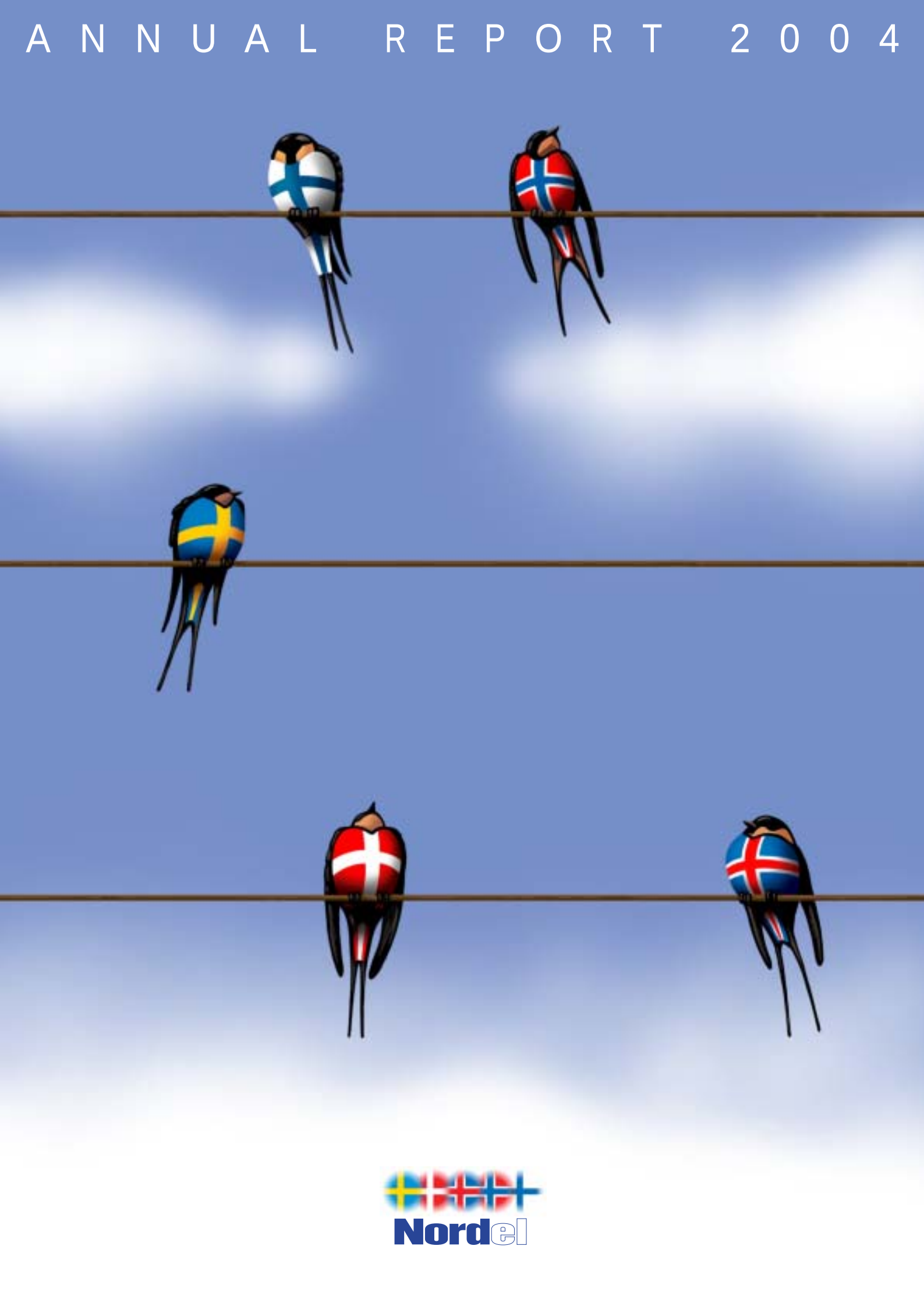
ANNUAL REPORT 2004



Nordel

Contents

Nordel

Nordel is the collaboration organization of the Transmission System Operators TSOs of Denmark, Finland, Iceland, Norway, and Sweden. Nordel's objective is to create the prerequisites for an efficient and harmonised Nordic electricity market, with no regard to national borders.

Nordel is also a forum of contact between the TSOs and the representatives of the market players in the Nordic countries. It is important for the development of an efficient electricity market that the system operators meet with the market players in order to exchange points of view.

Nordel's intention is to:

- Function as a TSO and work towards a harmonised Nordic electricity market.
- Be a driving force in the development of the Nordic and European electricity markets.
- Be jointly responsible for implementing the adopted measures in order to, among other things, increase the level of operational reliability.

This entails a number of duties in the following areas:

- System development and network design rules, e.g. coordinating network investments and dealing with bottlenecks.
- System operation, operational reliability, delivery reliability, and information exchange.
- Pricing principles for network and system services.
- International collaboration.
- Maintaining and developing contacts with organisations and authorities, both in the Nordic area and in Continental Europe.
- Drawing up and disseminating neutral information about the Nordic electricity system and market.

Nordel's highest decision-making body is its annual meeting. Here, representatives of the TSOs meet. Nordel's annual meeting elects the Chairman of the organisation for a period of two years. The post of Chairman rotates between the countries. The Chairman selects the secretary of Nordel and is responsible for the secretariat and its costs. The organisation has no budget of its own.

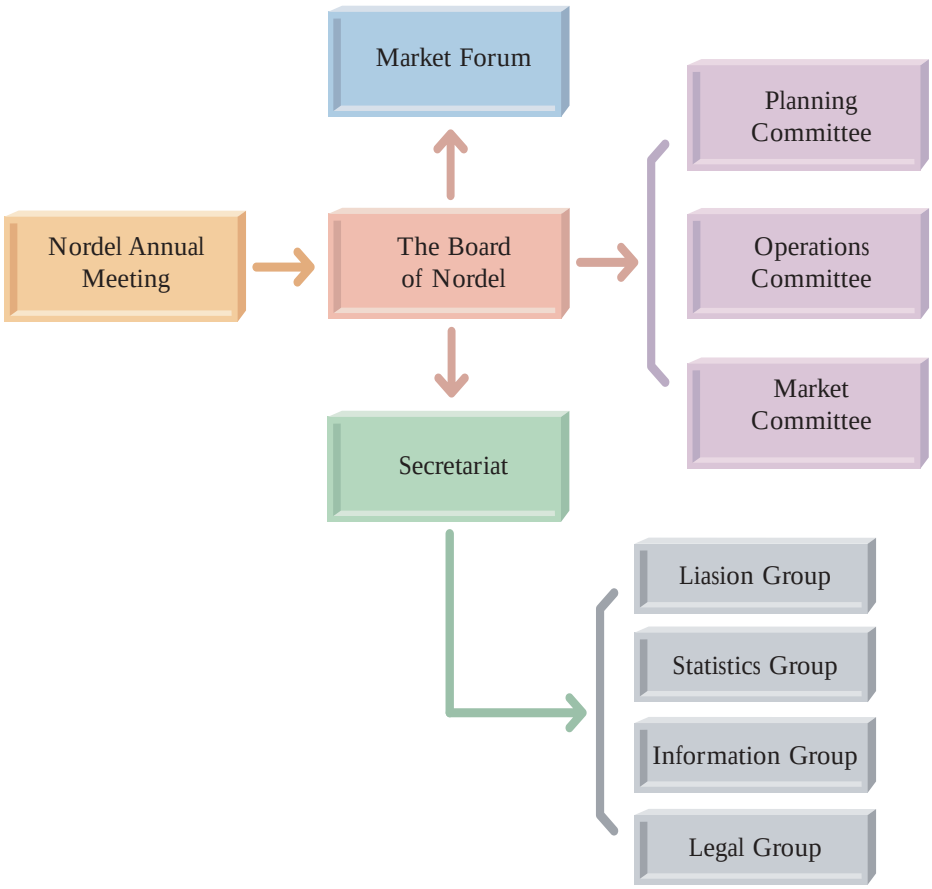
Nordel's executive body is its Board, which consists of the leaders of the TSOs in the Nordic area. The Nordel Board launches new projects, makes decisions regarding current matters and expedites the decisions made at the Nordel annual meeting. The Nordel Board is also responsible for the organisation's external information activities.

A large part of Nordel's work is carried out by committees and work teams. On Nordel's Operating, Planning, and Market Committees sit the leaders of the corresponding sections of the TSOs. The work teams are staffed by company specialists.

More information about Nordel, as well as reports and statistics, can be found at www.nordel.org.

Nordel Annual Meeting 2004 in Hämeenlinna, Finland. Photo: Flemming Wibroe

Organisation



Key figures for 2004

		Nordel	Denmark	Finland	Iceland	Norway	Sweden
Population	mill.	**24.5**	5.4	5.2	0.3	4.6	9.0
Total consumption	TWh	**399.5**	35.5	86.9	8.6	122.0	146.4
Maximum load[1]	GW	**67.0**	6.2	12.9	1.0	20.2	26.7
Electricity generation	TWh	**387.9**	38.4	81.9	8.6	110.5	148.5
Breakdown of electricity generation							
Hydropower	%	**49**	0	18	83	99	40
Nuclear Power	%	**25**	-	26	-	-	50
Other thermal power	%	**18**	76	42	0	0	4
Other renewable power	%	**8**	24	14	17	1	6

[1] Measured 3rd Wednesday in January - = Data are nonexistent 0 = Less than 0,5 %

Report of the Board

Continued focus on operational reliability and increased harmonisation

The Nordic electricity market is a concrete example of a smoothly-functioning regional electricity market. By means of good cross-border collaboration, the Nordic area has been able to create one of the world's most successful international electricity markets. We have a wide-reaching system operation agreement, joint balance regulation, a single power exchange for spot trading, partly harmonised tariffs, extensive information exchange, and good collaboration in critical situations. The fact that the market works well was indicated not least during the stresses and strains of the autumn and winter of 2002-2003, with low levels of water and several extensive disturbances on the grid. Even though the integration of the Nordic electricity market has been successful in several respects, it is a pressing issue to intensify and further develop Nordic collaboration.

The year 2004 was a better year regarding operational reliability then previous years and this issue will be in focus also in the coming years. The current design criteria, rules and methods have proven themselves to provide good operational reliability at reasonable financial cost. Against the backdrop of the outage in Southern Sweden and Zealand in September 2003, Nordel has reviewed the dimensioning and operational criteria of the Nordic electricity system with the aim of further improving the design and operational reliability of the Nordic grid. An initial report was presented on the Nordel annual meeting and submitted in June 2004 to the Nordic Council of Ministers. A number of points have been identified where improvements will be made, primarily in the application of the joint system of rules. In parallel with this, a deeper review of the rules is being carried out by means of, for instance, taking into account corresponding rules in the rest of Europe.

The Nordel annual meeting decided that the Nordic transmission grid should be augmented in five places. In doing this, electricity consumers will obtain a higher level of supply security, while at the same time improved prerequisites will be created for the Nordic electricity market. The proposed reinforcements are to be seen as a whole, without mutual prioritization. They can all be implemented in around 2010, and constitute an important step towards an even better Nordic infrastructure. The total investment will amount to approximately € 1 billion.

The Nordic area's energy ministers emphasized, at their meeting in Akureyri during the autumn of 2004, the importance of intensifying collaboration on the Nordic electricity market. The wish was expressed that Nordel would investigate a number of issues with the aim of identifying proposals providing continued Nordic harmonisation. These issues dealt with how the system operators would be able to coordinate their system responsibility, organise and finance joint investments in networks, and manage the peak-loads of the Nordic countries.

In February 2005, Nordel's report was submitted to the Nordic Council of Ministers. In this report, it was established that the TSOs' roles and responsibilities differ to some extent between the countries. These differences can work against a smoothly-functioning Nordic electricity market and Nordel will thus try to define the TSOs' fundamental duties so that the "interfaces" with the market and the authorities will be clear and in harmony. The same principles for financing the TSOs' services are also to be applied in all the countries. The rule should be that electricity market players benefiting from a measure or an activity must also pay for it.

Nordel has analysed several models for financing and organising network investments deemed able to benefit the entire Nordic electricity market. The best solution for ensuring a reasonable distribution of costs between the countries – at least in the medium-term – has proven to be bilateral financing in the usual way supplemented by bottleneck revenues earmarked for implementing network investments. This new order means that any charges the players pay in the event of network restrictions go directly to rectifying these problems.

The implementation of the proposed measures can be another important step towards a borderless market and a continued positive trend on the Nordic electricity market.

One important part of the system responsibility is promoting a smoothly-functioning electricity market. Of crucial importance to a smoothly-functioning electricity market is when both supply and demand react to price changes. Nordel is of the opinion that there is a considerable power resource to make use of on the consumer side during peak-load situations. Against the background of the report "Peak Production Capability and Peak Load in the Nordic Electricity Market", published in May 2004, the TSOs have drawn up national plans of action for increased flexibility on the consumer side. Nordel points out that the TSOs are not responsible themselves for an increased level of flexibility, instead collaboration with energy authorities, universities, and market players, among others, is necessary. Nordel's intention is instead to develop the role of catalyst in order to promote flexibility in the consumption of electricity and boost interest in power reductions. This issue is the subject of a special article included in this annual report.

Collaboration with market players, ministries, and energy authorities

During the past year, Nordel has continued to collaborate well with the market players, the Nordic countries' energy authorities, and the Nordic Council of Ministers.

Over the past year, Nordel has arranged open seminars dealing with current themes, with the dual purpose of accounting for work carried out within Nordel and paving the way for a broad and deep discussion concerning this issue.

The first seminar, held in Copenhagen in May 2004, dealt with the power issue. The theme of the second seminar, held in Oslo in January 2005, concerned rules for dealing with bottlenecks on the grid. The seminars have attracted attendees from market players, energy authorities, ministries, and the media in all the Nordic countries.

ETSO and the Florence Forum

The development of the European electricity markets is constantly ongoing. Within the framework of the Florence Forum, discussions are being conducted between representatives of the European Commission, the regulatory authorities (represented by CEER), the TSOs (represented by ETSO), and the European electricity industry.

During the winter of 2004/2005, a number of mini-forums were held around Europe dealing with the theme management of bottlenecks and the allocation of transmission capacities. Against the background of the experience gained from these forums, among other things, the European Commission is devising more in-depth guidelines relating to congestion management.

The European Commission's proposal regarding measures to augment the security of supply on the electricity market has continued to be a topic of discussion during the year. A seminar was held on 15 March 2005 under the auspices of ETSO and the regional TSO-organisations (UCTE, Nordel, UKTSOA and ATSOI) regarding the security of supply.

