Annual Report 2007

Nordel

Cover photo: Tuomo Kouti

Contents

Nordel

Nordel is the collaboration organisation of the Transmission System Operators (TSOs) of Denmark, Finland, Iceland, Norway, and Sweden.

Nordel's objective is to perform the following core tasks of system responsibility across the national borders:

- to ensure the operational security of the power system,
- to maintain the instantaneous balance between supply and demand,
- to ensure the long term adequacy of the transmission system,
- to enhance the efficient functioning of the electricity market.

Nordel continuously exchanges views with the authorities and the market participants. This is important for the evolution of an efficient electricity market and maintaining the security of supply.

The most superior decision-making body is Nordel's annual meeting. The annual meeting elects the President of Nordel for a period of two years. The Presidency rotates between the countries. The President appoints Nordel's secretary and is responsible for the secretariat and its costs. Nordel has no budget of its own.

The Nordel Board consists of the chief executive officers of the TSOs. The Board has overall responsibility for the work within Nordel.

A major part of Nordel's work is carried out by the Market, Operations, and Planning Committees as well as working groups. The Committees consist of the leaders in the corresponding sections of the TSOs. The working groups are staffed by the TSOs' experts.

Key figures for 2007

		Nordel	Denmark	Finland	Iceland	Norway	Sweden
Population	mill.	**25.0**	5.5	5.3	0.3	4.7	9.2
Total consumption	TWh	**412.6**	36.4	90.4	12.0	127.4	146.4
Maximum load[1]	GW	**61.1**	6.1	12.5	1.3	18.6	22.7
Electricity generation	TWh	**409.2**	37.0	77.8	12.0	137.4	145.1
Breakdown of electricity generation:							
Hydropower	%	**55**	0	18	70	98	45
Nuclear power	%	**21**	-	29	-	-	44
Other thermal power	%	**21**	81	53	0	1	10
Wind power	%	**3**	19	0	-	1	1
Geothermal power	%	**-**	-	-	30	-	-

[1] Measured 3rd Wednesday in January - = Data are non-existent 0 = Less than 0.5 %

Report of the Board

Co-operation - the fastest and most efficient way to enhance regional and European developments

The TSOs have an important role in facilitating the electricity market and in maintaining and developing the physical infrastructure for electricity trading. The Nordic electricity market has often been referred to as a forerunner and an example of a well-functioning regional electricity market. The Nordic TSOs have shown a good track record in contributing to this development and in ensuring a high level of security of supply.

Nordel is strongly committed to develop a seamless Nordic electricity market and to integrate it further with the neighbouring regions. Nordel is also confident that the co-operation between the unbundled TSOs is the fastest and most efficient way to enhance regional and European development. In the spring of 2007, Nordel identified the most important actions to ensure development both on the Nordic and multiregional level, and will implement them during the next years.

Increasing focus on multiregional co-operation

The development towards a single European market will bring new challenges in the co-operation between the TSOs, especially across the regional borders.

New interconnections and reinforcements of the existing ones increased the transmission capacity to the continent and the Baltic countries in 2007. The total import capacity to the Nordic countries was increased by 1,200 MW and the export capacity by 1,350 MW. New interconnections to Continental Europe, the Baltic countries and Poland are also planned.

New interconnections together with further market integration will lead to growing complexity in operating and planning the power system. Therefore, strengthened co-operation with the TSOs in the neighbouring regions is in focus on Nordel's agenda. The co-operation includes planning and interoperability of the power systems and market planning issues.

Market coupling of the Nordic market with Central West Europe (Belgium, France, Germany, Luxemburg and the Netherlands) is the next big step to integrate the European market. It is planned to be implemented at the beginning of 2009. Then, the integrated market will cover almost half of the European electricity demand. The integration process is driven in co-operation with the TSOs and the Power Exchanges.

The first multiregional planning process with the Baltic and Polish TSOs has been established, covering the Nordic and Baltic power systems as well as part of the continental power system.

An efficient integration of the electricity markets requires common market structures and harmonisation of the trading rules. Diverging developments of the sub-regions can jeopardize progress in European integration. To ensure a coherent development in the Nordic countries and Central West Europe, Nordel proposed the establishment of a common body for these regions by merging the existing Northern European and Central West European Regional Initiative areas in January 2008. The Regional Initiative areas were established in 2006 by the European Regulators' Group for Electricity and Gas (ERGEG) as a step in integrating the national markets.

More efficient functioning of the Nordic power system

Investments in the grid reinforcements and principles for congestion management in the operational phase are the most significant tools of the TSOs to contribute to the functioning of the electricity market in the long and short term. Implementation of the package of five prioritized Nordic grid reinforcements, worth more than one thousand million euros, is progressing with some changes and delays in the schedules. The original South Link project in Sweden will be replaced with a South-West Link project including a higher transmission capacity in Sweden and a new interconnection to Norway.

Nordic Grid Master Plan 2008 was released in March 2008. The report identifies the Nordic grid reinforcements to be implemented by 2025 and potential grid reinforcements from the Nordic countries to the neighbouring regions. Nordel recommends the launching of more detailed studies of the identified projects. These projects will reduce the congestions in the Nordic grid.

The grid investments in the Nordic countries increased substantially in 2007 reaching a level of about 500 million euros. During the next years the grid investments will further increase to over 600 million euros. The investments are used to build an adequate and robust Nordic transmission system for security and supply and to connect new power plants to the grid.

During the wet summer and autumn of 2007, the high hydropower production in Southern Norway resulted in considerable congestions on the interconnections to the neighbouring countries. The total congestion rent in the Nordic market increased to 174 million euros, which is the highest level so far. In 2007, Energinet.dk, Fingrid,

Statnett and Svenska Kraftnät entered into a new agreement on the sharing of the congestion revenues between the TSOs. The agreement is valid until 31 December 2011. During the term of contract the sharing key will be gradually changing to a principle where the revenues between two prices areas are divided equally between the corresponding TSOs.

Nordel has agreed on harmonised principles for balance management. The principles will be implemented nationally by the beginning of 2009. Harmonisation on the wholesale level thus paves the way for the development of a Nordic retail market.

Introduction of a Nordic intra-day market (Elbas) took a step forward when Elbas was established in Western Denmark in 2007. The first regional intra-day market in the world will be a reality when Norway will join the Elbas market.

Transparency of market information is important for an efficient electricity market, and it also contributes to security of supply. Nordel has actively contributed to the improvement of transparency using the website of Nord Pool Spot as a platform. European market transparency is also improved by releasing information on ETSOVista, the European website for market information in Europe developed by the European TSOs.

Future development of regional TSO co-operation

The EU Commission published a proposal for the 3rd package of European energy legislation in September 2007. The Commission proposed to strengthen co-operation between TSOs by establishing a European Network of Transmission System Operators for Electricity (ENTSOE). The purpose of ENTSOE is to facilitate the efficient functioning of the European electricity market. Nordel supports this proposal.

Strenghtened TSO co-operation provides the best prerequisites for the further development of the European electricity sector. The new co-operation structure will also serve as a "home base" for the current regional TSO co-operation in Europe, and Nordic co-operation will continue as an integral part of ENTSOE.

New President of Nordel

From 7 February 2007 Jukka Ruusunen, President & CEO of Fingrid Oyj, serves as the President of Nordel during the remaining period of the Finnish Presidency lasting until the Annual Meeting in June 2008.
Jan Magnusson left his position as Director General of Svenska Kraftnät at the end of March. Sture Larsson, Acting Director General of Svenska Kraftnät, replaced him in the Board from 1 April 2007.

The members of the Board and the Chairmen of the Committees

Jukka Ruusunen, *Fingrid Oyj (President)*

Odd Håkon Hoelsæter, *Statnett SF (Vice President)*

Peder Østermark Andreasen, *Energinet.dk*

Sture Larsson, *Svenska Kraftnät*

Thordur Gudmundsson, *Landsnet hf.*

Bente Hagem, *Statnett SF (Market Committee)*

Per Sørensen, *Energinet.dk (Operations Committee)*

Ulf Moberg, *Svenska Kraftnät (Planning Committee)*

Outgoing Board member on 31 March 2007

Jan Magnusson, *Svenska Kraftnät*

The laying of the NorNed cable between Norway and the Netherlands.
Photo: Statnett

Electricity market

Market coupling - to improve market efficiency

A wet summer and autumn with large inflows to the reservoirs together with a relatively mild early winter resulted in increased hydropower production as compared to 2006. The high hydropower production made Southern Norway a low price area during the summer and autumn. During this period, considerable bottlenecks and price differences could be observed between Southern Norway and Western Denmark. Price differences could also be observed between Sweden and Eastern Denmark. The yearly average price in Eastern Denmark was more than 18% higher than the average yearly system price. Southern Norway had the lowest average price in 2007, which was almost 8% below the average system price.

The prices and the power flows in the Nordic countries are also more and more influenced by trade with Continental Europe. The trade within Europe is increasing, and a larger fluctuation in the power flows between countries and regions can be observed. More renewable production, including wind, will increase the need for efficient mechanisms to handle short-term variations in the power flows.

