Report from the Nordic competition authorities No. 1/2003

A Powerful Competition Policy

Towards a more coherent competition policy in the Nordic market for electric power

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Copenhagen, Oslo, Stockholm
20 June 2003

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Preface

At the meeting between the Nordic competition authorities in Iceland 12 – 13 September 2002 it was decided to establish a working group on the power market.

The mandate of the working group:

> *The power markets in the Nordic countries have gone through major changes during the last decade: competition has been introduced and the national markets have been integrated.*
>
> *These processes have been successful but also brought new challenges for a suitable regulation of the market. Competition in the wholesale market for electric power takes place in the Nordic area, while competition policies are national. This raises the issue of an improved co-ordination of competition policy among the Nordic countries.*
>
> *Against this background the Nordic competition authorities decided at the meeting 13 September to establish a working group. The working group shall*
> - *identify common Nordic competition issues in the market for electric power,*
> - *consider actions to handle obstacles to competition,*
> - *consider suggestions to amend regulations in order to improve competition,*
> - *suggest co-operation solutions to improve the effectiveness of competition law enforcement.*
>
> *The working group shall also consider obstacles to competition as a consequence of the integration of actors between different levels of the power market.*
>
> *The working group shall take a broad view on competition policy, which means that it might be necessary to look at adjacent regulations of importance for the functioning of the markets, as for instance regulation of the electricity grids.*
>
> *The report of the working group shall be concluded by 1 June 2003 and shall be presented at the next meeting of the Nordic competition authorities in the autumn 2003.*

The members of the working group have been:
Lasse Ekeberg, the Norwegian Competition Authority (head)
Lasse Sundahl, the Danish Competition Authority
Marie Römpötti, the Swedish Competition Authority
Ove Skaug Halsos, the Norwegian Competition Authority
Per Kristian Bryng, the Norwegian Competition Authority

The working group has met four times:

Oslo	30 October 2002
Stockholm	20 January 2003
Copenhagen	14 March 2003
Oslo	2 – 3 June 2003

The report is organised in line with a typical competition analysis. In chapter 1 we give a general description of the Nordic power market. In chapter 2 the relevant markets are defined. Market concentration in the various relevant markets is calculated in chapter 3. In chapter 4 we discuss market power and its effects. Chapter 5 contains a market simulation modelling. Chapter 6

presents the legal framework and the scope for co-operation on cross-border mergers. Finally, chapter 7 contains our conclusions and recommendations.

We would like to thank all those who have contributed with helpful comments and other inputs to the report. In particular, we wish to thank the Danish system operator Eltra for the model simulations used in chapter 5.

SUMMARY

Conclusions and Recommendations

The Nordic Working Group has examined market power in the Nordic power market with a view to suggest measures to increase competition and improve co-operation on national competition policy enforcement.

The Working Group's opinion is that the deregulation of the Nordic electricity sector has been largely successful. However, some obstacles to competition remain:

- Bottlenecks in the grids divide the Nordic region into shifting constellations of relevant geographic markets.
- Market concentration figures in these geographic markets are very high.
- The high market concentration figures are partly due to cross-ownership and jointly owned production plants.
- Inflexibility of the production plants and capacity constraints on production enhances market power. Even a small firm can exert market power.
- Demand for electricity is very inelastic.
- Practises with negative effects on competition may have ripple effects all over the Nordic region.
- There are high barriers to entry.

The Working Group would like to draw attention to the following actions which could be used to promote competition:

- Mergers leading to increased market concentration must be carefully reviewed.
- The reasons for concern are more predominant regarding mergers between companies having flexible production technologies than between mergers involving inflexible technologies.
- One or two major producers dominate all national markets. The large extent of cross-ownership is an obstacle to well-functioning markets. Authorities should consider if and how more procompetitive company and ownership structures could be created.
- Transmission system operators should endeavour to increase the effective capacity utilisation of the transmission grids.
- Transmission system operators should pay due attention to competition considerations in investment analyses of new transmission capacity.
- Increased transmission capacity will usually reduce the scope for exerting market power. However, increases in transmission capacity will not fully eliminate market power.

In order to improve co-operation on competition policy enforcement in the Nordic region, the Working Group would like to point out:

- Although there are separate regional geographic markets the effects of many mergers and anticompetitive business practises are inter-Nordic.
- Market power being exerted in one region may have detrimental effects in all parts of the market.
- When national competition authorities handle mergers and anticompetitive business practises there is a risk that the overall effects will not be taken into consideration.
- In the power market the opportunity for exchanging information under the Nordic agreement on exchange of information will be of particular importance.
- The procedures should be implemented that will enable involvement of the Nordic national competition authorities in the handling of cases with effects in more than one country.
- An inter-Nordic working group should be established in order to exchange views and promote harmonisation of the analytical framework.
- The Nordic group should not be a closed forum but invite other European competition authorities to participate when relevant.
- Information exchange between Nord Pool, Nordic energy agencies, financial authorities and competition authorities should be strengthened.

The Nordic Electricity Sector

Since the beginning of the 90ties the Nordic countries have reformed their electricity sectors. Norway, Sweden, Denmark and Finland now have access to a common wholesale power market.

Generation of electricity in the four countries in 2001:

Country	Production (TWh)	Share
Sweden	158	41%
Norway	122	31%
Finland	72	19%
Denmark	36	9%
Total	388	100%

Hydropower generation totalled 213 TWh in 2001 (equalling 55% of total generation). Nuclear power totalled 91 TWh (24%), conventional thermal power 79 TWh (20%) and wind power 5 TWh (1%).

In Norway production of electricity is based on hydropower (99%), in Denmark on conventional thermal power (88%). Electricity generation in Sweden is based on hydropower (50%) and nuclear power (44%), in Finland on thermal power (50%) and nuclear power (31%).

Power trade between the Nordic countries makes use of the advantages to be gained from interconnecting hydropower and thermal power systems. It is expensive to build thermal power plants to meet short-term peaks in demand, and it is both time-consuming and costly to adjust production up and down in existing thermal power plants. Electricity generation in hydropower plants can be adjusted up and down rapidly and at low costs to meet short-term fluctuations in consumption or unexpected changes in power supplies. Thus, trade reduces the need for costly adjustment of thermal plants.

In hydropower plants the limiting factor is the inflow of water and the amount of water in the magazines. The pattern of demand for electricity, and thus the amount that must be generated, is generally the reverse of the fluctuations in inflow. When the inflow is high, production is often low, and vice versa. A system based entirely on hydropower production would have to rely on the ability to store water in the reservoirs. Trade reduces the need to invest in multi-annual water reservoirs.

The creation of an integrated Nordic market is also advantageous to competition. The reason is that the largest national producers have most of their production capacities located in their home country. In such a situation an enlargement of the market means an increase in the number of competitors and reduced market concentration.

Electricity prices are determined by supply and demand in the Nordic market. Nord Pool – the Nordic Power Exchange – is the most important marketplace for sales and purchases of electricity in the Nordic region. Being established in 1996 Nord Pool was the first multinational power exchange in the world.

Nord Pool operates the following marketplaces:
- A spot market for physical contracts, Elspot
- A financial derivatives market – futures and option contracts
- Clearing services for contracts traded in OTC bilateral contracts

Defining the market

The power market can be divided into several sub-markets. This report focuses on the wholesale market for physical delivery of electricity.

There are no close substitutes for electricity. In the short run (on an hourly basis) demand is very inelastic. Also in the longer run – during a season or some months –the price sensitivity of demand is low. We therefore ascertain that wholesale of electricity is a separate product market.

An important characteristic of the power market is the lack of opportunity to store the product. Electricity must be consumed in the same instant it is produced. The substitutability between different time periods is also restricted. The lack of possibilities for consumers to store electricity and the limited substitution between time periods implies that the relevant geographic market must be distinguished by the time at which the electricity is delivered.

In periods where there are no congestions in the inter-Nordic transmission network (no bot-

tlenecks), the relevant geographic market is delineated to the Nordic region (Norway, Sweden, Finland, Denmark). Bottlenecks separate the market geographically. The separate relevant geographic markets can vary from one hour to the next. The Nord Pool Elspot price areas (Sweden, Finland, Southern Norway, Middle/Norther Norway, Western Denmark and Eastern Denmark) may correspond to the relevant geographic markets.

The distribution of price areas within the Nordic area and the frequency with which they occur varies from year to year primarily due to variations in weather conditions. We have calculated the frequency of different constellations of Elspot price areas that occurred in 2001.

The table below shows the most encountered constellations of price areas in 2001.

The Nordic region	51.8%
Denmark West	19.1%
Norway Middle/Norway North	18.5%
Norway South	8.9%
Norway Middle	8.2%
Denmark West/Norway South	6.3%
Denmark East	5.4%
Norway North	5.3%
Finland, Denmark East, Sweden	5.3%

The integrated Nordic region is the most frequent price area. It occurred in 52% of the time in 2001. Note however, that in 2002 the percentage was 35% hour. It also means that half of the time or more the relevant geographic market is narrower than the Nordic region.

Market Concentration

Traditionally, market concentration has played an important role in competition policy analysis. The more concentrated a market is, the more likely it is that the market actors can utilize market power, either unilaterally or collectively. By assessing market structure (for instance market concentration) one can deduce probable market conduct and the market performance (the so-called SCP paradigm).
A well-known concentration index is the Herfindahl-Hirschman Index (HHI). The HHI is defined as the sum of the squares of market shares of all the firms in the relevant market. The HHI will vary between 0 (an atomistic market) and 10 000 (monopoly) if market shares are measured in percentages.

In the oligopoly Cournot-Nash model, in which firms compete on quantities, there is a direct relationship between market concentration – as measured by the HHI – and market power – as measured by the Lerner index (L), which is the difference between the market price and the marginal cost relative to the market price.

Cross-ownership denotes the situation where an investor owns shares in two or more companies in the same market, either in the form of direct ownership interests in several companies or by indirect ownership. In the latter case companies in the same market owns shares in each other.

An investor is supposed to maximise the value of his portfolio of shares in companies in the same market. Increased price of a product of one company will generate increased demand for the products of the other companies in the market. Therefore, cross-ownership means higher incentives for the investor to increase prices. It is possible to derive an incentives adjusted concentration index (HHIi).

Cross-ownership might also give the owner some degree of control over the firms and abil-

	HHI	HHI^{i}	HHI^{ic}
Finland	1766	2037	3005
Norway	1634	1980	3325
Sweden	2893	2923	2988
Denmark[1]	4844	4844	4844
The Nordic Market	892	989	1138

1 Calculating the various HHIs for the Danish markets does not give a fully realistic indication of the extent of market power, confer chapter 3.6.

ity to co-ordinate their behaviour in the market. It is possible to derive an incentive and control adjusted concentration index (HHIic).

The working group has calculated the HHI and the HHIic in certain candidate relevant markets, confer the table below:
According to the unadjusted HHI the national Nordic markets seem to be moderately concentrated, with the notable exception of Sweden and Denmark. However, taking the full effects of cross-ownership into account all four national markets are highly concentrated. It should also be emphasised that even the integrated Nordic electricity market is a moderately concentrated market, when the full effects of cross-ownership is being taken into account.

Hydropower plants in Norway and nuclear power plants in Sweden are jointly owned by two or more producers. Such joint ownership concerns a large part of total electricity production. Joint ownership concerns all nuclear power plants in Sweden, i.e. approximately 44 per cent of total production in Sweden. To our knowledge the situation is similar in Finland, but we have not been able to ascertain this information. Joint ownership of Norwegian hydropower production plants concerns approximately 30 per cent of total electricity production in Norway.

Taking into account the effects of joint ownership we find:
- The HHIic in Sweden is increased from 2988 to 3169.
- The HHIic in Norway is increased from 3325 to 3644.

Market power and its effects

The residual demand curve for a producer determines what quantity and what price will be most profitable. The residual demand is given by total market demand less the supply of the other producers at each price level. It shows the relationship between the price the producer chooses and the quantity the producer sells.

The following factors make the residual demand of a producer less price elastic:
- Inelastic market demand,
- lack of flexible production technologies,
- production capacity of competitors is constrained,
- bottlenecks (capacity constraints in the grids),
- weak competition between the producers.

The first of these factors concerns the elasticity of market demand. The other factors concern the elasticity of the rest supply.

The price sensitivity of the market demand for electric power is small in the short term (on an hourly basis). This is partly due to consumers not being informed of or charged for short-term price variations, partly because substitution possibilities are limited.

Production plants with flexible production technology are hydropower plants in Norway and Sweden and condensing power stations in Denmark and Finland (and to some degree in Sweden). Firms with inflexible production technologies will not be able to expand production to hinder exertion of market power. Therefore, a merger between two producers with flexible production technologies is worse than a merger between one with flexible and one with inflexible production technologies, which again is worse than a merger between two producers with inflexible production technologies.

When a firm operates at maximum capacity it will not be able to increase production as a response to an increase in market price. Again the firm would have inflexible production, not because of its production technology as above, but because it is operating at a maximum production scale. If all competitors operate at their capacity levels, the remaining producer will in fact operate as a monopolist towards its residual demand. The closer the market is to full capacity utilisation, the less risky it is for a producer to increase price, since there are fewer suppliers with a possibility to increase production.

Bottlenecks will prevent increased sales from a producer outside the relevant geographic market. Thus, bottlenecks will reduce the number of competing actors and lower the elasticity of the residual demand.

Finally, the elasticity of the residual demand also depends on the strategic behaviour of the competitors. Even if competitors are able to increase production as a response to an increase in market price, they might not be willing to do so. If competitors lack incentives to compete, it will be possible to exert some degree of market power.

There are certain features of the electricity power market, which makes it prone to collective dominance: Price is inelastic. Electricity is a homogeneous product with particularly transparent prices in the spot market. The market actors meet daily on the spot market. Other features indicate that collective market dominance may be less likely: Asymmetrical market shares may be an indication of conflicting interests between the producers.

Exertion of market power will partly increase the general price level and partly prolong price differences where such price differences would otherwise not have existed. These price effects may give rise to several types of efficiency losses, in both the short and the long run.

Market modelling

Due to various analytical challenges in competition analysis as such and competition analysis in the electricity sector in particular, modelling of markets and firm behaviour can be a useful tool. A market simulation model can be utilised to study the effects of for instance a merger on the Nordic market.

We present results stemming from two model simulations of week 3 in 2005 done by the Danish system operator Eltra on request from the Working Group. The first model simulation studies the incentives of Nordic generators to exercise market power and the effects on the Nordic market. The second simulation studies the effects on the Nordic market of an inter-Nordic merger. In the simulation a Norwegian and a Finnish generator are merged.

The model simulation shows at least two different examples of how to exercise market power.

Firstly, generators having market power prevent prices from falling below the level in the neighbouring countries during early morning hours. According to the model results, the immediate reallocation of wealth if this particular form of market manipulation happens five nights a week for five hours in three winter months the Danish and Finnish consumers loose DKK 56 Mio. each year.

Furthermore, the behaviour leads to an efficiency loss (in a partial static analysis) since more expensive generation in Sweden is substituted for cheaper generation in Finland. Whereas the increase in prices alters the allocation of wealth, the increase in Swedish generation reflects a real economic loss: Relatively inefficient production plants produce electricity when more efficient plants still have spare capacity.

Secondly, market power can be exerted during peak load hours in the middle of the day. The general price level in the Nordic countries is increased by approx. DKK 100 per MWh due to market power lowering the overall consumption. If this kind of market manipulation happens twice a week every second week the simulation shows that the total loss for Nordic consumers would amount to DKK 330 Mio. a year.

The simulation also shows that it is possible to exert market power during weekends.

From the simulation of an inter-Nordic merger between a Norwegian and a Finnish generator one important insight emerge: Such a merger can have effects on the entire Nordic system. Due to the merger the price level in peak load hours is increased in all Nordic areas. In low demand hours there seems to be no effect on the market. If this price manipulation due to the merger happens five times a week for seven hours in three months the yearly transfer of wealth compared to the alternative market power scenario amounts to approximately DKK 1,6 billions. Compared to a scenario with free competition the transfer of wealth is approximately DKK 4,5 billions.

All firms gain from exercising market power. Without the merger the two Danish generators

gain the most. The simulation of the merger shows that all the non-merging firms gain relatively more than do the merging firms. The fact that the non-participating firms receive the largest increases in profits due to the merger is not surprising. As can be expected the merging firms reduce output in order to increase prices. The other firms profit from the higher price and do not have to reduce output.

The Legal Framework and the Scope for Increased Co-operation

A comparison of the merger legislations in the four Nordic countries shows that there are both substantive and procedural divergences facing the Nordic enforcement agencies. Norway, for example, is the only Nordic country to apply the substantive test of "substantial lessening of competition", while Sweden, Denmark and Finland apply a "dominance test".

Differences in national competition legislation could potentially lead to some enforcement problems. On a procedural matter the subject of different timetables of which the enforcement agencies must uphold could also be troublesome. These differences are however not impossible to overcome. An increased harmonisation of the procedural rules would, however, help make co-operation between the enforcement agencies easier. It would thus be of interest for the competition agencies concerned to promote such a harmonisation.

The different substantive tests used by the competition authorities may risk causing diverging results in merger analysis. However, the key question for any competition authority regardless of the substantive test used is whether or not the merging companies will achieve or strengthen their ability to exert market power after the merger. It is desirable for the competition authorities to work towards a harmonised analytical framework. Such harmonisation would have to be consistent with the competition policy of the European Union.

Discussions between the competition authorities involved are a welcome device in many cases for national agencies. In the context of cases dealing with cross-border mergers they would provide a flexible instrument for the effective and non-bureaucratic exchange of views and ideas. However, such discussions will be insufficient if it is of importance for an agency to get access to confidential information held by other agencies.

Information sharing is very important when seeking a more effective regime for co-operation between the Nordic countries regarding cross-border competition cases. The focus here is on the sharing of confidential information. It would be extremely difficult for a competition authority to assess a merger without access to this kind of information. The ability to exchange such confidential information between the competition agencies concerned is of great importance when creating a fruitful climate for co-operation regarding cross-border mergers.

The foundations set up in the Agreement between Denmark, Iceland, Norway and Sweden on co-operation in competition cases (the Nordic agreement) represents a good platform for co-operation regarding cross-border competition cases. The market players on the Nordic power market can probably be expected to attempt further integrations in the near future, and the Nordic agencies would benefit from being able to co-operate with each other in response to such efforts on the part of the market players.

The advantage of the current agreement is the mere fact that it opens for the exchange of confidential information. One shortcoming of the agreement is that Finland has not entered the agreement. Another disadvantage is that it does not open up for the possibility of gathering information from undertakings on the request by another enforcement agency.

The ability to exchange confidential information does not seem to be fully satisfactory for the purpose of co-operation in the case of cross-border mergers in the power market. As laid out above in this chapter, there is a risk for diverging results when applying the national legislation regarding cross-border mergers. This risk would be lowered with increased harmonisation of the analytical framework.

1. THE NORDIC ELECTRICITY SECTOR[2]

1.1 The Reform of the Nordic Electricity Sector

In 1989-90 England and Wales were the first in Europe to liberalise their electricity markets. Since then, all the Nordic countries apart from Iceland have introduced market-based power trading.

The development of a common Nordic power market started out with the Norwegian 1990 Energy Act. The Act, which entered into force on 1 January 1991, reformed the electricity sector of Norway dramatically by moving from heavy regulation to liberalisation.

The objectives of the regulatory reform were, among others, to
- smooth out artificial price differences between different areas and different consumers,
- improve consumers utilisation of electric power,
- increase efficiency in both production and distribution of electric power,
- secure efficient building of new production capacity, in the right scale and order.

Prior to the reform there were substantial differences between the power prices in different regions. In 1989 the highest price was two and a half times as high as the lowest at the same time. Such differences could lead to undesirable decisions concerning investments in new production capacity. In high-price areas expensive projects could be effectuated while cheaper projects were rejected in low-price areas.

It was generally held that both the total volume of investments in production capacity and the ranking of the various projects were not efficient. There was a built-in tendency in the system to focus on the need to secure supply of electricity regionally, by means of investing in production facilities located near by. Alternatively, regional supply could have been secured by purchasing electricity on a national market, and thereby inducing perhaps more cost efficient investments in projects located elsewhere.

Basic elements of the reform were
- abrogation of the local monopolies of supply, consumers were free to buy electricity from a wide range of suppliers in all parts of Norway,
- establishment of common carriage principle,
- regulation of transmission tariffs,
- obligations for vertically integrated companies to split trade/production and transmission into separate divisions and have separate budgets and accounts
- divestment of Statnett SF (the Norwegian Power Grid Company) from Statkraft, which was thus transformed into a pure generating company,
- establishment of organised spot, future and regulation markets.

1 January 1996 the Swedish electricity market was reformed. New rules introduced competition on trade and production of electricity. The network remained a regulated monopoly. The objective of the reforms was, among other things, to increase the opportunities to choose and to lay the foundations for increased competition in power supply. From 1 November 1999 electricity prices were fully liberalised.

The Finnish Electricity Market Act came into force in 1995, and the electricity market was opened to all Finnish electricity users in

2 This chapter is based on different sources, foremost:
- Nordel Annual Report (2001)
- The Swedish Energy Agency (2002)
- Ministry of Petroleum and Energy (2002)
- SOU 2002:7
- OECD (2002)

November 1998, when standardised settlement was introduced for electricity consumers whose consumption was low. One of the main objectives of the reform was to use economic regulatory instruments and market economy mechanisms for creating the conditions for secure energy supply and competitive prices.

The electricity market in Denmark has been gradually liberalised since 1999, when it was opened to electricity customers with a consumption that exceeded 100 GWh annually. From 1 January 2001, all electricity users with a consumption of in excess of 1 GWh were given freedom of choice of electricity suppliers, and from 1 January 2003 all consumer are allowed to purchase electricity wherever they want.

On 1 March 2002 the last of the inter-Nordic cross-border tariffs were lifted when the Swedish Government decided to abolish the border tariff between Sweden and Denmark.

In 1996 Norway and Sweden set up a common market for electricity in the Nordic region. Statnett Marked AS expanded its area of operations and was renamed Nord Pool ASA – the Nordic Power Exchange. Nord Pool was the first multinational power exchange in the world. Statnett and Svenska Kraftnät each owns 50 percent of the Nordic power exchange.

Finland joined Nord Pool in 1997, Denmark West (Jutland) in 1999 and Denmark East (Zealand) in 2000. On 2 January 2002 Nord Pool split off the physical spot operation into a separate company, Nord Pool Spot AS, which from 1 July 2002 is owned by Nord Pool ASA (20%), Statnett SF (20%), Svenska Kraftnät (20%), Fingrid (20%), Eltra amba (10%) and Elkraft system (10%).

Norway, Sweden, Finland and Denmark now have access to a common Nordic wholesale power market.

In continental Europe, work is in progress in the EU to create an internal energy market. The Electricity Market Directive was adopted in December 1996. The aim of the Directive is to create common rules for the generation, transmission and distribution of electricity. According to the Directive, the market for electricity will gradually be opened to competition.

1.2 The Nordic Electricity Sector

1.2.1 Transmission

Electricity is transmitted from power stations to consumers by a network of power lines. The network is normally classified into three levels: national grid, regional networks and local networks. The consumption and generation of electricity must be in balance at every instant, which is achieved by balance control. Every country has a system operator who is entrusted with the task of maintaining this balance and being responsible for the national grid.

An objective for the Nordic national grid companies is that the market conditions for the infeed of electricity on the Nordic national grids should be harmonised, so that competitively neutral rules can be safeguarded for the players.

The possibilities for trade within the Nordic region and between the Nordic region and neighbouring regions depend on the capacity of the transmission lines. The transmission capacity between countries in northern Europe is listed in the table on next page.

The listed capacities are maximum technical capacities. Often capacities available to the market are smaller due to internal bottlenecks in the Nordic system. This is often the case for "Øresundsforbindelsen", which connect DK2 and Sweden. Because of internal bottlenecks in Sweden (Snitt 4) the Swedish TSO, Svenska Kraftnät, at times reduces import capacity into Eastern Denmark from 1.700 MW to 1.300 MW. Furthermore, the capacity reduction is announced in time for the generator in DK2 to act on the smaller import possibilities.

The capacity between Germany and DK1 is permanently lower than the maximum techni-

Transmission capacities between countries in northern Europe

Countries	One way (MW)	The other way (MW)
Sweden/Norway	*Sweden→Norway*	*Norway→Sweden*
South Norway (NO1)	2000	2100
Middle/North Norway (NO2)	2150	2150
Norway/Finland	*Norway→Finland*	*Finland→Norway*
	100	100
Finland/Sweden	*Finland→Sweden*	*Sweden→Finland*
	1650	2050
Sweden/Denmark	*Sweden→Denmark*	*Denmark→Sweden*
Western Denmark (DK1)	670	640
Eastern Denmark (DK2)	1350	1700
Denmark/Norway	*Denmark→Norway*	*Norway→Denmark*
DK1/NO1	1000	1000
Between Nordic countries and others	*To Nordic countries*	*From Nordic countries*
Sweden/Germany	400	450
Sweden/Poland	600	600
Norway/Russia	50	50
Finland/Russia	1000	60
Denmark/Germany	1800	1800

Source: Elkonkurrensutredningen (2002)

cal capacity listed in the table. Due to internal bottlenecks on Jutland and Funen the local TSO reduces import capacity.

Transmission capacity in and out of countries differs because of internal factors related to electricity generation, transmission and consumption in each country.

The flow of electricity may exceed the limits of a grid's capacity. There are two main ways to deal with such "bottlenecks", either by means of "price areas" or by use of "counter-purchase".

Price areas are used to deal with major or long-lasting bottlenecks in the grid (see 1.2.4). Counter-purchases is a system in which the system operator pays producers to increase or reduce production to create balance in the market.

In Norway, price areas are the main tools for dealing with bottlenecks within the borders and with bottlenecks across the borders to Sweden, Denmark West (Jutland) and Finland. Counter-purchase is used when smaller adjustments are needed. Sweden and Finland use price areas to deal with external bottlenecks and counter-purchases to deal with internal bottlenecks. Denmark is divided into two price areas but these areas are not interconnected.

The national transmission system operators (TSOs) of Sweden (Svenska Kraftnät), Norway (Statnett SF), Denmark West (Eltra), Denmark East (Elkraft) and Finland (Fingrid) are responsible for maintaining the balance between production and consumption. The continuous balance is handled through national regulating markets organised by the TSO's.

Nordel is a co-operation organisation between the Nordic TSOs.

1.2.2 Consumption and Production

Since 1990 the total consumption of electricity in the Nordic countries has increased by an average of 1.4% per year, confer the table on next page:

Electricity consumption in the four countries totalled 394 TWh in 2001. The highest increase has occurred in Finland with an annual average rate of 2.6 % since 1990.

Consumption of energy	Denmark				Finland				Norway				Sweden			
TWh	90	96	00	01	90	96	00	01	90	96	00	01	90	96	00	01
Industry	9	10	11	10	33	37	45	45	47	45	53	52	53	52	56	55
Residential, services etc	20	22	22	23	26	29	31	34	51	59	61	64	65	72	70	75
Others	2	3	2	2	3	3	3	3	7	9	10	9	22	19	21	21
Total	31	35	35	35	62	69	79	82	105	113	124	126	140	143	147	151

Source: The Electricity Market 2002, The Swedish Energy Agency

In Norway and Finland the industry sector accounts for a large part of the consumption.

Viewed in an international perspective, all Nordic countries, with the exception of Denmark, have a relatively high average per capita electricity consumption per year: Denmark (6600 KWh), Finland (15700 KWh), Norway (26700 KWh), Sweden (16700 KWh). Important reasons for the high per capita consumption are the high proportion of electricity-intensive industry and the cold climate.

Generation of electricity in the Nordic countries is based on hydropower, nuclear power and conventional thermal power. There are also a few oil-fired condensing power stations, gas turbines and wind turbines. The table below shows production of electricity in the Nordic countries based on different types of production technologies.

In 2001, electricity generation in the Nordic countries totalled about 390 TWh. Since 1990, electricity generation in these countries has risen by 44 TWh, or about 14 per cent.

Norway and Sweden are the largest power producers of the Nordic countries.

In 2001 generation of hydropower totalled 213 TWh, which accounted for 55% of total production of electricity. There are very large variations in precipitation from year to year. Generation is very dependent on variations in water inflow. Water inflow is the volume of water flowing from the entire catchment area of a river system into reservoirs. In the wettest years, precipitation is more than twice as high as in the driest years. The total normal year generation of hydropower in the Nordic countries is between 180 and 190 TWh. 1996 was a very dry year with a total electricity production of 167 TWh, while 2000 was a very wet year with production of 234 TWh. Average production in Norway is 119 TWh. The difference between the two years was thus 67 TWh. The year 2000 was a wet year in Norway and a new production record of 143 TWh was set. Average production in Sweden is 64.2 TWh. 2000 and 2001 were wet years in Sweden.

The electricity generated by nuclear power

Production of energy	Denmark				Finland				Norway				Sweden			
TWh	90	96	00	01	90	96	00	01	90	96	00	01	90	96	00	01
Hydropower					11	13	14	13	120	103	142	121	71	51	78	79
Nuclear power					18	19	22	22					65	71	55	69
Thermal power	24	49	30	32	23	36	31	36	1	1	1	1	5	14	9	10
Wind power	1	1	4	4	0				0				0	0	0	1
Total prod.	24	50	34	36	52	66	67	72	120	104	143	122	142	137	142	158
Total consump.	31	35	35	35	62	69	79	82	105	113	124	125	140	143	147	151
Imp. – Exp.	7	-15	1	-1	11	4	12	10	-16	9	-19	4	-2	6	5	-7

Source: The Electricity Market 2002, The Swedish Energy Agency

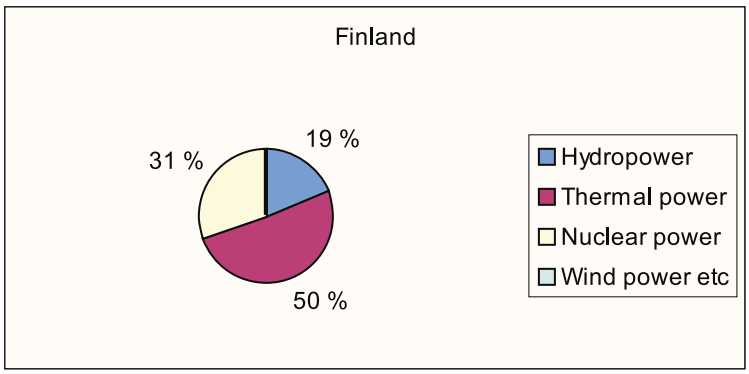
totalled 91TWh equalling 24% of total generation in the Nordic countries. Production is determined by the availability of the plant and by its maximum output. Availability is determined by the scheduled and unscheduled outages and by the annual overhaul shutdowns during summers. The maximum electrical output is restricted by the thermal loading and by the capacity of the generators.

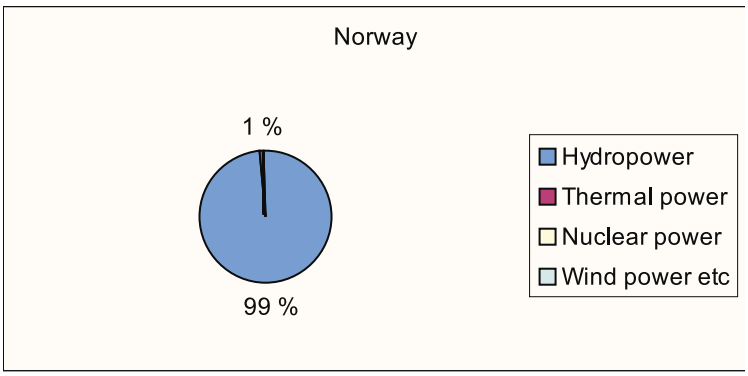
Nuclear power production in Sweden was particularly low in 2000 equalling 55 TWh as compared to 69 TWh in 2001. According to the Swedish Energy Agency's report "The Electricity Market 2001" this can be partly explained by the large inflow of water, but also that producers, according to the report, lowered nuclear production in order to uphold electricity prices. Closure of the first reactor in Barsebäck also contributed to the reduction of nuclear production.

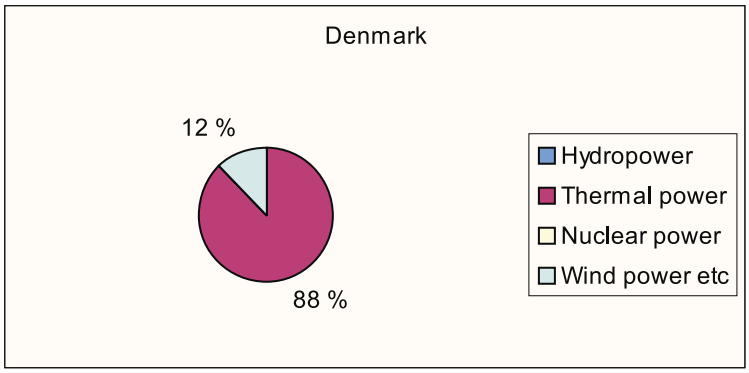
Production in conventional thermal power plants was 79 TWh - 20% of total production in 2001. These plants generate electricity by burning various fuels. The fuels used in the Nordic countries are coal, oil, natural gas, peat and bio fuels. Power is generated in combined heat and power stations, condensing power stations, and gas turbine power stations.

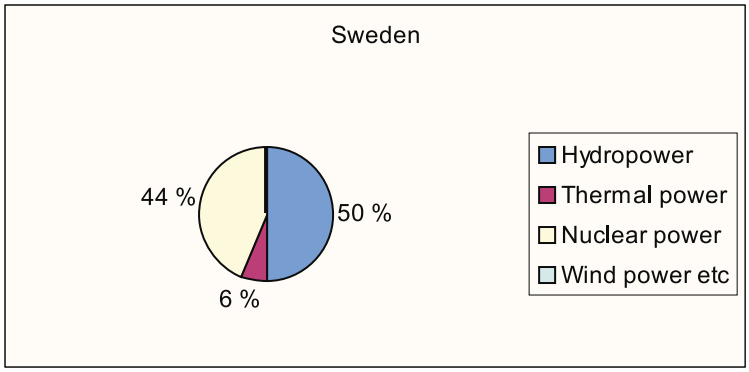
Wind power totalled 5 TWh equalling1% of total production.

The following figures describe the relative use of different sources of energy in the production of electricity in the Nordic countries in 2001.









In Norway production of electricity is almost totally based on hydropower (99%), in Denmark on conventional thermal power (88%). Hydropower accounts for half of the Swedish production and conventional thermal power for half of the Finnish production. The table below shows installed net power capacity in the Nordic countries at the end of 2001.

Hydropower accounts for more than 55% of the total installed capacity the Nordic market. Just below 60% of the installed power is in Norway and 35% in Sweden.

Nuclear power accounts for 14% of total installed capacity. 78% of the capacity is in Sweden.

Conventional thermal power accounts for 30% of total installed capacity. Finland and Denmark have 78% of the capacity.

1.2.3 The Electricity Market

Power trade between countries is determined by production and consumption patterns in each country, in addition to the capacity of the transmission network linking countries and the conditions for its use. One basis for power trade is the opportunity for mutual benefits deriving from differences in the production systems of different countries.

Power exchange between the Nordic countries makes use of the advantages to be gained from interconnecting hydropower and thermal power systems. In countries with thermal power-based systems, the capacity of the power plants determines how much electricity can be generated. In hydropower-based systems, the limiting factor is the quantity of energy available. The pattern of demand for electricity, and thus the amount that must be generated, is generally the reverse of the fluctuations in inflow. When inflow is high, production is often low, and vice versa. The energy sources on which electricity generation in thermal power countries is based (oil, coal, natural gas and uranium), can generally be acquired in whatever quantities are needed, and do not limit power production.

In countries with thermal power-based systems, it is expensive to build thermal power plants to

Installed capacity MW 2001	**Denmark**	**Finland**	**Norway**	**Sweden**	**Nordic countries**
Hydropower	11	2948	27571	16239	46769
Nuclear power		2640		9436	12076
Conventional thermal power	9983	11200	305	5753	27241
Wind power	2486	39	17	293	2835
Total installed capacity	12480	16827	27893	31721	88921

Source: Nordel Annual Report 2001

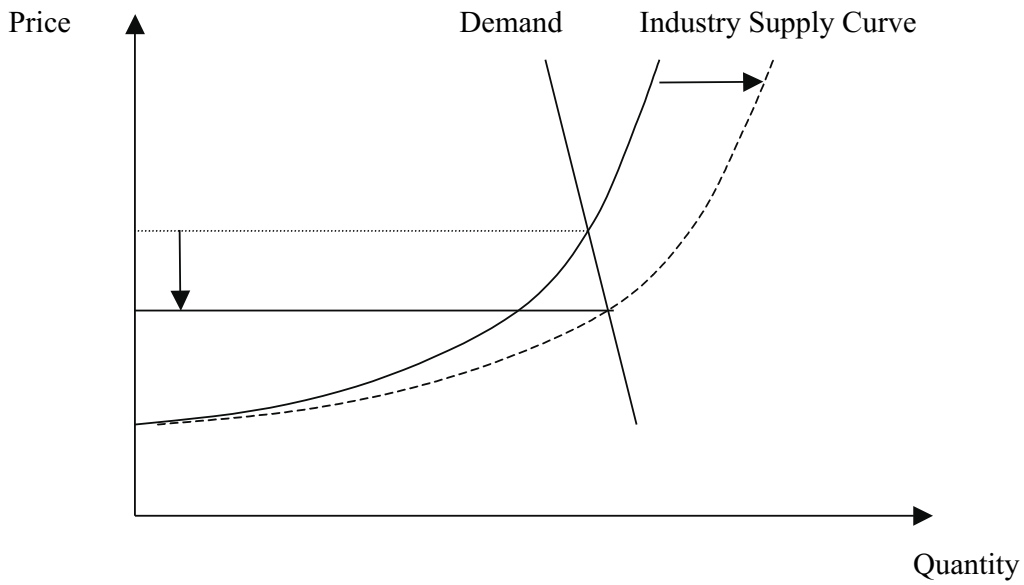
meet short-term peaks in demand, and it is both time-consuming and costly to adjust production up and down in existing thermal power plants. But thermal power plants can deliver relatively inexpensive electricity outside peak consumption periods, i.e. at nights and at weekends. Electricity generation by hydropower plants can be adjusted up and down rapidly and at low cost to meet short-term fluctuations in consumption or unexpected changes in power supplies. Trade reduces the need for costly adjustment of thermal plants, because excess supply of electricity can be exported and in case of a shortage of supply electricity can be imported. Trade also reduces the need to build new power plants and multi-annual water reservoirs.

The creation of an integrated Nordic market is also advantageous to competition. One of the reasons is that the largest national producers have most of their production capacities located in their home country. In such a situation an enlargement of the market means an increase in the number of producers and reduced market concentration. See also chapter 3.

Electricity prices are determined by supply and demand in the Nordic market. Production costs are lowest for hydropower. When price increases other technologies will be used in increasing "marginal cost order" (the industry supply curve): nuclear power, combined heat and power generation, condensing power stations (coal, oil), natural gas turbines. The marginal technology determines the price. In a year when hydropower production is close to the average level, electricity prices will largely be determined by the costs of producing electricity from coal. In periods when the consumption load is higher, power plants with higher production costs, such as oil condensate plants or gas turbine plants, will determine the prices. These are peak-load power plants, and are only used to produce electricity for short periods at a time.

Although hydropower has low operation costs, it still plays an important indirect role in the price determination. The reason is that it is possible to shift production between time periods by means of water reservoirs. One unit of water produced today means one less unit of water available for production tomorrow. The value of that unit lost tomorrow is called the water value. If the price today is above the water value production will increase and more water will be used. If the price today is below the water value production will decrease and water will be stored.

The ability to store water means that variations in consumption and water inflow will cause variations in hydropower production. This will shift the industry supply curve inwards or outwards, causing changes in the market price of electricity. This is illustrated in the figure below. Increased hydropower production caus-



es the industry supply curve to shift outwards and thus the price to fall, even if hydropower is not the marginal technology.

This ability to shift the industry supply curve is not confined to hydropower plants. For instance, reduced production by a nuclear power plant will shift the curve inwards. The main difference between hydropower and nuclear power is the degree of flexibility. Nuclear power is inflexible, while hydropower is very flexible also in the short term. We will return to this subject in chapter 4.

1.2.4 Nord Pool

In the wholesale electricity market, grid companies, large industrial enterprises and other large actors buy and sell electricity. Electricity is either traded bilaterally between market actors or on Nord Pool. A number of electricity transactions are standard bilateral contracts, which is still the main instrument for selling and buying electricity. But a growing proportion of contracts are traded in the Nord Pool's physical and financial derivatives markets.

Nord Pool operates the following marketplaces and market services:

- A spot market for physical contracts, Elspot
- A financial derivatives market – futures and option contracts
- Clearing services for contracts traded in OTC and bilateral markets.

In 2002 physical electric power trading at Nord Pool amounted to 124 TWh, which is 32 per cent of total consumption in the common Nordic market.

About 280 participants from Norway, Sweden, Finland and Denmark, as well as some other European countries and the USA, trade through Nord Pool. Participants are power producers, retailers, grid owners, brokers, market makers, traders and industrial companies.

Physical trade between the Nordic countries is based on Nord Pool's Elspot market, which is a market for physical delivery the next day. Hence, the market is referred to as a day-ahead market. Prices for sales and purchases are determined hourly throughout the day. Each participant bids a price-quantity curve for each individual hour of the day. The price-quantity curve provides information on how much the participant wants to produce or consume at given price levels. These bids are not observable for any player except the Exchange.

After the noon deadline for participants to submit bids, the Nordic Power Exchange's spot market gathers all buy and sell orders into two curves for each power delivery hour: one aggregate demand curve and one aggregate supply curve. The spot price for each hour is determined by the intersection of the aggregate supply and demand curves. The equilibrium price is also known as the system price. This is the spot price for physical delivery of electricity, equal in Norway, Sweden, Finland and Denmark. The system price is also used as a reference price for trade in the electricity derivatives market.

The system price is determined by supply and demand in the Nordic region, without regard for physical capacity limits in the transmission grid. However, the Nordic transmission grid has capacity limits, and trade on Elspot will in certain periods generate congestions in the transmission grid, so-called bottlenecks. Nord Pool handles bottlenecks by separating the

Development of Nord Pool's markets

Volume (TWh)	1996	1997	1998	1999	2000	2001	2002
Physical market	41	44	57	76	97	112	124
Financial market	43	53	89	216	359	910	1019
Bilateral contracts, clearing	*	147	373	648	1180	1748	2089

* Introduced 1997
Source: Nord Pool Annual Report 2002.

market into different Elspot price areas. The permanent price areas in the Nordic region are Sweden, Finland, Denmark West (DK1) and Denmark East (DK2), South Norway (NO1) and Middle/North Norway (NO2). Last winter Norway was divided further into four price areas.

The System Price is the reference price for handling potential grid congestions. Within Elspot price areas the system operators handle congestions by means of "counter-trade", based on bids from producers.

In Sweden and Finland, Elbas, is used as a short term market operating after closing of the spot market. Due to the lengthy time span of up to 36 hours between the Elspot price fixing and delivery, participants need market access in the intervening hours to improve their balance of physical contracts.

Variations in precipitation and temperature can result in large variations in the spot price. This means that the economic risk associated with electricity trading is high. To reduce the risk, producers, consumers and other actors in the market can enter into long-term physical and financial contracts.