The members of the Board

Jan Magnusson
Svenska Kraftnät, Sweden, Chairman

Christina Simón
Svenska Kraftnät, Sweden, Secretary

Peder Østermark Andreasen
Eltra amba, Elkraft System amba, Denmark

Thordur Gudmundsson
Landsvirkjun Transmission, Iceland

Odd Håkon Hoelsæter
Statnett SF, Norway

Timo Toivonen
Fingrid Oyj, Finland, Vice chairman

Outgoing members as at 1 March 2005

Georg Styrbro
Eltra amba, Denmark

Bent Agerholm
Elkraft System amba, Denmark

Developments in the Nordic Electricity System

New land based wind power plants with a total capacity of 400 MW are built in Denmark to the year 2009. Photo: Mikael Togeby

At the beginning of 2004, there was a considerable shortage of water in Swedish and Norwegian reservoirs, but levels returned to normal during the autumn. With low levels of hydropower production during the year, imports of electricity were 11 579 GWh. This was 2.9% of total consumption in the Nordic countries during 2004 compared with 4.4% during 2003.

During 2004, the Nordic countries were suffering from a considerable power deficit, with low levels of hydropower production. In 2003, the Nordic area imported electricity to the tune of 17 TWh, corresponding to 5% of total consumption. At the same time, this meant large volumes of power being transmitted internally between the Nordic countries.

The EU electricity and natural gas market directive, which came into effect on 1 July 2004, contains requirements that will impact upon the system operators. The most important of these requirements are:

- The network companies' tariffs, or the methods used to set tariffs, are to be approved in advance (ex ante).
- Methods of exercising the system responsibility are to be monitored.
- The management of bottlenecks is to be commercially sound.
- Compensation for transit costs must be reasonable.
- European grid tariffs are to be harmonised in the long-term.

Work is currently ongoing among the Nordic system operators to adapt their regulations to the EU directive.

Collaboration within Nordel has been intensive during 2004. In the spring of 2004, a programme of investments was presented to augment the Nordic transmission grid. These investments will reduce the number of bottlenecks on the transmission grid and boost the security of supply, thus improving the functioning of the Nordic electricity market. The following five projects involving the Nordic power grid are included in the programme:

- Fenno-Skan 2 between Sweden and Finland.
- Nea-Järpströmmen between Norway and Sweden.
- Skagerrak 4 between Norway and Denmark.
- The Great Belt Link in Denmark.
- Hallsberg-Scandia between Central and Southern Sweden.

The proposed augmentations are to be seen as a whole, without mutual prioritization. They can all be implemented in around 2010. The overall investment cost will amount to approximately € 1 billion. As part of the financing of the implementation of these network investments, the companies comprising Nordel have now agreed to earmark and use the bottleneck revenues originating from the players.

In May, Nordel set out a joint objective for safeguarding the supply of power during peak-loads. The departure point for this is that incentives for investment in new electricity production capacity are to be created via the market price. Price formation that works well and a clearer distribution of roles among, on the one hand, the system operators and on the other, the market players and authorities, will thus be crucial prerequisites for the players to be motivated to secure the necessary resources to perform their deliveries of electricity also during cold winter days. Nordel emphasizes the importance of an increased level of flexibility in the demand for electricity in order to strengthen the power balance. During the autumn, the TSOs drew up national plans of action in order to create improved prerequisites for such a development. Nordel has also presented a proposal regarding a financial product intended to give the market players the opportunity to hedge against high prices during peak-loads.

Furthermore, Nordel has reported on the results of a review of the dimensioning and operational criteria of the Nordic electricity system, against the backdrop of the outage in Southern Sweden and Zealand in September 2003. A number of points have been identified where improvements will be made, primarily in the application of the joint system of rules. In parallel with this, a more in-depth review of the rules is being carried out by, among other things, taking into account the corresponding rules in the rest of Europe.

For a number of years, work has been ongoing within Nordel to draw up joint rules for dealing with transmission constraints, known as bottlenecks, on the Nordic electricity network. In August, Nordel reported on the results of a review of the rules in order to determine the trading capacity of the Swedish-Norwegian links. One conclusion drawn was that the current system of rules was largely harmonised. Nordel proposed, however, that the issue of managing internal transmission constraints, and their consequences for the capacity of the links between the countries, should be further reviewed. The report also renders an account of how counter

Photo: Trond Isaksen

trading can be used to reduce the division of the market into separate price zones. Nordel emphasizes that the cost of a scheme for increased counter trading should be borne by the market players benefiting from the measure. At a seminar in Oslo in January 2005, the problem was dealt with and the conclusions reached there were that the tool to be used for temporary bottlenecks is increased counter trading and that the cost incurred by increased counter trading should be split between the categories of player benefiting from the increased trading opportunities.

During their meeting in Akureyri in Iceland during September 2004, the Nordic energy ministers noted that the Nordic market was working well and that the harmonisation process should now be moved forward. In the Akureyri Declaration, the TSOs were asked to investigate how further coordination of the functions of the system responsibility, financing, and organisation of Nordic investments in the transmission grids as well as joint management of the power issue could be established. Nordel's enquiry published its report "Enhancing Efficient Functioning of the Nordic Electricity Market" in February 2005. This primarily deals with:

- Definition of the system responsibility.
- Harmonisation of the rules of operation to achieve a smoothly-functioning electricity market.
- Collaboration during disturbances and situations of scarcity.
- The supply of power during peak-loads and mechanisms for jointly controlling this.
- Organisation and financing of joint investments (planned expansions of networks).

Energy and Climate Policy

Photo: Trond Isaksen

Denmark

On 29 March 2004, a broad political settlement was reached regarding the supply of energy in Denmark. This settlement was put into practice via a raft of changes to laws governing the supply of electricity, natural gas, and heating on 4 June 2004. These changes entail, among other things, that the network owners will obtain a free right of disposal regarding equity and that the state will assume the system responsibility and infrastructure on the energy market. Primarily, this applies to the 400 kV network and the overseas interconnectors, but the Danish state will simultaneously acquire the obligation to buy regarding the 132/150 kV network when the owners of these networks want to sell.

The political settlement meant that the system and grid responsibility regarding electricity and natural gas in Denmark was transferred to a joint company, Energinet.dk. The new company consists of the two TSOs Eltra and Elkraft together with Gastra, which operates the natural gas of Denmark. Energinet.dk is to 100% owned by the state.

The previously-existing obligation whereby electricity consumers primarily had to buy their electricity from wind generators and thermal power plants was removed on 1 January 2005. This means that the settlement of environmentally-friendly electricity is transformed into a financial contribution affected by market prices. All thermal power plants over 10 MW will in future be able to allocate their production on the market. They will also be given the opportunity to take part in the market for reserve and regulating power.

The settlement also entails a further two wind farms of 200 MW each being built (at Horns Rev and Rødsand). They are expected to be commissioned in 2008. The settlement also entails a reconstruction programme for old wind generators which is expected to result in approximately 400 MW of new land-based wind generators up until 2009.

A national plan of action is being drawn up – in which power contingency issues are also included – in order to augment the infrastructure of the electricity market up until 2010.

Finland

The Act governing the guarantee system for origin of electricity came into force on 1 July 2004. It requires the power trading company to inform the consumer as regards how the power was produced.

The Act governing trading in emission rights came into force on 4 August 2004. It applies to carbon dioxide emissions from combustion plants with a power input of 20 MW as well as smaller combustion plants connected to these via the same district heating network, oil refineries, coking plants, and some plants in the steel, mineral, and forestry industries.

An amendment to the Electricity Market Act came into force on 27 December 2004. By means of the Act, the new EU directive regarding the single market for electricity will be introduced, as well as the government programme's central guidelines for the evolution of the electricity market. Monitoring of the grid monopoly will become more effective when a new supervisory model goes into service. The Energy Market Authority will in advance set the bases of pricing for the network owners and the terms for the network charges.

Iceland

During the year, the Icelandic parliament adopted a new law entailing that the owner of the country's grid will also have the system responsibility.

During the year, it was decided to speed up the opening up of the electricity market, entailing that all consumers will freely be able to choose their electricity supplier as of 1 January 2006.

Norway

In December 2003, the Norwegian government submitted a white paper to the Norwegian parliament concerning, among other things, the security of the electricity supply. Among other things, this includes the following:

- Prerequisites for a secure supply of energy.
- Description and assessment of the power situation 2002 – 2003.
- Measures for obtaining a more robust electricity supply.
- Measures for dealing with situations when there is a scarcity of energy.
- Circumstances concerning investments in hydropower production.

Passage through parliament in May resulted in, among other things, Statnett being given extended responsibility during situations when there is a scarcity of energy, together with the responsibility for the energy balance during the winter season up until the start of the spring flood.

In August 2004, the government submitted a further white paper to the Norwegian parliament with the purpose of increasing the use of natural gas and the issue of introducing energy certificates in Norway. There are plans for Statnett to assume responsibility of the overall development of the infrastructure for electricity and the gas market, i.e. the same responsibility that Energinet.dk and Svenska Kraftnät have at present.

Sweden

In December 2004, a final report was submitted containing proposed amendments to laws as a consequence of the new EU electricity and gas market directive which applies from 1 July 2004. During the spring, the government is expected to bring a bill before parliament concerning the rules of the electricity and gas markets.

The government has appointed Svenska Kraftnät as the system operator for natural gas, effective 1 July 2005. Svenska Kraftnät has thus been tasked with monitoring that the system is functioning in an operationally-reliable way and is in a state of balance, as well as with managing the balance settlement and promoting competition on the natural gas market. Today, the Swedish market for natural gas amounts to approximately 11 TWh per annum.

Trading in Swedish energy certificates started on 1 April 2004 under the auspices of Nord Pool. Trading is managed as an integrated part of Nord Pool's trade in power. Trading is based thus on a Norwegian stock exchange concession from Kredittilsynet in Norway.

In 2003, the government set up an enquiry to review the forms of trading in emission rights ahead of the start of this type of trading within the EU on 1 January 2005. On 15 April 2004, the government put a bill before parliament proposing the introduction of a new law governing emissions of carbon dioxide. It includes certain stipulations regarding permits to emit carbon dioxide as well as how emissions rights are to be allocated.

Following several years of unsuccessful negotiations between the Swedish state and the nuclear power industry regarding the voluntary decommissioning of nuclear power, the government has decided that Barsebäck 2 is to be shut down by 31 May 2005 at the latest. This remaining reactor at Barsebäck generates 600 MW.

System Responsibility

Photo: Trond Isaksen

Denmark

The two TSOs Eltra and Elkraft and Gastra, which operates the natural gas of Denmark, joined the 1st of January 2005 in the state-owned company Energinet.dk, with head office in Western Denmark.

Finland

Fingrid entered into new agreements regarding operating reserves, which encompass both production capacity and disconnectable industrial loads. These agreements are long-term and through them the operational reliability has also been secured after the new nuclear power plant has been commissioned. Fingrid has also embarked upon a project to build a new 100 – 150 MW gas turbine in order to maintain requirements for operating reserves.

Iceland

On 1 January 2005, Landsnet (Icegrid) assumed the role of system-responsible grid owner. Landsnet is owned by Landsvirkjun, Statens Elverk, and Vestfjordenes Energiselskab, with Landsvirkjun owning over 70% of the company. Landsnet includes transmission facilities with tension levels of 66 kV and upwards. There are also some 33 kV facilities.

Norway

The security of supply is dealt with by the Norwegian parliament and Statnett is given extended responsibility for the energy balance during tight situations when there is a scarcity of electricity.

Sweden

The work of investigating the long-term conditions for the electricity supply in Greater Stockholm has continued and is expected to be completed during the spring of 2005.

Ahead of the winter of 2004/2005, Svenska Kraftnät procured 2,000 MW of peak-load reserves within the framework of the limited-duration transitional solution which Sweden's parliament has legislated upon to ensure a sufficient supply of power. After 2008, commercially-sound methods are expected to have come about for ensuring a sufficient supply of power.

From 1 July 2005, Svenska Kraftnät will also have the role of system operator for natural gas in Sweden.

Electricity Market

Photo: Trond Isaksen

Denmark

Denmark acts like a bridge between the Nordic area and Continental Europe. The price level in Western Denmark, under normal circumstances, lies somewhere between two zone prices. Periodically however, the Western Danish zone price can simultaneously be over/under both the Nordic and German system prices. This is due to the Western Danish electricity system being strongly characterized by a very large volume of decentralised and unregulated wind power production. In Eastern Denmark, prices follow those in Sweden, as a rule. However, it has been the case that constraints on the transmission network have led to the prices in the two zones differing.

The availability of the capacity on the cable interconnectors with Norway and Sweden is controlled by Nord Pool, while that between Western Denmark and Germany is distributed using annual, monthly, and daily auctions conducted by E.ON Netz. In Eastern Denmark, Elkraft System conducts monthly and daily auctions on the Kontek link with Germany. However, the auction systems do not guarantee the dynamics needed to ensure that cross-border exchanges always go from the cheapest to the most expensive zone. Several times, Eltra has tried to introduce a price linkage between the Western Danish and the German markets, but this idea has been met with huge resistance from the German side. Also in Eastern Denmark, negotiations are being conducted with the power exchanges involved as regards introducing a market linkage on the Kontek link.

In August, Elkraft System opened the door to trading on Elbas in order to provide the players with the opportunity to trade closer to the hour of operation.

During 2004, Eltra and Elkraft issued 430,000 electronic guarantees of origin for renewable electricity totalling 430 GWh.

The obligatory limit for hourly consumption metering was halved on 1 January 2005 to 100,000 kWh per annum. This limit is expected to be cut to 20,000-25,000 kWh in 2008.

During the spring of 2004, the merger between Denmark's largest electricity producer Elsam and its largest network owner NESA was approved. A precondition for the merger was that Elsam would divest itself of its financial interests in district-heating power plants and that the electricity market would be offered a virtual power plant of 600 MW at free disposal.

Finland

The transmission capacity for trade between Finland and Russia was utilized almost to the full throughout the year. During nights and weekends, imports were periodically less, reflecting the market situation.

The excavation work on the fifth nuclear power plant commenced during the summer and final construction licence was granted by the Government.

On 1 October 2004, the companies of the energy industry formed a new association for dealing with trade and industry policy issues and labour-market policy issues, Finnish Energy Industries (ET). ET began its real operations at the beginning of 2005, when the organisations Finnish Energy Industries Federation (Finergy), Finnish Association (Sener), Finnish District Heating Association and Finnish Association of Energy Employers ceased looking after their own interests.