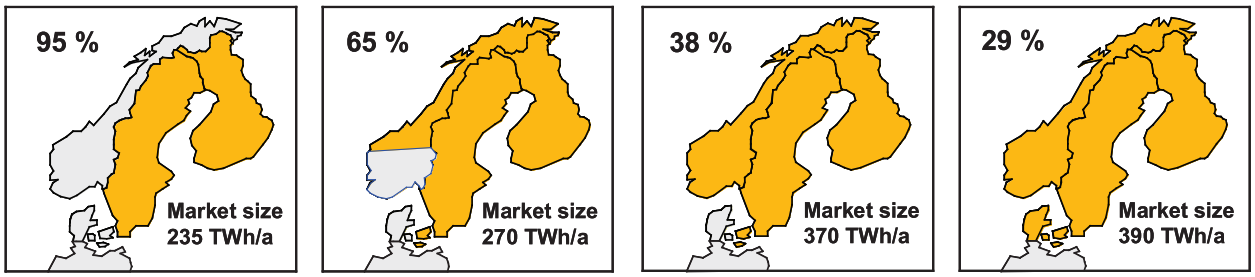


Figure 1. Nordic integration in 2007 illustrated by the duration of the same day-ahead price, percentage of hours, in different Nordic regions. The annual consumption of electricity (TWh/a) describes the size of the market in the corresponding region.

Further market integration is important

Further integration of the European electricity market is important in order to achieve an efficient market. Integration will improve the utilisation of the existing infrastructure, enhance competition and increase the security of supply. A critical and important step in this regard is to establish efficient market coupling.

A regional approach has been set out to achieve the goal of a single energy market in Europe. The objective of the regional initiatives is to make concrete improvements in the Internal Electricity Market (IEM). This is made by first integrating national electricity markets into regional markets, which is achieved by the identification and removal of obstacles to trade at a regional level.

In this regard, the following market coupling initiatives have been taken in order to improve efficient energy flow and price formation between nations/regions:

- Energinet.dk is co-operating with E.ON Netz, Vattenfall Europe Transmission, Vattenfall and the German power exchange EEX and the Nordic power exchange Nord Pool Spot in order to connect Denmark with Germany through day-ahead implicit auctioning. The European Market Coupling Company (EMCC) will be established for coupling these areas and will be effective in 2008. EMCC will then negotiate further with the owners of Baltic Cable to connect Sweden and Germany through implicit auctioning.
- The NorNed cable connects Norway and the Netherlands. The originally intended market coupling between the power exchanges Nord Pool Spot and APX in the Netherlands, could not be implemented as planned as the time of gate closures is not harmonised. Electricity trade will therefore be temporarily carried out by explicit auctioning. The NorNed parties seek to realise a full market coupling across the NorNed interconnector between the Nordic day-ahead market and the Central West European (CWE) market by 2009.
- A project launched by Nord Pool Spot will establish an Elspot area on the Estonian side of Estlink.

In addition, the CWE region implements flow-based market coupling between the markets in Germany, France and the Benelux countries. The governments, regulators, TSOs, power exchanges and the market participants in the CWE region have signed a Memorandum of Understanding (MoU) that aims to introduce market coupling within the region by 2009.

The electricity market in Russia is also opening step by step. This large reform will have an effect on how electricity will be traded between Russia and Finland in the future. Fingrid and the TSO of Russia have started a project to make the transmission rules between the countries more market-based.

The different projects aim to harmonise the market in many areas, including power exchange gate closure times. The projects will therefore need coherence. A reference group between CWE parties and Nordel has been established to secure that the different projects are well co-ordinated.

The Nordic TSOs agree that establishing a Common Market Coupling Office (MCO) for the market in North-Western Europe is the preferred solution as a first step. The MCO will be designed so that it can be expanded to other countries/regions.

When all the market coupling projects mentioned above are co-ordinated and finalized, the markets from France to the North Cape will be coupled. This will be a tremendous step towards an efficient Internal Electricity Market within the whole of Europe.

Transparent market information - a goal for Nordel

Market information that is transparent is an important strategic goal for Nordel. To reach this, guidelines and recommendations from the EU Commission and the European Group for Electricity and Gas (ERGEG) are evaluated and implemented. Nordel also proposes and implements relevant market information that goes beyond the requirements from the Commission and ERGEG.

The website of Nord Pool Spot is used as the main platform for market information. Additionally, information presented here is also a part of ETSOVista, which is a European platform and website for market information. ETSOVista is developed and funded by the European TSOs (ETSO) to facilitate access to European market-related information. Today, the market participants have access to the first phase of ETSOVista and ETSO is continuously working to develop and expand ETSOVista in co-operation with the market participants and the TSOs.

In order to increase the transparency of information available to the market participants, Nordel has implemented a registration of the congestions on the interconnections in Nordel. The registration is based on codes telling the reasons for and the location of the congestion. On this basis, Nordel is in the process to analyse congestions statistically.

Balance management - common Nordic principles in 2009

The TSOs use balance management for balancing the amount of power fed into and taken out of the system. Balance management consists of two different functions, maintanance of the physical balance in the operational phase and economic settlement of the imbalances.

Nordel works towards a harmonisation of the balance management in the Nordic area and common principles have been proposed to be implemented in January 2009. This will be a step towards a common end-user market. However, the principles will not lead to a fully harmonised balance management, as it will be too complicated to achieve this in one single step. Further developement and harmonisation is envisaged.

The proposed harmonisation consists of the following:

- Principles for cost allocation.
- Calculation and pricing of balance power and common fee structure.
- Introduction of common intra-day trading in the Nordic exchange area.

In the principles for cost allocation, the cost base for balance management has to be defined and will be financed by the Balance Responsible Parties (BRP). The main cost elements are operational reserves. As there is a lack of reliable statistics of the reasons to use the reserves, the cost allocation will be evaluated and possible adjustments of the recommendations will be considered.

The common cost basis is proposed to include 100% of the costs for frequency controlled normal operation reserve and 10-33% of the costs for frequency controlled disturbance reserve as well as fast active disturbance reserve. The cost base should also include 100% of the administrative costs, i.e. staff, IT systems etc. for balance settlement and control.

The proposal is to introduce two balances, one for production, which will be settled in accordance with the two-price system, and one balance for consumption and trade, named the "consumption balance". The consumption balance will be settled in accordance with the one-price system. The balances will be calculated per price area and settled with the balance power prices in the respective area.

Nordel finds it important to have incentive-based balance settlement. A two-price system for production will give stronger incentives to follow the production plans. A one-price settlement for the consumption balance could lead to more BRPs and hence better market competition. The one-price system will also eliminate the benefits that vertically integrated companies have today.

When a common pricing mechanism for balances becomes effective, it is also necessary to have the same tools available for the market participants to keep their balance. An application to introduce Elbas in Norway has been sent to the Ministry of Petroleum and Energy. The goal is to implement Elbas together with the proposed Nordic principles for balance management, making this market available within the entire Nord Pool Spot area.

After the introduction of the proposed model in 2009 and when the status of the implementation of the common end user market is better known, a second step can be planned.

Power exchange to be established in Iceland

Electricity trading in Iceland is based solely on bilateral contracts. Today there is a need for a platform for organised trade in electricity on a short-term basis, as well as transparency in the pricing of electricity in Iceland.

It is one of Landsnet´s primary role to encourage competition and to support the market environment. In that context, Landsnet has been investigating with Nord Pool Spot the possibilities of establishing a power exchange in Iceland based on a similar concept as the intra-day (Elbas) market. As the intra-day market grows and becomes more liquid it could migrate to a day-ahead (Elspot) market.

Further steps of preparation to evaluate the establishment of an intra-day electricity market in Iceland were carried out with the intent of starting the market in 2008. That preparation work was done in co-operation with Nord Pool Spot and the leading energy companies. A decision was taken both by the Board of Directors of Landsnet and by Nord Pool Spot to develop this project further and set up a power exchange in the autumn of 2008.

There is still considerable interest to make further investments in new aluminium plants and other heavy industries in Iceland.

A special-design transmission line tower "Pirkanpylväs", located in Lempäälä in Southern Finland, was provided with a lighting system in November 2007.
Photo: Juhani Eskelinen

Big trucks are needed to transport transformers to the converter station at Feda in Norway. Photo: Statnett

System responsibility and operation

Nordic co-operation - to maintain the security of supply

The overall operational challenge is to maintain the security of supply. Therefore, the main task in 2007 has been to study new measures for maintaining the frequency quality in the Nordic system. The need for new measures is due to increased frequency variations in the Nordic system as more and more markets are coupled and more interconnections are put into operation. This means that the co-operation within Nordel needs to be even closer and that it is necessary to look across borders to find the best suitable solutions.

Furthermore, the co-operation between the Market Committee and Operations Committee has turned out to be more and more crucial during the year.

Strategic projects in power system operation

Nordel has worked intensely during 2007 with the Nordel strategic action plan in order to specify the most important operational issues. Four main topics have been identified:

1. **Improved control of the daily operations.** This includes new Nordic measures for frequency control, improved training programmes for control room staff, common principles for outage planning and improved information exchange between the TSOs. The work has been going on in 2007 and will continue.
2. **Efficient use of the operational reserves,** both for automatic and manual reserves. The work was stopped during 2007, but is prioritised again. It will be carried out in close co-operation with the market participants from the second half of 2008 and two years ahead.
3. **Investigations into multiregional operational procedures.** Step one is a preliminary study of the existing operational procedures. This work is ongoing and will be finalized in summer 2008. The second step is a specification of common multiregional goals. This work has not yet started.
4. **Improvement of Nordic market transparency.** The Operations Committee and Market Committee co-operate to improve the market transparency. The contributions from the operations are in the implementation phase.