Nord Pool’s financial derivatives market covers the market for futures, forward and option contracts. Futures and forward markets are financial markets for price hedging and risk management. The system price in the spot market is the reference price for future and forward contracts traded on the Nordic power exchange. Power derivatives enable market participants to hedge purchases and sales of power with a time horizon of several years. Such products can be traded on the Nordic power exchange, but there are also other markets that organize trade with these products. Through power derivatives trade actors can hedge purchases and sales of power with a time horizon of up to four years.

Financial electricity market contracts traded at the Nordic Power Exchange are standardised products that are financially settled; there is no physical delivery of electric power. Settlement is conducted between Nord Pool’s clearing service and individual market participants.

In addition there are bilateral contracts, both long-term and forward contracts. The market players are free to agree on standardised or non-standardised, long-term or forward contracts, either on a bilateral level or through the commodity exchange, Nord Pool.

1.3 The Danish Electricity Sector

The Danish generation and wholesale market has been gradually liberalised and from 1 January 2003 the end-user market has also been opened.

Geographically the Danish market is placed between bigger power markets to the south (Germany) and to the north (Norway and Sweden). The Danish thermal production is primarily based on coal and gas.

There is an excess of generation capacity in Denmark and a lack of production capacity in the countries to the north. Denmark is therefore expected to strengthen its position as a power exporter in the future.

1.3.1 Network Operation

The structure of ownership in the Danish electricity sector is very fragmented. About 100 grid companies (owned by the consumers directly or by municipalities) each have a small share in one of the two transmission companies in east and west Denmark. No company has a majority influence in any transmission system operator (TSO).

Generation has to be legally separated from transmission, and each activity has to be carried out in separate companies. Furthermore, the management of the two kinds of companies has to be done by different people, and the same people are not allowed to be board members in the two types of companies. Generation companies are not allowed to own a significant share of transmission companies. But the grid companies own the transmission system, the transmission system operators as well as the two large generation companies. Thus, ownership integrates the industry vertically.

The Danish electricity market consists of two

2001 (MW)	Denmark West	Denmark East
Total production capacity	7.051	5.442
*Transmission capacity from Sweden	670	1.350
*Transmission capacity from Norway	1.000	0
**Transmission capacity from Germany	800	350
Total transmission capacity	2.470	1.700
Transmission capacity in percent of total production capacity	35%	31%

separate geographic markets: Denmark West (DK1) and Denmark East (DK2). The two markets are not interconnected but are part of the joint Nordic power market. Interconnectors between DK1 and Norway and Sweden connect DK1 with the Nordic market. An interconnector joins DK2 with Sweden. Both DK1 and DK2 are connected to the German power market. Correlation analysis shows that the two Danish price areas are not integrated with the Nordic market in hours where interconnectors are congested by imports, and that Denmark is never integrated with the German power market.

Total import capacity into both Denmark West and East is approximately 2000 MW. In 2001 the maximum consumption was 3 700 MWh/h in Denmark West and 2 700 MWh/h in Denmark East (2001).

Under normal conditions 90-95 percent of the time the Danish power market is part of the much larger Nordic market. Bottlenecks occur more frequently in some years than in others depending mainly on fluctuations in regional supply. In wet years – where the supply of hydro-produced electricity is large – the imports from especially Norway into western Denmark congest the interconnector relatively often. In 2001 the interconnectors from Norway and Sweden into western Denmark were simultaneously congested in 7 percent of the time. The interconnector between eastern Denmark and Sweden were blocked simultaneously in 5 percent of the time.

The transmission capacities between the two Danish submarkets and the Nordic area plus Germany indicates that the Danish electricity market is a relatively open market.

The interconnectors from Denmark West to Norway in the north and partly to Germany in the south were until 1 January 2001 occupied by long-term contracts between generators in the three countries. This disturbed trading across the borders. With the intervention of the European Commission the agreements were abandoned. Still a part of the interconnector between Denmark East and Germany is occupied by long-term contracts between generators in Sweden, Denmark and Germany. This reduces the capacity that is available for competitors in the market and seems to be an obstacle for integration between Germany and Denmark.

Denmark has two transmission system operators, namely Eltra, which is responsible for the national grid in Jutland and Funen, and Elkraft, which is the national grid company in Zealand. Just like other national grid companies, Eltra and Elkraft own the 400 kV grids and the links with Sweden and Germany. The transmission line systems of Eltra and Elkraft are not currently interconnected with one another.

The tariffs of the transmission system operator is regulated by an ex ante approval procedure. The grid companies' tariffs are determined by income caps set up by the regulator. The tariffs are separated into an entry charge (generation) and an exit charge (consumption). The main part of the charge is put on the exit charge. Tariffs vary across the day but not by location. All charges are put on flow (contrary to fixed tariffs or capacity). It is the general view that the tariff systems by the TSOs are transparent and facilitates an easy access to the network.

1.3.2 Production

Denmark's power generation is primarily based on coal-fired and natural gas-fired combined heat and power (CHP) stations and condensing

power stations. A minor proportion of power generation is based on bio fuels. Among the Nordic countries, Denmark has the highest proportion of electricity generated by wind power.

Environmental problems have played an important role in the energy policy in Denmark. This has resulted in high subsidies to renewable power production – wind and small scale CHP. Analysis has shown that the large subsidies given to the production of renewable power have been an expensive and rather ineffective way to obtain a reduction in CO2-emissions. The bill is being paid by the end-users through an obligation to buy renewable power.

Currently, 40 percent of the consumption of electricity is allocated outside the market. This in addition to the high Danish energy taxation means that the functioning of the power market does not have a crucial influence on the price of power at the household level.

Two generators dominate the Danish market: Elsam A/S in DK1 and Energi E2 A/S in DK2. The two companies are the result of politically driven mergers between a number of companies before the introduction of merger control in the Danish Competition Act 1 October 2000. Ten companies have become only three. The total installed capacity of Elsam and Energi E2 is 7 000 MW and 5 500 MW (including windmills) in DK1 and DK2 respectively. Of the total installed capacity in DK1, Elsam owns approximately 50 percent. In DK2 Energi E2 A/S owns approximately 80 percent. However, for competition policy considerations the relevant market shares of the two generators are closer to 100 percent of DK1 and DK2. If the interconnectors are blocked by imports the two companies hold a dominant position in the two markets. This happens most frequently in peak load hours with low non-commercial generation (windmills and small scale CHP).

Production of electricity takes place on (1) large production units mostly in combination with heat (2) windmills and (3) smaller CHP-units. Production from windmills and CHP-units is bought on non-market terms by the TSOs. The price, of this non-market electricity is, however, to some extent reflecting consumption patterns.

The Danish government has announced that all power consumption will be allocated through the market in the future. This will make the legal obligation to buy the renewable power production obsolete. When the prioritised production system is changed and all the production is sold on the market, there will be more generators competing. The two generators, Energi E2 and Elsam, will, however, continue to hold a dominant position in the Danish market in the foreseeable future.

1.3.3 New Capacity

It is the business of the TSO's to examine and plan the need for expansions of the transmission system. The TSOs (in co-operation with the transmission companies who also work under authorisation) have to apply for projects according to the plan. The TSOs (with the government authorities) have a crucial influence when deciding expansions of the transmission system.

Expansion of generation capacity has to be approved by the regulating authority. In reality the incentive to enter into generation is limited due to the existing excess thermal capacity in both Denmark West and Denmark East.

Except for the construction of subsidised renewable power production no plans for the construction of new generation has come up in Denmark in recent years. The main reason is the present low price of electricity compared to long run costs (reflecting a situation with excess capacity). A new large plant – decided 8-10 years ago – started production in 2002. The plant is located at the coast near Copenhagen. The reasons for this location are easy access to fuel/water and the demand for the production of heat (CHP-production) in the well-organised district heating system.

A key issue in setting up new generation capacity in Denmark will definitely be location considering the present lack of sites – especially because of local resistance due to environmental problems. In this way, location can

become a barrier to entry in the market. At the moment, it is not a requirement for the incumbent generators to offer sites to competitors when plants are shut down.

1.4 The Swedish Electricity Sector

The per capita electricity consumption in Sweden is relatively high compared to other countries. In 1999, Sweden was in the fourth place in the world, after Norway, Iceland and Canada. A common feature of countries that have high per capita electricity consumption is that they have access to inexpensive hydropower and have a high demand for heating by being in a relatively cold climatic zone.

In 2001 hydropower accounted for half of the Swedish electricity production, nuclear power for 44% and fossil-fired and bio fuel fired production for just over 6%.

1.4.1 Network Operation

The Swedish national grid is still a regulated monopoly. It is the responsibility of the Swedish Energy Agency to ensure that the grid is operated efficiently, that the grid tariffs to customers are reasonable and the grid companies do not act in such a way as to stifle competition in the sale of electricity.

The largest electricity producers, a couple of municipalities and industrial companies, own the regional grids. Local grids are owned by approximately 200 network companies, which are either part of power producing combines, municipalities or economic associations.

The dominating flow of power in the national grid is from the north to the south, where electricity consumption is high. Svenska Kraftnät (SvK) applies a spot tariff on the national grid. This means that a customer who is connected to the grid has access to the entire electricity market and can do business with any other player for the same network charge.

SvK has the responsibility for the central transmission network, which is owned by the state. SvK is also the transmission system operator and responsible for maintaining the balance between production and consumption in all parts of the country.

The Swedish tariffs have been adjusted to the conditions in most European countries, where the infeed from electricity generators account for a smaller proportion of the national grid tariff.

SvK co-operates with approximately 40 operators, which all have balance responsibility. This means that these balance provider companies accept economic responsibility for the Swedish electrical system being supplied during every hour.

The connections from north to the south have certain bottlenecks. The most important ones are between northern and central Sweden and between central and southern Sweden. Bottlenecks in Sweden are solved by counter-purchases. If the transmission capacity of the national grid is insufficient for transmitting the electrical energy to meet the actual demand, SvK uses counter-purchase as a method to reduce the physical energy flow on the grid, without the trade of customers being affected.

Individual ownership or control of the transmission links to Poland and Germany may create opportunities for exerting market power.

1.4.2 Production

The Swedish electricity market is characterised by few firms with large market shares. In the year 2001 six companies accounted for nearly 93 percent of the national production of electricity. The six companies concerned were Vattenfall, Sydkraft, Birka Energi, Fortum Kraft (previously Stora Enso), Skellefteå Kraft and Graninge. These six companies have now been reduced to five since Fortum bought the remaining part of Birka Energi. Birka Energi was created as a result of the merger between Stockholm Energi and Gullspång Kraft in 1998. Today the name of the company is Fortum.

The number of major companies has thus been reduced but their share of the production has basically not changed in the years between 1996 and 2000. However the ownership of

these companies has changed and become more international. Swedish companies have also been expanding internationally.

The Swedish nuclear plants are all jointly owned by the larger power companies, confer the table below.

The nuclear power companies are Forsmarks Kraftgrupp AB, the Ringhals group (Barsebäck Kraft AB and Ringhals AB) and OKG AB. Fortum owns Skandinaviska Energiverk, which owns 78.1% of Mellansvensk Kraftgrupp. In addition Fortum owns 8.9% of Mellansvensk Kraftgrupp, meaning that Fortum owns a total share of 22.2% of Forsmark Kraftgrupp AB.

Sydkraft owns 5.3% of Mellansvensk Kraftgrupp as well as 8.5% of Forsmarks Kraftgrupp AB, which gives Sydkraft a total ownership interest in Forsmark of 9.9%. Skellefteå Kraft owns 7.7% of Mellansvensk Kraftgrupp, which gives Skellefteå a total ownership interest in Forsmark of 1.9%.

Each owner reports its production requests for the next year (the planning period) to the operator of the nuclear company. Vattenfall is the operator (O) of the Forsmark, Ringhals and Barsebäck nuclear plants. Sydkraft is the operator of OKG. The requests take place within the restrictions that determine possible production volumes, such as planned revi-

Nuclear reactors	**Net effect MW**	**Production 2001 GWh**	**Owners**	**Ownership shares**
Barsebäck 2	600	4400	Vattenfall (O)	74.2%
			Sydkraft	25.8%
Forsmark 1	968	7300	Vattenfall (O)	66.0%
			Mellansvensk Kraftgrupp	25.5%
			Sydkraft	8.5%
Forsmark 2	964	7400	Vattenfall (O)	66.0%
			Mellansvensk Kraftgrupp	25.5%
			Sydkraft	8.5%
Forsmark 3	1155	8200	Vattenfall (O)	66.0%
			Mellansvensk Kraftgrupp	25.5%
			Sydkraft	8.5%
Oskarshamn 1	445	3100	Sydkraft (O)	54.5%
			Fortum	45.5%
Oskarshamn 2	602	4700	Sydkraft (O)	54.5%
			Fortum	45.5%
Oskarshamn 3	1160	9100	Sydkraft (O)	54.5%
			Fortum	45.5%
Ringhals 1	835	5800	Vattenfall (O)	74.2%
			Sydkraft	25.8%
Ringhals 2	870	6300	Vattenfall (O)	74.2%
			Sydkraft	25.8%
Ringhals 3	920	6300	Vattenfall (O)	74.2%
			Sydkraft	25.8%
Ringhals 4	915	6600	Vattenfall (O)	74.2%
			Sydkraft	25.8%
Totalt	9546	69200		

Source: The Swedish Energy Agency: The Electricity Market 2002
SOU 2002:7 Elkonkurrensutredningen

sions and technical restrictions. During the operating period (one year) the owners may present requests for changes of production. The nuclear company co-ordinates the owners' requests and orders changes of production.

The river regulating companies is also under joint ownership. The organisation Vattenreguleringsföretagen consists of the companies responsible for about half of Sweden's hydropower reservoirs. One of its tasks is to coordinate and maintain the use of the rivers. The hydropower plants along the river jointly own each river regulating companies. The major companies own plants in several rivers, which creates an opportunity to gain insights into certain business related information e.g. concerning cost structure.

The deregulation of the electricity market has led to various attempts at repositioning by the power companies so as to better meet the new challenges. Against this backdrop there has been a noticeable restructuring of the market. During the past years there has been a number of mergers in the Swedish electricity market. Most of these mergers have concerned larger companies buying smaller companies with limited market shares. The individual mergers have thus only meant small increases in market concentration.

1.4.3 New Capacity

In the past few years, the earlier surplus generation capacity in Sweden has been reduced. The oil-fired condensing power stations that were previously used as reserve capacity have been decommissioned, and the first nuclear reactor in Barsebäck has been shut down. The second Barsebäck reactor will not be shut down before the end of 2003 since the conditions for shutting it down before the end of 2003 have not yet been met. The conditions include that the loss of generation capacity can be compensated by reduced electricity consumption and new generation capacity.

Peak consumption has increased somewhat, meaning that the margins for achieving balance during peak periods have been lowered.

There are barriers to entry on the Swedish market for the production of electricity. Only limited new hydropower capacity is possible and no new capacity in nuclear power is allowed. A number of environmental concerns will influence the expansion in both hydropower and other technologies. The process of building new capacity is not only time consuming but it is also capital intensive.

1.5 The Norwegian Electricity Sector

Per capita energy use in Norway is somewhat higher than the OECD average. The proportion of energy use accounted for by electricity is considerably higher than in other countries. The main reasons for the high proportion of electricity use are that Norway has had access to rich supplies of relatively cheap hydropower and that the government investment has focused on hydropower development. A large energy intensive industrial sector has developed as a result and electricity is widely used to heat buildings and water.

1.5.1 Network Operation

There are several grid companies in Norway. A grid company may own a local, regional or central grid. In all, 178 companies are engaged in grid management and operations on one or more levels. Of these, 42 are solely grid operators, whereas the remaining companies are also engaged in electricity generation and/or trading. 136 companies are vertically integrated in the sense that they are engaged both in operations that are exposed to competition (production and/or trading) and in grid management.

The state, through Statnett SF, owns about 87 per cent of the central transmission grid. Private companies, counties and municipalities own the remainder. Statnett is the operator of the entire central grid. Municipalities and counties own most of the regional and distribution grids.

The authority to make decisions pursuant to the Energy Act has largely been delegated to the Norwegian Water Resources and Energy Directorate (NVE), which is subordinate to the Ministry of Petroleum and Energy. Because the grid is a natural monopoly consumers are

obliged to buy grid services from the owner of the local grid. The NVE is responsible for monitoring and regulating grid management and operations. Firstly, the NVE determines an income cap for each grid owner. Secondly, it determines how the point tariff structure must be developed.

Point tariffs means that a grid customer pays the same transmission charge regardless of whom electricity is bought from or sold to. An individual customer only pays a transmission tariff to the local grid company. Consumers pay one tariff to tap electricity from the grid (tariff for consumption), and generators pay another tariff to feed electricity into the grid (input tariff). Point tariffs provide easy market access for customers and thus promote the establishment of a nationwide power market.

Statnett is the Norwegian transmission system operator (TSO), and is therefore responsible for short and long term system co-ordination. This means that the enterprise co-ordinates the operation of the entire Norwegian power supply system. This includes ensuring that the amount of electricity generated is at all times exactly equal to the amount consumed.

The balancing market is a market organised by Statnett to maintain a stable frequency and a continuous balance between production and consumption. The balancing market opens after prices and quantities have been determined in the Elspot market. Statnett receives quotes from major producers or consumers that are willing to alter their power generation and/or consumption plans at short notice. This ensures that it is possible to adjust the amount of power in the grid either up or down right up to the hour of delivery.

In western and southern Norway and in Nordland county, electricity production exceeds consumption in the region. In Eastern Norway, on the other hand, electricity consumption is much higher than the amount generated in the region. This means that electric power must be transported from western and northern regions to the south and east of the country.

The currently available transmission capacity from Norway to its neighbours is about 4000 MW.

1.5.2 Production

Norwegian power generation is based mainly on hydropower. Norway is the sixth largest hydropower producer in the world and the largest in Europe.

A total of 156 companies are engaged in Norwegian electricity generation. Norway has a total installed capacity of 27596 MW at 740 hydropower plants larger than 1 MW. An additional capacity of 271 MW is provided by thermal power plants. The installed capacity of wind power plants is 13 MW. The mean annual production capability of hydropower plants is calculated on the basis of installed capacity and the expected annual inflow in a year when precipitation is normal. The estimate of hydropower production in a normal year is about 119 TWh, based on the period 1970 – 1999.

The state-owned Statkraft is the largest producer in Norway. Based on NVE's database Statkraft has an annual average production capacity of 34.7 TWh and an installed capacity of 8356 MW. If we include Statkraft's direct ownership shares in other producers of electricity it will have an annual average production capacity of 49 TWh and an installed capacity of 11900, which gives the company market shares exceeding 40%. Thus, Statkraft is a dominant producer in Norway. There are widespread cross-ownership in the Norwegian power industry, which increases market concentration even further, confer the calculations in chapter 3.

Recently, the Norwegian Competition Authority prohibited Statkraft's acquisition of Agder Energi and Trondheim Energiverk. However, the Ministry of Labour and Government Administration accepted the acquisition of Agder Energi on condition that Statkraft divest its interests in E-CO and Hedmark Energi. The Ministry upheld the prohibition of the acquisition of Trondheim Energiverk.

In addition to the fact that power companies have substantial ownership shares in each other, the companies also jointly own hydropower production plants. Joint ownership concerns more than 80 plants with a total annual production capacity of 35 TWh and an installed capacity of 9300 MW. This means that approximately 30% of the production capacity in Norway is jointly owned by two or more companies. In most of the cases one of the owners has the operation responsibility. The 10 largest power plants in Norway account for about one quarter of the country's production capacity. The table on next page lists the 10 largest power plants in Norway as of 1 January 2002.

The two last columns show that Statkraft holds direct ownership interests in the nine biggest water power plants in Norway. Statkraft's share of the installed capacity amounts to 3614 MW, which is 58% of the combined capacity installed in these ten plants.

Considering that Statkraft has an indirect ownership position in BKK (49.9%), Agder Energi (45.5%), SKK (66.6%) and E-CO Vannkraft (20.0%) its share of the installed capacity is 4207 MW, which is 67% of the combined capacity of the ten plants.

It should also be noted that Statkraft has a majority position in 7 of the 10 plants and, thus, a controlling position. It also has a considerably control over two of the three remaining plants, considering its ownership positions in Agder Energi and SKK. Only in Aurland I another company than Statkraft is the major owner. This is also reflected in the fact that Statkraft is operator (O) of 7 of the 10 plants.

Vertically integrated companies are engaged in both grid and production and/or trading activities. Like grid companies, they sell electricity to end users in the area where they own the distribution grid, and often compete for customers in the areas served by other grid companies.

In all, 136 companies are engaged both in operations that are exposed to competition (production and/or trading) and in grid management and operations. They are required to keep separate accounts. Such accounts are an important part of the basis of the regulatory system. One aim is to ensure that costs related to production and sales of electricity are not charged to grid management and operations (cross-subsidisation). Bills to customers must include separate prices for transmission services and electricity supplies.

1.5.3 New capacity

The largest hydropower development projects were carried out between 1970 and 1985. There was little increase in production capacity in the 1990s. The increase came from the upgrading and expansion of older power plants, which made better use of the capacity of existing power plants, and from the construction of some new small-scale power plants.

Entry into power production is severely restricted. New generation facilities imply large investments, which require high prices to be profitable. Such investments are strictly regulated through concession laws. The Norwegian hydropower projects that are currently being planned are generally small and some of them disputed. Expansion of existing power plants is more likely, but only already established actors can do this. The incentives for established actors to invest in new production capacity will be reduced if they possess market power.

The current concession law discourages entry into hydro generation through acquisition of existing capacity. The provisions oblige private undertakings to return acquired waterfalls to the State after a period of 60 years. These provisions do not apply to state or municipal companies. Therefore a difference is created between the discounted value of a private company and a state or municipal company. The provisions favour Norwegian state and municipally owned producers over foreign or privately owned producers. Due to complaints to EFTA's Surveillance Authority this rule is up for revision in the Norwegian parliament.

The government has granted concessions for building three natural gas-powered electricity plants in Norway. In 1997, the company

Power plant	County	Max capacity MW	Mean annual production GWh/year	Owner	Share
Kvilldal	Rogaland	1240	3517	Agder Energi	0.2 %
				Haugaland Kraft	2.5 %
				Lyse Produksjon	18.0%
				Otraverkene	7.3%
				Statkraft (O)	72.0%
Tonstad	Vest-Agder	960	4169	Agder Energi	12.2%
				Lyse Produksjon	41.1%
				SKK	14.6%
				Statkraft	32.1%
				Sira-Kvina (O)	
Aurland I	Sogn og Fjordane	675	2003	E-CO (O)	93.0%
				Statkraft	7.0%
Saurdal	Rogaland	640	1291	Agder Energi	0.2 %
				Haugaland Kraft	2.5 %
				Lyse Produksjon	18.0%
				Otraverkene	7.3%
				Statkraft (O)	72.0%
Sy-Sima	Hordaland	620	2075	BKK Prod.	26.3%
				Statkraft (O)	65.2%
				Sunnhordland	8.7%
Rana	Nordland	500	2123	Statkraft (O)	100%
Lang-Sima	Hordaland	500	1329	BKK Prod.	26.3%
				Statkraft (O)	65.2%
				Sunnhordland	8.7%
Tokke	Telemark	430	2221	Statkraft (O)	100%
Svartisen	Nordland	350	1996	Nordlandskraft	30.0%
				Statkraft (O)	70.0%
Brokke	Aust-Agder	330	1407	Agder Energi	68.6%
				SKK	31.4%
				Otrakraft (O)	

Source: The Energy Sector and Water Resources in Norway 2002, Ministry of Petroleum and Energy.

Naturkraft AS was granted construction and operating licences for two plants at Kollsnes in Hordaland and Kårstø in Rogaland. According to the plan, each of the two CCGT plants is to have an installed capacity of about 400 MW, corresponding to an annual production of about 3 TWh each. There is, however, reasonable doubt about whether the return on these investments will be positive at the current price level. Whatever the investment outcome will be, the capacity of the proposed natural gas generators will not be significant compared to existing capacity in the market.

Five wind power projects have been licensed by the Norwegian Water Resources and Energy Directorate (NVE), but have not yet been constructed. The NVE has received notifications of further 15 projects with a potential annual production totalling 3.7 TWh.

Currently, three ferro-alloy plants generate electricity totalling about 200 GWh/year from waste heat. It is estimated that a further 1 TWh/year could be generated by means of heat recovery from the ferro-alloy industry.

1.6 The Finnish power market

Power generation in Finland is based on conventional thermal power, nuclear power and hydropower. The fuels mainly used in Finnish thermal power stations are bio fuels, coal, natural gas and peat. A small proportion of the electricity generated is based on fuel oil.

Finland has two nuclear power stations in operation, with a total of four reactors. These power stations account for around 30% of the total electricity production in Finland.

Finland has a high share of imports from its neighbouring countries. In 2001 the net import was approximately 10TWh. There have been some discussions of whether to increase production capacity by increasing nuclear power capacity. Another alternative is to increase natural gas-fired power stations. These two alternatives are mentioned in the Finnish national climate strategy of March 2001 as a means to reduce the use of coal and thereby the emission of CO2.

Finland has around 120 companies and 4090 power stations that generate electricity. These companies and power stations are mainly classified into two groups. The two major players of the Finnish electricity generation are Fortum and PVO/TVO, accounting for more than 60% of the market.

Fingrid has the system responsibility and owns the national grid in Finland, and also the links with foreign countries. Fingrid ensures that the electricity system in Finland performs well technically, and that reliability is maintained. All parties on the electricity market is responsible for balance between electricity generation and electricity consumption being maintained at all times. Today, there are more than 30 balance provider companies. After the electricity exchange has closed and up to two hours before the delivery time, there is scope available for trading with balance power on the Elbas market. In the event of unbalance during the operating hour, Fingrid applies balance control.

In January 2002 the Finnish government reached a principal decision to erect a fifth nuclear power reactor. The same year the decision was approved by the Finnish parliament.

2. DEFINING THE MARKET

2.1 The sub-markets of the electricity sector

The power market can be divided into a physical market and a financial market. These two markets can be divided further into several sub-markets. We will describe briefly the various markets. Note, however, that these sub-markets do not necessarily constitute relevant markets as defined by competition authorities.

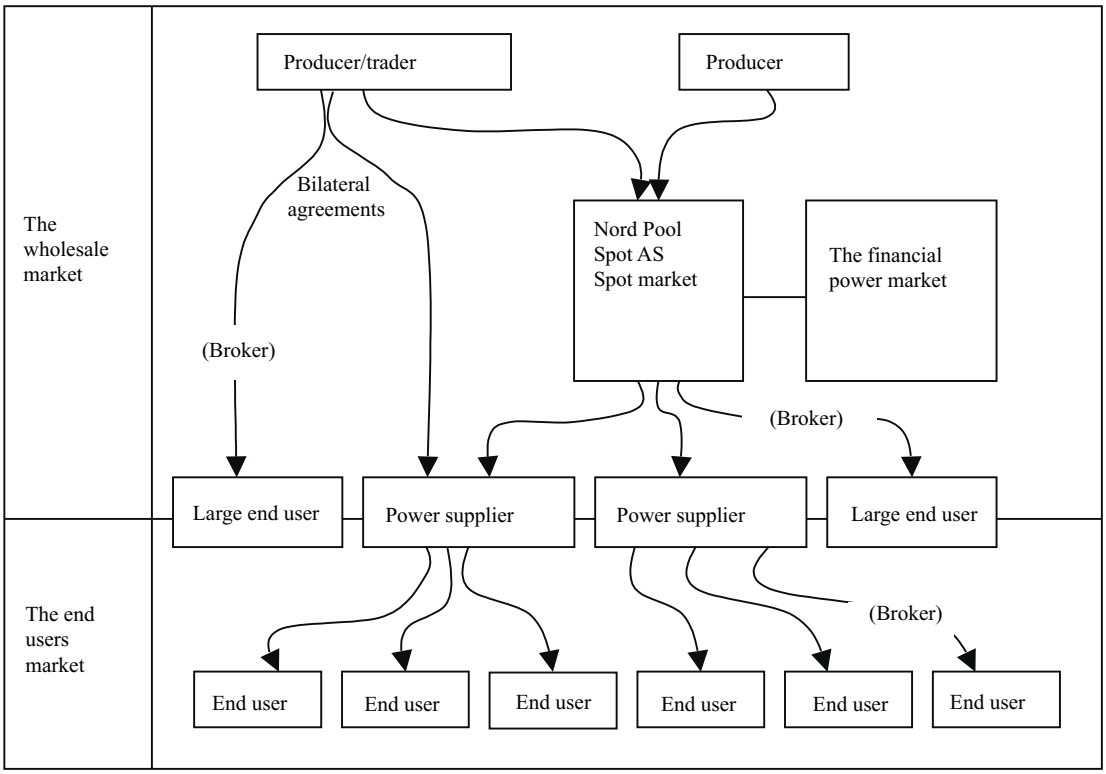
It is common to divide the power market into three different vertical levels. One level is transmission and distribution of power through the grid. A second level is the wholesale market where producers, suppliers, large industrial enterprises and other large units buy and sell electricity, and a third level is the retail market where power is sold from retail power companies to end users such as households and firms.

The transmission and distribution of electric power is usually regarded as a natural monopoly and therefore regulated in all the Nordic countries. There is no competition on this level of the power market. Since this report is aimed at preserving and developing competition in the market for electricity in the Nordic region, we will not focus on the transmission and distribution of power.

The division between the wholesale market and the end users market is sketched in the figure below.

Electricity is sold to most end users through power suppliers (i.e. retail power companies). Some of these companies also produce power, while others buy all the needed power on the wholesale market. In the retail markets there are barriers restricting purchase of power cross borders. The main reasons are differences in each countries regulatory regime, taxes and prices, which make cross border trade difficult. As a result, retail power companies are established in the country where they sell power. The retail markets do therefore also fall outside the scope of this report, since they contain few competitive issues relevant for the Nordic electricity market.

Based on the aforesaid we will limit our focus in this report to the wholesale market.



2.2 Definition of the relevant market

In competition analysis the aim is usually to determine whether one or more companies have or can acquire market power. To do this, competition authorities usually define the relevant market where the potential market power is or could be abused. The market definition is a tool used to identify and define the boundaries of competition between firms. In the U.S. horizontal merger guidelines the relevant market is defined as follows:

> *A market is defined as a product or group of products and a geographic area in which it is produced or sold such that a hypothetical profit-maximizing firm, not subject to price regulation, that was the only present and future producer or seller of those products in that area likely would impose at least a "small but significant and nontransitory" increase in price, assuming the terms of sale of all other products are held constant. A relevant market is a group of products and a geographic area that is no bigger than necessary to satisfy this test.*[3]

This test is also called the "SSNIP test" (Small but Significant and Nontransitory Increase in Price). The SSNIP test defines a relevant market as the narrowest collection of products over which a hypothetical monopolist would find it profitable to make a small but significant and non-transitory increase in price (SSNIP).

The U.S. market definition focuses solely on demand substitution factors--i.e., possible consumer responses. Supply substitution factors – i.e. possible production responses – are considered elsewhere in the Guidelines in the identification of firms that participate in the relevant market and the analysis of entry.

The European Commission's definition of a relevant market separates between the relevant product market and the relevant geographic market:

A relevant product market comprises all those products and/or services which are regarded as interchangeable or substitutable by the consumer, by reason of the products' characteristics, their prices and their intended use.

The relevant geographic market comprises the area in which the undertakings concerned are involved in the supply and demand of products or services, in which the conditions of competition are sufficiently homogeneous and which can be distinguished from neighboring areas because the conditions of competition are appreciably different in those areas.[4]

At the outset the two definitions differ somewhat. The EU definition of a relevant product market seems to include all substitutable products. Seemingly, this definition will include more products than what is necessary for the SSNIP test to be satisfied (it will be economically profitable to increase price even if some substitution to other products will take place, i.e. all substitutable products need not be included in the relevant market). Furthermore, the EU definition of a geographic market focuses on other aspects than whether demand substitution (or other restraints on market power) will hinder the SSNIP test from being satisfied.

However, in the Commission Notice on the definition of the relevant market (which reflects the jurisprudence of the Court of Justice and the Court of First Instance) the Commission interprets the definitions. The clarification makes clear that the SSNIP is applied both to the product and to the geographic market definition.

The Notice points out that firms are subject to three main sources of competitive constraints: demand substitutability, supply substitutability and potential competition. From an economic point of view, for the definition of the relevant market, demand substitution constitutes the most immediate and effective disciplinary force on the suppliers of a given product, in

3 The U.S. Department of Justice and Federal Trade Commission (1992)
4 The EU Commission (1997)

particular in relation to their pricing decisions. The competitive constraints arising from supply side substitutability and potential competition are in general less immediate.

According to the Notice, supply-side substitutability may also be taken into account when defining markets in those situations in which its effects are equivalent to those of demand substitution in terms of effectiveness and immediacy. This requires that suppliers are able to switch production to the relevant products and market them in the short term without incurring significant additional costs or risks in response to small and permanent changes in relative prices. The same reasoning applies to geographic areas.

Thus, unlike the U.S. Guidelines the EU Commission Notice may take supply substitution into account when delineating markets. However, the U.S. Guidelines makes clear that supply substitution may be considered when identifying firms that participate in the relevant market. Firms that would quickly and easily substitute supply in response to an attempted exercise of market power are considered to be competitors in the same market and are assigned market shares even though they do not currently sell. In practise it seems likely that both the EU and the U.S. approach is capable of identifying supply substitution competition in a meaningful way, which will produce similar conclusions.[5]

The hypothetical price increase is usually assumed to be 5% or 10%. The principal procedure to delineate relevant markets is to ask whether a hypothetical monopolist is able to profitably make such a price increase. If not, the market should be expanded by including the best substitute outside its borders, either in the product space or in the geographic space. By expanding the market in this way until the price increase becomes profitable, the relevant market will be delineated as the smallest group of products and the smallest geographic area in which the SSNIP test is satisfied.

It is not clear what shall be meant by "non-transitory". This is of some importance since demand is likely to be more elastic in the long than in the short run. The U.S. Guidelines considers supply substitution within the framework of one year. Copenhagen Economics (2002) considers the SSNIP test within a time period not shorter than twelve months.

The SSNIP test is particularly applicable to markets where the issue is whether a concentration will increase the price level in the market. It is less applicable as a tool to analyse whether a firm already possess market power. More on this subject can be found, for instance, in a paper from the Office of Fair Trading (2001).[6]

2.3 The relevant product market

The European Commission has traditionally defined the product market as the sale of electricity delivered through high-voltage network.

There are no close substitutes for electricity. In the short run (on an hourly basis) demand is very inelastic at current prices. The price sensitivity of demand is low also in the longer run - during a season or some months. This means that it will be possible for a hypothetical monopolist to impose a small but significant and non-transitory increase in price.[7] We therefore ascertain that wholesale of electricity is a separate product market.

However, we have to investigate whether there are smaller relevant markets within the wholesale market (confer that the relevant market is the smallest market in which it is possible to exert market power). In particular we are interested in knowing if electricity sold through bilateral contracts belong to the same relevant product market as the sale of electricity at the Nord Pool elspot market. Examining this problem using the SSNIP test, we ask if a hypothetical monopolist in the bilateral market (or the spot market) would be able impose a small but

5 For a discussion of the two approaches, see chapter V of Werden, Gregory J. (1992).
6 Office of Fair Trading (2001).
7 Confer the discussion in subsection 2.2.

significant and non-transitory increase in the electricity price without loosing profit due to loss of sales on the spot market (or the bilateral market).

Due to the range of different bilateral contracts it is hard to be completely affirmative, but the most probable answer to the above-mentioned question would be that the hypothetical monopolist would not have the incentive to increase the price on bilateral contracts. This is due to two constraining effects of such a price increase. Firstly, buyers that have entered into bilateral contracts will to some extent switch to the spot market as a response to a hypothetical price increase. And buyers operating on the spot market will be able to switch to bilateral contracts.

In the cases concerning Statkraft's acquisition of Agder Energi[8] and Trondheim Energiverk the Norwegian Competition Authority concluded that the bilateral market and the elspot market are close substitutes, both for suppliers and customers, and therefore part of the same relevant product market. An important argument was the fact that many bilateral contracts contain some reference to the system price. The decisions were appealed to the Norwegian Ministry of Labour and Government Administration who handled the cases in the second instance. The Ministry supported these findings.

The Danish competition authority confirmed this reasoning in a recent case concerning abuse of dominant position by two Danish market participants.[9] The Danish competition authority argued that a bilateral contract in essence comprises a spot market element and a financial element. The Nord Pool spot market governs pricing of the spot element whereas the financial element belongs to a completely different market – the market for risk. At this market the "good" traded is risk and not electricity. (Risk is also traded in different forms at the Nord Pool financial market).

A report written by Copenhagen Economics (2002) on the relevant power markets in the Nordic area[10] reached the conclusion that the bilateral market, the spot market, the Elbas market and the regulating power market all belong to the same relevant product market. Copenhagen Economics put much emphasis on the fact that supply substitution is feasible and likely to be swift, such that prices on one of the markets cannot rise significantly without generators quickly moving capacity from the other three markets to the market with the higher price. The generator does not need to make any significant technological adjustment but only needs to adjust the bid schedules on the spot market and on the regulating power market. These conclusions were backed by analysis of price correlation between all the wholesale sub-markets except for the market for bilateral contracts.

In this report we will base our analysis on a relevant product market that include all the wholesale sub markets.

2.4 The relevant geographic market

The European Commission has traditionally defined the geographic wholesale market for electricity as national. The argument is that the lack of international transmission capacity and the lack of formalized tools for international exchange of electricity effectively prevent demand and supply substitution outside the range of the national transmission networks.

An important characteristic of the power market is the lack of opportunity to store the product. Electricity must be consumed in the same instant it is produced. The substitutability between different time periods is also restricted. The lack of possibilities for consumers to store electricity and the limited substitution between time periods implies that the market must be distinguished by the time at which the electricity is delivered.

8 The Norwegian Competition Authority (2002)
9 Press release 26 March 2003.
10 Copenhagen Economics (2002)

In some instances where the time dimension matters it is natural to include it as a characteristic of the product (for instance new-grown potatoes). In the electricity market the time dimension is important because it influences the width of the geographical market. During different time periods there will be capacity constraints in the transmission network. Such capacity constraints limit the range of suppliers that can offer electricity in a particular region.

This concept of a relevant geographic market varying over time is a special feature of the electricity market. In competition cases concerning abusive behaviour in other markets the relevant market needs to be stable over a period of time in order for the competition authority to establish dominant position. This is not possible in the electricity market. What is crucial in establishing a dominant position on a given market is the ability to affect prices. If the prices can be affected from hour to hour then this period of time is long enough to establish dominance. In the electricity market, prices can be affected by the strategic behaviour of a generator from one hour to the next.

Congestions in the inter-Nordic transmission network divide the market geographically. Because of capacity constraints in the network grids (so-called bottlenecks), the structure of the power market can vary from one hour to the next.

In periods where there are no binding bottlenecks the relevant geographic market is delineated to the Nordic region (Norway, Sweden, Finland, Denmark). Even if the Nordic power market is also connected to other geographic regions like Poland and Germany, there are no indications that the relevant geographic market is ever bigger than the Nordic region. Copenhagen Economics has, in the above-mentioned report, analysed partial price correlations between areas, which clearly reject a hypothesis that the Nordic area is part of the same market as Germany.

When bottlenecks bind in the Nordic transmission grids the spot market is divided into two or more areas with different prices (so-called price areas). In these periods it is quite obvious that a hypothetical monopolist operating in an area into which imports are restricted, will be able to increase price without loosing demand to suppliers located in other areas. Thus, the SSNIP test will be satisfied for such a price area.

It is important to note that a hypothetical monopolist will be able to exercise market power also in an area with surplus supply, i.e. an area from which electricity is exported to surrounding areas. Market power may be utilised by preventing the price from falling to a lower level.

This means that whenever the wholesale market is divided into different price areas, each area represents a separate geographic market. Furthermore, a hypothetical monopolist in an area with surplus supply may raise the price to the level of the surrounding areas, and thereby level out price differences between price areas. This means that a price area may be a relevant geographic market even in periods where the capacity in the transmission grids is not fully utilized.

It should also be emphasised that there might be relevant geographic markets within each price area. Capacity constraints within price areas are handled by means of counter-purchase. Power companies operating in these markets may be able to exert market power towards the system operator.

How important are the transmission constraints that divide the Nordic region into smaller relevant geographic markets? The table below shows export and import openness[11] in the Nordic countries.

11 Export (import) openness is calculated as the permissible export (import) capacity divided by the total generation capcity.

Trade openness

	Denmark	Finland	Norway	Sweden
Export openness	0.29	0.11	0.21	0.28
Import openness	0.29	0.13	0.19	0.29

Source: Copenhagen Economics (2002)

The data indicates that all Nordic countries are well connected to each other, especially Denmark and Sweden where the import/export capacity is well above 20 per cent of the internal generating capacity. In Norway the same indicators is approximately 20 per cent and in Finland slightly above 10 per cent.

However, not all of the capacity of the transmission lines is fully utilised. For instance, the average degree of utilization of the transmission line from Sweden to Denmark West was just below 50 per cent in 2001. This indicates that there must be scope for increasing the effective transmission capacity by other means than increasing the physical capacity.

In those hours where no congestion constraints occur, wholesale prices are identical in all Nordic countries and the Nordic area is an integrated relevant market.

When congestion does occur, the relevant geographic market is separated into several geographic markets depending on the exact location of the congestion constraints. Some of these geographic markets are directly observable on the spot market because the congestion constraint is handled by means of Elspot price areas (see 2.2 and 1.2.4), giving rise to different prices in different price areas. Other geographic markets are only visible at the regulating power market, because the congestion constraint is handled by counter trade, giving rise to identical prices on the spot market, but different prices on the regulating power market.

The distribution of price areas within the Nordic area and the frequency with which they occur varies from year to year primarily due to variations in weather conditions. In wet years there will be congestion constraints in the transmission grids from Norway to Denmark and Sweden. For instance, in wet years (as the years 2000 and 2001) the two Danish price areas – dominated by expensive thermal generation – were isolated in more than 30 per cent of the time. In "normal" years the figure drop to approx. 5 per cent. Export from Denmark may be constrained when wind production is high or there are large imports from Denmark.

Copenhagen Economics (2002) has listed all combinations of price areas on the Nordic spot market. From this list we have calculated the frequency of different constellations of Elspot price areas. We have only counted the number of constellations involving three price areas or less.

The table below shows the most encountered constellations of price areas in 2001 and the percentage of time in which they occur. The figures vary between different years.

The Nordic region	51.8%
Denmark West	19.1%
Norway Middle/Norway North	18.5%
Norway South	8.9%
Norway Middle	8.2%
Denmark West/Norway South	6.3%
Denmark East	5.4%
Norway North	5.3%
Finland, Denmark East, Sweden	5.3%

The integrated Nordic region is the most frequent price area. It occurred in 52% of the time in 2001. Note however, that in 2002 the percentage was 35% hour. Half of the time or more the relevant geographic market has been smaller than the Nordic region.

3. MARKET CONCENTRATION

Traditionally, market concentration has played an important role in competition policy analysis. The more concentrated a market is, the more likely it is that the market actors can utilize market power, either unilaterally or collectively. By assessing market structure (for instance market concentration) one can deduce probable market conduct and the market performance (the so-called SCP paradigm).

The perhaps most common way to measure market concentration is to calculate the market shares of the largest actors. Market shares are usually calculated as each player's share of sales in the market either by volume or value. In the electricity market the market shares are ordinarily calculated as each player's part of the total production or installed capacity in the relevant markets.