According to a working group, appointed by the Ministry of Trade and Industry, it is not necessary to create a separate monitoring system for physical trading in Finland and monitoring should thus continue to be based on general competition legislation. The working group is of the opinion that the Nordic authorities should collaborate closely in issues concerning the monitoring of trade on the power exchange.

Iceland

The whole of 2004 has been dedicated to preparations for opening up the electricity market, with extensive collaboration between the players of the industry. In August, there was a brief but extensive seminar, among other things, concerning the roles, tariffs, and operational reliability of the Nordic system and grid operators.

Construction work has commenced on the hydropower plant at Karahnjukar in Eastern Iceland, rated at 690 MW. The plant includes a total of approximately 70 km of tunnels and three dams, the highest of which being 193 metres. The power plant will generate electricity for the aluminium works at Reydarfjordur in Eastern Iceland which is currently under construction. The planned capacity of the works will be 322,000 tonnes of aluminium per annum. Commissioning of the power plant and the aluminium works is estimated to start in April 2007.

Norway

The year commenced with low water levels in the reservoirs, which remained so until the autumn of 2004. Consequently, an own Elspot bidding area was formed in Nordvestlandet during the period 15 December 2003 to 30 May 2004. Following abundant precipitation and large inflows during September – December 2004, especially in Southern Norway, reservoirs were topped up and at yearend they were at 71% of their maximum and 14% higher than the previous yearend, and close to the average levels for 1990-2003.

Statnett is responsible for sufficient regulating power being available in order to cope with severe future operational situations. Via the options market for regulating power, RKOM, Statnett procures the necessary volumes of power for the regulating market. During 2004 RKOM developed to a weekly market from November 2004. Between January and March 2004, RK options totalling MNOK 47 were purchased, and MNOK 13 between November and December.

The market for frequency response was utilized during 2004. If there is a need for frequency response, besides the regulation carried out during normal droop of 6%, then Statnett will receive bids from players twice a week. Extra frequency response is purchased to meet the country's needs and any surpluses can be exported to the other Nordic countries (except Iceland). Exporting frequency response during 2004 yielded approximately MNOK 15 in revenues.

Sweden

In 2003, the government set up an enquiry to assess the deregulation of the telecom, electricity, postal, domestic air travel, taxi, and rail travel markets and to shed light upon the far-reaching effects of deregulation on society. The enquiry, which concluded on 17 January 2005 is of the opinion that none of the liberalised markets has attained its final form but that the reforms have nevertheless contributed to increased socio-economic efficiency. However, the need exists for further reforms in order to improve the markets' modus operandi. In particular, the enquiry points to the need for improved consumer support, an augmented state owner-function, and improved supervision of the markets.

An enquiry tasked with analysing the need for improvements to the Swedish electricity and natural gas markets, and making proposals regarding these, concluded in

December 2004. The enquiry is of the opinion that the Nordic market has to be strengthened and that the transmission capacity between the Nordic countries has to be expanded. Sweden should also work towards harmonising the rules governing the transmission of electricity and a Nordic joint consultation group is being proposed in order to boost the level of collaboration between the authorities and in order to counteract differences in the systems of rules. The competition situation on the natural gas market is described as undeveloped. A new system of rules will come into force on 1 July 2005, further opening up the market for natural gas consumers. It is also felt that it is important for the electricity and natural gas markets to be monitored efficiently. Finally, there is a proposal to extend the system of energy certificates beyond 2010.

Parliament decided that monthly reading would apply to all domestic customers effective 2009. This reform is a "two-stage rocket" whereby the limit for hourly metering is reduced to 63 A (light industry, shops and up). The new limit will be introduced on 1 July 2006. The next step is that all exit points not being metered hourly (i.e. normal domestic consumers) are to have monthly readings by 2009 at the latest.

Svenska Kraftnät has issued just over 10 million energy certificates for 2004. Since the system started, approximately 18 million energy certificates have been turned over at an average price of approximately SEK 215/energy certificate. During 2004, biofuel-fired electricity production accounted for approximately 73% of the energy certificates issued, hydropower for approximately 19%, and wind power for just over 8%.

Perfect balance. Photo: Trond Isaksen

The Transmission Grid

Photo: Trond Isaksen

Denmark

The North Jutland Line – the 400 kV link between the Nordjyllandsværket (Aalborg) power plant and Trige (Århus) – has been supplemented with an approximately 120 km-long overhead line and 14 km of cable. The new link has strengthened the Western Danish high-tension network considerably and has thus improved the security of the supply. At the same time, the transmission capacity from north to south through Jutland has increased noticeably, entailing that a long-standing bottleneck north of Århus has largely disappeared.

Wishes have been expressed to double the capacity of the 400 kV link through Southern Jutland and Sønderjylland (between Vejen and Kassø at the Danish-German border) by building another line system along the route. The project application is being processed by the Danish planning authorities for a decision during the spring of 2005.

The substantial technical renewal of the 40-year old Konti-Skan 1 link between Northern Jutland and Western Sweden is going according to plan. Renewal will boost the capacity of the link by 100 MW from the autumn of 2005.

In Eastern Denmark, the Energy Board approved four facility projects on the transmission network last year. This partly involves the 132 kV lines along the motorway to Elsinore (Helsingør) where underground cable will be laid along the section between Glentegård in Gentofte and Stasevang in Northern Zealand in order to secure the supply to Copenhagen.

The Energy Board has also approved a project in the Kalundborg area where rising electricity consumption has caused a new 132 kV switching station to be built and a cable to be laid between the new station and a 50 kV station. Additionally, a transformer station in the Copenhagen area is being rebuilt from 50 kV to 132 kV and the overhead 132 kV line north of Hovegård is being rebuilt to improve the Kyndbyværket power plant's connection with the transmission network.

In the middle of October, the Kontek link went into service again following an extensive technical rebuild of the land cable. The link was disconnected on 3 May 2004 for rebuilding work. Work on the cable has, according to plan, been interrupted on two occassions during the summer in order to safeguard the security of supply in Eastern Denmark. Work has been carried out according to plan and without accidents or problems.

Finland

Fingrid and Svenska Kraftnät conducted a profitability study concerning a new interconnection between Finland and Sweden. According to the study, it will be profitable to build the planned new cable link Fenno-Skan 2. In February 2005, the decision was thus made to build the interconnection.

Analyses concerning the environmental impact (EIAs) of the links Olkiluoto-Huittinen and Ulvila-Kangasala in Western Finland were concluded in 2004. The lines are necessary in order to be able to connect the new nuclear power plant and to improve the transmission capability in the area.

The 400 kV station at Pikkarala in Northern Finland has been rebuilt. The new structure augments the transmission capacity between Finland and Sweden in the north.
The 400 kV station at Pirttikoski in Northern Finland has also been rebuilt and a new 400/110 kV transformer station at Visulahti in South-eastern Finland has gone into service.

An extensive trial of "Power Swing Stabilizers" in large generators was completed in collaboration with Helsinki University and Sintef Energy research institue in Norway. As a result of the trial, the technology has been improved with the purpose of maintaining transmission capacities.

A project with new 400 kV lines, including augmentations of stations, is ongoing in Central Finland between Toivila and Vihtavuori as the ageing 220 kV network in the area needs to be replaced. Other ongoing projects include new 400 kV transformers and the expansion of the 400 kV stations in Salo and Tammisto in Southern Finland. Additionally, the replacement of aluminium pylons with steel ones will continue over the next couple of years.

Iceland

During the year, construction work began on foundations and roads for two new power lines in connection with the building of the new hydropower plant and aluminium work in Eastern Iceland. The lines are rated at 420 kV and are 50 km long. During the year, construction work started on a new 119 km long 420 kV power line to the already-existing aluminium works on Iceland's west coast.

Cable installation. Photo: Trond Isaksen

Norway

On 30 December, an agreement was signed between Statnett and its Dutch counterpart TenneT as regards constructing a cable link between Norway and the Netherlands (NorNed). Trade will be based on implicit auctions and a market coupling between Nord Pool Spot and APX.

The import capacity from Sweden to Southern Norway has been reduced during low-load periods (nights and weekends) due to the west coast constraint in Sweden. This has been a dominant bottleneck throughout 2004. Capacity between Sweden and Northern Norway has also periodically been greatly reduced and has entailed bottlenecks in connection with overhauls in Northern Sweden during the winter of 2004, upgrading of the 420 kV switching station at Rana, and a tension upgrade of the 300 kV (420 kV) Nea-Klæbu link. During upgrading of the Nea-Klæbu link, temporary system protection was put in place in order to give the market the maximum possible capacity.

In Nord-Vestlandet, considerable expansion of the network has taken place in order to increase the security of supply, especially due to new industry establishing in the area. The transformer station at Viklandet, and the 420 kV lines between Aura-Viklandet and Viklandet-Ørskog (upgraded from 300 kV) went into service in June 2004. The 420 kV line Klæbu-Viklandet went into service in December 2004. A further 420 kV line from Viklandet to Fræna will be constructed in order to supply the gas terminal for the Ormen Lange gas field.

Sweden

Following the outage on 23 September 2003 in Southern Sweden, which also hit Zealand, the focus on operational reliability has increased even more. In a report dated 4 November 2003, a raft of measures was listed in order to further strengthen Sweden's electricity system. The following measures have either been or are being implemented and form part of the investment plan which Nordel has drawn up with the aim of strengthening the Nordic transmission network and boosting the trading capability:

- A new 400 kV line from Hallsberg to Scania is investigated. It is planned to be in operation 2010-12 and an investment decision can be taken in May 2005.
- An investment decision is made in February 2005 for a new DC link to Finland in parallel with the existing Fenno-Skan link. The link, which is planned to go into service in November 2010, will be rated at 600-800 MW, as opposed to the present 550 MW.
- Engineering Studies are performed for a new 400 kV line from Järpströmmen in northern Sweden to Nea in Norway. It is planned to be commissioned during 2009. An investment decision was made in February 2005.

An extensive rebuild of the stations on the grid has been embarked upon. The station at Horred outside Varberg has been rebuilt so that faults of the type that occurred on 23 September 2003 will not be able to happen again. A programme is started to renew the larger main grid stations. Additionally, the control and monitoring of the maintenance of the grid will be augmented. All these measures will halve the risk of outages on the grid.

Snowfighting, Tunnsjødal-Marka Norway. Photo: Trond Isaksen

Operational Disturbances

Denmark

On Sunday 10 October at 17 hours, Bornholm was blacked out when the submarine cable from Tomelilla in Sweden to Hasle on Bornholm went down and no production plants were in operation on Bornholm. The submarine cable consists of three single-phase 60 kV PEX cables. The fault was due to an anchor fouling one of the phases. At 21 hours, all consumers had power again, generated by Østkraft's own plants.

Finland

The operational security in the Finnish grid was very good and no major operational disturbances occurred during 2004.

The transmission reliability of the interconnector between Finland and Russia raised to a higher level than in the previous years thanks to improvements in the operational reliability made on the Russian side.

Iceland

On 29 December, a disturbance caused by a short-circuit at one of Landsvirkjun's switching stations in the most South-westerly part of the country caused an outage.

Norway

A major disturbance hit Western Norway on 13 February 2004. There was a broken phase-conductor on a 300 kV line between Nesflaten and Sauda. Due to unusual circumstances, the 300 kV line between Hylen and Sauda was also disconnected. The outages on these two lines meant that the third and final line in to Bergen was also disconnected and there was no supply to the area between Bergen and Haugesund. Thus, approximately 2,400 MW of consumption could not be delivered. This is the biggest outage ever recorded in Norway. Power was restored to the entire area after about an hour. The fault was first repaired temporarily and then permanently in June. In September, an error occurred on the line and, following repairs, the transmission capacity of the line was considerably reduced as there was a risk of weak joints. In November and December, the line was periodically disconnected during the day for repairs. Bad weather delayed work and at yearend, there were still transmission restrictions on the line.

Sweden

Operational reliability has been good during the year and no large operational disturbances occurred.

Control panel. Photo: Trond Isaksen

Important Events During the Year

13 February
Disturbance in Western Norway. Faults on the 300 kV line between Sauda and Nesflaten and a further two lines meant that the Bergen – Haugesund area could not be supplied with electricity. In total, 2,400 MW of load was disconnected, the biggest disturbance ever in Norway.

29 March
Broad political settlement regarding the Danish energy supply and changes in energy legislation. Agreement reached that the state would assume the system responsibility and the grid owned by Eltra and Elkraft.

4 May
Nordel holds a seminar on securing peak-load capacity in collaboration with the Nordic Council of Ministers and because of Nordel's work concerning the power problem in Copenhagen. Nordel published its report "Peak Production Capability and Peak Load in the Nordic Energy Market" on 28 April.

18 May
Statnett obtains extended responsibility for the energy balance during tight situations when there are scarcities of power.

9 June
Nordel holds its annual meeting in Finland and publishes a Nordic investment plan drawn up with the intention of strengthening the Nordic transmission grid and boosting the trading capacity. The plan covers the five most pressing network augmentations for the future, based on a Nordic perspective. Jan Magnusson, General Director of Svenska Kraftnät, was nominated Chairman of Nordel and Christina Simón as Secretary of Nordel for two years.

18 June
Nordel publishes its report on the Nordic Grid Code.

28 June
Nordel publishes its report on Dimensioning criteria and operational security in the Nordic electricity system.

1 July
A number of EU directives – i.e. the EU electricity and natural gas market directive - came into force, impacting upon the electricity market and being of significance to the TSOs.

1 August
Trading in Swedish energy certificates starts on Nord Pool.

6 August
A white paper submitted to the Norwegian parliament regarding increased utilization of natural gas and the introduction of energy certificates in Norway.

17 August
Elkraft System provides the players with the opportunity to trade on Elbas.

30 August
Nordel publishes its report on Rules for congestion management.

2 September
The Nordic energy ministers meet at Akureyri in Iceland. Within the framework of the Akureyri Declaration, the energy ministers seek proposals regarding how intensified Nordic collaboration can be realized. In accordance with the wishes of the Nordic Council of Ministers, Nordel is investigating the possibilities of harmonising the system responsibility and realising measures to promote operational reliability and the functioning of the Nordic electricity market.

10 December
The Icelandic parliament decides to speed up opening up the Icelandic electricity market until 1 January 2006.

14 December
The Danish parliament decides to enact a law governing the formation of a joint TSO for electricity and gas consisting of Elkraft, Eltra and Gastra.