Stable frequency quality - a challenge

It is a challenge to maintain the frequency quality in the synchronous Nordic system. One of the reasons is an increased variation in the hourly trade with Continental Europe and between the Nordic countries. As the transfer capacity out of the Nordel area is expected to increase even further in the coming years, more market areas will be coupled, and additional capacity will be traded on the intra-day markets. This causes that even small price changes may lead to large changes in the power flow.

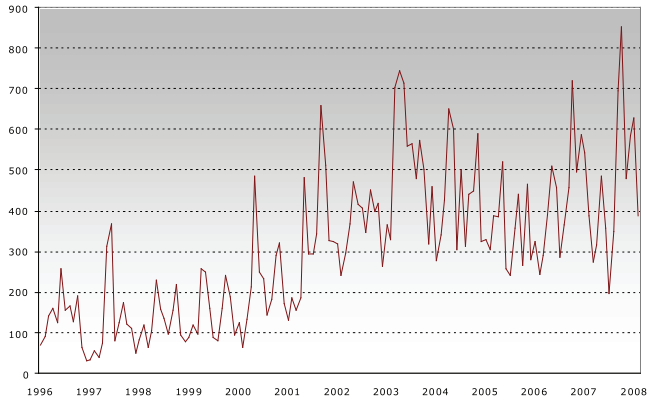


Figure 2. Frequency quality in the synchronous Nordic power system from 1996 to 2007. The quality is based on the requirement of the highest permissible variation in the frequency during normal state. It is registered in number of minutes with frequency deviations over 50.10 Hz and below 49.90 Hz.

It has been crucial to implement new measures immediately to improve frequency quality and balance management. Therefore, Nordel works on a stepwise implementation plan as follows:

- Ramping restrictions on all HVDC links out of the area have been implemented. This is necessary as an immediate measure, but it restricts the market and may influence the market price.
- At the beginning of 2009, harmonised time limits for intra-day gate closures will be implemented. Production plans and regulating bids have to be submitted to the TSOs no later than 45 minutes before the operating hour. This is the first step towards a general harmonisation of gate closures.
- A package of measures including models for better operational planning, use of system protection schemes on HVDC links and models for better secondary control is analysed together with a change of responsibility for frequency control so that it is entrusted to only one TSO. The final measures are expected to be implemented and in operation by the end of 2009.

Multiregional co-operation is crucial

Nordel considers it very important to strengthen co-operation with the TSOs in the neighbouring North European regions. Both within the Union for the Co-ordination of Transmission of Electricity (UCTE) and Nordel, operational co-operation between the TSOs has developed over several years. The current rules and recommendations are expressed in the UCTE Operational Handbook and the Nordel System Operation Agreement. Today, operational co-operation between UCTE and the Baltic, Russian and Nordel parties exists mostly as bilateral co-operation between neighbouring TSOs.

The existing co-operation may be developed into co-operation between regions, resulting in a broader and more harmonised view of the exchange of operational resources. Still, the operational conditions within the respective associations are taken into account.

The first part of Nordel's work is to:

- describe the present situation regarding operational co-operation between the Nordic countries and the neighbouring countries,
- analyse possible development areas, with focus on co-ordinated outage planning, operation of interconnections, utilisation of operational reserves, operational planning fundamentals and information exchange.

The work will be finished during 2008.

Information exchange between the TSOs

The Nordic Operational Information System (NOIS) contributes to improved transparency of information between the TSOs and further strengthens operational co-operation.

The NOIS system serves as a tool for the control rooms of the Nordic TSOs and supports the operational processes in the management of balance, capacity, reserves and planned outages. Furthermore, the system has supportive functions for urgent operator alerts, reporting and statistics plus basic data and user management.

The project started in November 2006. During 2007 the first release of the system has been developed and presented to a group of TSO representatives. Functionality testing has also been initiated. The system is planned to be implemented in late 2008.

Operational review - no larger operational disturbances during the year

The Nordic electricity system did not suffer from any operational disturbances leading to blackouts, and no power deficit was observed in 2007. Yet, several incidents led to bottlenecks in the transmission grid and reduced the transmission capacity available to the market.

In Sweden, extensive planned disconnections due to reinforcements caused reductions in the market capacity both inside Nordel and out of the region in the summer and autumn. Heavy rainfall in the summertime resulted in high production in Southern Norway and large exports to Sweden and Denmark. This high production combined with reductions in capacity between the southern part of Norway and Sweden resulted in quite large price differences occasionally.

Also faults in the transmission system caused reduced transfer capacity on the interconnections within and out of the Nordel area. The Skagerrak 3 interconnection between Western Denmark and Norway with a capacity of 500 MW was out of operation for several months because of a transformer fault on the Danish side.

A fault in the Russian system caused a reduction in exports to Finland in order to cover Russian power deficit and to relieve overloaded lines feeding the St Petersburg area. Additionally, maintenance work in the Russian electricity system caused a restriction of 200 MW in the transfer capacity to Finland during the last months of the year.

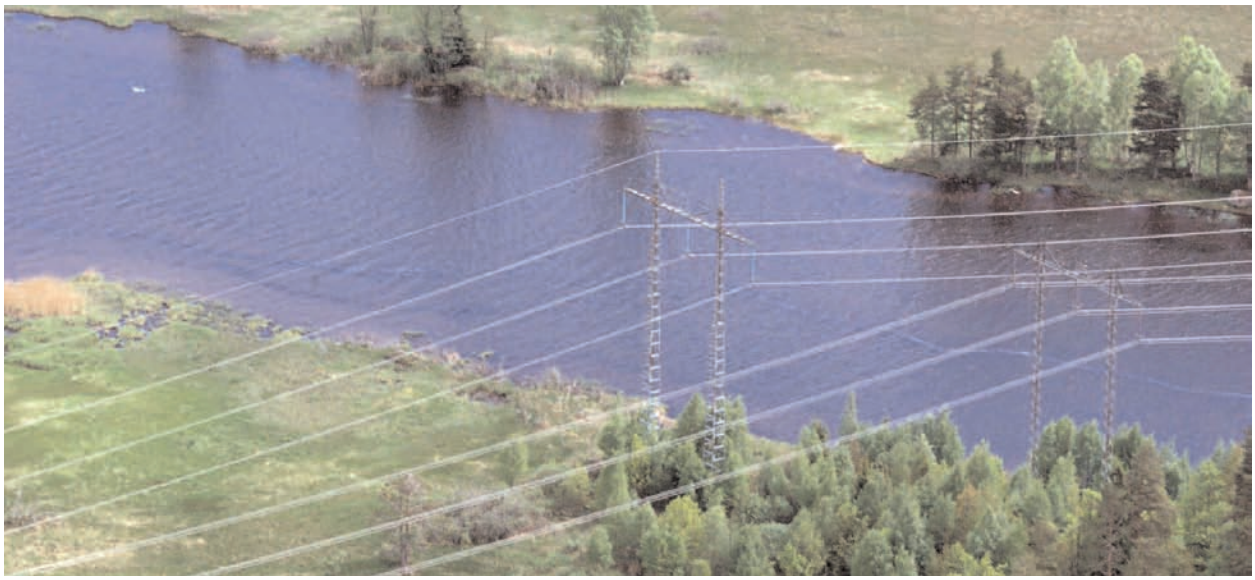
Western Denmark and Flensburg were in island operation for approx. four minutes due to a fault in Germany. The transition to island operation gave rise to a momentary demand for downward regulation of approx. 1,100 MW. This was handled partly by activating the emergency power available on the interconnections to Norway and Sweden – approx. 360 MW. The rest was handled by internal regulation of primary power stations combined with a manageable loss of generation by wind turbines and local units.

In December, a reactor exploded in the converter station on the Danish side of the Kontiskan connection, and it was disconnected for a couple of hours.

In Iceland, the year 2007 had some important challenges for Landsnet. The Karahnjukar hydropower plant and Fjardaal aluminium plant in Eastern Iceland were connected to the grid and by this the total generation capacity in Iceland was increased by 45%. Of the total capacity, 30 % is now located in Eastern Iceland. Due to delays in the Karahnjukar hydro project, the power plant was not in operation until late October. This brought new challenges for system operation, as the aluminium plant started its operation in early April with power from the 132 kV network.

At the end of the year, hydro station Sultartangi had a failure in the step-up transformers resulting in a shortage of generation capacity in the South-West area of Iceland. This resulted in high power transmission from Eastern Iceland to the South-East area. The 132 kV network connecting these areas was therefore operated close to its transmission capacity most of the year.

The transmission system in Iceland suffered from heavy storms in December, with a breakdown of one 220 kV line steel tower and a few towers on a 132 kV line on the west coast. A human error in a 220 kV substation in August caused a widespread disturbance in the grid and was the major cause of unavailability in 2007.



Power transmission lines in Sweden.
Photo: Svenska Kraftnät

In January 2008, the headquarter of Energinet.dk moved to a new building in Fredericia.
Photo: Palle Peter Skov

Work carried out on the 400 kV line Ulvila - Kangasala in South-Western Finland. Photo: Juhani Eskelinen

Network development

Five Nordic transmission grid projects are proceeding - more is to come

The investments in the Nordic grid have risen to over 500 million euros/year which is more than twice as much as the investments in the previous years. This higher level is expected to continue in the future, which is shown in figure 3. The rise in investments is caused by the large number of reinforcements that are under way in the Nordic countries. This will lead to a significantly strengthened Nordic power grid.

