

**THE FUTURE NORDIC ELECTRICITY MARKET:
POWER FLOW HEADING SOUTH - PRICES NORTH...**



NETWORKING ENERGIES

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Further publications

- View on Electricity Markets (monthly publication)
- Weekly Germany
- Weekly Nordic
- Morning Report Nordic
- Weekly France
- Informe semanal (Spanish weekly)

EGL marks the occasion of Norway being the special partner country of the 2006 «E-world of Energy» in Essen, with this special publication analysing and predicting the Nordic power market. The Nordic market exemplifies EGL's vision of the ideal future pan European electricity market. It is open, international, highly liquid and advanced. Not only due to geographic and meteorological conditions, but also due to the fact that the governments, authorities and energy companies of the Nordic countries have shown an exemplary will and ability to keep the interests of the end consumers and environment at the forefront of their priorities. These are the two parties that in other markets have lacked a strong and coherent voice. The result is that the Nordic power market can boast that over time it has delivered the lowest prices and emissions, in a European context.

This analysis, produced by our research group, argues that the days of relatively low prices we are currently enjoying in the Nordic market are numbered, and that ever more physical interconnectors and market based cross border regimes will lead to a convergence of prices, unless of course we again have a very wet hydrological year. This analysis therefore underlines again, that it is impossible for Nordic energy producers and consumers not to occupy themselves with continental fundamental factors. Up to the minute information, analysis and market access is something that EGL already provides to its expanding customer and partner base throughout Europe.

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THE FUTURE NORDIC ELECTRICITY MARKET: POWER FLOW HEADING SOUTH - PRICES NORTH...

Natural relief factors such as mountainous ridges, abundant precipitation and windy spots formed the Nordic electricity market as well as its demand and supply structure more than in other countries: water abundance and wind are harnessed to produce cheap power which resulted in a high demand for electricity - in fact the highest per capita all over Europe.

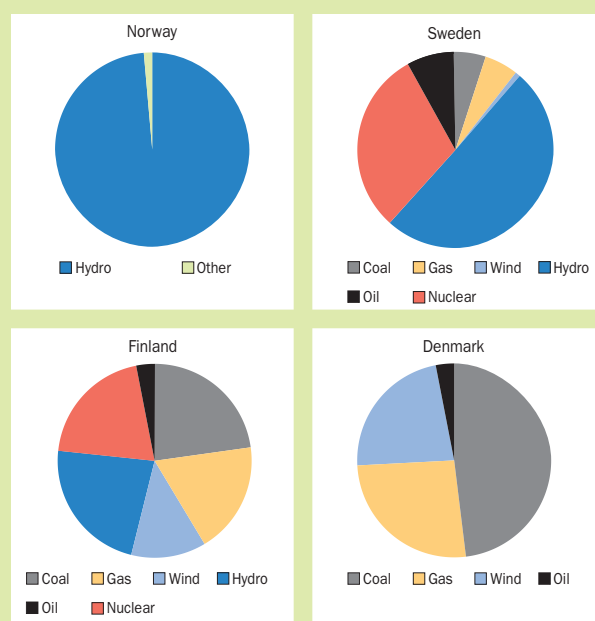
...hydro dominates production

According to the seasonal variations in temperature the consumption pattern exhibits highest demand in winter and lowest in summer. In contrast to Southern European countries with an increasing use of air conditioning during summer, the consumption of the Nordic countries* did not show a significant demand growth in summer. Likewise, the production shows a seasonal pattern with 9'000 GWh/week in winter and 5'500 GWh/week in summer. During the past six years the average yearly consumption in the Nordic region increased only slightly (compare table 1) from 383.5 TWh to 386.7 TWh (+0.8%). Within the Nordic countries Sweden is the biggest power consumer and producer, followed by Norway, Finland and Denmark.

The most important energy source in the Nordic is water. In Norway over 99% of the installed capacity is provided by hydro power stations (compare figure 1), in Sweden it sums up to 50% and in Finland to 22%. Nuclear power is also still a major energy source, even if only Finland and Sweden run nuclear power plants. To a smaller extent coal and gas are energy sources too - especially in Denmark and Finland, while

nowadays oil fuelled plants only marginally contribute to the power supply in the Nordic.