Another well-known concentration index is the Herfindahl-Hirschman Index (HHI). The HHI is defined as the sum of the squares of market shares of all the firms in the relevant market. The HHI will vary between 0 (an atomistic market) and 10 000 (monopoly) if market shares are measured in percentages, or equivalently between 0 and 1 if market shares are measured as decimals. Since the shares are squared the HHI will put more emphasis on large than small firms. For example, the HHI contribution of two firms having 20% market shares each is 202 + 202 = 400 + 400 = 800. The contribution of one firm having 40% is 402 = 1600.

The US merger guidelines[12] stipulates an a priori assumption that markets with a HHI below 1000 is unconcentrated, a HHI between 1000 and 1800 is moderately concentrated, and a HHI above 1800 highly concentrated. Ten firms having 10% market shares will produce a HHI = 1000. When five firms have 20% market shares each the index will equal 2000.

When calculating the HHI each firm is treated as independent from its competitors. This way of calculating the HHI will be misleading in the case of cross-ownership between the competitors. In the case of cross-ownership the owner's objective will be to maximize the total profit of his portfolio of shares, i.e. both his direct and indirect ownership interests. The profitability of a price raise will increase, because the lost sales due to the price raise in one firm will partly accrue to other companies in which the owner have direct or indirect shares. Thus, cross-ownership will make the owner more concerned with the profitability of the whole market. It is therefore in the owners' interests to compete less aggressively. The HHI adjusted for the incentives effect of cross-ownership is denoted HHI^{i}.

Cross-ownership may also give the owner some degree of control over the company, making him able to co-ordinate the activities of two or more companies in the market. The incentives and control adjusted HHI is denoted HHI^{i}.

In chapters 3.2 to 3.6 we have made calculations of the three types of Herfindahl-Hirschman indexes. The results of the calculations are summarised in the table below.

	HHI	HHI^{i}	HHI^{ic}
Finland	1766	2037	3005
Norway	1634	1980	3325
Sweden	2893	2923	2988
Denmark[13]	4844	4844	4844
The Nordic Market	892	989	1138

According to the unadjusted HHI the national Nordic markets seem to be moderately concentrated, with the exception of Sweden and

12 The US Department of Justice and Federal Trade Commission (1992).
13 Calculating of the various HHIs for the Danish markets does not give a fully realistic indication of the extent of market power, confer chapter 3.6.

Denmark. Taking the full effects of cross-ownership into account, the four national markets are all highly concentrated. The Norwegian national market is the second most concentrated at the moment, but after sales of E-CO and Trondheim Energiverk the HHIic will be reduced to 2735.

Even the integrated Nordic electricity market is moderately concentrated when the full effects of cross-ownership is being taken into account.

As noted in chapter 2.5 the distribution of price areas and the frequency with which they occur will vary from year to year. There are constellations of elspot areas that are separate price areas with some frequency, for instance Denmark West/Norway South, which are not covered in the calculations below. Depending on the case in question it may be necessary to calculate market concentration in other price areas than the ones we have covered below.

The justification for the SCP paradigm is found in the Cournot-Nash model. In subsection 3.1 below we present the model and its extensions to the case of cross-ownership.

The calculations of the various Herfindahl-Hirschman indexes in relevant Nordic markets are presented in chapters 3.2 – 3.6.

In section 3.7 we have made some alternative calculations taking into account the effects of jointly held production plants.

3.1 The Lerner Index and the Hirschman-Herfindahl Index

In 3.1.1 we explain the relationship between market power – as measured by the Lerner index – and market concentration as measured by the unadjusted HHI.

If not adjusted for the reduced incentives to compete due to cross-ownership the HHI can be a misleading measure of market power. In subsection 3.1.2 we will present an index adjusted for cross-ownership – HHI^{i}.

Minority ownership may also give the owner some control over the firm. A power index is presented in subsection 3.1.3. The index is a measure of the degree of control.

When owners' have the opportunity to exert control over companies, it will also be possible to co-ordinate the activities of the companies. In subsection 3.1.4 we will present a concentration index adjusted both for reduced incentives to compete and the increased opportunity to exercise control – HHI^{ic}.

3.1.1 The Lerner Index and the Unadjusted HHI

The Lerner index is an indicator of the degree of market power. When price equals marginal cost the Lerner index is zero and the firm has no market power. This will happen if market demand is endlessly elastic or – slightly more realistic – it will approximate zero as the market share of the firm approximates zero. The highest possible Lerner index is 1.

Consider a market where the firms engage in Cournot-Nash quantity competition, i.e. in order to maximise profits the firms simultaneously choose quantities to be supplied in the market. As shown in the appendix the first order condition for this maximization problem is that each firm n will have market power which equals:

(1)

$$L_n = \frac{P(Q) - C_n'(q_n)}{P(Q)} = \frac{s_n}{\varepsilon}$$

is the size of the price-cost mark-up for firm n, i.e. the market price as a function of total supplied quantity – P(Q) – minus the marginal cost of firm n as a function of the quantity supplied by firm n – Cn'(qn) – relative to the market price. The Lerner index of each firm is equal to the market share – sn – divided by the elasticity of the demand e.

In the appendix it is shown that the weighted (the weights are the market shares) average Lerner index - - in the market will equal HHI divided by the elasticity of demand. That is,

(2)

$$\bar{L} = \frac{HHI}{\varepsilon}$$

If competition is perfect all firms will be price takers and the elasticity of demand will be irrelevant. If we have a monopoly only the elasticity of demand is relevant. In an oligopoly both market demand and the degree of competition matter.

It is generally presumed that the demand for electricity is inelastic, especially in the short term, since the consumers may lack technology to switch to other sources of energy or even lack information about the market price. A low elasticity of demand means that market concentration must also be low if the prices shall not be significantly higher than marginal cost. It may be of some interest to calculate at what levels of concentration the price-cost margin is below 10%.

To simplify the calculations of these threshold levels of the HHI it is presumed that all N firms in the market are of the same size (which will only occur if all firms have similar costs). The price-cost margin is:

$$\frac{P(Q)}{C'(q)} = \frac{N\varepsilon}{N\varepsilon - 1}$$

In the following table we have for different values of the elasticity of the market demand calculated the number of firms necessary for the price-cost margins not to exceed 10% and the corresponding threshold levels of the HHI.

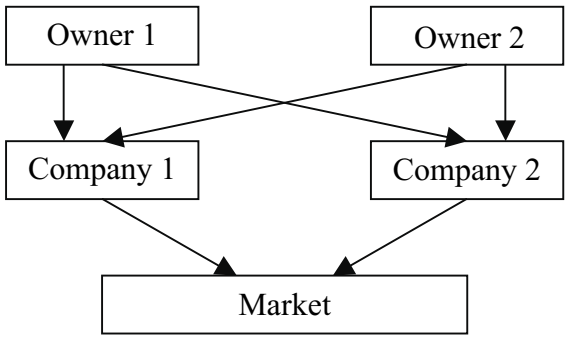
As shown in the table the number of firms in the market must be quite large to prevent a substantial degree of market power. Note that all the HHI values are within the area that is called "unconcentrated market" in the US merger guidelines.

3.1.2 The Lerner Index and the Incentives Adjusted HHI[14]

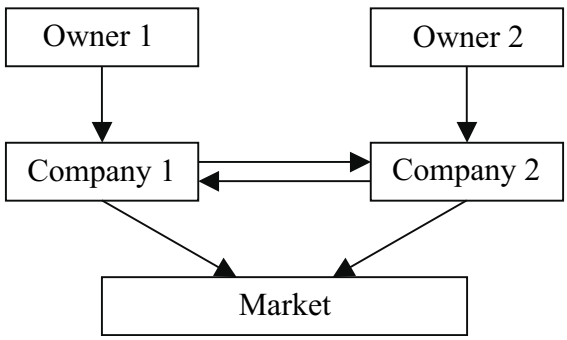
Cross-ownership denotes the situation where an investor (also called an "external owner") owns shares in two or more companies in the same market, either in the form of direct ownership interests in several companies ("diversified ownership") or by indirect ownership. In the latter case companies in the same market own shares in each other.

Direct and indirect cross-ownership is illustrated in the figure below:

Direct ownership



Indirect ownership



	ε = 0,1	ε = 0,2	ε = 0,5	ε = 0,8	ε = 1,0
N	110	55	22	14	11
HHI	91	182	455	714	909

14 This chapter is largely based on von der Fehr et al (1998).

There may, of course, be combinations of direct and indirect ownership. In both cases the "real" owners are the external owners. When a company holds ownership interests in another company it is in reality its own owners that have shares in the other company.

An investor is supposed to maximise the value of his portfolio of shares. Increased price of a product of one company will generate increased demand for the products of the other companies in the market. Therefore, cross-ownership means higher incentives to for the investor to increase prices. The external investors with diversified ownership in more than one company in the same market will be less inclined to compete aggressively and more inclined to take the profitability of the whole market into consideration.

Thus, even if external owners have no control over the indirectly owned companies, cross-ownership will increase incentives to charge higher prises. The effects of control will be discussed in subsection 3.1.3 and 3.1.4. In this chapter we will abstract from the question of control by presuming first that a company's minority interests in another company does not give rise to control. Under this presumption only external owners can exert control over a company. Second, no external owner has ownership in more than one company in the market. Since no external owners have diversified interests in the market and since no company can exert control over another company, no external owner can co-ordinate decisions in the companies in which they have ownership interests. Under these presumptions the only effects of cross-ownership will be reduced incentives to compete aggressively. Furthermore, the external owners will have joint interests in maximisation of the value of that company.

In the appendix it is shown that the Lerner index of company n is:

(3)

$$L_n^{\ i} = \frac{P(Q) - C_n'(q_n)}{P(Q)} = \frac{s_n}{\varepsilon} + \frac{\sum_{s \neq n}^{N} \frac{b_{ns}}{b_{nn}} s_s}{\varepsilon}$$

Comparing (3) and (1) we see that Lni > Ln: Cross-ownership enhances the market power of the companies.

Multiplying (3) on both sides by the market share of company n and summing over all n, we get the following expression:

(4)

$$\overline{L}^i = \frac{HHI^{\,i}}{\varepsilon} = \frac{HHI}{\varepsilon} + \frac{1}{\varepsilon} \sum_{n=1}^{N} \sum_{s \neq n}^{N} \frac{b_{ns}}{b_{nn}} s_s s_n$$

where is the weighted average incentives adjusted Lerner index and e is the elasticity of demand.

$HHI^i = \sum_{n=1}^{N} \sum_{s=n}^{N} \frac{b_{ns}}{b_{nn}} s_s s_n$ is the incentives adjusted Herfindahl-Hirschman index.

Comparing (4) and (2) we see that $HHI^i >$ HHI: The incentives effect of cross-ownership increases the concentration index.

In this subsection we have shown that the incentives effects of cross-ownership leads to increased market concentration and market power. This result holds even if the buyer does not achieve any degree of control over the company in question. Article 3(1)(b) of Council Regulation (EEC) No 4064/89 on the control of concentrations between undertakings, provides that a concentration occurs in the case of an acquisition of control. National competition legislations in Denmark, Sweden and Finland have similar provisions. The current Norwegian control of acquisitions of enterprises encompasses all acquisitions of shares. However, there is a proposal to harmonise this provision with the EC Merger Control provisions. It therefore seems that the provisions to control acquisitions of shares do not fully encompass the situation that has been analysed in this subsection.

3.1.3 The Normalised Banzhaf Power Index

The literature on ownership control generally presumes that a majority of votes – i.e. an ownership share above 50 percent – will give the owner complete control. That is, if there is a majority shareholder he or she has all the voting power and none of the other shareholders has any voting power at all.

The more interesting question is how much control a minority owner might exert upon a

company. It is necessary to distinguish between an owner's voting share – as given by his ownership share in the company – and his voting power.

The Banzhaf power index[15] is based on the idea that the voting power of a member reflects how often the voting share can be used to "swing" a losing coalition into a winning one. The power index is not related in a simple way to the ownership share. The power index is defined by an owner's ability to swing a coalition of votes (i.e. a group of owners voting similarly) from a losing to winning coalition. This swinging ability arises because an owner may join the coalition.

Following Leech (2001)[16] the Banzhaf power index can be defined formally as follows: Let the owners be indexed by the set N = {1, 2,…,n} and let the members of the set vote "for" or "against" a motion. The ownership of each member of the set is denoted wi and arranged in decreasing size order such that $w_i \geq w_{i+1}$ for all i = 1, 2,…,n. A coalition of members all voting "for" is denoted by the function $w_i \geq$. Thus, $w(S) = \sum_{i \in S} w_i$. The coalition is said to be winning if $w(S) > 0.5$.

The power index of each owner is defined by the number of "swings". A swing is a pair of coalitions represented by subsets, (Si, Si+{i}) such that w(Si) ≤ 0.5 and w(Si+{i}) > 0.5. That is, Si represents a losing coalition which becomes winning with the addition of the votes of member i. Let the number of such swings be hi. The number of such subsets is 2^{n-1}. The non-normalised Banzhaf index makes use of the number of coalitions of the set N which do not include owner i, i.e. 2^{n-1}:
$B_i' = h_i/2^{n-1}$

The normalised Banzhaf index, Bm, makes use of the number of swings of all the owners:
$B_i = \eta_i/\sum_i \eta_i$

The normalised Banzhaf index sum to one. We will make use of the normalised Banzhaf index in our calculations.

Calculation of power indexes can be quite complicated when the number of owners is large. Below we will present a simple example.

Consider four owners of a company: N = {1, 2, 3, 4} having voting shares w_1 = 40%, w_2 = 30%, w_3 = 20%, w_4 = 10%. The owners may either support (A) or oppose a motion (Ã). The number of possible coalitions that an owner i may join is $2^{n-1} = 23 = 8$. The possible coalitions of the three other owners can be arranged as follows:

{Ã, Ã, Ã}
{Ã, Ã, A}
{Ã, A, Ã}
{A, Ã, Ã}
{Ã, A, A}
{A, Ã, A}
{A, A, Ã}
{A, A, A}

Consider first the 40%-owner. The coalitions above correspond to the following coalitions of votes "for" the motion:
{Ø}
{10%}
{20%}
{30%}
{20%, 10%}
{30%, 10%}
{30%, 20%}
{30%, 20%, 10%}

Coalition (i) is the empty set and joining that one will of course not produce a winning swing. Joining coalition (ii) will not produce a swing either, since 40% + 10% = 50%, which will not turn into a winning majority. Joining a coalition that is already winning, as is the case for coalition (xvi), will not produce a swing either. By joining the five other coalitions the 40%-owner will produce a swing. Thus we have:
B1' = 5/8 = 0.625.

15 Banzhaf, J. (1965)
16 Leech, Dennis (2001)

The 30%-owner may join the following voting coalitions: {Ø}, {10%}, {20%}, {40%}, {20%, 10%}, {40%, 10%}, {40%, 20%}, {40%, 20%, 10%}. The 30%-owner can produce a swing by joining the coalitions {40%}, {20%, 10%}, {40%, 10%}. Thus:
B2' = 3/8 = 0.375.

The 20%-owner may join the following voting coalitions: {Ø}, {10%}, {30%}, {40%}, {30%, 10%}, {40%, 10%}, {40%, 30%}, {40%, 30%, 10%}. The 30%-owner can produce a swing by joining the coalitions {40%}, {30%, 10%}, {40%, 10%}. Thus:
B3' = 3/8 = 0.375.

The 10%-owner may join the following voting coalitions: {Ø}, {20%}, {30%}, {40%}, {30%, 20%}, {40%, 20%}, {40%, 30%}, {40%, 30%, 20%}. The 30%-owner can produce a swing by joining the coalition {30%, 20%}. Thus:
B4' = 1/8 = 0.125.

Note that the voting power for the 20%-owner is equal to that of the 30%-owner, which reflects that the latter does not have the power to influence the voting result anymore than the former.
There are in total 5 + 3 + 3 + 2 = 12 swings.
The normalised Banzhaf index is:
B1 = 5/12 = 0.42
B2 = 3/12 = 0.25
B3 = 3/12 = 0.25
B4 = 1/12 = 0,08
Note that the power indexes of Owner 1 and Owner 2 are higher than their ownership shares of the company. The power indexes of Owner 2 and Owner 4 are lower than their company shares.

It is important to realise that a power index does not measure actual voting power, which will depend on the preferences of the owners and the cases to be voted on. Only if all coalitions are equally likely the power index can be seen as a swing probability.

3.1.4 The Lerner Index and the incentives and control adjusted HHI^{ic}

Cross-ownership does not only change the incentives of the market actors, as discussed in section 3.1, but also gives the owner influence and control over the company. This makes the owner able to co-ordinate the conduct of competitors to increase the value of his portfolio of shares. In this subsection we will presume that each company maximises the value of its owners' portfolio of shares in the market, where the weights are given by a power index gmn, which measures owner m's relative power of influence in the company n. The power index can for instance be the Banzhaf index, which was discussed in 3.1.3.
In the appendix it is shown that the Lerner index of company n is:
(5)

$$L_n^{ic} = \frac{P(Q) - C_n'(q_n)}{P(Q)} = \frac{s_n}{\varepsilon} + \frac{1}{\varepsilon} \sum_{s \neq n}^{N} \frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} s_s$$

Comparing (5) and (1) we see that $L_n^{ic} > L_n$.

Multiplying (5) on both sides by the market share of company n and summing over all n, we get the following expression.
(6)

$$\overline{L}^{ic} = \frac{HHI}{\varepsilon} + \frac{1}{\varepsilon} \sum_{n=1}^{N} \sum_{s \neq n}^{N} \frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} s_s s_n$$

where $\overline{L}^{ic}$ is the weighted average Lerner index and e is the elasticity of demand.

$HHI^{ic} = \sum_{n=1}^{N} \sum_{s=1}^{N} \frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} s_s s_n$ is the incentives and control adjusted Herfindahl-Hirschman index.

Comparing (6) and (2) we see that HHIic > HHI: The incentives and control effect of cross-ownership increases the concentration index.

3.2 The Nordic Market

The data in this section, as well as in section 3.3 to 3.6 is mainly based on Europower's database on production (2001) of actors in the Nordic market. We have calculated the market shares of the 15 largest companies in each rele-

vant market. Our aim has been to let the production data include the portion of the production in partially owned companies that reflect the ownership share of that company. However, when one company holds a stake in another company that is among the 15 largest ones, then none of that production is allocated to the parent company. Otherwise the total production of the 15 largest companies would have been inflated and their market shares would have been exag-gerated, confer the discussion of company values in the annex. We have used different sources of information, among other things annual reports and the database of the NVE[17].

3.2.1 The unadjusted HHI

The unadjusted HHI indicates that the Nordic market is an unconcentrated market:
HHI = 892.

3.2.2 The incentives adjusted HHIi

As shown by the cross-ownership matrix (COM) there is no cross-ownership between the three largest Nordic electric power producers. The most important cross-ownership holdings are Statkraft's ownership positions in its competitors Sydkraft (45%), E-CO (20%), BKK (50%), Agder Energi (46%) and Vannkraft Øst (13%). Other important cross-ownership holdings are Fortum's 27% share of TVO, which is also owned with 27% by PVO.

The Nordic market	Production GWh 2001	Market share	HHI
1. Vattenfall	75200	19 %	376
2. Fortum	60600	16 %	244
3. Statkraft	44800	12 %	133
4. Sydkraft	33200	8 %	69
5. Teollisuuden Voima (TVO)	15100	4 %	15
6. Elsam	14600	4 %	14
7. Energi E2	11800	3 %	9
8. E-CO	10200	3 %	7
9. Norsk Hydro	9800	3 %	6
10. Pohjolan Voima (PVO)	8000	2 %	4
11. BKK	8000	2 %	4
12. Agder Energi	7900	2 %	4
13. Lyse Energi	5900	2 %	2
14. Helsingin Energi	5400	1 %	2
15. Vannkraft Øst	4900	1 %	2
15 largest producers	315400	81 %	892
Total market production	388000		

17 The Norwegian Water Resources and Energy Directorate.

COM **Nordic market**	Vattenfall	Fortum	Statkraft	Sydkraft	TVO	Elsam	Energi E2	E-CO	Norsk Hydro	PVO	BKK	Agder Energi	Lyse Energi	Helsingin Energi	Vannkraft Øst
Vattenfall															
Fortum					27%										
Statkraft				45%				20%			50%	46%			13%
Sydkraft															
TVO															
Elsam															
Energi E2															
E-CO															29%
Norsk Hydro															
PVO					57%										
BKK															
Agder Energi															
Lyse Energi															
Helsingin Energi															
Vannkraft Øst															

Taking into account the incentives effect of cross-ownership interests between power producers in the Nordic market:
HHIi = 989

3.2.3 The incentives and control adjusted HHIic

The external ownership matrix (EOM) shows that there is no diversified ownership involving the eight largest producers in the Nordic market. The only example of major diversified ownership position is the Norwegian state, which owns 100% of Statkraft and 44% of Norsk Hydro.

We have also calculated the corresponding Banzhaf power indexes (confer 3.1.3), which is presented in the EOM as decimals below the ownership shares. Since PVO owns more than 50% of TVO its power index equals 1.00 .

EOM **Nordic market**	Vattenfall	Fortum	Statkraft	Sydkraft	TVO	Elsam	Energi E2	E-CO	Norsk Hydro	PVO
Swedish state	100% 1.00									
Others Fortum		100% 1.00								
Norw. state			100% 1.00						44% 0.80	
E.ON Scand.				55% 1.00						
Others TVO					16% 1.00					
Others Elsam						100% 1.00				
Others Energi E2							100% 1.00			
Municipality of Oslo								80% 1.00		
Others Norsk Hydro									56% 0.20	
Others PVO					1.00					100% 1.00

Taking into account the incentives and control effects:
HHIic = 1138

The total effect of cross-ownership in the Nordic market is to increase the Herfindahl-Hirschman index from 892 to 1138, equalling a 28 percent increase of the index. Thus, the effect of cross-ownership is to move the market from the nonconcentrated to the moderately concentrated area (confer the 1992 U.S. Merger Guidelines).

3.3 The Finnish Market

3.3.1 The unadjusted HHI

Finland	Production GWh 2001	Market share	HHI
1. Fortum	23500	33 %	1076
2. Teollisuuden Voima (TVO)	15100	21 %	444
3. Pohjolan Voima (PVO)	8000	11 %	125
4. Helsingin Energia	5400	8 %	56
5. Kemijoki	4100	6 %	32
6. Vaskiluoden Voima	2400	3 %	11
7. Tampereen Sähkölaitos	1700	2 %	6
8. Oulun Energia	1500	2 %	4
9. Alholmens Kraft	1500	2 %	4
10. Lahti Energia	1000	2 %	2
11. Espoon Sähkö	1000	1 %	2
12. Vantaan Energia	1000	1 %	2
13. Kuopion Energia	500	1 %	1
14. Kainuun Voima	500	1 %	0
15. Lappeenrannan Lämpövoima	500	1 %	0
15 largest producers	67700	95 %	1766
Total market production	71645		

The Finnish market is moderately concentrated before the effects of cross-ownership is taken into account:
HHI = 1766

No producer is dominant in its own right, although the three largest companies – Fortum, TVO and PVO – has a large joint market share and contribute by more than 1600 to the total HHI.

3.3.2 The incentives adjusted HHI[i]

As shown in the cross-ownership matrix, there are some important cross-ownership shares between the top 15 companies in Finland. The largest company – Fortum – owns 27% of the second largest company TVO, which is also owned with 57% by the third largest company PVO. Furthermore, Fortum also owns 18% of Kemijoki and 50% of Lappeenrannan Lämpövoima. PVO owns 50% of Vakiluoden Voima.

COM Finland	Fortum	TVO	PVO	Helsingin Energia	Kemijoki	Vaskiluoden Voima	Tampereen Sähkölaitos	Oulun Energia	Alholmens Kraft	Lahti Energia	Espoon Sähkö	Vantaan Energia	Kuopion Energia	Kainuun Voima	LappeenrannanLämpövoimaHels
Fortum		27%			18%										50%
TVO															
PVO		57%				50%									
Helsingin Energia															
Kemijoki															
Vaskiluoden Voima															
Tampereen Sähkölaitos															
Oulun Energia															
Alholmens Kraft															
Lahti Energia															
Espoon Sähkö															
Vantaan Energia															
Kuopion Energia															
Kainuun Voima															
Lappeenrannan Lämpövoima															

Taking into account the incentives effects of cross-ownership between power producers in the Finnish market:
HHI^{i} = 2037.

3.3.3 The incentives and control adjusted HHI^{ic}

The external ownership matrix shows that diversified ownership is of great importance in the Finnish market. UPM-Kymmene has a large minority share in PVO. The corresponding power index is 0.52. UPM-Kymmene has the same power over TVO. PVO's 50% share of Vaskiluoden Voima also gives its eksternal owners a certain control over that company.

EOM Finland	Fortum	TVO	PVO	Helsingin Energia	Kemijoki	Vaskiluoden Voima	Tampereen Sähkölaitos	Oulun Energia	Alholmens Kraft	Lahti Energia
Others Fortum	100% 1.00									
Helsinki by		0.02	1.4% 0.02	100% 1.00	0.9% 0.00	0.001				
Pori by		0.02	1.2% 0.02			0.001				
UPM-Kymmene		0.52	38.7% 0.52		4,1% 0.00	0.360				
Others PVO		0.44	58.7% 0.44			0,138				
Others TVO		16.0% 0.00								
Others Kemijoki					77.0% 1.00					
Others Vaskiluoden						50% 0.50				
Others Tampereen							100% 1.00			
Others Oulun								100% 1.00		
Others Alholmsen									100% 1.00	
Others Lahti										100% 1.00

Taking into account the incentives and control effects:
$HHI^{ic} = 3005$

The total effect of cross-ownership in the Finnish market is to increase the Herfindahl-Hirschman index from 1766 to 3005, equalling a 70 percent increase of the index. Thus, the effect of cross-ownership is to move the market from the moderately to the highly concentrated area. Cross-ownership has a considerable effect on market concentration in Finland.

3.4 The Norwegian Market

3.4.1 The unadjusted HHI

Norway	Production GWh 2001	Market share	HHI
1. Statkraft	44840	37 %	1354
2. E-CO	10190	8 %	70
3. Norsk Hydro	9800	8 %	65
4. BKK	8050	7 %	44
5. Agder Energi	7870	7 %	42
6. Lyse	5870	5 %	23
7. Vannkraft Øst	4860	4 %	16
8. Hafslund	3260	3 %	7
9. Nord-Trøndelag Elverk	2640	2 %	5
10. Østfold Energi	1820	2 %	2
11. TrønderEnergi	1640	1 %	2
12. Salten Kraftsamband	1600	1 %	2
13. Buskerud Kraftproduksjon	1520	1 %	2
14. Sunnhordland Kraftlag	1450	1 %	1
15. Elkem	1380	1 %	1
15 largest producers	106790	88%	1634
Total market production	121872		

The figures for the unadjusted HHI give the impression that Norway is a moderately concentrated market.
HHI = 1634

Statkraft is the largest company, contributing more than 1300 to the HHI.

The Norwegian competition authorities[18] have ordered Statkraft to sell its recently acquired shares in Trondheim Energiverk and, as a condition for allowing the acquisition of Agder Energi, to sell its 20% stake in E-CO and 100% stake in Hedmark Energi (not included among the 15 biggest companies). Provided that the shares are not sold to any of the top 15 producers in Norway, the effect of these requirements is to reduce the HHI from 1634 to 1338.

3.4.2 The incentives adjusted HHIi

Cross-ownership is widespread in the Norwegian market. In particular, it should be noted that Statkraft has high ownership shares of BKK (50%), Agder Energi (46%) and E-CO (20%).

18 The Norwegian Competition Authority and the Ministry of Labour and Administration).

COM Norway	Statkraft	E-CO	Norsk Hydro	BKK	Agder Energi	Lyse	Vannkraft Øst	Hafslund	Nord-Trøndelag Elverk	Østfold Energi	TrønderEnergi	Salten Kraftsamband	Buskerud Kraftproduksjon	Sunnhordland Kraftlag	Elkem
Statkraft		20%		50%	46%		13%								
E-CO							29%						30%		
Norsk Hydro															
BKK														33%	
Agder Energi															
Lyse															
Vannkraft Øst															
Hafslund															
Nord-Trøndelag Elverk															
Østfold Energi								3%							
TrønderEnergi															
Salten Kraftsamband															
Buskerud Kraftproduksjon															
Sunnhordland Kraftlag															
Elkem															

Taking into account the incentives effects of cross-ownership between power producers in the Norwegian market:
HHIi = 1980.

Selling out Trondheim Energiverk (TEV), Hedmark Energi and E-CO will reduce HHIi from 1980 to 1580.

3.4.3 The incentives and control adjusted HHI^{ic}

The EOM matrix shows that the diversified ownership in the Norwegian power market is widespread. The Norwegian state owns 100% of Statkraft and 44% of Norsk Hydro, having corresponding power indexes of 1.00 and 0.80. The municipality of Oslo owns 80% of E-CO and 53.7% of Hafslund, giving it full control over these companies. Since Statkraft is a large owner of BKK and Agder Energi, the Norwegian state also has a large power over these companies (0.60 and 0.75 respectively).

EOM Norway	Statkraft	E-CO	Norsk Hydro	BKK	Agder Energi	Lyse	Vannkraft Øst	Hafslund	Nord-Trøndelag Elverk	Østfold Energi
Norw. state	100% 1.00		44% 0.80	0.60	0.75					
Municipality of Oslo		80% 1.00						54% 1.00		
Others Hydro			56% 0.20							
Others BKK				50% 0.4						
Others Agder Energi					54% 0.25					
Others Lyse						100% 1.00				
Others V.Ø.							58% 1.00			
Others Hafslund								20% 0.00		
Others N.Trd.lag									100% 1.00	
Others Østfold E.										100% 1.00

Taking into account the incentives and control effects:
HHIic = 3325

The total effect of cross-ownership in the Norwegian market is to increase the Herfindahl-Hirschman index from 1634 to 3325, equalling a 103 percent increase of the index. Thus, the effect of cross-ownership is to move the market from the moderately to the highly concentrated area. Cross-ownership has a considerable effect on market concentration in Norway.

If Statkraft's shares in Trondheim, Hedmark and E-CO are sold to independent parties, the HHIic will be reduced from 3325 to 2735.

3.5 The Swedish Market

3.5.1 The unadjusted HHI

Sweden	Production GWh 2001	Market share	HHI
1. Vattenfall	74500	47 %	2168
2. Sydkraft	32200	20 %	404
3. Fortum	27900	17 %	304
4. Skellefteå Kraft	4700	3 %	9
5. Graninge	3400	2 %	4
6. Älvkraft i Värmland	1700	1 %	1
7. Mälarenergi	1210	1 %	1
8. Jämtkraft	1100	1 %	1
9. Nybroviken Kraft	1100	1 %	1
10. Gulsele	900	1 %	0
11. Lulekraft	600	0 %	0
12. Tekniska Verken Linköping	600	0 %	0
13. Karlstad Energi	500	0 %	0
14. Holmen Kraft	400	0 %	0
15 largest producers	150810	94 %	2893
Total market production	160000		

The table shows that the Swedish electricity market is highly concentrated: HHI = 2893

Vattenfall is the largest company, having a 47% market share. The three largest companies in the market have a combined market share of more than 80%, contributing almost all to the HHI.

3.5.2 The incentives adjusted HHIi

Cross-ownership between electricity producing companies is not widespread in Sweden. Most notable is Sydkraft’s 23% share of Graninge.

COM Sweden	Vattenfall	Sydkraft	Fortum	Skellefteå Kraft	Graninge	Älvkraft Värmland	Mälarenergi	Jämtkraft	Nybroviken Kraft	Gulsele	Lulekraft	Tekniska Verken	Karlstad	Holmen Kraft
Vattenfall								21%		35%				
Sydkraft					23%					15%				
Fortum						5%			10%					
Skellefteå Kraft														
Graninge														
Älvkraft i Värmland														
Mälarenergi														
Jämtkraft														
Nybroviken Kraft														
Gulsele														
Lulekraft														
Tekniska Verken Linköping														
Karlstad Energi														
Holmen Kraft														

Taking into account the incentives effects of cross-ownership:
HHIi = 2923.

3.5.3 The incentives and control adjusted HHI^{ic}

The EOM matrix shows that there is one instance of direct diversified ownership in the Swedish electricity market. E.ON Scandinavia holds a controlling position in Sydkraft and a minority position of 13% in Graninge. Since Sydkraft also holds a minority position of 23% in Graninge and the other ownership positions are small, E.ON's power index in Graninge is fairly large (0.42) compared to the small ownership share. Statkraft has indirect diversified interests in the Swedish market through its 45% share in Sydkraft, and indirectly in Graninge since Sydkraft also holds 23% of that company. The indirect share gives Statkraft a power index of 0.08 in Graninge.

EOM Sweden	Vattenfall	Sydkraft	Fortum	Skellefteå Kraft	Graninge	Älvkraft Värmland	Mälarenergi	Jämtkraft	Nybroviken Kraft	Gulsele
Swedish state	100% 1.00									0.42
E.ON Scand.		55% 1.00			13% 0.42					0.08
Others Fortum			100% 1.00							
Statkraft		45% 0.00			0.08					
Others Skellefteå				100% 1.00						
Others Graninge					64% 0.50					
Others Värmland						95% 1.00				
Others Mälarenergi							100% 1.00			
Others Jämtkraft								79% 1.00		
Others Nybroviken									90% 1.00	
Others Gulsele										50% 0.50

Taking into account the incentives and control effects:
HHIic = 2988

The total effect of cross-ownership in the Swedish market is to increase the Herfindahl-Hirschman index from 2893 to 2988, equalling a 3 percent increase of the index. Thus, cross-ownership does not play a large role for market concentration in Sweden.

3.6 The Danish Market

Two generators, Elsam and Energi E2, dominate each of the two Danish markets for wholesale electricity. In 2001 the two companies produced 13.3 TWh and 11.8 TWh respectively.

In the table below "central production" represent the electricity sold on market terms. Elsam owns 97 percent of the installed capacity of central production in Denmark West. In Denmark East Energi E2 owns 98 percent of the installed central production capacity.

If calculated the HHI's are 3136 and 7056 for DK1 and DK2 respectively. Weighed by the shares of total installed capacity reveals a HHI of 4844 in Denmark. However, calculating the HHI heavily underestimates the market concentration relevant for competition policy analysis, since CHP and wind power are supplied at fixed non-market based prices. Elsam and Energi E2's market shares in generation – relevant for competition policy considerations – are close to 100 percent in the two Danish sub-markets, giving HHIs of nearly 10000.

Further refinements of the HHI-measure, taking into account cross-ownership and ownership-control, are not relevant when looking at the Danish electricity market in isolation[19].

Installed capacity Denmark West (DK1)

2001 (MW)	Total	Elsam	Elsam's market share %
Central production	3.596	3.500	97
CHP	1.523	267	18
Wind power	1.932	166	9
Total	7.051	3.933	56

Installed capacity Denmark East (DK2)

2001 (MW)	Total	Energi E2	Elsam's market share %
Central production	4.258	4.172	98
CHP	630	290	46
Wind power	554	131	24
Total	5.442	4.593	84

3.7 Joint Ownership of Production Plants

As described in chapters 1.4.2 and 1.5.2 hydropower plants in Norway and nuclear power plants in Sweden are jointly owned by two or more producers. Such joint ownership concerns a large part of total electricity production. Joint ownership concerns all nuclear power plants in Sweden, i.e. approximately 44 % of total production in Sweden. To our knowledge the situation is similar in Finland,

19 However, vertical ownership structures rather than horizontal causes concern. The grid companies own the transmission system operators and the two large generators Elsam and Energi E2. These concerns about potential foreclosure effects are not a topic for this report.

but we have not been able to ascertain this information. Joint ownership of Norwegian hydropower production plants concerns approximately 30 % of total electricity production in Norway.

It is important to note that in most cases the largest owner is also responsible for the operation of the plant.

In the calculations of the concentration indexes above we have not taken into account the possible negative effects on competition of joint ownership of production plants. This means that each company is treated as if it is free to dispose over its part of the production, which is a presumption that could be seen extreme. There are reasons to believe that conflicts of interests will arise between the owners, and that such conflicts must be solved by a procedure that will reflect the power of the individual ownership interests.

Each company will want its competitors to reduce production in order to raise market prices. This means that if the companies possess some degree of market power if they act together and one of the owners wishes to decrease his production, he would like the other owners to decrease their production as well. This conflict of interest may, for instance, arise because one owner has a higher market share than the other owners.

The typical situation in the jointly owned plants is that one of the owners has a majority interest in the plant and is also the operator. A major owner will normally have the opportunity to ensure that the management will favour its interests. But, let's say that the above-mentioned procedural rule constitute a restriction of the major owner's disposal over the plant. The majority owner has the advantage of having the operator role of the plant. This may imply that the management of the plant will be biased towards promoting the interests of the major owner. To what extent is it possible for the other owners to control the management and ensure that their own interests are taken into account? The management may insist that there are certain technical problems that will restrict production for all owners and thereby be able to co-ordinate the production of the owner in a way that will promote the interests of the largest owner.

One possible way to treat the jointly owned production plants is to treat them as any other company in the market. This would mean that ownership positions of all the owners affect their incentives to compete. The opportunity for an owner to exert power over the management of the company should then be reflected by a power index. An owner, which has a majority interest in the company, should thus be considered to have full control over the company. We have made these assumptions to explore the consequences of joint ownership of production plants in the Norwegian and Swedish electricity markets.

Thus, in Sweden we have singled out the nuclear companies as separate actors in the market. The production of the owners of these companies has been correspondingly lowered. Thus, the production of Vattenfall has been reduced by 37TWh, corresponding to its 74% shares of the Ringhals group (Barsebäck Kraft AB and Ringhals AB) and 66% shares in Forsmark Kraftgrupp AB. The production of Sydkraft has been lowered with 19TWh, corresponding to its 55% shares of OKG AB, 10% shares of Forsmark and 26% of Ringhals. The production of Fortum has been decreased by 13TWh, corresponding to its 46% shares of OKG and 22% shares of Forsmark. The production of Skellefteå has been decreased by 0.5TWh, corresponding to its 2% shares of Forsmark.

We have applied the same procedure for the ten largest hydropower plants in Norway. The results is that the incentives and control adjusted Herfindahl-Hirschman Index is increased:
The HHIic in Sweden is increased from 2988 to 3169.
The HHIic in Norway is increased from 3325 to 3644.

Appendix

The unadjusted HHI

There are N firms in the market. Firm q_n produces quantity $C_n(q_n)$ of a homogenous product. The costs are for n = 1,…, N. The inverse market demand is a function of total supplied quantity: $P = P(Q)$, where $Q = q_1 + q_2 + ... + q_N$. The market share of firm n: $s_n = q_n / Q$.

The profit of firm i is given by:

$$\pi_n(q_n, q_{-n}) = P(Q)q_n + C_n(q_n)$$

where q_{-n} is the production of all firms except firm n.

The firm chooses q_n to maximise its profits. The first order condition for profit maximum is:

$$\frac{d\pi_n}{dq_n}(q_n, q_{-n}) = P'(Q)q_n + P(Q) - C_n'(q_n) = 0 \quad for\ n = 1,...,N$$

$$\frac{P(Q) - C_n'(q_n)}{P(Q)} = -\frac{P'(Q)q_n}{P(Q)} = \frac{q_n/Q}{-P(Q)/QP'(Q)} = \frac{s_n}{\varepsilon}$$

where ε is the price elasticity of the market demand.

Thus, we have

(1) $$L_n \equiv \frac{P(Q - C_n'(q_n)}{P(Q)} = \frac{s_n}{\varepsilon}$$

Multiplying both sides by sn and summing over all n gives the following expression:

$$\sum_{n=1}^{N} \frac{P(Q) - s_n C_n'(q_n)}{P(Q)} = \sum_{n=1}^{N} \frac{s_n^2}{\varepsilon}$$

or

(2) $$\bar{L} \equiv \frac{P - \bar{c}}{P} = \frac{HHI}{\varepsilon}$$

where $\bar{c}$ is the weighted average of the marginal costs of the firms at the equilibrium quantities. The weights are the market shares of the firms. Thus, $\bar{L}$ the weighted average of the firm specific Lerner indexes in the market.

Company values

External ownership shares are expressed by the coefficients αmn, which is Owner m's share of Company n, m = 1,…,m, n = 1,…,N. Cross-ownership between companies in the same market is expressed by the coefficients β_{ns}, which is company n's share of company s. It is presumed that a company cannot have shares in itself: $\beta_{ns} = 0$.

Since the shares of one company sums to 1 we have the following identity:

$$\sum_{m=1}^{M} \alpha_{mn} + \sum_{k=1}^{N} \beta_{kn} \equiv 1$$

A distinction should be drawn between the operating profits and the total value of a company:

π_n: The operating profits of company n, i.e. the value of the company excluding ownership interests in other companies in the market.

V_n: The total value of company n, i.e. the operating profits of company n plus the value of company n's shares in other companies in the market.

The total value of a company is given by:

$$V_n = \pi_n + \sum_{s \neq n} \beta_{ns} V_s \quad n = 1,2,...,N$$

Let

$\pi = (\pi_1, \pi_2, \ldots, \pi_n)$ be the vector of the own values of the companies in the market, while

$V = (V_1, V_2, \ldots, V_n)$ is the vector of the total values of the companies.

Then the equation above can be expressed in matrix form in the following way:

$$V = \pi + BV$$
$$\Rightarrow (I - B)V = \pi$$
$$\Rightarrow V = (I - B)^{-1}\pi$$

where I is the NxN identity matrix.

For n ≠ s the term b_{ns} in the matrix $\mathbf{B_t} = (\mathbf{I - B})^{-1}$ denotes the total direct and indirect shares of company s which is owned by company n, while bnn will be equal to 1 plus the indirect ownership of company n.

When companies own shares in each other $V_n > \pi_n$: Cross-ownership "inflates" the value of the companies but, of course, do not create values as such. The total value of the assets of the external owners must be equal to the sum of own values of the companies in the market. Cross-ownership interests do not change the total real value of the companies in the market,

but it affects the division of these values between the external owners.

The value of Owner m's shares in the market is

$$W_m = \sum_{n=1}^{N} \alpha_{mn} V_n \quad m = 1,2,...,M$$

A is the matrix of external owners' direct shares, while $\mathbf{A}_t = [a_{mn}]$ is the corresponding matrix that includes the effects of both direct and indirect ownership. A_t is determined by

$$\mathbf{A}_t = \mathbf{A}[\mathbf{I}-\mathbf{B}]^{-1}.$$

Let $\mathbf{W} = (W_1, W_2, \ldots, W_M)$ be the vector of the values of the external owners' portfolios:

$$\mathbf{W} = \mathbf{AV} = \mathbf{A}[\mathbf{I} - \mathbf{B}]^{-1}\pi = \mathbf{A}_t\,\pi$$

Summing the values of the external owners portfolios gives *W*, i.e. the total values of the portfolios:

$$W = \sum_{n=1}^{N} \alpha_n V_n = \mathbf{1}[\mathbf{I} - \mathbf{B}]\mathbf{V} = \mathbf{1}\pi = \sum_{n=1}^{N} \pi_n = \pi$$

The incentives adjusted HHI^i

Company n maximises the value of its external owners' portfolio of shares:

$$\Pi_n = \alpha_n V_n = \alpha_n \sum_{s=1}^{N} b_{ns}\pi_s = \alpha_n \sum_{s=1}^{N} b_{ns}\left[P(Q)q_s - C_s(q_s)\right]$$

The first equality shows that company n maximises the value of the shares of the external owners of the company (α_n). V_n is the total value of the company (the company's own value + the value of its ownership positions in other companies). The second equality expresses that the total value of company n is equal to the sum of its ownership shares in the companies in the market – b_{ns} – which expresses both the direct and indirect shares of company n in company s. In the third equality we have used the same profit function as above.