One way to measure the effectiveness of a regional electricity market is to compare the cross-border import transmission capacity to the national peak load. The EU Commission has recommended a ratio of at least 10%. The transmission capacity in the Nordic system clearly exceeds this target, as shown in figure 4. This will be further improved after the implementation of the ongoing and planned grid investements.

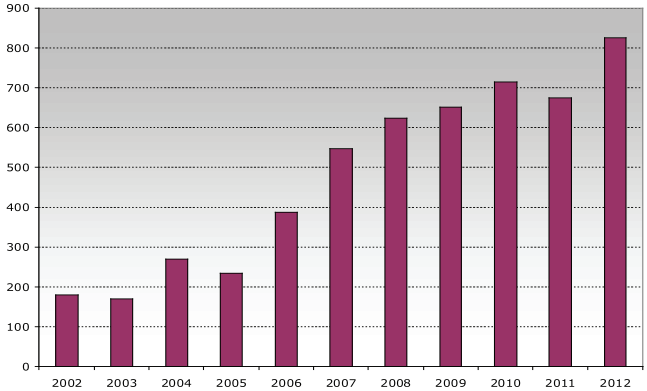


Figure 3. Nordic investments 2002 – 2012.

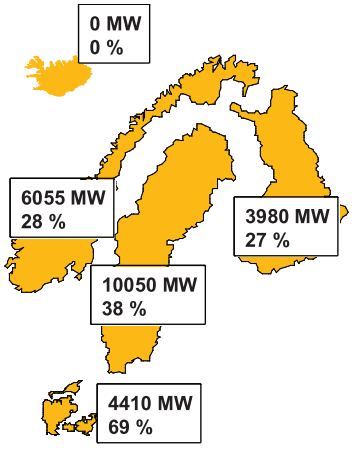


Figure 4. Import transmission capacity available for the market (MW) and relation to the peak load (%).

In June 2004, Nordel recommended the reinforcements of five cross-sections in the Nordic transmission grid with the purpose to improve the effectiviness of the Nordic electricity market and increase the reliability of the system.

The status of the five projects is as follows:

• Järpströmmen - Nea
The existing 275 kV line between Järpströmmen in Sweden and Nea in Norway will be replaced with a new 400 kV line. The new line will be mainly built in parallel with the existing one. Most of the existing line will be demolished. During 2007 all permits needed for construction have been received from Norwegian and Swedish authorities. The building period starts during the summer of 2008 and the commissioning of the new line will be during the summer of 2009.

• Fenno-Skan 2
A new HVDC connection will be built in parallel with the existing one between Sweden and Finland. On the Swedish side, a 70 km direct current overhead line will be built to a new substation Finnböle where the converter station will be placed. The planned capacity is 800 MW. Civil engineering work and the purchase process for parts of the project have started. The new connection will be commissioned at the end of 2011.

• The Great Belt connection
The project comprises a 56 km HVDC link between Eastern Denmark, which is part of the Nordel synchronous area, and Western Denmark, which is part of the UCTE synchronous area. The connection will be a 600 MW conventional HVDC link. Energinet.dk signed contracts with converter station and cable vendors in the spring of 2007. The laying of the land cable is expected to start in 2008 and laying of the sea cable is scheduled for the summer of 2009. The new link will be commissioned in the first half of 2010.

• The Southern Link, replaced by the South-West Link
In January 2008, it was decided that the Southern Link will be part of a larger infrastructure project, the South-West Link. The capacity is twice as high as compared to previous plans. The South-West Link will be constructed in three sections. From a substation close to the town of Jönköping and southwards to the province of Skåne, new HVDC technology with underground cables will be used. A link from Jönköping to Norway will be constructed with the same technology and will be connected to the substation near Jönköping and to the Norwegian national grid west or north of the Oslo fiord. Subject to necessary decisions being taken in Norway, Statnett will be responsible for the part of the link on the Norwegian side of the border.

• Skagerrak 4
The existing Skagerrak interconnection with 1,000 MW capacity connects Kristiansand in Norway with Tjele in Denmark. Statnett and Energinet.dk are examining the possibilities of increasing the capacity by approx. 600 MW by laying a fourth cable along the existing three cables. The investigation of business cases continues according to a principal agreement from December 2006. The earliest date of commissioning is 2012.

Nordic Grid Master Plan 2008 has been finalized where new investments in the transmission grid are proposed. This is described in the article "TSO co-operation in grid planning within Nordel" on page 22.

Transmission capacity to Europe is increasing

New interconnections and reinforcements of the existing ones have increased the transmission capacity between the Nordic countries and Europe and several projects are in the planning phase.

Denmark – Germany
In February 2007, the trading capacity between Western Denmark and Germany was increased from 800/1,200 MW in the northbound/southbound direction to 950/1,500 MW. This is only the first step in a joint grid project between E.ON Netz and Energinet.dk, aiming at a considerable increase in the transmission capacity during the next decade.

Energinet.dk has invited Svenska Kraftnät and Vattenfall Europe Transmission to investigate the opportunity of a joint TSO project for combining a new HVDC link between Germany, Sweden and Eastern Denmark with the grid connections of the planned off-shore windfarms at Kriegers Flak.

Norway – Netherlands
Statnett and the TSO in the Netherlands, TenneT, are in the process of finalizing the NorNed cable.

Norway – Germany
Statnett and E.ON Netz have launched a joint feasibility study for a DC cable between Norway and Germany called NORD.LINK. The capacity of such a new interconnector is expected to be in the range of 700 to 1,400 MW.

A cable between Norway and Germany is listed in the EU's programme for trans-European electricity networks (TEN-E programme) which aims at improved market integration in Europe and which is supported by the EU. Statnett and E.ON Netz intend to finalize

their feasibility study by the autumn of 2008. A similar initiative for a cable between Norway and Germany has been launched by NorGer AS.

Finland – Russia
In the autumn of 2007, Federal Grid Company of Russia and Fingrid launched a technical study to investigate the possibilities of bi-directional operation on one of the 350 MW HVDC converter bridges in Vyborg.

Sweden – Lithuania
During 2007, Svenska Kraftnät and the transmission system operator of Lithuania started a feasibility study concerning a cable between Lithuania and Sweden.

National projects will also strengthen the Nordic power system

In addition to the interconnections mentioned above, the TSOs implement many national grid investments in order to connect new power plants to the grid, to meet the increasing demand and to ensure the security of supply.

Denmark
In connection with the planning of a new overhead line at the beginning of the year, it became obvious that the existing guidelines for the use of overhead lines and cables were no longer valid in practice. It was considered appropriate to review the guidelines. In May the Minister of Transport and Energy asked Energinet.dk to convene a committee to work out a technical report about the future expansions of the transmission grid. The committee reported to the Minister in March 2008 and subsequently a political decision process will lay down the principles for future guidelines. As a consequence of this ongoing process, major transmission grid projects are temporarily on stand-by.

Finland
Measures for increasing the degree of compensation on three series-compensated lines in the internal North-South cross-section P1 were finished during the spring of 2007. Fingrid made a contract on the purchase of a 200 Mvar static var compensator to be placed in the Kangasala substation in Southern Finland. In the autumn, the construction of the Petäjäskoski–Keminmaa 400 kV line was also started. These reinforcements – when completed – will help to better utilise the existing transmission system and to relieve possible constraints.

Construction of the grid connection of Olkiluoto 3 power plant achieved an intermediate milestone when overhead line arrangements in Olkiluoto, a substation in Huittinen and the overhead line Olkiluoto-Huittinen were completed.

Fingrid has started grid connection studies for the potential new nuclear power plant, FIN6. Plans are being prepared for several alternative sites along the Finnish coastline.

Iceland
During 2007, Landsnet published a long-term system development plan for the Icelandic transmission system together with the annual five-year plan. The long-term system development plan presented the need to strengthen the connection and increase transmission capacity between the 220 kV system in South-Western Iceland and the load and generation areas in the northeast. Several solutions were suggested, which are now being studied in further detail.

At the beginning of 2007, Landsnet decided to start preparing and planning the strengthening of the transmission system in Reykjanes in order to connect future geothermal power plants in the area and to be able to deliver power with higher availability both to and from the area.

During the year, two 50 km 400 kV transmission lines in Eastern Iceland were taken into operation together with a new 220/132 kV substation in Fljótsdalur. The lines and substation connect the aluminium plant in Reydarfjördur to the power plant (690 MW) at Karhnjukar as well as to the existing 132 kV transmission system.

Landsnet continued the preparation and planning of all necessary transmission system work in conjunction with two future aluminium plants, one in Helguvík near Keflavik airport and the other in Bakki near Húsavík in Northern Iceland.

Furthermore, Landsnet continued the preparation and planning of system work in Northern Iceland with the aim of connecting new and existing geothermal power plants in the area with the planned aluminium smelter near Húsavík.

Norway
In July 2007, Statnett received the final licenses to build a new 420 kV line between Skåreheia and Holen in Southern Norway. Construction started in August 2007 and the line will be completed in the 3rd quarter of 2009.

