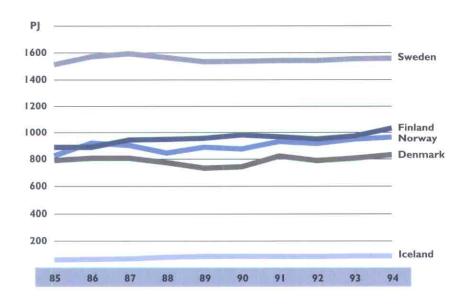
S20Gross consumption 1985-1994, TWh



S21Gross consumption per inhabitant
1985-1994, kWh



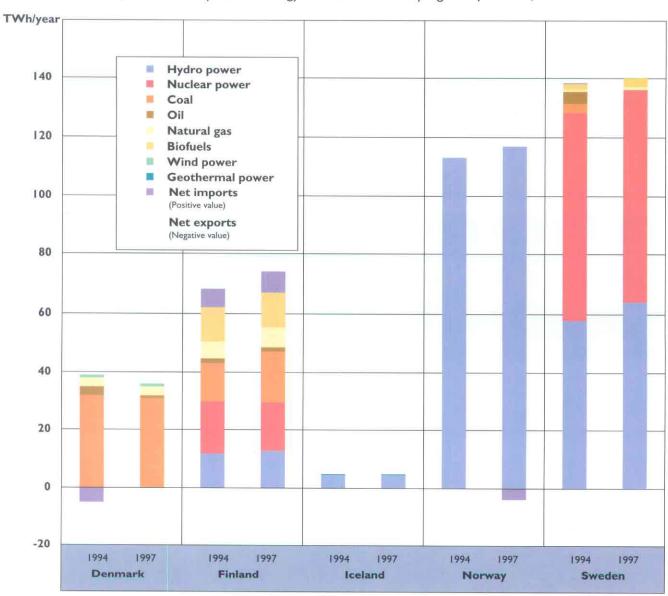
S22 Total energy supply 1985-1994, PJ



\$23 Total consumption 1994, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Generation 1994	38 044	62 108	4 774	113 528	137 656	356 110
Net imports 1994	-4 843	6 103		84	253	1 597
Total consumption 1994	33 201	68 211	4 774	113 612	137 909	357 707
Generation 1993	31 882	58 005	4 720	120 205	141 062	355 874
Net imports 1993	1 189	7 540		-7 791	-621	317
Total consumption 1993	33 071	65 545	4 720	112 414	140 441	356 19
Change in total consumption	0.4%	4.1%	1.1%	1.1%	-1.8%	0.4%

524 Distribution of total consumption on energy sources 1994 and prognosis for 1997, TWh



S25 Gross consumption in 1994 and prognoses for 1997 and 2000, TWh

Year	Denmark	Finland	Iceland	Norway	Sweden	Nordel
1994	33	68	4.5	108	134	347.5
1997	36	74	4.6	108	140	362.6
2000	38	79	4.7	112	146	379.7

S26 Peak load demand in 1994 and prognoses for 1997 and 2000, MW

Year	Denmark	Finland	Iceland	Norway	Sweden	Nordel
1994	7 426	11 270	729	19 786	24 400	63 611
1997	7 854	13 000	751	20 660	28 000	70 265
2000	8 251	13 900	783	21 500	29 100	73 534

\$27 Installed capacity in 1994 and prognoses for 1997 and 2000, MW

Year	Denmark	Finland	Iceland	Norway	Sweden	Nordel
1994	10 342	14 525	1 046	27 426	35 037	88 376
1997	10 084 1)	15 400	1 042	27 565	35 600	89 691
2000	10 675 1)	16 200	1 072	27 605	35 900	91 452

Environmental information

In the Nordic countries' objectives for the energy field, and especially the electrical energy field, a great and still increasing importance is being attached to the concern for the environment.

The reduction of the air pollution caused by the fossil-fired power stations has for several years been given a high priority in Denmark, Finland and Sweden, among other measures by reducing the emission of sulphur dioxide (SO₂).

The figure below shows the emission of SO₂ per produced kWh in the mentioned 3 countries. Much work has been and is still being done to reach very low values, and in Denmark, where fossil fuels constitute the major part of the electricity

generation, a successful result has been a significant reduction of the SO, emission

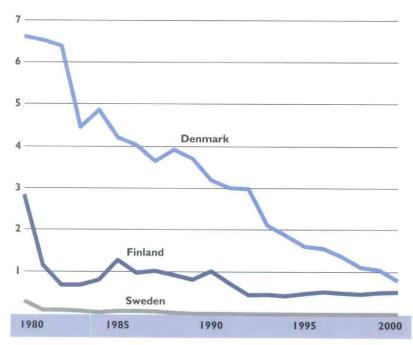
The means by which a reduction of the SO₂ emission, among other things, has been obtained, are listed below:

- Desulphurization plants at large coal-fired power stations
- Use of low-sulphur coal and low-sulphur oil at small power plants
- Increased use of natural gas and renewable energy sources

Similarly, the power stations are working on reductions of NO_x emission and other emissions.

S28 SO₂- emission 1980 - 1993 and prognoses for 1994 - 2000





In Denmark, Finland and Sweden the power stations cooperate on the generation of electricity and heat. The curves shown above appear by distributing the emissions on electricity and heat on the basis of the energy content of the two products: Annual SO_2 emission divided by the sum of the produced kWh electricity and kWh heat.

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