16 December
The Swedish government decides that Barsebäck 2 is to be shut down on 31 May 2005 at the very latest.

27 December
The new EU directive on the single market for electricity becomes incorporated into the new Finnish Electricity Market Act.

30 December
Agreement between Statnett and TenneT to construct the DC interconnector NorNed.

1 January 2005

- Landsnet in Iceland becomes the system-responsible grid company with Thordur Gudmundsson as its Director General.
- The obligation to buy wind power production is removed in Denmark.
- Trading in emission rights commences in the EU.
- Eltra, Elkraft, and Gastra form Energinet.dk in Denmark. Energinet.dk becomes the TSO for both electricity and natural gas.

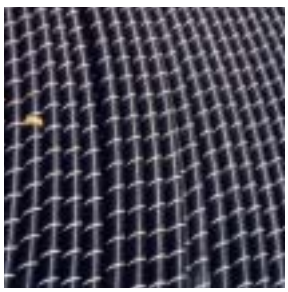


Photo: Henning Pedersen, Trond Isaksen, Mika Kuivalainen, Emil Thor

Activities of the Planning Committee

Hans Henrik Lindboe
Chairman

Objective and organisation

The Planning Committee is responsible for transmission grid development, long-term technical challenges to the power system and information exchange regarding the development of the power system. The Committee works from a Nordic perspective but incorporates international viewpoints. It is composed of planners in leading positions with the TSOs, and the Committee works as a coordinated management team.

The objectives of the Planning Committee are to:

- Obtain coherent and coordinated Nordic planning between the TSOs to form the best possible conditions for a well-functioning and efficient, integrated Nordic power market.
- Initiate and support changes in the Nordic power system to ensure satisfactory security of supply through efficient use of existing and new installations.
- Participate in environmentally friendly development of the Nordic power system. Nature and environment must be considered when transmission installations are planned.

The following measures have been defined in order to reach the above-mentioned objectives:

- The Planning Committee is to elaborate scenarios for the development of the Nordic power system within a time frame of up to 20 years. The Planning Committee may take initiatives based on the scenarios to promote its objectives.
- The Planning Committee is to present yearly forecasts of future energy and power balances. The energy fore casts are to focus on normal years and years with little precipitation. The power forecasts are to focus on normal peak power demand and extreme peak power demand.
- Every other year the Planning Committee is to present a summary Nordic Grid Master Plan, primarily describing projects that affect the transmission capacity between the interconnected areas of the TSOs.
- The Planning Committee heads the preparation and updating of the Nordic Grid Code.
- The Planning Committee is to ensure the collection, updating and use of grid, consumption and production data.

The Planning Committee is organised with two permanent working groups, the Net Group and the Balance Group, and ad hoc groups. The tasks are organised in such a way that the working groups make most of the analyses while the Planning Committee acts as a natural steering committee for the work. The Net Group mainly handles grid issues while the Balance Group mainly handles energy and power-balance issues.

Duties and results in 2004

Prioritised cross sections

In summer 2004 the Planning Committee concluded the work by identifying the spots where the transmission system should be reinforced. The future bottlenecks in the interconnected Nordic transmission system were analysed in the ”Nordic Grid Master Plan” published in 2002. In the light of these findings, Nordel recommended in June 2004 to continue the work with five specific investments at just under € 1 billion, the so-called ”prioritised cross sections”. Together the projects will strengthen the Nordic infrastructure to the benefit of the security of supply and the electricity market. The Planning Committee finds it important that the joint planning is translated into specific actions, and, as far as necessary, the Committee will coordinate the decisions to be taken by the TSOs.

Nordic Grid Code

After the blackout in Southern Sweden and Zealand on 23 September 2003, Nordel prepared a report that concluded that the existing criteria, rules and methods for transmission grid dimensioning and operation provide good operational security with reasonable considerations regarding economy. However the interpretation and implementation should be revised. In autumn 2004 the Planning Committee, in collaboration with the Operations Committee, initiated the task of revising and developing Nordel’s rules and recommendations.

Energy and power balance

Power balance for winter 2004/2005

The Balance Group has provided the calculations for the Nordic power balance for the winter 2004/2005. The report was published on Nordel's website in December 2004.

Energy and power balance for the three-year period up to 2007

The Balance Group calculates the so-called three-year balance. Statistics for 2004 (energy) and winter 2004/2005 (power) are included in the report. Forecasts three years ahead are also shown, i.e. up to 2007 and winter 2007/2008 respectively. The report is published on Nordel's website.

Demand response project

The Balance Group, assisted by an ad hoc group, has initiated a project with the aim of establishing a system to monitor the price sensitivity of electricity consumption. The project is part of the work involved in the follow-up on the Akureyri Declaration from the meeting of the Nordic Council of Ministers.

Nordic Grid Code

In June 2004 Nordel presented the "Nordic Grid Code", which is a compilation of existing agreements and recommendations in Nordel. It is the responsibility of the Planning Committee to ensure the development of the 'Nordic Grid Code'. The work was initiated in autumn 2004 with the Net Group in charge of the completion of the task.

Common Nordic data collection

It is an essential prerequisite to the activities of the Planning Committee to have reliable and consistent data as a basis for analyses. This applies to both grid analyses and balance calculations. The Planning Committee has therefore given the tasks of developing and maintaining the necessary common data and calculation models to the Net Group and the Balance Group.

Transformator on its way to Vester Hassing at Aalborg (Konti-Skan 1)
Photo: Jan Lykkegaard

Activities of the Operations Committee

Håkon Borgen
Chairman

Objective and Organisation

The Operations Committee is responsible for handling short-term technical system-related aspects associated with the daily system operations of the common Nordic power system. These tasks include defining the framework for both technical and market-related issues. The Committee is in charge of operational cooperation between the TSOs. Its key objective is to ensure that the inter-Nordic transmission system is utilised to optimum effect in order to meet the requirements of the energy market, while taking into account technical quality and operational security parameters.

The Committee has three permanent subgroups responsible for executing its work. The Analysis Group is tasked with supporting the Operations Committee in respect of matters relating to technical systems within the framework of system operations, while the Operational Development Group is tasked with promoting development in day-to-day system operations. The functions covered by the Operational Group involve routine matters connected with system operations relating to control room activities. The Operations Committee also has three contact groups.

Duties and results in 2004

The Akureyri Declaration

The Visionary Committee of the Nordic Council of Ministers has drawn up the Akureyri Declaration, based on a number of joint reports prepared by the Nordic TSOs, with a view to further harmonising the rules governing the activities of the TSOs. The objective is to achieve greater integration of the Nordic electricity market. The Operations Committee and the Market Committee were jointly responsible for parts of the subproject entitled "Joint Mechanisms for Peak Load", and the Operations Committee was also responsible for the "System Operation" subproject.

The Operations Committee was responsible for those parts of the "Joint Mechanisms for Peak Load" subproject which involved defining a set of principles for handling peak load situations. The work included mapping and clarifying principles relating to manual active reserves and peak load resources, as well as risk assessments and consequent proposals for new operational methods, and was based on Nordel's past and ongoing work concerning power balance. This work has resulted in proposals relating to the introduction of common Nordic criteria for dimensioning and localisation of operational reserves (model for coordination of manual reserves), the development of a common market for operational reserves, joint regulations on the utilisation of resources during transition arrangements, the development of more trading opportunities for end-users and the harmonisation of price limits for balancing power.

The "System Operation" subproject examines operational methods in extreme situations and experience acquired from major power outages. The Nordic System Operations Agreement, which was established at the end of the 1990s, regulates joint TSO cooperation. The knowledge and capability required to handle extreme situations has continued to increase and the most recent outage resulting in blackout showed that there were no major shortcomings.

Regardless of how good the existing working relations between the TSOs are, it is important to go on developing them in the future in order to ensure high levels of operational security. Important areas of development include the handling of reserves, the coordination of calculation methods for the setting of transmission limits and the improvement of data exchange between control rooms to ensure a better overview of operational security throughout the Nordic area. It has been proposed that future areas of commitment should include better coordinated maintenance planning by the Nordic TSOs and the additional training of control room personnel aimed at equipping them better to handle various situations and power outages. Joint TSO activities have been commenced in respect of the latter two items.

Integration of Eltra in the common Nordic regulating power market

The Operations Committee has been working on the integration of Eltra in the common Nordic regulating power market. A prerequisite for integration was that marginal price determination should be introduced on Jutland in respect of imbalances, and that regulating power bids on Jutland would have to satisfy activation time requirements. These conditions were met during the course of the year.

With the spring of 2004 a trial period commenced for increased utilisation of regulating resources in the two synchronous areas, which has been established in order to gain practical experience. There are a number of problems associated with linking these two different synchronous areas together in a common regulating power market. During autumn 2004 work was undertaken on a number of models in order to meet these challenges. A final solution has not been established, but this work has been allocated high priority by the Operations Committee.

Frequency quality

Frequency quality in the synchronous area has weakened in the past few years. This is connected with an increase in trade with the Continent and between the various subsystems. The Committee is focusing intently on measures, both short- and long-term, designed to turn around and improve this tendency. In the long term work will include joint requirements relating to generation plans, and requirements relating to exchanges between subsystems and to the Continent. In the short term the TSOs' control rooms will focus particularly on operational factors which affect frequency quality and they will be authorised to implement necessary measures in the form of special regulation, etc.

Preliminary study on future development of the Nordic Operation Information System (NOIS)

A pilot study has been developed for a common Nordic Operational Information System for the TSOs' control rooms. This system has been in operation for several years in order to gain experience. In 2004 a preliminary study for a new joint Nordic Information System was developed. The realisation of this project will be an important step towards closer cooperation between the control rooms of the various Nordic TSOs.

Nordel's operating and dimensioning criteria

The power outages which affected Southern Sweden and Eastern Denmark on 23 September 2003 have raised many questions about whether the system is correctly dimensioned and whether operation of the system provides adequate margins when serious outages occur. A group set up under the Planning Committee and the Operations Committee has concluded that the current criteria, rules and methods provide good operational security with reasonable financial considerations. Nevertheless, it would be expedient to apply the rules and criteria more consistently. A review of these rules and criteria is therefore required in order to agree on a common operational security philosophy and terminology relating to Nordel's grid dimensioning rules and operational security criteria. The requirements relating to generation plants will also need to be assessed. This ongoing work was commenced during the autumn of 2004, and will be incorporated in the future "Nordic Grid Code".

Updating the Nordic System Operations Agreement

The Nordic System Operations Agreement has been updated in accordance with Nordic collaboration developments and changes in the power market. Particular emphasis has been placed on rules for handling major power outages which can result in power interruptions in one or more subsystems.

Power balance

The Operations Committee prepares an annual forecast relating to Nordel's power balance. The power balance during the winter of 2004-2005 was at the same level as the previous year. A better water situation and better opportunities for imports from areas outside Nordel had a favourable effect on the power balance.

Increased utilisation of constrained power transmission corridors

The possibility has been considered of removing more of the load constraints on transmission corridors which have been constrained in the last few years, using various short-term measures, e.g. system protection. A number of measures have been implemented. Analysis has shown that more reactive components in the network are needed to further increase transmission capacity in important corridors.

Review of load shedding

The status of and development requirements for frequency-controlled load shedding in the Nordic region have been analysed. It has been concluded that the total requirement for frequency-controlled load shedding should be based on the acceptable risk for complete network breakdowns and the criteria applicable to network splitting. It is up to each TSO to assess the overall requirements of its own subsystem. At Nordic level it is important to coordinate recommendations relating to protection and the optimal distribution of frequency-controlled load shedding in order to avoid an increased risk of complete system breakdown in the event of major power outages.

This work has continued with an assessment of the need for voltage-controlled load shedding. There are a number of problems associated with voltage-controlled load shedding, which can result in a greater risk of non-selective disconnection of consumption. The consequences can therefore be greater with voltage-controlled load shedding than without. In order to further develop knowledge in this field, analyses are currently being carried out on the voltage collapses which occurred in Southern Sweden/Zealand on 23 September 2003, where this type of protection is being implemented in the calculation model.

New, larger power generation units

A new 1,600 MW nuclear power plant (Olkiluoto 3) is being constructed in Finland, which will be the largest power generation unit in the Nordic region. Assessments have been carried out of the Nordic requirements relating to automatic frequency-controlled reserves, geographical location, technical properties, effects of transmission capacity and self-regulating capacity, as well as the effect of voltage-controlled reserves on transmission capacity. It has been concluded that no further measures will be required since system protection will be connected to Olkiluoto 3. The requirements relating to manual reserves will be evaluated in 2005 in connection with the work being undertaken to develop a common Nordic power balance model.

Preliminary study of causes behind the increased number of emergency power interventions

During the course of 2004, there were many power outages in the synchronous area, which gave rise to emergency power intervention on DC links, particularly on Konti-Skan. The production outages which gave rise to the emergency power intervention were relatively modest. The reserves in the system are thus being queried. In order to undertake analyses, it has been necessary to install some new monitoring equipment in the network. This work will be concluded in the spring of 2005, after which the analyses can be implemented.

Other activities – international cooperation

The Operations Committee has an annual meeting with a similar UCTE (Union for the Coordination of Electricity Transmission) organisation, the Working Group "Operations and Security". This meeting took place in Hamburg in December 2004. Discussion topics at the meeting included the interconnection of the two UCTE areas, the challenges linked to increasing quantities of wind power, experience gained from the major power outages which occurred on the Continent, the operation of links between the UCTE and Nordel systems, and the development of short-term trading on UCTE and Nordel links.

The new Swedish "Combined breaker" contains both disconnector and breaker. Photo: Pentti Lehto

Activities of the Market Committee

Juha Kekkonen
Chairman

Objective and organisation

The objectives of the Market Committee are to:

- Contribute towards creating a borderless Nordic market for the players in order to thereby strengthen the efficiency and functionality of the market.
- Contribute to the European rules of play being formulated in such a way as to promote a positive market trend and efficient interplay with the Nordic market.

The Market Committee has organised its work via three permanent work teams, as well as ad hoc teams as and when needed.

Duties and results in 2004

Work has largely focused on further harmonisation and development of the rules of play on the Nordic electricity market in order to promote its functioning. Among other things, this work includes strengthening the market mechanisms, clarifying the roles of the market players, TSOs and authorities, and developing joint rules for managing network restrictions. A large part of the activities of the Market Committee during the autumn has been characterized by the work arising from the Nordic energy ministers' Akureyri Declaration. The task has included, among other things, a review of the system responsibility from the market perspective and the organisation and financing of Nordic network investments.