There was extensive planning during 2007, and Statnett has applied for licenses to build two new 420 kV lines and has made preliminary applications to build another new 420 kV line as follows:

- New 420 kV line Fardal–Ørskog in Eastern Norway. Application for license.
- New 420 kV line Namsos–Roan in Central Norway. Application for license.
- New 420 kV line Balsfjord–Hammerfest in Northern Norway. Preliminary application.

Sweden
In June 2007, Svenska Kraftnät presented a report with the conditions and consequences of introduction of prioritised admission of wind power to the national grid

including the impact of large-scale wind power production on balance regulation and the need for regulating resources. The report concluded that questions concerning network connection are important in the case of large-scale introduction of wind power. The report proposes a changed practice to the permission to connect power generation to the grid in order to facilitate introduction of wind power.

Svenska Kraftnät has decided to build a new 400 kV substation in Ängsberg, south of the city of Gävle. The new substation, which will be in operation in 2010, is important for the new Fenno-Skan 2 link.

Additionally, two projects are proceeding with the aim to improve the robustness and reliability of the electricity supply of the cities of Stockholm and Uppsala.

Photo: Katrin Seuss

Photo: Emil Thor

Photo: Trond Isaksen

The transmission grid in the Nordic countries

Photo: Sami Kuitunen

Photo: Emil Thor

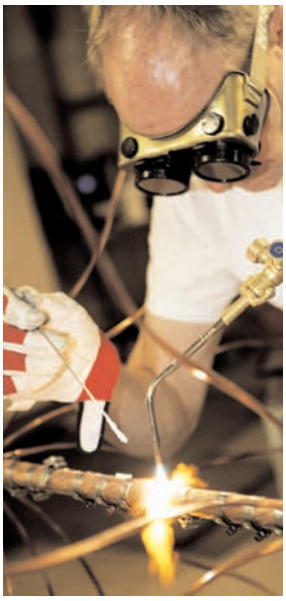


Photo: Erik Thallaug

Photo: Palle Peter Skov

Photo: Katrin Seuss

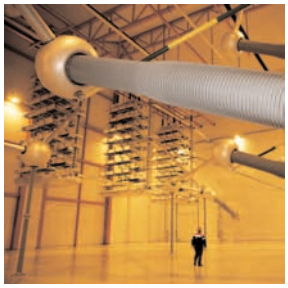


Photo: Erik Thallaug

Photo: Håkan Flank

Important events during 2007

4 January
Estlink cable between Finland and Estonia was taken into commercial operation.

19 January
Government plan for a new energy policy until 2025 was published in Denmark.

1 February
The trade capacity between Western Denmark and Germany was increased by 300 MW in the southbound direction and by 150 MW in the northbound direction.

8 February
A new peak load record was reached in Finland, 14,914 MW. Fingrid activated peak load resources to maintain the power balance.

13 February
Fenno-Skan link between Finland and Sweden back to commercial operation after a damage in December 2007.

12 March
Kontek in operation again after being disconnected since the beginning of the year.

10 April
The new aluminium plant in Eastern Iceland started operation with electricity from Landsnet's 132 kV grid.

12 April
Elbas was introduced in Western Denmark.

1 May
The Finnish Act on the feed-in tariff of electricity produced from fuel peat in condensing power plants came into force.

1 June
Border tariffs were abolished from electricity trade between Finland and Estonia.

15 June
Nordel held its annual meeting at Snekkersten in Denmark.

28 August
Skagerrak 3 was disconnected due to a fault in a transformer on the Danish side. It is expected to be back in operation in May 2008. The capacity was reduced by 500 MW.

31 August
Reykjavik Energy became a shareholder in Landsnet with a share of 7%.

13 September
The board of Nord Pool Spot signed a contract with Landsnet on establishing an electricity market in Iceland in 2008.

19 September
The EU Commission launched a proposal for the 3rd package of European energy legislation.

20 September
The Minister of Transport and Energy set up a committee to review the existing guidelines for the use of overhead lines and cables in the Danish power system.

26 October
Several malfunctions occurred in the NorNed cable during the testing of the cable. During this period, it became clear that the cable cannot become available to the market before 2008.

19 November
The Olkiluoto Gas Turbine Plant of 100 MW, jointly constructed by Fingrid Oyj and Teollisuuden Voima Oy (TVO), was put into operation.

30 November
Official opening of the 690 MW Karahnjukar Hydro Power Plant in Eastern Iceland.

21 December
Svenska Kraftnät and Statnett decided that OMX will acquire Nord Pool ASA's clearing and consulting operations and international derivatives products and will establish a business unit for international energy derivatives.

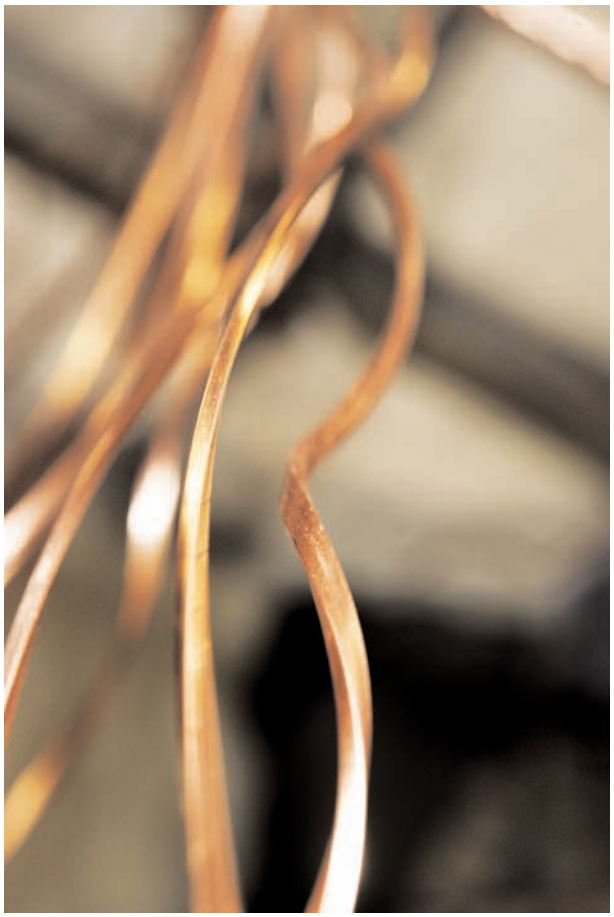


Photo: Erik Thallaug

Photo: Erik Thallaug

Photo: Emil Thor

Statnett employees at work.
Photo: Erik Thallaug

TSO co-operation in grid planning within Nordel

Organisation and tasks

The history of common Nordic grid planning goes back to the autumn of 1959 when the Nordic Council of Ministers recommended that the Nordic countries should investigate extended co-operation regarding the production and exchange of power. A proposal of guidelines for the co-operation organisation was presented, with the name Nordel appearing for the first time. The power companies in the Nordic countries showed considerable interest in such an organisation and Nordel was founded in 1963.

The successful Nordel co-operation in system planning aims at developing the grid from a Nordic perspective taking into account the international aspects and paying attention to environmental impacts. The Planning Committee, consisting of the leaders responsible for the corresponding issues within the TSOs, is responsible for these tasks.

During the last decade, the planning process of Nordel has proceeded in the direction of integrated Nordic co-operation concerning grid reinforcements and expansions. This regional co-operation is unique in Europe and shows that Nordel is a forerunner in the work for a well-functioning regional electricity market. The work has resulted in three common Nordic grid master plans in the past decade.

The main objective is to achieve continuous and co-ordinated Nordic planning between the TSOs and identify the grid investment projects that will ensure an efficient functioning of the integrated Nordic electricity market and the targeted level of adequacy in the Nordic power system.

Specific issues in planning co-operation include:

- Nordic scenarios for transmission grid planning. Realistic and alternative scenarios of the energy sector including environmental issues, electricity production and consumption etc. are important inputs in analysis and system development plans performed by Nordel.
- Grid master plans. Based on the scenarios and performed power system simulations, the grid master plans suggest projects that improve system reliability or the trading capacities between the Nordic countries or between the Nordel area and the neighbouring countries. The plans mainly look 5-10 years into the future.

- Development of a common Nordic Grid Code. The Grid Code governs technical co-operation between the TSOs in the interconnected Nordic countries. It concerns the operation and planning of the electric power system of the TSOs and the market participants' access to the grid. The Code lays down fundamental common requirements and procedures that govern the operation and development of the electric power system.
- Development of common planning tools. In order to perform high-quality analysis, good planning tools are required. Development of tools is therefore an important part of planning. Also, collection of data regarding the grid, consumption and production is important.

The Planning Committee has established two permanent working groups, the Balance Group and the Grid Group. The main task of the Balance Group is to deliver power and energy balance predictions for the Nordic power system and to perform system analysis. The Grid Group is responsible for gathering static and dynamic data of the Nordic power system and for performing grid analysis.

Future development of Nordic planning co-operation

Nordel shares the vision of an efficient and seamless European electricity market with high power system security. One step into this direction is to expand planning co-operation by involving the neighbouring regions.

The first multiregional grid planning has started with the Baltic TSOs. The goals of common grid planning with the Central West European region will be decided during 2008.

Furthermore, in order to ensure a more proactive planning process and faster delivery as well as faster decision making, Nordel will investigate and assess existing work plans, organisational issues and what would be the best practice for decision-making.