The first order condition for profit maximum:

$$\frac{d\Pi_n}{dq_n} = \alpha_n \sum_{s=1}^{N} b_{ns} P'(Q)q_s + \alpha_n b_{nn}[P(Q) - C_n'] = 0$$

$$\Rightarrow \frac{P(Q) - C_n'}{P} = \frac{-P'}{P}\sum_{s=1}^{N}\frac{b_{ns}}{b_{nn}}q_s = \frac{1}{-\frac{1}{P'}\frac{P}{Q}}\sum_{s=1}^{N}\frac{b_{ns}}{b_{nn}}\frac{q_s}{Q}$$

$$\Rightarrow L_n^{\,i} \equiv \frac{P(Q) - C_n'}{P} = \frac{\sum_{s=1}^{N}\frac{b_{ns}}{b_{nn}}s_s}{\varepsilon}$$

Separating out the term where s = n gives us equality (3).

For the purpose of calculations it is useful to express the equilibrium in matrix form:

$$\frac{P(Q) - C_n'}{P} = \frac{-P}{P'}\tilde{\mathbf{B}}_{tn}\mathbf{q}'$$

where $\tilde{\mathbf{B}}_{tn}$ is row n in the normalised matrix $\tilde{\mathbf{B}}_t$ with elements b_{ns}/b_{nn}.
q = $(q_1,\ldots,q_N)$ is the vector of the companies' equilibrium quantities.

Multiplying the first order condition with s_n and summing over all n, we get:

$$\sum_{n=1}^{N} s_n \frac{P(Q) - C_n'}{P} = \sum_{s=1}^{N}\frac{b_{ns}}{b_{nn}}\frac{q_n/Q}{PQ/P'}m_s = \frac{1}{\varepsilon}\sum_{n=1}^{N}\sum_{s=1}^{N}\frac{b_{ns}}{b_{nn}}s_n s_s$$

which gives us

$$(4) \qquad L^i \equiv \frac{P - \overline{C}_n'}{P} = \frac{HHI^i}{\varepsilon} = \frac{HHI}{\varepsilon} + \frac{1}{\varepsilon}\sum_{n=1}^{N}\sum_{s\neq n}^{N}\frac{b_{ns}}{b_{nn}}s_n s_s$$

where

$\overline{C}_n' = \sum_{n=1}^{N} s_n C_n'$ and

In matrix form the HHIi can be written:
$HHI^i = \mathbf{s}\tilde{\mathbf{B}}\,\mathbf{s'}$
where **s** is the row vector of the market shares of the firms and
$\tilde{\mathbf{B}}$ is a matrix with elements b_{ns}/b_{nn}.

The incentives and control adjusted HHI^{ic}

Each company maximises the value of its owners' portfolio of shares in the market, where the weights are given by a power index γ_{mn}:

$$\Pi_n = \sum_{m=1}^{M}\gamma_{mn}W_m = \sum_{m=1}^{M}\gamma_{mn}\sum_{s=1}^{N}a_{ms}\pi_s = \sum_{m=1}^{M}\gamma_{mn}\sum_{s=1}^{N}a_{ms}\left[P(Q)q_s - C_s(q_s)\right]$$

The first equality shows that the objective function of company n is a weighted average of the value of the portfolio of shares of the external owners. The second equality reflects that the value of the portfolio of owner m is the sum of his direct and indirect shares of the own value of the the N firms in the market (as measured by a_{ms}). And the third equality once more uses the same profit function as above.

First order condition for profit maximum for company n:

$$\frac{d\Pi_n}{dq_n} = \sum_{m=1}^{M} \gamma_{mn} \left\{ \sum_{s=1}^{N} a_{ms} P'(Q) q_s + a_{mn} \left[P - C_n'(q_n) \right] \right\} = 0$$

Multiplying by Q/Q and 1/P

$$\sum_{m=1}^{M} \gamma_{mn} \left\{ \sum_{s=1}^{N} a_{ms} \frac{P'(Q)Q}{P} \frac{q_s}{Q} \right\} + \sum_{m=1}^{M} \gamma_{mn} a_{mn} \frac{\left[P - C_n'(q_n) \right]}{P} = 0$$

$$\Rightarrow L_n^{ic} \equiv \frac{\left[P - C_n'(q_n) \right]}{P} = \frac{1}{\varepsilon} \sum_{s=1}^{N} \frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} s_s$$

Separating out the term where s = n gives:

(5)

$$L_n^{ic} \equiv \frac{\left[P - C_n'(q_n) \right]}{P} = \frac{s_n}{\varepsilon} + \frac{1}{\varepsilon} \sum_{s \neq n}^{N} \frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} s_s$$

Multiplying the first order condition on both sides by s_n and summing over all n:

$$\bar{L}^{ic} \equiv \sum_{n=1}^{N} s_n L_n = \sum_{n=1}^{N} s_n \frac{\left[P - C_n'(q_n) \right]}{P} = \frac{1}{\varepsilon} \left\{ \sum_{n=1}^{N} \sum_{s=1}^{N} \frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} s_s s_n \right\}$$

or

$$\bar{L}^{ic} \equiv \sum_{n=1}^{N} s_n \frac{\left[P - C_n'(q_n) \right]}{P} = \frac{HHI^{ic}}{\varepsilon}$$

where

$$HHI^{ic} = \sum_{n=1}^{N} \sum_{s=1}^{N} \frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} s_s s_n$$

Separating out the term where s = n gives equality (6).

In matrix form the HHIic can be written:

$HHI^{ic} = \mathbf{s\ D\ s'}$

where $\mathbf{D} = \Gamma' \mathbf{A}_t \text{diag}([\Gamma' \mathbf{A}_t])^{-1} = \left[\frac{\sum_{m=1}^{M} \gamma_{mn} a_{ms}}{\sum_{m=1}^{M} \gamma_{mn} a_{mn}} \right]$

Γ is a MxN matrix with elements γ_{mn}.

$\mathbf{A}_t$ is a MxN matrix with elements a_{mn}.

diag$\Gamma' \mathbf{A}_t$ is a NxN diagonal matrix with elements $\sum_{m=1}^{M} \lambda_{mn} a_{mn}$ (it has the same elements on the diagonal as the matrix $\Gamma' \mathbf{A}_t$, while all elements outside the diagonal equals 0).

4. MARKET POWER AND ITS EFFECTS

4.1 What is market power?

When competition is restricted one or several enterprises have the opportunity to act in contravention of the interests of consumers without entailing large losses of market shares. Enterprises in such a position are said to possess market power. Normally the notion is connected to the opportunity to withhold production in order to maintain high prices, even though market power also may have other effects.

In the absence of market power, price will equal marginal costs when production is organised as efficiently as possible. Enterprises with market power will take into account that higher volumes result in reduced prices, and will therefore be more reluctant to increase volumes. An enterprise has significant market power if it can profitably maintain prices that are significantly higher than the lowest possible marginal production costs.

The exertion of market power only becomes an abuse of market power if the firm is dominant. That is, if a firm is able to increase its price above marginal costs due to a competitive advantage, the firm has at least some degree of market power. However, the positive price-cost margin does not necessarily reflect abuse of market power.

The exertion of market power is an integral part of a well functioning competitive market. Superior products or technologies can result in market power. Firms try to obtain market power in order to maximise profit. However, the market power possessed by a dominant firm allows it to profitably raise prices without being superior. The abuse of a dominant position is prohibited in the Nordic countries (and in the EU). It is important for the competition authorities to recognise the difference between the two.

Market power also encompasses a buyer's ability to determine its own purchase prices. Such buyer power may under certain circumstances have negative effects on efficiency similar to those associated with the market power of suppliers.

Market power may be exerted unilaterally by a single enterprise (unilateral market power), or collectively by a limited number of enterprises (collective market power or tacit collusion).

4.2 Unilateral market power

Unilateral market power means that an enterprise can exert market power without entailing co-ordinated responses from competitors. An enterprise having a monopoly, especially one which is not threatened by new entry, will have such market power.

A market dominant enterprise may also have the opportunity to exert unilateral market power. Generally the incentives to increase price will increase with the market shares of the enterprise. The reason is that the gains from price increases become large compared to the losses entailed by reduced volumes.

4.2.1 The residual demand

The residual demand curve facing an individual producer determines what quantity and what price will be most profitable. The residual demand is given by total market demand less the supply of the other producers at each price level. It shows the relationship between the price the producer chooses and the quantity the producer sells.

Formally[20], the residual demand facing producer I, qi, can be expressed as

$$q_i(p) = D(p) - \sum_{j \neq i} S_j(p)$$

20 Varian, H.R. (1992): *Microeconomic Analysis*, 3rd edition, Norton, New York

where p is the market price, $D(p)$ is the market demand and $S_j(p)$ is the supply of the other producers.

The ability to exert market power will depend on the elasticity of the residual demand, i.e. the percentage change of quantity relative to the percentage change of price. The elasticity of the residual demand is:

$$\varepsilon_i = \frac{p}{q_i}\frac{dq_i}{dp}$$

If the elasticity is low the producer will lose little demand by increasing prices. The more inelastic the residual demand, the larger the increase in price as a result of reduced production, and the larger the market power of the producer.

Taking the derivative of the residual demand with respect to the market price, and making use of the expression for the elasticity of the residual demand, we get:

$$\varepsilon_i = \frac{p}{q_i}\left(\frac{dD(p)}{p} - \sum_{j\neq i}\frac{dS_j(p)}{dp}\right) = \frac{p}{q_i}\left(\frac{dD(p)}{p}\frac{p}{Q}\frac{Q}{p} - \sum_{j\neq i}\frac{dS_j(p)}{dp}\frac{p}{S_j}\frac{S_j}{p}\right)$$

$$\Rightarrow \varepsilon_i = \frac{1}{q_i}\left(\varepsilon_D Q - \sum_{j\neq i}\varepsilon_{s_j} S_j\right)$$

where ε_D is the elasticity of market demand and ε_{S_j} is the elasticity of the rest supply (the supply of the other producers).

If competition is perfect the elasticity of the residual demand curve is infinite: The producer will lose all market share by setting a higher price. If the residual demand curve is perfectly inelastic, i.e. non of the competitors will increase their production if the price increases and consumption remains unchanged, the producer can, in theory, increase its price infinitely without losing market share. Under the likely presumption that the derivative of the market demand with respect to price is negative ($\varepsilon_D < 0$) and the derivative of the rest supply with respect to market demand is strictly non-negative ($\varepsilon_D \geq 0$), the elasticity of the residual demand is negative ($\varepsilon_D < 0$).

The residual demand will be more elastic the more elastic the market demand, the more elastic the rest supply, and the smaller the market share of the producer (q_i is small). If a price increase results in a large proportion of customers leaving the market (ε_D is large), the price increase will be less likely to be profitable. The price increase is also likely to be unprofitable if it results in a large increase of supply by the other producers (ε_{S_j} is large). Finally, the price increase is less likely to be profitable if the producer is small (q_i is small), because the resulting loss of supply will represent a larger proportion of supply for the producer. All else equal, a small producer has a weaker incentive to raise prices than a large producer.

4.2.2 Factors influencing the elasticity of the residual demand

The following factors make the residual demand of a producer less price elastic :

- inelastic market demand,
- lack of flexible production technologies,
- production capacity of competitors is constrained,
- bottlenecks (capacity constraints in the grids),
- weak competition between the producers.

The first of these factors concerns the elasticity of market demand. The other factors concern the elasticity of the supply of the other suppliers.

Market demand

The price sensitivity of the market demand for electric power is low in the short term (on an hourly basis). This is partly due to consumers not being informed of or charged for short-term price variations, and partly due to the fact that substitution possibilities are limited and that it is costly to fine-tune consumption hour by hour for most consumers. Only when prices are much higher than today's price level, some industrial firms may find it profitable to decrease their demand. Also in the intermediate run – during a season or some months – price sensitivity is limited. In the long run

21 The following is inspired by ECON (2002)

demand is more elastic, since households and industries can invest in energy conservation equipment or switch to other types of energy.

It is to be expected that demand will be more elastic in the future. Firstly, the deregulation has had the effect that consumers more often are faced with price variations reflecting actual variations of demand and supply and congestions in the electricity grid. An example is the reduced consumption last winter as a response to the high prices due to the exceptional low reservoirs filling. Secondly, technological development will result in cheaper and better metering equipment, making it cheaper and easier for consumers to respond to short term price changes.

Flexible production technology

As described in chapter 1 there are different production technologies in the Nordic electricity sector. These technologies have different properties with regard to their flexibility in increasing or decreasing production in the short run.

Production plants with flexible production technology are hydropower plants mainly situated in Norway and Sweden and condensing power stations mainly situated in Denmark and Finland (and to some degree in Sweden). These technologies will under free competition follow the load of the system from hour to hour. Therefore, it is the response of plants with these technologies that in most situations determine the elasticity of the rest supply.

The more concentrated the production based on flexible production technologies is, the more likely it is that it will be profitable for a producer to withhold production in order to increase price, since the short run response from other producers will be limited.

HHI will be a misleading guide to the degree of market power in markets in which some of the firms are are constrained due to inflexible production. Biggar (2002)[22] shows that the average Lerner index in such a market is

$$\bar{L}_n = \frac{HHI^{adj}}{\varepsilon}$$

where

$$\bar{L}_n = \frac{P - \hat{C}}{P}$$

$$\hat{C} = \sum_{n=1}^{N_u} \left(s_n + \frac{\bar{s}}{N_u} \right) C_n'(q_n)$$

$$HHI^{adj} = \sum_{n=1}^{N_u} s_n \left(s_n + \frac{\bar{s}}{N_u} \right)$$

N_u is the number of unconstrained firms and $\bar{s}$ is the total market share of the constrained firms. Note that $\hat{C}$ is a weighted average of the marginal costs of the unconstrained firms, meaning that the average Lerner index ($\hat{L}$) is a weighted average of the Lerner index of the unconstrained firms.

Consider a market with 10 equally sized firms. Eight of the firms have inflexible production technologies, for instance wind power plants and combined heat and power plants: $N_u = 80$. The two remaining producers have flexible production technologies, for instance hydropower plants with reservoirs and coal or gas condense plants: = 2. Suppose the two firms with flexible production technologies merge.

The unadjusted HHI would increase from 1000 to 1200. The adjusted HHI would before the merger also be 1000: 10(10 + 80/2) + 10(10 + 80/2) = 1000. After the merger HHIadj = 20(20 + 80/1) = 2000.

Suppose that the absolute value of the short-run elasticity of demand is 0.4. The unadjusted Lerner index increases from 0.1/0.4 = 0.25 to 0.12/0.4 = 0.3, representing a price increase of 7.1% (supposing constant marginal costs). The adjusted Lerner index increases from 0.25 to 0.2/0.4 = 0.5, representing a price increase of 50%.

Thus, taking into account that the competitors have inflexible production technology the merger will have more negative effects on competition

22 Biggar, Darryl (2002).

Consider a merger between one producer with flexible and one with inflexible production technology. Again the unadjusted HHI increases from 1000 to 1200. The adjusted HHI on the other hand increases form 1000 to 1550.

Note that after the merger there will be 7 firms with an inflexible technology and 2 firms with flexible technology, one of them with a market share of 20%, the other with a market share of 10%: $\bar{s}$ = 70, m = 2. Thus, we have:
HHIadj = 10(10 + 70/2) + 20(20 + 70/2) = 450 + 1100 = 1550.

The negative effects on competition of such a merger are considerably less than the one between the two firms with flexible production. One might wonder why there are any anticompetitive effects at all, since the merged firm has not gained any increased control over the flexible production capacity. The reason is that the size of the merged firm (measured by qi) has grown, making the residual demand less elastic.

Thus, from a competition point of view a merger between two producers with flexible production technologies is worse than a merger between one with flexible and one with inflexible production technologies, which again is worse than a merger between two producers with inflexible production technologies.

Production capacity constraints
The situation with inflexible production is analogous to the situation with production capacity constraints. In a market where some firms operate at their maximum capacity levels, these firms will not be able to increase quantity as a response to a quantity reduction by another firm. Again the firm will have inflexible production, not because of its production technology as described above, but because it is operating at a maximum production scale. In the power markets the number of firms that face capacity constraints will vary. As demand increases more and more firms will face such constraints.

If all competitors operate at their capacity limits, the remaining producer will in fact operate as a monopolist towards its residual demand. The closer the market is to full capacity utilisation, the less risky it is for a producer to increase price, since there are fewer suppliers with an opportunity to increase production.

An inverted L is the typical shape of the cost function of power producers. This means that the producers' production functions have constant economies to scale up to the capacity constraints, where the costs increase very rapidly

In the Nordic power market a relatively large share of the capacity belongs to so-called competitive fringe firms, i.e. producers that in practise will be too small to exert market power and therefore will act as price takers. These firms will produce at maximum capacity as long as price is above marginal costs (and, if they have available capacity, increase their production if price increases and covers the marginal costs of increased production.)

Moreover, a relatively large proportion of production capacity in the Nordic region has low variable (alternative) production costs and limited or no flexibility: wind power plants, hydropower without reservoir capacity, nuclear power. The effective production capacity of wind power plants depends on variable wind conditions. Inflow of water plays a similar role for river hydropower plants. In combined heat and power (CHP) generation (power station that generates both electricity and heat for supplying neighbouring district heating networks or industrial processes), the demand for heat determines power production. Production plants with low marginal costs will often operate at full capacity. The reason is that the marginal value of any foregone production (the price-cost margin) is high, making it costly to hold back production.

When the market is close to full capacity utilization these producers are likely to be capacity constrained. These firms will not be able to increase production as a response to price increases. Only producers having marginal costs higher than the market price will be able to increase production as a response to a price increase. If these producers have marginal costs that are high compared to the present

price level, a producer with market power will be able to increase the prices up to this level without entailing increased production from other producers (since these are capacity constrained).

During the 90ties the increase in capacity has been lower than the increase in consumption in the Nordic region. The situation has been the same in all Nordic countries except Denmark. This means that there will be fewer instances of idle capacity. Considering the limited prospects for new production capacity (confer chapter 1) it is likely that demand will increase more than production capacity in the years to come.

Bottlenecks
As described in chapter 2.5 constraints in transmission capacity will reduce the number of competing actors. Thus, bottlenecks lower the elasticity of the residual demand.

When bottlenecks split the Nordic region into two or more separate relevant geographic markets market power can be exerted in two ways.[23]

Firstly, a producer in a deficit market area may find it profitable to exert market power within that area when there are constraints on imports from producers located in other areas. A producer with market power might find it profitable to hold back production in order to create a deficit area or strengthen the price effect of an already existing deficit area.

Secondly, in a surplus area where the export capacity is fully utilised prices may fall considerably below the price in neighbouring areas. A producer with market power might find it profitable to hold back production in order to push up the price level. This behaviour might in fact lead to prices being equal to prices in other price areas, meaning that a separate price area will not be created.

The second case illustrates that it might be possible to exert market power in a region, even when that region is not separated out as a price area. This possibility will not be eliminated even if the transmission capacity into the region is improved.

Generally, the larger the market is, the more competitors there are, which is also the reason why market concentration is much smaller in the Nordic area as a whole than in the national markets. However, the constellation of suppliers operating in the Nordic market and the location of their production capacity emerged before the deregulation of the national markets. To a large extent actors have the main part of their production capacities concentrated in their respective national markets.

Weak competition
Finally, the elasticity of the residual demand also depends on the strategic behaviour of the competitors. Even if competitors are *able* to increase production as a response to an increase in market price, they might *not be willing* to do so. If competitors lack incentives to compete, it will be possible to exert some degree of market power.

In chapter 3.1.1 we have shown that competition will not be perfect in a Cournot-Nash setting, and that market power will increase with the market concentration. This is an example where weak incentives to compete might lead to unilateral market power.

Weak incentives to compete may also lead to so-called "collective market power", which is the subject matter of the next chapter.

4.3 Collective market power

4.3.1 Introduction
In markets with a limited number of enterprises collective market power may arise as a result of co-ordinated behaviour. The co-ordination can take the form of tacit or explicit collusion. We will focus on the conditions conducive to tacit collusion.

23 In chapter 5 we show the results of a market model, which will demonstrate further how market power can be exerted.

On June 6th the European Court of First Instance (CFI) overturned the European Commission's decision to block Airtours proposed acquisition of First Choice[24]. According to the CFI, a collective dominance situation significantly impeding competition arises when each member of the dominant oligopoly considers it possible, economically rational and hence preferable, to adopt a common policy on a long-lasting basis.

The CFI outlined three conditions that need to be met to block a merger on collective dominance grounds:

I) The companies concerned need to have both an incentive and the ability and the opportunity to coordinate their behaviour. The market thus needs to be sufficiently transparent in order for the companies concerned to accurately monitor each other's behaviour.
II) It is also necessary for the companies concerned to be able to maintain co-ordination over time. There has to be an incentive not to deviate from the common strategy. There needs to be a retaliation mechanism against companies deviating from the common strategy so as to ensure that there is a long term incentive to conform to the common strategy.
III) The third aspect deals with the countervailing power of potential and existing competitors and consumers. Can these, as a group or individually, act in such a way that the effects of the common policy will be mitigated?

The following discussion will focus on some of the characteristics of the Nordic electricity market in the light of EC case law. The list of market characteristics is not exhaustive.

4.3.2 Incentive to co-operate

Concentration and market shares
As shown in subsection 3.2.1 the five largest companies achieve a joint market share of approximately 60 % in the Nordic market. In 3.2.3 we calculated the cross-ownership adjusted Herfindahl-Hirschman index to be 1138. Thus, the integrated Nordic market is relatively unconcentrated. Market concentration in regionally delimited relevant markets is on the other hand very high.

In EC law there has been no presumption of dominance based on achieving a specific market concentration. To determine whether collective dominance is likely in the Nordic electricity market the analysis needs to be extended further.

A large market share indicates an ability to exert market power. An oligopoly with the same market share as a single firm is generally assumed to have a lesser ability to exert market power. An oligopoly contains an inherent instability arising from the differing interests that, to some extent, always exist between the individual companies, each company striving to strengthen its own position in the market.

An oligopoly is considered more stable over time if the distribution of market shares is symmetrical. Symmetrical market shares may be an indication that the companies have similar incentives to co-operate and similar opportunities to retaliate against each other. Tacit collusion may be facilitated if the market shares within the oligopoly are evenly distributed while at the same time the other companies on the market only have small market shares.

In 3.2.1 we found that the market shares of the five largest actors on the integrated Nordic market are distributed as follows: Vattenfall 19 %, Fortum 16 %, Statkraft 12 %, Sydkraft 8 % and Elsam 4%. The distribution of markets shares between the five largest companies is not particularly symmetrical. In the long run this might contribute to the instability of the oligopoly.

The transparency of the market
The transparency of the market is important since it enables the oligopolists to monitor

24 T-342/99 Airtours/First Choice

each other's behaviour in the market. To be able to maintain tacit collusion over time they need to be able to detect deviations quickly and accurately to determine who deviated and to what extent.

The Commission has concluded that electricity is a homogenous product[25]. With a homogenous product it is easier to compare prices since it reduces the need for comparing price with quality. This increases the transparency of the market.

In homogenous product markets price is an important decision parameter. Thus, price will be an indicator of whether a company deviates from the common strategy. Price is either determined in bilateral contract or on the power exchange, i.e. Nord Pool.

Nord Pool publishes its prices on the Internet, which enables interested parties to follow the price on an hourly basis. Nord Pool publishes both the system price and the price for the different price areas. The power exchange also provides information on certain factors influencing supply. Every participant on Nord Pool has access to the same relevant information, which is important for the functioning of the market. The price on this part of the market is transparent.

The trade on Nord Pool encompasses about 1/3 of total trade on the Nordic electricity market. The other part is sold through bilateral contracts. In most of these contracts it is up to the buyer and seller to determine the price. When determining price in a bilateral contract the spot price is one of the variables that will be considered. The actual contracted price is confidential and there is no obligation on the parties to publicly report this price. Nevertheless a certain transparency can be assumed in this market too, since the prices are determined with an eye on the transparent prices on the Nord Pool power exchange.

Price elasticity

For households price elasticity is assumed to be inelastic considering the preference for heating and light. Looking at industrial buyers it is reasonable to assume that they to some extent have more options. As a consequence the elasticity for industrial buyers can be considered higher than for household customers. Kwoka[26] has found that the elasticity is -0.12 for households and -0.84 for industry in the U.S. The Commission found in VEBA/VIAG that the electricity market was signified by low price elasticity. Statistics Norway (Statistisk Sentralbyrå) considers that short-run price elasticity of demand for households normally is -0.05, in the longer run between - 0,20 and -0.25.

Low price elasticity means that the customers are unlikely to switch suppliers or products when prices go up. Thus, if acting collectively producers would be able to exert market power both with regard to household customers and industrial customers.

Cost structure

The cost structure of a company influences its strategic choices. Differing cost structures may indicate an inclination to make different strategic choices. Symmetrical cost structures may facilitate tacit collusion since the companies would be more inclined to make the same kind of strategic choices.

As described in subsection 1.2.2 there are differences in production technology between the different companies. It follows that the five largest producers in the Nordic region may have differing incentives based on their choice of production technology since each production technology has its own cost structure.

A symmetrical structure would make it easier for the companies to gain insights into each others cost structures and likely choices. To some extent this effect will exist on the Nordic market even though the companies have different production technologies, since there are

25 COMP/M.1673 VEBA/VIAG p.71
26 Kwoka, Jr.,J.E., (1996) Power Structure – Ownership integration, and competition in the U.S. electricity industry.

considerable overlaps. An example is Vattenfall, which is involved in a wide range of production technologies giving it a better understanding of the different choices and opportunities belonging to different technologies.

Opportunities to interact
The meetings of the companies will, over time, provide them with opportunities to achieve an informed opinion about the way their competitors are likely to act in the market. One important meeting place is Nord Pool.

Another aspect to consider is the asymmetry in information between larger and smaller companies. Larger companies tend to have more information about the market, e.g. concerning the cost of production, the premises for production, residual demand, the supply offered on Nord Pool, the bilateral contracts. The information published by Nord Pool partly mitigates this asymmetry. However, this information is to a large extent internal company information, which indicates that a certain information advantage will be unavoidable.

Another important meeting place enabling an exchange of information is the joint ownership of various assets. As described in subsection 1.4.2, the Swedish nuclear power companies are owned jointly by Vattenfall, Sydkraft and Fortum, together with some smaller companies. To our knowledge the same goes for Finnish nuclear plants. Many Norwegian hydropower plants are also owned jointly by hydropower producers. In order to operate a jointly owned production facility the owners need to agree on how to run the facility including how much to produce and when. Exchanging information about operating costs, planned sales and so on will enhance the transparency on the market, particularly since the joint ownership of production facilities usually means continuous contacts over a longer period of time. After a time the companies will have amassed a historical knowledge of probable behaviour which will help them in forecasting the behaviour of their competitors.

Conclusion
The comparatively concentrated market is an indication that there might be an incentive to collude, while the relative uneven spread of market shares can be seen as an indication that the companies may have differing views regarding most profitable behaviour. The market is transparent. Price changes are easily monitored and it would be relatively easy to follow other market developments. Most of the five major companies enjoy repeated opportunities to interact in a number of different situations. It is also reasonable to assume that the producers are able to exert at least some market power.

4.3.3 Retaliation Mechanisms

The CFI emphasised the need for a retaliation mechanism in the Airtours-judgement. If tacit collusion is to be profitable it needs to be of a certain duration, which means that an incentive not to deviate from the common behaviour is needed. It is only if all members of the dominating oligopoly comply with the parallel behaviour that they can benefit. It is thus necessary that there are sufficient deterrents to ensure a long-term incentive not to deviate from the common strategy.

The ability to retaliate swiftly
A retaliation mechanism is more effective if retaliatory measures can be used swiftly. The production technology most suitable for quick adaptation is hydropower with water reservoirs. A relatively small increase in production would cause a large price cut due to the low price elasticity of demand. In Sweden, Vattenfall is the company with the largest capacity in hydropower, though Sydkraft and Fortum also own hydropower plants. In Norway the dominating production technology is hydropower, which means that all the Norwegian producers have access to this technology. The Danish producers do not use any significant hydropower.

The means of retaliation
Even when a theoretical opportunity to retaliate exists it cannot automatically be assumed that such an opportunity would be used. Every retaliatory measure comes at a price. On the Nordic electricity market it is likely that the price for effective retaliation would be high. It

could be discussed whether it is likely that the companies in the present situation would be inclined to make use of a theoretical opportunity to retaliate.

Conclusion
The most common way to retaliate against deviating companies is to initiate a price war. The cost of such behaviour would be high and it would affect all the companies concerned. A more detailed study of the actual costs involved would be of interest to better be able to judge the actual costs that would be incurred by this choice of action.

4.3.4 Countervailing power

The buyers mainly consist of industry, electricity retailers and other producers/sellers of electricity. Some of these buyers are large and financially strong companies in their own right. However, when buying electricity these companies do not have such a position on the market that they can exert the kind of countervailing power that would mitigate the effects of tacit collusion.

High barriers to entry are held to facilitate tacit collusion. The barriers would discourage potential competitors from entering the market and make it less likely that a new entrant will disrupt the benefits gained, e.g. through offering lower prices. The production of electricity is capital intensive with a large proportion of sunk costs when the plant cannot be sold to another producer. The lead times for building new production capacity are fairly long.

Conclusion
There is no real countervailing power from buyers and potential competitors in the short and medium range. In the long range there may be other options for some of the buyers but this is not of sufficient importance to act as a countervailing power today.

4.4 How to Exert Market Power

It is useful to split the analysis in two parts. Firstly, when the domestic Elspot area is a potential high price area the net flow of electricity goes into that area (import). Secondly, when the domestic Elspot area is a potential low price area the net flow goes out of the area (export). In both cases the incentive of a dominant generator (a generator with market power) is to hold back production.

In the import-scenario (that is when the domestic price area is a potential high-price area), the domestic generator has an incentive to reduce generation in order to create a bottleneck on the transmission line. The generator can set the price at a level above it's marginal costs depending on the degree of market power. In the extreme, there is no upper limit to the price in this scenario.

Considering the export scenario (that is when the domestic price area is a potential low-price area), the domestic generator still has the incentive to reduce production but now in order not to congest the transmission line. Thereby the generator can sell all it's production at the high price set in the other area. There is an upper limit to the price in this scenario, though. The generator cannot increase its price above the (higher) price in the neighbouring area.

In normal and wet years, electricity has historically flown from areas with predominantly hydropower plants to areas with primarily thermal power plants. The flow is expected to be reversed in normal years as the Nordic energy balance tightens. Production of electricity in Finland, Denmark West (DK1) and Denmark East (DK2) are primarily based on thermal power, while production in Norway and partly in Sweden are based on hydropower.

Every time a thermal production plant is activated real start-up costs are paid. These start-up costs typically amounts to approximately DKK 150000 (cold start), which makes it costly to exert market power in the form of short-term up-scaling and down-scaling of production. However, the up- or down-scaling of generation can be highly profitably for a thermal generator if it possesses market power. Scaling down production might cause future start-up costs, but the price increase can easily outweigh this.

The lower the price-cost mark-up is, the less valuable is the loss of a marginal decrease of supply. Therefore, the cost of exerting market power by reducing supply to increase price is lower when the mark-up is low. Thus, all else being equal a producer with low marginal costs has a lower incentive to exert market power than a producer with high marginal costs. A nuclear power producer has lower incentives than a producer of condensing power based on coal.

Hydropower plants have low production costs. However, since the supply of water is limited, it is the alternative value of the water that is the relevant production cost. One unit of water produced today means that there will be one unit of water that cannot be produced tomorrow. By producing today the producer will "lose" the income that this unit would have generated tomorrow. Therefore, the alternative value of hydropower plants will often be close to the market price.

Hydropower production differs from thermal production in the sense that a reduction of production in one period of time necessitates an increase in production in another time period, provided that no water is to be wasted. A reduction of production will reduce the usage of water in the electricity production, filling up water reservoirs. It is possible to spill water by allowing magazines to overflow, but this may be more costly for the producer than to produce at low prices, since the alternative value of the water is lost. In contrast, the alternative value of inputs held back from thermal production is not lost. Therefore, hydropower producers have a reduced incentive to deliberately spill water, although this possibility cannot altogether be ruled out. By exerting market power through withholding production, the probability of spilling water increases.

However, the hydropower producers do not need to forsake production (i.e. deliberately let the water spill) in order to utilise market power. In the power market, price differences between different periods of the day and year will frequently occur, since demand and supply conditions vary. If there is competition, the companies will wish to produce as much as possible in the high-price periods and as little as possible in the low-price periods. As long as the producers anticipate price differences, production will be moved from periods with low price to periods with high price. This means that prices will have a tendency to be evened out between periods, which will bring an increase in economic efficiency.

A producer with market power may find it profitable to utilise the fact that the elasticity of the residual demand curve varies between periods. In a period without binding bottlenecks the residual demand is more elastic than in periods where bottlenecks bind. The residual demand is also more elastic in periods with low consumption (low load periods) than in periods with high consumption (high load periods). This means that the price increase induced by reduced production in high load periods is higher than the price reduction induced by the (corresponding) increased production in a low load period. Hence, a producer with market power will reduce production in periods with low price elasticity and increase production in periods with a high elasticity, meaning that price variances increase.

Thus, utilisation of market power means excess price variations compared to market prices under free competition.

4.5 Efficiency Effects

A supplier with market power has the opportunity to influence the market price by changing his own behaviour. Utilisation of market power will partly increase the general price level and partly enhance price differences where such price differences would otherwise not have existed. Higher prices and larger price differences lead to economic loss.

When prices are higher than marginal costs the customers are willing to pay more for the production increase than the costs of the increased production. A loss of economic efficiency occurs because the quantity produced is too small. This loss is called a "dead-weight loss" because production that is beneficial for the society is not realised. The loss of economic efficiency is aggravated if the lack of competi-

tion means that the enterprises are not encouraged to innovate or produce at the lowest cost possible.

Market power may also result in a loss of production efficiency. Under competition, available production technology is utilised in the most efficient way possible at every point of time. In chapter 1.2.3, the industrial marginal cost curve is described. Production costs will be minimised when price is determined by the intersection of this supply curve and the demand curve. This will not necessarily be the result if the actors utilise market power. Utilisation of market power means that some capacity is withdrawn resulting in increased prices. The price increase might entail that more expensive production technologies are brought into production. A loss in production efficiency will arise if the withdrawn capacity is cheaper than the most expensive capacity that is utilised in production. The loss will be greater the larger the difference between the marginal costs of the two production technologies.

In the long run market power will influence price expectations and therefore long term market behaviour.

The costs of investing in the network grids should be based on the gains in form of reduced price differences between the price areas. If market power is exerted, price differences may be both increased and reduced (confer chapter 4.2 "bottlenecks"). Thus, the prices will not provide the correct investment signals from an economic point of view.

Market power will not give the right signals about bottlenecks, meaning that new production capacity may not be located where the gains to society are largest.

When high power prices are expected, decisions on the demand side will also be affected. For instance, concerns about high prices and market power will contribute to greater risk for the closure of businesses, reduced amounts of new investments or investments in other types of technology than would otherwise have been the case. High prices will also change behaviour in other demand sectors with respect to investments in power consuming equipment, investments in energy saving equipment, investments in heating technology and in the choice of fuel etc.

5. MARKET MODELLING

5.1 Why modelling

Due to various analytical challenges in competition analysis as such and competition analysis in the electricity sector in particular, modelling of markets and firm behaviour can be a useful tool. A market simulation model can be utilised to study the effects of for instance a merger on the Nordic market.

The purpose of the present chapter is to illustrate how competition authorities may use market models in the analysis of the electricity market as well as other markets. The Eltra market model is used to study exertion of market power. Further work needs to be done in order to establish the full welfare effects.

The Nordic market for wholesale electricity is inherently prone to market manipulation. One special characteristic of the electricity market is that even firms with relatively small market shares may exert market power unilaterally in certain periods. This is due to the mix of the non-storability of electricity and capacity constraints in the production and transmission of electricity, cf. chapter 4.

The unilateral or multilateral exertion of market power may have widespread effects in the Nordic market. Higher prices due to the exercise of market power in one area may cause higher prices in other areas, and expensive generation may be substituted for cheaper resulting in a real economic loss and not just a reallocation of wealth. Inter-Nordic mergers can influence the overall flow and pricing of electricity.

Note however, that despite of the many valuable insights that can be gained from the use of simulation models in competition policy the models are still only one of a number of tools that can be employed in order to reach decisions in competition cases. Furthermore, the competition authorities need to gain more experience from the application of models in competition policy analysis.

What is studied in the model is the "exertion of market power" not to be confused with the legal term "abuse of market power". By definition a firms has market power if it profitably can raise its prices above marginal costs.

This chapter presents results stemming from two model simulations done by Eltra[27] on request of the Nordic competition authorities. Eltra has developed a model of the wholesale power market in the Nordic area including the northern part of Germany. This chapter starts with a short description of the model and the theory behind it. Afterwards two model simulations are analysed. The first model simulation studies the incentives of Nordic generators to exercise market power and the effects on the Nordic market. The second simulation studies the effects on the Nordic market of an inter-Nordic merger. In the simulation a Norwegian and a Finnish generator is merged.

5.2 The Eltra Model

The model used for analysing market power in this chapter is Eltra’s market simulation model, MARS. The development of the model started in 2000 and is now (May 2003) in its final phase. This section is based on Eltra (2003a).

The model is a supply function equilibrium model. The theory of supply function equilibrium mixes Cournot and Bertrand competition. Klemperer and Meyer (1989) argued that under uncertainty firms would adopt supply functions as strategic variable instead of quantities (capacities) or prices. In this way firms form price quantity pairs stating exactly what quantity can be supplied at a given price or vice versa. This is what happens in the Nord Pool market.

A supply function equilibrium model has

27 The transmissions system operator (TSO) in the western part of Denmark, Nord Pool area DK1

Bertrand competition (perfect competition) as one extreme and Cournot competition as the other. Under perfect competition a firm will bid in production at it's true marginal costs. If they did not they would loose sales. If the firm, however, possesses market power it would not maximise profit by bidding in true marginal costs. Due to the market power it can profitably raise the price and/or withhold capacity, cf. chapter 4. In the model, firms can choose to add a mark-up to their marginal costs. A more detailed description is made below. Reference is also made to the description of the model and the simulations done be Eltra enclosed at the end of this report.

The purpose of the model is to analyse the effects on prices, production, demand and exchanges in the wholesale market for electricity of market power. All outputs are calculated on an hourly basis. The model uses the principles of the Nord Pool market mechanism including the division of the Nordic countries into price areas with price-dependent bids. Particular focus has been given to the use of game theory in analysing the producer's behaviour, i.e. the incentives to exercise market power. It should be noted that the model ignores the existence of bilateral contracts. The model assumes that all electricity on the wholesale level is traded at Nord Pool prices.

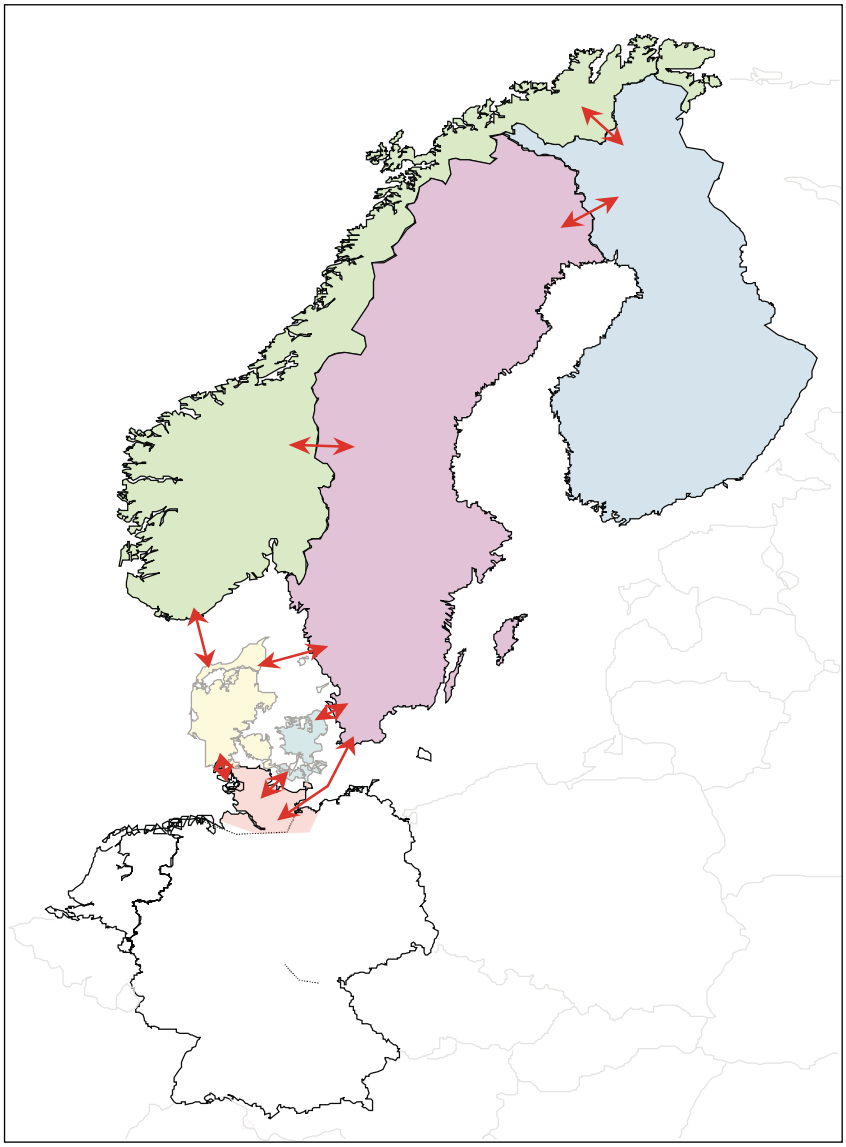
As a supplement to the analyses presented in the previous sections the model can provide valuable insights into the consequences of changes in transmission or generation capacities, market design, demand or further tightening of the capacity balance.

Model input is based on data reported to Nordel by transmission system operators. The data is converted into hourly basis using the available information of for instance the distribution of consumption. Data of cost structure of production plants are one of the model inputs.

The model simulates the Nordic area containing 6 different potential price areas and 9 interconnectors between price areas. Price areas and interconnectors are shown in figure 5.1.[28] All interconnectors are modelled as market-controlled (as in Nord Pool). However, point-of-access tariffs are included in the allocation of capacity of the 3 interconnectors to Germany. This is a short cut in order to model the fact that the German interconnectors are not fully integrated in the Nordic market.

28 It is possible to change the number of price areas in the model. For instance Poland and the remaining part of Germany are to be included in the future.

Figure 5.1 The model area in MARS (as of April 2003)
Source: Eltra (2003)



Modelling of demand
The demand is modelled as price dependent with constant elasticity. The inverse demand function is a Cobb-Douglas function

$$p = kq^{1/\beta}$$

where p is price, q is quantity, k is a calibration constant and β is the elasticity of demand.

Supply
A supply function is made every hour for each production plant in the model. Some supply is price dependent and some is not. The short-term variable cost of the individual plants forms the basis of the estimation of the supply functions.

Hydropower production from plants with reservoirs that can be regulated is also modelled as price-dependent production. In estimation of the supply functions water values from the Nordic EMPS model are used. The water values in the EMPS model are calculated from the date used in MARS.

