Nordel Annual Report 2001

Nordel

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Nordel's Annual Meeting 2001 took place in the scenic Swedish village Mariefred.

Photo: Ole Gjerde.

Nordel

Nordel is a body for co-operation between the transmission system operators (TSOs) in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden), whose primary objective is to create the conditions for, and to develop further, an efficient and harmonised Nordic electricity market.

Nordel also serves as a forum for contact and co-operation between the TSOs and representatives of the market players in the Nordic countries. In order to create the right conditions for the development of an efficient electricity market, it is important for the TSOs to be able to consult with the market players. Likewise, it is important for the market players to be given the opportunity to make useful contributions and proposals to the TSOs. A Market Forum has been set up within the new Nordel organisation in order to pursue this dialogue.

Nordel's tasks fall mainly into the following categories:

- System development and rules for network dimensioning;
- System operation, operational security, reliability of supply and exchange of information;
- Principles of transmission pricing and pricing of ancillary services;
- International co-operation;
- Maintaining and developing contacts with organisations and regulatory authorities in the power sector, particularly in the Nordic countries and Europe;
- Preparing and disseminating neutral information about the Nordic electricity system and market.

Nordel's highest decision-making body is the Annual Meeting, whose participants are drawn from representatives of the TSOs. The Annual Meeting elects the chairman of the organisation for a term of two years. The chairmanship rotates between the Nordic countries. The chairman appoints Nordel's secretary and is responsible for the secretariat and for the related costs. The organisation has no budget.

Nordel's executive body is the Board, composed of one representative from each of the Nordic TSOs. The Board of Nordel makes initiatives and decisions on topical issues, and implements the decisions taken at Nordel's Annual Meeting. The Board is also responsible for the organisation's external information activities. In order to support the Nordel Board with its information activities an Information Group was established in 2001.

Most of Nordel's work is carried out by committees and working groups. Nordel's Operations Committee, Planning Committee and Market Committee are made up of the leaders responsible for the corresponding sectors in the TSOs. The working groups are composed of technical specialists drawn from the various sectors involved in co-operation within Nordel.

Key figures 2001

		Nordel	Denmark	Finland	Iceland	Norway	Sweden
Population	mill.	**24,3**	5,4	5,2	0,3	4,5	8,9
Total consumption	TWh	**401,0**	35,4	81,6	8,0	125,5	150,5
Maximum load							
(measured 3rd Wednesday in January)	GWh/h	**64,6**	6,1	11,5	0,9	21,0	25,1
Electricity generation	TWh	**395,4**	36,0	71,6	8,0	121,9	157,8
Breakdown of electricity generation							
Hydropower	%	**55**	0	19	82	99	50
Nuclear Power	%	**23**	.	31	.	.	44
Other thermal power	%	**20**	88	50	0	1	6
Other renewable power	%	**2**	12	0	18	0	0

. No nuclear power production.

0 Less than 0,5.

Report of the Board of Nordel

At the start of 2001, the Board of Nordel was concerned with making the new Nordel organisation fully operational, with new mandates and the task of manning committees and working groups. This was a result of the resolution passed at Nordel's Annual Meeting in the summer of 2000, when it was decided to transform the organisation into a body for co-operation between the Transmission System Operators (TSOs) in Denmark, Finland, Iceland, Norway and Sweden. The change of direction took effect in the autumn of 2000 and all Nordel's committees were set up in accordance with the new structure in January 2001.

In the winter of 2001, Nordel initiated a strategy process, and during a workshop begun formulating a vision and objectives for Nordel. From this work there also materialised a number of strategic projects which it was decided that Nordel would carry out.

Based on the premise that the function of Nordel is to promote the efficient development of the electricity market in the Nordic region, the Board formulated the following vision and objectives for the organisation:

Nordel shall:

- Act as a Nordic TSO and be the basis for a harmonised Nordic electricity market
  - Co-ordinate grid investments
  - Resolve the challenges associated with congestion management
  - Apply harmonised operating rules
  - Solve transit issues
- Be in the front rank in the development of the Nordic electricity market
- Be a strong force in the development of the European electricity market
  - Continue to maintain a leading position in developments in the future
  - Be capable of arriving at common solutions even where internal opinions differ
- Have the ability to react quickly to challenges, make decisions and have a shared commitment to implementing them.

From the work done to formulate Nordel's strategy, the following strategic projects were defined:

- Nordel's Grid Master Plan
- Rules for congestion management
- Financing new grid interconnections
- Tariff harmonisation
- Transit principles
- System operations
- Promoting the image of Nordel as an organisation
- Acting as one Nordic TSO

Work has been proceeding on these projects since the spring of 2001, and a very considerable effort has been put into implementing them and arriving at workable solutions.

Nordel's Grid Master Plan will be presented to the Board of Nordel in spring 2002. It is the first joint grid master plan made in the Nordic countries. Based on the analyses and assessments that have been performed, proposals will be made for prioritising the transfer corridors in the electricity grid on which Nordel should focus to effect reinforcements.

Closely linked to the Grid Master Plan is the project to deal with the financing of new grid interconnections. In the spring of 2002, proposals will also be put forward concerning how to finance the necessary reinforcementss in the Nordic electricity grid in the time ahead.

The question of rules for managing congestion is a topic that has involved many parties in the Nordic electricity market. The aim of the work done on Nordel's strategic project was to look at alternative solutions to current practice. Proposals will be discussed with the market players in spring 2002.

In April 2000, the Nordic TSOs presented a report on the harmonisation of the main grid tariffs in the Nordic region. The purpose of the work was to introduce more equal tariff principles, and to ensure more equal competitive conditions for the producers in the Nordic countries by equalising power input tariffs.

The proposal that was put forward in the spring of 2000 was, in concrete terms, that the power input tariff, excluding the loss element in the main grid tariffs, should be in the interval between 0.5 Swedish øre +/- 0.3 Swedish øre/kWh. With the adjustments made in each country with effect from 1 January 2002, the tariffs in all the interconnected Nordel countries are within the interval that was adopted.

The first step of a nordic transit solution was implemented from 1 January 2002, and this solution that has been drawn up as part of the strategic project on transit principles is described in a separate article in this Annual Report, and will not, therefore, be discussed any further here.

The project dealing with system operations comprises a number of general operationally-related issues such as the possibilities for better frequency quality, a joint regulating power market, the updating of the system operation agreement, etc. The Nordic system operation agreement has been updated and will be put into effect on 2 May 2002. A scheme for a joint regulating power market has been prepared, which will also start up on the same date. Here, all the TSOs will receive regulating power bids into their areas, which will be put together to form a joint regulating power price list for each hour. As long as there is no congestion in the system, the cheapest regulating object will be used irrespective of where it is in the Nordic system. For each operating hour a joint regulating power price will be obtained equal to the marginal price for regulation in the hour, and this will be used as a reference price for settling imbalances.

A permanent information group has been set up within Nordel, which includes all the chief information officers from the TSO companies. The work here is of a more long-term nature, and will to a certain extent be governed by developments in the harmonisation process.

The last of Nordel's strategic projects, to act as aone TSO, will in several ways have to pick up the results from Nordel's other projects and co-ordinate its activities so that outwardly the TSOs appear to be acting in the same way towards the players in the Nordic electricity market.

In addition to the work done inside Nordel, throughout 2001 initiatives were taken to set up regular meetings between the Nordic regulators and the Nordic TSOs through the agency of Nordel's Board. This was done in recognition of the fact that, in order to create a harmonised and efficient Nordic electricity market, it is absolutely essential that not only the practical solutions, but also the regulatory conditions, be harmonised.

The work described above has achieved results. However, it is also important to bear in mind that the interconnected Nordic electricity market comprises four countries, with four national assemblies, four governments, and four regulators. There are five TSOs which have different forms of formal organisation and which have been assigned different tasks by the authorities. It is important to be aware of that fact, so that realistic expectations can be set as regards the possibilities and the pace of the Nordic integration process.

In line with Nordel's new By-Laws, Nordel set up a Market Forum in 2001, which is designed as a forum for the market players and the TSOs in the five Nordic countries. The Market Forum provides a common resource in all matters dealt with internally in Nordel and is of equal importance to both sides in relations between the market players and the TSOs.

Co-operation between the European TSOs through the organisation ETSO was consolidated in the summer of 2001 when ETSO was granted official legal status and also opened a permanent office in Brussels. While Nordel's Chairman, Odd Håkon Hoelsæter, was President of ETSO for the first two years of its existence from 1 July 1999 to 1 July 2001, Juha Kekkonen, Executive Vice President of Fingrid, was elected chairman of ETSO's Steering Committee for the period from 1 July 2001 to 1 July 2003.

One of ETSO's most important tasks is to advance the work of creating a smooth-functioning electricity market in Europe. Particular focus has been placed on facilitating electricity transmission across national borders, and on opening up the electricity market to competition. In this connection, ETSO has played an important role in achieving the opening up of the European electricity market which began on 1 March 2002 and which will continue throughout 2002. ETSO is now working on a more permanent solution, to take effect from 1 January 2003.

Many representatives from Nordel's member organisations take active part in the work done by ETSO. Through Nordel's solution for connecting to the European market solution, Nordel has helped to ensure that the Nordic market players, without paying any extra within the Nordic region, have access to the entire Continental European electricity market.

Odd Håkon Hoelsæter,
President and CEO, Statnett SF,
Norway (Chairman)
Photo: Trond Isaksen.

Georg Styrbro,
Managing Director,
Eltra amba, Denmark
(Vice chairman)
Photo: Jørgen Schytte.

Ole Gjerde,
Senior Adviser, Statnett SF,
Norway (Secretary)
Photo: Trond Isaksen.

Bent Agerholm, Managing
Director and CEO,
Elkraft System amba,
Denmark
Photo: Martin Dyrløv.

Timo Toivonen,
President and CEO,
Fingrid Oyj, Finland
Photo: Juhani Eskelinen.

Fridrik Sophusson,
Managing Director,
Landsvirkjun, Iceland
Photo: Odd Stefan Thórisson.

Jan Magnusson,
Director General,
Svenska Kraftnät, Sweden
Photo: Hans Blomberg.

The Planning Committee's activities in 2001

Objectives and responsibilities

The Planning Committee is responsible for technical matters of a long-term nature concerning the transmission system and the exchange of information in relation to the expansion of the electricity system. The Committee works basically from a Nordic perspective, albeit having regard for necessary international angles of approach. The Planning Committee is composed of the management of planning functions of the transmission system operators (TSOs), and they work together as a co-ordinated planning and management team.

The Planning Committee's objectives are:

- To achieve continuous and co-ordinated Nordic planning between the TSOs, so that the best possible conditions can be provided for a smooth-functioning and effectively integrated Nordic electricity market;
- To initiate and support changes in the Nordic power system, which will enable satisfactory reliability of system supply through the effective utilisation of existing and new facilities
- To be instrumental in developing the Nordic power system in ways that are consistent with environmental sustainability. When planning transmission facilities, impact assessments must integrate the need to preserve and protect the natural environment.

In order to achieve these objectives, the following main tasks have been defined:

- The drawing up of future scenarios for the expansion of the Nordic power system with a time horizon of up to 20 years. Working with these base scenarios, the Planning Committee can take the initiative to advance its objectives.
- The Planning Committee's main product will be the publication of a Nordic Grid Master Plan. The plan will be based on alternative scenarios with a time horizon of up to 20 years, and will primarily consist of projects which either impact on capacity between the Nordic TSOs or on important corridors of the national grids.
- The continuous updating of recommendations for common grid dimensioning rules (planning criteria) for the TSOs and the Nordic main grid. The recommendations will comprise technical, financial and environmental matters.
- The preparation and updating of joint system requirements for future connections to the grid of generation, transmission and consumption facilities as well as for ancillary services required by the TSOs.
- The consolidation of the work involved in gathering, updating and applying shared grid, consumption and production data.

The Planning Committee's activities

The Planning Committee is organised with two working groups, the Grid Group and the Balance Group. The tasks of these two groups are organised so that the working groups do most of the actual analyses and surveys, while the Planning Committee functions as a natural steering group for the work that is carried out. The Grid Group deals primarily with grid-related matters, while the Balance Group deals primarily with matters relating to energy and power balances. The chairs of the two working groups attend all the Planning Committee's meetings. The most important tasks in 2001 were:

- The Nordic Grid Master Plan 2002
- Compilation of common data sets
- Nordic Grid Code
- Data exchange agreement between TSOs
- Energy and power balances for the three-year period 2002-2004

The Nordic Grid Master Plan 2002

The Nordic Grid Master Plan 2002 is the first common grid master plan. The plan was drawn up by the Planning Committee in close co-operation with its two working groups, the Grid Group and the Balance Group. Work on the plan took up a large part of the working groups' activities in 2001.

The objective of drawing up a Nordic plan is, among other things, to secure the infrastructure necessary for a well-functioning electricity market and a reliable electricity supply. The plan focuses on future capacity requirements both for the transfer corridors between the Nordel countries but also for important domestic transfer corridors.

The plan brings together political and regulatory frameworks, which are based both on the EU single market directives and on environmental considerations, as well as national laws, resolutions and directives. The plan also brings together current economic and technical frameworks. The economic frameworks are important for the investment capability of the TSOs, and they vary from country to country. The technical frameworks are Nordel's recommendations, which are supplemented by bilateral agreements and joint technical analyses.

The plan describes the current situation for the Nordic market with regard both to energy and power balances, strengthenings in the power system that will be ongoing until 2005, and the market trends that are being observed. In relation to market trends the plan deals with problems such as market power, new to production capacity, the introduction of possible environmental markets, and the adjustment of price areas. Furthermore, the plan designates the most important corridors within the Nordic grid and on the connections to Nordel's neighbours, in addition to establishing transmission capacities. This is an important prerequisite for the analyses of the Nordic electricity system, which are performed as part of the Nordic Grid Master Plan 2002.

The plan also sets out how the Nordel system is expected to develop until the year 2010. Based on given forecasts, the plan describes the expected future energy balance with related transport patterns in the Nordel system. On the basis of the results of analyses of future transport patterns, the plan seeks to show where constrained corridors are expected to arise in the future. Here, the plan builds on analyses done with the program “Samkjøringsmodellen” in addition to more qualitative assessments of the current operating and market situation. The assessments of the corridors are supplemented with computations of the utilitarian value of increasing corridor capacity in constrained corridors. The plan also points to challenges with regard to security of supply for both energy and power in relation to cold winter days as well as to dry years.

On the basis of the various assessments, priorities will be set in terms of which corridors Nordel should focus on to effect reinforcement if possible. A cost-benefit analysis will therefore be made of the prioritised corridors. A key aspect here will also be to consider possible financial solutions for whatever corridor reinforcements the Planning Committee decides to recommend based on the cost-benefit analysis.

Compilation of common data sets

In connection with the Planning Committee’s activities, it is important to have a good basic set of data to facilitate the various analyses. This is perhaps particularly so where the preparation of the Nordic Grid Master Plan is concerned, but for other activities it is also important to create a shared understanding of analysis results. The Planning Committee has therefore given the working groups the task of preparing the necessary data models, which will cover the market areas for Nordel as well as important neighbouring areas. The work commenced in connection with the Nordic Grid Master Plan and will be carried further in 2002. The Grid Group is working on putting together a common set of Nordic grid data for use with grid analyses on the Nordic transmission grid. It will be possible to use the data set for load-flow studies as well as dynamic studies in PSS/E. The Balance Group has used the program “Samkjøringsmodellen”, which can be applied to energy balance studies and energy transport studies. The work has already begun and the aim is to complete it during the first half of 2002. In the time ahead it will be decided whether a common data set should be created for the TSOs for other calculation tools also, for example tools like SAMLAST or MAPS.

Nordic Grid Code

A Grid Code is a set of rules for the construction and use of the transmission grid. The Grid Group has carried out some preliminary work in connection with the possible preparation of a joint Nordic grid code to replace Nordel’s current system of recommendations. The Grid Group has recommended that the code be divided into three parts: a Planning Code, an Operational Code, and Connection Conditions. The main responsibility for the development of a Nordic Grid Code has been assigned to the Operations Committee by the Nordel Board.

Data exchange agreement between TSOs

The Planning Committee’s Grid Group has drawn up proposals for an agreement between the TSOs on shared access to data, and the use and confidentiality of data. The agreement is a prerequisite for the use of the shared Nordic grid data set and the balance data set for carrying out system analyses, also in connection with Nordic grid master plans.

Energy and power balances for the three-year period 2002-2004

The Balance Group has drawn up a report to be presented at Nordel’s Annual Meeting entitled Power balances for the three-year period 2002-2004. The report provides an overview of the energy and power balance for the Nordic power market. The forecasts contained in the report focus on the individual Nordel countries and the maximum transmission capacity between them.

The energy forecasts are based on both average precipitation and dry years. Thermal power with maximum capacity is included in the forecasts. Provided that the most expensive forms of production (including oil condensing plants and gas turbines) are not used for generating energy, Nordel has a small surplus in years with average precipitation in the hydropower reservoirs. However, both Norway and Sweden still need to import even in years with average precipitation. In dry years, Nordel as a whole also needs to import electricity, much of which must be taken from imports from Nordel’s neighbours, and this despite the fact that expensive production methods are being used internally within the Nordel region. In dry years, the Balance Group believes that electricity consumption can be reduced somewhat by means of high prices and information via the media. The results of the energy forecasts show that the margins which would permit the Nordel region to handle a dry year are not very substantial. A prerequisite here will be high utilisation of capacity in the interconnections with neighbouring countries outside Nordel. The internal interconnections within Nordel will also have to be utilised to a high degree. Provided that the power market functions well as regards factors such as competition, price determination, information, availability in the production system and grid, and imports and exports between the countries inside and outside Nordel, conditions over the next few years should enable the Nordel system to handle the energy situation without having to resort to rationing.

The power forecasts to be reported at Nordel’s Annual Meeting provide an overview of the respective countries’ power capacity for extremely cold winters. The consumption forecasts apply to load levels with a return time of ten years. The report takes into account the constraints within the production system and requirements for instantaneous reserves. Physical capacity on the interconnections with neighbouring countries outside Nordel has also been analysed. The forecasts are described in further detail in the report on the activities of the Operations Committee.

The Operations Committee's Activities in 2001

From one committee to another

The revision of Nordel's by-laws in the summer of 2000 resulted in the introduction of a new Operations Committee at the beginning of 2001. The new Committee had its first official meeting in January, and it has thereafter worked intensively with new challenges and objectives. The Operations Committee had a total of 9 meetings during its first year.

Nordel's Operations Committee is responsible for technical system issues in the short term and for the technical framework for grid operations. The Committee serves as a leading group for Nordic operational issues, and it consists of the managers of operation of the Transmission System Operators (TSOs) in Denmark, Finland, Norway and Sweden. Iceland is involved as an observer. The Committee members aim at active dialogue with the electricity market parties in their area of responsibility.

The Operations Committee co-ordinates operational co-operation between the TSOs and aims to promote to the ideal utilisation of the inter-connected Nordic electricity transmission system as per market needs, taking into account the agreed technical quality as well as operational and supply reliability. The Committee also contributes to international co-operation and monitors how the deregulation of various organisations progresses.

Nordel's strategic projects guided the work of the Operations Committee during 2001, with the objective of improving system operation within the Nordic power system. Those tasks that were not completed by the previous Operations Committee before the expiry of its term were taken over by the new Committee. Two permanent working groups have worked under the Committee: the operative working group for power system operations and the analysis working group. Some ad-hoc working groups have also been established to work under the Operations Committee.

Operations reporting

Power balances

Power balance in the Nordic power system has deteriorated over the years, and the margins have become smaller and smaller. Power balance during the winter period of 2000/2001 gave a clear indication of a highly difficult situation in the Nordic countries at high loads, involving a need to import electricity from Germany and Russia, among other countries. The power margin in Sweden south of intersection 2 is still limited despite the additional power reserve acquired at the end of the year 2000. The power margin in Norway is also very limited. Statnett has therefore secured a sufficient operational reserve by introducing a power reserve market with bids from both power producers and industrial consumers. Long-term imports from Russia give Finland a certain power margin.

On 5 February, the Nordic electricity market was put to the test. A very cold weather front covered all Nordic countries, and high electricity consumption figures were to be expected. In Sweden, a warning of a power shortage was given a day before, and an appeal was made to the general public to save electricity. The entire power reserve in Sweden was made available at Nord Pool's elspot market.

The consequence of the measures taken was that system operation was not compromised excessively, and there was no power shortage. In fact, the situation was quite the opposite: almost all production capacity was in use and the frequency was high, which resulted in down-regulation even though a consumption record was reached in the morning hours in Sweden, Norway and Finland. Electricity was imported into the Nord Pool area from Russia and Germany.

A report drawn by the balance working group states that Finland, Norway and Sweden will have a power deficit also during next winter while Denmark shows a surplus. Despite anticipated imports of electricity from beyond Nordel, the total deficit is 600 MW, which means that some fast disturbance reserve needs to be used in order to reach balance during very cold winter days.

Electricity transmission

In order to promote the inter-Nordic electricity market and to decrease price differences between the various elspot areas, Nordel decided to introduce a trial arrangement in counter trading during planned outages on cross-border connections. The trial period commenced on 1 June and lasted until the end of the year. During the trial period, a maximum of 500 MW of electricity was counter-traded for up to two weeks, and the costs were shared between the TSOs.

The trial period revealed both advantages and disadvantages: the price differences between the various elspot areas decreased, but system reliability was also reduced in certain situations for instance as a result of fewer regulation bids to the regulation power market. The total costs of the trial were approx. EUR 1.6 million. The transmission system operators will review the trial in light of the experiences gained, paying attention to the potential future solutions for satisfying the needs of the electricity market concerning transmission capacity.

Frequency quality

Frequency quality has suffered in line with the increased hourly trading. There are extensive differences in the volumes traded from one hour to another within the Nordic electricity exchange area, and there are also similar differences between the Nordic and European power systems. When consumption varies on a continuous basis, production and hourly trading will lead to great physical imbalances at the hour change and consequently to poor frequency quality.

An ad hoc working group is working on this issue, attempting to find solutions for improving frequency quality. More even operation of generating units and HVDC-connections which can better cope with the hourly consumption variations could improve frequency quality over a short period of time. The working group is also studying ways in which TSOs would be better aware of production and consumption variations within the power system.

Activities of the working groups

Operative working group

The operative working group works with problems related to system operation. The working group co-ordinates system operation planning, intensifies balance regulation, follows critical situations, develops practicable routines, exchanges experiences and aims at the harmonisation of regulation.

In 2001, the working group revised and updated the Nordic system operation agreement and its appendices; this agreement constitutes the formal basis for co-operation within system operation.

The Nordic system operation forum is a shared forum for discussion and exchanging experiences between the operational and system control personnel of the Nordic TSOs. The operative working group is responsible for this forum. The forum was arranged for the second time from 30 to 31 May at Skanör Falsterbo in southern Sweden.

Analysis working group

The analysis working group supports the operations committee in system technology issues over a shorter time span within the framework of system operation. The foremost task of the analysis working group is to carry out necessary analyses concerning disturbance situations and other events in the power system.

The most significant disturbance occurred on 19 June by a spark-over to a tree from the 420 kV line between Röd and Hasle east of the Oslo fjord in Norway, resulting in a fire in the area. Southern Norway was separated from the remaining synchronised grid, leading to a regional over-frequency of 51.2 Hz while the frequency within the remaining synchronised Nordel area was 49.45 Hz.

One of the tasks of the analysis working group has been to review the status of frequency-controlled load disconnection in the Nordic power system. This work has been based on the studies and report by the previous working group for power system operations. The analysis working group continues to review the development needs.

The working group also studied various methods for improving the quality of analyses concerning both calculations and actual values. Related methods will be tested when a complete system operation model is available for the entire existing Nordic power system.

Other operations

In other areas of Nordel's Operations Committee, there were ad hoc working groups which worked for enhancing co-operation between the TSOs and making suggestions concerning shared rules.

Balance and system services

A working group aims to develop balance regulation co-operation. The objective is that the entire Nordic power system would make up a single market for regulation power and that regulation would take place on the basis of a jointly compiled Nordic regulation list. The related new model will be introduced in 2002.

Another ad hoc group is working with primary regulation, studying a potential shared Nordic market for the management of momentary reserves. This work continues, with the objective being a partial market in 2003.