POWER GENERATION PARKS



(Fig. 1)

*1

... the import/export pattern

Also the import/export pattern heavily depends on the water reservoir levels. Historically, the Nordic region used to be a net exporter, but between 2001 and 2004 it was on average a net importer. During this period Denmark was a net exporter and Finland a net importer, while Sweden and Norway oscillated between being net exporter and importer depending on

PRODUCTION AND CONSUMPTION IN THE NORDIC COUNTRIES

| GWh | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | |
|----------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|-------------|------------|-------------|------------|--|
| | consumption | consumption | consumption | consumption | consumption | consumption | production | consumption | production | consumption | production | |
| Denmark | 34'899 | 36'122 | 35'650 | 35'273 | 35'590 | 38'584 | 35'310 | 34'653 | | | | |
| Finland | 79'116 | 80'356 | 84'786 | 86'200 | 87'864 | 82'901 | 83'630 | 68'993 | | | | |
| Norway | 121'633 | 127'006 | 122'294 | 116'421 | 122'947 | 111'153 | 123'406 | 140'284 | | | | |
| Sweden | 147'818 | 151'277 | 151'210 | 147'593 | 148'596 | 150'707 | 145'334 | 157'617 | | | | |
| Nordic | 383'465 | 394'761 | 393'940 | 385'487 | 394'997 | 383'345 | 387'680 | 401'547 | | | | |

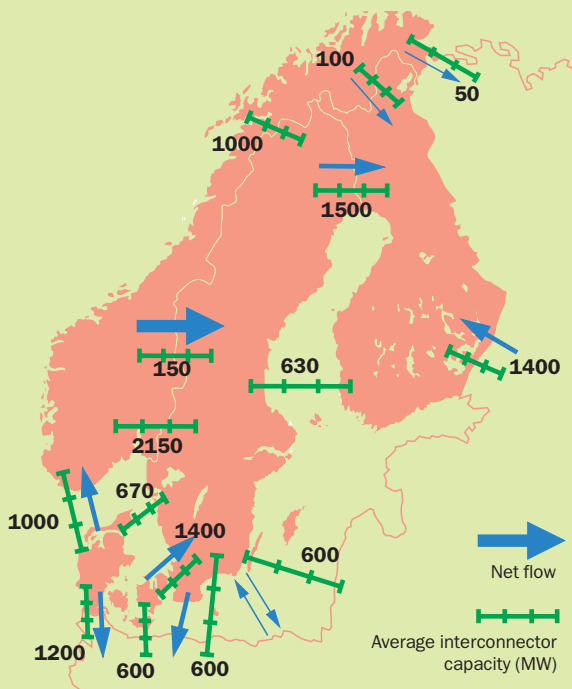
(Tab. 1)

*2

the water reservoir levels respectively. The Danish import/export shows a seasonal pattern with a net import during summer and net export during winter. The remaining countries do not exhibit such oscillations, since their seasonal reservoir oscillations compensate the seasonal demand. In normal hydrological years, Norway is a power importing country (compare figure 2), while Denmark is an exporter and Finland depends on imports from Russia and Sweden.

In order to enable importing and exporting power, the Nordic countries are well interconnected. Grids and **inter-connectors** are regularly upgraded to increase the transmissi-

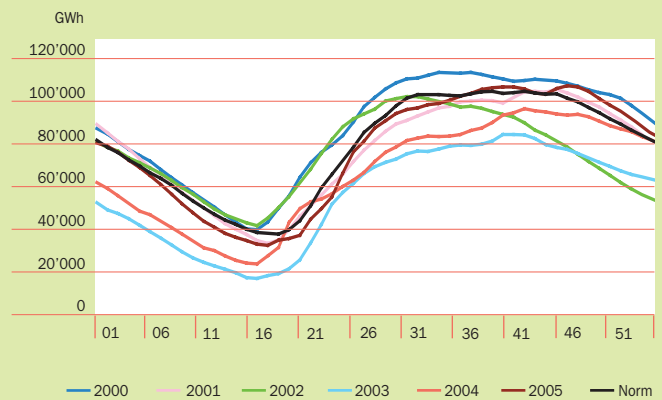
INTERCONNECTORS AND NET IMPORT/EXPORTS



(Fig. 2) *1

on capacity in the region. Nevertheless, export restrictions still exist due to the lack of transformer stations. In addition, the interconnection to Germany (Baltic Cable) often has to be restricted in order to prevent imbalances and grid instabilities. They occurred in the South of Sweden as a result of the closure of Barsebäck 2. In order to overcome such restrictions and in