The lead time from the decision of an investment to the commissioning date can be long due to licencing procedures. In order to assess the possibility of shortening implementation lead times, Nordel will survey the differences between the processes of each country. Nordel will, if possible, make a proposal for streamlining the licencing procedures for internal and cross-border investments.

The control room of Fingrid's Power System Control Centre was renovated in 2007. The revision also covered the updating of the operation control system. Photo: Juhani Eskelinen

Examples of Nordel planning - grid master plans

Developing a grid master plan is an extensive work that runs for a couple of years. A very important criterion in this work is that the development of the grid is done from a Nordic perspective. This means that it is the benefit of the complete Nordic electricity market and power system which makes the basis for the evaluation of the profitability of the different projects being analysed. In addition, national reinforcements are studied separately by each TSO.

The first grid master plan was published in 2002. This plan was based upon energy balance calculations with the purpose to identify cross-sections where reinforcements could be interesting. The plan suggested a number of important internal Nordic areas for further studies.

In 2004, a comprehensive analysis of potential for new investments in the Nordic electricity transmission infrastructure was carried out. The results were published in the Nordic Grid Master Plan (NSUP2004) with proposals for grid reinforcement in five prioritized cross-sections (Fenno-Skan 2, Järpströmmen-Nea, South Link, the Great Belt and Skagerrak 4). Four out of these five large reinforcement projects were decided during 2005. These four projects will be in operation before 2015. Only Skagerrak 4 has not been decided. However, a letter of intent has been signed of this interconnection.

In 2007, it was decided to make a new analysis of the potential for further investments in the power infrastructure. The analysis is called Nordic Grid Master Plan 2008.

Nordic Grid Master Plan 2008

The objective of the study was to identify cross-section reinforcements which will be cost-effective according to prospectives for 2015 and 2025 based on the Nordel scenarios described below.

Analysis method and assumptions
An adequate list of potential power infrastructure reinforcements has been set up by the Nordel members. The list covers internal reinforcements within the Nordel area and connectors to the neighbouring regions. The analysis is based on a socio-economic analysis of the costs and benefits of the potential cross-border connections.

The costs and benefits of all potential reinforcements have been calculated and analysed. However, the costs of the reinforcements as well as the increase in capacity they provide have been estimated using "standard values". It has been assumed that all five previously decided prioritised reinforcements will be in operation in 2015.

Construction work on a new 420 kV line at the Meisa mountain in Norway.
Photo: Statnett

A new 132 kV substation at Teigarhorn in Eastern Iceland.
Photo: Emil Thor

The analysis includes the calculation of benefits from improved market efficiency, improved security of supply and reduced electrical losses. Furthermore, market power has been evaluated qualitatively. Figure 5 shows the main workflow.

The robustness of the different future forecasts has been analysed in the form of a sensitivity analysis. The mutual effect of the reinforcements has been quantified.

The analyses of benefits from the new lines are estimated using the Samlast model and MAPS model (see text box). The investment and operation costs of the new or reinforced lines have been estimated and compared to the benefits. The costs and benefits are summarised, and a cost-benefit ratio has been set up for all reinforcements.

Samlast is a combination of the market model called EFI's Multiarea Power Scheduling-model (EMPS) and a power flow model including a transmission grid description of the Nordic countries. The power flow model also includes inter-area transmission capacities. The model optimises production and exchanges to cover the load.

The **MAPS model** is a simulation tool for analysing security of supply in an electricity production system together with a transmission network. The tool calculates "Loss of Load Probability" (LOLP), "Expected Unserved Energy" (EUE) and "Expected Power Not Served" (EPNS) for each area and for the complete system by using Monte-Carlo simulations.

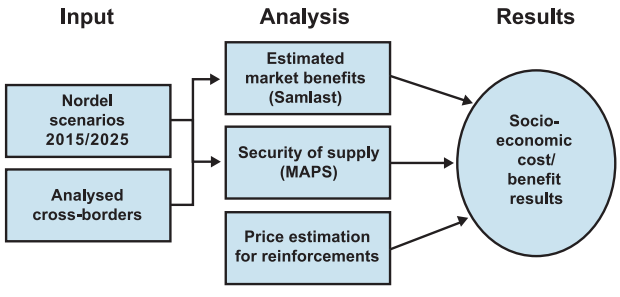
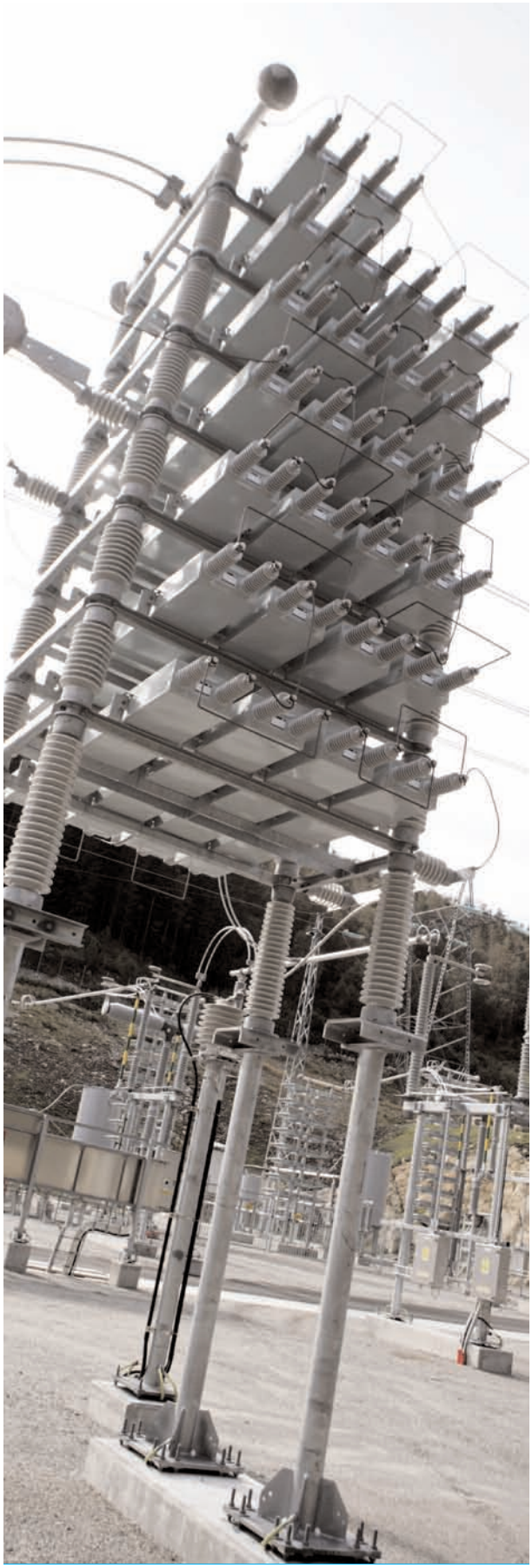


Figure 5. Workflow in socio-economic analysis of reinforcements.



Capacitor at Feda converter station in Norway.
Photo: Erik Thallaug

Scenarios used in Nordic Grid Master Plan 2008
Nordel has developed different scenarios for the future electricity market. The purpose is to analyse the costs and benefits of investments with different future pathways, see figure 6. These scenarios are defined as a business-as-usual scenario in 2015 and as three alternative paths for development until 2025. The three scenarios in 2025 are called Climate & Integration 2025, National Focus 2025 and the reference scenario Business as usual 2025. The Business as usual scenario has been divided into a scenario with a small increase in capacity (BAU -2025) and a scenario with a large increase in capacity (BAU +2025).

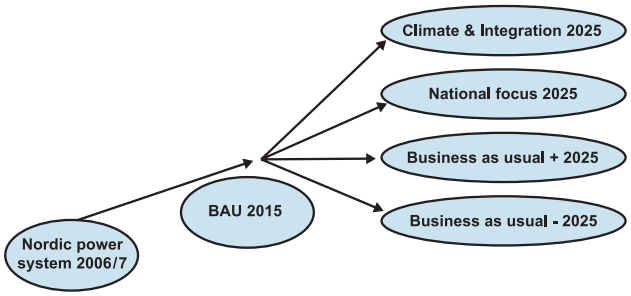


Figure 6. The Nordel scenarios used in Nordic Grid Master Plan 2008.

The focus on environment and the level of international co-operation are some of the significant driving forces in the development of production and consumption.

Results of the Nordic Grid Master Plan 2008
The results of the analysis show that some internal Nordic reinforcements are highly beneficial. Areas with a significantly high benefit from internal Nordic reinforcements are found in Central Norway where a reinforcement will also strengthen the North-South transport axis in Sweden and Norway. Another area is the grid around Oslo, Norway and the connection between Sweden and Norway through the West coast corridor, and finally in the Arctic region. Previous and new reinforcements are shown in figure 7. In addition, 2-3 external interconnections to the neighbouring regions could be profitable.

Apart from the reinforcements identified in the analysis described above, a number of national reinforcements that are important to the Nordic power system are under way.

The Nordic Grid Master Plan 2008 is available on Nordel's website.