The water values express the marginal value of the water in the reservoirs and are used in MARS to determine market equilibrium in the same manner as the marginal costs of thermal generation. This means that the supply function of a hydropower producer in a given hour is affected by the volume of water left in the reservoir, the time of year and the inflow into the reservoir.

Optimisation and equilibrium
The market price calculation in the model is done on an hourly basis as a maximisation of the socio-economic surplus in the model areas consisting of consumer and producer surplus and congestion rents. The optimisation is restricted by the capacity constraints in generation and transmission. After the calculation of production the content of water reservoir is updated using the calculated production and inflow data before calculating the equilibrium price in the next hour.

In the Nordic market model, an exporting producer obtains the price applicable in the producer's price area. Similarly, the importer (the consumers in the import area) pays the price applicable in the price area where he is situated. In cases where transmission capacity limits the exchange between price areas, the price in the import area will be higher than the price in the export area. This creates a positive difference (congestion rent) between the payment from the consumers in the import area and the payment to the exporting generator. This congestion rent accrues to the system operators involved and is a part of the socio-economic surplus. It equals transmission capacity multiplied by the price difference.

Simulation of market power
It is assumed in the model that all generation maximises company profit. The Nordic power market is an oligopolistic market. Players in an oligopoly expect other players to react to different choices of strategic variables such as price and quantity. This means that a player's profit depends not only on the player's own activities but also on the activities of other players in the market and visa versa. The objective of the model simulations is to find Nash equilibria in the market.

In the model the opportunity to exercise market power is given specific players in the market by letting them choose to add a mark-up to the marginal costs. This may affect the resultant supply function. The (inverse) resultant supply function with market power is modelled as $p=\mu q+\mu c$, where p is the price, q is the supply at p, μ is a mark-up coefficient and mc is the marginal cost at q. The mark-up is then equal to μq and $\mu=0$ corresponds to price taking behaviour. The model calculates Nash-equilibria in μ. This means that no player has the incentive to change bidding strategy (her choice of μ) given the strategies (μ) of all the other players.

The search for the equilibrium strategies is time-consuming, as it is necessary to calculate a sufficient number of price equilibria in each hour in order to determine the optimal strategy. Furthermore, the more generators that are able to exercise market power ($\mu>0$), the more steps the procedure will comprise, which makes it even more difficult to achieve convergence. Thus, in order to facilitate calculations in the model the players can choose strategy from a final discrete strategy space. The discrete strategy space means that the individual generator has a predefined final number of mark-up coefficients to choose from when maximising profit.

The fact that a set of possible strategies is predefined (and exogenous) for each individual generator makes it possible to find a solution. However, it introduces requirements to the selection of the strategy space. If the intervals between mark-up coefficients are large in order to test different values there is a risk of missing Nash-equlibria. However, if the intervals are too small in order to make a more precise estimation of m Nash-equilibria outside the set might be ignored.

5.3 Nordic snapshots of the exertion of market power

This section presents the results of a simulation of market outcomes in a high demand winter week (week 3) in 2005. The effects of introducing imperfect competition are analysed. That is, the benchmark scenario is one of perfect competition where all generators bid in price quantity pairs in accordance with true marginal costs.

The figures shown are price curves and flow maps. Price curves show the development in prices during a week and flow maps show a snapshot of the Nordic system in one particular hour. First, price curves are presented for selected Nordic areas showing the simulated

price development of week 3 in 2005. From these curves the exertion of market power can be spotted. Second, three individual hours are selected for further analysis by means of flow maps. The flow maps also indicate welfare effects.

Week 3 is characterised by a relatively high demand, especially in Norway. In this situation the two primary thermal systems – Denmark and Finland – are net exporters.

Simulations of a summer week has been done but is not presented here. However, some of the results are alike. Generally, the incentives to exercise market power in peak load hours are intact. During low load hours incentives differ due to the lower water value, which makes import into the thermal areas possible. Reference is made to Eltra (2003b).

In the simulation presented in this section and section 5.4, seven producers are price setters while the rest are price takers. The distribution of price setters is: One in DK1, one in DK2, one in Norway, two in Sweden, one in Finland and one in Germany North.

Figures 5.2, 5.3 and 5.4 show the price pattern in the simulated winter week in DK1, DK2 and Finland. The simulated Norwegian and Swedish price patterns are not shown in this section since they follow the Danish price patterns except during nights and weekend (the price patterns are shown in section 5.4 below).[29] The figures show the price in all hours of the week (1 to 168) starting Monday hour 1, that is the hour between 24 and 1 the night between Sunday and Monday. Two price curves are shown: "PC" for Perfect Competition and "MP, no merger" for Market Power without merger, that is with seven independent price setters. (In section 5.4 two of the price setters are merged).

Figures 5.2 to 5.4 show at least two different examples of generators exercising market power. The first episode reflecting the exertion of market power appears during early morning Monday (day 1) in Denmark and to a certain

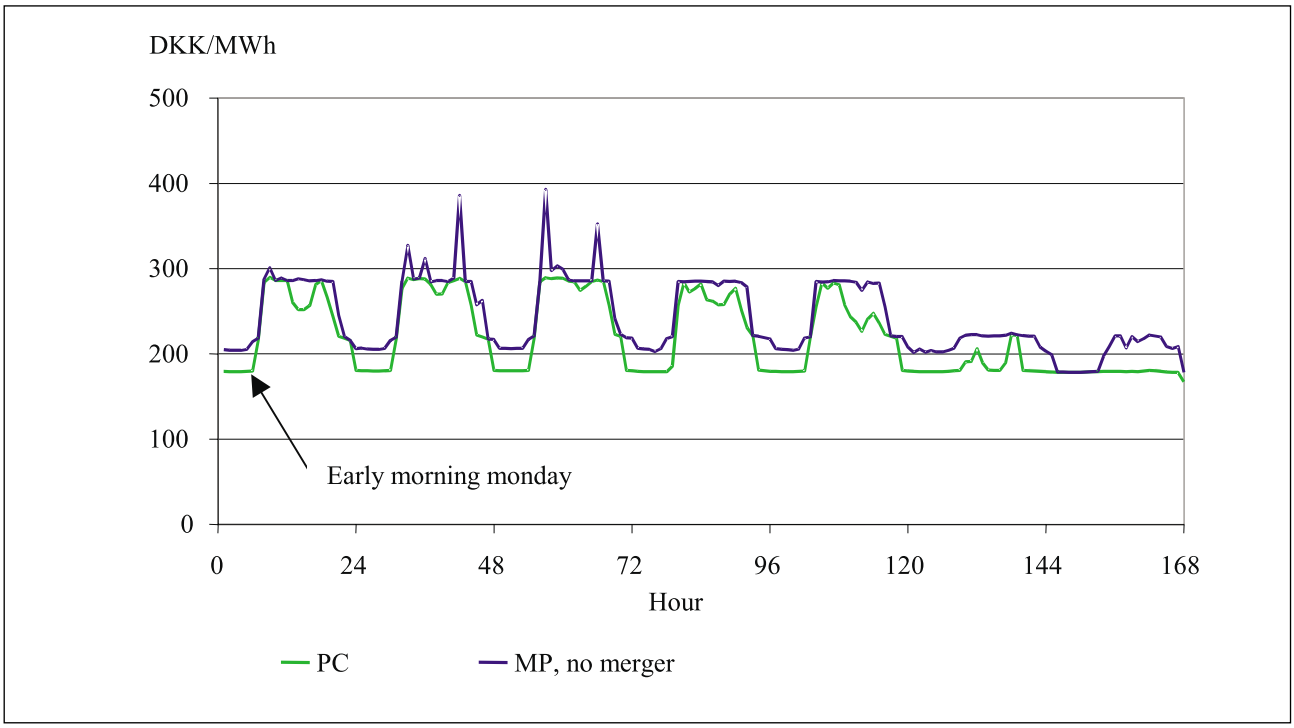


Figure 5.2 Prices in DK1 – week 3, 2005 – introducing market power

29 Since the scope of this report is Nordic and the interconnectors to Germany are incompletely modelled Germany is left out of the analyses. However, it is obvious that the German market can have an important role in the functioning of the Nordic market.

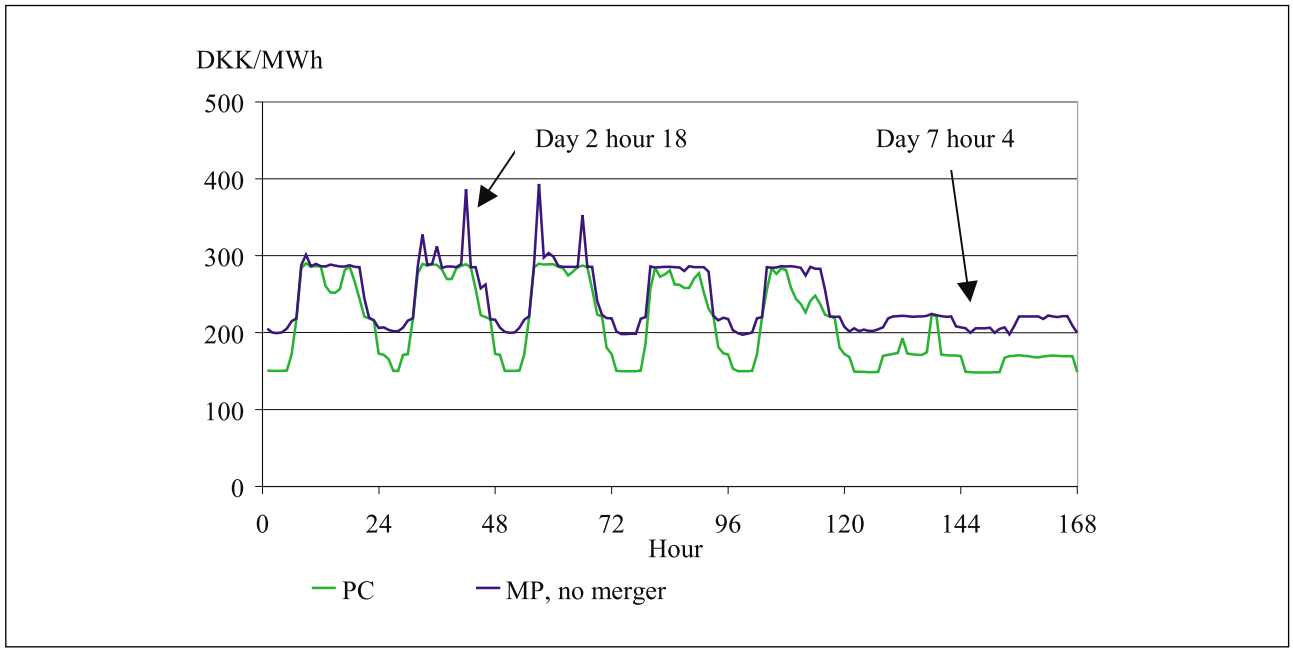


Figure 5.3 Prices in DK2 – week 3, 2005 – introducing market power

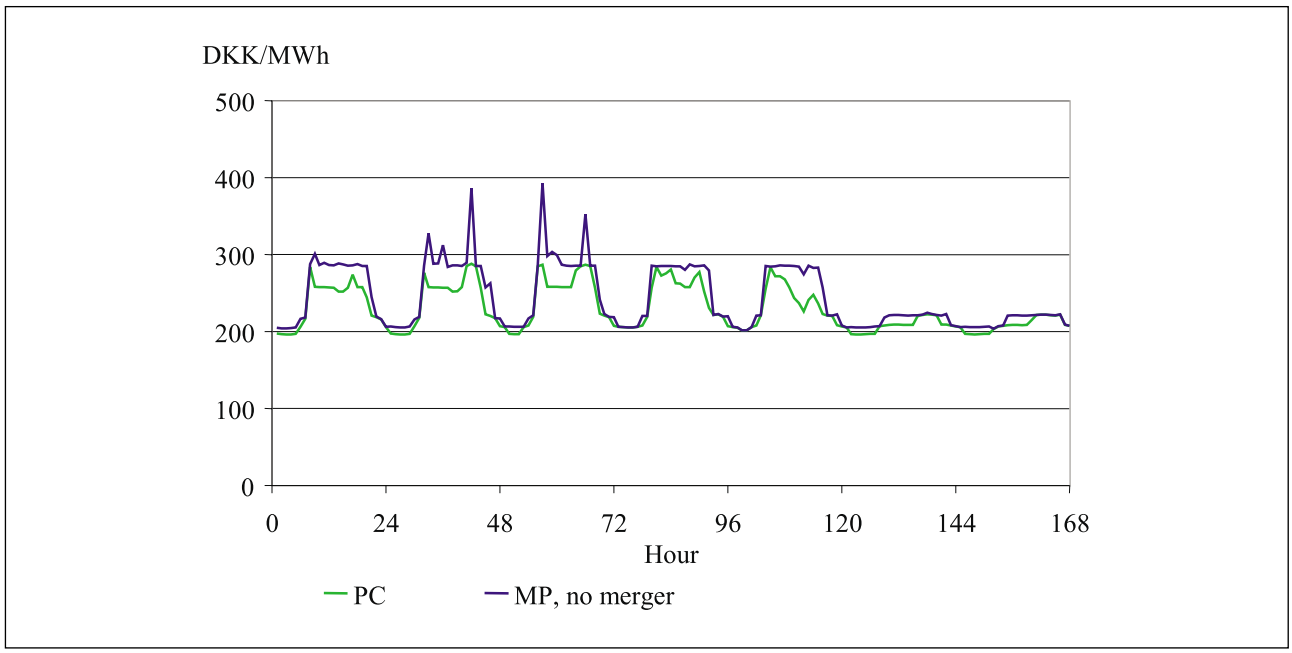


Figure 5.4 Prices in Finland – week 3, 2005 – introducing market power

degree also in Finland. Similar patterns occur during the morning of all work days.

In week 3 in a normal year with the expected power balance in the Nordic countries the marginal cost of thermal generation is below the marginal cost of hydro generation (the water value). Therefore the power will flow in direction of the large hydro areas. This leads to surplus generation in Finland – where thermal capacity accounts for approx. half of total capacity – and in the two Danish areas. To equalise supply and demand under free competition the Finnish and Danish area prices fall below the Swedish and Norwegian prices.

Figures 5.5 and 5.6 show the flow maps corresponding to the hour 3 Tuesday in week 3, 2005. That is the hour between 2 and 3 in the morning. The flow maps show prices, generation and consumption in all price areas and exchanges between price areas. It can be seen that when no generator is exercising market power electricity fills all transmission lines

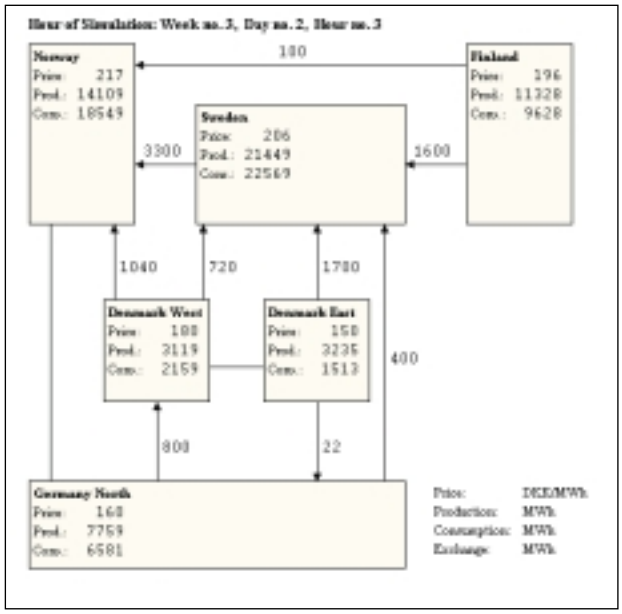


Figure 5.5 Flow map – perfect competition

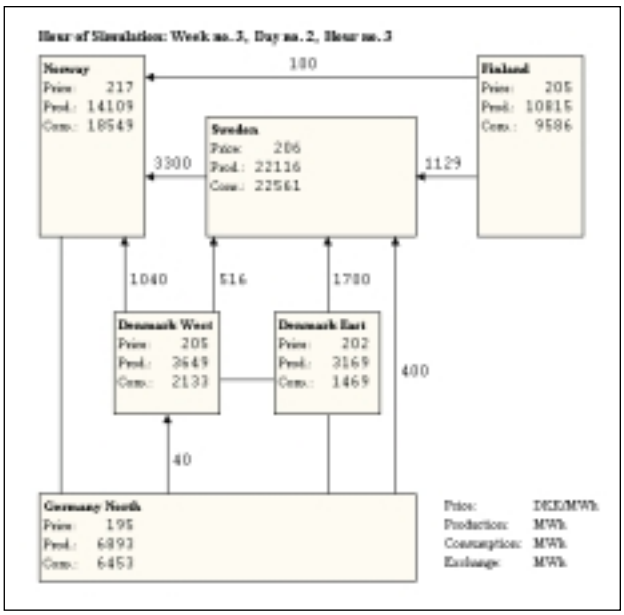


Figure 5.6 Flow map – introducing market power

from Denmark and Finland to Sweden and Norway and from Sweden to Norway. Thus, Sweden is used for transit to transport Danish and Finnish power to Norway. Norway and Sweden are high price areas. The price in Sweden is lower than the price in Norway due to the lower cost of nuclear power generation compared to the water values assumed in this simulation.

In the perfect competition scenario, the generator in DK2 (Denmark East) bid in capacity at its true marginal costs. This result in an area price of DKK 150 per MWh. Granted the possibility to add a mark-up the generator would profit from raising its price to just below the Swedish price still exporting 1.700 MW to Sweden.

A Finnish generator adapts differently. To avoid congestions in the transmission line to Sweden – and hence raise the Finnish price to the Swedish level – the price setting Finnish generator reduces production by approx. 500 MWh and thereby obtains a DKK 10 price increase on all infra marginal production.

The manipulative behaviour illustrated in the figures results in higher prices in Denmark and Finland. Furthermore, the behaviour leads to an efficiency loss since more expensive generation in Sweden is substituted for cheaper generation in Finland. Whereas the increase in prices alters the allocation of wealth, the increase in Swedish generation reflects a real economic loss: Relatively inefficient production plants produce electricity when more efficient plants still have spare capacity. Calculating the immediate reallocation of wealth if this particular form of market manipulation happens five nights a week for five hours in three winter months the Danish and Finnish consumers loose DKK 56 Mio. each year.

Note that the price increase in Western Denmark does not reflect the exertion of market power by the local generator. The loss of import from Germany reduces supply and causes an increase in local production and, hence, in the marginal costs. This can be seen from studying mark-ups (not shown).

A second episode of the exertion of market power appears during peak load hours on Tuesday evening shown in figures 5.7 and 5.8 below. In this hour all price-setting generators manipulate the price upward resulting in a decrease in consumption (a so-called dead weight loss).

In the perfect competition scenario shown in figure 5.7 a Swedish generator sets the prices in the region with exception of the Finnish

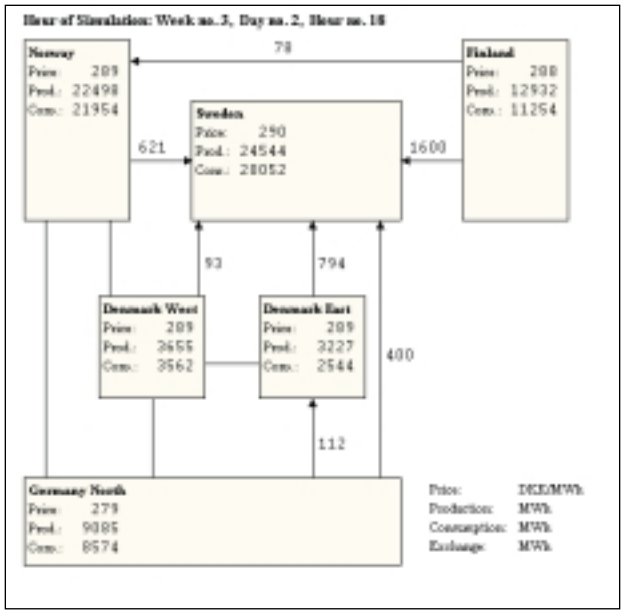


Figure 5.7 Flow map – perfect competition

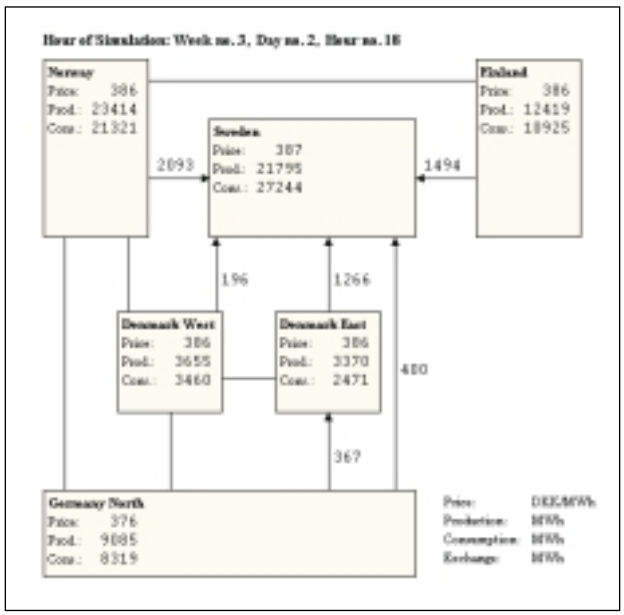


Figure 5.8 Flow map – introducing market power

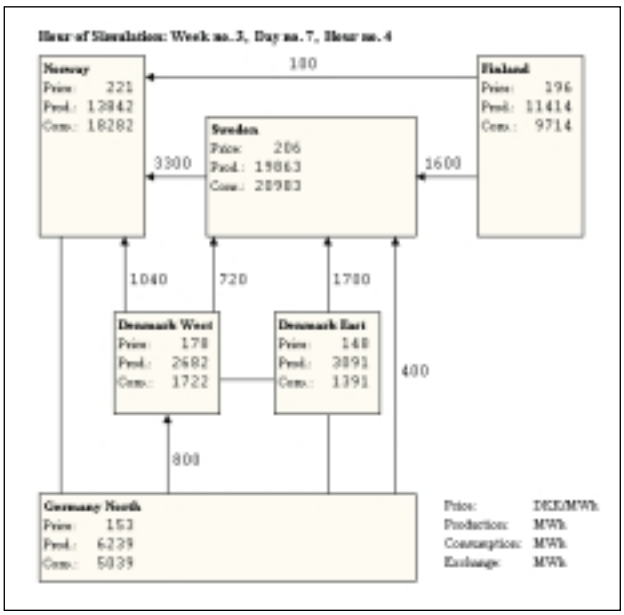


Figure 5.9 Flow map – perfect competition

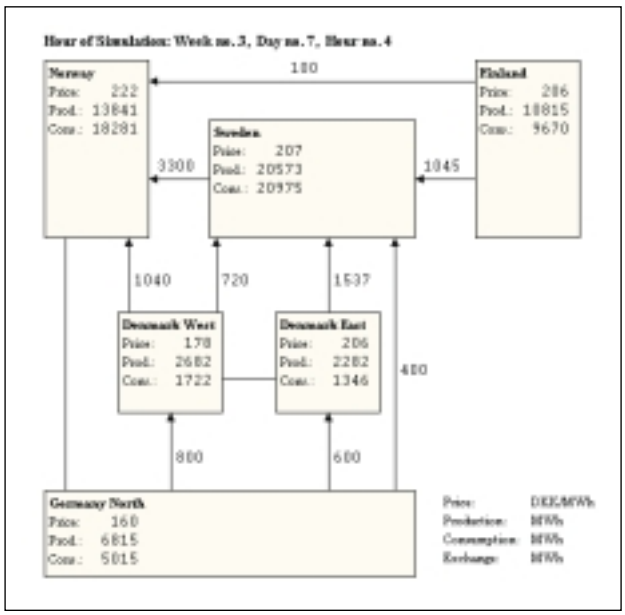


Figure 5.10 Flow map – introducing market power

price. The capacity of the transmission line between Sweden and Finland is too small to equal supply and demand resulting in a (slightly) lower Finnish price. Figure 5.8 shows the model simulation where the price-setting firms are allowed to add a mark-up to their price. First of all, the general price level in the Nordic countries is increased by approx. DKK 100 per MWh due to market power lowering the overall consumption. Second, the Finnish generator reduces generation in order to avoid filling the cable to Sweden and in turn keep the Swedish price level.

One immediate consequence of this upward manipulation of the price level is that the Nordic consumers in this particular hour pay approx. DKK 6 Mio. more for what is consumed, and they consume 1.945 MWh less electricity. If this kind of market manipulation happens twice a week every second week the total consumer loss would amount to DKK 330 Mio. a year.

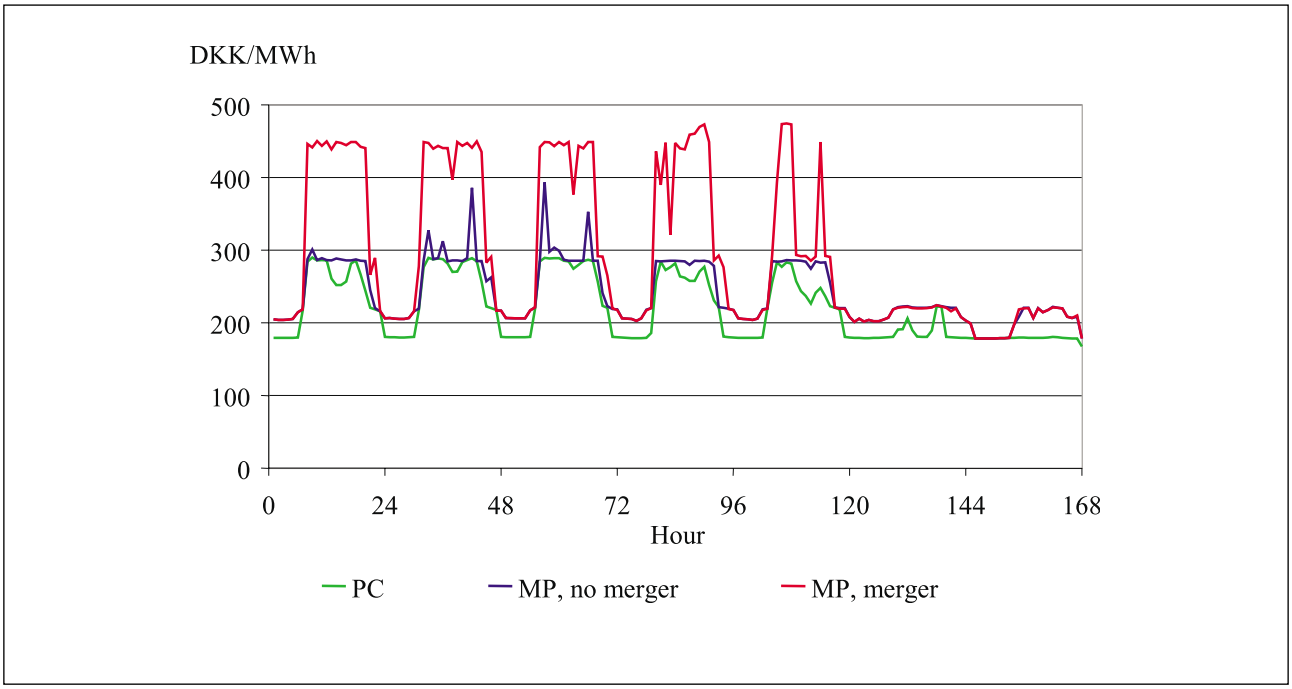


Figure 5.11 Prices in DK1 – week 3, 2005 – Nordic merger

Figures 5.9 and 5.10 show a snapshot of the Nordic system in a weekend hour, namely the hour between 3 and 4 on Sunday morning. Figure 5.9 shows the well-known picture of exports out of the thermal areas Finland and Denmark resulting in lower prices. Introducing market power reveals that the incentives of the thermal generators are very alike. Both the Finnish and the Danish generator (DK2) reduce production to avoid congesting the cable to Sweden. It follows directly from the flow maps that this behaviour has rather dramatic welfare consequences. Besides the price increase in Finland and in Denmark East more efficient production units are substituted for less efficient ones. The generation in Sweden is increased by approx. 700 MWh while generation in both Denmark East and Finland is reduced.

Calculating the immediate consumer loss reveals a loss of DKK 55 Mio. in DK2 and Finland. Consumption and price in the other areas are unaltered by the market manipulation in this particular hour.

5.4 Effects of an inter-Nordic merger

In a market as integrated as the Nordic wholesale market for electricity the effects of a merger among Nordic generators are difficult to establish. In this section a model simulation attempts to pinpoint effects of the hypothetical merger of a large Norwegian and Finnish generator. The simulation is done for a high and a low demand week as in the previous section.

The simulation of area prices is shown below. Figure 5.11, 5.12 and 5.15 are similar to figure 5.2, 5.3 and 5.4 except from the inclusion of the simulation of the price after the above merger.

From the price patterns shown in figures 5.11 to 5.15 one important insight emerge: A Nordic merger among generators can have effects on the entire Nordic system. Due to the merger of a Finnish and a Norwegian generator the price level in peak load hours is increased in all Nordic areas. In low demand hours there seems to be no effect on the market. This fits the theory of flexible production, cf. Chapter 4. In peak load hours competing generators are less able to respond to price increases due to capacity constraints.

Since the effect of the merger is in peak load hours only the flow maps corresponding to day 2 hour 18 is shown, figure 5.17. This figure 5.17 can be compared to figure 5.7 and 5.8 in

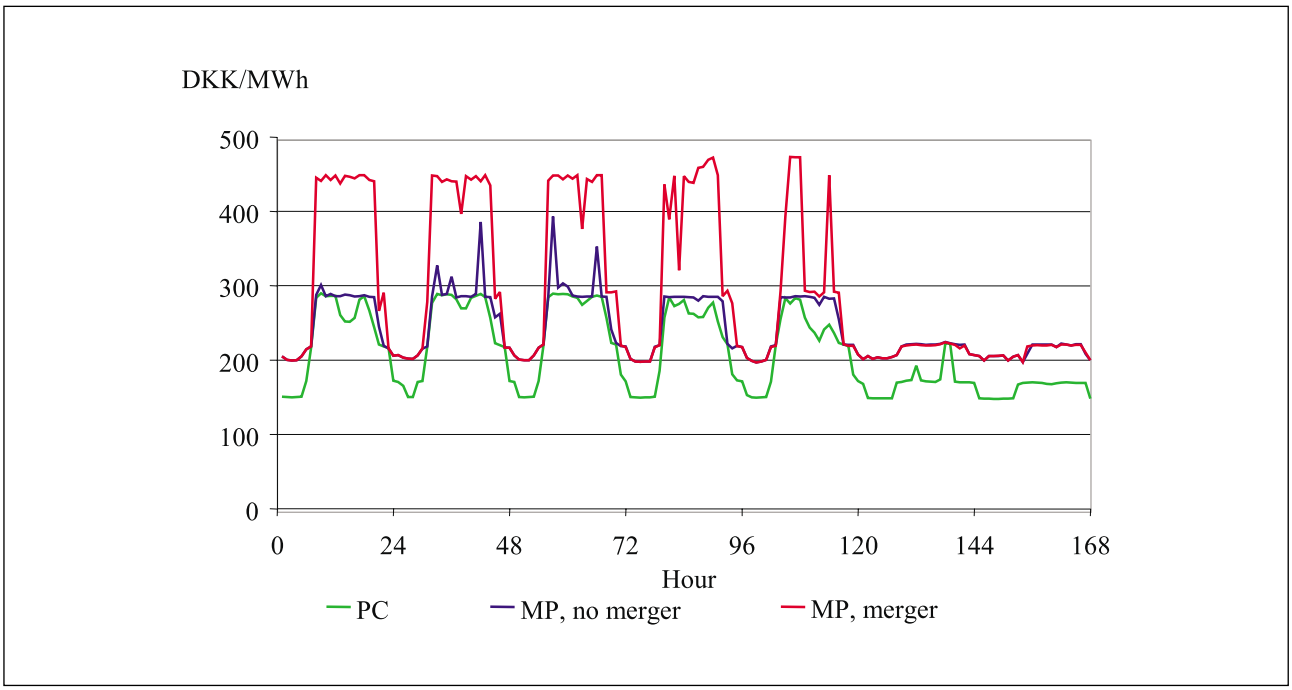


Figure 5.12 Prices in DK2 – week 3, 2005 – Nordic merger

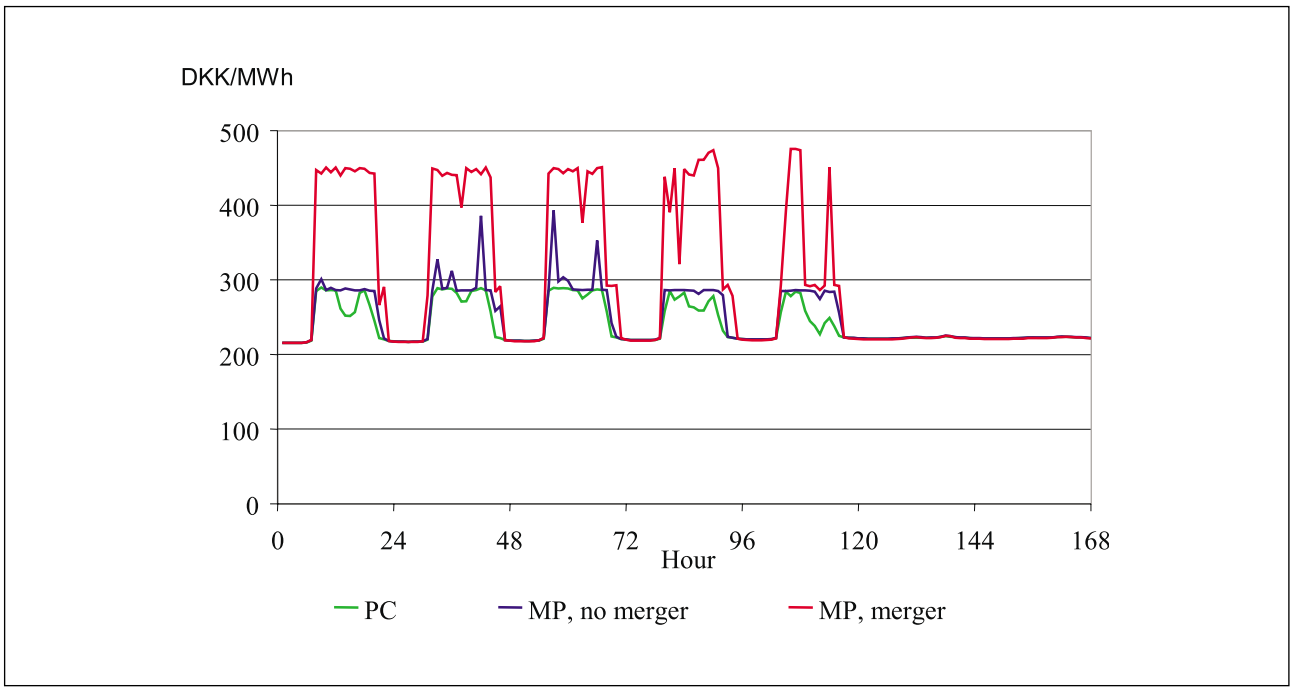


Figure 5.13 Prices in Norway – week 3, 2005 – Nordic merger

section 5.2. These figures show the perfect competition and market power, no merger simulations for that hour.

Comparing figure 5.17 below with 5.7 and 5.8 it is obvious that the merger results in a reallocation of wealth from consumers to producers. The merger leads to a price increase in this particular hour in all areas of approx. DKK 150 per MWh compared to the perfect competition scenario and DKK 50 per MWh compared to the market power scenario. In hours with a low demand the merger has little effect on the market.

The immediate transfer of wealth from consumers to producers in the Nordic area in this particular hour amounts to approx. DKK 10 Mio. and DKK 4 Mio. if compared to the perfect competition and market power scenario respectively. If this price manipulation due to

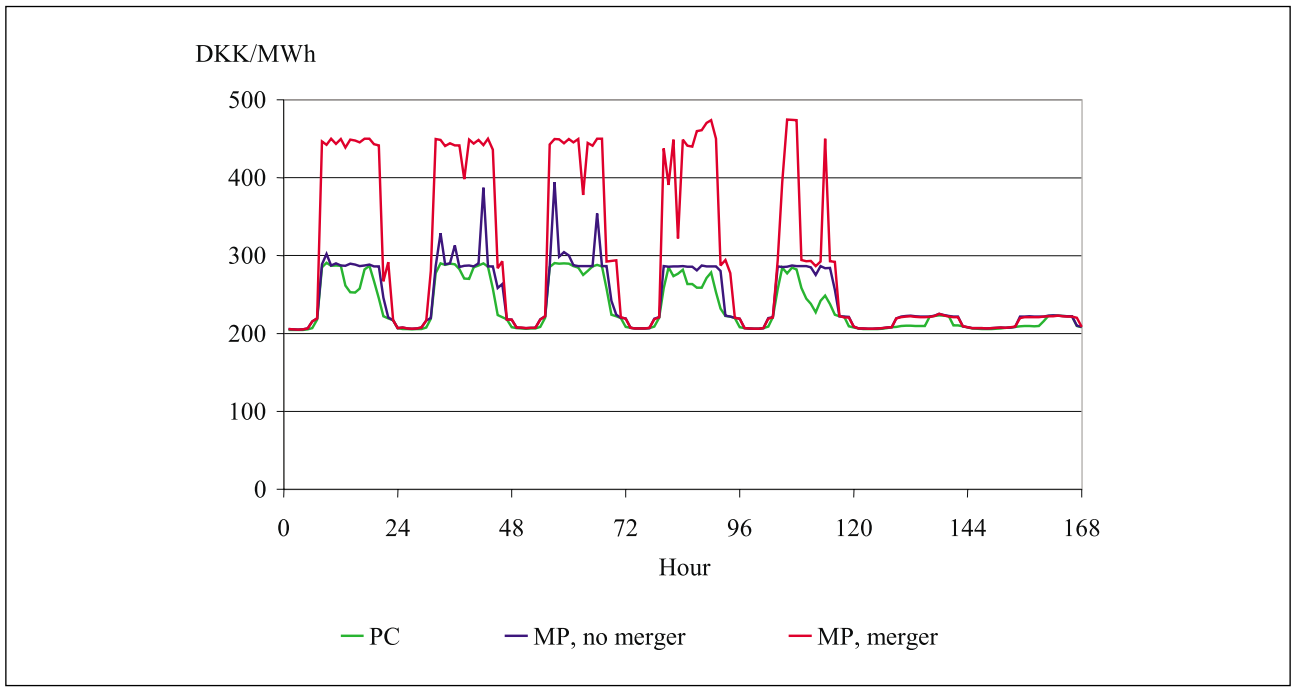


Figure 5.14 Prices in Sweden – week 3, 2005 – Nordic merger

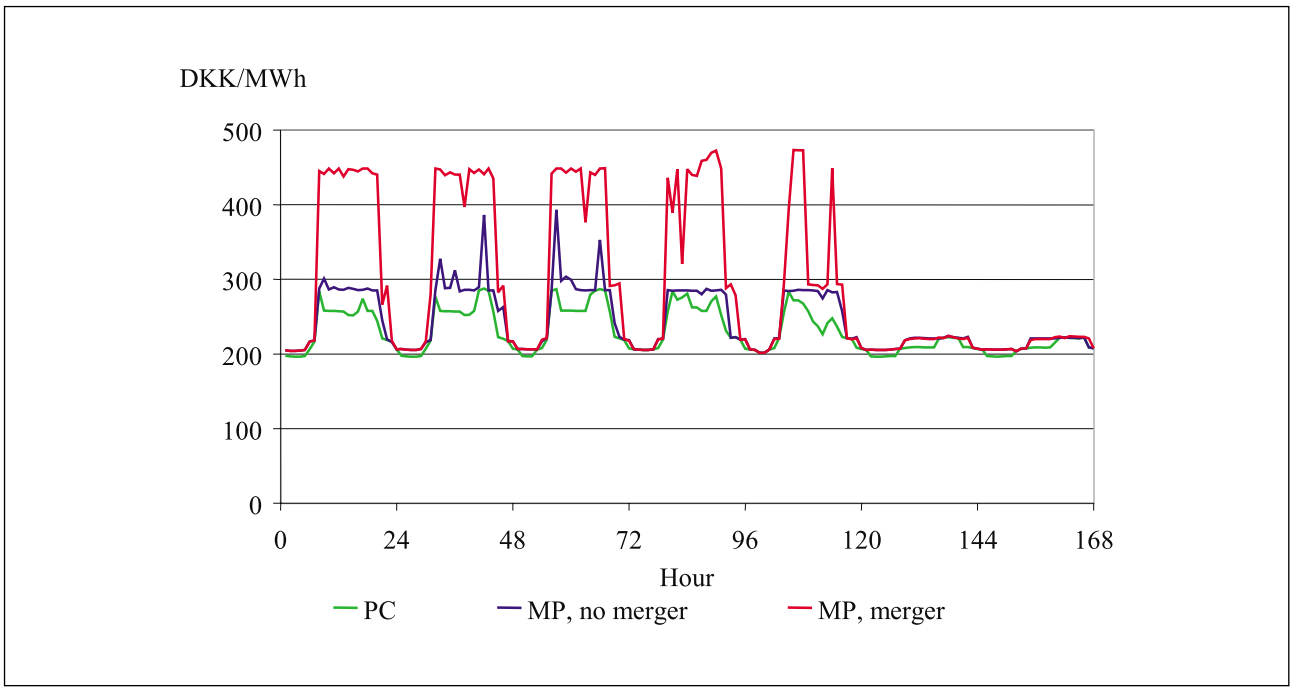


Figure 5.15 Prices in Finland – week, 3, 2005 – Nordic merger

the merger happens five times a week for seven hours every forth week the yearly transfer of wealth amounts to approx. DKK 4,5 bio. and DKK 1,6 bio. respectively.

The merger also affects the distribution of generation. As can be expected the merged firm reduces output – production is reduced from 22.498 MWh in Norway and 12.932 MWh in Finland to 20.782 and 11.238 respectively – in order to increase prices. Production in the other areas remains unaltered compared to the perfect competition scenario. Compared to the market power scenario production is decreased in Norway and Finland and increased in Sweden.

It should be noted that welfare effects indicated by the model are only static welfare effects. The model does not capture dynamic welfare effects.

The merger alters the profits of all price-setting firms – especially the ones not participating in the merger. The changes in profits of the price-setting firms in this simulation are shown in figure 5.18 below. Three different changes in profits are shown for each generator. "MP, no merger – PC" shows the relative increase in profits from introducing market power in the model compared to the perfect competition scenario. "MP, merger - PC" shows the relative increase in profits from merging two generators with market power compared to the perfect competition scenario. "MP, Merger – MP, no merger" shows the relative increase in profits from merging two generators with market power compared to the scenario where two generators with market power are not merged. For instance the generator in DK2 sees a 25% increase in profits from exercising market power relative to not exercising market power. If the Norwegian and Finnish generator are merged the generator in DK2 sees an increase in profits of almost 70% compared to the scenario where no generators are merged and no generators have market power. Compared to the scenario where generators are exercising market power the generator in DK2 sees a 35% increase in profits due to the merger if it is given the opportunity to exercise market power.