NORDIC WATER RESERVOIR (THE NORM IS BASED ON THE SUM OF THE NORWEGIAN (1990-2003) AND THE SWEDISH (1950-2001) NORM)



(Fig. 3) *2

anticipation of the increasing need for transmission capacity new interconnectors between Finland and Estonia (Estlink, 350 MW), Norway and the Netherlands (NorNed, 700 MW) as well as Finland and Sweden (Fenno-Skan 2, 600 MW) are currently being built and should come into operation in late 2006, 2007, 2010 respectively. Moreover, there are also discussions on further cable projects between Russia to Finland and Sweden.

... the prices

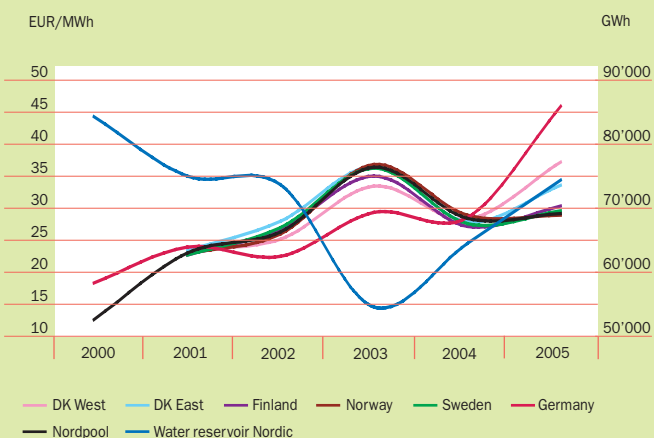
Short term power prices are dependent on various **price determinants** such as demand, availability of power plants and fuel prices. Due to the powerful hydro power park reservoir levels are the major price determinants in the Nordic countries more than in other European markets.

The abundant hydro resources have historically enabled the Nordic region to produce cheap power and to be a net exporter of electricity as mentioned before. However, temporary adverse hydro conditions used to push prices up and forced the Nordic region to import power. During wet and normal hydrological years average Nordic power prices are therefore lower than in the continental European market. Generally, it

can be observed that the electricity price within the Nordic region negatively correlates with the percentage of installed hydro power. Thus, normally prices are lowest in Norway followed by Sweden, Finland, Denmark East and Denmark West. The major reasons for the higher prices in Denmark are the close interconnection to Germany as well as the more thermal dominated power plant park. The high degree of combined heat and power plants dampens in that case the price effect of thermal power plants. Moreover, the restrictions on the Baltic Cable impact prices in Denmark too. In dry years the price pattern is in reverse order with lowest prices in Denmark West and highest in Norway.

In the previous six years **reservoir levels** were only in 2000 clearly above the norm, while 2002, 2003 and 2004 were dry years resulting in reservoir levels below the norm (compare figure 3). Thanks to heavy precipitation in the course of 2005, levels recovered and are currently around the norm. As a result, during this period average yearly spot prices were highest in 2003 and 2002 (compare figure 4 and figure 5) when the reservoir levels were significantly below the norm. In these years, even average German prices were lower, despite the price spikes during the heat wave in 2003.