Author: Fredrik Norlund, secretary of the Nordel Planning Committee, Svenska Kraftnät

Previously proposed

1 Fenno-Skan II (Decided)
2 Great Belt (Decided)
3 Nea - Järpströmmen (Decided)
4 South Link (Decided) *
5 Skagerrak IV (Letter of Intent)

Proposals for possible new reinforcements

6 Sweden - Norway (South) *
SouthWest Link
7 Sweden – Norway (North-South axis)
Ørskog - Fardal
8 Arctic region
Ofoten – Balsfjord - Hammerfest

* Combined in the "SouthWest Link"

Possible external reinforcements
(Not prioritised)

Reinforcements requiring additional analysis

9 Finland - Sweden

National reinforcements of importance to the Nordic grid

Decided or planned

Under consideration

Figure 7. Previous and new proposals for reinforcements in the Nordic grid and to neighbouring countries.

Statistics

Annual statistics is available at
www.nordel.org

Responsible for statistics (Statistics Group)

Jussi Matilainen, Fingrid Oyj (Chairman)
Christoffer Nicolaj Rasch, Energinet.dk
Ragnar Stefánsson, Landsnet hf.
Morten Torgalsbøen, Statnett SF
Agata Persson, Svenska Kraftnät

Sources

Danish Energy Association
Finnish Energy Industries
Icelandic National Energy Authority
Nordel
Nord Pool
Norwegian Water Resources and Energy Directorate
OECD (Organisation for Economic Co-operation and Development)
Statistics Denmark
Statistics Iceland
Statistics Sweden
Swedenergy

Definitions, units and symbols

Combined heat and power generation (CHP)
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 the industry.

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.

Electricity generation (net electricity generation)
The electrical energy generated by the power plants, excluding the plants' own consumption.

Exchange of electricity
The physical exchange of electricity between the countries.

Gross consumption
The total consumption minus occasional power to electric boilers.

Gross temperature corrected consumption
Gross consumption corrected to correspond normal yearly temperature variations.

Installed capacity (net capacity)
The rated capacity of the power plants excluding the power plant's own consumption of electricity (exclusive heat production).

Losses
Losses in the transmission and distribution networks.

Net consumption
The sum of the electricity delivered to the end users.

Occasional power to electric boilers
The supply of electricity to electric boilers for the generation of steam or hot water, which may alternatively be generated using oil or some other fuel.

Pumped storage power
The electricity used for pumping water up to a reservoir for electricity generation later on.

Total consumption
The sum of electricity generation and net imports.

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

Units and symbols

kW	kilowatt
MW	megawatt = 1,000 kW
GW	gigawatt = 1,000 MW
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 non-existent
..	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

Electricity generation

S5 Electricity generation 2007, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total generation	37 025	77 769	11 976	137 387 [2]	145 087	**409 244**
Nuclear power	-	22 496	-	-	64 278	**86 774**
Other thermal power	29 824	41 111	3	1 443	13 849	**86 230**
- Condensing power	14 001	14 507	-	0	606	**29 114**
- CHP, district heating	13 752 [1]	14 489	-	120	7 135	**35 496**
- CHP, industry	2 011	12 107	-	593	6 082	**20 793**
- Gas turbines, etc.	60	8	3	730	26	**827**
Hydro power	30	13 971	8 394	135 043	65 529	**222 967**
Wind power	7 171	191	-	901	1 431	**9 694**
Geothermal power	-	-	3 579	-	-	**3 579**
Total generation 2006	43 328	78 590	9 925	121 715 [2]	140 314	**393 872**
Change compared to 2006	-14.5 %	-1.0 %	20.7 %	12.9 %	3.4 %	**3.9 %**

[1] Includes condensing power generation.
[2] Gross electricity generation: net electricity generation + power plant's own electricity consumption.

Electricity consumption

S9 Electricity consumption 2007, GWh

	Denmark	Finland	Iceland	Norway	Sweden	Nordel
Total consumption	36 446	90 434	11 976	127 352	146 402	**412 610**
Occasional power to electric boilers	-	0	177	4 311	1 892	**6 380**
Gross consumption	36 446	90 434	11 799	123 041	144 510	**406 230**
Temperature corrected gross consumption	*36 703*	*91 553*	*11 645*	*126 242*	*147 062*	***413 205***
Grid losses	2 244	3 343	817	10 727	10 989	**28 120**
Pumped storage power	0	-	0	1 596	34	**1 630**
Net consumption [1]	34 202	87 091	10 982	110 718	133 487	**376 480**
- housing	9 778	21 150	941	37 425	39 400	**108 694**
- industry (incl. energy sector)	9 933	47 586	8 591	46 725	59 800	**172 635**
- trade and services (incl. transport)	11 015	17 181	965	24 913	28 100	**82 174**
- other (incl. agriculture)	3 476	1 174	485	1 655	6 187	**12 977**
Total consumption 2006	36 392	90 111	9 925	122 572	146 366	**405 366**
Change compared to 2006	0.1 %	0.4 %	20.7 %	3.9 %	0.0 %	**1.8 %**
Population[2] (million)	5.5	5.3	0.3	4.7	9.2	**25.0**
Gross consumption per capita, kWh	6 657	17 063	37 696	26 151	15 737	**16 265**

[1] Estimated net consumption.
[2] At the end of the year.

System load

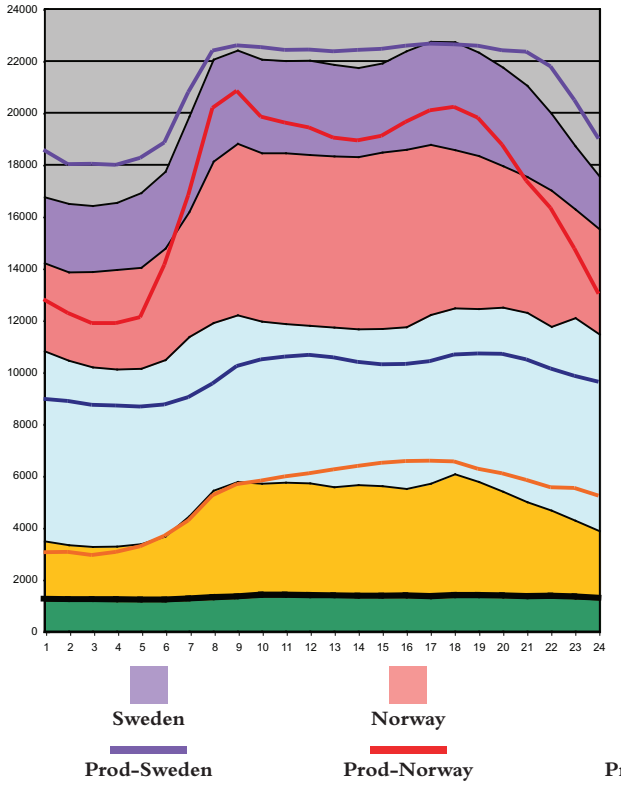
S13 Maximum system load in 2007

	Simultaneous maximum[1)] 21 February 18:00-19:00 (CET) MWh/h	Maximum system load in each country MWh/h	Date/time (local time)
Denmark	6 050	6 372	24 Jan 18:00-19:00
Finland	14 250	14 914	08 Feb 07:00-08:00
Iceland	N.A.	1 711	10 Dec 18:00-19:00
Norway	21 450	21 588	14 Dec 08:00-09:00
Sweden	26 200	26 200	21 Feb 18:00-19:00
Nordel	67 950		

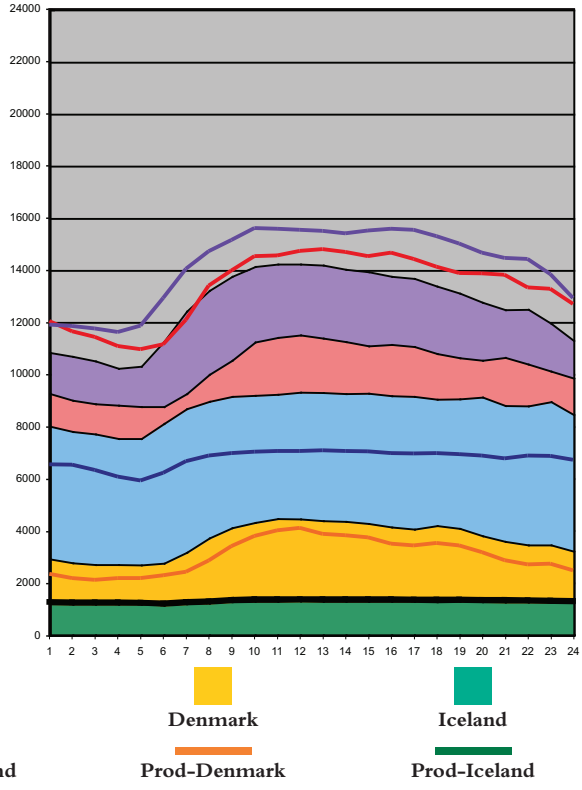
[1)] In the interconnected Nordic power system.

System load 3rd Wednesday in January and in July 2007

Average 24-hour consumption and production 3rd Wednesday in January (2007-01-17) MWh/h



Average 24-hour consumption and production 3rd Wednesday in July (2007-07-18) MWh/h



Maximum system load 3rd Wednesday in January and in July 2007

	3rd Wednesday in Jan 2007 17:00 - 18:00 - MWh/h	3rd Wednesday in July 2007 12:00 - 13:00 - MWh/h
Denmark	6 065	4 378
Finland	12 455	9 301
Iceland	1 324	1 288
Norway	18 558	11 391
Sweden	22 730	14 197
Nordel	61 133	40 554

All hours are local time.