Information technology

In line with increasing co-operation and need for information exchange, a decision was made to study new opportunities to exchange information between the Nordic TSOs. The development of a web-based information system, Nordic Operational Information System, was launched. The system is intended for the exchange of operational information so that all TSOs have access to the same information. At the first stage, there will be a pilot project covering selected information. This pilot project will provide the foundation for a decision concerning the establishment of a more extensive information system. The pilot project is expected to be ready during the first half of 2002.

One ad hoc group has worked with interconnecting the Nordic data communications network through Electronic Highway, which serves as the main communications channel within ETSO. Most of the network is ready but some connections are still missing. These are expected to be complete at the beginning of 2002.

The contact group for information technology issues (NORCON) continues its work with IT issues primarily as concerns system operation, and it also serves as a contact group between the organisations in other information matters. Exchange of experiences is an important part of the work of this group. As a new task, the group is to discuss data security by analysing the current situation and reviewing which options are available.

Grid disturbance statistics

This ad-hoc working group continued its work in 2001, aiming to improve the rules for grid disturbance statistics compiled within Nordel. This work was launched by the previous Operations Committee, and the final report is to be expected at the beginning of 2002.

International co-operation

UCTE also underwent an organisational revision in 2001, with new committees established within it. Nordel's Operations Committee had a meeting with UCTE's Operations and Security committee in Denmark in September. Exchange of experiences was the primary purpose of this meeting. It was decided that similar meetings be held once a year.

The Market Comittee's Activities in 2001

Objective and tasks

The goals of the Market Committee are:

- to contribute towards creating a borderless Nordic market for the market players, thereby augmenting the market's efficiency and functionality,
- to contribute towards the rules of play in Europe being formulated in such a way as to promote a positive market trend and efficient interplay with the Nordic market.

It is a central task of the Market Committee to work with tariff and transit issues as well as issues pertaining to the management of network restrictions. The Committee will also work towards joint rules for power settlement and towards trading in certificates for renewable energy.

During the year, the Market Committee has had the following configuration of work groups:

- The market development group, with a subgroup for calculating network losses in connection with transits
- The balance settlement and EDIEL group
- The ad hoc group for renewable energy
- The ad hoc group for price sectors

Activities during the year

There follows an outline of the work conducted in the various work groups during the year.

Nordic transit solution

The work of devising a system for compensation for transits within the Nordic area has been a prioritized task during the year. The grid operators of Nordel have agreed terms for compensating one another during 2002 for transmission loss costs caused by transits. This transmission loss compensation is to be seen as a first step towards a fully developed mechanism for transit compensation which also takes into account the need for subsidies for covering changes in infrastructure costs, such as investment costs and possibly system services which are caused by transits. Investigation work is being carried out with the aim of enabling the introduction of the developed payment system for transits from 2003. (See also the special article in this edition)

Nordic ETSO CBT

Within the European system operators' collaboration organisation, European Transmission System Operators (ETSO), work is also being carried out on developing a system for transit compensation. Pending joint EU rules concerning "Cross Border Trade", ETSO has agreed on a stopgap solution intended to be in force between 1 March and 31 December 2002. The agreement means that the system operators will reciprocally make compensation for transit costs within the framework of a kitty of 200 million euro per annum. This will be financed by charging 1 €/MWh for planned exports and 1 €/MWh for net exchanges. The system includes the following continental European countries: Belgium, France, Germany, Holland, Italy, Luxembourg, Portugal, Spain and Switzerland. Austria is not taking part immediately but might join later. The Nordic area is connected as a peripheral area via Denmark and Sweden. The UK, Ireland and Greece are correspondingly regarded as peripheral countries.

Nordel will pay, in line with the other peripheral countries, 1 €/MWh for planned exports from Nordel at the borders between Denmark and Germany. The system operators of Nordel will correspondingly, with the exception of imports via the Baltic Cable, invoice 1 €/MWh for exports from the continent to the Nordic area. The system operators of Norway, Finland and Denmark have reached agreement as regards how costs and revenues will be distributed internally. Following a planned legislative amendment in Sweden, Svenska Kraftnät is also expected to take part. Southbound transmissions on the Baltic Cable are to be settled at a rate of 1 €/MWh on the German side of the border. Thus, this will not be distributed among the TSOs of Nordel.

Nordic tariff harmonisation

The Nordic grid operators agreed in the spring of 2000 to strive towards harmonising grid tariffs, in order to ensure rules of play that do not affect competition between the players on the Nordic market. Other demands placed on the tariffs are that they must be correct cost-wise, simple to understand and objectively formulated.

In accordance with the grid operators' decision, the new tariffs are to be introduced into the individual countries by 2002 at the latest. It can be pointed out that the grid tariffs from 1 January 2002 are in compliance with the laid down harmonisation principles, but that certain differences remain, especially on the lower voltage levels included.

Market power

A seminar and workshop on market power was arranged in October 2001 to which competition and regulatory authorities, among others, as well as government departments from the Nordic countries, had been invited. One result of the seminar was that those involved see market power on the Nordic electricity market as a joint issue. The Market Development Group is now preparing to continue with its work.

Review of division into elspot areas

An ad hoc group was appointed during the year to investigate the prerequisites for implementing the division of the electricity spot elspot areas which follow the physical bottlenecks without regard to national borders. This against the background of experience from previous years with network restrictions arising, especially during wet and dry years, but also during more normal circumstances, resulting in different sector prices in the Nordic exchange area. The group notes difficulties in assessing whether the bottlenecks are of a structural or temporary nature. All the bottlenecks investigated can be structural during extreme years. However, during more normal years, the nature of the bottlenecks is assessed to be more difficult to determine. The inquiry points out a possible solution where a combination of price sectors and counter-purchasing is applied. The number of electricity spot sectors in the Nordic area is being increased to ten, entailing that Norway will obtain four electricity spot sectors and Sweden three, while Finland, Western Denmark and Eastern Denmark each constitute one electricity spot sector. Extended counter-purchasing is included as a part of the potential solution, internally in Sweden as well as between Sweden and Finland and between Sweden and Eastern Denmark.

Harmonisation of balance settlement in the Nordic area

Harmonisation of balance settlement in the Nordic area is a long-term project. Preliminary work has begun with the aim of charting the current systems of rules in each respective country and analysing the advantages and disadvantages of different systems vis-à-vis the central functions of balance settlement (e.g. pricing systems). Subsequently, an assessment can be made regarding the possibilities of achieving harmonised Nordic balance settlement. During the year, the balance settlement and Ediel group has started on the work of charting the systems of rules for balance settlement in each respective country.

Joint rules for trading in certificates for renewable energy

During the year, the ad hoc group for renewable energy has produced a feasibility study on the foundations for a single market for renewable energy, ”A Nordic Market for Renewable Energy”. The study, which aims to assess the need to develop joint rules for renewable energy, describes the main features of the Renewable Energy Certificate System (RECS) and the current political developments surrounding renewable energy. Additionally, the function of RECS from a Nordic perspective is analysed, as well as the system operators’ role in this context.

International co-operation

The Market Committee has a coordinating role in Nordic collaboration work vis-à-vis ETSO in issues concerning the long-term development of systems of rules and market conditions. It has continuously monitored developments within ETSO via, among other things, representation in ETSO’s steering and work groups. Over and above this, Nordel has collaborated across national borders within the framework of the European collaboration project the Renewable Energy Certificate System (RECS).

The bridge between Malmö and Copenhagen (Öresundsbron). Photo: Svenska Kraftnät.

Developments in the electricity market and the Nordic economies in 2001

The electricity market

Eastern Denmark was integrated into the common Nordic electricity market on 1 October 2000. The year 2001 was, therefore, the first entire year of full integration of the electricity market in the four countries of Denmark, Finland, Norway and Sweden. On 1 March 2002, an obstacle to the further development of the Nordic electricity market was removed when the Swedish Government decided to abolish the border tariff between Sweden and Denmark.

The Nordic power exchange, Nord Pool, experienced yet another record year in 2001, when the total volume traded on the exchange was 1,022 TWh. Clearing of power contracts traded OTC accounted for an additional volume of 2,769 TWh. The cornerstone of Nord Pool's operations, physical electric power trading, amounted to 112 TWh. This figure represented 29% of all consumption in the common Nordic market.

On 2 January 2002, Nord Pool split off the physical spot operation into a separate company, Nord Pool Spot AS. The EL-EX electric power exchange is also included in Nord Pool Spot AS. In addition, Nord Pool's clearing operation has been split off into a separate company, Nordic Electricity Clearing House ASA (NECH).

Ownership of the company Nord Pool Spot AS is shared equally among Nord Pool, Statnett and Svenska Kraftnät, but the intention is also for the Finnish and Danish TSOs to come in as owners. NECH is purely a subsidiary undertaking of the parent company Nord Pool.

Nord Pool Spot AS has been awarded a marketplace licence by the regulator, NVE, pursuant to the new Energy Act in Norway. Nord Pool has also been awarded a licence for financial trading and clearing with effect from 1 March 2002. Financial trading will be effected as an exchange under the new Norwegian Stock Exchange Act, and clearing pursuant to an amended Securities Trading Act.

The winter of 2001 was cold, and on 5 February 2001 a number of consumption records were set in the Nordic countries. In total in the four interconnected Nordel countries, on the 10th hour of that day there was a new consumption record of 69,327 MW.

In Sweden, Norway and Finland, a peak load was recorded of 26,800 MW, 23,054 MW and 13,310 MW respectively, while in Western Denmark and Eastern Denmark consumption stood at 3,685 MW and 2,657 MW.

Power and reserve capacity were both areas that came more into focus in the course of 2001. Sweden and Norway in particular have smaller margins than before to cope with peak consumption levels.

In Sweden in 2000, an output reserve of 1,000 MW was bought in, in co-operation between Svenska Kraftnät and the trade association Svensk Energi. At the end of 2001, the Swedish Government charged Svenska Kraftnät with the task of purchasing more supplementary output. In January 2002, Svenska Kraftnät signed an agreement for 500 MW of supplementary output both in the form of generation and reduction of electricity consumption, which would apply to the winter of 2002 and the following winter.

In Norway, Statnett introduced a market for reserve output for the winter of 2000-2001. It was decided to continue this arrangement in autumn 2001. A change was also made in the time definition of contracts so that contracts could be entered into for 1, 3 or 12 months at a time. For the winter of 2001-2002, reserve output was purchased for up to around 2,000 MW per month. A rough division between generation and consumption has been 1/3 generation and 2/3 consumption.

The restructuring of the industry continued also throughout 2001. Several mergers and acquisitions took place in production, network operations, sales and distribution. The result of this will be fewer players in total in the Nordic electricity market.

Prices in the electricity market remained consistently higher in 2001 than previously.

The economies of the Nordic countries

Economic developments in 2001 were marked by the economic slowdown in the USA and the resulting effect that has had on the rest of the world. In 2001, there was a sharp halt in GDP growth in the Nordic countries. The forecasts for 2002 also indicate a reduction in growth.

In **Denmark** as well as internationally there was a decline in the economy, with a lower rate of growth as a result. However, the bottom is thought to have been reached in 2001 with an anticipated growth of 1% in GDP. A slight rise in growth is expected in the next few years.

In 2001, domestic demand as a result of the fall in investments was at the same level as in 2000, in other words zero growth.

Overall growth of 1% in GDP is, therefore, solely a result of net exports. Exports are forecast to grow by 4.4% and imports by 2.3%.

The surplus on the balance of payments rose considerably from DKK 27 billion in 2000 to a record-high surplus of DKK 48 billion in 2001. A slight fall is expected in 2002, although it is forecast to rise again in 2003 and 2004. This will mean that Denmark's overseas debt will disappear entirely in 2004. There is, however, some uncertainty attached to these assessments. The major fluctuations in share prices in the past couple of years underscore this uncertainty. Danish holdings of foreign shares are relatively larger than other countries' holdings of Danish shares. A global fall in share prices will therefore impact negatively on Denmark's net position vis-à-vis overseas.

For 2002, domestic demand is expected to increase as a result of a rise in domestic consumption.

Unemployment fell from 150,000 in 2000 to 145,000 in 2001, while wage costs rose by 4.7%.

In **Finland,** growth in GDP slowed down after seven years of large increases. GDP, which totalled 135.1 billion Euros in 2001, stopped at 0.7% below last year, compared with 5.6% growth the year before. The increase in the past few years has been so marked that total production in 2001 was 40% higher than in 1993. Socio-economic growth was entirely the result of high domestic demand. Finnish households consumed so much that total production maintained a high level.

Service production rose by 1.8% while primary production fell by 2.9% and secondary production or processing by 0.6%. Exports of telecommunication products was so greatly reduced that metal, machinery and motor vehicles are now Finland's largest export industries. The export share of GDP fell to 40%. The timber and paper industry was reduced by 7%.

Consumer prices rose by 2.6%. Household income increased in terms of real value by 2.9% while corporate profits fell slightly.

Unemployment fell to 9.1%. In Finland, an average of 238,000 people were without work during the course of 2001.

The **Icelandic** economy greatly improved toward the end of 2001. GDP rose by 2.2% from 2000 to 2001. Growth from 1995 to 2000 averaged 4.7% per year. The balance of with the fall in the value of the Icelandic krone in 2001 the balance of payments deficit lessened and the latest forecasts indicate that it was 6.6% of GDP. In 2000, there was a negative balance of payments, which was 10% of GDP. The export sector is growing rapidly, while the import sector was greatly reduced during the year. Unemployment was low and averaged 1.4% during the year, the same as in 2000. Inflation climbed to 6.7% compared with 5.5% in 2000 and 3.4% in 1999.

In **Norway,** 2001 marked the end of a five-year period of strong economic expansion. The pause in growth that characterised the Norwegian economy in 2000 continued throughout 2001. The increase in GDP for Mainland-Norway was 1.0% compared with 1.8% in 2000. However, the slowdown in the rate of growth was due to the unusually high precipitation in 2000 with high growth figures for the power supply. Excluding the power supply from these calculations, the rate of growth was about the same in both years.

Growth in employment was 0.4%. Unemployment was 3.6% compared with 3.4% in 2000.

The surplus on the current account balance in 2001 was NOK 217.7 billion. This is the highest surplus ever recorded for the second consecutive year, and accounted for 14.8% of GDP. Inflation was 3.0%, as against 3.1% in 2000. Wage inflation was 4.9% calculated per standard work-year, 0.6% more than in 2000. This is the first time since 1998 that wage inflation increased.

The global economic slowdown led to GDP growth in **Sweden** of only about 1% in 2001. The forecasts for 2002 also indicate a continuing low rate of growth in GDP. The economic situation in the surrounding countries and Sweden is not expected to recover until the second half of 2002. Industrial growth in Sweden was weak during the year, and industrial production fell by 5.1% compared with 2000.

The value of exports and imports fell by 2% and 3% respectively compared with 2000. However, imports were reduced more than exports, which led to an increase in net trading compared with 2000. Swedish exports have been hit by low demand for motor vehicles and telecoms products.

Inflation in the form of the consumer price index increased during the year by about 3%. There was a strong rise in inflation in the first six months as a result of increases in energy prices and to some extent food prices. Inflation nevertheless fell toward the end of the 2001 as price increases lessened.

Employment figures rose by 0.5% compared with 2000. Employment increased in the service industries and the educational sector but fell in industry. Unemployment was reduced marginally (0.1%), resulting in an unemployment rate of approximately 4%.

Electricity consumption and electricity generation

Electricity consumption in the five Nordel countries totalled 401 TWh in 2001. Gross electricity consumption in 2001 totalled 394 TWh (excluding supplies to electric boilers), which is an increase of 2.6% compared with 2000. The increase was 1.5% in Denmark, 3.1% in Finland, 4.8% in Iceland, 2.0% in Norway and 2.8% in Sweden.

Total electricity generation in the Nordel countries was 395 TWh in 2001, an increase of 1 TWh or 0.4% on 2000.

- Hydropower was by far the largest production source with 219 TWh, which is 21 TWh down on the record year 2000 and represents 55.5% of overall production.
- Nuclear power was the second largest production source, with an annual output of 91 TWh. Nuclear power's share of total production was thus 15 TWh up on the previous year, ending at 23% in 2001, compared with 19.4% in 2000. As in previous years, the average efficiency in the nuclear power units, from an international perspective, was excellent.
- Other thermal power had an output of 78 TWh and accounted for 19.9% of total production. This was an increase of 9.9% compared with 2000.
- All other energy, including wind power and geothermal power, totalled 6 TWh, which is the same as in 2000. This accounted for 1.6% of total energy generation.

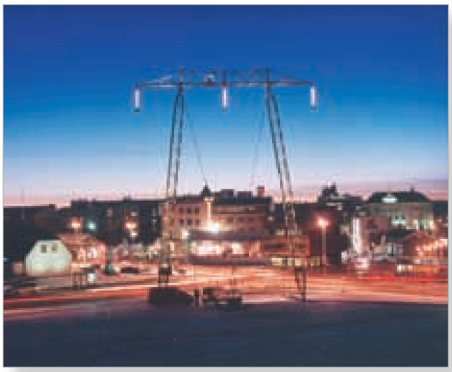
Power trading between the four interconnecting Nordel countries totalled 21 TWh, against 36 TWh the year before. Added to this is trade with Germany, Russia and Poland comprising 19 TWh, which was 7 TWh more than in 2000. During the year, Sweden was the largest net exporter of power (7 TWh), while Finland was the largest net importer (10 TWh).

Denmark

Norway

Finland

Sweden



Iceland

Denmark

On 6 May 2001, the world's largest offshore wind farm at Middelgrunden near Copenhagen was officially inaugurated. The wind turbines supply 3 per cent of Copenhagen's electricity consumption.

Photo: Mads Eskesen.

Energy policy

Following the change of government in November 2001, the Danish Ministry of Environment and Energy was split up, and the energy division was placed under the auspices of the Ministry of Economic and Business Affairs, the new minister for which is Bendt Bendtsen, leader of the Danish Conservative Party. The minister gives priority to a secure and stable energy supply at a reasonable price as a necessary condition for growth in the Danish economy.

As in 2000, electricity supply in 2001 was influenced by the implementation and adaptation of the new Electricity Supply Act from the end of 1999. Its specifications concerning the system operators' tasks in relation to the handling of supply security, connection to and use of the grid as well as fiercer competition entered into force at the beginning of the year. In mid-2001, further amendments were made to the Act, specifying the rules applying to surcharges on renewable energy and control of expenses paid by consumers to public service obligations.

On 3 October 2001, the European Commission approved the planned Danish certificate market for renewable energy. Trade in certificates is still planned to commence in 2003. In September 2001, the Danish parliament's Energy Policy Committee conducted an energy hearing, in which representatives of the business sector and organisations participated. The hearing included a discussion of the forthcoming certificate market. Focus was on a fixed price system versus the market model's combination of market price and revenue from sales of certificates. In continuation of this discussion, the political talks to postpone the commencement of the certificate market continue.

In January 2002, the Minister for Economic and Business Affairs presented his first major concrete vision of Denmark's future energy policy, announcing that he intends to remove the requirement for power companies to establish three additional offshore wind farms besides the two that are already underway. At the same time, the minister underlined that the government will respect the agreements between the various political parties on which the electricity reform and the new Electricity Supply Act are founded.

The responsibility for handling civilian electricity emergency services under the new company structure was settled during 2001. In a brief from the Danish Energy Agency, Eltra and Elkraft System have been assigned to handle the overall and coordinating planning and operating electricity supply tasks in case Denmark is exposed to threats, disasters or thrown into war. Eltra is to oversee this assignment in Western Denmark and Elkraft System in Eastern Denmark, but the two companies are to coordinate their assignments. Grid, transmission and production companies have also been assigned to handle their own planning and execution of concrete assignments connected to the emergency services. A mutual coordinating committee has been established for all parties affected. To gear the emergency services even better to the electricity supply, the establishment of a special legal framework of such services in the Electricity Supply Act is being considered.

The past years' massive growth in unregulated production in Western Denmark has created a need for new monitoring, planning and control tools in the electricity supply system. System Plan 2001, which Eltra submitted to the energy authorities in June, showed that the Jutland-Funen electricity supply system has been "turned upside down". Around half of the production comes from small-scale production plants connected to the grid at the 0.4, 10 and 60 kV level. Consequently, the system balance can no longer be secured by simply monitoring and controlling the overall HV system. In March, the Danish Energy Agency set up a team of experts to assess the technical and economic consequences of the steadily increasing electricity surplus in Western Denmark. The team concluded its work in October with the publication of a report outlining the problem and possible solutions in detail. First of all, it is important to abolish the sections in the energy acts that prevent system operators from handling the electricity surplus in an economically optimum fashion. In practice, this means that it should be possible to replace natural gas by electricity surplus as energy source in district heating boilers. At the end of the year, political talks were started to ensure a majority for the implementation of the necessary legislative amendments. However, in the Eltra area, it proved necessary to introduce a temporary emergency plan in December to handle electricity surplus in particularly critical situations. The plan comprises bypass operation of power station units and the planned shutdown of selected small-scale CHP plants and wind farms.

The electricity market

Since 1 January 2001, customers with an annual consumption of 1 GWh have had access to the free electricity market, and from 1 January 2003 all consumers will be allowed to purchase electricity wherever they want. To ensure that consumers can change suppliers in a simple and non-discriminatory manner, the system operators have started cooperating with the grid companies, the electricity trading companies and the authorities. This cooperation is designed to ensure that rules are laid down and requirements are made for the systems that are to administer relations between electricity traders, grid companies, system operators, etc. and handle settlements between the electricity market players.

On 1 January 2001, the entire capacity of the Skagerrak connection between Jutland and Norway was left at the mercy of the market forces (Nord Pool). The opening of this crucial connection immediately stabilised price developments in the price area Denmark West. On Monday 5 February, the connection proved its full worth when the highest load of the year in Norway and Sweden was registered. On the whole, 2001 saw fewer cases of presumed illegal use of market power than the previous year.

In January, developments in the Elspot price in Eastern Denmark were affected by limitations in the trading capacity on the Øresund Link, replicating the trend from the year before. Later in the year, the price in Eastern Denmark was again above the Swedish price because of limitations in the Øresund Link, albeit to a lower extent than in January.

In April, the market players' interest in using the Kontek cable between Eastern Denmark and Germany for imports grew. In fact, interest was so avid that the cable's capacity proved insufficient to meet the demand. Initially, Elkraft System sold the capacity as subscriptions, but to ensure a better market-related distribution of the capacity on the Kontek Link, Elkraft System has developed an auction system for distribution of capacity. The auctions started on 1 January 2002.

In 2001, the Danish system operators continued to push for the removal of the Swedish border tariff. The Swedish Minister for Business Affairs agreed with the former Danish Minister for Environment and Energy that the border tariff should be lifted to promote an efficient electricity market. The border tariff was removed as from 1 March 2002.

Electricity consumption

Electricity consumption in Denmark including losses in the transmission grid aggregated 35.4 TWh – i.e. an increase of 1.5 per cent unadjusted. Housing, industry and trade/service/public companies each accounted for approximately 30 per cent of the electricity consumption. Agriculture and transportation accounted for the remaining consumption.

Electricity production

Overall electricity production totalled 36.0 TWh – i.e. an increase of 5 per cent. In net figures, Denmark exported around 0.6 TWh. Electricity production broke down as follows:

- 22.2 TWh at primary power stations
- 9.5 TWh at small-scale power plants
- 4.3 TWh at wind power installations

On Zealand, Energi E2 A/S commissioned the new gas and biomass-fired 600 MW CHP unit at Avedøre Power Station. Among the authorities' conditions for approving this power station was the decommissioning of old power stations corresponding to 550 MW. Consequently, operations at the oldest unit at Asnæs Power Station were discontinued, and a further 400-500 MW will be scrapped in 2002.

In 2001, 55 MW of new wind power was established east of the Great Belt. This means that a total of 554 MW of wind power has been established in Eastern Denmark. 2003 will see a further 150 MW added to this figure with the offshore wind farm south of Lolland, which Energi E2 is currently building together with DONG A/S and Sydkraft AB.
In the past year, Energi E2 acquired an existing industrial CHP plant. In conjunction with this plant, Energi E2 intends to establish a wood-pellet factory, which is to supply fuel to the main boiler at Avedøre 2. Moreover, the company plans to establish a straw-pellet factory if it is granted permission to rebuild Amager Power Station's unit 2 into a straw pellet-based unit.

During the year, 100 new wind turbines were erected west of the Great Belt and 33 small wind turbines were dismounted. The overall wind output increased by net 87 MW to 1,950 MW.