The power supply in tight situations

A precondition for a smoothly-functioning electricity market is the ability to maintain the balance between supply and demand. Nordel has dealt with this theme in its report "Peak Production Capability and Peak Load in the Nordic Electricity market", presenting its vision for the Nordic market.

According to Nordel's vision, the market players are expected to invest in resources in order to be able to meet their commercial obligations and maintain the security of supply in the long-term. The Nordic market offers a good starting point for commercially-sound decision-making; an effective and competitive market with marketplaces which price the electricity credibly. Nordel's vision is based on this, i.e. that the authorities do not intervene in the market, even if prices are high.

There is no single means of realizing the goals of the Nordic vision in a commercially-sound way. Therefore, the Market Committee has proposed various measures for augmenting the market mechanisms by:

- Promoting flexibility in electricity consumption when there are high prices, thus contributing to the reduction of demand.
- Launching a financial hedging product which can improve the players' possibilities of managing risks during tight power situations, thus creating better financial opportunities for investment in corresponding physical resources.

For the long-term evolution of the Nordic electricity market, it is important that the different countries largely have the same responsibilities and incentives regarding investments in new electricity production. This entails the system of rules defining a clear distribution of roles between the market players and system operators in order that financial incentives may be effective driving forces of investment.

According to Nordel's vision regarding power supply, the system operators' role as regards the power balance will be restricted to the instantaneous balance and operating reserves needed for this task.

Nordel arranged a power seminar in Copenhagen in May and requested the market players' comments on the report. The conclusions of both the seminar and the circulation for comment show that the recommended measures are considered sufficient at this stage. It is a widely-held opinion that the central procurement of peak-load capacity can be avoided by strengthening the market mechanisms.

In accordance with the recommendation of the report, each and every one of the TSOs has drawn up a plan of action for promoting flexibility in consumption. Nordel values the need for joint initiatives on the Nordic level. Nord Pool ASA has planned the introduction of a new financial product in Western Denmark during the first quarter of 2005.

Joint rules for congestion management

Trading in electricity via the interconnectors varies with the status of the market. In each power system, temporary bottlenecks arise when the technical transmission capacities of the lines are lower than the players' requirements for transmitting power. Bottlenecks are dealt with either by division into price areas or by using counter-trade (altered utilization of resources). Counter-trade is used during the operation phase. By means of this, the system operators can guarantee a certain trading capacity for one calendar day after the close of trading the day before.

The Market Committee has concluded an enquiry into the possibilities of harmonising the congestion management in the Nordic market, efficiently utilizing the transmission capacity, securing the optimum availability of transmission capacity and increasing counter trade.

Clearer and more transparent principles will be defined in order to determine the trading capacity of both the cross-border interconnectors and internal bottlenecks within a control area.

Increased counter-trade during the planning phase contributes to a more stable availability of the trading capacity and a reduction of the market players' risks regarding division of the market. The Market Committee recommends a limited increase in counter-trade during temporary congestions. The majority of the market players supported this proposal in their responses to the circulation for comments regarding the report. Increased costs for counter-trade are to be paid by those receiving the benefit.

Elspot is recommended as a marketplace for counter-trade provided that any negative impact on the market can be avoided. Nordel will jointly investigate these issues with Nord Pool Spot.

Further development of the collaboration to coordinate planned outages was seen as a possible way to reduce the impact upon the trading capacity.

At the beginning of January 2005, Nordel arranged a seminar on issues concerning congestion management.

Trading in energy certificates for renewable energy

A market for trading in energy certificates has been established within the framework of the international collaboration conducted via the organisation the AIB (Association of Issuing Bodies). The aim is to promote the production of renewable energy. In order to meet market requirements, the joint Nordic IT support for issuing and recording certificates has been further developed in order to be compatible with other countries' systems. The system has also been developed to include EU requirements regarding guarantees of origin.

The Market Committee deems energy certificates to be the likely long-term solution as regards promoting the production of renewable energy and meeting the requirements of the directive. During recent years, the trade in energy certificates has increased markedly.

The collaboration in Nordel has been an important forum for creating a common approach within the AIB.

Integration of the European electricity market

The Market Committee plays a coordinating role in Nordic efforts vis-à-vis ETSO and the European Commission in issues relating to the long-term evolution of systems of rules and market conditions. During the year, the Committee followed developments within ETSO by means of Nordic representation on the ETSO steering and work groups.

Development of the European transit solution continues, with the aim of improving the model. Discussions principally concern the components of the model and the definition of costs.

The Market Committee supports efforts to establish a market linkage on the interconnectors between the Nordic area and the Continent.

On the way to a borderless electricity market

At their meeting in Akureyri in September 2004, the Nordic Council of Ministers assessed the current situation for the Nordic electricity market and came to the conclusion that the market has been working well, but that there is still a need for further development on the

way to a borderless electricity market. The energy ministers asked the Nordic system operators to investigate how increased coordination of the system responsibility as well as the joint organisation and financing of network investments and power management could be realized in concrete terms within the Nordic area.

The Market Committee, supplemented by the Chairmen of the Operational and Planning Committees, were tasked with investigating the issues that the energy ministers had highlighted. Nordel conducted an investigation of the differences and similarities of the system responsibilities of the various countries. The investigation also assessed the reasons behind the differences and their significance for the market. The Market Committee has analysed various financing and organisation models for Nordic investments.

Nordel submitted its report to the Nordic Council of Ministers in February 2005. This report was partly based on previous investigations by Nordel and partly on the investigations carried out for this task.

The power lines of Landsvirkjun reflect in the river of Burfell, Iceland. Photo: Emil Thor

Developing Demand Response on the Nordic Electricity Market

- The activation of Demand Response is a technology competing with investments in peak-load generation resources and operating reserves.
- Demand Response secures market clearing and reduces the financial risk for the market players, created by the tighter power balance, by reducing price spikes in the market.
- The price signal must reach the consumer before Demand Response is realized.
- More market price connected contracts and more widespread hourly metering will enable the price signal to reach more end-users.
- The activation of Demand Response is primarily a task for the authorities, TSOs and commercial market players.

Introduction

The TSOs have as one of their goals to facilitate an efficient functioning of the electricity market. In April 2004, Nordel presented its vision for handling of peak production capability and peak load in the Nordic electricity market. The market players are expected to secure the level of adequacy so that supply will meet demand and new generating capacity will be built by the market players when needed. The market players are responsible for ensuring that their planned generation and procurement meet their commercial delivery commitments, even in peak-load situations. The balance responsibility of the TSOs should be limited to the operational security and the operating reserves needed for this task.

The main prerequisite for a functional Nordic market is that the marketplace provides credible electricity prices, and thus a steady basis for the decision-making of the market players.

This article explains why Demand Response (DR) is necessary for the efficient functioning of the Nordic market, especially as the power balance has been tightening up during recent years. The article outlines what has been done and what will be needed in order to develop DR in the Nordic market and describes the challenges ahead.

What is DR and what are its benefits?

DR is defined as a short-term change in electricity consumption as a reaction to a market price signal.

This change may be in order to:

- Reduce consumption during periods when price exceeds consumer benefit from using electricity.
- Move consumption to periods with lower prices.
- Increase consumption during periods when consumer benefit from using electricity exceeds price.

This feature article will focus on the first two types of DR, i.e. elasticity of demand relating to high prices, as this will be a joint Nordic challenge during coming years.

The tighter power balance

The Nordic electricity market has experienced a tightening up of its power balance, with more price spikes as a result of increased demand and fewer investments in new generating capacity. This tighter power balance increases the risk of market clearing failure in extreme situations. In the short-term, increased DR will decrease this risk and reduce price spikes. While reflecting consumer willingness to pay for electricity, increased DR will also result in more reliable pricing.

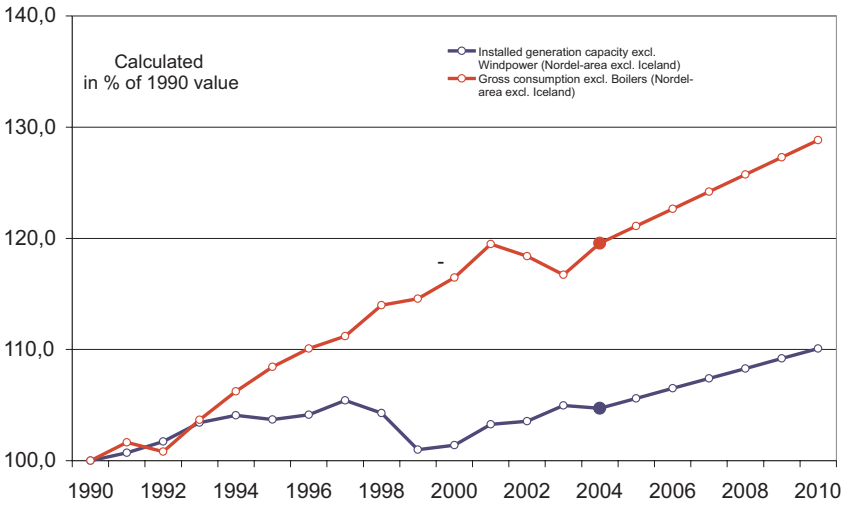


Figure 1: The tightening of the Nordic power balance

Increased DR is an alternative to investment in peak-load generating capacity. However, it is often more suitable for shorter activation than peak generation. In the long-term, the differences between the various peaking technologies will receive more attention, and the market will utilize the different technologies, DR included, corresponding to their individual strengths and weaknesses.

In the Nordic market, the activation of DR is the only way for the system to generate a scarcity rent for peak-load generators, without compromising the security of the supply. Thus, increased DR in the long-term is a necessity for investment in peak-load generation.

In addition, DR has other attractive benefits:

- If many consumers offer DR it is possible to maintain the balance between supply and demand during extreme scarcity situations where forced load shedding might be necessary if no DR is available. Disconnection of end users through DR will allocate the necessary compensation to the disconnected end users.
- It decreases incentives to abuse market power as it erodes the profit of producers contemplating exploiting dominant positions. This is done because they know that setting a high price will activate DR, thus reducing the demand and the total profit.
- It promotes competition in the marketplace for operating reserves.

The TSOs act as a catalyst in enhancing DR. The active contribution of the authorities and market players is also needed. The TSOs' contribution may be grouped into two different categories:

- Measures that lie within their responsibility to ensure the operational reliability of the power system and to maintain the instantaneous balance between supply and demand in each control area.
- Measures taken within the TSOs' area of responsibility to ensure the effective functioning of the electricity market.

The value of DR in relation to the operational reliability of the power system

The security of the supply has several dimensions. The TSOs are responsible for the operational reliability of the power system. To resolve this task and, in particular, to maintain the national instantaneous balance, the TSOs need to have access to operating reserves and other ancillary services, including frequency control and reactive power.

Payment for these services quantifies the price of operational reliability within the TSOs' system responsibility. Any other payment rendered by the TSOs for DR in the context of operational reliability could disturb the market formation and result in wrong decisions by the market players.

The potential of DR

The practical potential of DR depends on factors such as the time available before response, the duration and frequency of the response, and the trade cycle of industrial companies. In general, the potential in the Nordic area is expected to be substantial, and, as DR already exists in the system, it would be possible to activate it on a relatively short-term basis.

Currently, energy-intensive industry has the best prerequisites for actively participating in the markets there are sub-processes whereby the demand can be reduced or the load totally shut down. In addition, these companies are used to evaluate all measures in monetary terms and have interval metering. Also, they are often direct players on the Nord Pool Elspot market. Energy-intensive industry can respond in large units, which is why this type of industry has had an immediate potential for the TSOs in their purchasing of operating reserves.

Electric heating, ventilation, and lighting constitute a substantial potential, although the smaller units may require higher investments before the potential can be realised. Back-up generation is also an interesting potential. It is not directly DR, but it is often considered in the context of DR as it is a resource located by end-users. For space and water heating, there are possibilities of reducing consumption or moving it to other hours with lower prices, or changing over from electricity to other fuels when electricity prices exceed a certain level. Short-term response from these resources requires a high level of automation.

Market Framework

Price is the driving force behind activating DR

Economic benefit is the driving force behind activating DR in the marketplace. The technical potential will only be activated in the marketplace if it is economically efficient for end-users to react.

Predictable revenues are necessary to cover the initial investments that may be needed to enhance preparedness. One prerequisite for activation is that the price signals reach the end-users. Before consumers become interested in preparing for DR, the anticipated net benefits of DR must be positive. When this cost-benefit balance is in favour of DR, it is good economic sense to react. Money talks!

Economic benefit can be realised on the electricity markets (Elspot, Elbas and/or the regulating power market). In addition, revenues can be generated by payments for acquiring operating reserves and different bilateral sales contracts between electricity suppliers and end-users.

It is obvious that increased DR will generally reduce price spikes by means of reduced demand. Consumer reactions will directly affect market equilibrium. In tight situations, where the supply curve of the electricity markets is almost vertical, even small amounts of DR can have a major impact on the market clearing price, see Figure 2 below. It is thus important that DR could be managed and offered to the markets by the consumers themselves, or by commercial market players on their behalf. The TSO must not act like a market player, disturbing pricing.

Today, there are different types of contracts whereby certain parts of the demand reduction resources are paid for by options to be available during operation in the regulating power market. Mechanisms like these secure the provision of DR to the regulating power market, in order to handle deviations and disruptions during the operating phase. At the same time, it is a priority to activate DR in Elspot, thereby ensuring that the daily Elspot market balances. The part of DR which is activated (reduced) through Elspot is excluded from the regulating power market or Elbas, as this DR is already being used through Elspot. The different market potentials for DR are described in detail below.