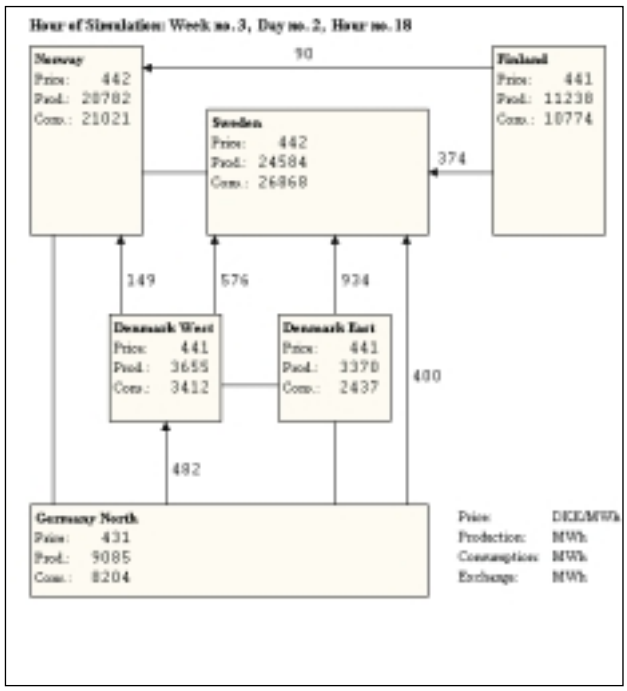


Figure 5.17 Flow map – Nordic merger

It is shown that all firms gain from exercising market power. Without the merger the two Danish generators gain the most relatively. The simulation of the merger shows that all the non-merging firms gains relatively more than do the merging firms.

The fact that the non-participating firms receive the largest increases in profits due to the merger is not surprising. As can be seen

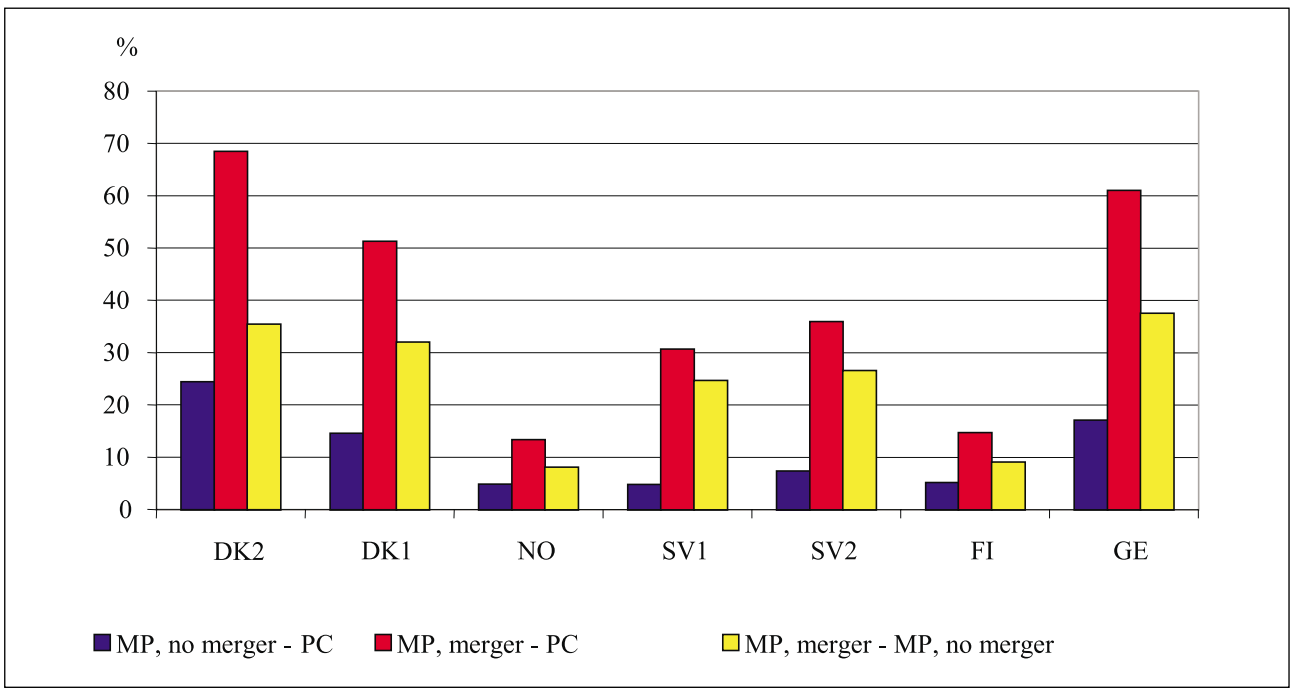


Figure 5.18 Change in profits – week no. 3, 2005

form comparing figure 5.7 (or 5.8) and 5.17 the merging firms reduce output in order to increase prices. The other firms profit from the higher price and do not have to reduce output.

Elasticity of demand
To describe the flexibility of demand an elasticity of demand is used in this model. In the two model simulations presented above a wholesale elasticity of –0.1 is used. This is a quite large (numerically) elasticity. A lower elasticity (numerically) would increase the price setting firms' incentives to exercise market power because the decrease in consumption due to a price increase would be smaller. This would increase the price obtained in the two market power scenarios and increase the transfer of wealth from consumers to producers.

Cross-ownership
The model treats all firms as independent. This is a problematic assumption. Cross-ownership can in a number of ways inflict production decisions and alter the incentives to exert market power, cf. Chapter 3. Introducing cross-ownership into the model would most likely sharpen the results presented in this chapter.

6. LEGAL FRAMEWORK AND THE SCOPE FOR INCREASED CO-OPERATION

6.1 Introduction[30]

In an economic context, mergers mainly fall into three categories. Horizontal mergers are those between companies, which operate in the same relevant market. Vertical mergers are those between companies, which operate at different distributive levels of the same relevant market. Finally, conglomerate mergers are those between firms, which have no connection with each other in any relevant market. In a legal context however, the categorisation of a merger has no significance for the application of the different national merger control provisions. The category of the merger in question will on the other hand play a crucial part in the analysis of the substantive test in any merger regulation regime.

In the Nordic power market, horizontal mergers between power producers are potentially most liable to pose a threat to competition. A horizontal merger resulting in high market shares may enable the new entity to set price and output in the same manner as a single-firm monopolist, with the same negative consequences for consumer welfare. The impact of vertical mergers on competition is more controversial. In essence, a vertical merger is a form of vertical integration. Such a relationship can be potentially anti-competitive, e.g. through the foreclosing of outlets to other producers, but may also create efficiencies, e.g. economies of scale. Conglomerate mergers have the least potential for being anti-competitive. On a general note, one negative effect of such mergers is the possibility for cross-subsidies from one product to another in order to defeat or out-compete new entrants, i.e. predatory pricing.

This chapter is mainly set up with the merger cases in mind. However, some of the views taken in this chapter can be of relevance to all enforcement activities.

6.2 The overriding objective of this chapter

In this chapter we seek to describe and clarify some of the substantive and procedural divergences that may come about in the case of a hypothetical inter-Nordic merger in the power market. By doing so, the report attempts to smooth the path for potential future co-operation between Nordic enforcement agencies regarding cross-border mergers in the electricity sector.

There are a number of enforcement issues that arise in the case of cross-border mergers. Firstly, the issue relating to the competence of the relevant enforcement agencies involved and the different substantive issues of merger control can cause problems with regard to co-operation on merger control. Secondly, the different procedural principles such as the obligation to notify, time limits for intervention and confidentiality issues may also create difficulties. Thirdly, there are other co-operative factors to be considered that are not construed in any law, like the division of labour, ongoing dialogue, possible convergence of analysis and so forth.

This chapter will furthermore seek to explore how to overcome the obstacles to co-operation on cross-border mergers. The existing agreements will also be discussed.

6.3 Substantive tests in merger regulation

Merger control has produced a wider range of substantive principles than has been the case in other areas of antitrust law, i.e. cartel enforcement or abuse of market dominance.

Merger control regimes today apply mainly three substantive tests. These different substantive tests are discussed in brief detail below. However, it is important to bear in mind that

30 For further reading on an introductory level see Craig & de Búrca, EU-law (Oxford University Press, 1998), chapter 22.

the outcome of merger cases depends to a great extent on the enforcement agencies discretionary application of the substantive test. Normally, the method used when defining the relevant market and when assessing potential market power, i.e. the economic analytical approach, will influence the result. Potential market effects in many merger cases are to some extent elusive and competition analyses might potentially produce different conclusions based on the same facts.

Although the different standards of review are an area of concern, there have been signs of convergence in the analytical approach taken by the different enforcement agencies in the assessment of mergers, also in the Nordic region.

6.3.1 Market dominance

In essence, the dominance test implies that a merger creating or strengthening a dominant position can be blocked by an enforcement agency. This approach can be viewed as an application of the monopolisation concept found in legislation such as the US Sherman Act or the abuse of dominant position provisions in article 82 EC.

The market shares of the parties in the relevant markets are an important factor when applying the substantive test to a merger. High market shares mean that the market will be concentrated and a high market concentration is generally seen as a necessary condition for competition to be restricted. Also the increase in market concentration is important in merger analyses, the larger the increase the larger the potential anticompetitive effects. Other elements to take into account when applying the dominance test are, inter alia, the degree of bargaining power of customers, the existence of potential competition and efficiency effects.

The European Commission, which applies the EC-merger regulation, issued a draft Notice on the appraisal of horizontal mergers on December 11 2002. The draft Notice states that appraisals of mergers notified under the regulation contains a definition of the relevant product and geographical market. It further states that the competitive assessment of horizontal mergers under the dominance test may include appraisals of the likelihood that the merger would have anti-competitive effects in the relevant markets in the absence of countervailing factors: the likelihood that buyer power would act as a countervailing force to an increase in economic power as a result of the merger, the likelihood that entry by new firms would maintain effective competition in the relevant markets, the likelihood that efficiencies will result from the merger and the conditions for a failing firm defence.

6.3.2 Substantial lessening of competition

This test allows for a merger that will lead to a substantive lessening of competition on the relevant market to be blocked by an enforcement agency. It must be noted that the terms comprised by the test will not be met if a merger simply lessens competition on the relevant market. It is an invariable condition that competition will be substantially lessened as a consequence of the merger for the test to be satisfied.

The core concept of the substantial lessening of competition test is a comparison of prospects for competition with and without the merger. Market shares are a key factor also in this test. Furthermore, possible loss of rivalry, deterrence of new entries, potential buyer power, cross ownership and prospective tacit collusion, failure of the target company and efficiency gains all fall within the frame of reference for an enforcement agency applying the test.

In their 1992[31] Merger Guidelines the US Department of Justice and the Federal Trade Commission state that merger assessment under the substantial lessening of competition test can include whether the merger would significantly increase concentration and result in a concentrated market, whether the merger in light of the market concentration raises concerns about potential adverse competitive

31 Revised 8 April 1997

effects, whether entry would be timely, likely and sufficient either to deter or to counteract the competitive effects, whether the merger brings efficiency gains that reasonably cannot be achieved by the parties through other means and whether either party to the transaction would be likely to fail, causing it's assets to exit the market.

6.3.3 Public interest

As the name indicates, the public interest test is a broad standard in which other considerations than merely competition issues can be of relevance. Enabling the use of public interests in merger control implies that more politically laden factors such as e.g. regional welfare, consumer welfare, and employment, culture and exports promotion or security of supply can be taken into account alongside competition issues. The public interest test is normally adopted where the legislator has provided a more political body of government with the merger enforcement task, e.g. ministries or other bodies close to the political sphere.

6.4 Nordic merger control legislation

In this section we give a brief presentation of the merger legislation in Sweden, Norway, Denmark and Finland. A comment will be given on the relevant topics for the purpose of this report, such as which mergers are caught, control and minority interests, jurisdictional thresholds, filing, foreign mergers, suspensions, timetable for clearance, and publicity and confidentiality issues. A brief comment will also be given on the framework of rules, which will pave the way for cooperation between the national competition authorities.[32]

6.4.1 Sweden

The Swedish merger control provisions contained in the Swedish Competition Act of July 1993, amended in April 2000, are based on the provisions set up in the EC-Merger Regulation. The case law of the Commission and ECJ/CFI will provide guidance when applying the act, as will notices from the Commission.

The Swedish Competition Authority has primary responsibility for the enforcement of the act. The Stockholm City Court may at the request of the Competition Authority prohibit a concentration that is subject to compulsory notification in accordance with the act, or which has been voluntarily notified in accordance with the special provisions in the act. If it is sufficient to eliminate the adverse effects on competition, a party to a concentration in order to obtain a conditional clearing may undertake to divest an undertaking, or part of an undertaking or to take other measures having a favourable effect on competition. A ruling of the Stockholm City Court can be appealed to the Market Court.

The merger control regulations are based on the concept of concentration. A concentration must be notified to the Competition Authority if the undertakings concerned have a combined aggregate worldwide turnover of more than SEK 4 billion, and at least two of the undertakings concerned have a combined turnover in Sweden of more than SEK 100 million each. If the turnover requirement according to the first threshold is met, the Competition Authority may, if there are particular reasons thereof, order that the concentration must be notified even if the second threshold requirement is not met. A party and other participants in a concentration always have the right to voluntarily notify a concentration where the first threshold requirement is met.

The determination of the existence of a concentration is based on both qualitative and quantitative criteria, focusing on the concept of control. These criteria include considerations of both law and fact, thus providing for a concentration to occur on a legal or de facto basis. Under the act, a concentration occurs when two or more previously independent undertakings merge, or either one or more persons, already controlling at least one or more under-

32 The following presentation of the Nordic national merger legislation is based on the more comprehensive presentations given in Global Competition Review, *Merger Control 2002*.

taking, or one or more undertakings acquire, whether by purchase of securities or assets, by contract or by any other means, direct or indirect control of the whole or parts of one or more other undertaking(s). Acquisitions of minority interests are hence only caught by the merger provisions if they include a de facto acquisition of control.

The creation of a joint venture, which on a lasting basis fulfils all the functions of an autonomous economic entity, constitutes a concentration within the meaning of the act. Provided the full-functioning joint venture falls within the scope of the merger provisions of the act, filing is mandatory.

Also foreign-to-foreign mergers are caught by the Act when the turnover thresholds are met. In practice, this means for instance that the creation of a full-function joint venture with no (or limited) foreseen activities in Sweden can still be caught by the Act's merger rules if the parent companies meet the thresholds.

From the date of receipt of a complete notification, the Competition Authority has 25 working days in which to form a decision either that there are no grounds for action or that it will initiate a special investigation of the merger. Within 10 working days from receipt of the notification, the Authority will inform the parties whether the notification is complete. After a decision to carry out a special investigation, the Authority has an additional three months in which to lodge an application to the Stockholm City Court. Provided the notifying parties agree this time limit can be extended with not more than one month at the time. If exceptional grounds exist, this time limit may be extended without their consent.

Under the Act, a concentration shall be prohibited if it creates or strengthens a dominant position, which significantly impedes, or is liable to significantly impede the existence or development of effective competition on the Swedish market as a whole or on a substantial part thereof. However, a concentration may be prohibited only if such a prohibition can be issued without significantly setting aside national security or essential supply interests.

In conformity with the practice of the European Court of Justice, a concentration could also be challenged under the Swedish Competition Act if it would strengthen or be liable to strengthen a collectively dominant position.

Customers and competitors and other third parties can be invited to comment on the proposed concentration. No companies other than those concerned by the concentration are treated as parties to the procedure.

The Competition Authority publishes the date of all notifications, the names of the notifying parties, the affected sector, whether the Authority has initiated a special investigation and it's final decision in the case on its website. As for confidentiality, the general rule in Sweden is that all documents held by a public authority are in the public domain. Special provisions on confidentiality and business secrets are contained in the Secrecy Act.

The Competition Authority is also part of the co-operation on multiple filings through The European Competition Authorities (ECA).

6.4.2 Norway

Current standing

Norwegian merger control legislation is contained in the Competition Act of 1993, enforced by The Norwegian Competition Authority (NCA), which may intervene in acquisitions of undertakings constituting a viable threat to workable competition on the affected market or markets. Decisions of the NCA may be appealed to the Ministry of Labour and Government Administration. Companies active in the Norwegian market must respect the EEA competition rules as well as the domestic Norwegian rules. The 'one-stop-shop principle', however, prevents duplication either by the European Commission, the EFTA Surveillance Authority or the NCA.

There are no jurisdictional thresholds under the Act. However, the NCA has issued guidelines stating that, as a general rule, it will only investigate transactions in which the combined

market share of the parties to the transaction exceeds 40 per cent, or where the combined market share of the three largest market participants (including the combined market share of the parties) exceeds 60 per cent.

Mandatory filing is thus no requirement under the Act, though a voluntary filing can be made. Such a filing has the effect of forcing the NCA to decide within three months whether or not to investigate the transaction further. If a filing is not made, the NCA may delay its decision for six months and in special circumstances up to one year.

The Act sets out a list of events covered by the concept of acquisition of undertakings, namely mergers, acquisition of stocks or shares and acquisition of parts of a business. Joint ventures are subject to merger control under the Act, provided the joint venture can function as an independent market operator. The merger control provision covers all transactions affecting the Norwegian markets, and thus potentially catches foreign-to-foreign mergers.

There is no general definition of control in the Act. Merger control under the Act applies to acquisitions of enterprises, irrespective of whether or not the acquiring company obtains control of the acquired company.

The substantive test adopted in the act allows for intervention in acquisitions resulting in a substantial lessening of competition contrary to the purpose of the act, which is the efficient utilisation of society’s resources through workable competition. The assessment involves three stages. The NCA will initially define the relevant markets affected by the transaction and calculate the market shares of the parties. As a second step, the NCA will evaluate whether or not the transaction will create or strengthen a substantial lessening of competition. In its assessment, the NCA will consider whether the parties either alone or in combination with other market players, will be able to exercise market power in the affected markets as a result of the transaction, hence allowing a merger to be challenged on oligopoly grounds. Third, as the object of the Act is to achieve efficient utilisation of society's resources, the NCA will not intervene in a transaction, which creates efficiency gains that outweigh the detriment to competition.

The NCA will normally inform customers, suppliers and competitors and invite them to give their views on the case and submit relevant information. No time limits or formal procedures exist for contact between the NCA and third parties. Complainants and other interested parties may request access to the NCA's files, including any voluntary notification, though confidential information is exempt from scrutiny. The NCA makes public the reception of a voluntary filing or that it has started investigation of a merger, and it issues press releases in most cases.

The NCA co-operates with the European Commission and with the EFTA Surveillance Authority in accordance with the EEA Agreement, which sets out rules on co-operation equivalent to the EC rules. For the purposes of meeting Norway's obligations to foreign states or international organisations under international agreements, the Act empowers the NCA to exchange confidential information with foreign competition authorities where the information is necessary to promote the competition rules of Norway or of the state or organisation in question.

The revised Norwegian competition act proposal

In November 2000, the Norwegian government appointed a committee to review the current Competition Act, including its merger provisions. The committee presented its proposals for new regulations in April 2003. The main features of the proposal regarding merger enforcement include the substantial lessening of competition test, definition of concentrations as applied in the EC Merger Regulation, notification of concentrations, and a suspension clause for notified mergers. The revised Norwegian Competition Act is expected to come into force in 2005.

6.4.3 Denmark

The main legislation on competition in Denmark is adopted in the Danish Competition

Act. In the field of merger control, two Ministerial Orders on the calculation of turnover and on the notification of concentrations accompany the provisions of the Competition Act. The Competition Council is the principal enforcer of competition law in Denmark. In practice, however, it is the Competition Authority, which is the secretariat of the Competition Council that is in charge of day-to-day administration of the Act and that prepares the decisions of the Council. The decisions of the Competition Council are subject to appeal before the Competition Appeals Tribunal.

The merger control provisions apply to concentrations where either the combined aggregate turnover in Denmark of all the undertakings concerned is more than DKK 3,8 billion and the aggregate turnover in Denmark of each or at least two of the undertakings concerned is more than DKK 300 million, or the aggregate turnover in Denmark of at least one of the undertakings concerned is more than DKK 3,8 billion and the aggregate worldwide turnover of at least one of the other undertakings concerned is more than DKK 3,8 billion.

The filing of merger notifications in Denmark is mandatory if the turnover thresholds are met. If a concentration falls within the thresholds, it must be notified to the Competition Authority not more than one week after the conclusion of the agreement, the announcement of the public bid or the acquisition of a controlling interest.

The provisions of merger control apply to 'concentrations'. In accordance with the EC Merger Regulation, a concentration will be deemed to arise where either two or more previously independent undertakings merge; or one or more persons already controlling at least one undertaking, or one or more undertakings acquire, whether by purchase of securities or assets, by contract or by any other means, direct or indirect control of the whole or parts of one or more other undertakings.

The Competition Act comprises a definition of control, which is consistent with the law and practice under the EC Merger Regulation. Control can be constituted by rights, contracts or any other means which either separately or jointly confers the possibility of exercising decisive influence on an undertaking. In cases where outright legal control is not acquired, rights attached to shares, or contained in shareholder agreements, board representation, ownership and use of assets and related commercial issues may be considered. In the case of the acquisition of minority shareholdings, the Competition Council will for instance assess the strength of voting rights and other factors. Such considerations may lead to the conclusion that the possibility of exercising control as defined exists. Whether or not control has actually been exercised is irrelevant.

The creation of a full-function joint venture, i.e. a joint venture performing all the functions on an autonomous economic entity on a lasting basis, also constitutes a concentration. In this respect, the preparatory works make explicit reference to the European Commission’s notice on the concept of full-function joint ventures.

Foreign-to-foreign mergers satisfying the turnover thresholds are subject to notification to the Danish Competition Authority.

A concentration notified to the Competition Authority must not be put into effect before the Competition Council has approved it, or the Council's time limit(s) have expired. This imply a suspension clause of four weeks (stage 1) or three months (stage 2) after the filing of a complete notification. Foreign mergers meeting the thresholds cannot be completed outside Denmark without breaching the Competition Act's suspension obligation unless the Competition Council grants derogation. The Act makes express provision for an early pre-merger clearance of cases, which do not pose any substantive issues.

The substantive test to be applied by the Competition Council is whether the concentration creates or strengthens a dominant position as a result of which effective competition would be significantly impeded. Unless this is the case, the merger must be approved.

Concentrated markets as well as oligopolistic markets will in some cases be considered col-

lectively dominated by an oligopoly. This may well form a basis for challenging the concentration.

The Competition Authority generally makes public a merger notification and invites comments. Further, the Authority will often seek comments from the market. The statement will include information on the identity of the parties, the nature of the concentration and the affected industry. Generally, the Competition Authority issue press releases after it adopt decisions in every important case. Pre-notification consultations can take place secretly, and under the simplified fast-track procedure, publicity is delayed until the transaction has been consummated.

Subject to reciprocity, the Competition Authority may exchange information with competition authorities in other countries. This right applies explicitly to information covered by the Competition Authority's secrecy obligations. The Competition Authority also generally co-operates with the European Commission.

6.4.4 Finland

The relevant legislation is adopted in Finland's Act on Restrictions on Competition. The provisions on merger enforcement entered into force on October 1st 1998. The Finnish Competition Authority (FCA) investigates concentrations in phase one, and either clears them with or without conditions, or requests the Market Court (former Competition Council) to prohibit them. Thus, the Market Court is empowered to block concentrations.

The filing of a notification with the FCA is mandatory if the Competition Act covers the concentration. A concentration must be notified to the FCA if the combined aggregate worldwide turnover of the parties concerned exceeds approximately ¤ 336,3 million and, where the aggregate worldwide turnover of at least two of the parties exceeds approximately ¤ 25,2 million, provided that the target company or a company in the same group is engaged in business activities in Finland. Notification must be made within one week from the acquisition of control of an undertaking or the acquisition of a business, i.e. from the signing of the acquisition agreement.

The Competition Act applies to concentrations, defined as the acquisition of control of an undertaking, acquisition of the whole or part of the business of an undertaking, merger or the creation of a joint venture performing on a lasting basis all the functions of an autonomous economic entity.

In absence of a legally founded definition of control in the Competition Act, the interpretation of control corresponds with the European Commission's practice. Consequently, minority shareholdings and other interests not constituting control may confer joint control and are therefore caught by the Restrictions on Competition Act.

The Competition Act will also cover foreign-to-foreign transactions if the turnover thresholds are exceeded and the target of the acquisition, or a company in which the target exercises control is engaged in business activities in Finland. The FCA has taken the view that this means a physical presence in Finland, e.g. through a subsidiary, sales office, service provider or, in some cases, an appointed agent.

In phase one, the FCA will examine the concentration. The FCA has a period of one month of which it must clear the concentration, conclude that the Competition Act will not cover the transaction or decide to initiate a further investigation. If an in-depth investigation is carried out, the FCA must, within three months (or five months with the permission of the Market Court) of the decision to initiate the investigation, either clear the concentration or ask the Market Court to block it. On receiving the FCA's request, the Market Court must make its decision to clear or prohibit the concentration within three months. The second-phase procedure could mean a total investigation period of nine months.

The concentration may be prohibited if it creates or strengthens a dominant position as a result of which competition would be significantly impeded in the Finnish market or a sub-

stantial part thereof. Under the Competition Act, an undertaking is considered dominant if it significantly influences the level of prices or conditions of supply or other competition conditions at a certain production or distribution level. In the assessment of dominance, market share is not the only criterion, nor is there any specific market share threshold, which the authorities would consider to establish dominance. Among other factors to be taken into account are any specific competitive benefits that the concentration could exploit, the bargaining power of the customers and suppliers, potential competition and barriers to entry. The only transactions in which non-competition issues are relevant are those concerning electricity distribution. Under a special provision, a concentration, which would lead to a 25 per cent share of electricity distribution in Finland in a network with a capacity of 400V being obtained, can be blocked. The purpose of this provision is to control any negative effects of vertical integration between electricity producers and distributors.

The FCA's view is that the substantive test also allows the Market Court to prohibit cases of joint or collective market dominance. However, the Market Court has not yet confirmed this interpretation of the Competition Act.

As a main rule, competitors of the parties to the concentration will be heard in the investigation.

The FCA only considers whether a dominant position is created or strengthened in the Finnish market or a substantial part thereof, and thus the FCA may not impose a remedy that does not strictly address and have an effect on this market. In this context, it is likely that the FCA will co-operate with the authorities in other jurisdictions in the case of multi-filing transactions. The FCA co-operates on a regular basis with other antitrust authorities. The co-operation is of an informal nature, and there is no formal framework for collaboration.

6.5 Inter-Nordic merger enforcement – uneven playing field?

In this subsection we look at some key issues regarding merger enforcement in the Nordic power market specifically, but the views taken here will be of relevance for mergers concerning other markets as well. The presentation of the Nordic merger control legislation above has shown that there are differences on both substantive and procedural matters between the Nordic countries. These differences include inter alia the substantive test for merger control, provisions for thresholds and notifications, and enforcement time limits. In some cases these formal differences can lead to diverging results. Furthermore, the approach chosen when analysing the market impact may affect the outcome of merger enforcement. As an illustration, an example of a Nordic cross-border merger will briefly be presented.

In the case of EQT Scandinavia LTD/Rosenlew Retail Products Ltd. the parties notified the concentration to the Finnish, Swedish and Norwegian competition authorities, resulting in clearance from Sweden and Norway, and a conditional clearance from the Finnish Competition Authority. Rosenlew Retail Products Ltd manufactured paper and plastic bags for the retail industry and paper bags for industrial use. The Swedish and Norwegian authorities found no impediments to competition resulting from the concentration. The Finnish authority found that the parties achieved a considerable market share in the market for block bottoms paper bags. Supported by other arguments causing concerns for the post-concentration level of competition, the Finnish authority found that the concentration lead to the creation of a dominant position significantly impeding competition in the said market, subsequently adopting a decision of conditional clearance. In this context it is important to keep in mind that diverging assessments are often justified by the different impact on the national markets caused by the concentration.

Whether or not this apparently uneven playing field will represent an obstacle for effective cross-border merger enforcement will be assessed in the following sub-sections.

6.5.1 The EC common market thresholds and national jurisdiction

The "one-stop-shop" principle in the EC merger regulation article 21 (1) provides the

Commission with sole jurisdiction regarding decisions provided for in the regulation. Accordingly the thresholds of the EC merger regulation must first be taken into consideration. Article 21 (2) of the regulation stipulates that no member state shall apply its national legislation on competition to any concentration that has a Community dimension.

According to article 1 (2) a concentration has a Community dimension where (a) the combined aggregate worldwide turnover of all the undertakings concerned is more than ECU (euro) 5 000 million; and (b) the aggregate Community-wide turnover of each of at least two of the undertakings concerned is more than ECU 250 million, unless each of the undertakings concerned achieves more than two-thirds of its aggregate Community-wide turnover within one and the same member state. Norway, being a member state of the EFTA, has adopted the same legislation via the EEA Agreement.[33] The major difference is that the "two-thirds" exception given in the thresholds in annex XIV to the EEA Agreement apply to the EEA consisting of both EU and EFTA member states. A merger having effect in Norway, Sweden, Denmark and Finland must hence be notified to the Commission, provided that a Swedish, Danish or Finnish undertaking operating in the power market achieves more than two-thirds of its aggregate Community-wide turnover within Norway, as the "two-thirds" exception rule in the EC merger regulation is not met. It must, however, be noted that such a scenario is unlikely to occur.

The Commission may refer a notified concentration to the competent authorities of the Member state(s) concerned, on terms specified in the EC-merger regulation article 9. In this context a note must be made on EC member states' possibility for protecting legitimate interests other than those protected by the EC-merger regulation in accordance with article 21 (3) of the regulation. Following Commission practise such legitimate interests can consist of special provisions for regulation of the water industry, and it is furthermore possible that the Finnish provision for mergers resulting in a 25 % market share in the electricity transmission operations will form a legitimate interest. One or more member states may also according to article 22 (3) request the Commission to adopt the merger regulation in cases where the thresholds are not fulfilled.

The question of national jurisdiction must be examined by any agency dealing with competition law enforcement. In general, the Norwegian competition act applies to terms of business, agreements and actions which have an effect, or are liable to have effect in the realm of Norway, thus adopting the effects doctrine. The geographical scope of the Swedish competition act is less evident due to lack of a clear provision in the act. The Swedish rules regarding concentrations refer to the country as a whole, or a substantial part thereof. However, the preparatory work and comprehensive practise of the authority states that the act will be applicable to any activity directed at the Swedish market, resulting in appreciable effects on this market. Similarly, the Danish competition act does not state the extent of its geographical scope. Danish jurisprudence shows that the Danish competition act comprises any restriction on competition with effect on the Danish market. The Finnish Act on Competition Restrictions states in a general provision that the Act shall not be applicable to a competition restriction which restrains competition outside of Finland insofar as it is not directed against Finnish customers. In relation to merger cases the Act covers concentrations to which the parties conduct business in Finland, thus adopting a modified effects doctrine.

Having adopted the effects doctrine all enforcement agencies in the Nordic region will have jurisdiction in the case of a Nordic cross-border merger having effect in all parts of the Nordic market, with a possible reservation for Finland.

33 Legislation adopted in annex XIV of the EEA-agreement (substantial provisions) and in protocol 4, part III, chapter XIII of The Surveillance and Court Agreement (procedural provisions).

There are also national thresholds to consider when assessing the jurisdiction of Nordic enforcement agencies. Unless these are met, national agencies will refrain from assessing the merger, due to the presumed minor size and potential market impact of the undertakings concerned. As shown above in section 1.4, all Nordic enforcement agencies except the Norwegian must consider national thresholds before a merger investigation can commence.

The Community thresholds described above therefore constitute the basic criteria for Nordic enforcement agencies' jurisdiction or competence in merger cases. The following discussions are applicable when these criteria are not fulfilled.

6.5.2 Scope for co-operation

As laid out in the presentation of the national legislation of the Nordic countries above, there are differences both on substantive and procedural principles in the current legislation. The substantive tests used by the competition authorities may risk causing diverging results in merger analysis. However, this discrepancy must not be exaggerated so as to impose a complete hindrance to co-operation regarding cross-border mergers. The key question for any competition authority regardless of the substantive test applied is whether or not the merging companies will achieve or strengthen their ability to exert market power after the merger.

Looking back at subsections 1.3.1 and 1.3.2 above we can see that the European Commission and the US Department of Justice and the Federal Trade Commission emphasise basically the same factors, albeit adopting different substantive tests. The outcome of merger cases will e.g. depend on the principles for delimitation of the relevant market(s). A narrow approach to the definition of the geographical market will normally result in higher concentration for the undertakings concerned, and vice versa. Furthermore, the different inputs and the emphasis put on various factors with the potential to impede competition can be shown to be decisive for the outcome of merger analysis.

On this background it can be upheld that the legal framework in competition law in the Nordic region does not block the path for successful co-operation on cross-border mergers in this region. It is desirable for the competition authorities to work towards a harmonised analytical framework. Such harmonisation would have to be consistent with the competition policy of the European Union. It would promote the discussion of the same key issues in the merger cases concerned. Not only would this constitute a benefit for the enforcement agencies involved, but it would also benefit the undertakings concerned, promoting legal certainty for the outcome of the case. The benefit of giving the parties involved the prospect and opportunity to foresee the outcome of the assessment must not be underestimated.

In cases concerning cross-border mergers between two or more undertakings, there is a need to develop a joint understanding of the effects of increased concentration, and how the market should develop in order to promote sound and well-functioning competitive markets. In the Nordic power market this could be of help to competition authorities and undertakings, especially considering the barriers to entry existing on the market resulting in weaker prospects of potential competition.

As showed in chapter 3 all national markets in the Nordic region are highly concentrated, each having one or two dominant firms. Other national markets in Europe are also heavily concentrated. In some instances further domestic growth of a dominant firm have been actively encourage and there has been debate about whether the dominant firm should be able to reach dominance on the home market in order to succeed on the European or even global market. However, if such a policy is promoted by all nations this may create a vicious circle and constitute an obstacle to a well-functioning Nordic and a future European market. A harmonised analytical framework might help to stop or slow down such a development.

As to a harmonised analytical framework, there is also the concept of remedies to be taken into

consideration. If the competition authorities find that the requirements for blocking a merger are satisfied, such remedies may be considered. The legislation in the Nordic countries gives the competition authorities power to e.g. order divestiture as a condition for clearing a merger. The Commission's Notice on remedies acceptable under Council Regulation (EEC) No 4064/89 and under Commission Regulation (EC) No 447/98 deals with divestitures in connection with mergers. Another Nordic working group has been looking at remedies in connection with mergers to learn about the effectiveness of remedies.

In the power market there is comprehensive cross-ownership. Competition authorities may consider using remedies as a powerful means to reduce cross-ownership.

6.5.3 Existing co-operation agreements

Unlike cases concerning the application of EC articles 81 and 82, the need for a co-operation agreement between the European Commission and the national agencies in merger cases has never arisen simply because of the clear provisions on the one-stop-shop principle in the EC merger regulation. Nonetheless, the Commission has the aforementioned possibility of transferring a case to a national agency if the concentration would be likely to impede competition on the home markets of the member state if the relevant authority agrees.

The European Competition Authorities (ECA) consists of the competition authorities in member states of the EU and EFTA, and of the European Commission and EFTA's Surveillance Authority (ESA). ECA has given a notice on the exchange of information between members on multi-jurisdictional mergers. If the notifying parties file notifications to more than one national enforcement agency, the first agency to receive such a notification shall establish contact with officials in the other agencies. The purpose of this contact is to exchange views on the case, but the notice does not give agencies the opportunity to exchange confidential information. This opportunity is only open to agencies whose legislation makes this possible. The authorities may seek permission from the parties to exchange confidential information. The notice may be developed further and expanded from time to time as the authorities' experience of these arrangements develop. The ECA has set up a model "ECA Notice" for the purpose of informing other agencies on forthcoming notifications.

In the Guidelines[34] for cooperation between competition authorities of the Nordic countries, the competition authorities[35] are called upon to inform each other of any cases liable to cause detriment to competition in another Nordic country. The authorities will seek to exchange information found necessary to handle cases, and perform investigations on behalf of other member states as far as the legislation and the available resources allow for this. When investigating the same or linked cases, the authorities shall attempt to co-ordinate their activities. If action taken by one authority has the potential of damaging competition in another member state (negative comity) the competition authorities shall consult with one another. A competition authority can request necessary precautions from another authority to avoid possible detriment to competition in its area of jurisdiction (positive comity). The guidelines state that when this co-operation is implemented unnecessary bureaucracy should be avoided.

On 1 April 2001 the Agreement between Denmark, Iceland and Norway on co-operation in competition cases entered into force. The agreement applies to both anti-competitive behaviour and mergers and to the acquisition of undertakings as defined in the member states' national competition legislation. With the agreement the Nordic countries wish to strengthen and formalise co-operation

34 Please note that guidelines are not legally binding.

35 These guidelines were approved on 30 May 2000 and concern the following competition authorities: Konkurrencestyrelsen (Denmark), Konkurrensverket (Finland), Kappingarskrivstovan (Faroe Islands), Samkeppnistofnun (Iceland), Konkurrensetilsynet (Norway) and Konkurrensverket (Sweden)

between competition agencies for the purpose of achieving more effective enforcement of the member states' national competition legislation. Article 2 of the agreement gives the agencies the possibility to provide each other with information in cases concerning inter alia a merger or acquisition of an undertaking in which one or more of the parties to the transaction is an undertaking registered, founded pursuant to the legislation of, or domiciled in one, two or all three member states. In article 3 the parties agree that it is in their common interest to exchange non-confidential information, and article 4 stipulates that it is in the parties' common interest to exchange confidential information. The exchange of confidential information is subject to a duty of confidentiality on the recipient's hand, and it may only be used for the purposes stipulated in the agreement. Such information may only be passed on with the expressed consent of the agency that supplied the information. The agreement also allows for the exchange of confidential information with the expressed consent by the undertaking(s) concerned, thereby giving a waiver to their legislative right to protection of such information. Provided all parties to the agreement consent, the agreement may be extended to embrace new contracting parties. On 9 April 2003 Sweden signed the agreement.

6.5.4 Multilateral discussions between enforcement agencies

Multilateral discussions between enforcement agencies offer an opportunity for co-operation between these agencies. Such discussions can be operated on a case-by-case basis, or be set up as a more comprehensive regime for handling a variety of cases over time.

The advantage of multilateral discussions concerning a pending case is the possibility of focusing on the specific competition issues at hand, thus giving agencies the opportunity to discuss distinguishing features of each case. The negative aspect is the lack of obligations put upon the agencies in multilateral discussions, but the mutual interest in the efficient handling of cases should provide an incentive to promote such discussions.

The Nordic competition authorities have already participated in bilateral discussions regarding competition cases. In one case the companies waived their right to confidentiality. The smooth and non-bureaucratic manoeuvring of bilateral and multilateral discussions promotes effective co-operation on cross-border competition case.

6.6 Information sharing between enforcement agencies

Gathering and assessing confidential information is important in any case concerning mergers. Details on market shares, turnover, customer-relations and strategies for future operations on the market are typically considered confidential information in national legislation. It is evident that without access to these data, analysing a merger case will be a very difficult task.

The concept of information sharing entails two different scenarios. Firstly, there is the sharing of information already possessed by an enforcement agency. Secondly, an agency can send a request to another agency, asking for information that is still to be retrieved. This scenario implies that agencies can gather information from undertakings situated within their jurisdiction and share this information with an agency of a different nationality.

6.6.1 Legislation and agreements

Every civil servant is under an obligation not to disclose confidential information which he or she obtains in connection with his or her work. This applies as a general rule of law in most European legislative systems. This is why any exchange of confidential information between competition enforcement agencies, subject to the general rule of law, must have an independent basis in law.

The Norwegian competition act, as any other competition act, gives the NCA the power to call for the information it deems necessary, including confidential information. According to article 6-1 all are required to give the competition authorities the information demanded by these authorities in order to perform their

tasks in accordance with the Act. The Danish competition act article 17 empowers The Competition Council to request any information, including accounts, accounting records, copies from the books, other business records and electronic data, which are considered necessary for its activities or for deciding whether the provisions of the Act shall apply to a certain matter. A similar provision is contained in the Swedish Competition Act article 45. On the basis of these provisions the enforcement agencies come into the possession of confidential information.

In order to fulfil Norway's contractual obligations towards a foreign state or international organisation, article 1-8 of the Norwegian Competition Act stipulates that the NCA may regardless of the statutory duty of secrecy furnish the competition authorities of foreign states with such information as is necessary to promote the competition rules of Norway or of the state or organisation concerned. The Danish act article 18A and the Swedish act article 56A give the Danish and Swedish competition authorities the same competence.

The agreement between Denmark, Iceland, Norway and Sweden on co-operation in competition cases article IV stipulates that it is in the parties common interest to exchange confidential information. The agreement only permits the exchange of confidential information already possessed by an enforcement agency. Requests for information to be gathered for the single purpose of transporting that information to another (foreign) competition authority falls outside the scope of the agreement. This means that e.g. the Danish enforcement agency is unable of having their Norwegian colleagues requesting confidential information from undertakings in Norway in order to enforce Danish national competition issues. Only information already possessed by the NCA can be exchanged in this situation.

6.7 Concluding remarks

The issue which this chapter has discussed is basically the question of how cross-border mergers in the power market can be handled more effectively.

From the presentation of the national legislation we have seen that there are both substantive and procedural divergences facing the Nordic enforcement agencies. Norway, for example, is the only Nordic country to apply the substantive test of "substantial lessening of competition". This could potentially lead to some enforcement problems. On a procedural matter the subject of different timetables of which the enforcement agencies must uphold could also be troublesome. These differences are however not impossible to overcome. An increased harmonisation of the procedural rules would, however, help make co-operation between the enforcement agencies easier. It would thus be of interest for the competition agencies concerned to promote such a harmonisation.

Discussions between the competition authorities involved are a welcome device in many cases for the national authorities. In the context of cases dealing with cross-border mergers they would provide a flexible instrument for the effective and non-bureaucratic exchange of views and ideas. However, such discussions will be insufficient if an authority needs to get access to confidential information held by other authorities.

Information sharing is very important when seeking a more efficient framework for co-operation between the Nordic countries regarding cross-border competition cases. The focus here is on the sharing of confidential information. It would be extremely difficult for a competition authority to assess a merger without access to this kind of information. The ability to exchange such confidential information between the competition authorities concerned is of great importance when creating a fruitful climate for co-operation regarding cross-border mergers.

The foundations set up in the Agreement between Denmark, Iceland, Norway and Sweden on co-operation in competition cases (the Nordic agreement) represents a good platform for co-operation regarding cross-border competition cases. The market players in the Nordic power market can probably be expected to attempt further integration in the near future,

and the Nordic competition authorities would benefit from being able to co-operate with each other in response to such efforts on the part of the market players.

The advantage of the current agreement is the fact that it opens for the exchange of confidential information. One shortcoming of the agreement is that Finland has not entered the agreement. Another disadvantage is that it does not open up for the possibility of gathering information from undertakings at the request of another competition authority.

The ability to exchange confidential information does not seem to be fully satisfactory for the purpose of co-operation in the case of cross-border mergers in the power market. As laid out above in this chapter, there is a risk for diverging results when applying the national legislation regarding cross-border mergers. This risk would be lowered with increased harmonisation of the analytical framework.

The working group has found that for the benefit of competition there is a need for continued co-operation on cases and competition policy in the Nordic power market.

7. CONCLUSIONS AND RECOMMENDATIONS

In this concluding chapter we will specifically reply to three requests in the mandate of the working group:

- identify common Nordic competition issues in the market for electric power,
- consider actions to handle obstacles to competition (including regulatory reforms),
- suggest co-operation solutions to improve the effectiveness of competition law enforcement.