The contribution from small-scale CHP plants was modest in 2001. The overall capacity increased by net 57 MW to 1,525 MW.

Electricity prices

At the beginning of 2002, the average electricity price for private consumers (annual consumption of 4,000 kWh) amounted to 62.38 øre/kWh. On top of this comes government tax of 66.60 øre/kWh plus 25 per cent VAT – a total of 161.23 øre/kWh.

When the consumption is 15,000 kWh (typical electric heating customers), the average price is 53.85 øre/kWh, government tax is 61.83 øre/kWh plus 25 per cent VAT – a total of 144.60 øre/kWh.

The transmission grid

From a technical standpoint, Western Denmark have been an integral part of the West European electricity supply system for the past 40 years. As a consequence of the increasingly closer technical cooperation developing between the TSOs in the area, Eltra was admitted as an associated member of UCTE at the end of October.

A significant bottleneck in the 400 kV grid between Northern and Central Jutland will be eliminated by 2004. The background to this is that Eltra has been able to complete the North Jutland HV ring by establishing a 400 kV transmission line between Aalborg and Århus – a stretch of approximately 110 km. More than 10 years of negotiations with the authorities have been conducted prior to this, which ended in an intervention by the Minister for Energy. The project's approval was contingent upon the use of cables for crossing Gudenåen and Mariager Fjord.

Eltra received 48 proposals in an open design competition for new 400 kV pylons for the North Jutland overhead line. The successful proposal, prepared by Bystrup Architects, Copenhagen, is seen in the photo.

In addition, there will be underground cabling into Aalborg. The Minister for Energy also made it a condition that a design competition was launched for a new 400 kV transmission tower to be used on part of the stretch. Almost 50 proposals were submitted to the panel of judges.

Another 400 kV line in Southwest Jutland, which was also subject to lengthy consideration by the authorities, was put into service in October. The line that connects Vejen and Endrup is to ensure supply security for Esbjerg and be a connection point for the feed-in of energy from the Horns Rev offshore wind farm in the North Sea 20 km off the coast. The 160 MW wind farm, which is being built by Elsam, will be commissioned in autumn 2002. Eltra is charged with bringing the production ashore and leading it to the transmission grid. In the spring, Eltra built a transformer platform at Horns Rev, which will be connected to the shore with a new 150 kV submarine cable.

To secure supply in the Copenhagen area, Elkraft System had to ask Nesa to postpone the dismantling of the 132 kV overhead lines along the Helsingør Motorway between Glentegård and Stasevang substations. According to the plans from 1993, the lines should have been removed by 2003.

The background to the postponement is improvements made at the power stations in Copenhagen in combination with upgrading of the transmission grid and the fact that the obligation to supply electricity no longer lies with the generators. Combined, this means that supply security in the greater Copenhagen area is weakening. Against this background, analyses of the possibilities of ensuring the future supply in the Copenhagen area were conducted during the past year. In 2002, Elkraft System will make the final decision on which solution to choose.

Elkraft Transmission is currently establishing a new 400/132 kV substation in North Zealand, which is to maintain supply in the area. The substation will be ready for commissioning in 2003.

In connection with the establishment of Nysted offshore wind farm, which is expected to be commissioned in 2003, a 132 kV cable connection is to be established between the wind farm and a substation on shore. The cable will consist of a submarine cable and a land cable. The cables will have a transmission capacity of around 160 MW. SEAS Transmission will establish and own the connection.

The new unit 2 at Avedøre Power Station has been connected to the power station's 400 kV station, from which 400 kV cables lead to H.C. Ørsted Power Station and the 400 kV substation in Ishøj. In addition, 400/132 kV transformation has been established in Avedøre Power Station's 400 kV substation, connecting the 400 kV substation to Avedøre Power Station's 132 kV station. This improves the grid connection for the Avedøre Power Station's units 1 and 2.

In the past year, ownership of the electrical Øresund links was settled. Consequently, the 400 kV cables are now owned by Svenska Kraftnät and Elkraft Transmission, while the 132 kV cables are owned by Sydkraft and Elkraft Transmission.

Elkraft Transmission is constructing a new 400 kV substation in North Zealand. Photo: Mogens Carrebye.

New transmission line towers made of glued laminated timber at Viherlandia in Jyväskylä, Finland. The towers have been designed by Professor Antti Nurmesniemi and Jorma Valkama, Interior Designer.

Photo: Juhani Eskelinen.

Energy policy

In the spring, the Finnish Government presented to Parliament its programme concerning measures used for fulfilling the obligations stipulated in the Kyoto Protocol. Finland intends to reduce its emissions to the level of the year 1990. The measures used to achieve this are energy conservation and promotion of renewable forms of energy as well as the use of such forms of energy generation which alone can achieve half of the objective set. Parliament required that the proposed programme be discussed again after a decision concerning a potential new nuclear power unit in Finland has been made.

The application submitted by Finnish industries concerning a new nuclear power unit was in circulation for comments during 2001. Most of the comments given were in favour of nuclear power. In accordance with this, the Government decided at the beginning of 2002 to advocate the application. Parliament is to make its decision in the matter during the latter half of the same year. A potential decision concerning the actual building of a new nuclear power unit will be made later by the relevant power company.

The new Environmental Act, which came into force in the year 2000, required that many power plants needed to apply for a new concession in 2001. Almost all power plants are required to apply for a new concession in any case before 2005.

The forecasts presented in the EU's green paper "Towards a European strategy for the security of energy supply" have great significance for Finland, especially as concerns the use of natural gas. Finland argues that energy policy should be left to the member states as thus far. The directive proposal concerning emissions trading is of utmost importance to the Finnish climate policy.

Electricity market

Extensive structural changes within the Finnish electricity industry continued. Electricity utilities established shared sales companies and reorganised their mutual ownership relationships within production. Even new players entered the market. At the end of the year 2001, the number of distribution network companies had gone down to 98. When the Electricity Market Act came into force in 1995, there were 117 distribution network companies, and 141 in the early 1990s. In the 1960s, they numbered as many as over 300.

The Ministry of Trade and Industry completed its evaluation of the functioning of the electricity market. The conclusion made in the report was that the Finnish electricity market works in a satisfactory manner. In order to intensify the market further, certain amendments to the Electricity Market Act were still initiated, concerning the separation of network operations from the other businesses, securing the availability of slow reserve capacity and empowering the Energy Market Authority to impose operational norms. The preparation of the law amendment will continue in 2002.

Despite long-term efforts to make the Finnish system operator a co-owner in the Nordic electricity exchange Nord Pool Spot, the negotiations did not yield a satisfactory outcome from the Finnish point of view. So far, the Danish and Finnish system operators do not have an equal status in the electricity exchange.

Electricity consumption

In the year 2001, a total of 81.6 TWh of electricity was used in Finland, which was over 3 per cent or 2.4 TWh more than in the year 2000. The calendar and temperature adjusted growth rate was 1.4 per cent. Domestic generation increased by 6.5 per cent as the import volume decreased.

Series capacitors at the Uusnivala substation on the 400 kV line between Pikkarala and Alajärvi. The project for upgrading the 400 kV connection between northern and southern Finland by means of series compensation progressed on schedule and was completed in the spring. The modernisation increased transmission capacity between northern and southern Finland by 400 MW. Photo: Jarmo Naumanen.

Electricity consumption reached a new record level of 13,310 MW on 5 February. Corresponding values were also reached at the beginning of 2002 even though many industries were still having their Christmas breaks. Industries and the construction sector accounted for 53 per cent of all electricity consumption in Finland, households and agriculture for 25 per cent, and the service and public sectors for a total of 18 per cent. Industrial consumption of electricity decreased by more than 1 per cent while that by households increased by some 9 per cent and consumption by the public sector by approx. 7 per cent.

Electricity production

The proportion of combined heat and power production (CHP) in Finland increased to 32 per cent in 2001. Nuclear power accounted for 27 per cent of all production, hydropower for 16 per cent, and coal and other conventional condensing power for almost 13 per cent. The proportion of electricity imports went down to 12 per cent from the 15 per cent in the year 2000.

Net imports of electricity into Finland were 10 TWh. Imports from Sweden and Norway decreased to a half while imports from Russia increased by 57 per cent to 7 TWh. The increase corresponds to the annual production of one unit at the Loviisa Nuclear Power Plant.

Due to the cold weather, combined heat and power production also reached a record figure of 26 TWh, which is 6 per cent more than in the previous year. The primary fuels used in CHP are natural gas, coal and domestic biomass. Finland is the leading country globally in CHP. In 2001, the world's biggest power plant firing biofuels was commissioned in Pietarsaari by Alholmens Kraft, and another major biopower plant was commissioned in Kokkola.

Nuclear power production grew by 1 per cent to 21.9 TWh. The availability of the Finnish nuclear power units represents the pinnacle on a global scale.

The hydropower situation was poorer than in the year 2000. Hydropower production decreased by 8 per cent to 13.3 TWh.

Electricity prices, taxes and fees

The poorer hydropower situation was reflected in the prices at the electricity exchange and in the transmission volumes between Finland and the other Nordic countries. As the transmission capacity that was made available to the market by Fingrid was mostly sufficient, the price differences between Finland and the rest of the electricity exchange area decreased. During the entire year, Finland was separated as a price area of its own for a total of 74 hours.

The trend of decreasing electricity prices, which had commenced in the autumn of 1998 when the electricity market was opened, came to an end last year. The higher prices at the electricity exchange together with the poorer financial results of sellers of electricity during the past few years were reflected in elevated electricity prices for the end customers. More than half of electricity sellers raised their list prices of electricity in 2001. The official list prices went up by an average of 10.9 per cent. The transmission fees within electricity distribution increased by an average of 1.3 per cent in 2001.

The total price of electricity including tax increased by an average of 5.8 per cent in 2001. The average price of household electricity was 52.5 Finnish pennies per kWh at the end of the year. This means an increase of 2.6 pennies per kWh or approx. 5 per cent in a year. The price of electricity, including electric energy, transmission and tax, for

New duties and challenges for the newly commissioned Network Control Centre in Hämeenlinna. Control of the Finnish grid was centralised at the Power System Control Centre in Helsinki and at the Network Control Centre in Hämeenlinna, and some operations were outsourced. Foto: Juhani Eskelinen.

medium-sized industry was 30.2 pennies per kWh. This price increased by 1.9 pennies per kWh, i.e. some 6.2 per cent, over the past year.

Extensive development work with grid customers and authorities resulted in the introduction of new grid service contracts at the beginning of 2002. The contracts conform to Nordel's principles concerning tariff harmonisation. The price level continues to remain at the same level as in the year 2000, which in real terms means that the price level has decreased by one fifth in comparison with the previous contract period.

Main grid and cross-border connections

Electricity transmission between Finland and the other Nordic countries changed from exports from Finland in the early part of 2001 to abundant imports into Finland towards the end of the year. Despite this, the Finnish national grid caused but very small restrictions thanks to the reinforcements of the grid which had been carried out well in advance, taking into account the needs of the electricity market.

Fingrid's investments in the Finnish grid totalled FIM 197 million in 2001. The series compensation project at intersection P1 between northern and southern Finland was completed during the year. The series compensation enabled an increase of approx. 400 MW in transmission capacity. This modernisation also offers more opportunities to utilise electricity transmissions between Finland and Sweden in the north.

The building of the third 400 kV cross-border connection from Russia between the Viipuri substation in Russia and the Kymi substation in south-eastern Finland commenced in 2001. The project will be ready at the beginning of 2003, and it will increase the transmission capacity from the current 1,000 MW to 1,400 MW.

Other investment projects include the Keminmaa – Sellee 400 kV line near Tornio in northern Finland, including a substation and a transmission line. The work was completed in the spring of 2002. Moreover, there were several investment and modernisation projects in the 110 kV network. Decisions to supplement the Alajärvi 400 kV substation and to modernise the Pikkarala and Pirttikoski 400 kV substations during 2003 and 2004 will also improve the utilisation of cross-border connections between Finland and Sweden.

Most of the Finnish national grid was built in the 1960s and 1970s. According to current maintenance plans, it is expected that modernisation projects will account for an increasing portion of the future investments. One of the significant projects in the coming years is the replacement of aluminium towers with steel towers on the 700-kilometre line between Huutokoski in eastern Finland and Kukkolankoski on the Finnish/Swedish border as well as on the Alajärvi – Seinäjoki line.

The full transmission capacity available between Russia and Finland was used during 2001. The experiences gained from Fingrid's revised transmission service on the cross-border connection from Russia have been positive. The final reservations of transmission capacity on this connection made last autumn diversified the users of the service, and there are also more international players involved.

Grid operation in Finland was reorganised in the year 2001. All operational planning and control of Fingrid's 110 kV network as well as control of the 220 and 400 kV networks were centralised from four regional offices to the new Network Control Centre in Hämeenlinna. Operational planning and monitoring of the 220 and 400 kV networks continue to be managed by the Power System Control Centre in Helsinki. Local grid operation, telecommunications maintenance as well as measurement and testing services were outsourced.

The operational reliability of the Finnish power system was good. There were a total of 266 minor disturbance situations, 50 of which took place in the 400 kV grid. In order to further intensify grid operation and to boost reliability, Fingrid commissioned a new training simulator.

The biggest disturbance situations in the 400 kV network took place when a tower fell over in January and when a crossarm of an aluminium tower broke in December just a few months before the planned replacement of the tower. In April, there was disturbance on two lines simultaneously at the P1 intersection. However, these disturbance situations did not necessitate restrictions in electricity transmission.

In November, the Finnish grid was struck by the most severe storms in decades. The electricity supply of approx. 900,000 consumers was interrupted as a result of the storm damage. However, the national grid managed the storms without considerable disturbance or damage.

Restrictions in electricity transmission during planned outages were compensated for through counter trading. More accurate and better planning of outages which have an impact on the transmission capacity gave good results and decreased the need for counter trading. The market was also continuously informed of the available transmission capacity and of the state of the power system in real-time at Fingrid's Internet pages.

The balance service was developed, and the structure of balance service contracts was simplified. New balance service contracts were signed with balance providers. The number of parties providing balance service rose to 22 during 2001.

Iceland

From the Reykjavik festival "Light in Darkness".

Poto: Emil Thor.

Energy policy

The restructuring of the Icelandic electricity supply industry has been delayed somewhat. The new energy act was not laid before the Icelandic Parliament by the end of 2001 as planned. The Icelandic Government still aims to lay the energy act before Parliament and to finish debating it in 2002. The new act is expected to clearly separate monopolistic activities (system operator responsibility, transmission and distribution) from competitive activities (production and sale). There have been tough discussions among the Icelandic energy companies concerning several parts of the new act, although the final result is expected to receive broad support. If everything goes according to plan, the first step towards a free market will be taken in 2002 and the entire reform will be complete no later than 2007.

A licence application for the Karahnjuka power plant in eastern Iceland was considered during the year. The report on the environmental impact study for the power plant was not approved by the respective institutions, and so responsibility for making a decision rested with the Minister for the Environment following a complaint by Landsvirkjun, the national power utility, and several municipalities. The Minister overturned previous decisions concerning the Karahnjuka power plant but also set requirements for improvements to minimise its impact on the environment.

The electricity market

The Nordic Aluminium smelter increased its capacity in 2001 by 30,000 tonnes. Further expansion of the smelter is being considered, which will probably increase annual production from 90,000 tonnes to 240,000 tonnes in the near future. The ISAL smelter has also shown interest in increasing its annual capacity by 260,000 tonnes.

Landsvirkjun is continuing discussions with Reydaral to deliver power to an aluminium smelter in eastern Iceland with an annual production of 260,000 tonnes, and with the possibility of increasing annual production to 390,000 tonnes.

The energy market

Geothermal energy production will increase in the next few years. The energy companies Reykjavik Energiverk and Sudurnes Energiverk are planning to expand their geothermal stations in order to enhance their competitive situation when the new electricity act comes, which will open up competition. Some of their operations will involve delivering energy to large industrial corporations wanting to increase their production capacity. A licence application for Landsvirkjun's planned 575 MW hydropower station at Karahnjukar in eastern Iceland has been considered and the procedure completed in 2001. The hydropower station's capacity will later be increased to 700 MW.

Electricity consumption

In 2001, Iceland's gross electricity consumption totalled 8.0 TWh, including all losses and the power stations' own consumption. The corresponding figure for 2000 was 7.7 TWh, representing a rise of 4.5%. Consumption comprised 7.3 TWh primary power and 0.7 TWh non-guaranteed power. Electricity consumption per capita on Iceland increased substantially in 2001 and is now greater than Norway, which previously held the world record.

Of the total electricity consumption, energy-intensive industry accounted for 64.3% (63.4% in 2000). General use rose by 1.7%. If consumption is adjusted for deviations in temperature from the average temperature, the increase is 2.9%. The proportion of electricity in terms of total energy supplied to end-users was 26%.

General use is expected to increase by 55% until 2025.

Electricity generation

The generation of electricity covers total electricity consumption, including transmission losses. In 2001, of the total production of 8.1 TWh, 6.6 TWh or 81.9% was generated by hydroelectric power (6.4 TWh or 82.7% in 2000),

Kárahnjúkar. Photo: Hreinn Magnússon.

while 1.5 TWh or 18.1% was generated by geothermal power (1.3 TWh or 17.2% in 2000).

Consumption in 2001 set new records yet again, with a peak load of 989 MW and 7.7 TWh. The increase is primarily attributable to increased consumption by energy-intensive industry.

Installed capacity in the production facilities totalled 1,427 MW at year-end 2001 (compared with 1,353 MW the year before). Landsvirkjun's new hydropower station, Vatnsfell, became operational in November 2001 when the first unit came into service. Reykjavik Energiverk increased its production capacity by 30 MW in June when the third turbine was installed in the geothermal power plant at Nesjavellir.

The price of electricity

Landsvirkjun's wholesale tariff to the distribution companies was raised by 4.1% on 1 July 2001. The distribution companies changed their tariffs by between -3.2% and + 9.6% during the year.

There were no changes in tax or duties levied on electricity in 2001. The only tax on electricity is value added tax at the general rate of 24.5% or 14% on domestic heating.

In order to even out the price difference between the majority of domestic customers who are able to use geothermal power to heat their homes and the minority who are obliged to use the more expensive electricity, the State subsidises the latter category. Heating for commercial premises is not subsidised.

There has been a steady increase in domestic heating subsidies, which for 2001 are expected to total approximately ISK 760 million. These costs represent by far the biggest costs to the State in the energy supply sector. Various state subsidies are also helping to fund the operation of new district heating utilities, which will replace heating by electricity. There is currently a debate going on as to whether the most expensive district heating utilities should be subsidised. Landsvirkjun will also contribute ISK 92 million.

The transmission system

Work is progressing on various projects to analyse whether the system's transmission capacity can be increased by upgrading or rebuilding individual components or subsystems. Studies are also being made of whether new innovative solutions can be used in maintenance or whether intelligent protection scheme can be installed, which can provide increased transmission capacity by coming close to system boundaries.

A new 400 kV line is being planned from the Sultartangi hydropower station at Thjorsa to the Brennimelur transformer station, close to the Nordic Aluminium smelter and the ferrosilicon plant in Hvalfjørdur. A licence application for the line is now being considered.

From the Reykjavik festival "Light in Darkness". Photo: Emil Thor.

If the large industrial corporations in south-west Iceland are going to continue expanding capacity, it will be necessary to increase the transmission capacity in the area by building a 400 kV transmission system. Lines built in the past few years have therefore been constructed to tolerate 400 kV, even if they are currently operating with a voltage of 220 kV.

Other relevant events

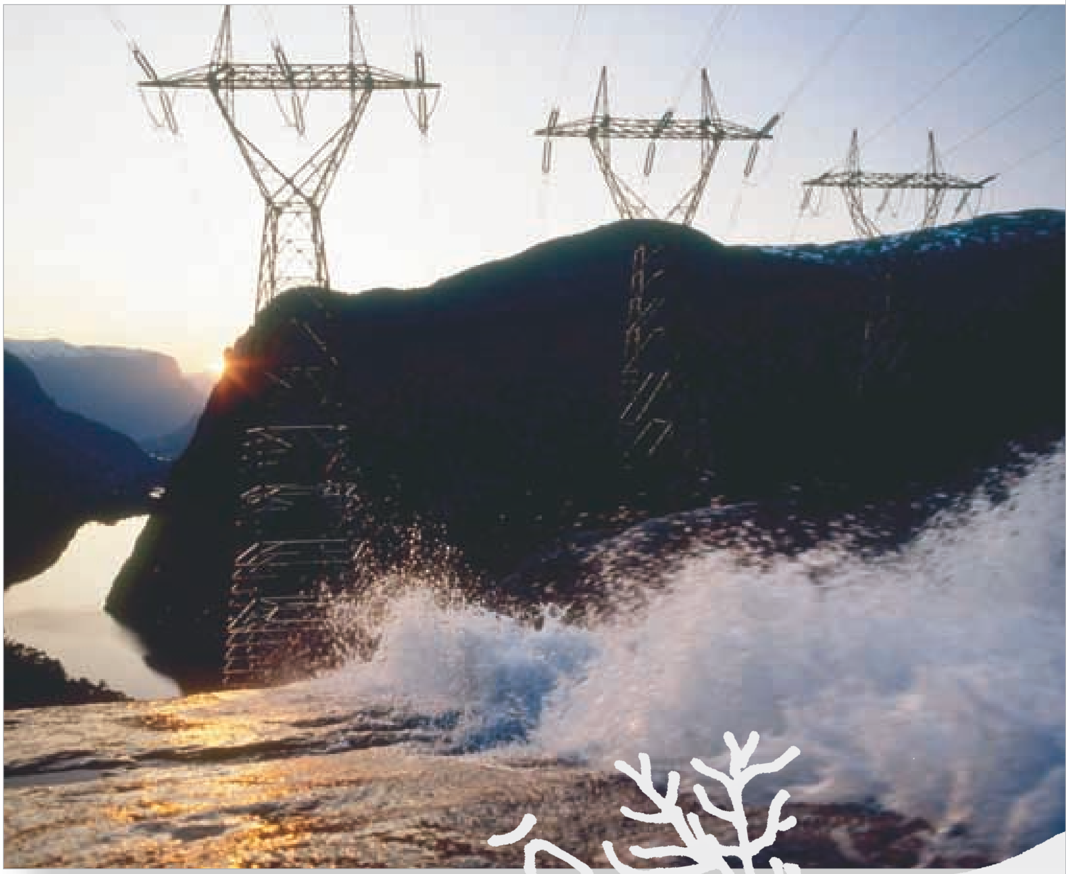
Landsvirkjun's new national control centre will become operational in the autumn of 2002, after Landsvirkjun signed a contract with Alstom in France in 2001 for its delivery. The major electricity companies have been active in buying up smaller players. The objective is to build up large and more economic entities and improve the companies' competitiveness.

The State has bought up 40% of Vestfjord Energiverk energy company from the municipalities in the region. With this, the State has taken over all the shares in the company which has now been converted into a limited liability company. It is expected that Rarik (the State electricity utility) will take over this company during 2002. Rarik and Nordenergi are still considering a merger, but no date has been set for a final decision.

Hafnarfjördur Elverk electricity company and the municipal energy company at Vestmanna islands have merged with Sudurnes Energiverk energy company.

Dimmugljúfur. Photo: Hreinn Magnússon.

Norway



Pylons in Western Norway, Aurland in the Sogn region.

Photo: Husmo-foto/Megapix.no

Energy policy

The Norwegian Storting passed amendments to the Energy Act on 15 June 2001, and the Ministry of Petroleum and Energy provided new regulations to the Energy Act on 14 December 2001. The new Act came into force on 1 January 2002. The most important changes in relation to the earlier Act are:

- The Preamble to the Act has been changed so that energy use is mentioned among the functions to be legally safeguarded by means of the Act.
- A separate licensing scheme has been set up for the operation of an organised market place for physical trade in electricity.
- A new chapter has been included in the Act bringing together provisions for the system operator responsibility, rationing and delivery quality requirements.
- The legal basis for energy planning is collected in a separate provision in a new chapter.
- The provision governing access to the grid has been made clearer.

As a result of the changes to the Energy Act, some functions that were previously regulated by means of guidelines will now be regulated by means of regulations. This applies among other things to the system operator where the regulator NVE (the Norwegian Water Resources and Energy Administration) is responsible for formulating the regulations.