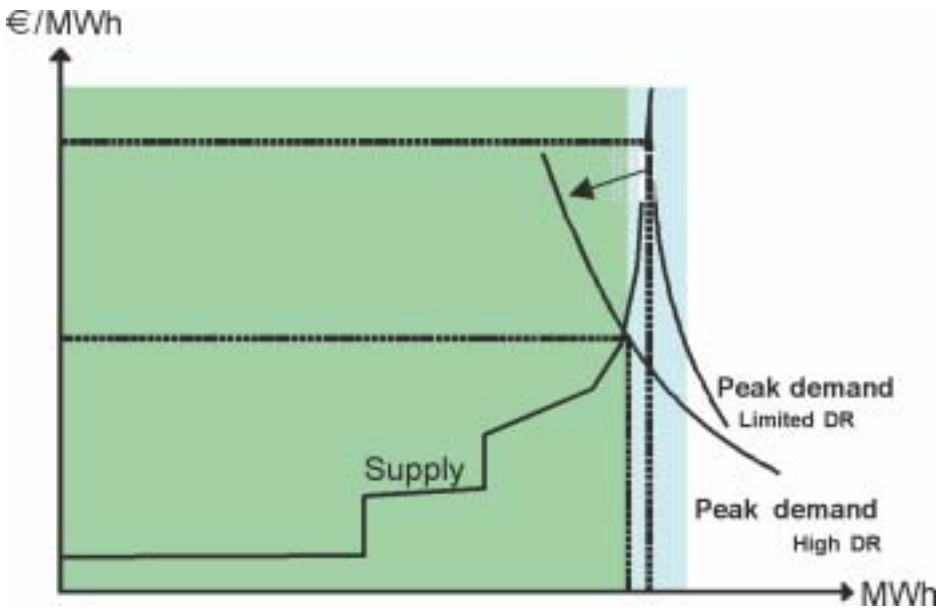


Figure 2: The effect of DR on Elspot prices

The different electricity markets

One day ahead, the hourly balance between purchase and sale is determined on the Elspot market. Most of the offers in this market are made as single offers including generation and consumption. A consequence of this is that it is difficult to provide exact proof of the correlation between the prices in Elspot and DR.

In between the transactions in the day-ahead market and the operating hour, meteorological and other conditions may change, leading to real-time imbalances. In Finland, Sweden, and Eastern Denmark, market players may use the separate intra-day market, Elbas, to reduce expected imbalances. So far, Elbas has primarily been used by producers, but consumers may also take part.

The regulating power market is the tool by which the TSOs manually maintain the system balance between supply and demand in real-time operation, both in normal and disrupted situations. The Nordel area is balanced as a whole, with transmission constraints taken into consideration. All Nordic regulating power bids are collected in one common merit order list. The cheapest Nordic resources available are applied to balancing. Consumers are now also involved in this market by offering changes in their consumption. There is a potential for increased DR involvement in this market.

The financial market is used to hedge price risks. Currently available standard trading products cover a time period of up to three years ahead. Financial trading products can create a link between economic risk management and physical resources, including DR resources. Thus, the financial market can also be an incentive for utilising DR resources, by creating predictable revenues. Nordel has proposed the introduction of a new financial trading product for hedging price spikes. The various markets and their timescales are shown in Fig. 3. In addition to these marketplaces, electricity is also traded bilaterally between market players.

TSO initiatives to utilise DR

The responsibilities of the TSOs include having sufficient operating reserves at their disposal to be able to balance the system in real time. At present, the TSOs use different strategies to perform this task, using DR to varying degrees.

Svenska Kraftnät has secured part of the requirement for fast operating reserves by means of a service agreement with an industrial corporation to provide a demand reduction of 90 MW. As a supplement to the operating reserves, Svenska Kraftnät has contracted peak-load resources on the basis of temporary legislation which will expire in 2008. These contracts are signed for the winter period and run for between one and five years. These peak-load resources consist of both generating capacity and demand reduction services, mainly from industrial companies. For the winter of 2004/2005 a total volume of about 140 MW, including backup generation (26 MW), has been contracted via DR. The bids remaining in the tendering procedure amounted to a larger capacity than agreed upon. This is a clear signal that additional DR resources are available. The generation reserves are normally restricted to being used in the regulating power market. The DR resources may be bid into the day-ahead spot market in order to stabilise pricing during scarce balance situations.

At the moment, Fingrid has contracted demand resources amounting to 790 MW as fast disturbance reserves. Next year, the contracted amount will be increased by 70 MW. At the moment only the half of the contracted amount is in operational use and can be activated within 15 minutes. The other half can be operational if needed with a few hours or days notice depending on the situation. The demand resources are primarily contracted for use in case of disturbances and are only to a limited extent available for the regulating power market in power shortage situations. Fingrid has made long-term bilateral contracts to ensure access to these resources in the long term. Also here, the tender resulted in larger capacity than required.

Financial market	Elspot	Elbas	Regulating Power Market
3 years - 13 h	36 - 12 h 0,1 MW	33 - 1 h 0,1 MW	The operating hour 10 / 25 MW

Figure 3: The various markets, timescales, and minimum bids and offers

Statnett has established a market for fast (15 minutes) operating reserves, called Reserves Option Market (RKOM). So far, the maximum purchase from the demand-side has been 1,360 MW (mainly from power-intensive industry). Statnett developed this option market to secure sufficiently fast operating reserves during high-demand periods. In its initial version, this market was launched in 2000.

RKOM is a catalyst for securing the availability of sufficient regulating power in the regulating power market. Statnett is purchasing the right (options) to dispose of regulating resources in both generation and demand. Both kinds of resources are to compete on equal terms. During the early phase, contracts had a duration of 1-12 months. From the autumn of 2004, contracts have been made weekly. Fig. 4 shows the total volumes traded.

RKOM has resulted in a substantial volume of demand to compete with generation. So far, mainly large industries have taken part, and there is a potential for further demand to take part. Statnett is initiating pilot projects in order to arrange packages of smaller consumers.

The Danish TSOs have two pilot-projects concerning back-up generation as operating reserves, each amounting to 25 MW. In addition, 3 MW of consumption has so far been acquired as an operating reserve in Denmark. In Denmark, operating reserves are acquired by means of tenders where DR is encouraged to take part.

Eltra and Elkraft are working on a new set of rules for simplified settlement procedures for regulating power supply from the demand side. This will also allow non-balance responsible parties to be aggregators of demand-side bids for operating reserves. This is expected to boost DR involvement in tenders for operating reserves in Denmark. In addition, bilateral contacts are being made with the largest electricity consumers, trying to activate their DR involvement in tenders.

In the future, the members of Nordel will develop the exchange of operating reserves, including DR reserves, between the areas of the Nordic region. Some cross-border trading has already occurred. For example, Eltra has purchased reserves physically located outside the Western Danish area as part of its tendering programme for operating reserves. For January-March 2004, Eltra entered into an agreement with Statnett regarding 150 MW of reserves to be provided via RKOM.

Experience from situations of scarcity

In the Nordic hydropower dominated system, it is important to distinguish between scarcity of energy and scarcity of capacity. In general, scarcity of energy creates high prices over a long period, while scarcity of capacity creates temporarily extreme price spikes.

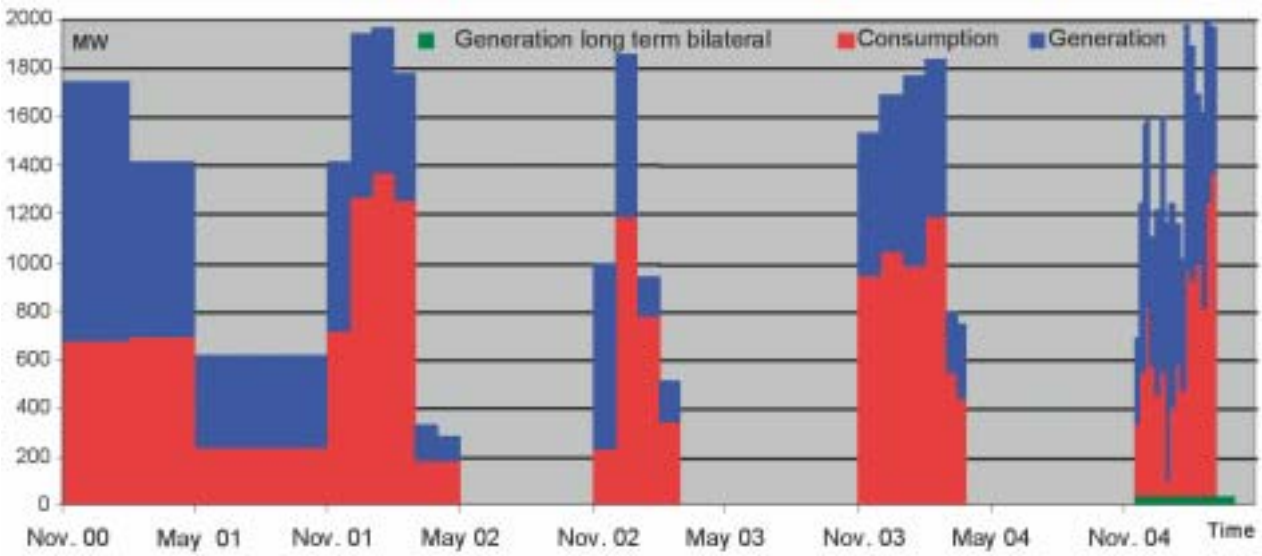


Figure 4: Volumes of reserves purchased in RKOM

The Nordic market had a taste of a scarcity of energy during the winter of 2002/2003. In general, the market was functioning smoothly, even though price elasticity was found to be relatively low.

On 5 February 2001, when the Elspot system price exceeded € 100/MWh for 8 hours, there was one of the worst cases of a scarcity of capacity so far. There was only limited DR to these extreme prices.

Prerequisites or obstacles when activating demand response

One prerequisite for increased end-user DR seems to be more frequent metering and settlement. The point is to inform consumers about the price level and, through supplying contracts, provide them with significant incentives to respond to high prices. During the winter of 2002/2003, Norwegian electricity consumption was reduced when prices were high [1]. This was partly due to a low proportion of fixed-price contracts on the end-user level.

The main precondition for DR is that the market price signal reaches the end-users. This is not often the case today. Apart from Norway, most end users in the Nordic countries have fixed-price contracts with few or no quantity restrictions. This is the main reason for almost no price-related DR by end users in the Nordel area so far. It is important to change this situation so that all consumers may benefit from a response to the Elspot price, or other market prices. This not only includes the major industries that have on-line price information and incentives to respond today, but also residential electricity consumers.

Two-way communication and centrally-organized arrangements, including hourly metering at end-users, will change this situation. So far, the cost of this advanced level of communication has been too high, but the cost is rapidly falling at the moment. In the near future, new technology combined with large-scale installations will surely make these investments profitable. This effort directed at residential consumers will surely enable them to take part in DR. The current initiative in Sweden regarding remote meters may allow a time resolution that can reward DR to the market prices, but fixed-price contracts will also have to be changed before consumers obtain the incentives to respond to high prices.

Finally, the consumers must be aware of the potential gains from DR. Several measures have been taken by the TSOs to enhance this awareness, primarily through information and pilot projects. As part of their market development responsibility, the TSOs can also contribute to the identification of business models and a contractual framework, bringing increased DR. However, this is a task not only for the TSOs, but also for the market players and the authorities.

DR can reduce risks for the market players

In the current situation, with only limited DR – even at extreme prices – there is a risk that the Elspot market fails to clear. The tightening up of power balances during recent years has made this more likely to happen.

For the market players, there should be significant opportunities of using the demand side to reduce financial risks. If the markets do not clear, then some market players, especially those without generating capacity, will become financially insolvent.

Recently, some of the TSOs have modified their requirements concerning financial collateral for balance providers in order to better take advantage of even the more extreme price levels on the market. More changes in this area may be expected in the future. DR could be a cost-effective alternative to financial collateral.

Specific future market development initiatives to promote DR

In the Nord Pool Elspot market, there are a number of products that can be used to make price-dependent demand offers: i.e. ordinary hourly bids, block bids, and flexible hourly bids. The flexible hourly bid can be used to reduce the demand during the most expensive hour of the day. To facilitate demand bids, new products can be developed in the future, e.g. a flexible bid covering more then one hour or bids to reduce demand during expensive hours by moving it to less expensive hours.

It may be useful to adjust the products on the markets for operating reserves and other ancillary services in order to facilitate better demand-side involvement, e.g. by means of short reservation periods on weeks, days or parts of days, or by reducing the size of minimum offers, which are currently 10 MW (25 in Norway). Small and medium-sized consumers should be grouped

together by commercial market players, and offered into the regulating power market, so that TSOs do not have to perform many small steps during the operation. This is, of course, especially important in the case of major disturbances. Longer bilateral contracts can also be used to guarantee that predictable revenues pay back the transaction costs of DR in these markets.

Cost-effective development of DR

The Nordic countries have strong electrical interconnections enabling effective cross-border trade. This offers the opportunity for the cost-effective development of DR within the Nordic area. DR in one region will have an impact on the prices in other regions within Nordel.

A model [2] that takes into account, among other things, the capacity of the interconnections has been used to simulate the impact of DR on the Elspot price. Demand is set at the present reference volume + an extra load of 10 % in all countries. The results are shown below for Elspot price DK1 (Denmark West) during weeks 2-6 of 2005, using different assumptions about country-specific elasticity. First, elasticity is set at almost zero in all areas. Second, it is increased symmetrically in all countries, and finally, DR elasticity is chosen from a Nordel survey where Norway is the only country to have a significant degree of elasticity. The results are shown below.

The results are interesting since price spikes are eliminated in DK1 to the same extent, no matter whether the elasticities are increased symmetrically or just in Norway. The findings are consistent with the other regions. In other words, DR in just one price region stabilizes the prices in all the other regions of the Nordel area.

Thus, the general result is that all the Nordel countries are able to benefit from DR resources, no matter where DR is activated. Of course, there may be special cases where congestion and temporary constraints on the interconnections can limit the effect in other regions caused by DR in Norway. Because of the general result, it is essential that the development of DR focus on identifying the load resources with the lowest transaction cost, no matter where it is located within the Nordel area. This means that the activation of DR is a task which will best be addressed by the Nordel countries jointly.