Interconnections

S14 Existing interconnections between the Nordel countries 2007

Countries/Stations	Rated voltage kV	Transmission capacity as per design rules[1] MW		Total length of line km	Of which cable km
Denmark - Norway		**From Denmark**	**To Denmark**		
Tjele - Kristiansand	250/350=	1 000	1 000	240/pole	127/pole
Denmark - 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
Vester Hassing - Lindome 1 and 2	2x285=	740	680	149/pole	87/pole
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	-
Raumo - Forsmark	400=	550	550	233	200
Tingsbacka (Åland) - Senneby	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~	2 200 [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

S15 Existing interconnections between the Nordel countries and other countries 2007

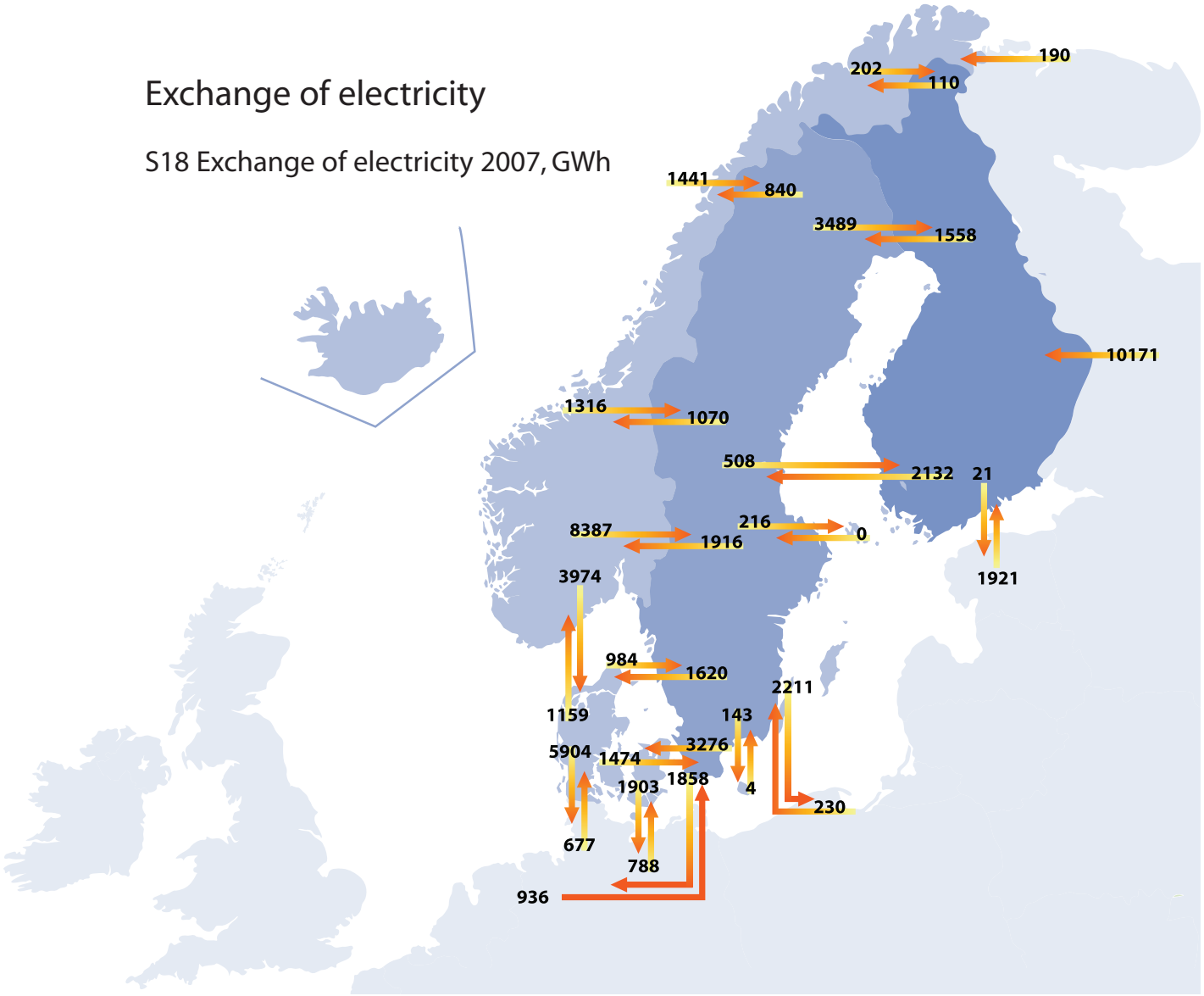
Countries/Stations	Rated voltage kV	Transmission capacity MW		Total length of line km	Of which cable km
Denmark - Germany		**From Nordel**	**To Nordel**		
Kassø - Audorf	2 x 400~	1500	950	107	-
Kassø - Flensburg	220~			40	-
Ensted - Flensburg	220~			34	-
Ensted - Flensburg	150~	150	150	26	5
Bjæverskov - Rostock	400=	600	600	166	166
Finland - Russia		**From Nordel**	**To Nordel**		
Imatra - GES 10	110~	-	100	20	-
Yllikkälä - Viborg [2]	2 x 400~	-	1400	2 x 67	-
Kymi - Viborg [2]	400~			132	-
Nellimö - Kaitakoski	110~	-	60	50	-
Finland - Estonia		**From Nordel**	**To Nordel**		
Espoo - Harku	150=	350	350	105	105
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 limitation in the German network.

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

Exchange of electricity

S18 Exchange of electricity 2007, GWh



S19 Exchange of electricity 2007, GWh

From: To:	Denmark	Finland	Norway	Sweden	Other countries[1]	∑ From
Denmark	-	-	1 159	2 462	7 807	**11 428**
Finland	-	-	110	3 690	21	**3 821**
Norway	3 974	202	-	11 144	-	**15 320**
Sweden	5 039	4 213	3 826	-	4 069	**17 147**
Other countries [1]	1 465	12 092	190	1 166	-	**14 913**
∑ To	**10 478**	**16 507**	**5 285**	**18 462**	**11 897**	**62 629**
					Nordel	
Total to	10 478	16 507	5 285	18 462	**50 732**	
Total from	11 428	3 821	15 320	17 147	**47 716**	
Net imports	-950	12 686	-10 035	1 315	**3 016**	
Net imports/total consumption	-2.6 %	14.0 %	-7.9 %	0.9 %	**0.7 %**	

[1] Russia, Estonia, Germany, Poland.

Mountains near the popular tourist place Landmannalaugar in Southern Iceland.
Photo: Emil Thor

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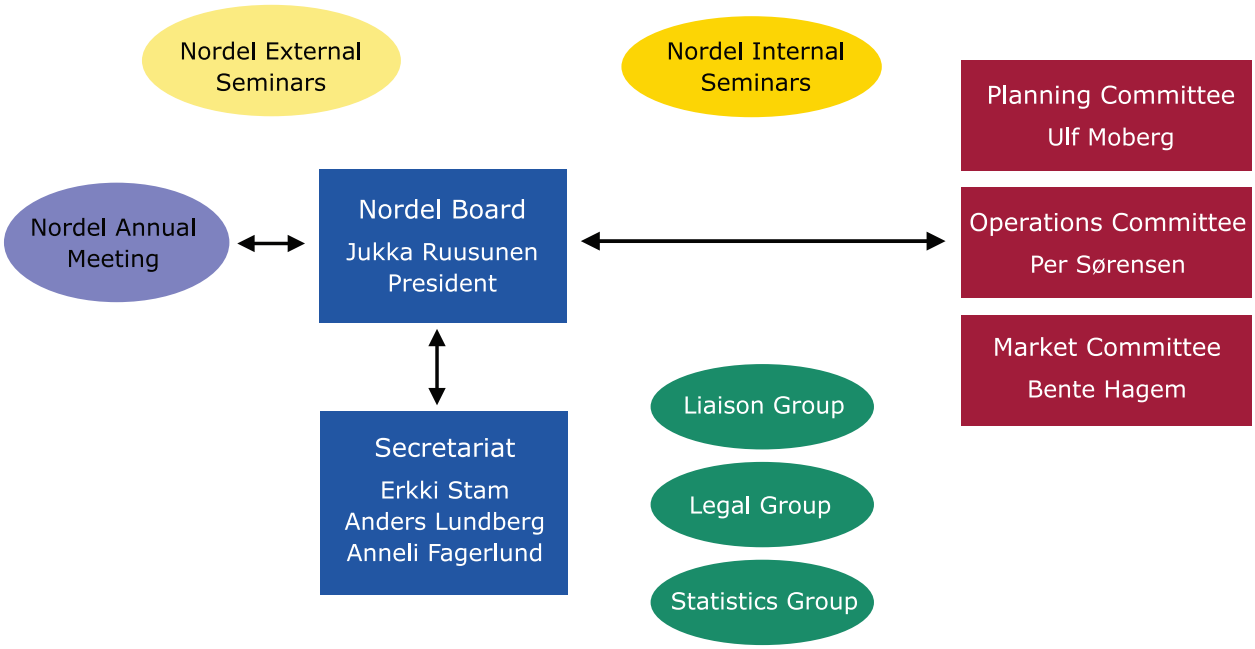

Nordel's annual meeting 2007 was held at Snekkersten, in North-Eastern Zealand in Denmark. The meeting was preceded by a sailing trip in Öresund on board Madonna. Photo: Flemming Wibroe

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