In connection with the debate on the revised National Budget for 2000, the Storting resolved to review the tasks and organisation of Statnett following the considerable development that had taken place in the electricity market since the company was established in 1992. On this basis, in association with the state budget for 2002, the Government put forward a review of Statnett's tasks and organisation. The matter was debated in a session of the Storting on 19 February 2002, in which the Storting was unanimous in its view that Statnett should remain organised as a Transmission System Operator (TSO) with responsibility for co-ordinating the Norwegian electricity system and owning most of Norway's main grid. There was also a majority in favour of the transformers between the main grid and lower grid levels being included in the main grid. The Storting sent a motion to the Government proposing that a report to be prepared on the question of whether it would be most useful with only one grid level under the main grid. The Storting moved unanimously to request the Government to report to the Storting and put forward a proposal for different models of grid tarification.

A Gas Technology Committee was appointed by the Stoltenberg Government at the beginning of October 2001 and had its mandate adjusted by the Bondevik Government in November 2001. The Committee's mandate was to assess how research and development can be used to stimulate the testing, commercialising and introduction of new environmentally friendly natural gas applications in Norway, including hydrogen and CO2-free gas-fired power plants. The Committee gave its recommendations to the Petroleum and Energy Minister on 1 March 2002. It is evident from the Committee's conclusions that the Committee believes it is of the highest priority to produce technologies capable of realising commercial gas-fired power plants with CO_2 handling as quickly as possible. In order to make such gas-fired power plants economically competitive internationally, a change in technology will be required. The Committee estimates that this will take 10 – 15 years to accomplish.

None of the three gas-fired power plants at Kollsnes, Kårstø and Skogn which have been granted licences to build have taken a final decision on when construction will commence.

The Storting resolved in the autumn of 2001 to authorise the expansion of the Snøhvit field, which is a gas field off the coast of Finnmark. This is the first gas field in Norway where the gas will be delivered in the form of LNG. The gas will be piped onshore at Sørøya near Hammerfest, where it will be cooled and transported in LNG tankers. A gas-fired power station will be built in conjunction with the installation on Sørøya.

The state-owned enterprise ENOVA SF was formed in Trondheim on 22 June 2001, and was fully operative from 1 January 2002, when it took over the task of managing the national energy efficiency scheme, formerly done by the energy companies, as well as administering the funds allocated for energy reorganisation, formerly done by NVE. The aim of establishing ENOVA SF has been to reinforce the work of reorganising environmentally friendly energy use and energy production. ENOVA's operations are financed by a newly established energy fund. The Storting's aims in working to reorganise energy use and production have been formulated as follows:

- To delimit energy use to a considerably greater degree than if development was to be left to itself
- To use 4 TWh more water-borne heat annually based on new, renewable sources of energy, heat pumps and waste heat by the year 2010
- To build wind farms capable of generating 3 TWh annually by the year 2010
- To increase the use of natural gas in Norway

The electricity market

The restructuring of the Norwegian electricity market continued in 2001. Domestic consumers changed suppliers at a rate of 40,000 to 60,000 per quarter and business customers at a rate of approximately 9,000 per quarter. This means that about 300,000 or 13.5% of domestic consumers have a different supplier than the dominant supplier in their particular grid area. For business customers this figure is approximately 54,000 or 20%.

Statkraft continued its acquisition of shares in Norwegian energy companies. During 2001, the company acquired 45.5% of the shares in Agder Energi AS and the entire company Trondheim Energiverk AS. On 21 March 2001, the Norwegian Competition Authority banned Statkraft from implementing the purchase of the shares in Agder Energi AS on the grounds that it would lead to a substantial restriction of competition in the wholesale power market in Southern Norway. Statkraft has announced that it will appeal the Competition Authority's decision.

NVE is currently dealing with or has dealt with applications to build wind farms with anticipated generation of 5.4 TWh. Eight of the planned 23 wind farms in Norway may lead to such considerable problems for radar and telecommunications installations that they should not be built. Adjustments must be made to a further 8 planned installations before they are acceptable. These 16 wind farms represent half of anticipated generation.

In June 2001, the Government awarded a licence to Opplandskraft DA and Tafjord Kraftproduksjon AS for hydropower expansion in Øvre Otta. The two hydropower plants at Framruste and Øyberget will together generate about 525 GWh annually.

In 1989 and 1990, licences were granted for the expansion of the three hydropower plants at Beiarn, Bjellåga and Melfjord in the Saltfjellet-Svartisen area in Nordland. The planned expansion was halted by the Government, and the Storting confirmed the decision. The owners, Statkraft and Nordland County Municipality, have received compensation for the costs already incurred by the projects.

Statnett bought grid installations from Norsk Hydro and Statkraft during the year, so that at year-end 2001 Statnett owned 87% of the Norwegian main grid. In the summer of 2001, Statnett was awarded a licence for an HVDC connection from Norway to England. The connection will be 750 km long and consist of two marine cables. The connection will be dimensioned for a capacity of 1400 MW.

At the end of October 2001, the boards of E.ON Energie AG and Statkraft SF approved an agreement terminating the power agreement linked to the Viking Cable. This was the result of talks between the parties after E.ON Energie had declared hardship in June 2001 under the terms of the power exchange agreement. After it was clear that the power exchange agreement had been terminated, E.ON Energie and Statnett entered into negotiations to see whether it would be possible to realise the actual cable project between Norway and Germany. Towards the end of 2001, it became evident that that would not be possible.

Electricity consumption

In 2001, gross total consumption in Norway, i.e. consumption including transmission losses, was 125.5 TWh. This represented an increase of 1.7 TWh (1.4%) on 2000. Gross consumption in the ordinary supply totalled 86.3 TWh, an increase of 4.1 TWh on 2000. Adjusted to normal temperature conditions, ordinary consumption was estimated at 86.9 TWh, an increase of 0.2 TWh (0.2%) in relation to the same period last year. Consumption by power-intensive industries was 31.5 TWh, a reduction of 0.6 TWh (1.9%) on 2000. Overall power consumption for electric boilers and pumped storage power was 5.9 TWh, a fall of 11.9% on 2000.

The consumption of light heating products (light fuel oils and paraffin) totalled 794 million litres, which was 86 million litres (12%) up on 2000. The consumption of heavy fuel oils was 281 million litres, which is 88 million litres (46%) up on 2000. NVE estimates net domestic final consumption of energy in 2001 at 820 PJ, which is 25 PJ (3.0%) more than in 2000. Of this, electricity consumption accounts for 49.4%, which is a reduction of 0.3 percentage points on 2000. Petroleum products accounted for 36.6% and solid fuels for 13.3%. District heating accounted for around 0.7%.

The maximum load relating to domestic consumption, including electric boilers and pumped storage power, occurred at the 10th hour on 5 February 2001 and totalled 23,054 MW, a rise of 2,634 MW compared with 2000. 1,105 MW were imported in the maximum load hour, at a system price of NOK 1,387 per MWh.

Electricity generation

Hydropower generation was measured at 121.0 TWh in 2001. An additional 0.9 TWh of thermal power brought total generation up to 121.9 TWh, which is 20.9 TWh (14.7%) less than last year. Power trading with other countries resulted in a net import of 3.6 TWh. This represents a change of 22.6 TWh compared with 2000, when 19.0 TWh were exported.

New hydropower capacity in 2001 totalled net 28 MW, with a mean annual production of 100 GWh. The capacity is spread over a total of 8 plants.

NVE estimated that mean annual production in the Norwegian hydropower system at 1 January 2002 was 118.2 TWh, based on precipitation data collected between 1970 and 1999. In addition to hydropower, Norway's thermal power stations are capable of generating 1.5 TWh. Overall power generation in Norway in 2001 was therefore 102.4% in relation to an estimated theoretical mean production. Installed capacity in the hydropower stations at 1 January 2002 totalled 27,571 MW. At the same date, reservoir capacity totalled 84.1 TWh.

Before Svenska Kraftnät could upgrade the 420 kV Borgvik-Hasle line, 26 pylons had to be lengthened.
Photo: Svein Erik Dahl/Samfoto

Electricity prices, taxes and dues

The Norwegian Competition Authority has calculated that the average weighted power price to domestic consumers at 1 January 2002 was 41.01 øre/kWh including VAT and consumption tax (electricity tax). This represents an increase of 15.3% on 1 January 2001. The average weighted transmission price to domestic consumers excluding VAT at 1 January 2002 has been estimated at 20.81 øre/ kWh, compared with 19.27 øre/kWh at 1 January 2001.

Consumption tax (electricity tax) is levied on the consumption of power, and is added to the power price (but not the grid hire) before VAT is calculated. Industry, mining and labour market companies engaged in industrial production and greenhouse industries are exempt from electricity tax. Tax exemption applies only to electric power used in connection with actual production processes. Consumers in the far northern counties of Finnmark and Nord-Troms do not pay electricity tax.

In 1999, consumption tax stood at 5.94 øre/kWh, while for 2000 it was raised to 8.56 øre/kWh and then raised again in 2001 to 11.3 øre/kWh. On 1 July 2001, the tax was lowered again, to 10.3 øre/kWh, and from 2002 it has been cut yet again to 9.3 øre/kWh.

In common with all other goods and services, electricity is also subject to VAT, which is currently 24%. The three northern-most counties are not liable to VAT.

The Main Grid and System Operations

The winter of 2001 was colder than for several years past, and a number of new consumption records were set. The transmission requirement during high load periods approached the maximum of grid capacity, particularly on exports from Southern Norway to Sweden over Hasle. The Skagerrak cable from Norway to Jylland was opened for spot trading in the power market from 1 January 2001. In the operating phase the transit possibilities to Sweden over Skagerrak and Kontiskan were often used to relieve the transmission at Hasle, and from Western to Eastern Norway. During the course of the winter, the energy situation with water levels in reservoirs below the median led to net imports from neighbouring countries. This situation lasted until later in the autumn, when abundant precipitation, especially in Southern Norway, filled the reservoirs well up for the winter.

The physical electricity market (Elspot) is used to manage structural bottlenecks in the main grid. This is done by dividing Norway, on a seasonal basis, into spot areas based on network and precipitation conditions. Each day the Nordic TSOs set a trading limit between adjoining areas based on the current operating situation. If the transmission requirement between two areas exceeds the given trading limit, a bottleneck arises (where the size of the bottleneck is the transmission requirement less the available capacity). Half the price difference between the two areas multiplied by the size of the bottleneck is known as the socio-economic cost (market cost).

Market costs in the main grid were estimated at NOK 30 million in 2001, a considerable reduction compared with NOK 120 million the year before. Some of the reduction is because the price differences in the congestion situations were small and the transmission requirement between spot areas was less than last year. Another reason for the reduction is the trial scheme introduced between 1 June and 31 December, with a limited counter-trading when there was maintenance on the interconnectors between the elspot areas. With counter-trading, the trading limit between affected areas was set higher than the basis provided by the actual physical capacity. Counter-trading was restricted to 500 MW and limited to a maximum of 2 weeks per outage. Counter-trading costs were covered by the TSOs. The purpose of the scheme was to provide incentives for limiting outage times as well as smaller price differences in the spot market in periods with maintenance. The resulting imbalance in the operating phase was controlled with the help of the regulating power market.

Other transmission restrictions and bottlenecks in the operating phase are managed by special regulations, which incur costs for the system operator. In 2001, special regulation costs totalled NOK 60 million. Of this, NOK 28 million was due to bottlenecks with intact grid and NOK 15 million arose from outages. Operating disturbances gave rise to special regulation costs of NOK 11 million. NOK 16 million of the costs with intact grid arose because of a long-term deficit situation in the northern part of Western Norway. At the beginning of the year reservoir levels were low in this area after a dry autumn in 2000. A conductor break on the Nesflaten-Sauda line led to a disconnection time of approximately 1 week and special regulation costs of NOK 8 million.

To ensure that there is sufficient power reserve, a market for this purpose was opened for the winter of 2000-2001. Three-month and one-year reserve power contracts were entered into. The reserve power market was continued for the winter of 2001-2002, with the possibility of monthly bidding rounds and agreements of alternatively 1, 3 and 12 months.

The Nordic countries collaborate closely on balance regulation. The cheapest regulating object must be used if there is no congestion in the grid.

In 2001, a market was opened for payment of primary response. In the event of a need for primary response over and above that provided by a normal droop setting of 6%, Statnett put into operation a routine which involved Statnett obtaining bids once a week and on that basis purchasing extra primary response in order to comply with Norway's requirement for primary response, and also so as to be able to export primary response to Sweden. Statnett made such purchases from week 20 to 41. A limited sum, NOK 10 million, was contracted for this purpose. It has been decided to continue and develop this market further for 2002.

Transmission capacity between Sweden and Southern Norway was increased by 200 MW in November 2001 after extensive works in Sweden.

Sweden

Termovision to detect breakage on power lines

Photo: Jonas Karlsson.

Energy Policy

The energy policy changeover programme of 1997 aims to cost-effectively reduce the consumption of electrical heating, utilize the existing electricity system more efficiently and increase the supply of electricity and heating from renewable sources of energy.

According to the government, the promoting of renewable sources of energy and a more efficient utilization of energy and resources is to take place through new and more market-based control measures. One step in this direction is the findings of the Government Commission on Electricity Certification in the autumn of 2001, which include proposals for how a quota-based certificate-system could be formulated. The purpose of the new system is to promote production from renewable sources of energy and create a market which provides the prerequisites for technological development and cost-effectiveness. The objective of the commission is that electricity production from renewable sources of energy will increase by 10 TWh up until 2010. The proposed certification system, which will issue so called green certificates, is envisaged to replace the current support for renewable and small-scale electricity production. Certifiable electricity consists, in principle, of electricity included in the current support system and production from new plants without any size limitation, plus increased output from existing hydropower plants. The Government Commission on Electricity Certification proposes that the system be introduced on 1 January 2003.

As an element in the changeover programme, the two reactors at Barsebäck were to be decommissioned. A review during 2000 showed that Parliament's conditions for closing the second reactor had not been met. A new review during the autumn of 2001 showed that circumstances had not changed since the year before and the government stuck to its previous assessment. The most important criterion for whether or not the conditions can be said to have been met is that decommissioning does not have a palpably negative effect on electricity prices, the supply of power to industry, the power balance or on the environment and climate. The government recommends that a new review be carried out in 2003.

The government appointed a special investigator to review competition on the Swedish electricity market whose final report was submitted on 17 January 2002. Price formation and competition on the deregulated electricity market is assessed by the investigation to be working well, but certain requirements for supplementary measures have been identified. Rising electricity prices can be explained by the energy balance having been impaired by increased consumption and production plants being shut down simultaneous to the first reactor at Barsebäck being decommissioned. Swedish electricity prices are now largely determined by the marginal costs of producing electricity in Danish and Finnish fossil-fuelled CHP and condensing plants. The investigation has not been able to demonstrate any misuse of market leverage, but expresses concern about the reduced number of players in production and trading as this will entail the increased risk of a concentration of power. It is also pointed out that there are circumstances hampering and preventing customer mobility on the electricity market, e.g. the exchange of information working badly during changes of supplier. Among the proposed measures can be noted the introduction of a sanction against network owners who impede changes of supplier. Further proposals include a special licence to be an electricity trader, a turnover concession, and the Swedish National Energy Administration being given the clear-cut role of expert authority in electricity-trading issues.

A government proposition preventing network companies from having a joint MD or a joint Board majority together with a trading company has been presented to Parliament. The background to this is concern that companies in the power industry will practice cross-subsidization between power trading, which is exposed to competition, and their network operation, which is a monopoly. The Standing Committee on Economic Affairs, however, points out the risk that under this proposal small companies will be knocked out and that cross-subsidization could also take place between trading companies and district heating companies, which accordingly should also mean these not being allowed to have a joint MD either. The committee is of the opinion that this is an unfortunate solution and has asked the government to reconsider the issue and return with a new proposal.

Photo: Svenska Kraftnät.

In December, a proposal of principle was submitted regarding long-term agreements with energy-intensive industries aimed at cutting emissions of climate-impacting gases. In brief, the proposal entails that power-intensive companies can undertake to introduce an energy management system and take rationalizing measures over and above normal profitability requirements. In exchange, the state will offer financial incentives, primarily through relieving environmental taxes on energy.

At the end of February 2002, the government decided that paid connection fees for the Swedish grid will, as of 1 March 2002, also entitle the use of the overseas interconnectors to Zealand and Jutland. The removal of the border tariff towards Denmark is regarded as a step forwards in the evolution of the Nordic electricity market.

Electricity market

During 2001, the electricity market has continued to be characterized by the number of players declining as acquisitions and mergers continue. In the power industry, the trend is towards ever greater and more integrated energy companies with operations in several countries. On the trading side too, changes are taking place as municipalities are increasingly selling off their trading companies in step with stiffening competition.

According to an investigation carried out in August 2001, on the instructions of the Profile Delegation and trade association Swedenergy, about 30% of low-tension customers have been active by way of either changing supplier or renegotiating electricity prices.

On 5 February 2001, it was severely cold and Svenska Kraftnät forecast that the consumption of power could exceed 28,000 MW, the maximum the electricity system is able to cope with. Svenska Kraftnät issued a warning about power shortages and appealed to the public to reduce consumption. Consumption fell by about 2,000 MW as a consequence of the resulting high electricity prices and subdued consumption. Consumption amounted to 26,800 MW, setting a new record.

Prior to the winter of 2001/2002, there were fears that the power situation would be strained, despite the reserves of 1,000 MW previously procured by Svenska Kraftnät in collaboration with trade association Swedenergy. The continuing strained power situation was partly due to Oskarshamn 1, with an output of 445 MW, being shut down for overhaul in December. Forecasts also hinted at the situation not getting much better prior to the coming winter of 2002/2003. In November 2001, the government commissioned Svenska Kraftnät to procure power supplements of 400-600 MW in order to safeguard the power balance in the short-term. In January 2002, Svenska Kraftnät signed an agreement regarding approximately 500 MW of supplementary power in the form of electricity production and voluntary reductions in consumption for the current winter, as well as the coming one. The government has also given Svenska Kraftnät the task of devising, in consultation with the Swedish National Energy Administration, a system of power management which will be capable of resolving the output problem in the long-term. An account of the task is to be rendered in the autumn of 2002, and the system is to be introduced by the winter of 2003/2004 at the latest.

During the year, the SwePol link was hit by a number of cable faults on one of the return conductors leading to its capacity temporarily being reduced from 600 MW to 470 MW.

Electricity consumption

Overall electricity consumption in Sweden during 2001 amounted to 150.5 TWh, an increase of 2.8% on last year's record. Adjusted for normal temperature, consumption can be said to be largely the same as that of 2000. The increase can be explained by the boom prevailing during most of the year and the high price of oil, which led to a shift from oil to electricity for heating.

Electricity consumption in industry has fallen by about 3%, amounting to 55.5 TWh for the entire industrial sector. This reduction can be explained by high electricity prices, a high dollar rate and the economic downturn towards the end of the year. The energy-intensive pulp and paper industry has reduced consumption by 5% to 21.6 TWh. There was a 4 percent increase in the base chemicals industry whose consumption amounted to 4.6 TWh. In the housing and services sector, consumption amounted to 75.2 TWh, an increase of about 3% on last year.

During the year, transmission losses amounted to 12.2 TWh, 2.8 TWh being grid losses.

Electricity production

Overall electricity production during the year was 157.8 TWh, an all time high. Last year, 141.9 TWh was produced. This record can be explained by the continuing high level of hydropower production and a high level of utilization of nuclear power. Hydropower production in Sweden amounted to 78.5 TWh, marginally beating last year's record. At the beginning of 2002, the degree of filling of the reservoirs was 67.3%, 0.9 percentage points above the median value. The degree of filling at the beginning of 2001 was 73.4%. Nuclear production rose from last year's 54.8 TWh to 69.2 TWh as a result of the normalized water situation in Norway. Wind power production continues to grow and amounted to 0.5 TWh, an increase of 0.1 TWh. Thermal power production accounted for 9.7 TWh.

Imports were down on 2000 and amounted to 11.2 TWh, while exports rose to 18.5 TWh. During the year, Sweden's net exports were thus 7.3 TWh, which can be compared with net imports of 4.8 TWh last year. However, net imports during 2000 were per se a trend break as Sweden is normally a net exporter.

Electricity prices and taxes

For a low-tension customer, the overall cost of electrical energy is made up of costs for grid transmission at around

35% and taxes at around 40%. The remainder, i.e. 25%, is made up of the cost of electricity and is the only part of the overall cost that the customer is able to influence.

In Sweden, electrical energy is taxed upon being produced as well as consumed. Tax is differentiated and varies with localisation and range of application. From the turn of the year 2001/2002, the selective tax was raised by SEK 0.017 to SEK 0.198/kWh for the majority of customers. For certain municipalities in Norrland, the selective tax will be SEK 0.14/kWh. For electricity consumed during the supply of electricity, gas, heating or water, the energy tax amounts to SEK 0.174/kWh in parts of the country not included in the regional exemption, i.e. where the tax is SEK 0.14/kWh. For electricity consumed between 1 November and 31 March in electrical boilers with an installed capacity exceeding 2 MW, a tax of SEK 0.164/kWh is levied in municipalities included in the regional exemption. In all other municipalities, the electrical boiler tax is SEK 0.198/kWh. Finally, manufacturing industry, farming, forestry, aquaculture and commercial greenhouse cultivation are still exempt from energy tax. The increase in the energy tax is justified by the fact that the carbon dioxide tax has been increased. If the electricity tax were not increased, the price of electricity would be lower than for fossil fuels. Petroleum and diesel are exempt from the tax increase which also applies to manufacturing industry which henceforth has a tax rebate of 70%. Last year it was 65%.

The environmental bonus for wind power that was previously linked to the energy tax was not increased, and thus remains at SEK 0.181/kWh. Temporary financial support of SEK 0.09/ kWh is also charged for small-scale electricity production.

Since 2000, electricity produced in nuclear power plants is encumbered with a power tax which amounts to SEK 5,514/ MW, which can be said to correspond to approximately SEK 0.027/kWh. Pursuant to the Studsvik Act, a fee of SEK 0.0015/ KWh is also charged on electricity produced in nuclear plants to cover the costs of Studsvik's previous operations.

The grid

The Nordic grid operators are striving towards harmonising the market conditions for inputting electricity into the grid in order to ensure rules of play that do not affect competition for the players on the Nordic market. As an element of this work, Svenska Kraftnät has introduced a new tariff structure effective 2002. The change, which is also in line with the recommendation being developed for the European market, means the ratio between entry and exit fees being altered in such a way that the competitive disadvantage of Swedish electricity producers, in comparison with Finnish and Danish, is reduced. The change, i.e. the reduction for electricity production and the increase for the regional networks, is approximately SEK 0.0015/kWh. The cost of transmitting electricity on Sweden's grid is SEK 0.014/kWh on average.

The gradual expansion of capacity between the Nordic countries continues. After extensive rebuilding work, Borgvik switchyard went into service in November. The purpose of rebuilding was to boost capacity by 350 MW for transmissions to Norway. On the Norwegian side, corresponding measures are being implemented. Capacity on the line between Jämtland and the Trondheim area will also be increased by 100 MW. Svenska Kraftnät has also decided to invest in a new transformer for the grid in Västerbotten. At times, the old transformer has restricted transmissions on the line which follows the Umeälven river to Norway.

A new 400 kV line between Alvesta and Hemsjö went into service at the beginning of 2001, boosting the transmission capability between northern and southern Sweden by 500 MW. An augmentation of the grid in Blekinge in the form of a renewed transformer station will improve capacity for transmissions to southern Sweden. Work will commence in 2002, and in 2003 the renewed station is expected to go into service.

Svenska Kraftnät has sold its stakes in the 130 kV transmission cables between Scania and Zealand in the Straits of Öresund to Sydkraft and has bought Sydkraft's stakes in the 400 kV cables in the Öresund link.

Svenska Kraftnät's expansion of the opto backbone continues. During the year, the routes Norrköping – Kalmar and Enköping - western Stockholm went into service. The opto rectangle in southern and central Norrland was also completed during the year. Expansion of the route Porjus – Midskog – Ljusdal was commenced. In August 2000, the government gave Svenska Kraftnät the task of ensuring that Sweden's principal municipal centres obtain access to a high-capacity optic fibre network. So far, around 190 municipalities have the opportunity of connecting to Svenska Kraftnät's, or another operator's, network. Planning work on the expansion to include the remaining municipalities is ongoing. Among other things, the financing of the continued expansions is being looked into.