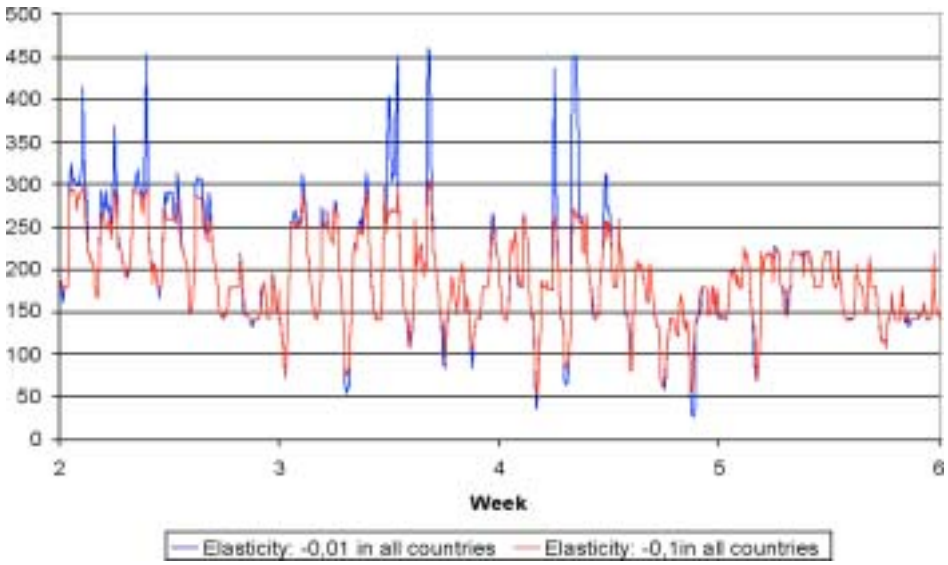


Figure 5: Simulated prices in DK West during weeks 2-6 – symmetric DR. 1 DK=0,13 Euro (April 2005)

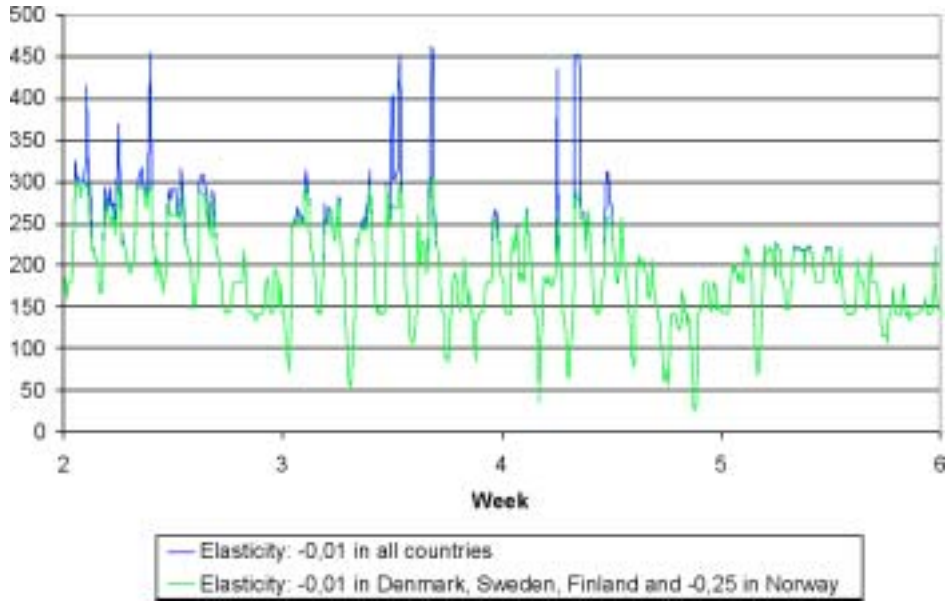


Figure 6: Simulated prices in DK West during weeks 2-6 – asymmetric DR. 1 DK=0,13 Euro (April 2005)

Summary and Conclusions

The Nordic power balance has been tightening up in recent years. This has increased the focus on the potentials of DR resources which can react to price signals in the electricity markets. DR is an alternative to peak-load generating capacity, though best suited to short activation periods.

Economic benefit is the driving force behind activating DR in the marketplace. DR can be profitable for end-users as well as commercial market players, who can use it to hedge the risk associated with extreme price spikes. It is a prerequisite of activation that the price signals reach the end-users. Most end-users in the Nordic countries have fixed-price contracts which remove the incentives for consumers to react to the hourly price signal. Hourly metering or bilateral contracts, including DR arrangements, are necessary in order for profits from DR to accrue to end-users.

Situations of scarcity have shown that there is only limited DR even to extreme prices in the Elspot market. To secure the functioning of the market, as the power balance tightens up, it is vital to make more DR available. Through different arrangements, the TSOs have acquired a substantial amount of DR to be used as operational reserves as a competitive alternative to generation resources.

DR can make a substantial contribution to the management of peak-load situations in the common Nordic market. Much has been done, but there is further potential. The Nordel countries, in collaboration, can contribute to activating the market players and end-users for increased DR.

[1] Also Note: ECON Notat 7/03 "Tørrår i Norden - Sank forbruket i Norge?" and Nordel (2003): Statistical analysis of price response of the aggregated electricity demand
[2]The Mars Model (Eltra) - Reference: www.eltra.dk/Elmarkedet/Markedsmodel: MARS (pdf-file)

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Nordel Recommendations

Availability Concepts for Thermal Power
September 1977
Nordic version

Localisation of System Oscillations Equipment
August 1992
Nordic version

Network Dimensioning Criteria
October 1992
Nordic version
English version

Common Disturbance Reserve
February 1992
Nordic version

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

Summary of recommendation
May 1997
Nordic version
Swedish version

Operational Performance Specifications for Thermal Power Units larger than 100 MW
August 1995
English version

Operational Performance Specifications for Small Thermal Power Units
August 1995
English version

Standardised Communication Procedure
August 1995
Nordic version

Trade with Reserves within the Nordic Countries
August 1998
Nordic version

Recommendation on definitions of energy, reliability, power reliability and reliability of delivery
June 2000
Nordic version

System Operation Agreement

The agreement and its appendices regulate the operational collaboration between the TSOs of the Nordic area. Several of the stipulations in the agreement are based upon recommendations issued by Nordel.

The agreement contains the following:
• Definitions
• Operational security standards
• Balance regulation standards
• Exchange Information
• System protection
• System services
• Joint operation between the Norwegian and Swedish subsystems
• Joint operation between the Finnish and Swedish subsystems
• Joint operation between the Norwegian, Finnish and Swedish subsystems in Arctic Scandinavia
• Joint operation between the Norwegian and Western Danish subsystems
• Joint operation between the Western Danish and Swedish subsystems
• Joint operation between the Eastern Danish and Swedish subsystems
• Joint triangular operation between the Norwegian, Swedish and Western Danish subsystems
• Managing transmission limitations between subsystems
• Rules for managing power shortages during high consumption, bottlenecks or disturbances
• Joint operation between the interconnected Nordic power system and other systems

April 2004
Nordic version
English version

Nordic Grid Code

The Nordic Grid Code contains rules governing the system operators' operation and planning of the electricity supply system as well as the market players' access to the network. The Grid Code describes the joint, fundamental requirements and procedures governing the operation and development of the electricity supply system.
The Grid Code consists of:
- General stipulations for collaboration
- The Planning Code
- The Operational Code
- The Connection Code
- Data agreement between the Nordic system operators

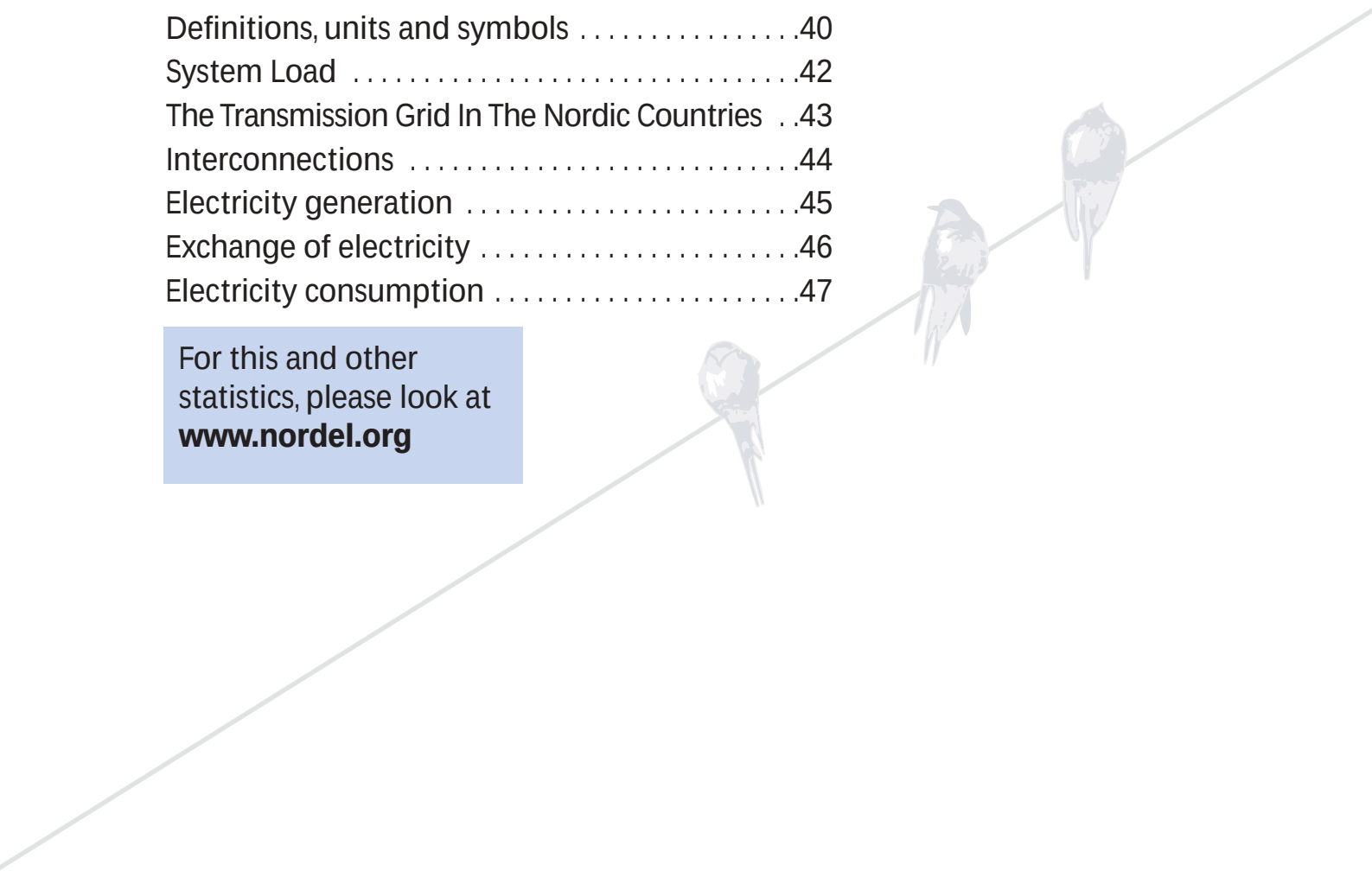
The Operational Code and the exchange of data constitute binding agreements with their own solutions in the event of disputes. The Planning and Connection Codes should be complied with and correspond to Nordel's recommendations in these areas.

June 2004
Nordic version
English version

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

Statistics

For this and other statistics, please look at **www.nordel.org**



Definitions, units and symbols

Units and symbols

kW	kilowatt
MW	megawatt = 1,000 kW
GW	gigawatt = 1,000 MW
J	joule
kJ	kilojoule
PJ	petajoule = 10^{15} J
kWh	kilowatt-hour = 3,600 kJ
MWh	megawatt-hour = 1,000 kWh
GWh	gigawatt-hour = 1,000 MWh
TWh	terawatt-hour = 1,000 GWh
~	Alternating current (AC)
=	Direct current (DC)
–	Data are nonexistent
..	Data are too uncertain
0	Less than 0.5 of the unit given

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

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 highvoltage 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 backpressure generation.

Other renewable power

Wind power, biofuel, waste and geothermal power.

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Responsible for processing of the statistics

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System load

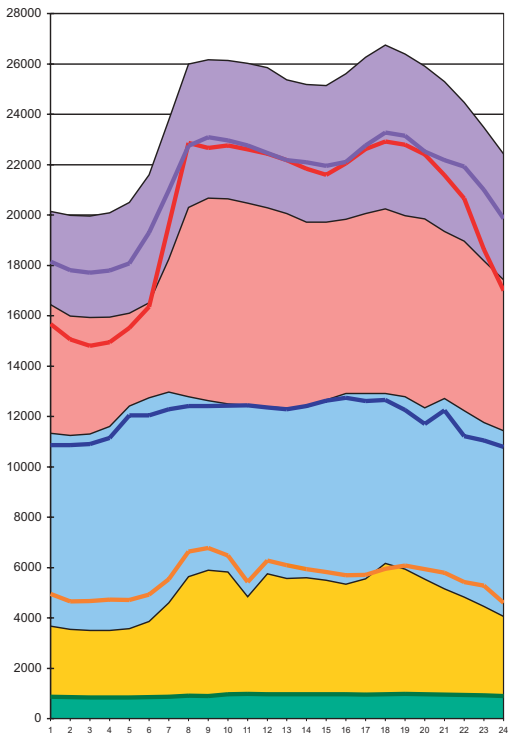
S5 Maximum system load for each country in 2004 [1)]

	MWh/h	Date/time
Denmark - West	3,618	01.27.04 09.00 - 10.00 am
Denmark - East	2,628	01.06.04 05.00 - 06.00 pm
Finland	13,570	02.11.04 06.00 - 07.00 pm
Iceland	1,033	12.17.04 10.00 - 11.00 am
Norway	20,675	01.21.04 09.00 - 10.00 am
Sweden	27,300	01.22.04 08.00 - 09.00 am

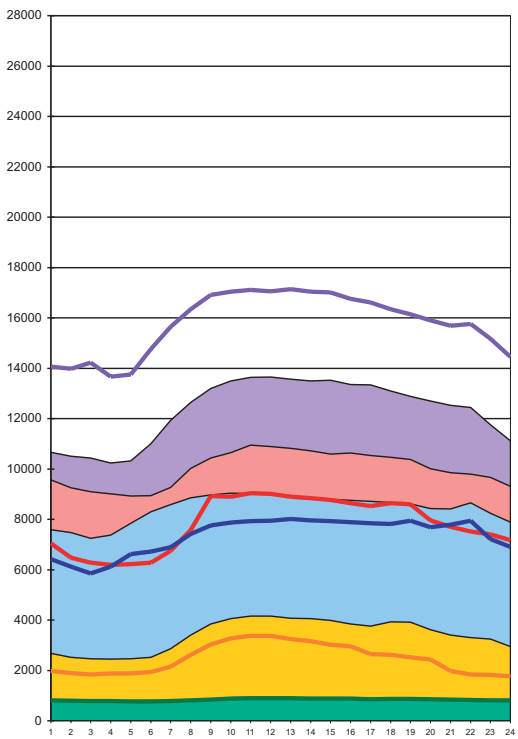
[1)] The system load is not corrected vs. temperatures and is local time