7.1 Competition Concerns on the Nordic Power Market

The Working Group would like to emphasise that the deregulation of the Nordic electricity sector has been largely successful. The reforms have made it possible to utilise the complementarities of the coexisting different production technologies. In addition, integrating the national markets of Sweden, Denmark, Finland and Norway has decreased market concentration. Or to be more precise: the negative effects on competition of increased concentration in the national markets have been to some extent been offset by market enlargement.

However, it would be an exaggeration to state that the Nordic market is fully integrated. Statistics from Nord Pool shows that the market was fully integrated in 52% of the time in 2001 and 35% in 2002. This means that in more than half of the 8760 hours of the year the Nordic market is divided into two or more regional markets. Therefore, the relevant markets may vary from one hour to the next.

The national markets are heavily concentrated: Vattenfall has almost 50% of the Swedish market. The two Danish producers Energi E2 and Elsam are almost monopolists in respectively Denmark East and Denmark West. Statkraft has approximately 45% of the Norwegian market (including its share of production in BKK, Agder Energi and E-CO). And in Finland the duopoly Fortum and PVO/TVO together have 65% of the market.

Widespread cross-ownership among the Nordic power producers makes the markets even more concentrated. Taking cross-ownership into account we find the following Herfindahl-Hirschman concentration indexes in relevant Nordic markets:

The Nordic region:	1138
Sweden:	2988
Finland:	3005
Norway:	3325
Denmark[36]:	4844

The calculations show that the national markets are highly concentrated, while the integrated Nordic market is moderately concentrated.[37]

Joint ownership of power plants in Norway and Sweden adds to the market concentration. Taking these effects into account we find the following HHIs:

Sweden:	3169
Norway:	3644

The Working Group would like to point out that market concentration indexes in the national markets are high. The integrated Nordic market is moderately concentrated according to the cross-ownership adjusted HHI. The market concentration figures give cause for concern about how well competition functions in the relevant Nordic power markets.

In addition the power market has certain characteristics that add to this concern. In particular, production technologies vary with respect to flexibility and in high load periods several plants will operate at maximum capacity. This means that the competitive check on producers

36 Calculating the various HHIs for the Danish markets does not give a fully realistic indication of the extent of market power, confer chapter 3.6.
37 According to the 1992 U.S. Merger Guidelines, confer chapter 3.

trying to exert market power might be restricted in periods, confer section 4.2.

Furthermore, demand for electricity is inelastic. This means that there are high potential profits to be extracted from the market if competition is limited. As a result, the incentives to exert market power are high.

These concerns are underlined by the results of the market model MARS, developed by the Danish system operator Eltra. According to modelling results there is ample scope for exerting market power. A hypothetical inter-Nordic merger will increase the scope for exerting market power in certain high load periods. Furthermore, the model shows that generators have incentives to exert market power in low demand hours by withholding capacity. One important aspect of the results from the simulations is that practises with negative effects on competition originating in one country may have negative ripple effects in the entire Nordic region.

7.2 Possible Pro-Competitive Actions

The production capacities of the major producers are concentrated in separate areas. Therefore, the Working Group believes that further increases in concentration would give rise to competition concerns, because of the possible negative effects on competition and consumer welfare. Each merger case must, however, be analysed on its own merits.

With respect to short-run exercise of market power the concerns are most predominant regarding mergers between producers with flexible production technologies. Competition authorities should work towards including the effects of different production technologies in their analyses.

One or two major producers dominate all national markets. The large extent of cross-ownership is an obstacle to well-functioning markets. Cross-ownership reduces firms' incentives to compete and creates a forum for anti-competitive information sharing. The ability of competition authorities to intervene in acquisitions of minority shares is limited. In particular, competition authorities do not have the authority to order divestment of share holdings, except as a condition for accepting another acquisition of companies.

The Working Group recommends that the relevant national authorities should consider if and how more procompetitive company and ownership structures could be created.

The Working Group would like to point out that the transmission lines are not always fully utilised, confer section 1.2.1. The scope for exerting market power would be lower if effective utilisation of the lines is increased. Transmission system operators should endeavour to increase the effective capacity utilisation of the transmission grids.

Investments in new transmission capacity may also lower the degree of market power – though not eliminate it. One important pro-competitive action is that the transmission system operators should pay due attention to competition considerations in investment analyses of new transmission capacity. The reason is – among other things – that even a small increase in transmission capacity can have large effects on the market due to effects on competition.

However, the Working Group would like to stress that one of the major advantages of markets with functioning competition is that inefficient investment in new capacity is avoided. A promising supplement or alternative to new investments is to promote increased competition in the relevant markets.

7.3 Improved co-operation regarding competition policy

The exertion of market power in one part of the Nordic region will tend to have detrimental effects in other regions. While the effects are Nordic the competition authorities are national – provided that the EU/EEA competition rules are not applicable. When national competition authorities handle mergers and anticompetitive practises there is a risk that the overall effects will not be taken into consideration.

The Working Group would like to draw attention to the Guidelines for cooperation and the Nordic agreement on exchange of information. In the Guidelines the competition authorities are called upon to inform each other of any actual or potential cases liable to cause detriment to competition in another Nordic country.

When investigating the same or linked cases the competition authorities shall seek to co-ordinate their activities. The implementation of the Nordic agreement is important for the development of efficient co-operation on competition law enforcement in the power market.

The procedures should be implemented that will enable involvement of the Nordic national competition authorities in the handling of cases with effects in more than one country.

The Working Group recommends establishment of an inter-Nordic working group. The group should meet regularly with the aim to exchange views and promote harmonisation of the analytical framework. The working group should develop competition policy analyses of the power market, giving special note to the use of market modelling and other methods for analysing past and future market behaviour. The Nordic group should not be a closed forum but invite other European competition authorities to participate when relevant.

Furthermore, it is recommended that Nord Pool, the Nordic energy agencies, financial and competition authorities develop closer co-operation in order to exchange information concerning the market.

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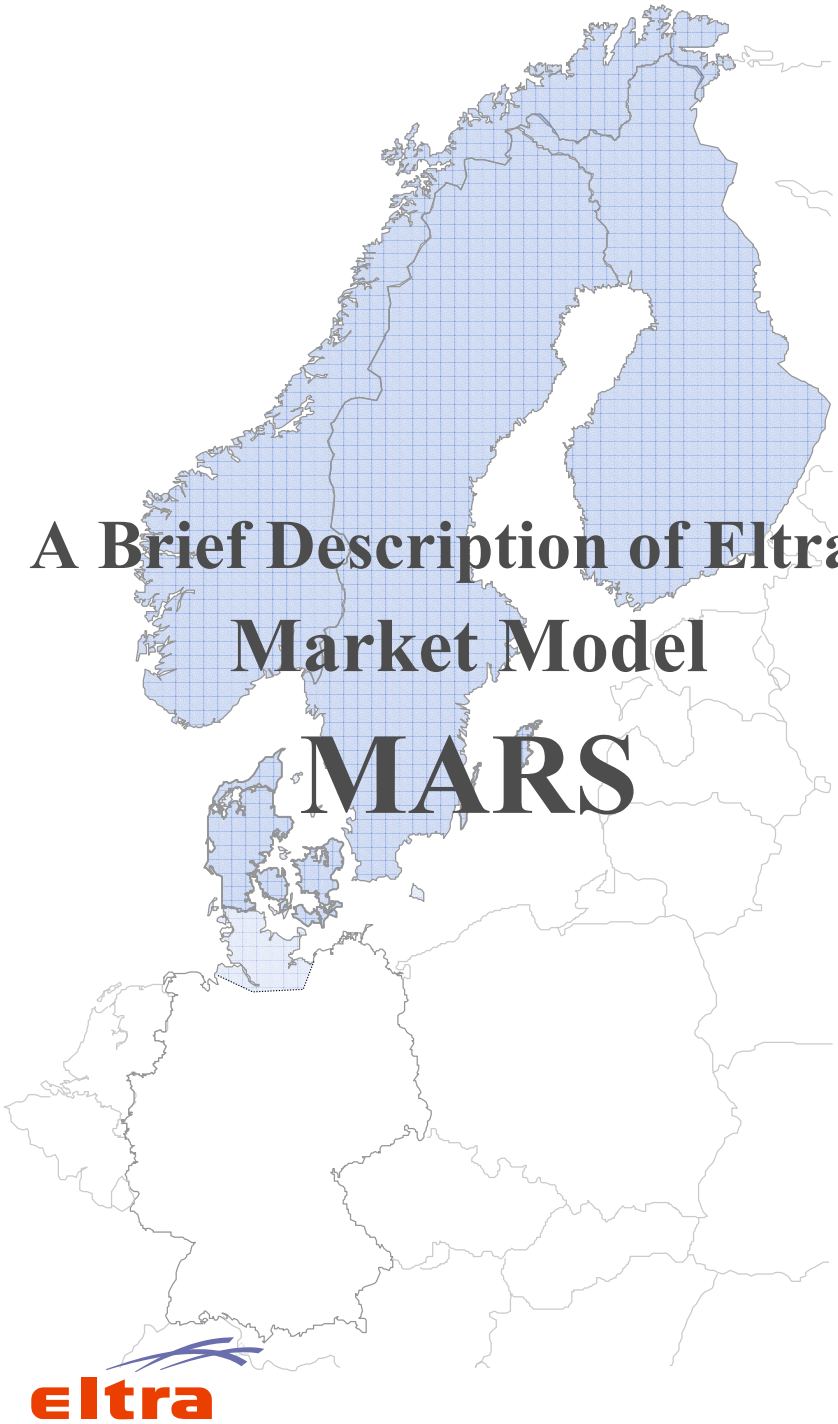


A Brief Description of Eltra's Market Model

MARS

ELT2003-122

Development
Date: April 14, 2003
Case No.: 5053
Doc. No.: 156884 v1
Our Ref.: BBK/PUK

MARS Documentation – Seminar on April 24, 2003

Table of Contents

1. Introduction

MARS (**MAR**et **S**imulation) is Eltra's new market model for the simulation of prices, production, demand and exchanges in the power market.

The model area comprises the Nordic countries (the Nord Pool area) and currently Northern Germany.

The new feature of this model is that prices, exchanges, etc. are calculated on an hourly basis. The model uses the same principles as Nord Pool, including the division of the Nordic countries into price areas with price-dependent bids.

The model is designed for both hydropower and thermal production, nuclear power and wind power. On the demand side, price elasticity is taken into consideration (i.e. that demand varies according to price).

Particular focus has been given to using game theory to simulate the producers' strategic behaviour, i.e. producer options for exercising market power.

In addition to an analysis of strategic behaviour, the model can provide a simulation of the impact on the market of for instance:
- Changes in transmission capacities due to expansions or revisions
- Addition of new production capacity
- Changes in market design
- Changes in demand
- Further tightening of the capacity balance in the Nordic countries in future.

The data basis is based on the data reported to Nordel by the transmission system operators for, among other things, the EMPS model. Data is then converted to an hourly basis based on the available information on distribution of consumption, etc. This was based on information from Nord Pool's ftp server and a purchased database of production plants in various countries as well as various other sources.

2. Modelling of Price Areas and Transmission Connections

The following price areas are currently included in the model:

- DKO – Denmark east
- DKV – Denmark west
- NOR – Norway
- SVE – Sweden
- FIN – Finland
- TYN – Germany north

It is possible to change the number of price areas in the model. For instance, Poland and the rest of Germany are to be included in the model in the future.

The model contains the following connections:

DKO-TYN (point-of-access tariff)	NOR-SVE
DKO-SVE	NOR-FIN
DKV-TYN (point-of-access tariff)	SVE-FIN
DKV-NOR	SVE-TYN (point-of-access tariff)
DKV-SVE	

All connections are modelled as market-controlled (as in Nord Pool). However, point-of-access tariffs have been included in respect of the three connections to Germany. This is a simple way of simulating that the connections are not fully integrated in the Nordic market.

The connection between Finland and Russia has been modelled as price-independent production (annual exports from Russia to Finland).

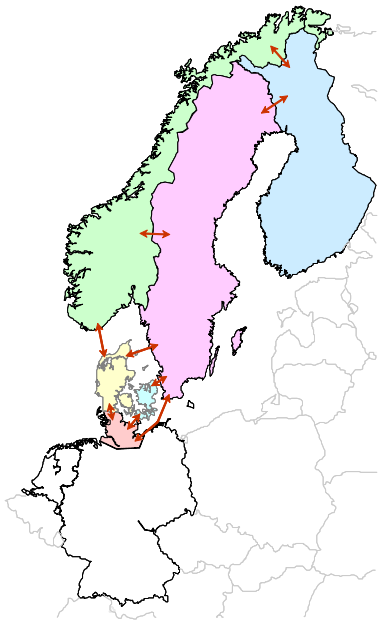


Figure 1 *The model area in MARS (as at April 2003).*

3. Modelling of Demand

In respect of the price-dependent demand, the demand function is created on the basis of the expression

$$p = k \cdot q^{1/\beta} \qquad (1.1)$$

where p is price, q is quantity, k is a calibration constant and β is elasticity of demand.

The function (1.1) is a Cobb-Douglas function, one of the properties of which is that it is iso-elastic. This means that elasticity, defined as the relative demand change divided by the relative price change, is constant throughout the curve.

The calibration constant, k, is estimated for each price area on the basis of market observations.

4. Modelling of Supply Function

4.1 General Points

For each production plant in the model, a calculation is made of the supply function depending on plant type and on whether the quotation is price-dependent. Piecewise linear functions have been used in the model to describe the supply functions. This has been done to obtain the best possible simulation of the actual bids made in Nord Pool's spot market.

4.2 Price-independent Production

Bound electricity production (such as some CHP plants) is modelled with price-independent supply. The same applies to wind power production and hydropower (hydropower plants without a reservoir) which cannot be regulated. The supply of this type of production will thus be a vertical line in a quantity-price diagram.

4.3 Price-dependent Production

Unbound electricity production is modelled with a price-dependent supply function. For such a supply function, the price always increases as a function of quantity. This corresponds to the guidelines to be followed by players in connection with the submission of bids in Nord Pool's spot market. A supply function for price-dependent production may in extreme situations be vertical, but not absolutely horizontal.

The short-term variable marginal costs of the individual plants form the basis of the estimate of the supply functions.

Hydropower production from plants with reservoirs that can be regulated is also modelled as price-dependent production.
In connection with the generation of the supply function, water values from the Nordic EMPS model, calculated using the same data basis as MARS, are used.

The water values (as a function of reservoir content and time of year) express the marginal value of the water and are used in MARS to determine market equilibrium in the same way as marginal costs from thermal plants. This means that the supply function for a hydropower producer depends upon the volume of water in the reservoir, the time of year and the inflow to the reservoir.

Water values are only used as “marginal costs” in the generation of the supply function, and not in the calculation of the producer’s profit. The water values from the EMPS model are entered in MARS as weekly values in connection with reservoir contents of between 0 and 100 per cent and with increments of 2 per cent. In MARS, the current water values are determined by interpolating between the input values.

4.4 Resultant Supply Function

The resultant supply function is generated for each price area and each producer.

Together with the resultant demand function, the resultant supply function for the price area forms the basis of the market price calculation in section 5.

The resultant supply function for the producer is used as the basis for simulations of market power. In connection with the exercise of market power, a mark-up is added (see section 6.1) to the supply function of each producer.

5. Market Price Calculation

5.1 Optimisation Problem

The market price calculation (equilibrium point) in the MARS model is done on an hourly basis and as a maximisation of the socio-economic surplus in the model area as follows:

$$\max z = \sum_{i} (C_i + P_i) + 0{,}5 \cdot \sum_{\substack{i,j \\ j \neq i}} F_{i,j} \qquad (1.2)$$

where

z	is the total socio-economic surplus in the model area
C_i	is the consumer surplus in area i
P_i	is the producer surplus in area i
$F_{i,j}$	is congestion rent from the exchange between areas i and j
i , j	area index

The socio-economic surplus is the sum of consumer and producer surplus as well as congestion rent.

The optimisation is restricted by the capacity constraints of production plants and transmission lines.

After each hour’s calculation of production, the content of the water reservoirs is updated on the basis of the calculated production and current inflow data.

As an example, the supply function, demand function and equilibrium point for a price area without imports/exports are shown in **Figure 2**. Furthermore, the producer and consumer surplus are shown.

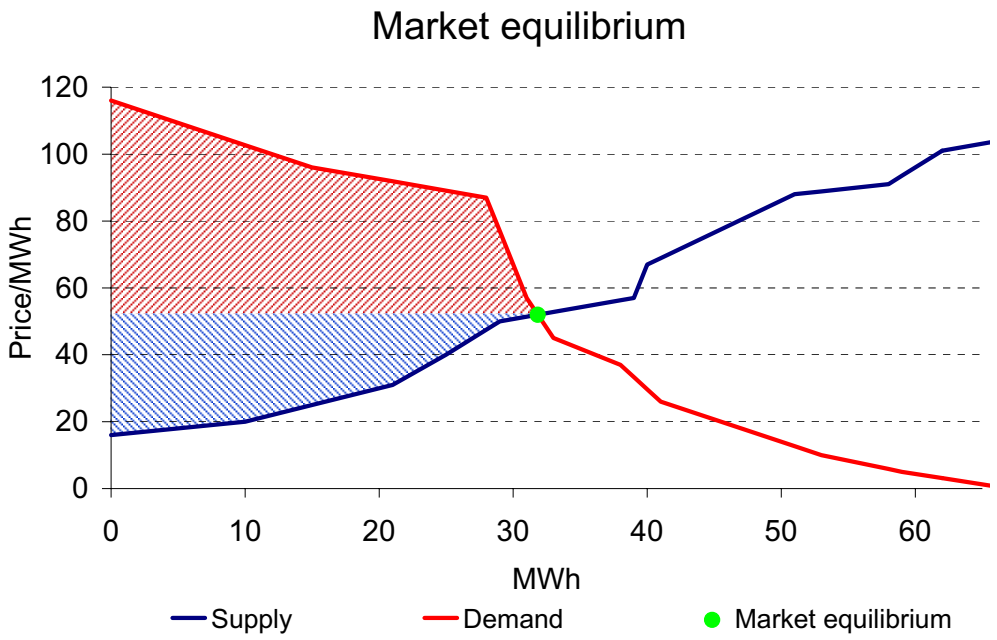


Figure 2 *Supply, demand, price equilibrium and producer and consumer surplus.*

Consumer surplus is the utility or benefit the consumer gains from a given equilibrium point. Consumer surplus is the red area of the area below the demand function and above the equilibrium price in **Figure 2**.

Similarly, producer surplus is the benefit or profit the producer gains from a given equilibrium point. Producer surplus equals the blue area below the equilibrium price and above the supply function, see **Figure 2**.

5.2 Congestion Rent

When the market is divided into several price areas with the possibility of exchange between the areas, the situation is not quite as simple as regards socio-economic surplus.

In the Nordic model, an exporting producer obtains the price applicable in the producer's price area. Similarly, the importer (the consumers in the import area) pays the price applicable in his own area. In cases where transmission capacity limits the exchange between the price areas, the price in the import area will be higher than the price in the export area, which will generate a positive difference between the payment from the consumers in the import area and the payment to the exporting producer.

This positive difference (congestion rent) accrues to the transmission operators involved and must be incorporated into the socio-economic surplus. It equals transmission capacity multiplied by price difference.

The socio-economic surplus for the entire model area divided into several price areas is thus the sum of consumer and producer surplus in all the price areas plus the sum of all congestion rent.

5.3 Algorithm for the Market Equilibrium Calculation

Figure 3 shows a flow diagram for market equilibrium calculation in MARS assuming perfect competition.

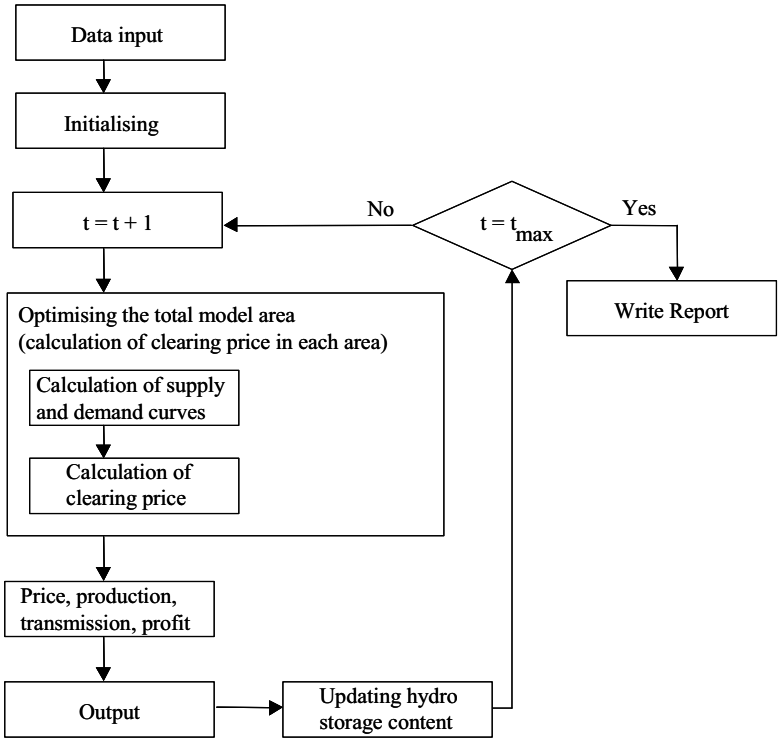


Figure 3 *Flow diagram for the simulation of perfect competition in MARS.*

Figure 3 is self-explanatory. It should be noted that the algorithm determines prices, production, demand and exchanges simultaneously for every hour. The algorithm is programmed in GAMS.

6. Simulation of Market Power

In connection with the simulation of market power, it is assumed that all major producers wish to maximise their profit.

The Nordic power market is not characterised by perfect competition, but is rather an oligopoly market, i.e. a market in which there is not only one player (a monopoly) and not an infinite amount of players (perfect competition). In an oligopoly market, the players should expect the other players to react to their activities. This means that a player's profit depends not only on the player's own activities in the market, but also on the activities of the other players. And that a player's own activities affect the other players' profit functions.

In MARS, the simulation of market power is a simulation of the players' profit maximisation. Since everyone (who has the possibility of exercising market power) is also trying to maximise their own profit function, this can be described as a multi-criteria problem. The reason for this is that all the players have their own goals for success, which are not necessarily identical to those of the other players.

In section 6.1, the method used in MARS to manage the individual players' exercise of market power is shown. The objective of the simulation is to find the market equilibrium. The equilibrium sought in MARS is a Nash equilibrium. Section 6.2 contains the definition of a Nash equilibrium. And the principle of the iterative procedure for the determination of the Nash equilibrium is described in 6.3.

6.1 Mark-up

In MARS, the exercise of market power by each player is used as an opportunity to add a mark-up to the player's own resultant supply function.

The chosen mark-up strategy in MARS is dependent on the quantity produced.

$$p = \mu \cdot q + MC \qquad (1.3)$$

where

p	the price offered
q	the quantity corresponding to p
μ	mark-up coefficient
MC	marginal costs

As shown in (1.3), a player will behave as a price taker in the market if the mark-up coefficient is 0.

An example of a supply function with and without a mark-up is shown in **Figure 4**.

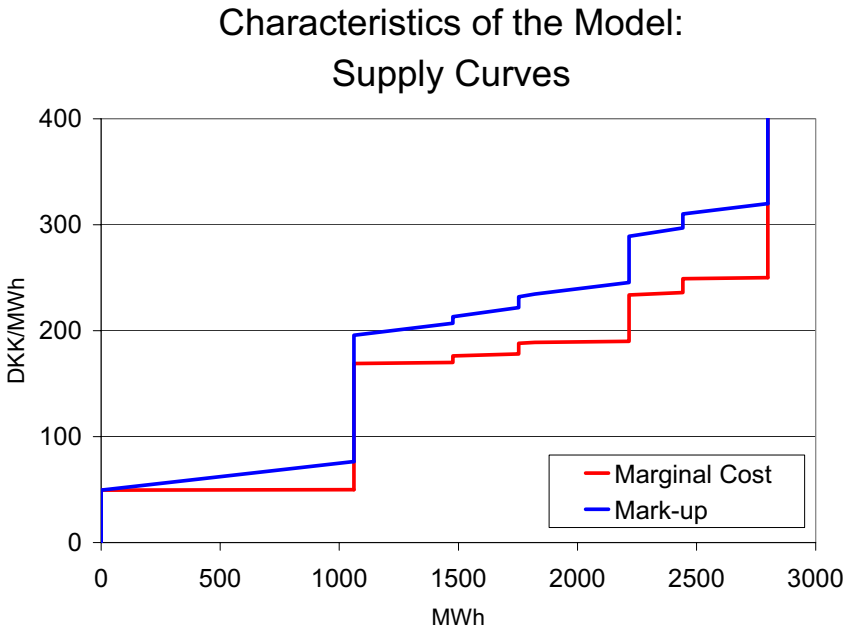


Figure 4 *Illustration of the effect of the supply curve of a positive mark-up.*

6.2 Nash Equilibrium: Definition

The Nash equilibrium is defined as a set of strategies according to which all producers have separately chosen the optimal strategy given the strategies of the other producers.

Mathematically it can be shown as follows:

$$\Pi_i\left(\mu_1^*,\mu_2^*,...,\mu_i^*,...,\mu_n^*\right) \geq \Pi_i\left(\mu_1^*,\mu_2^*,...,\mu_i,...,\mu_n^*\right),\ \forall \mu_i \in S_i,\ \forall i \in I \qquad (1.4)$$

where

$\Pi_i\left(\mu_1,\mu_2,\mu_3,...,\mu_n\right)$	is the profit of the i^{th} producer
μ_i	is the strategy of the i^{th} producer
μ_i^*	is the optimal strategy of the i^{th} producer
S_i	event space for the i^{th} producer's choice of strategy

6.3 Method for the Determination of Nash Equilibrium

The following iterative procedure for the determination of Nash equilibrium has been developed by IMM, Technical University of Denmark (DTU).
If the event space for strategies contains a combination of strategies which results in one or more Nash equilibriums, the following iterative procedure will converge to this.

Initialisation	$\mu_i = 0,\ \forall i$.
Step 1	μ_1^* is determined so that (1.4) is satisfied for $i = 1$.
Step 2	μ_2^* is determined so that (1.4) is satisfied for $i = 2$.
.	
.	
.	
Step n	μ_n^* is determined so that (1.4) is satisfied for $i = n$.

Steps 1 to n are repeated until the equilibrium has been determined. In MARS, μ can be initialised at 0 or at the resultant set of strategies from the previous hour.

6.4 Discrete Strategy Space

The method described in section 6.3 is time-consuming, as it is necessary in each step to calculate a sufficient number of price equilibriums for the optimal strategy to be determined. Furthermore, the more producers that are able to exercise market power, the more steps the procedure will comprise, which makes it even more difficult to achieve convergence.

With a view to facilitating the calculations, it has thus been necessary to consider a discrete strategy space. Discrete space means that the individual producers have a predefined final number of mark-up coefficients to choose between.

The fact that a set of possible strategies is predefined for each individual producer makes it possible to find a solution for the problem. However, it also introduces requirements for how the discrete room is selected. If the gaps between the mark-up coefficients are made too large with a view to covering a large interval, there is a risk that Nash equilibriums will be ignored. However, if the gaps are made too small with a view to carrying out a more precise analysis, the interval being analysed must be relatively small with a view to reducing the calculation time, which means that Nash equilibriums outside the interval might be ignored.

6.5 Example of Simulation Results from MARS

In connection with the verification of the model, simulations with MARS have been carried out in order to compare the consequences of perfect competition and market power. The calculated prices for a future winter week with periods of high wind power production are shown in **Figure 5**.

In the market power simulation, the seven largest producers currently in the market can choose the optimal strategy among 11 discrete strategies. Every hour a Nash equilibrium is determined and used as the starting value of the iterations of the subsequent hour.

The figure shows that the model calculates considerably higher prices in the market power situation. The prices and the price variations due to the volume of wind power are thought to be realistic in view of the general observations made in Nord Pool.

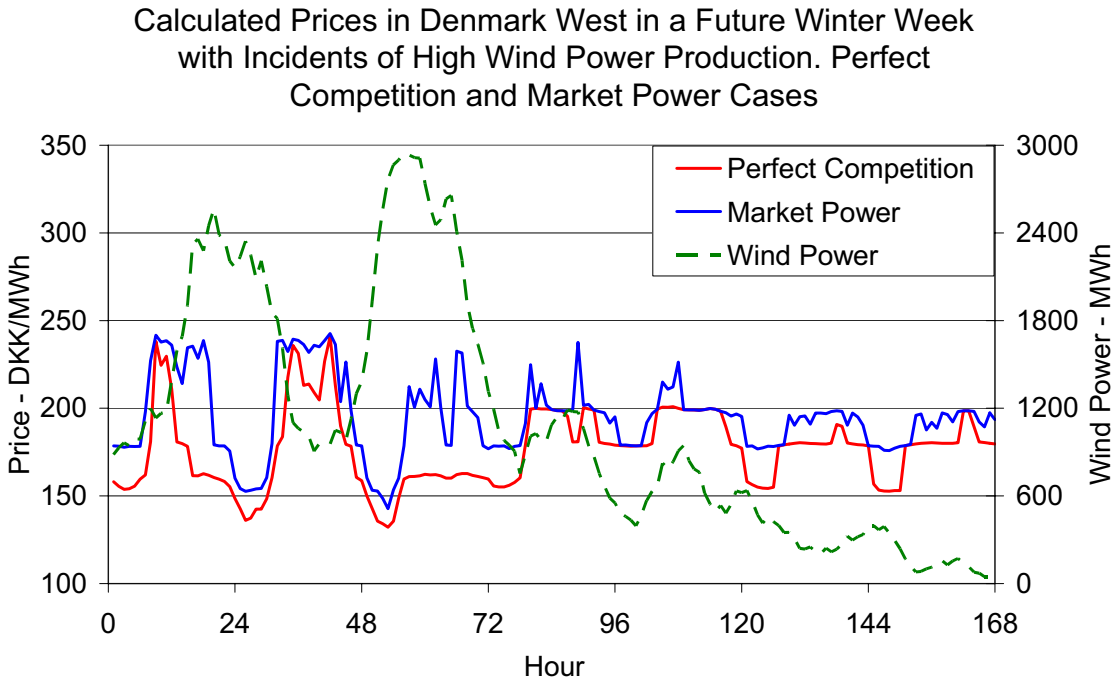
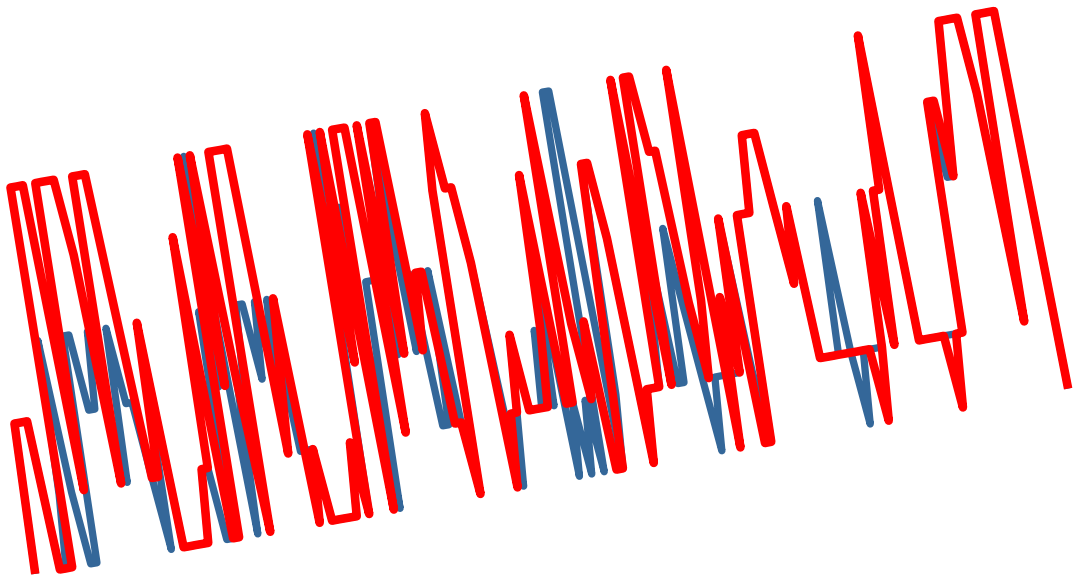


Figure 5 *Example of simulation results from MARS.*

ELT2003-170a

Model Simulations

of Hypothetical Mergers of Major Generators in the Electricity Market



Work carried out in cooperation with the Danish Competition Authorities

eltra

June 2003

Development
Date: June 19, 2003
Case No.: 5053
Doc. No.: 162105 v1
Our Ref.: BD-BBK/PUK-DGR

Model Simulations of Hypothetical Mergers of Major Generators in the Electricity Market

1. Introduction

In cooperation with the Danish Competition Authority, Eltra has conducted a series of simulations using the MARS market model with the object of assessing the significance of hypothetical mergers of major generators in the Nordic electricity market. The simulations will be used by the Danish Competition Authority in connection with cooperation with the other Nordic competition authorities.

The competition authorities would like to see simulations conducted on the basis of preliminary investigations using the market model with a view to shedding light on the hypothetical merger of a Finnish and a Norwegian generator. Furthermore, the authorities wish to establish the incentives for a Danish generator to exercise market power and the effect which such action may have on the Nordic market as a whole.

2. Summary of Results

In summary, it is believed that the possible merger of the Finnish and the Norwegian generator will provide the merged company with considerable incentives to exercise market power in those winter periods where demand is particularly high. This is the case on certain weekdays or in the daytime during weekdays with large consumption – in the present survey hours when wind power production is furthermore very low. All the generators will increase their profits as a result of the higher prices brought about by the merger, regardless of whether they are price-takers or participate in the exercise of market power.

In summer, demand is not sufficient for the merger to provide particular incentives. There is, however, a basis for material price increases in the summer as a result of the market power exercised by the seven largest generators with ownership shares in the production capacity as it is known today. Price increases will primarily be seen during peak-load hours on weekdays.

The assessment required by the competition authorities in respect of a Danish generator shows that the price in Denmark East, regardless of the generator's mark-up, will for

part of the time follow levels in Germany North on account of the limited production capacity in Denmark East with low marginal costs. The price in Denmark East will, however, for certain hours be determined by the generator. For example, the generator could, for particular night hours in winter, have chosen to keep the price down at the level in Germany North, thereby avoiding significant imports from this area. Instead, the Danish generator chooses to increase the price materially to match the Swedish level, the result being a fall in production, while the company's profit is increased by about 50 per cent for the hour in question compared to perfect competition.

In such a situation, the Danish generator's exercise of market power does not materially affect prices in the other Nordic countries. For example, prices in Norway, Sweden and Denmark West remain largely unchanged in comparison with a situation with perfect competition.

The assessments made in the present document are based on model simulations during relatively limited periods of time. Furthermore, no parameter studies as such have been carried out in respect of significant parameters. This means that the results can mainly be used to illustrate the possible market mechanisms and do not amount to a complete description of the market conditions.

3. Simulations

Using the MARS model, the following types of simulations have been carried out for a week in winter and a week in summer in 2005:

- Perfect competition
- Market power without mergers
- Market power with merger of a Finnish and a Norwegian generator.

The simulation periods chosen are not representative for the entire winter or the entire summer periods of 2005, but have been elected to illustrate the market conditions during two very different periods. In the week in winter, demand in Norway is high, resulting in northbound transports from Denmark and Germany at most hours. In the week in summer, the water values in Norway and Sweden are, on the other hand, sufficiently low for transports to be going in both directions in a situation with perfect competition.

Market power is simulated by means of mark-ups on the available production. The optimum mark-up is determined through maximising the profit of the individual generator, given the mark-ups applied by the other generators (Nash equilibrium). Furthermore, the optimisation includes the profit on any CHP production and wind power owned by generators.

In the simulations of market power, seven generators are able to exercise their market power in the listed price areas:

- One in Denmark East
- One in Denmark West
- One in Norway
- Two in Sweden
- One in Sweden and Finland
- One in Germany North.

The other generators are price-takers.

Owning a material share of the production capacity in Sweden, the Finnish generator can in the simulations exercise market power in both Sweden and Finland, i.e. pursue different strategies in the two price areas.

In the simulation of market power following the merger of the Finnish and the Norwegian generator, the merged company is able to pursue different strategies in Norway and Sweden as well as Finland.

The strategies are calculated with a view to optimising the company's total profit. The model simulates market power hour by hour. The generators' strategies are not optimised over time, i.e. the model does not optimise the hydropower generators' seasonal use of the reservoirs to exercise their market power. Refer to Eltra doc. no. 2003-122.

4. Assumptions

The model area comprises six price areas with interconnections as shown in Figure 1. Table 1 shows the large generators' ownership shares in the production capacity available for market power. The simulations have been carried out on the basis of the assumptions listed in Table 2.

Price area	**Abbreviation**	**Large generators**	**Ownership shares in the production capacity available for market power**
Denmark East	DKO	Energi E2	100%
Denmark West	DKV	Elsam	100%
Norway	NOR	Statkraft	41%
Sweden	SVE	Vattenfall Sydkraft Fortum	53% 18% 18%
Finland	FIN	Fortum	40%
Germany North	TYN	E.ON	60%

Table 1 Model price areas and ownership shares of large generators.

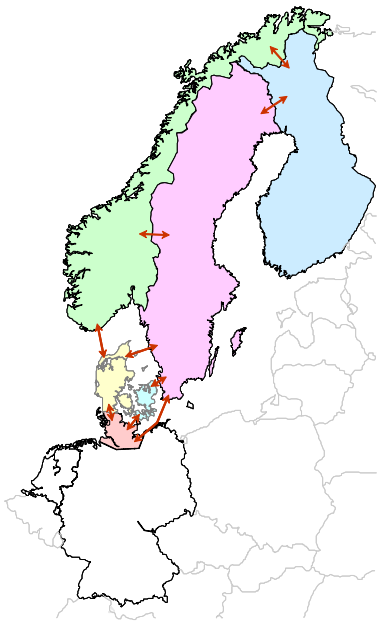


Figure 1 Model area.

Parameter	Description
Annual consumption	EMPS data for 2005 with increased consumption.
Consumption profile for the year	Hourly values from 2001 for DKO, DKV, NOR, SVE and FIN. Statistical data from 2000 for TYN.
Demand in all price areas	Annual average price: DKK 200/MWh Demand elasticity: –0.1
Production	For DKO, DKV, NOR, SVE and FIN, EMPS data for 2005 are used. In DKV local CHP units have been integrated in the market. For TYN a combination of EMPS data for 2005 and a production database for the whole world is used.
Wind power profile for land-based and offshore wind turbines	Hourly values from DKV for 2001 are used in DKO, DKV, SVE and TYN. Profile for land-based wind turbines has been measured. Profile for offshore wind turbines has been calculated.
Water values	EMPS data for 2005 with increased consumption.
Profile for inflow in NOR, SVE and FIN	EMPS data. Inflow series for 1952.
Exchange capacity	EMPS data without Great Belt Link and without connection between NOR and TYN.
Point-of-access tariff	DKK 10/MWh for exchanges DKV-TYN, DKO-TYN and SVE-TYN, otherwise DKK 1/MWh.

Table 2 Assumptions concerning input data.

5. Analysis of Results

The analysis of hypothetical mergers in the electricity market which has been conducted has been documented by means of the figures listed below, which are all attached at the end of the document:

Figure 2 - Figure 7	Prices in week no. 3, 2005
Figure 8 - Figure 15	Mark-up of dispatchable production in week no. 3, 2005
Figure 16	Profit changes due to market power and merger in week no. 3
Figure 17 - Figure 19	Flow maps for a particular daytime hour in week no. 3, 2005
Figure 20 - Figure 22	Flow maps for a particular night-time hour in week no. 3, 2005
Figure 23 - Figure 25	Flow maps for a particular daytime hour in week no. 3, 2005
Figure 26 - Figure 27	Flow maps for a particular night-time hour in week no. 3, 2005
Figure 28 - Figure 33	Prices in week no. 32, 2005
Figure 34 - Figure 41	Mark-up of dispatchable production in week no. 32, 2005
Figure 42	Profit changes due to market power and merger in week no. 32
Figure 43	Wind power production in Denmark West in weeks no. 3 and 32, 2005

5.1 Prices

The prices calculated for the individual price areas in week no. 3 are shown in Figure 2 - Figure 7 with a comparison of the three types of simulation, perfect competition, market power without mergers and market power following merger of the Finnish and the Norwegian generator.

The exercise of market power without mergers is reflected in the price curves in different ways in the individual price areas. In Denmark and Germany prices increase to match the Swedish level in the low-load periods, i.e. at weekends and at night on weekdays. In these periods, only slight price changes are seen in Norway, Sweden and Finland as a result of the exercise of market power. The merger does not affect prices in the low-load periods.

It should be noted that with perfect competition, prices in Denmark West are higher in the low-load periods than the corresponding prices in Denmark East, the result being that the exercise of market power would seem to have more effect here. This is attributable to the fact that local CHP units are integrated into the electricity market with a price of approx. DKK 180/MWh in Denmark West, while the local units are included with a very low price in Denmark East.

It can be seen that in the daytime on weekdays, market power without mergers only results in significantly higher prices for a few hours (price spikes). On the other hand,

the model finds that the hypothetical merger results in materially higher prices during almost all daytime hours in comparison with perfect competition. This applies to all price areas.

General price increases in the daytime on weekdays as a result of the exercise of market power (without mergers) are seen on several days in Finland, but are also seen mid-afternoon on Monday and on Thursday and Friday afternoons in all other price areas.

The prices calculated for week no. 32 can be seen in Figure 28 - Figure 33. The general assessment for this week is that the merger will not result in additional incentives for the exercise of market power than would be the case in a situation without a merger.

In week no. 32 market power is seen, in particular, in the daytime on weekdays, resulting in material price increases. However, this is not the case in Norway, where price patterns are the same in all three simulation types. The scope for exercising market power is deemed to be dependent on wind power production. This has, however, not been analysed in further detail in the context of this study. *Figure 43*, showing wind power production in Denmark West for the simulated weeks, has been included for information.

5.2 Mark-up

Figure 8 - Figure 15 show the generators' mark-up in the form of the mark-up coefficient (μ) on account of market power with and without merger in week no. 3. The figures have been prepared in such a way that all, and only all, the possible variation intervals for the individual generators' mark-up coefficients are shown on the y axis. For model-technical reasons, the minimum value for the mark-up coefficient of DKK $0.001/(MWh)^2$ is used for all generators. The minimum value is also used for simulation of perfect competition.

Initial calculations have been carried out to seek to adjust the variation intervals so that the individual generator is not subject to inexpedient restrictions in his exercise of market power, and so that the individual steps between two strategies are sufficiently small to ensure that even minor incentives to exercise market power are detected by the model. The same variation interval has been used for a given generator regardless of the simulation period and simulation type.

The merger results in significantly increased mark-up coefficients for several generators, but especially for the merged generators. For example, there are many daytime hours on weekdays when the Norwegian generator in the non-merger situation decides to offer production at a price corresponding to the water value (plus the minimum mark-up), while the mark-up coefficients in the merger situation reach DKK $0.05/(MWh)^2$. This is, for example, the case on Monday in hour 15, when the generator's production is approx. 4,800 MWh. This means that the generator's mark-up

is approx. DKK 240/MWh, which when added to the water value results in a price of approx. DKK 450/MWh in Norway.

The mark-up coefficients for the simulations of the summer week (week no. 32) are shown in Figure 34 - Figure 41. In concordance with the analysis of the area prices, it can be seen that in general the exercise of market power with a merger is less in the summer week than in the winter week.