Compact pole with three phases closely located in a triangle reduces the magnetic fields considerably.
Photo: Dan Karlsson.

The transit solution in the Nordic electric power system

Market-based power trading was introduced into the Nordic countries in the 1990s. In Continental Europe, the process has gathered considerable pace in the last 2-3 years. The reason for introducing market-based power trading was to obtain a more effective utilisation of resources in both the short and long term, which will benefit consumers and producers alike. The Transmission System Operators (TSOs), authorities and regulators have encountered many challenges in connection with deregulation. One of these is how to compensate for transit when cross-border tariffs are removed. Other challenges are associated with bottleneck or congestion management, balance settlement, ensuring security of supply is maintained, etc.

A general description of the open Nordic power market was provided in Nordel's Annual Report for 1999. Congestion management was dealt with in the 2000 Annual Report. The focus in this article is on transit.

Transit is a term used in connection with the transfer of electric power through an area when the power has neither been generated in the area nor will be consumed there. The power systems are often developed from local generation covering the local consumption to large interconnected power systems where there is no longer any simple link between generation and consumption within a geographical area. The opening of the electricity markets across national borders and the introduction of equal conditions of access to the power grids for all market players has led to an increased focus on solutions for transit management. This applies both to resolving how to compensate for the costs arising from the transit of electricity and who is to pay for the transit.

This article describes what transit is, both from an electric power-related and a market perspective. It gives an account of the first step of the Nordic solution for transit compensation. The solution for transits and cross-border trade in the single European electricity market is also discussed. Finally, future developments in this area are outlined.

Introduction

England and Wales were the first in Europe to deregulate their electricity markets. This took place in 1989-90. Norway followed suit in 1991. Since then, all the Nordic countries apart from Iceland have introduced market-based power trading. Important framework conditions associated with the introduction of market-based power trading in the Nordic countries were to remove transmission tariffs based on distance and contracts, and to introduce a point of connection tariff system.

Through the EU Directive that was adopted in1996, it was also decided to deregulate the electricity sector in Europe. The Directive was introduced on 19 February 1999. Proposed amendments to the Directive and a proposal for a regulation were presented on 14 March 2001. These documents are still being debated by the EU (the European Council of Ministers and the European Parliament).

Although market-based power trading has been introduced in the Nordic region and also in parts of Continental Europe, regulators, market players and the TSOs are still faced with the challenge of creating a more efficiently functioning market. Perhaps the biggest challenge facing us today is associated with the removal of transaction-based tariffs, for example cross-border tariffs. It is also important to focus on further harmonisation in tarification, congestion management (see the special article in Nordel's Annual Report 2000), balance management and ancillary services.

When the national markets in the Nordic region were expanded to form a single Nordic electricity market, the focus was on removing cross-border tariffs. Since 1 March 2002 there have been no cross-border tariffs between any of the Nordic countries.

The application of cross-border tariffs was based on the following:

- That payment should be charged for the use of other power systems' transmission grids
- Financing and regulatory controls on power exchange across national borders
- The need to safeguard the security and reliability of the TSOs' own systems.

As the final drafts of the EU Directive and the regulation have been formulated, there will be a requirement ordering the removal of cross-border tariffs between countries. The reason for this is to provide the incentive for the creation of a more efficient electricity market.

With the removal of cross-border tariffs, the TSOs are faced with the important challenge of establishing a system for transit compensation which will help make the market more efficient than with a system of cross-border tariffs.

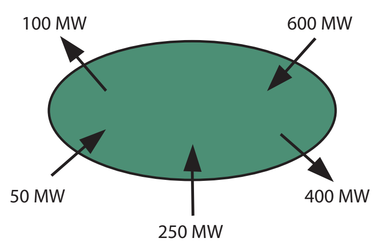
What is transit

Transit means electric power that flows through a particular area without it being generated or consumed in that area. If power generated in Eastern Denmark is consumed in Finland, the power will flow through the Swedish grid, giving rise to transit through Sweden.

Transit is normally defined as a minimum of a TSO area's import and export. Fig. 1 shows an example of a transit situation.

If either the import or export is zero, the transit is also defined as zero.

Figure 1. The TSO area illustrated in the diagram has a total import of 900 MW and a total export of 500 MW. According to the definition, transit through the area is 500 MW.



In an electric power system in which many subsystems are connected, as for example in the Nordel grid, transit becomes almost unavoidable. Electric current knows no boundaries; it chooses the route of least impedance (resistance).

When electricity flows, a small portion is always lost in the network. The transit of electricity gives rise to changes in such transmission losses in a network area. These losses increase if the transit increases the load on the grid. However, transit can also reduce the load on the grid if the transit goes in the opposite direction compared with internal transfers within the area, and thus losses are reduced.

Aspects from a deregulated market

As a result of the deregulation of the electricity markets in the 1990s, the link between the transmission of power and the generation and sale of power has become ever weaker. A system of point of connection tariffs has been introduced in all the Nordic countries. This means that the buyer or seller of power is unable to benefit from knowing, for example, the geographic distance to the counterparty to the buying or selling contract when it comes to estimating the costs of transmitting the power.

In the “old” system it was important to have precisely that knowledge of where the purchaser was situated if one was selling power out of one’s own local area. On the basis of power exchange contracts one paid for a transmission capacity irrespective of if it was subsequently used. One also had to negotiate access to a channel through the grid in order to be sure that the power went where it was supposed to go.

In case of power flow from Norway to Finland, a fee would be paid to feed the power into the grid in Norway. Capacity would also have to be negotiated through Norway. The same exercise would be required to get the power through Sweden. Finally, it would be paid to feed the power into the Finnish grid before the Finnish consumer could draw the power from the point to which she was connected. This accumulative effect of costs is known as “pancaking”.

If there were two other players carrying out an equivalent transaction the opposite way and thus “setting” the physical power flow to zero, this would not have consequences for what the players paid in the form of tariff. It was the contract and only the contract between the players that governed the tariff payment.

Fig. 2 shows how the power flow is distributed if 100 MW is fed into the grid in southern Norway and the “same” 100 MW is withdrawn in southern Finland. In addition there is the assumption that 19 MW goes over the DC lines from Norway to Sweden via West Denmark, and that 32 MW goes over the DC line between Sweden and Finland. The power is otherwise distributed according to the electricity laws.

The power does not flow the shortest geographic route into Finland. A tariff based on distance and contracts has no clear connection with the way in which the grid is used. Nor will paying for the distance which the power flows in theory be consistent with paying for that part of the transmission grid that is actually used. An important factor in this connection is that the power will go the same way irrespective of which tariff system is applied. For this reason, a point of connection tariff system is more effective than a system founded on transaction-based tariffs.

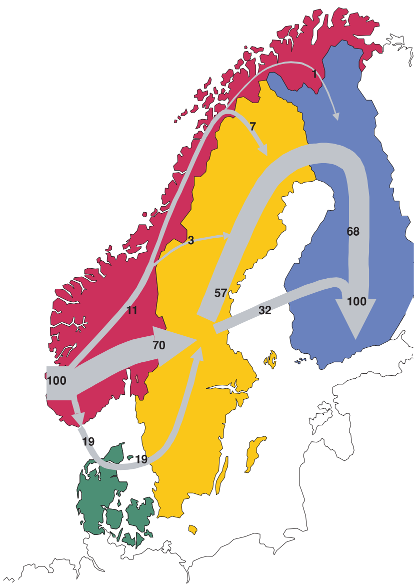
Why compensate for transit

Exporting electric power from Southern Norway to Germany via West Denmark would involve transit through the grid in West Denmark. If this transit resulted in increased costs for the TSO, it would be reasonable to compensate the TSO financially for those costs.

Previously, the TSOs financed transit largely with the use of cross-border and transit tariffs. With the aim of creating a more efficient power market, cross-border tariffs in the Nordic countries and the rest of Europe are now being removed. However, that basically reduces the TSOs revenues. And it will be claimed that it is unreasonable for national players to cover those costs in full. This makes it necessary to find an alternative system to ensure that transit is compensated for. A challenge here is to define a system which also takes account of the fact that transit can help the TSOs to reduce their costs. This would be the case, for example, if a TSO area were to import into a local shortfall area and at the same time export from a local surplus area.

An example of a case where transit would result in increased costs is if power were to be transited from Northern Norway through Sweden to Southern Norway. In this case the transit is going in the same direction as the dimensioning power flow in Sweden. An example of transit resulting in reduced costs would be an export from Norway to Sweden

Figure 2. Power flow through the Nordic grid with power fed into the grid in southern Norway and withdrawn in Finland.



starting in Southern Norway at the same time as an export from Sweden to Finland in the north. This can also be termed counter-transit. In this case, the costs to the main Swedish grid would be lower with transit compared to a situation without transit.

The Nordic transit solution

Gradually as the Nordic power market has expanded, efforts have increasingly been focused on finding a model for transit compensation. In 2001, a model was agreed to compensate for loss as a result of transit. In 2002, further work will be done on a model to compensate capital expenditure and investment. The aim is to produce a model to include compensation for, among other things, loss and capital expenditure, which can come into effect from 2003.

Compensation for grid loss

The model that has been established for 2002 must be able to compensate for change in grid loss as a result of transit. Fig. 3 shows the power exchange between the Nordel countries for a randomly chosen hour.

According to the definition, Sweden had a transit of 1,413 MW for this hour. This figure is arrived at by adding together the exports, which are 736 MW, 101 MW, 205 MW and 371 MW.

At the same time, we can see that West Denmark had a transit of 979 MW. In this case it is the import that determines the transit volume.

The starting point for transit compensation is to calculate the change in loss as a result of transit through the system. It is then necessary to do a loss calculation in two stages.

Figure 3. The load situation as a basis for calculating change in grid loss owing to transit.

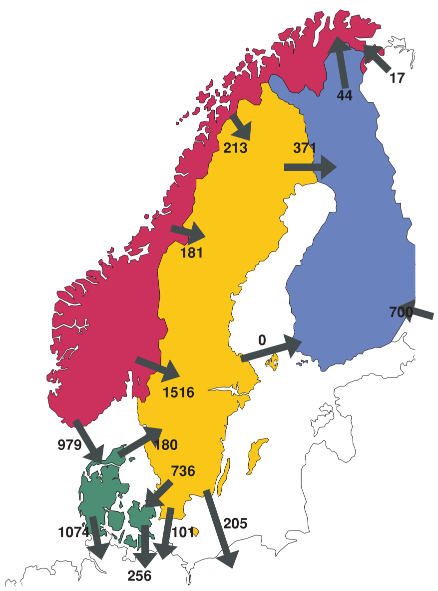
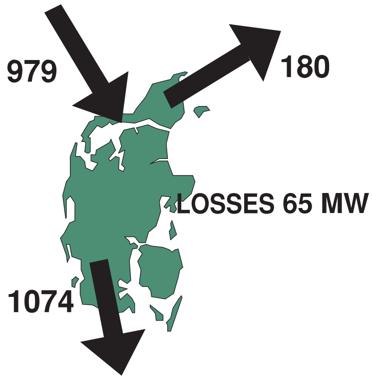


Figure 4. Losses in West Denmark with transit.



Situation with transit

In the first stage, the total loss is calculated iin each TSO's own area. The basis for the calculation is taken from the TSO's control center system and possibly from the balance settlement system.

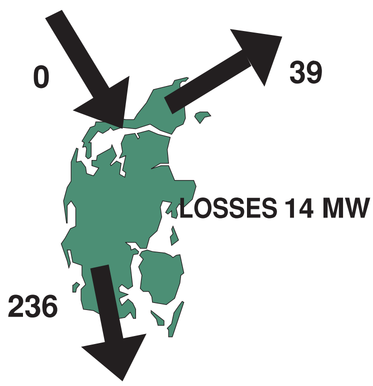
As shown in Fig. 4, in this hour West Denmark had aggregated losses of 65 MW. These are losses which, in a system without transit compensation, would be covered by all the TSO's customers, including the customers who had not caused the transit.

Situation without transit

In the second stage, the total losses without transit are calculated per hour. Here, the starting point is taken in the situation with transit, and assuming that the load and generation distribution in the transit country is kept constant. If it is export that determines the transit volume, as for Sweden in Fig. 3, all export lines are disconnected, while the resulting import is apportioned on a pro rata basis on all the import lines. If the transit is defined by import, as for West Denmark in Fig. 3, all import lines will likewise be disconnected while the resulting export is apportioned on a pro rata basis on all export lines.

When the flow in an individual TSO's grid is determined for a situation without transit, the grid losses can be calculated in that situation.

Figure 5. Result of calculated losses in West Denmark without transit.



The difference in losses with and without transit is, in other words, losses caused to the TSO's grid which have not been caused by customers connected to that grid. Accordingly, they should not be expected to pay for them.

The financial compensation due to West Denmark as a result of transit can be arrived at by multiplying the change in losses: 65 MW – 14 MW = 51 MW, by the area's market price for power for the hour in question. If the market price in West Denmark is 19 €/MWh, their compensation will be 969 Euro for the hour concerned.

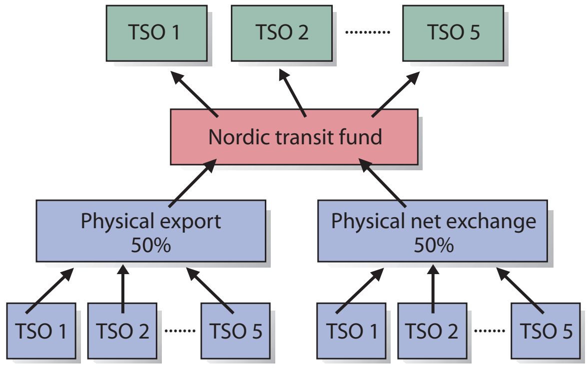
Distribution of transit costs

An important prerequisite with regard to covering transit costs is that they should not be met by the players who trade across the borders. In other words, costs should not be met by introducing cross-border tariffs. In the Nordic system, where trade between the Nordel countries is based primarily on spot trading, it will also be impossible to define which players are engaged in cross-border trading and thus giving rise to transit or flow between the countries.

It is the physical exchange of power that results in loss in the grid, and which therefore gives rise to changed losses for the TSOs as a result of transit. It is, therefore, the physical value that provides the basis for calculating how much an individual TSO must pay.

Fig. 6 contains a box that is defined as a transit fund. For each TSO, this is the difference between the compensation he is due to receive as a result of transit in his TSO area and what he has to pay as a result of the players in his area causing transit in other TSO areas. The payment is calculated based on the TSO's gross export and net exchange per hour. The latter is illustrated by the arrows pointing from the bottom boxes towards the boxes termed, respectively, "Physical export" and "Physical net exchange". From the transit fund box, an arrow points to each TSO. This is the net compensation due to each TSO as a result of the difference betwen costs and revenues to which transit gives rise. In the Nordic countries, the sum total of this net compensation will be zero.

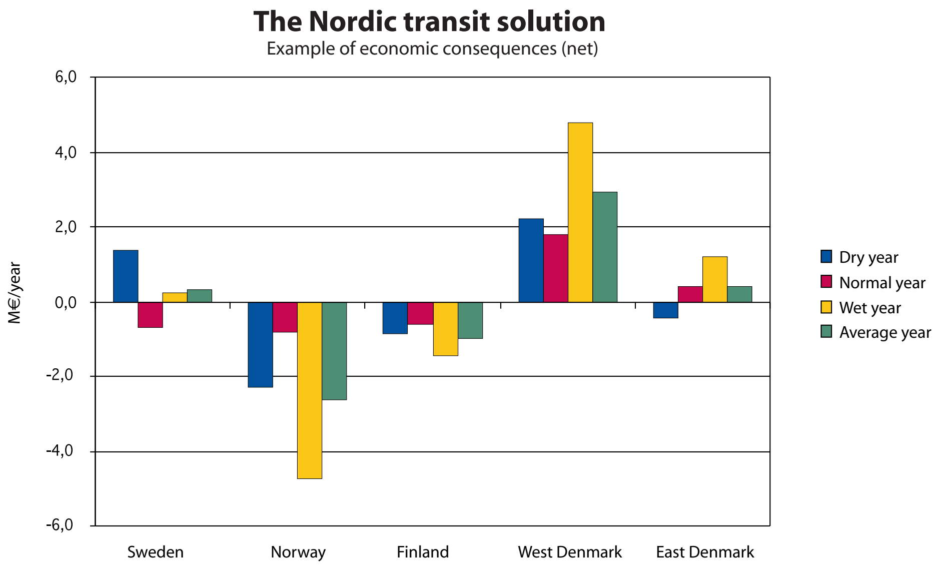
Figure 6. Distribution of revenues and costs in the Nordic transit settlement system.



However, even if there is a zero result in the interplay between the TSOs, a transit settlement will give rise to costs for some TSOs and to revenues for others. These costs and revenues will in their entirety contribute to adjusting the level of the national transfer tariffs. No TSOs, therefore, stand to increase their earnings as a result of a transit settlement.

Payments into and out of the transit fund are both based on hourly calculations of transit, net exchange and gross exports. The financial settlement takes place once per quarter. If the accumulated grid loss is negative, that is if the grid has in real terms been relieved during the quarter, the grid loss will be set at zero.

Figure 7. Estimate of the economic consequences of the Nordic transit solution for 2002. Negative values mean payment.



Financial scope

The financial scope of a transit settlement will be determined by which cost components are included and the state of the physical flow in the grid. The Nordic power system consists of approximately 50 per cent hydropower, and this means that generation capability will vary considerably from year to year. This will also be reflected in how extensive the transit settlement is in total and for each TSO.

Estimates have been made indicating that total compensation for 2002 will be in the region of 3-5 million Euro. However, in order to limit the risk to the TSOs, a ceiling of 10 million € has been set for 2002. Fig. 7 shows a rough estimate of how the transit scheme is expected to work out for individual TSOs, where negative values indicate a net payment.

Compensation for other costs

Through 2002, work will also be done on expanding the transit model so that it also takes into account capital expenditure and investment costs, among other things. We are currently working on two models, one of which has points of similarity with the model it has been agreed to implement in the Continental ETSO area from March 2002.

In another model we are looking into calculating MWkm for the power through a TSO's area with and without transit.

Important factors that must be taken into consideration when developing the model further include quality assurance for the calculations and that the model should be kept as simple as possible. Other questions under discussion are how to take into account the fact that transit can relieve a transmission system and how standard costs can be defined, for example for capital expenditure and investments.

Management of transit in connection with the opening of the single electricity market in Europe

In connection with the implementation of the EU Directive concerning the opening of the power market in the IEM, one of the objectives is the removal of cross-border tariffs. The tariffs for exporting, importing or transiting power through countries varied in 2001 between 0-4 €/MWh. The removal of these tariffs will result in a considerable loss of revenues for many TSOs; revenues that have helped cover costs incurred by the power system as a result of transit.

ETSO has been working for 3 years to find a harmonised model to compensate TSOs for transit. When that work began, most of the focus was on creating a system in which each single transaction would have to pay for transit through the countries to which the contract applied. For example, a contract from Germany to Italy would pay for flow through Germany, then a cross-border tariff for Switzerland and a new cross-border tariff on reaching Italy. This would have led to a "pancaking effect" inasmuch as the tariffs get higher the more borders that are passed. As described above, tariffs like these that are contractually based are incompatible with the development of an efficient power market.

ETSO's work has proceeded parallel to the outlining of the European Commission and the regulators of various proposals for rules governing the formulation of a long-term transit model. Organisations like Eurelectric (producers), IFIEC (major consumers), EFET (traders), EuroPex (power exchanges) are also following this process closely. All these players meet twice yearly in Florence at the "Florence Regulatory Forum" to consider current status, and to lay down the terms of the work to be done in the time ahead. It was through this forum that, in 1999, the terms of a temporary transit scheme were agreed, under which the total compensation due to TSOs for transit was set at 200 million euro. This amount was based on calculations done by the TSOs themselves.

The temporary transit scheme became effective on 1 March 2002. According to this model, the TSOs are responsible for collecting in 1 €/MWh from planned or programmed exports and approximately 1-2 €/MWh for net exchange depending on the flows. Furthermore, exports from the Nordel area to the Continent will be charged with 1 €/MWh. For the lines from Denmark to Germany, this cost will be met by the TSOs in Denmark, Finland and Norway. Svenska Kraftnät will take its share of the costs when the Swedish legislation permits. For the Baltic Cable between Sweden and Germany, which is owned and operated by the power companies, E.ON Netz will claim 1 €/MWh on imports to Germany from Sweden.

Further developments

The most important aspect of the transit solution in Europe from 1 March 2002, from Nordel's point of view, is that cross-border tariffs will not exist and that the transit settlement will be based on physical values. This will simplify considerably the administrative management of such a settlement.

The scope of the transit settlement

Future transit models will contain costs linked to losses and also costs arising from existing as well as new investments.

However, it is difficult to formulate a transit model capable of doing justice to the historic investments that have been made to expand the national grid system. The purpose of the transit settlement is to ensure that TSOs which experience increased costs as a result of third parties transiting power through their area do not have a negative economic incentive to maintain a capacity that is in line with efficient market development.

The choice of model will have consequences for the size of the settlement. A large horizontal grid will typically result in a more costly transit settlement. A costlier transit settlement will probably make it more difficult to argue in favour of the socialisation of transit costs. There will be arguments to claim to a greater degree "that it is unfair that those who neither export nor import are required to cover such a large part of the costs of transit as long as they have nothing to do with it".

A large transit settlement will also create greater uncertainty attached to the economic consequences for the Nordic players. This is because it is very difficult to say anything about the power flow in the months and years ahead and thus about the economic consequences of the transit settlement.

The circumstances that affect power exchange are:

- The more effective the electricity trading between the Nordel area and Germany, Poland and Russia is, the more the power prices in those countries will affect power exchange. This assumes the existence of smooth-functioning power markets in all our neighbouring countries. The utilisation of some lines is currently restricted to certain players, which means that the capacity is not always used to the optimum.
- Power prices in the Nordic countries vary from year to year depending on various factors, including precipitation. In dry years, prices are higher than in years with abundant precipitation. The closure or construction of new power plants and consumption both have a bearing on the power balance and thus price formation and power exchange.
- The removal of cross-border tariffs can contribute to increased power exchange and hasten harmonisation.
- Increased consumption and increased demand, for example from new cables to England, will also affect the power exchange in the Nordic countries.

If both old and new investments are to be included in a transit settlement, there may still be some discussion, however. An important factor here is that new investments become old as they come into use. It is also difficult to separate investment from reinvestment. This shows how a transit model can quickly become very complicated.

In some cases it may be possible to define which lines have been built for transit. In most instances, however, it is impossible to isolate a reason for building the lines. And although a line is built to transit power today, that line may have a completely different function in the future. Because of that, it would be unreasonable for this line to be covered wholly and in full by means of a transit settlement.

The important thing in a long-term transit solution is to focus on the function of the grid installations. It is whether the line is used for transit that is important. The reason why it was built is not relevant in a future transit settlement.

Physical values

In the long-term transit model, it is also important to use the physical power flow as the basis for the financial settlement, as long as transit costs are determined precisely by physical flow. Another argument for using physical values is that the use of trading values complicates the formulation of a transit agreement between the TSOs. This applies to, among other things, what access the TSOs are to have to information regarding the players' transactions in other countries. As the power markets develop on the Continent and more organised marketplaces are established, the knowledge of which players are giving rise to transit over national borders will also be lost. Then there will really only be the physical values that are accessible for the TSOs when calculating compensation for transit.

No transaction-based tariffs

Nordel is clear on the fact that there will be no transaction-based tariffs for the players. This applies both to borders between countries and internally in those countries. A transaction-based tariff system will never be in line with the development of an efficient market.

A transit settlement is only meant to be a transfer of money between the TSOs, a zero sum game, and compensate for the changed costs the TSOs incur as a result of transit through their grid. In other words, one could use the term "cost reflective" with regard to which transit costs the TSOs should be compensated for. A transit settlement is not meant to provide signals to the players to enable an effective adjustment to be made in the short or long term, however. Those signals will be given through a TSO's tariffs and through the management of transmission congestion.

The authors of this article are: Tore Granli, Statnett SF, Ole Gjerde, Statnett SF, Kurt Lindström, Fingrid Oyj, Flemming Birck Pedersen, Elkraft System amba, Tania Pinzón, Svenska Kraftnät and Flemming Wibroe, Eltra amba.