YEARLY AVERAGE SPOT PRICES (BASE) AND RESERVOIR LEVELS

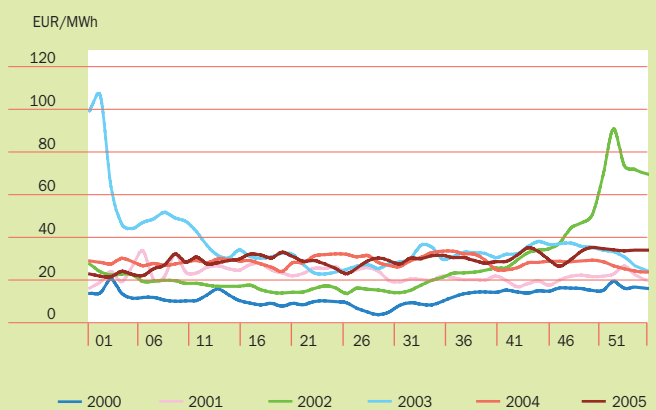


(Fig. 4)

*2, *3, *4

In 2005, however, when the reservoir levels recovered, prices were lower than in 2002 and 2003, but still on a higher level than in 2001 when the water reservoirs were equally. This indicates that the Nordic prices are, to an increasing degree, influenced by the price level in countries outside the Nordics such

SPOT PRICE (BASE) HISTORY IN THE NORDIC COUNTRIES



(Fig. 5)

*3

as Germany due to the increase of cross border trading. As a consequence, the introduction of the CO₂ emission trading in 2005 impacts implicitly the Nordic countries prices too, despite the high percentage of emission free power production. This effect is expected to increase when the NorNed Cable comes into operation enabling an enhanced interconnection between the Nordic region and the continental European markets.

... but wind and gas are catching up

The future power price development in a specific area very much depends on its economic development and the resulting demand evolution as well as the political framework and its decisions concerning **future power generation parks**.

Our model for long term forecasts provides prices, data on import/export patterns and changes in the power plant park, based on demand and fuel price developments from official

studies as well as currently known political guidelines. According to these model results the total installed capacity in the Nordic countries should be expanded until 2020 by around 20% of the actual installed capacity (compare figure 6). There should be an increase in installed wind, gas, nuclear and hydro capacity while the installed coal capacity is expected to remain constant. Installed oil capacity should decrease. Broken down to the individual countries the power plant parks are expected to change as following:

- In Denmark there will be a decrease of installed oil capacity, existing coal will be replaced by new coal plants and new gas and wind plants will be installed.
- In Finland the total installed coal capacity will decrease while installed nuclear (in 2009 and 2015), wind and gas capacity will increase.
- In Norway there will be an increase of installed wind, gas and hydro capacity.
- In Sweden the installed oil capacity will decrease, existing coal will be replaced by new coal plants and gas, wind, hydro new installed.

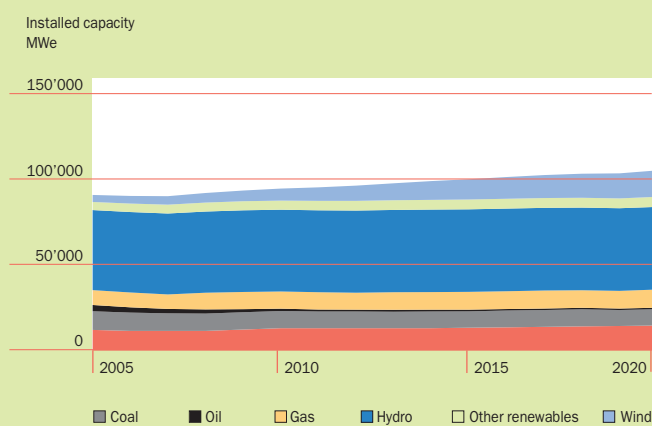
As a result, **average spot prices** in the Nordics are expected to reach more than 45 EUR/MWh until 2008 followed by a decrease below 40 EUR/MWh and rebounding until 2020 above 40 EUR/MWh.

... if politics are favourable

As previously mentioned, not only economic factors but also the **future political framework** is of major importance when it comes to the decision to build new power plants. The political regime in the Nordic countries is on the one hand rather reserved concerning the building of new power plants but on the other hand eager to assure the region's energy self-sufficiency.

There are numerous projects for on- and offshore wind parks in all Nordic countries. Some of these projects may stop because of political opposition, lack of grid capacity and commercial reasons. Developers are now awaiting the joint Norwegian-Swedish market for green certificates, which will

EVOLUTION OF INSTALLED CAPACITY



(Fig. 6)

* 5

boost new projects. Although the future shape of this market is still subject to disagreements regarding the treatment of hydro power, it is expected to come into operation in 2007. In summary, wind power is expected to increase but the modelled amount might mark a maximum.