System load 3rd Wednesday in January and in July 2004

Average 24-hour load
3rd Wednesday in January (1-21-04) MWh/h



Average 24-hour load
3rd Wednesday in July (7-21-04) MWh/h



Maximum system load 3rd Wednesday in January and in July 2004

	3rd Wednesday in Jan 2004 5:00 - 6:00 PM - MWh/h	3rd Wednesday in July 2004 12:00 - 01:00 PM - MWh/h
Denmark	6,157	4,076
Finland	12,911	8,933
Iceland	974	890
Norway	20,235	10,825
Sweden	26,745	13,562
Nordel	67,023	38,286

All hours are local time

The Transmission Grid In The Nordic Countries

Interconnections

S6 Existing interconnections between the Nordel countries

Countries/Stations	Rated voltage/kV	Transmission capacity as per design rules[1] MW		Total length of line km	Of which cable km
Denmark West - Norway		**From Denmark**	**To Denmark**		
Tjele-Kristiansand	250/350=	1,000	1,000	240/pol	127/pol
Denmark East - Sweden		**From Sweden**	**To Sweden**		
Teglstrupgård - Mörarp 1 and 2	132~	1,350	1,750	23	10
Gørløsegård - Söderåsen	400~			70	8
Hovegård - Söderåsen	400~			91	8
Hasle (Bornholm) - Borrby	60~	60	60	48	43
Denmark West - Sweden					
Vester Hassing - Göteborg	250=	290	270	176	88
Vester Hassing - Lindome	285=	380	360	149	87
Finland - Norway		**From Finland**	**To Finland**		
Ivalo - Varangerbotn	220~	100	100	228	-
Finland - Sweden		**From Sweden**	**To Sweden**		
Ossauskoski - Kalix	220~	1,600[2]	1,200[2]	93	-
Petäjäskoski - Letsi	400~			230	-
Keminmaa - Svartbyn	400~			134	-
Rauma - Forsmark	400=	550	550	235	200
Senneby - Tingsbacka (Åland)	110~	80	80	81	60
Norway - Sweden		**From Sweden**	**To Sweden**		
Sildvik - Tornehamn	132~	1,000[4]	1,300[3, 4]	39	-
Ofoten - Ritsem	400~			58	-
Røssåga - Ajaure	220~			117	-
Nea - Järpströmmen	275~			100	-
Linnvasselv, transformator	220/66~	50	50	.	-
Lutufallet - Höljes	132~	40	20	18	-
Eidskog - Charlottenberg	132~	100	100	13	-
Hasle - Borgvik	400~	2,150[4]	2,150[4, 5]	106	-
Halden - Skogssäter	400~			135	-

[1] Maximum permissible transmission.

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

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

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

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

Interconnections

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 West - Germany		**From Nordel**	**To Nordel**		
Kassø - Audorf	2 x 400~			107	-
Kassø - Flensburg	220~	1,200	800[3]	40	-
Ensted - Flensburg	220~			34	-
Ensted - Flensburg	150~	150	150	26	5
Denmark East - Germany					
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~	-	1,400	2 x 67	-
Kymi - Viborg [2]	400~			132	
Nellimö - Kaitakoski	110~	-	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 limitaion in the German network.

[2] Back to Back HVDC (+85 kV =) in Viborg and synchronous operation of NWPP power plant.

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

Electricity generation

S11 Electricity generation 2004, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total generation	38,377	81,920	8,621	110,545[2]	148,484	**387,947**
Thermal power	29,050	55,952	5	582	80,323	**165,912**
- nuclear power	-	21,779	-	-	75,039	**96,818**
Other thermal power [1]	29,050	34,173	5	582	5,284	**69,094**
- CHP, district heating and condensing power	27,206	29,971	-		3,527	**60,704**
- CHP, industry	1,841	4,164	-	207[3]	1,751	**7,963**
- gas turbines, etc.	3	38	5	375	6	**427**
Renewable power	9,327	25,968	8,616	109,963	68,161	**222,035**
- hydro power	26	14,726	7,132	109,280	59,529	**190,693**
Other renewable power	9,301	11,242	1,484	683	8,632	**31,342**
- wind power	6,583	120	-	260	850	**7,813**
- biofuel	1,365	10,146	-	296	6,971	**18,778**
- waste	1,353	976	-	127	811	**3,267**
- geothermal power	-	-	1,484	-	-	**1,484**
Total generation 2003 [3]	43,754	80,377	8,495	107,122[2]	132,547	**372,295**
Change as against 2003 [3]	-12.3%	1.9%	1.5%	3.2%	12.0%	**4.2%**

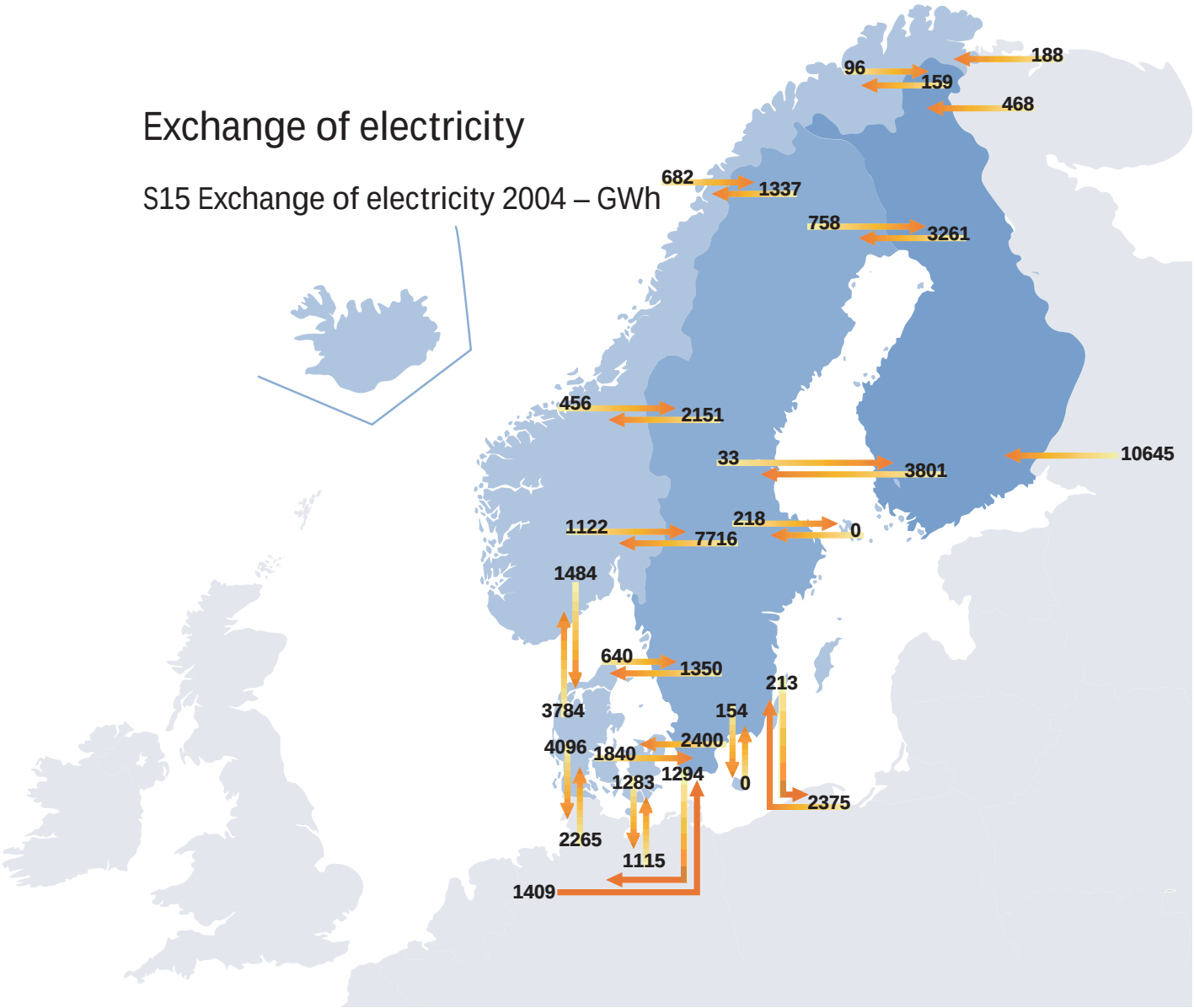
[1] Fossil fuels (coal, oil, etc)

[2] Gross production

3) Includes heat recovery production from industry.

Exchange of electricity

S15 Exchange of electricity 2004 – GWh



S16 Exchange of electricity 2004 – GWh

From: To:	Denmark	Finland	Norway	Sweden	Other countries[1]	∑ From
Denmark	-	-	3,784	2,480	5,379	**11,643**
Finland	-	-	159	7,062	-	**7,221**
Norway	1,484	96	-	2,260	-	**3,840**
Sweden	3,904	1,009	11,204	-	1,507	**17,624**
Other countries [1]	3,380	11,113	188	3,784	-	**18,465**
∑ To	**8,768**	**12,218**	**15,335**	**15,586**	**6,886**	**58,793**
						Nordel
Total to	8,768	12,218	15,335	15,586		**51,907**
Total from	11,643	7,221	3,840	17,624		**40,328**
Net imports	-2,875	4,997	11,495	-2,038		**11,579**
Net imports/total consumption	-8.1%	5.7%	9.4%	-1.4%		**2.9%**

1) Germany, Russia and Poland.

Electricity consumption

S20 Electricity consumption 2004, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total consumption	35,502	86,917	8,621	122,040	146,446	**399,526**
Occasional power to electric boilers	-	50	199	3,700	1,414	**5,363**
Gross temp correct consumption	35,760	86,937	7,843	125,434	147,462	**403,436**
Gross consumption	35,502	86,867	8,422	118,340	145,032	**394,163**
Losses, pumped storage power	2,608	3,314	499	9,848	11,240	**27,509**
Net consumption [1)]	32,894	83,553	7,923	108,492	133,792	**366,654**
- housing	9,800	20,456	676	34,756	40,950	**106,638**
- industry (incl. energy sector)	9,547	46,976	6,166	47,623	59,594	**169,906**
- trade and services (incl. transport)	10,747	15,261	706	24,413	26,548	**77,675**
- other (incl. agriculture)	2,800	860	375	1,700	6,700	**12,435**
Population (million)	5,400	5,236	0,293	4,590	9,011	**24,530**
Gross consumption per capita, kWh	6,574	16,600	29,423	26,588	16,252	**16,287**
Gross consumption 2003	35,210	85,224	8,495	115,008	145,476	**389,413**
Change as against 2003, %	0.8%	2.0%	1.5%	6.1%	0.7%	**2.6%**

[1)] Estimated net consumption.

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Hämeenlinna, Finland provided the setting for the Nordel Annual Meeting 2004. Photo: Flemming Wibroe

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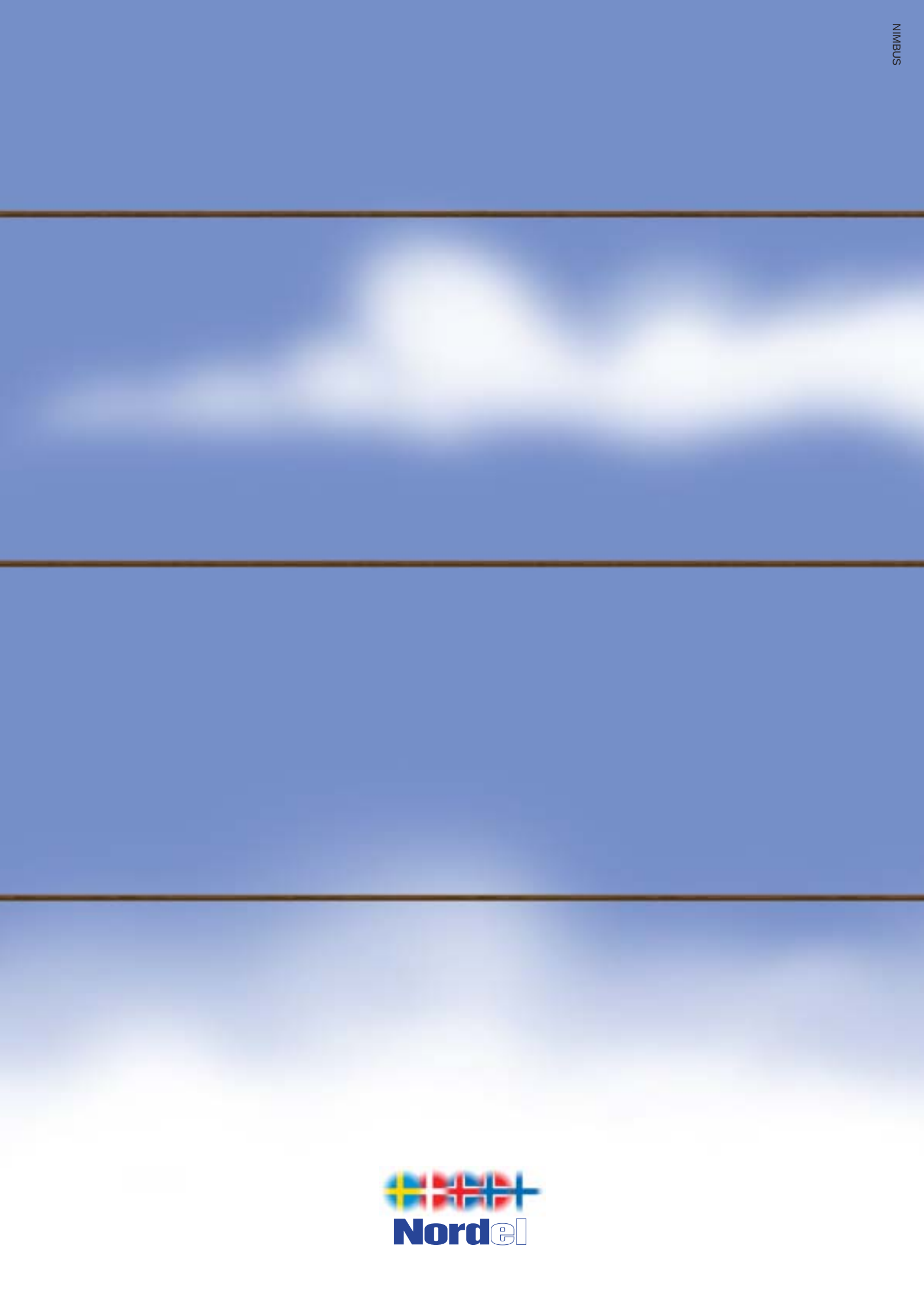
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