Words and abbreviations

ETSO: Association of European Transmission System Operators – organisation which consists of the TSOs in the EU Member States plus Norway, Switzerland and Slovenia, in total 18 countries.

Cross-border tariffs: Transaction-based tariffs linked to the crossing of a national border. Tariffs that are paid to cross a national border.

Horizontal grid: The main grid for the transmission of power in a country. As opposed to a vertical grid which goes from the generation source and up to the transmission grid and from the transmission grid down to the consumer. The horizontal grid (HG) will normally include grid installations on the highest voltage levels.

IEM: Internal Electricity Market = EU plus Norway and Switzerland.

Continental ETSO: ETSO minus Nordel, Great Britain, Ireland, Greece and Slovenia.

Grid tariff: The charge paid for the transmission of power.

Point of connection: Charges paid by either the producer or consumer and independent of power exchange contracts. The tariff amount is determined by the point at which power is delivered or withdrawn.

Socialisation of transit costs: Costs from the transit settlement are added to the TSO's total cost framework, so that only the internal users in the TSO's area are charged.

Transaction-based tariffs: The charges for transmission are linked to the contract for the purchase or sale of power. An alternative term that covers the same is contract-based tariffs.

Transit tariff: Transaction-based tariff for transporting power through a country.

TSO: Transmission System Operator.

Statistics

Photo: Ole Christiansen.

Definitions, units and symbols

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

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

Exchange of electricity:
The monthly sums (in GWh) of the physically registered MWh values for each connection between the individual countries, per hour of exchange.

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

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

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

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

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

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

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

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

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

Units and symbols

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

Calculation of the electricity consumption

Electricity generation
\+ Imports
\- Exports

= Total consumption
\- Occasional power to electric boilers

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

= Net consumption

Responsible for statistical data on the individual countries:
Jørgen Olsen – Elkraft System, Denmark East
Henning Parbo – Eltra, Denmark West
Aki Laurila – Fingrid, Finland
Ólafur Pálsson – Statens Energistyrelse, Iceland
Jan Foyn – Nord Pool ASA, Norway
Agata Persson – Svenska Kraftnät, Sweden

Responsible for processing of the statistics:
Jan Foyn – Nord Pool ASA, Norway

The present statistics were prepared before the 2001 official statistics for the individual countries had become available. Certain figures in the Annual Report may thus differ from the official statistics.

The statistical data can also be read on Nordel's Internet pages at www.nordel.org

Installed capacity

S1 Installed capacity on 31 Dec. 2001, MW

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Installed capacity, total [1]	12 480	16 827	1 427	27 893	31 721	**90 348**
Hydropower	11	2 948	1 105	27 571	16 239 [2]	**47 874**
Nuclear power	.	2 640	.	.	9 436	**12 076**
Other thermal power	9 983	11 200	120	305	5 753	**27 361**
- condensing power [3]	.	3 912	.	73	1 023 [8]	**5 008**
- CHP, district heating	9 275 [4][5]	3 712	.	12	2 340	**15 339**
- CHP, industry	438 [6]	2 698	.	185	929	**4 250**
- gas turbines, etc.	270	878	120	35	1 461 [8]	**2 764**
Other renewable power	2 486	39	202	17	293	**3 037**
- wind power	2 486	39	.	17	293	**2 835**
- geothermal power	.	.	202	.	.	**202**
Commissioned in 2001	912 [7]	225	75	33	883	**2 128**
Decommissioned in 2001	372 [7]	20	1	2	56	**451**

1) Refers to the sum of the rated net capacities of the individual power plant units in the power system, and should not be considered to represent the total capacity available at any single time.
2) Includes the Norwegian share of Linnvasselv (25 MW).
3) Includes capacity conserved for an extended period, Finland (700 MW).
4) Includes condensing power.
5) Includes the German share of Enstedværket (313 MW) and long-time reserve of Vendsyssleværket (295 MW).
6) Included industrial generated producer (apr. 37 MW).
7) Inlcudes reclassification of power plants.
8) Includes capacity of power plants which are included in the agreement considering power reserves in Sweden.

S2 Average-year generation of hydropower in 2001, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Average-year generation 2001	-	12 759	6 580	118 051	64 000	**201 390**
Average-year generation 2000	-	12 720	6 380	117 921	64 000	**201 021**
Change	-	39	200	130	0	**369**
Reference period	-	1961-90	1950-95	1970-99	1950-90	

S3 Changes in installed capacity in 2001

Power category	Power plant	Commiss-ioned MW	Decom-missioned MW	Change in average-year generation (hydropower) GWh	Type of fuel
Denmark - East					
Condensing power	Avedøreværket blok 2	594			Natural gas, biofuel
	Asnæsværket blok 5	10			Coal/oil
	H.C. Ørstedværket blok 5	70			
	Stigsnæsværket blok 2		4		Coal/oil
CHP, district heating	Decentral CHP	69	18		Natural gas, biofuel
CHP, industry	Decentral CHP		52		Natural gas, biofuel
Gas turbines	Kyndbyværket 41, 51-52		6		Gas oil
Wind power	Windmills	23			
Denmark - West					
Condensing power	Fynsværketblok 3		3 [1]		Natural gas
	Fynsværket blok 7		47 [1]		Coal/oil
	Studstrupværket blok 3		30 [1]		Coal/oil
	Studstrupværket blok 4		30 [1]		Coal/oil
	Vendsysselværket blok 2		10 [1]		Coal/oil
	Vendsysselværket blok 3		39 [1]		Coal/oil
	Enstedværket blok 3		58 [1]		Coal/oil
	Enstedværket Biokedel	40			Straw/peat
	Esbjergværket blok 3		35 [1]		Coal/oil
	Skærbækværket blok 3		25 [1]		Natural gas
CHP, district heating	Decentral CHP		2		Biofuel, peate
	Decentral CHP	5			Natural gas
	Decentral CHP		1		Other
	Industrial CPH	3			Natural gas
	Local CHP	2			Biofuel, peate
	Local CHP	13			Natural gas
	Local CHP	1			Other
Gas turbines	Studstrupværket gasturbine		12 [1]		Oil/gas oil
Wind power	Windmills	82			
Finland					
CHP, district heating	Ykspihlaja	20			Wood chips, waste wood
CHP, industry	Jakobstad/Pietarsaari	240			Peat, waste wood
	Jämsänkoski		20		Peat
Wind power	Oulu 1	1			
Hydropower	Kelukoski	10		39	
Iceland					
Hydropower	Vatnsfell	45		200	
Geothermal power	Nesjavellir	30			
Gas turbines	Various engines for stand by		1		Oil
Norway	Moelv	1		6	
Hydropower	Svartkulp kr. verk	4		21	
	Ovf. Kalklavdalsvatn	0		17	
	Kildalen (rev.)	1		2	
	Blåfalli V	8		25	
	Stadheim	5		25	
	Sage	9	2	30	
	Åsedøla	2		6	
Wind power	Mehuken, Vågsøy	4			
Sweden	Höljebro	39			
Hydropower	Boel	1			
	Various changes	5	6		
	Höljebro		29		
Nuclear power	Various changes		3		
Condensing power	Karlshamn G2 [2]	332			Oil
	Aros G3 [2]	243			Oil
CHP, district heating	Högdalen	46			Waste/oil
	Ängelholm	29			Natural gas
	Hallsberg		4		
	Various changes	10	5		
CHP, industry	Munksund		5		Biofuel
	Karlsborg	6			Biofuel
	Various changes		4		
Gas turbines	Lahall G3 [2]	60			Oil
	Lahall G4 [2]	60			Oil
Wind power	Approx. 50 new aggregates	52			

1) Adjustment in accordance with the agreement about the minimum production capacity.
2) Included in the Swedish power reserve plants which are conserved for an extended period of time.

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

Power category	Power plant	Capacity MW	Estimated start-up Year	Average-year generation (hydropower) GWh	Type of fuel
Denmark - East					
Wind power	Rødsand	150	2003		
Denmark - West					
Wind power	Horns Rev	160	2002		
Finland					
CHP, industry	Äänekoski	26	2002		Peat, waste wood
	Kuusankoski	55	2002		Peat, waste wood
	Jämsänkoski	46	2002		Peat, waste wood
	Ristiina	10	2003		Peat
CHP, district heating	Parkatti	15	2002		Peat, waste wood
	Savonlinna	17	2003		Peat, waste wood
Hydropower	Valajaskoski	28	2003	23	
Iceand					
Norway					
Hydropower	Bjølvo (net increase)	15	2003	65	
	Tyin (net increase)	168	2004	230	
Wind power	Smøla	40	2002		
	Havøygavlen (Måsøy)	40	2002		
Sweden					
CHP, district heating	Härnösand	12	2002		Biofuel
	Kungsbacka	1	2002		Biofuel
	Hofors	2	2002		Biofuel
	Jämtkraft	45	2002		Biofuel
CHP, industry	Katrinefors	10	2002		Biofuel
	Munksund	25	2002		Biofuel
Gas turbines	Hallstavik	120	2002/2003		Oil

System load

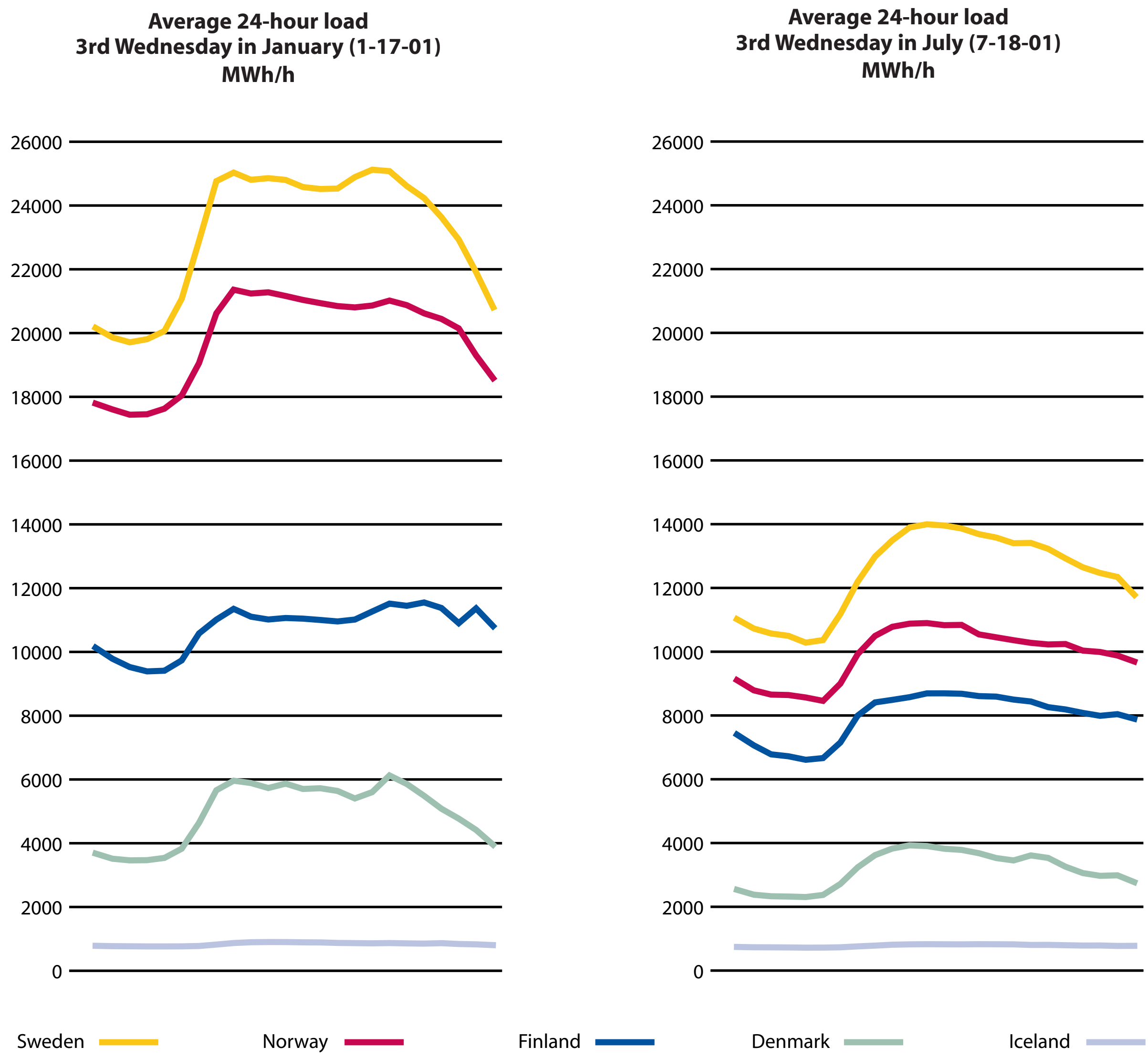
S5 Maximum system load for each country in 2001 [1)]

	MWh/h	Date/time
Denmark	6 229	02.05.01 at 10 - 11 AM [2)]
Finland	13 310	02.05.01 at 08 - 09 AM
Iceland	989	12.28.01 at 06 - 07 PM
Norway	23 054	02.05.01 at 09 - 10 AM
Sweden	26 800	02.05.01 at 05 - 06 PM

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

[2)] Denmark-East: 2657 MWh/h 02.05.01 at 05 - 06 PM, Denmark-West: 3685 MWh/h 02.05.01 at 10 - 11 AM.

System load 3rd Wednesday in January and 3rd Wednesday in July 2001



All hours are local time.

	Maximum system load 3rd Wednesday in Jan 2001 5:00 - 6:00 PM GWh/h	Minimum system load 3rd Wednesday in July 2001 12:00 - 01:00 PM GWh/h
Denmark	6,1	3,8
Finland	11,5	8,7
Iceland	0,9	0,8
Norway	21,0	10,8
Sweden	25,1	14,0
Nordel	**64,6**	**38,1**

The Grid System in the Nordic countries

S6 Existing interconnections between the Nordel countries

Countries Stations	Rated voltage kV	Transmission capacity as per design rules [1] MW		Total length of line km	Of which cable km
Denmark - Norway		**From Denmark**	**To Denmark**		
Tjele-Kristiansand	250/350=	1040	1040	240/pol	127/pol
Denmark - Sweden		**From Sweden**	**To Sweden**		
Teglstrupgård - Mörarp 1 och 2	132~	350 [2]	350 [2]	23	10
Hovegård - Söderåsen 1	400~	800 [2]	800 [2]	91	8
Hovegård - Söderåsen 2	400~	800 [2]	800 [2]	91	8
Vester Hassing - Göteborg	250=	290	270	176	88
Vester Hassing - Lindome	285=	380	360	149	87
Hasle (Bornholm) - Borrby	60~	60	60	48	43
Finland - Norway		**From Finland**	**To Finland**		
Ivalo - Varangerbotn	220~	100	70	228	.
Finland - Sweden		**From Sweden**	**To Sweden**		
Ossauskoski - Kalix	220~			93	.
Petäjäskoski - Letsi	400~	1600 [3]	1200 [3]	230	.
Keminmaa - Svartbyn	400~			134	.
Raumo - Forsmark	400=	550	550	235	198
Senneby - Tingsbacka (Åland)	110~	80	80	81	60
Norway - Sweden		**From Sweden**	**To Sweden**		
Sildvik - Tornehamn	132~	50	120	39	.
Ofoten - Ritsem	400~	700	1350 [4]	58	.
Røssåga - Ajaure	220~	415 [5]	415 [4,5]	117	.
Linnvasselv, transformator	220/66~	50	50	.	.
Nea - Järpströmmen	275~	700 [5]	700 [5]	100	.
Lutufallet - Höljes	132~	40	20	18	.
Eidskog - Charlottenberg	132~	100	100	13	.
Hasle - Borgvik	400~	2000 [5]	2000 [5,6]	106	.
Halden - Skogssäter	400~			135	.

[1] Maximum permissible transmission.
[2] Thermal limit. The total transmission capacity is 1775 MW to Denmark and 1700 MW to Sweden.
[3] In certain situations, the transmission capacity can be lower than the limit given here.
[4] Thermal limit. Stability problems and generation in nearby power plants may lower the limit.
[5] The transmission capacity can in certain situations be lower, owing to bottlenecks in the Norwegian and Swedish network.
[6] Requires a network protection system during operation (production disconnection).

S7 Existing interconnections between the Nordel countries and other countries

Countries Stations	Rated voltage kV	Transmission capacity MW		Total length of line km	Of which cable km
Denmark - Germany		**From Nordel**	**To Nordel**		
Kassø - Audorf	2 x 400~			107	.
Kassø - Flensburg	220~	1200	1200 [3]	40	.
Ensted - Flensburg	220~			34	.
Ensted - Flensburg	150=	150	150	26	5
Bjæverskov - Rostock	400=	600	600	166	166
Finland - Russia		**From Nordel**	**To Nordel**		
Imatra - GES 10	110~	.	100	20	.
Yllikkälä - Viborg [2]	2 x 400~	.	1000	67	.
Nellimö - Kaitakoski	110~	60	60	50	.
Norway - Russia		**From Nordel**	**To Nordel**		
Kirkenes - Boris Gleb	154~	50	50	10	.
Sweden - Germany		**From Nordel**	**To Nordel**		
Västra Kärrstorp - Herrenwyk	450=	600 [1]	600 [1]	269	257
Sweden - Poland		**From Nordel**	**To Nordel**		
Stärnö - Slupsk	450=	600	600	256	256

[1] The transmission capacity is currently limited to 460 MW from Nordel and 390 MW to Nordel due to limitations in the German network.

[2] Back to Back HVDC (+85 kV =) in Viborg.

[3] The transmission capacity is limited to 800 MW due to internal restrictions in Denmark West.

S8 Interconnections: decisions taken

Countries Stations	Rated voltage kV	Transmission capacity as per design rules MW	Total length of line km	Of which cable km	Estimated commissioning Year
Denmark - Denmark					
(Storebælt/The Great Belt)					
Eltra - Elkraft System	400=	300	ca 70	ca 70	[1]
Finland - Russia					
Kymi - Viborg	400~	400	132		2003

[1] According to plans, the Great Belt connection will be in operation in 2004. The capacity will be 300 MW. This appears in Energistyrelens letter dated October 27. 2000 to the System Operaters in Denmark.

Transmission lines

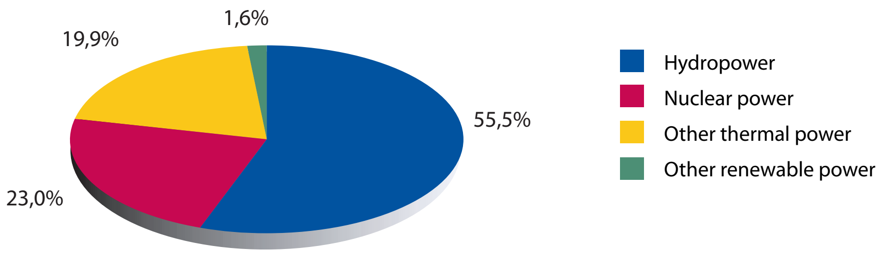
S9 Transmission lines of 110-400 kV in service on 31 Dec. 2001

	400 kV, AC and DC km	220-300 kV, AC and DC km	110, 132, 150 kV km
Denmark	1 346 [1]	504 [2]	3 954 [3]
Finland	3 926 [4]	2 400	15 200
Iceland	94 [6]	514	1 315
Norway	2 144	5 639 [2]	10 470
Sweden	11 063 [5]	4 602 [2]	15 000

[1] Of which 2 km in service with 150 kV and 46 km with 132 kV.
[2] Of which 80 km in Denmark and 96 km in Sweden (KontiSkan), 89 km in Denmark and 382 km in Norway (Skagerrak) in service with 250 kV DC, and 75 km in Denmark and 74 km in Sweden (KontiSkan 2) in service with 285 kV DC.
[3] Of which 13 km in service with 60 kV and 118 km with 50 kV.
[4] Of which 99 km submarine cabel (DC) and 34 km land cabel (DC) in Finland (Fenno-Skan).
[5] Of which 99 km submarine cabel (DC) and 2 km land cabel (DC) in Sweden (Fenno-Skan). Also 38 km submarine cabel (DC) in Sweden, 182 km in international water and 22 km in Poland, + 2 km land cabel (DC) in Sweden and 12 km in Poland (SwePol Link).
[6] At present in service with 220 kV.

Electricity generation

S10 Total electricity generation within Nordel 2001



S11 Electricity generation 2001, GWh

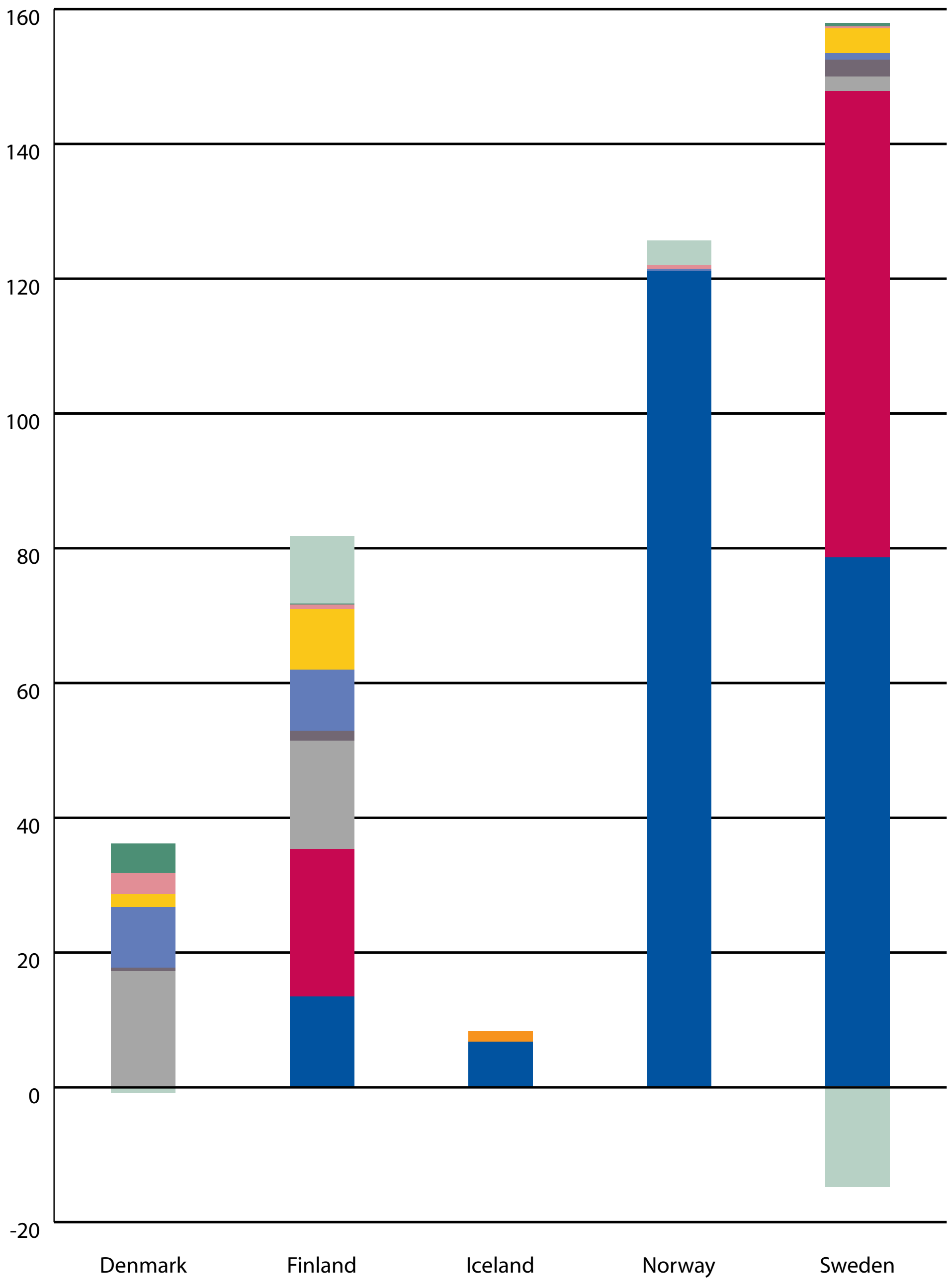
	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total generation	36 009	71 645	8 028	121 872 [3]	157 803	**395 357**
Hydropower	27	13 287	6 574	120 981	78 454	**219 323**
Nuclear power	.	21 879	.	.	69 210	**91 089**
Other thermal power	31 672	36 408	3	862	9 661	**78 606**
- condensing power	..	10 529	.	186	485	**11 200**
- CHP, district heating	29 517 [1]	14 409	.	.	4 773	**48 699**
- CHP, industry	2 155	11 465	.	394	4 392	**18 406**
- gas turbines, etc.	-	5	3	282	11	**301**
Other renewable power [2]	4 310	71	1 451	29	478	**6 339**
Total generation 2000	34 230	67 190	7 678	142 847 [3]	141 894	**393 839**
Change as against 2000	5,2%	6,6%	4,6%	-14,7%	11,2%	**0,4%**