The governments have decided to grant limited licences to gas fired plant projects. But due to the high gas prices and the CO₂ obligations many producers hesitate to build gas-fired plants. In addition, the lack of supply infrastructure for natural gas is also expected to hinder a fast growth in Sweden. Nonetheless, we expect the percentage of the gas-fired power to increase as predicted by our model to back up the volatile wind contribution.

With the planned new nuclear power reactor the policy regarding the future of nuclear power in Finland is definite. The 1600 MW reactor will go online in 2009. In Sweden the electorate voted for nuclear power to be phased out completely by the year 2010. As a result the two reactors, Barsebäck 1 and Barsebäck 2, were decommissioned in November 1999 and in May 2005 respectively. But the future policy is vague since full implementation of a nuclear closure plan would lead to severe energy policy challenges, as the country would become more dependent on both electricity imports and CO₂-emitting fossil

fuels. Our forecast thus includes no further nuclear decommissioning.

The hydro development has been constrained by environmental objections to dam construction and some existing hydro plants are also restricted in terms of the water they can use. Thus, we consider the forecasted slight increase of installed capacity as reasonable.

Due to their lower CO₂ emission intensive power production gas stations were favoured over coal plants. However, coal regained economical attractiveness due to the recent prominent increase of gas prices. In addition, new technologies lead to an improvement of the technical efficiency reducing the disadvantage compared to gas fired stations with respect to greenhouse gas emissions. We therefore expect the governments to slightly ease restrictions and to increasingly grant licences for building coal plants.

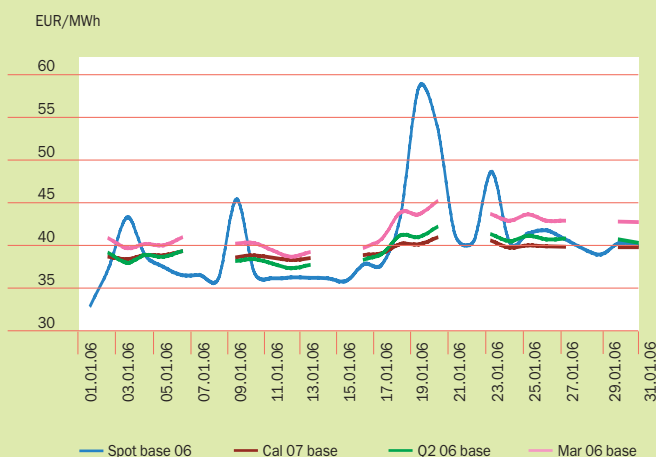
...concluding, power flow is heading south and prices north!

Spot prices rose significantly during the first days in 2006 and are currently on a much higher level than last year (compare figure 7). Reasons for this increase are the low precipitation in the beginning of January and the cold snap in the second half. In addition, the full incorporation of the Danish area prices into the Nordpool prices from the first of January and therefore the bigger influence of Germany also contributed to the price shift. This despite the fact that the small Danish volume only accounts for round about 10% of the overall System price. Moreover, given the fact that reservoir levels are around the norm, the wind contribution was good and exports were reduced such high prices are still rather exceptional. This indicates that in future the supply situation could worsen even in normal hydrological years.

In order to ensure the Nordic countries' energy self-sufficiency governments and utilities are therefore challenged to bring forward a sustainable energy policy. Despite higher CO₂

emissions, restrictions for the building of new thermal plants might be eased. Thus we consider our model forecasts exhibiting an increase in wind, gas and to a smaller extent also hydro and coal capacity to be reasonable. In addition, further interconnector projects might arise in order to make increasing needs for imports and exports available.

ACTUAL PRICES



(Fig. 7)

As a consequence the dominance of hydro power should decline and the influence from the fuel- and CO₂- on power prices will grow. Thus, our modelled average spot price scenario appears plausible. However, compared to the neighbours in the South the Nordic prices should stay rather low and therefore net power flow should continue to head south.

*note that «Nordic countries» refers to Sweden, Norway, Denmark and Finland throughout the article.

*1 Nordel, *2 Syspower, *3 Nordpool, *4 EEX, *5 EGL


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