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

S12 Total electricity generation by energy source, and net imports and exports 2001, TWh

- Net imports
- Geothermal power
- Wind power
- Other [1) 2)]
- Biofuel
- Natural gas
- Oil
- Coal [3)]
- Nuclear power
- Hydropower
- Net exports (negative value)

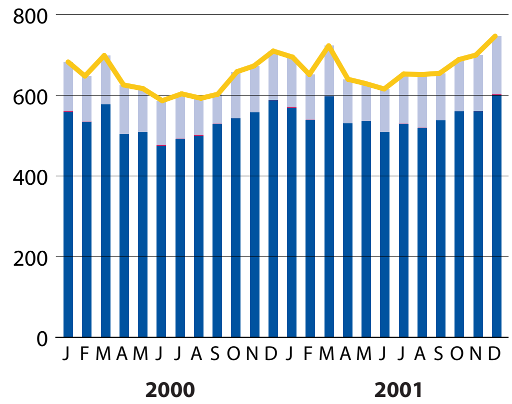
1) In Denmark orimulsion and refinery gas.
2) In Finland blast furnace gas
3) Included 5.4 TWh wood chips for Finland (previous defined as biofuel)



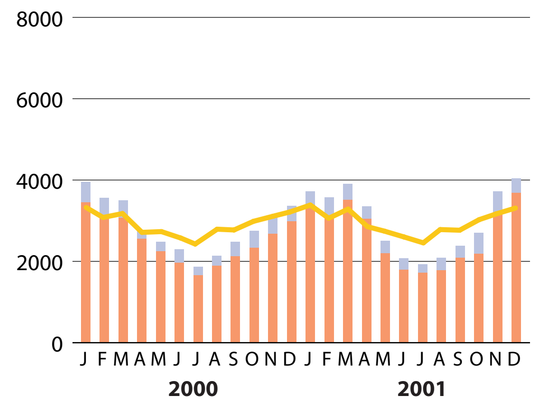
S13 Monthly generation and total consumption of electricity 2000-2001, GWh

- Total consumption
- Wind power or geothermal power
- Nuclear power
- Other thermal power
- Hydropower

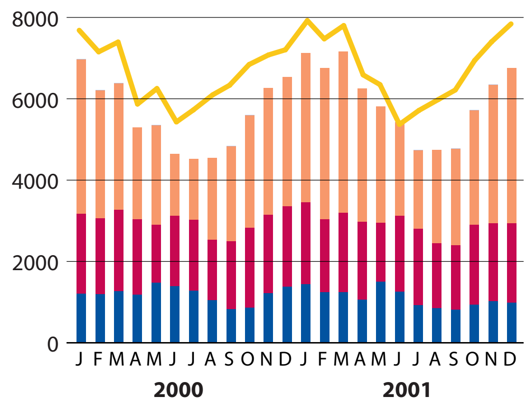
Iceland



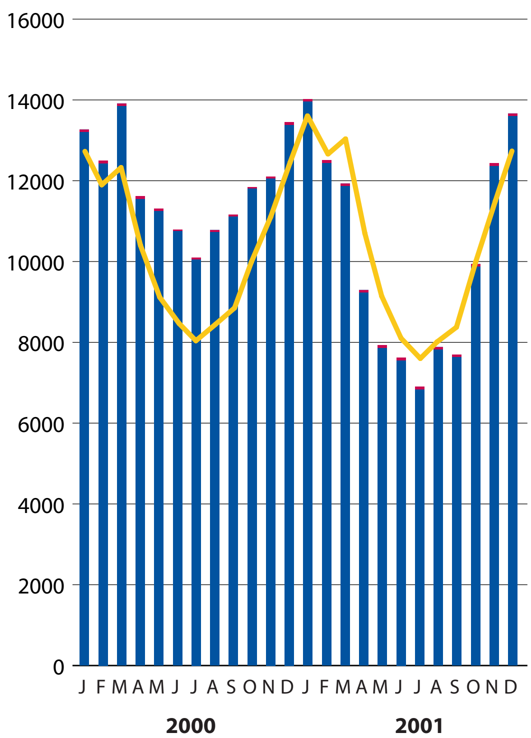
Denmark



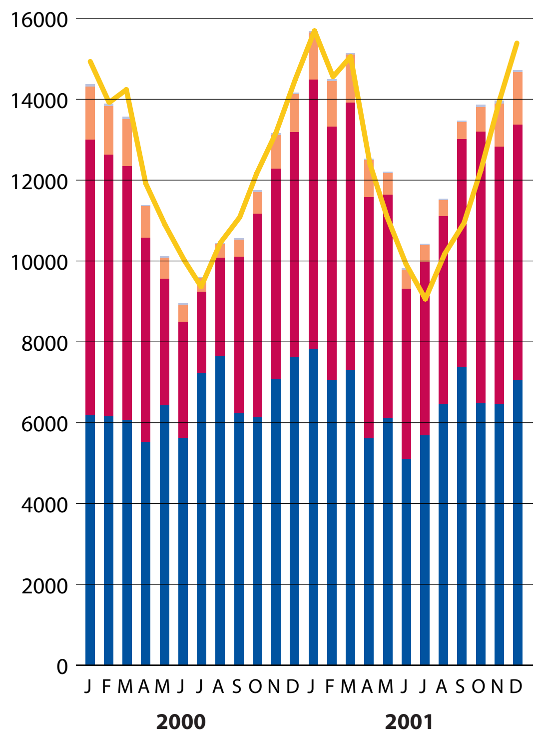
Finland



Norway



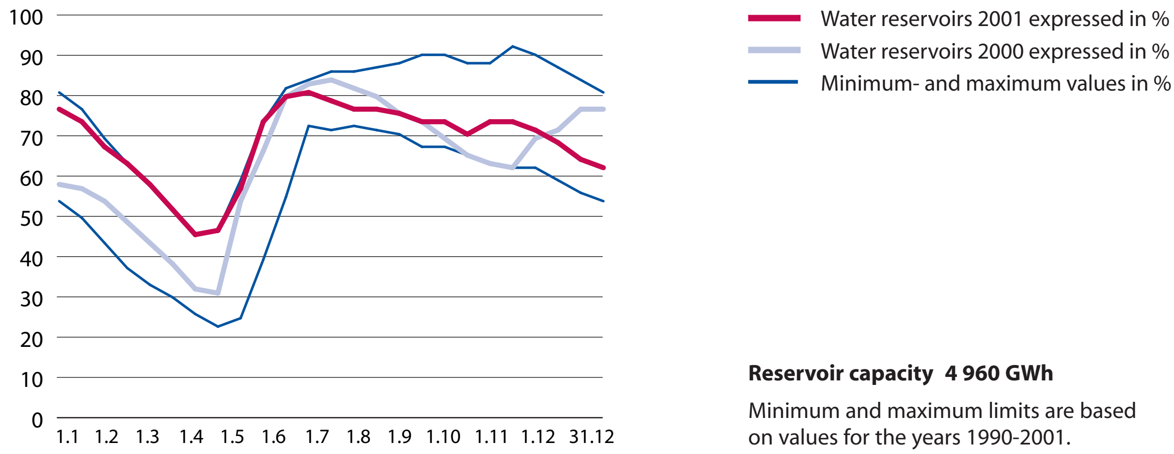
Sweden



Water reservoirs

S14 Water reservoirs 2001

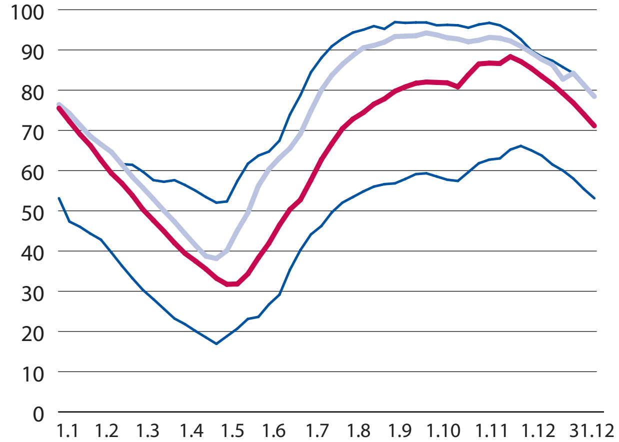
Finland



Reservoir capacity 4 960 GWh

Minimum and maximum limits are based on values for the years 1990-2001.

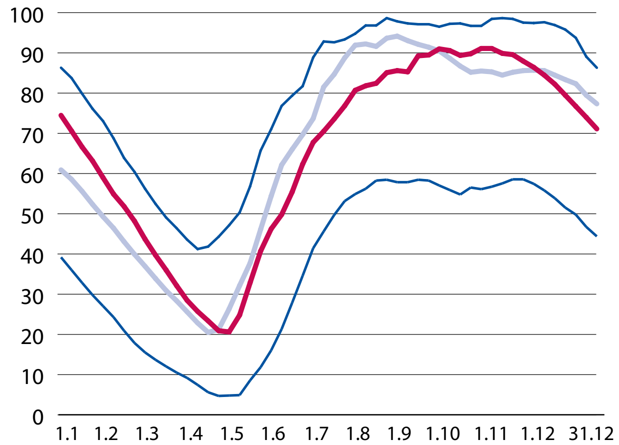
Norway



Reservoir capacity 81 729 GWh

Minimum and maximum limits are based on values for the years 1990-2000.

Sweden

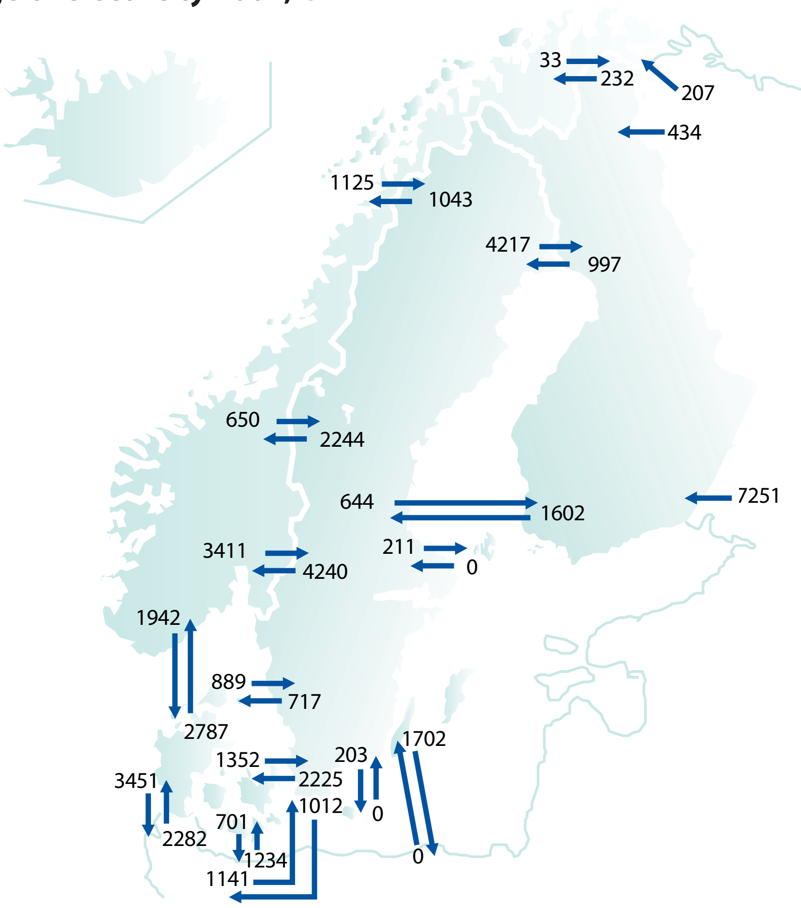


Reservoir capacity 33 758 GWh

Minimum and maximum limits are based on values for the years 1950-2001.

Exchange of electricity

S15 Exchange of electricity 2001, GWh



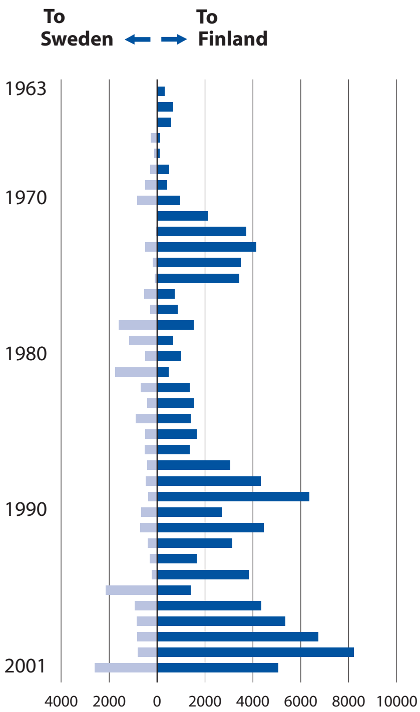
S16 Exchange of electricity 2001, GWh

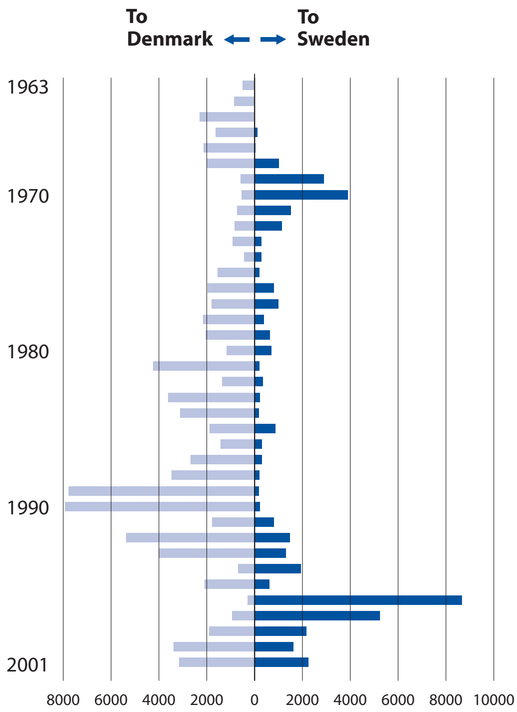
From	To Denmark	Finland	Norway	Sweden	Other countries[1]	Σ From
Denmark	.	.	2 787	2 241	4 152	**9 180**
Finland	.	.	232	2 599	.	**2 831**
Norway	1 942	33	.	5 186	.	**7 161**
Sweden	3 145	5 072	7 527	.	2 714	**18 458**
Other countries[1]	3 516	7 685	207	1 141	.	**12 549**
Σ To	8 603	12 790	10 753	11 167	6 866	**50 179**

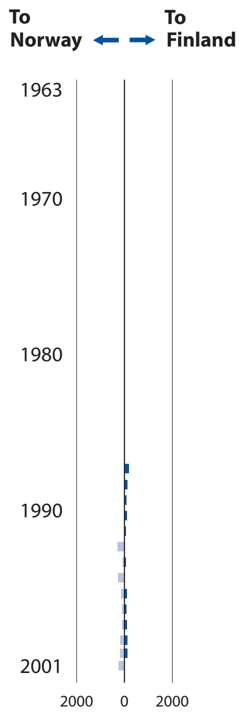
	Denmark	Finland	Norway	Sweden	Nordel
Total to	8 603	12 790	10 753	11 167	**43 313**
Total from	9 180	2 831	7 161	18 458	**37 630**
Net imports	-577	9 959	3 592	-7 291	**5 683**
Net imports/total consumption	-1,6%	12,2%	2,9%	-4,8%	**1,4%**

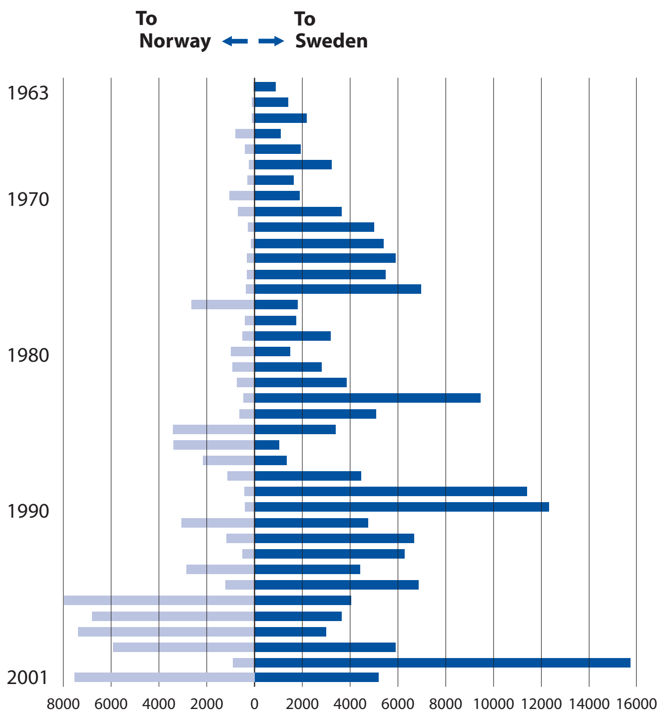
[1] Germany, Russia and Poland.

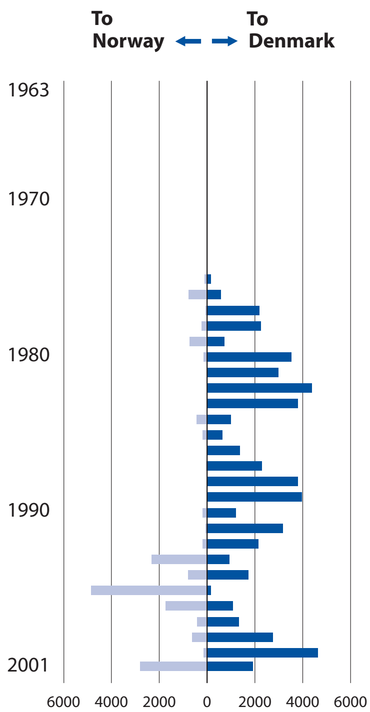
S17 Exchange of electricity between the Nordel countries 1963 - 2001, GWh



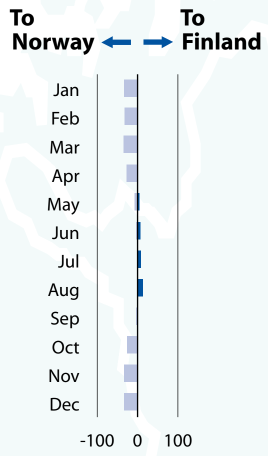


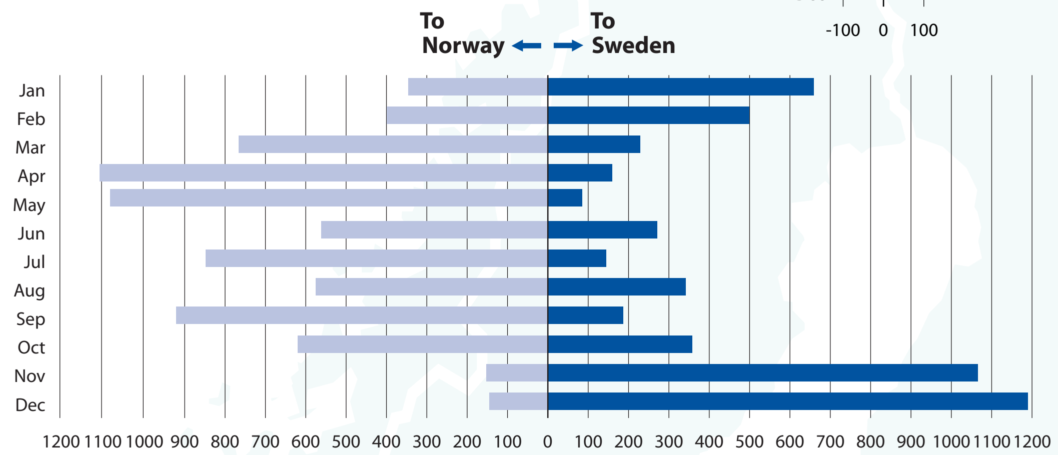


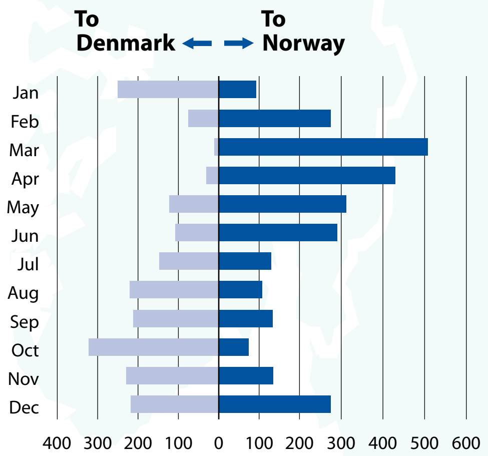


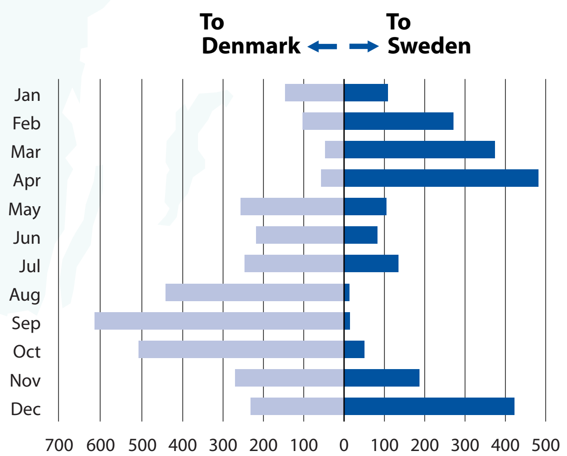


S18 Monthly exchange of electricity between the Nordel countries 2001, GWh



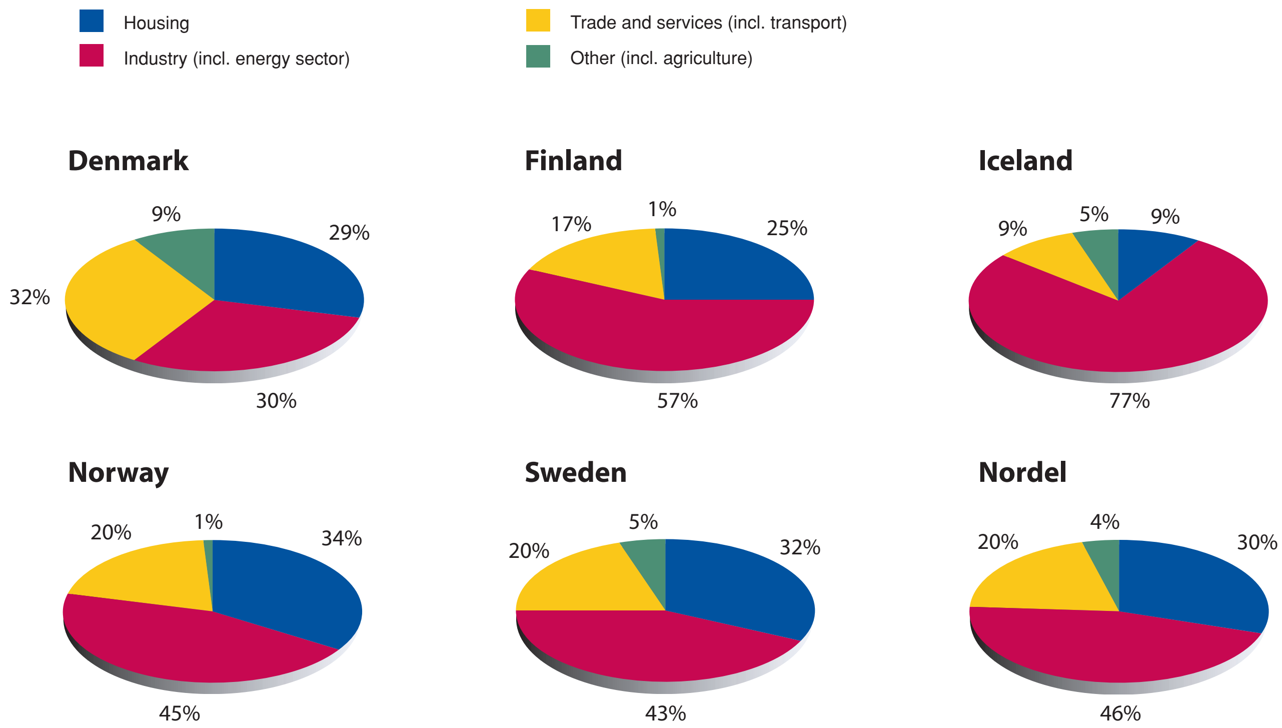






Electricity consumption

S19 Net consumption of electricity 2001, by consumer category

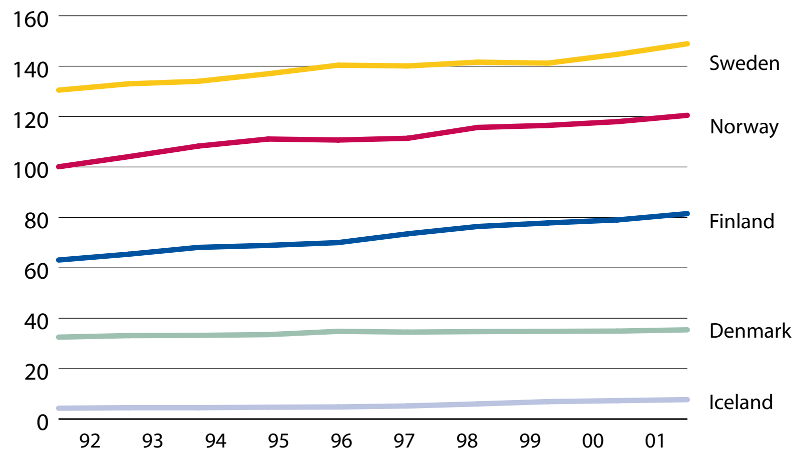


S20 Electricity consumption 2001, GWh

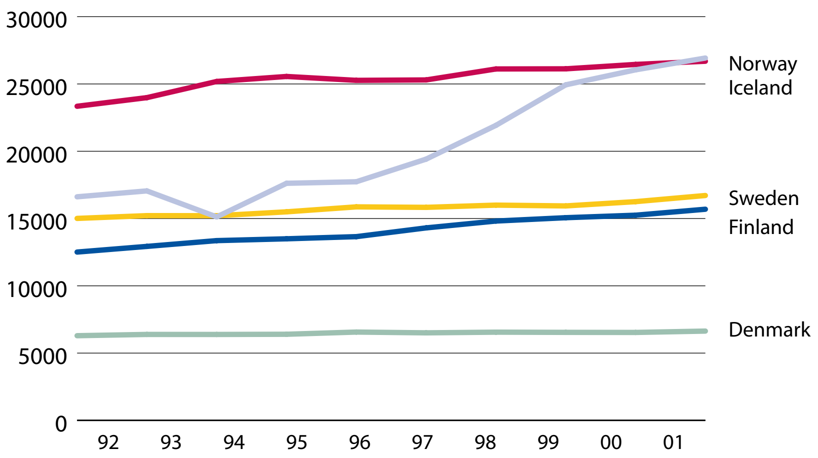
	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total consumption	35 432	81 604	8 028	125 464	150 512	**401 040**
Occasional power to electric boilers	.	88	327	5 102	1 600 [1]	**7 117**
Gross consumption	35 432	81 516	7 701	120 362	148 912	**393 923**
Losses, pumped storage power	2 252	3 000	392	10 435	11 912	**27 991**
Net consumption	33 180	78 516	7 309	109 927	137 000	**365 932**
- housing	9 600	19 820	650	36 963	43 700	**110 733**
- industry (incl. energy sector)	9 900	44 864	5 600	49 228	59 000	**168 592**
- trade and services (incl. transport)	10 700	12 982	691	22 156	27 200	**73 729**
- other (incl. agriculture)	2 980	850	368	1 580	7 100	**12 878**
Population (million)	5,355	5,195	0,286	4,510	8,911	**24,257**
Gross consumption per capita, kWh	6 617	15 691	26 927	26 688	16 711	**16 240**
Gross consumption 2000	34 896	79 050	7 346	117 977	144 819	**384 088**
Change as against 2000, %	1,5%	3,1%	4,8%	2,0%	2,8%	**2,6%**

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

S21 Gross consumption 1992 - 2001, TWh



S22 Gross consumption per capita 1992 -2001, kWh

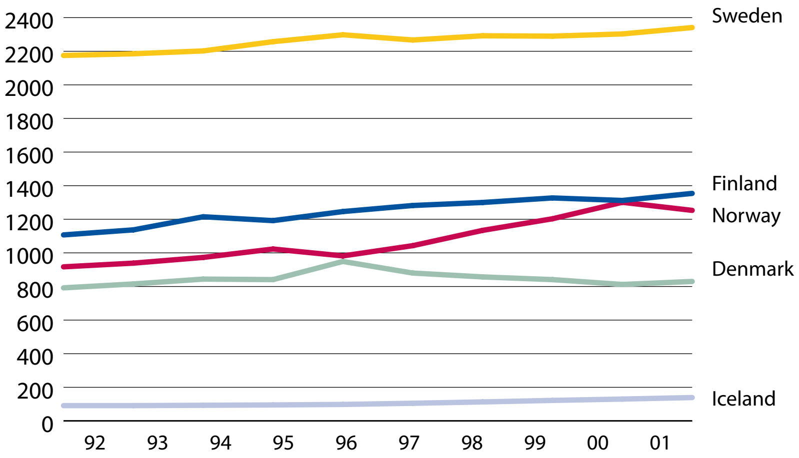


S23 Total consumption 2001, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Generation 2001	36 009	71 645	8 028	121 872	157 803	**395 357**
Net imports 2001	-577	9 959		3 592	-7 291	**5 683**
Total consumption 2001	35 432	81 604	8 028	125 464	150 512	**401 040**
Generation 2000	34 230	67 190	7 678	142 847	141 894	**393 839**
Net imports 2000	666	11 881		-19 023	4 687	**-1 789**
Total consumption 2000	34 896	79 071	7 678	123 824	146 581	**392 050**

Total energy supply

S24 Total energy supply 1992 - 2001, PJ



Prognosis

S25 Gross consumption of electricity 2001 and prognosis for 2002, 2005 and 2010, TWh

	Denmark [2]	Finland [3]	Iceland [4]	Norway [5]	Sweden [6]
2001 [1]	35	82	7,7	120	149
2002	36	84	7,9	122	150
2005	36	87	8,1	125	148
2010	38	93	8,4	131	152

[1] The consumption is not corrected vs. temperatures.
[2] Prognosis based on data from Eltra and Elkraft System.
[3] Prognosis based on data from Finergy.
[4] Prognosis based on data from Energi prognose komiteen.
[5] Prognosis based on data from Statnett SF.
[6] Prognosis based on data from Statens Energimyndighet.

S26 Maximum system load 2001 and prognosis for 2002, 2005 and 2010, MW

	Denmark	Finland	Iceland	Norway	Sweden
2001 [4]	6 229	13 310	1 130	23 054	26 800
2002 [1]	6 524	13 820	1 120	23 439 [2]	27 300 [3]
2005 [1]	6 616	15 100	1 150	24 086 [2]	27 600 [3]
2010 [1]	6 856	16 100	1 200	25 445 [2]	29 000 [3]

[1] Includes supply to electric boilers only for Iceland.
[2] Prognosis according to 10 years winter temp.
[3] Prognosis according to 2 years winter temp.
[4] The consumption is not corrected vs. temperatures.

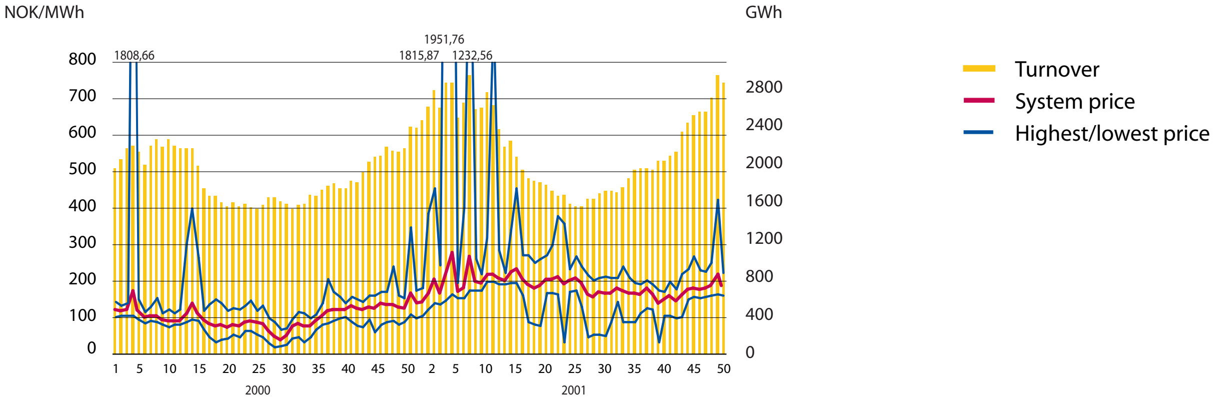
S27 Installed capacity[1] 2001 and prognosis for 2002, 2005 and 2010, MW

	Denmark	Finland	Iceland	Norway	Sweden
2001	12 480	16 827	1 427	27 893	31 721
2002	12 230	16 894	1 472	27 980	32 100
2005	12 921	[2]	1 472	28 200	31 800
2010	13 413	[2]	1 520	30 100	32 900

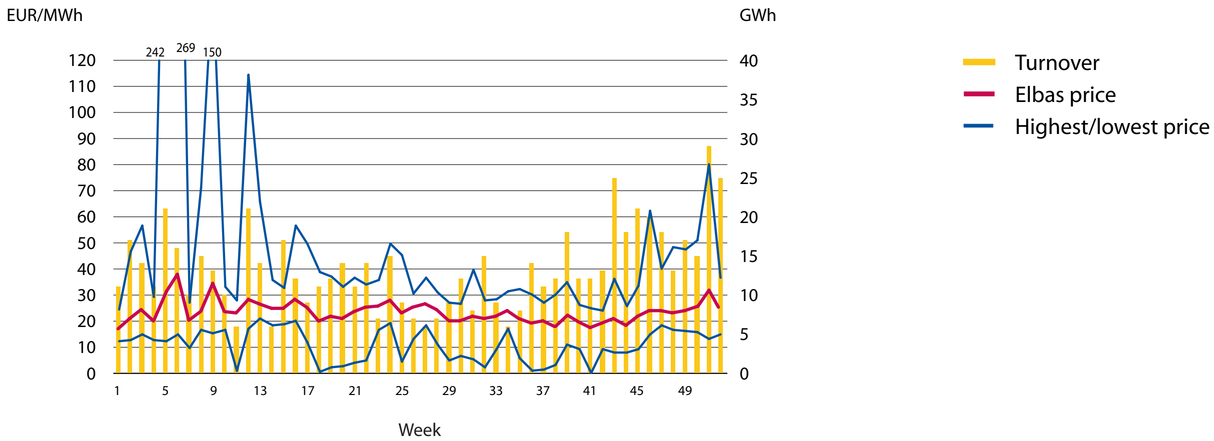
[1] Refers to the sum of the rated net capacities of the individual power plant units in the power system, and should not be considered to represent the total capacity available at any single time.
[2] Prognosis not available.

S28 Spot prices and turnover on the Nordic electricity exchanges 2000-2001

Nord Pool ASA spot market - average system price and turnover per week



ELBAS market - turnover per week 2000



Information on the environment

Environmental aspects play a central role in the electricity sector. The fossilbased electricity production give rise to transboundary air pollution, which is regulated by international agreements. Wind power, hydropower and nuclear power give rise to other environmental effects not included here. The actors in this sector take an active part in the work at national and EU level for the development of programmes and rules in order to limit the sector's environmental impact. The environmental impact from the electricity production has been reduced over the years by introducing efficient combustion and cleaning technologies and using CHP plants with high overall efficiency.

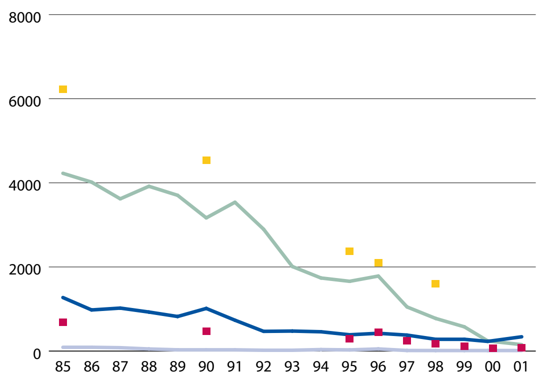
The trade in power between the Nordel countries has also helped reduce environmental impacts by ensuring that resources are used efficiently between electricity systems based on thermal power and systems based on hydropower.

The diagrams below show the emissions of the greenhouse gas CO_2 and the acidifiers (SO_2 and NO_x) in relation to total electricity generation in each country. The substances are regulated by international conventions on transboundary air pollution acceded to by the Nordic countries and the EU. Due to the considerable share of electricity generation based on fossil fuels, Danish and Finnish electricity systems generate significantly more air pollution than electricity systems in Island, Norway and Sweden. In these countries a large part of electricity generation is based on hydropower, nuclear power and geothermal power, which causes no air pollution.

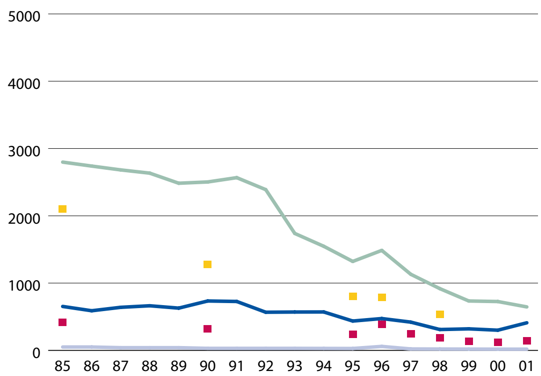
The air pollution per kWh has been steadily falling since the mid-1980s, except from 1996 where there was a sharp increase in the consumption of fossil fuels, particularly in Denmark and Finland due to an exceptionally dry year with low electricity generation in the hydropower-based systems. In Denmark and Finland the specific CO_2 emissions in 2001 have slightly increased compared to the previous year. One of the reasons is that 2000 was a warm year while 2001 was close to a normal year.

Below, average emissions within the EU and within Nordel are given for some reference years. Swedish data for 2001 are not ready yet, and therefore data for 2000 have been used for the diagram. The emissions of CO_2 and acidifiers are lower in Nordel than in the EU. The charts are to be viewed as indicative, in part because different calculation methods have been used in preparing them. When electricity and heat are produced at the same thermal plant, significantly greater fuel efficiency is achieved. There are several ways to allocate the environmental impact between electricity and heat. At the international level, there is no transparency in the environmental impacts from the use of electricity when the individual countries and organisations use different methods to allocate emissions between electricity and heat produced at CHP plants. There is no single internationally recognized method for allocation of emissions between electricity and heat. In this presentation we have used the total energy approach, in which electricity and heat are viewed as equal products. This method assigns electricity the full benefits of CHP production. The Kyoto Protocol includes other greenhouse gasses than CO_2, for instance methane and nitrous oxide. The electricity sector's contribution to the emission of these substances is not yet available.

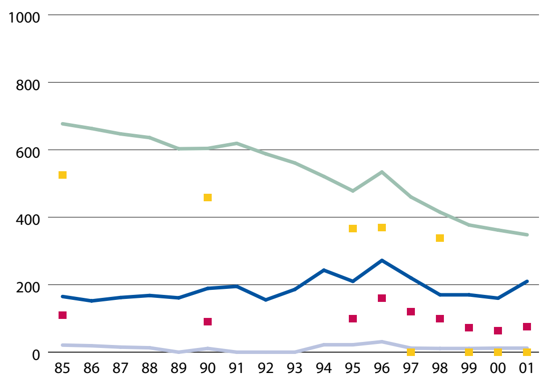
SO_2 - mg/kWh



NO_2 - mg/kWh



CO_2 - g/kWh



EU — Denmark
Nordel — Finland
Sweden

Current Nordel recommendations

- **Availability Concepts for Thermal Power**
  September 1977

- **Localisation of System Oscillations Equipment**
  August 1992

- **Network Dimensioning Criteria**
  August 1992

- **Common Disturbance Reserve**
  February 1992

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

- **Operational Performance Specifications for Small Thermal Power Units**
  August 1995

- **Standardised Communication Procedure**
  August 1995

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

  Summery of recommendation
  May 1997

- **Trade with Reserves within the Nordic Countries**
  August 1998

- **Recommendation on definitions of energy reliability, power reliability and reliability of delivery**
  June 2000

Symbols:

Nordic version

English version

Electronic versions of most recommendations are available at www.nordel.org

Nordel members and organisation

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Odd Håkon Hoelsæter, President and CEO, Statnett SF, Norway (Chairman)
Georg Styrbro, CEO, Eltra amba, Denmark (Vice chairman)
Ole Gjerde, Senior Adviser, Statnett SF, Norway (Secretary)
Bent Agerholm, Managing Director and CEO, Elkraft System amba, Denmark
Timo Toivonen, President and CEO, Fingrid Oyj, Finland
Fridrik Sophusson, Managing Director, Landsvirkjun, Iceland
Jan Magnusson, Director General, Svenska Kraftnät, Sweden

Liasion Secretariat

Ole Gjerde, Senior Adviser, Statnett SF, Norway (Secretary of Nordel)
Flemming Birck Pedersen, M.Sc.E.E., Elkraft System amba, Denmark
Flemming Wibroe, Senior Project Manager, Eltra amba, Denmark
Kurt Lindström, Director, Fingrid Oy, Finland
Thordur Gudmundsson, Transmission Director, Landsvirkjun, Iceland
Tania Pinzón, M.Sc.M.E., Svenska Kraftnät, Sweden

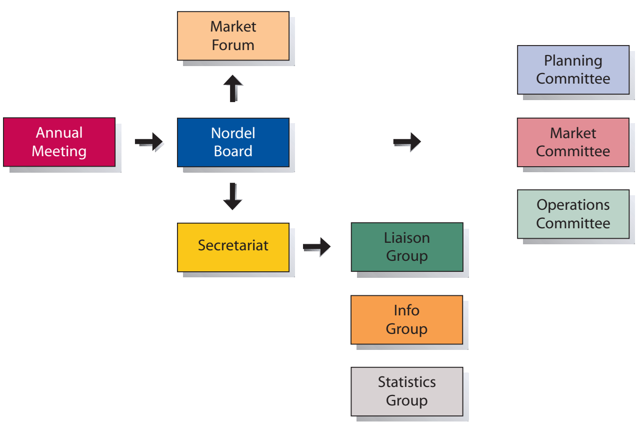
Nordel's Secretariat till 13. June 2002

(For contact information see cover).
Ole Gjerde, Senior Adviser, Statnett SF, Norway (Secretary of Nordel)
Gro Berglund/Cecilie Wessel, Corporate Communications Consultant, Statnett SF, Norway
Jan F. Foyn, Head of Statistics, Nord Pool ASA, Norway

Information Group

Per Andersen, Head of Information, Eltra amba, Denmark
Kaare Sandholt, Head of Corporate Communications, Elkraft System amba, Denmark
Kurt Lindström, Director, Fingrid Oyj, Finland
Thorsteinn Hilmarsson, Head of Corporate Communications, Landsvirkjun, Iceland
Tor Inge Akselsen, Director of Corporate Communications, Statnett SF, Norway
Mårten Norgren, Head of Corporate Communications, Svenska Kraftnät, Sweden
Hartvig Munthe Kaas, Head of Corporate Communications, Nord Pool ASA, Norway (Correspondent)

Organisation structure



Members of Committees:

Operations Committee

Eero Kokkonen, Managing Director, Fingrid System Oy, Finland (Chairman)
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Nils Gustavsson, Manager, System Operation, Landsvirkjun, Iceland (Correspondent)
Hans-Henrik Clod-Svensson, Director, System Operation, Elkraft System amba, Denmark
Carl Hilger, Head of System Operation Division, Eltra amba, Denmark
Ivar Glende, Executive Vice President, Statnett SF, Norway
Bo Krantz, Director of Operations, Svenska Kraftnät, Sweden

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Paul-Frederik Bach, Deputy Director, Eltra amba, Denmark
Preben Jørgensen, Director, Transmission, Elkraft System amba, Denmark
Pertti Kuronen, Planning Manager, Fingrid Oyj, Finland
Eymundur Sigurdsson, System Manager, Grid Development, Landsvirkjun, Iceland
Sture Larsson, Grid Technology Director, Svenska Kraftnät, Sweden

Market Committee

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Christina Simón, B. Com., Svenska Kraftnät, Sweden (Secretary)
Peter Jørgensen, Head of Market Division, Eltra amba, Denmark
Lene Sonne, Director, Market Administration, Elkraft System amba, Denmark
Juha Kekkonen, Executive Vice President, Fingrid Oyj, Finland
Gudmundur Ingi Asmundsson, Head of System Operation, Landsvirkjun, Iceland
Bente Hagem, Executive Vice President, Statnett SF, Norway

Market Forum

Market participants
Per Ebert, Director, Strøm A/S, Denmark
Niels O. Gram, Head of Energy Department, Dansk Industri, Denmark
Kjeld Oksbjerg, Head of Production Management, Energi E2 A/S, Denmark
Magnus Buchert, President and CEO, Graninge Energia Oyj, Finland
Jouko Isoviita, President and CEO, Power Deriva Oy, Finland
Mikko Rintamäki, Development Manager, Outokumpu, Finland
Eiríkur Briem, Deputy Managing Director, Statens Elverk, Iceland
Thorleifur Finnsson, Director of Development and New Products, Reykjavik Energi, Iceland
Edvard G. Gudnason, Head of Marketing, Landsvirkjun, Iceland
Egil G. Arntsen, Managing Director, Østfold Energi AS, Norway
Atle Neteland, Managing Director, BKK AS, Norway
Ragnar Ottosen, Managing Director, Skandinavisk Kraftmegling, Norway
Leif Josefsson, Vice President, Sydkraft AB, Sweden
Per Möller, President and CEO, Dalakraft AB, Sweden
Christer Sjölin, President and CEO, Fortum Kraft AB, Sweden

TSO representatives
Odd Håkon Hoelsæter, President and CEO, Statnett SF, Norway (Chairman)
Ole Gjerde, Senior Adviser, Statnett SF, Norway (Secretary)
Bent Agerholm, Managing Director and CEO, Elkraft System amba, Denmark
Georg Styrbro, CEO, Eltra amba, Denmark
Timo Toivonen, President and CEO, Fingrid Oyj, Finland
Fridrik Sophusson, Managing Director, Landsvirkjun, Iceland
Jan Magnusson, Director General, Svenska Kraftnät, Sweden

NORDEL´S SECRETARIAT
(until June 13th 2002)

Statnett SF

Postal address:
P.O. Box 5192, Majorstua
N-0302 Oslo
Norway

Visiting address:
Husebybakken 28B
Oslo

Telephone: +47 22 52 70 00
Telefax: +47 22 52 70 40
e-mail: nordel.secretariat@statnett.no
Internet: www.nordel.org

Ole Gjerde
Senior Adviser, Statnett SF
(Secretary General of Nordel)

Gro Berglund (until Dec. 2001)/
Cecilie Wessel (from Dec. 2001)
Corporate Communications Consultant,
Statnett SF

Jan Foyn:
Head of Statistics, Nord Pool ASA

NORDEL´S SECRETARIAT
(from June 13th 2002)

Eltra amba

Postal address:
P.O. Box 140
DK-7000 Fredericia
Denmark

Visiting address:
Fjordvejen 1-11
Fredericia

Telephone: +45 76 22 40 00
Telefax: +45 76 24 51 80
e-mail: nordel.secretariat@eltra.dk
Internet: www.nordel.org

Flemming Wibroe
Senior Project Manager
(Secretary General of Nordel)

Lene Egeberg-Gjelstrup
International Co-ordinator, Eltra amba

Jan Foyn:
Head of Statistics, Nord Pool ASA

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