5.3 Changes in Profit

For the three scenarios simulated, the total profit has been calculated for all players on a weekly basis. Figure 16 shows the changes (in per cent) in the profit figures of the seven largest generators in week no. 3 between the three scenarios.

Blue indicates the changes (in per cent) in the players' profit figures between the simulation of market power without merger (MP, no merger) and the simulation of perfect competition (PC).
Red shows the difference (in per cent) in the player profit figures between the simulations of market power with merger (MP, merger) and perfect competition.
And finally, yellow indicates the difference (in per cent) in the players' profit figures between the simulations of market power with merger and market power without merger.

The figure shows that all the players show a benefit from the exercise of market power, whether or not there is a merger. All the players see a higher increase in profit (in per cent) when exercising their market power following the merger than without the merger.

The Danish and German generators win the most (in per cent) through the exercise of market power, whether or not there is a merger, while the Norwegian, Swedish and Finnish generators see slightly lower increases (in per cent) in profits.

Corresponding to the results for week no. 3 in Figure 16, Figure 42 shows the change (in per cent) in the profit of the seven largest generators in week 32. As expected, the changes in profit (in per cent) in connection with the exercise of market power without mergers in comparison with perfect competition (blue columns) are smaller in week no. 32 than in week no. 3. The fact that the merger does not affect the week in summer is reflected in the yellow columns being virtually zero, while the red columns, which represent the difference between market power with a merger and perfect competition, are practically as high as the blue ones.

5.4 Analysis of Flow Maps

Four different hours from the week in winter (week no. 3) have been selected for further analysis of the differences between the simulations carried out of perfect competition, market power without mergers and market power following the merger.

The four hours are one daytime hour (day no. 1, hour no. 15), a night-time hour (day no. 2, hour no. 3), one hour (day no. 2, hour no. 18) during which the prices in the simulation of market power without mergers become particularly high in all price areas, and one hour (day no. 7, hour no. 4), in which a Danish generator has an incentive to exercise its market power.

Day no. 1, hour no. 15:
Figure 17 - Figure 19 show that in hour no. 15 on Monday, no bottlenecks are seen between the price areas in the three types of simulations. The same price is therefore calculated for the entire model area, with the exception of Germany North due to the cross-border tariff. The prices do, however, differ quite a lot from simulation to simulation. With perfect competition, the price is, for instance, approx. DKK 252/MWh throughout Scandinavia. In the simulation of market power without mergers, the price increases to DKK 287/MWh and in the simulation of market power with a merger, the price increases further to approx. DKK 448/MWh.

With perfect competition and with the exercise of market power without mergers, Norway is a net exporter of 73 MWh and 330 MWh, respectively. This changes significantly in the simulation of market power with merger where Norway becomes a net importer of 1,169 MWh. Norway receives a significant share of its imports from Denmark West, 828 MWh, of which 332 MWh are transit from Germany.

Prices and volumes exchanged thus illustrate that the merged generators have more incentives for exercising market power than they would have if acting independently. The market power is exercised by increasing the price of the production offered, which corresponds to withholding production.

A comparison of the supply curves for the generator in Denmark East in the simulations of perfect competition and the simulations of market power without mergers shows that the generator's offer in the market power simulation does not result in a reduction in (withholding of) production.

Day no. 2, hour no. 3:
The flow maps for this night-time hour between Monday and Tuesday in week no. 3 can be seen in Figure 20 - Figure 22. Bottlenecks are observed. With perfect competition, all the connections to Norway amount to bottlenecks because the price in Norway is higher than in the neighbouring areas. Bottlenecks are also seen between Norway and Sweden on the one hand and Denmark and Germany on the other.

In the simulation of market power without mergers, price increases are seen only in Denmark, Germany and Finland. The prices in these countries increase to a level

corresponding to the Swedish price, but without this leading to a material reduction in the considerable exchanges from South to North.

In the market power simulation, the price in Denmark East is being increased to just under the Swedish level, resulting in the bottleneck towards Sweden being maintained. The production of the generator in Denmark East is reduced by only 66 MWh. The simulations show that the price in Denmark East would have followed the level in Germany North (plus/minus cross-border tariffs) independently of the level of the mark-up by the Danish generator. This is because Denmark East has insufficient production capacity with low marginal costs.

The merger does not give the merged company greater incentives to exercise market power. For that particular hour, the results are the same, whether or not there is a merger.

Day no. 2, hour no. 18:
For this hour, a relatively high price has been calculated in the simulation of market power without mergers as compared with most other daytime hours in week no. 3. Hours with such high prices are seen when the price with perfect competition is also high.

It is deemed that for certain hours the model finds an alternative Nash equilibrium in simulations of market power without mergers.

Figure 23 - Figure 25 show flow maps for the hour in question. Very few bottlenecks are seen in the three types of simulation. The variation in exchanges between the simulations is deemed to be attributable to the interplay between generators.

Day no. 7, hour no. 4:
A decision has been made to present the results from this hour because the price in Denmark East is to a larger extent determined by the generator here than can be seen from the results of the hours presented earlier.

In the situation with market power without the merger, the generator in Denmark East could have decided to keep the price below the level in Germany North of DKK 160/MWh + DKK 10/MWh (cross-border tariff), thereby avoiding significant imports from Germany North, cf. Figure 26 - Figure 27. Instead, the generator decides to increase the price considerably to match the Swedish level of DKK 206/MWh. The generator's production is consequently reduced by approx. 800 MWh, while the company's profit increases by approx. 50 per cent for the hour in question compared to perfect competition.

5.5 Elasticity of Demand

In all the simulations made, a demand elasticity of –0.1 of the wholesale price has been used. The present analysis thus does not include an assessment of the sensitivity of results to elasticity. However, on the basis of simulations carried out previously in connection with Eltra's seminar on MARS in April 2003, it is deemed that a more elastic demand dampens the incentive to exercise market power. Refer to Eltra doc. no. 2003-122.

Initial calculations have shown that the considerable price increase seen in week no. 3 as a result of the exercise of market power and the merger is not typical for the winter months, but is seen because demand is particularly high in Norway. Thus, simulations incorporating greater flexibility of demand would be expected to reduce the significance of the merger, or possibly eliminate it.

Results from simulation of week no. 3, 2005 (winter):

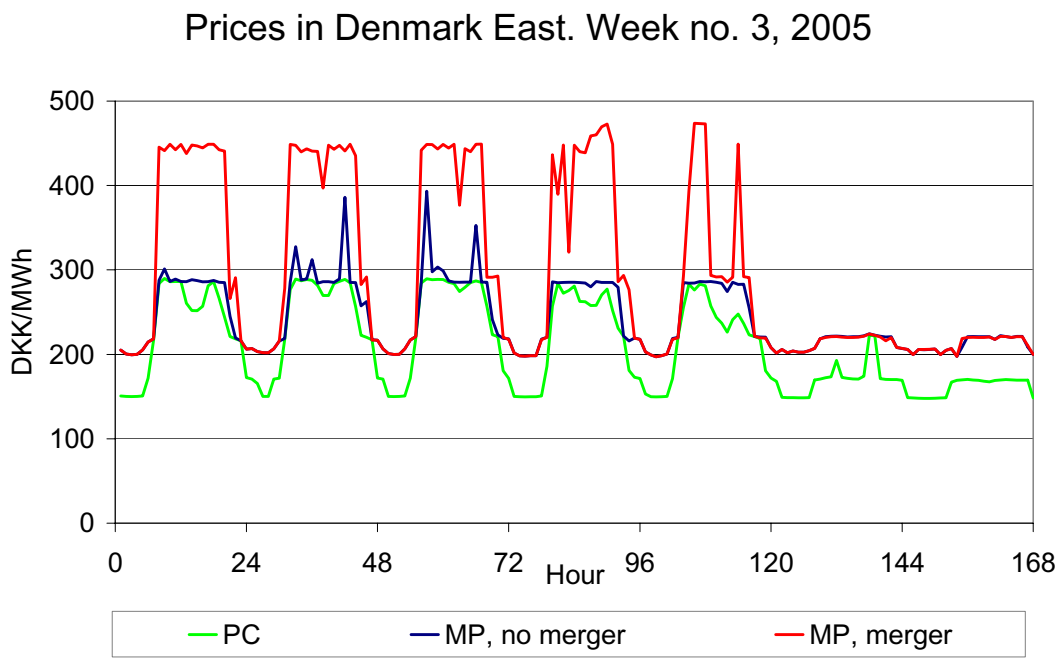


Figure 2 Prices in Denmark East in week no. 3, 2005 (winter).

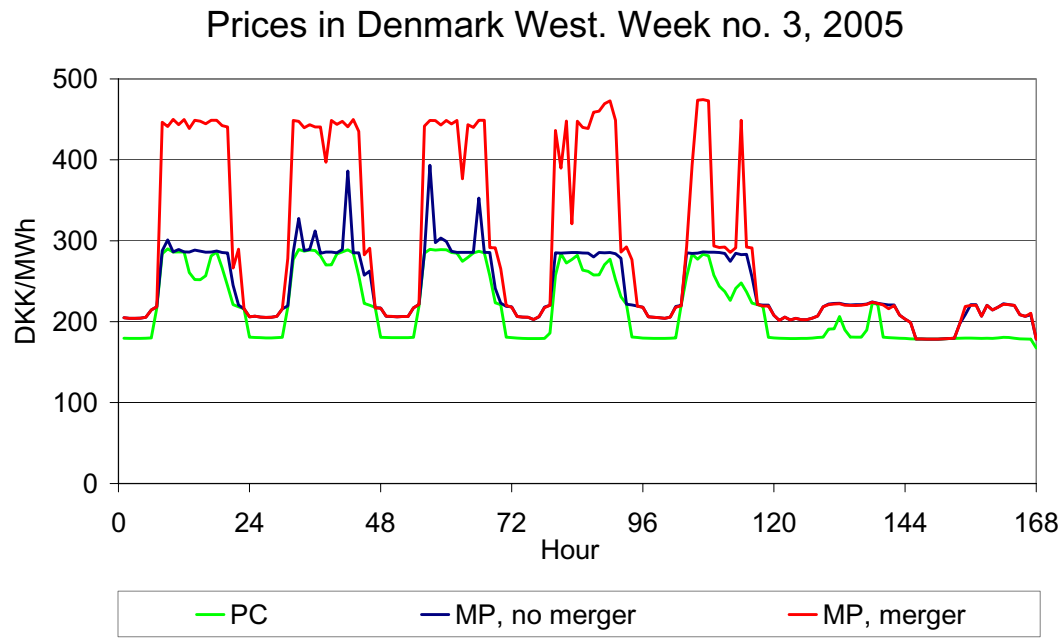


Figure 3 Prices in Denmark West in week no. 3, 2005 (winter).

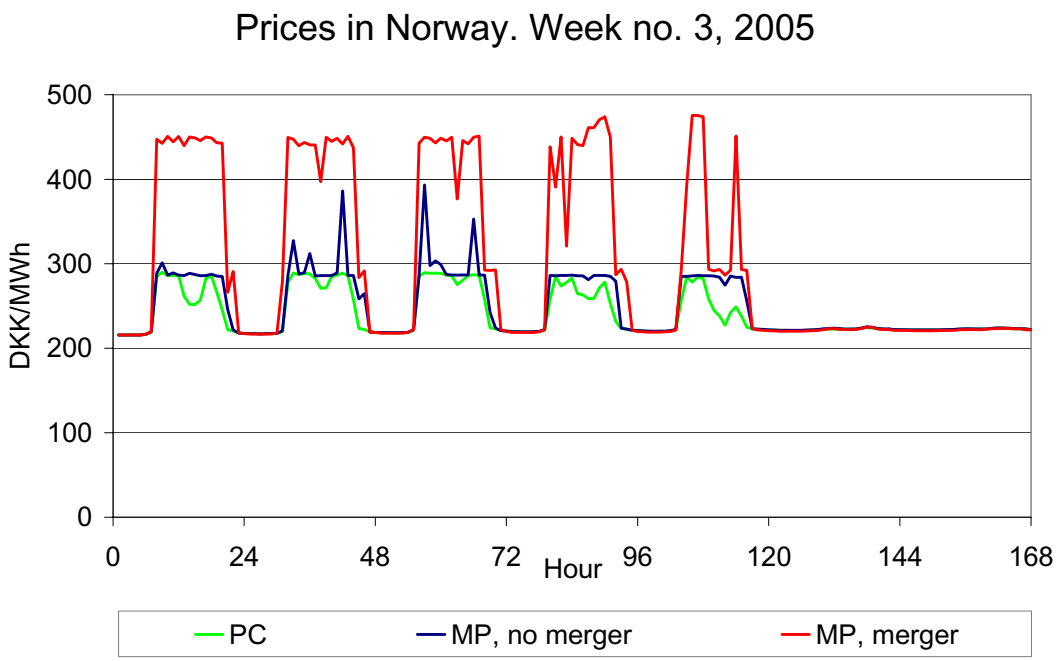


Figure 4 *Prices in Norway in week no. 3, 2005 (winter).*

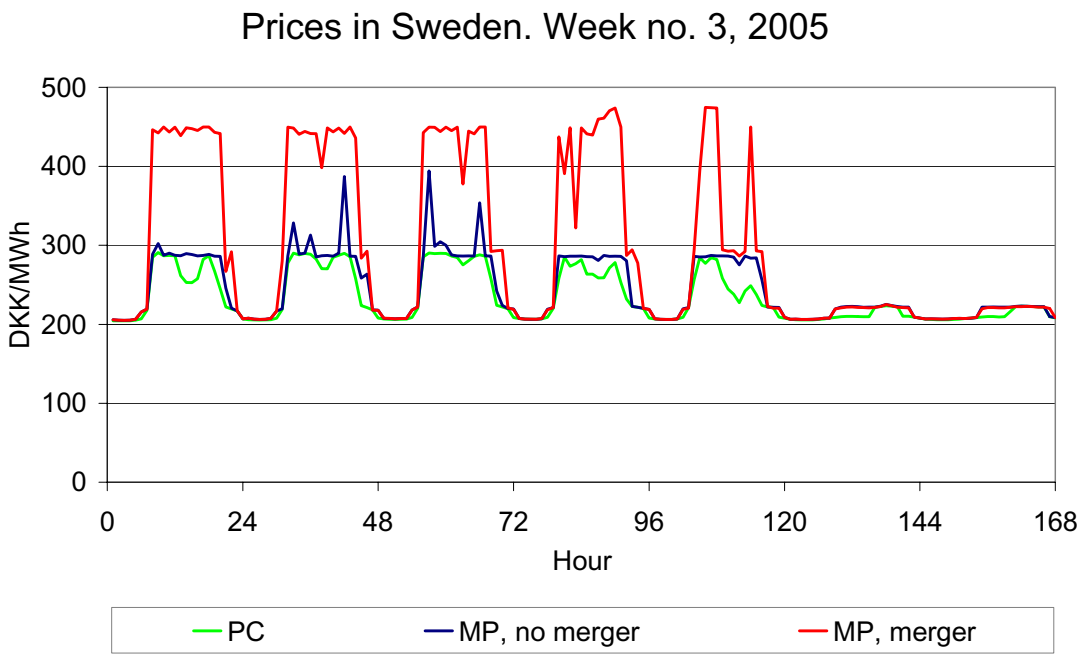


Figure 5 *Prices in Sweden in week no. 3, 2005 (winter).*

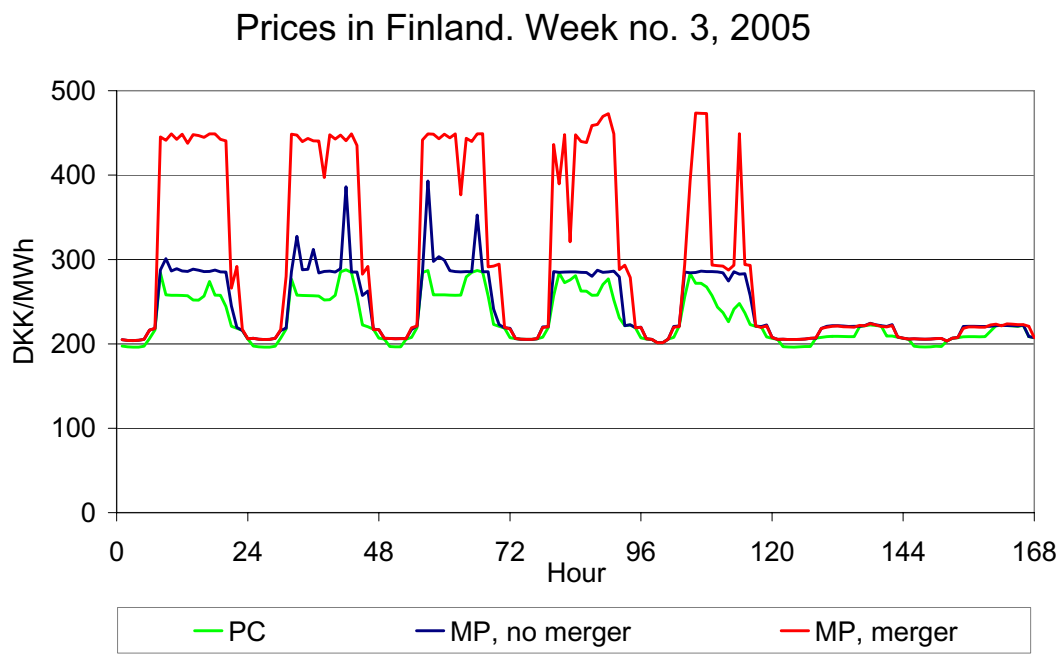


Figure 6 Prices in Finland in week no. 3, 2005 (winter).

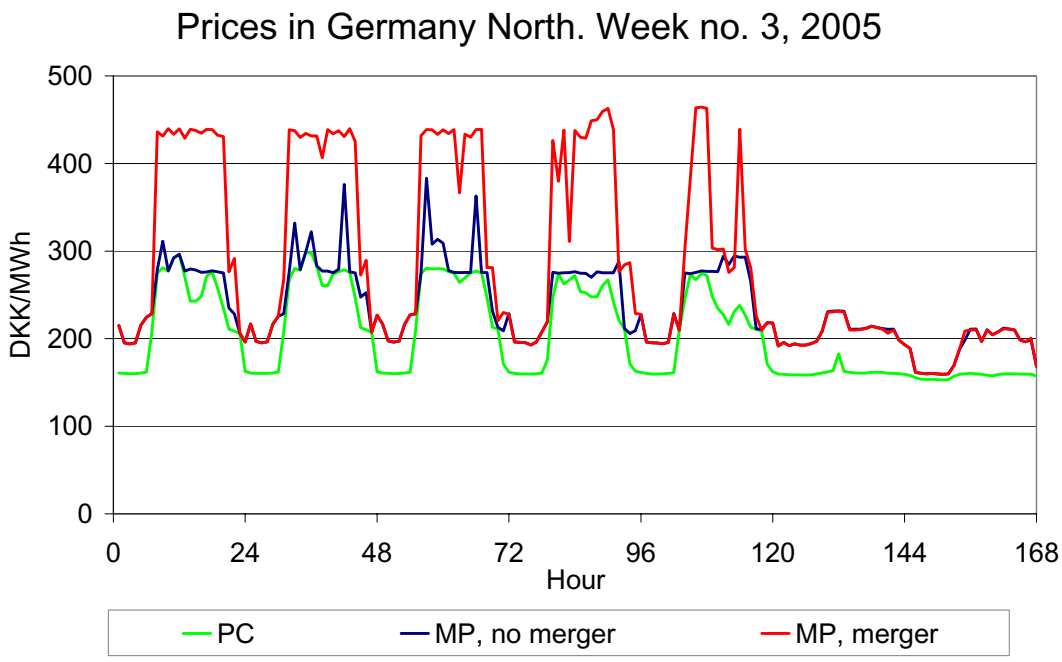


Figure 7 Prices in Germany North in week no. 3, 2005 (winter).

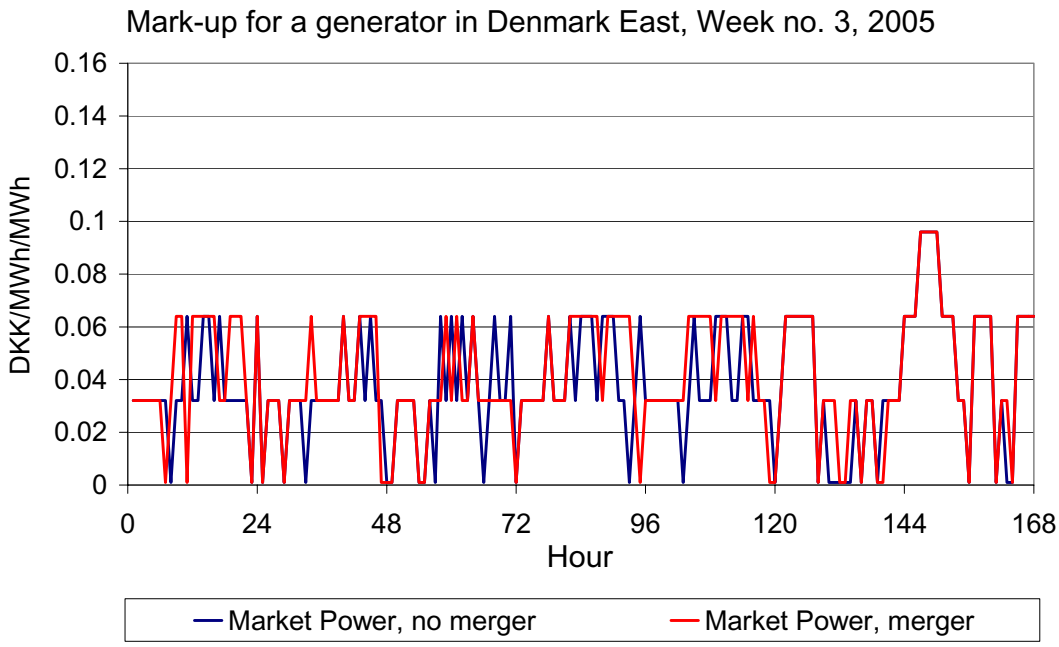


Figure 8 *Mark-up of dispatchable production of a generator in Denmark East. Week no. 3, 2005 (winter).*

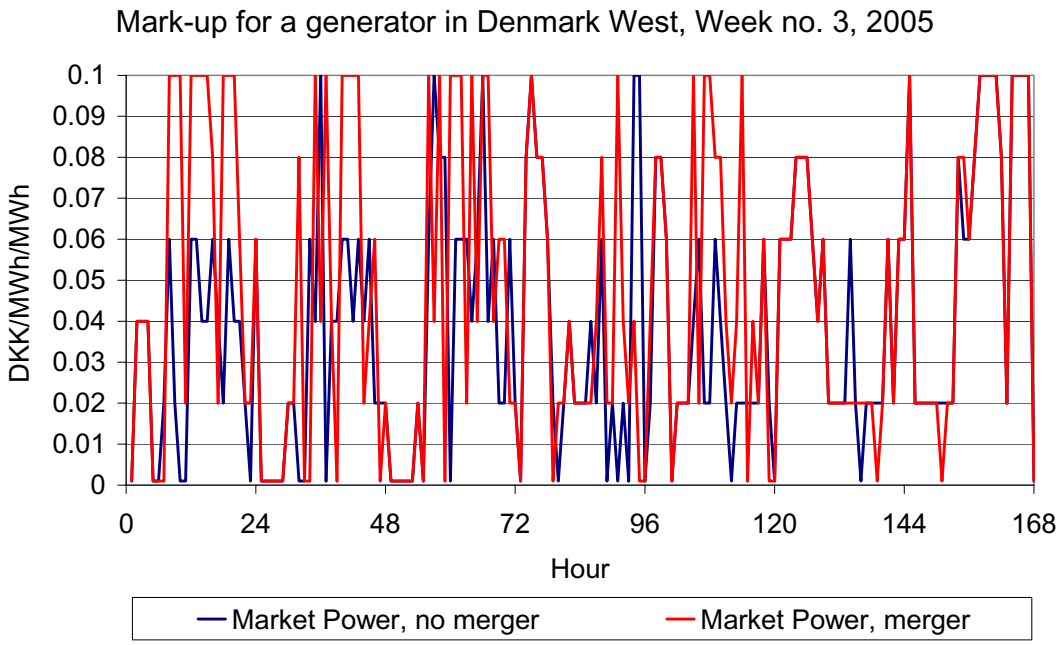


Figure 9 *Mark-up of dispatchable production of a generator in Denmark West. Week no. 3, 2005 (winter).*

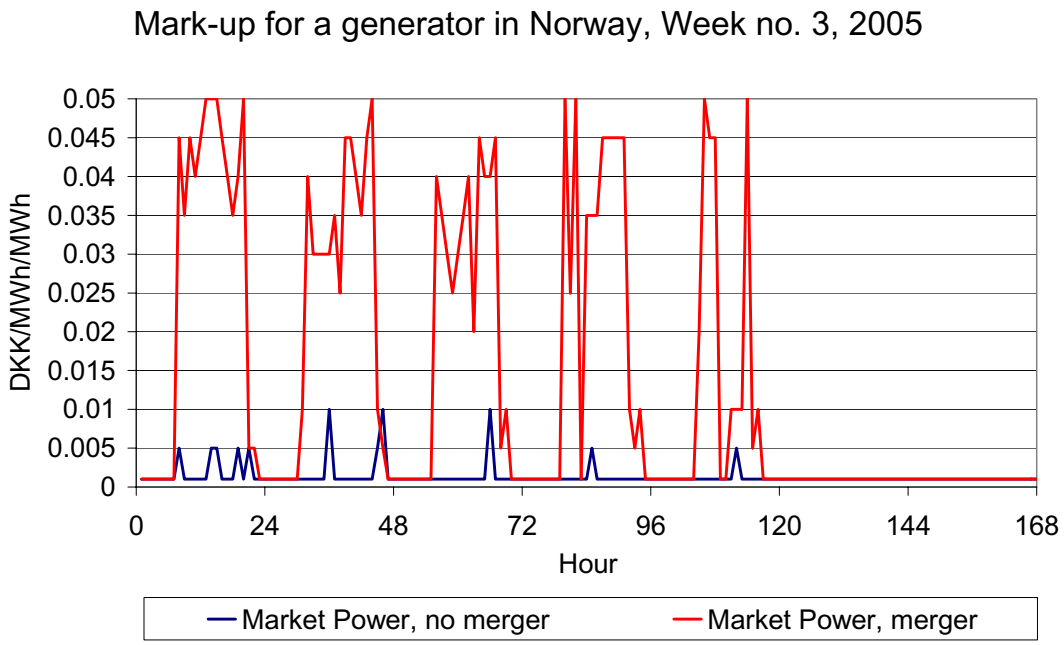


Figure 10 *Mark-up of dispatchable production of a generator in Norway. Week no. 3, 2005 (winter).*

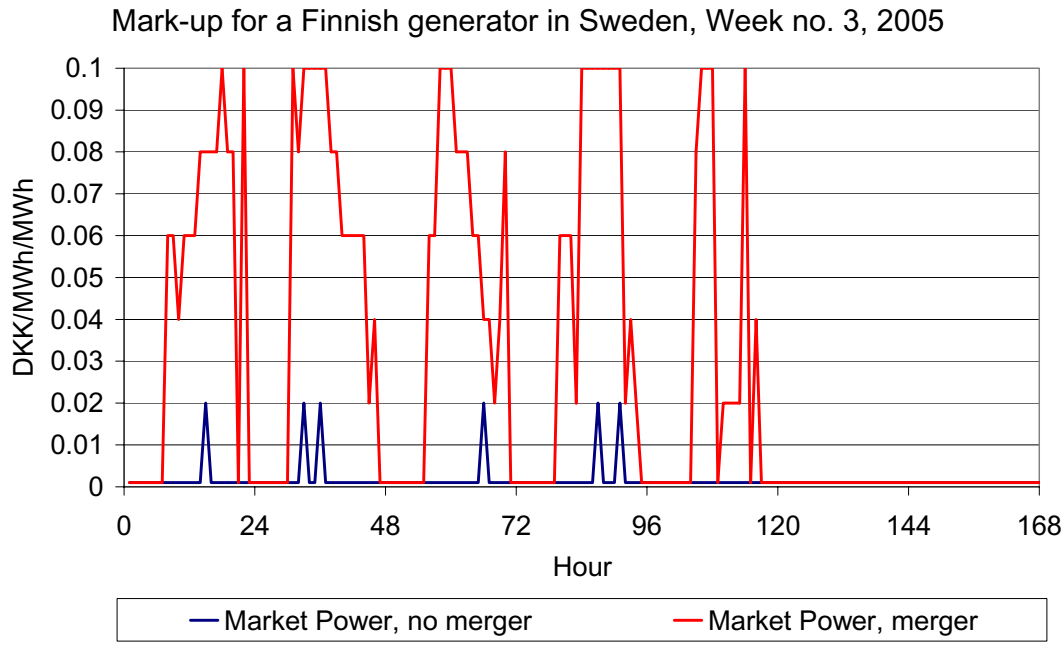


Figure 11 *Mark-up of dispatchable production of a Finnish generator in Sweden. Week no. 3, 2005 (winter).*

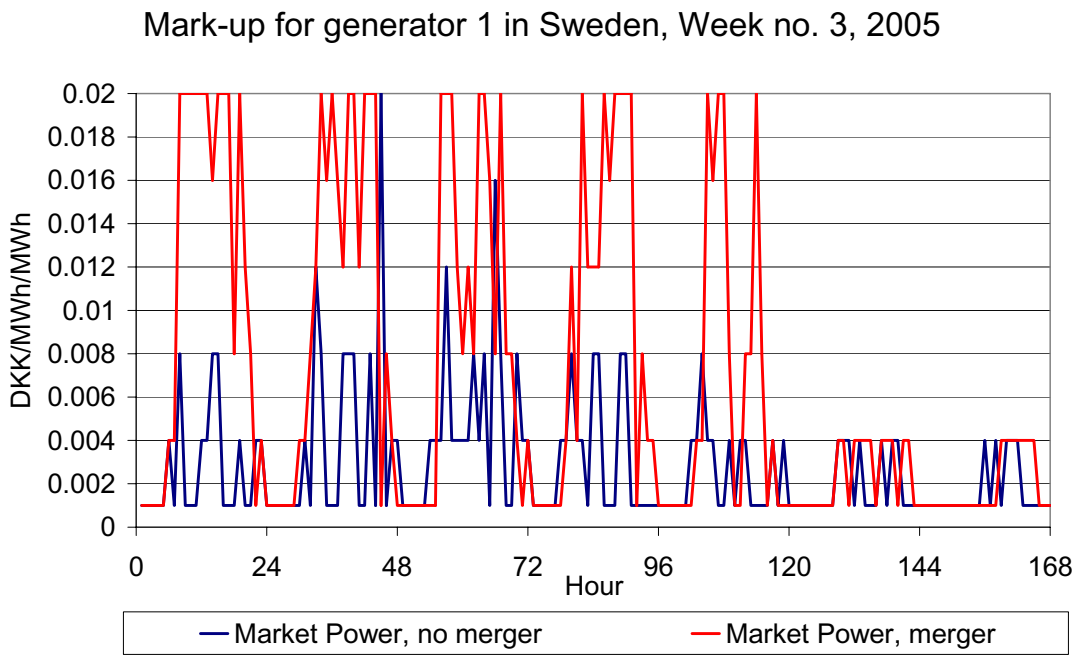


Figure 12 *Mark-up of dispatchable production of generator 1 in Sweden (18% ownership of production capacity in Sweden). Week no. 3, 2005 (winter).*

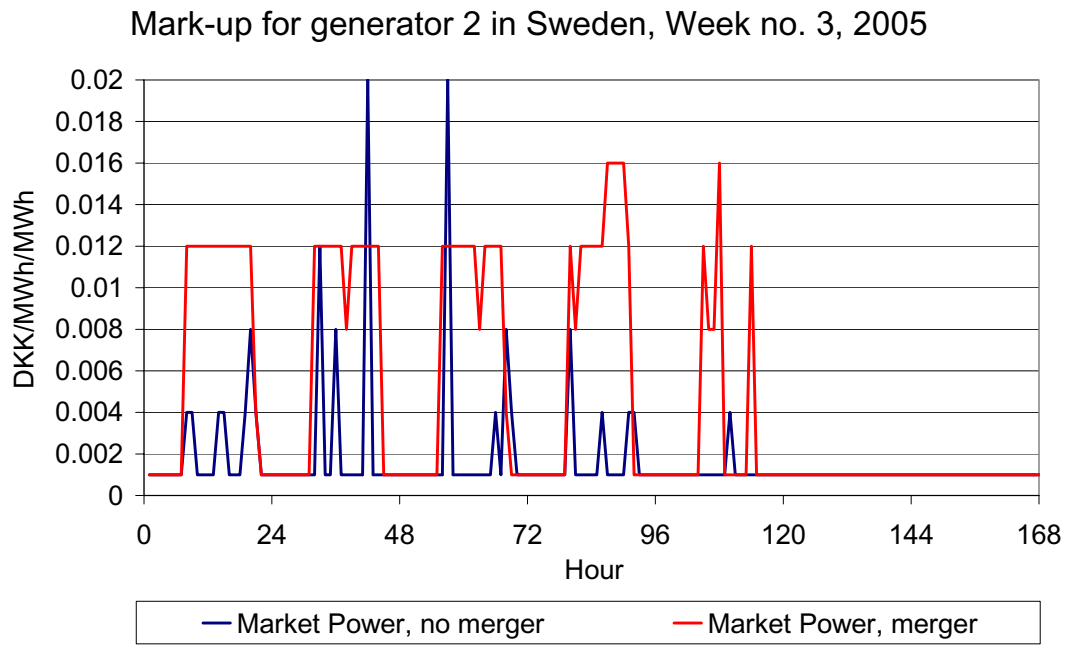


Figure 13 *Mark-up of dispatchable production of generator 2 in Sweden (53% ownership of production capacity in Sweden) . Week no. 3, 2005 (winter).*

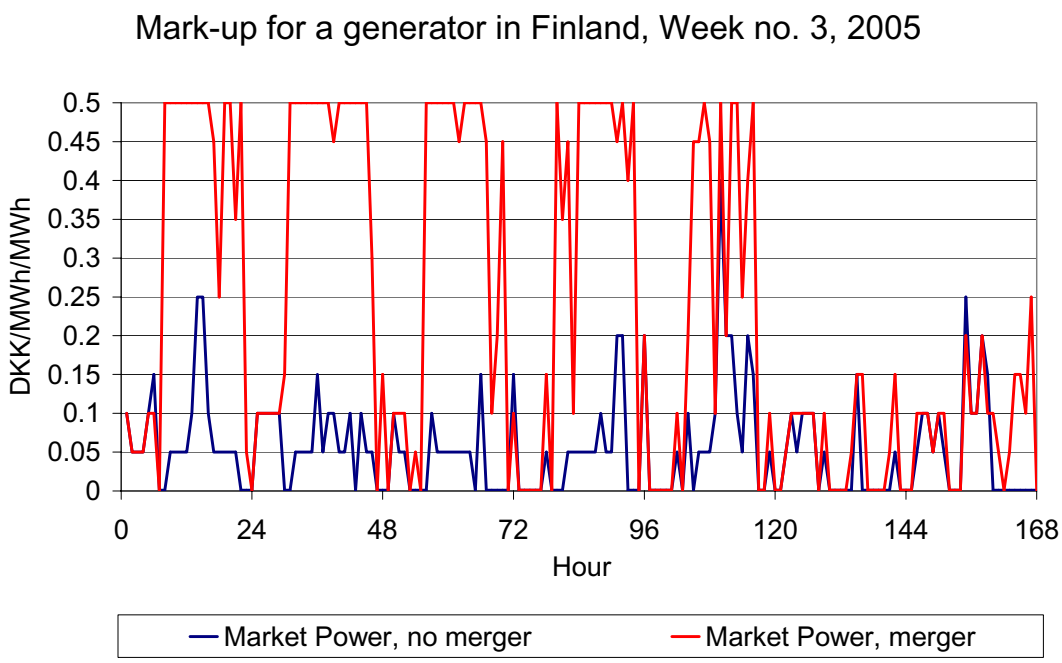


Figure 14 *Mark-up of dispatchable production of a generator in Finland. Week no. 3, 2005 (winter).*

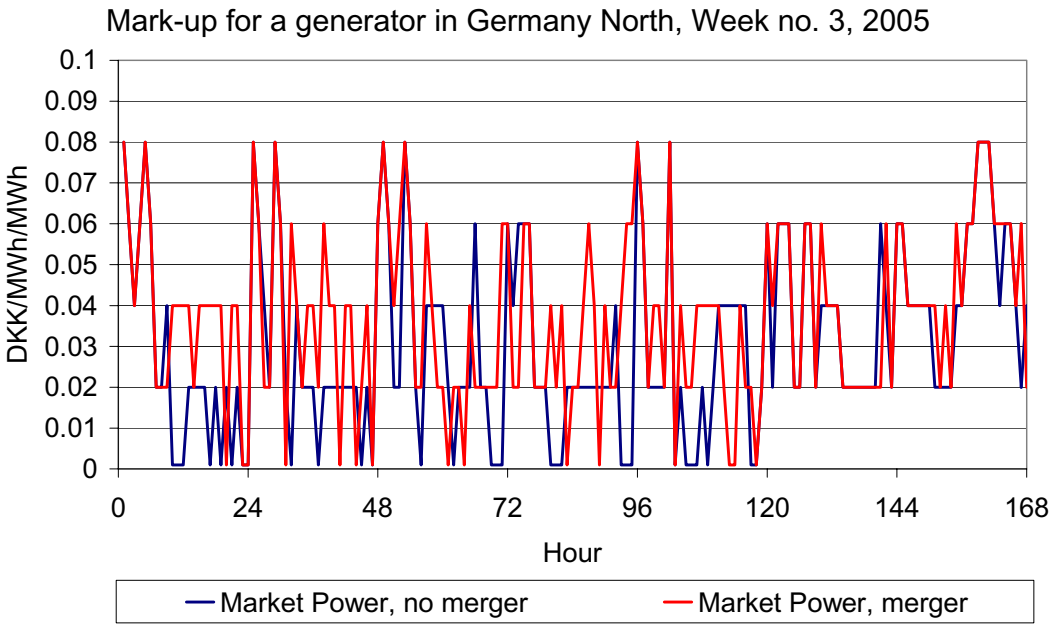


Figure 15 *Mark-up of dispatchable production of a generator in Germany North. Week no. 3, 2005 (winter).*

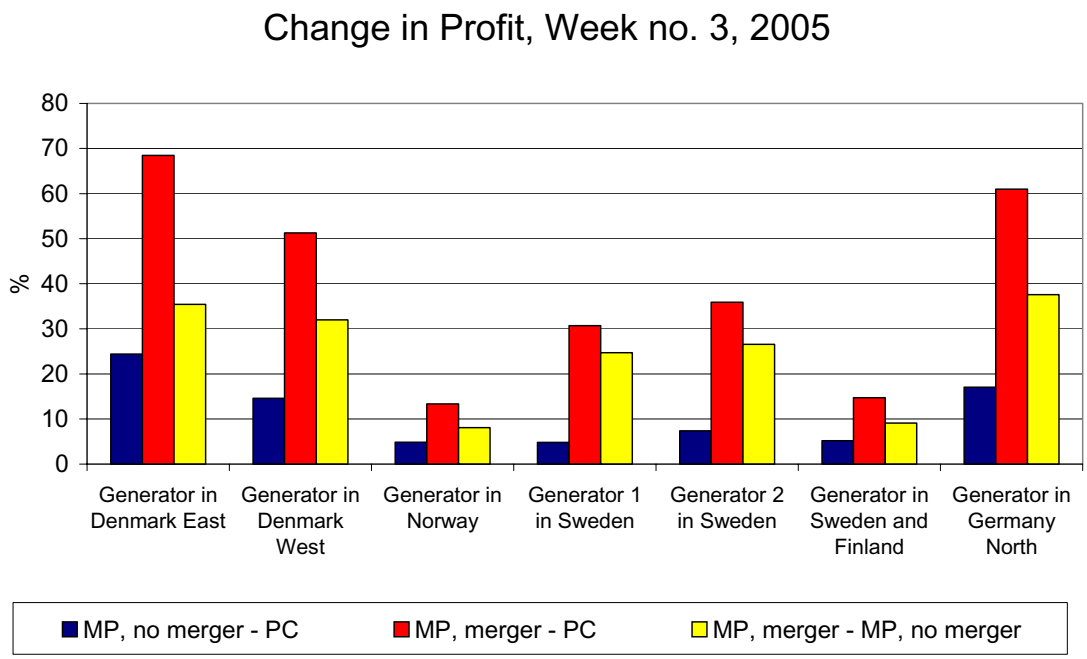


Figure 16 Profit changes due to market power and merger. Week no. 3, 2005 (winter).

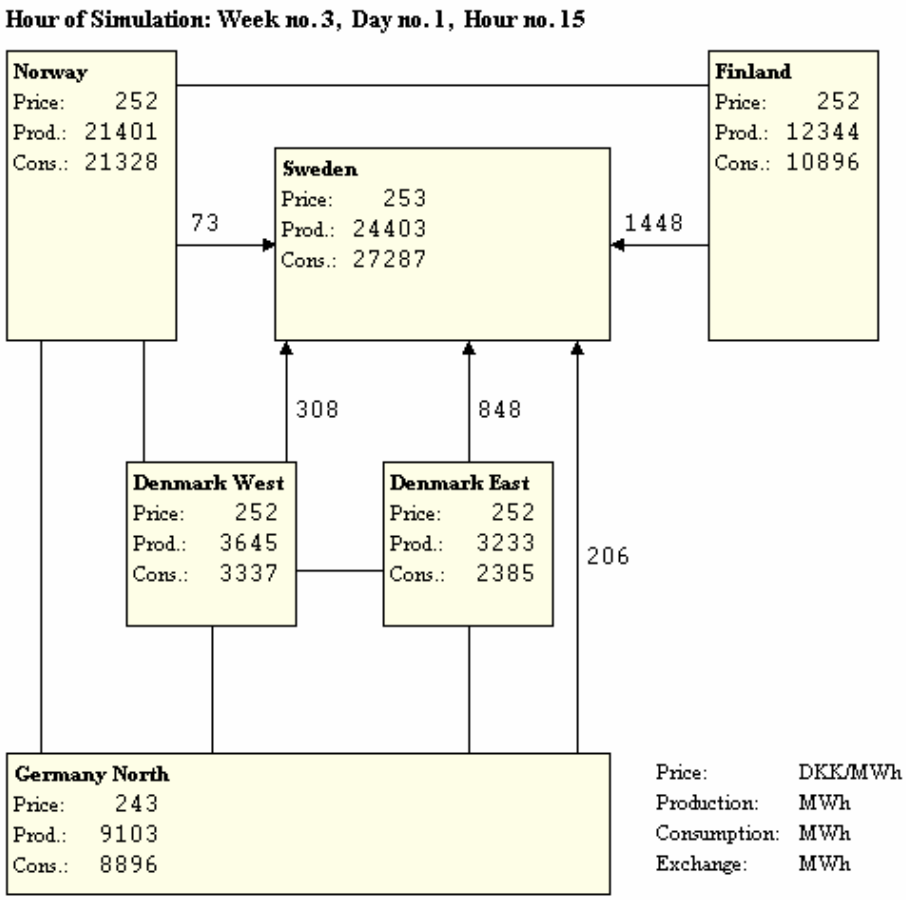


Figure 17 Flow map with results from perfect competition simulation. Winter 2005, week no. 3, day no. 1, hour no. 15.

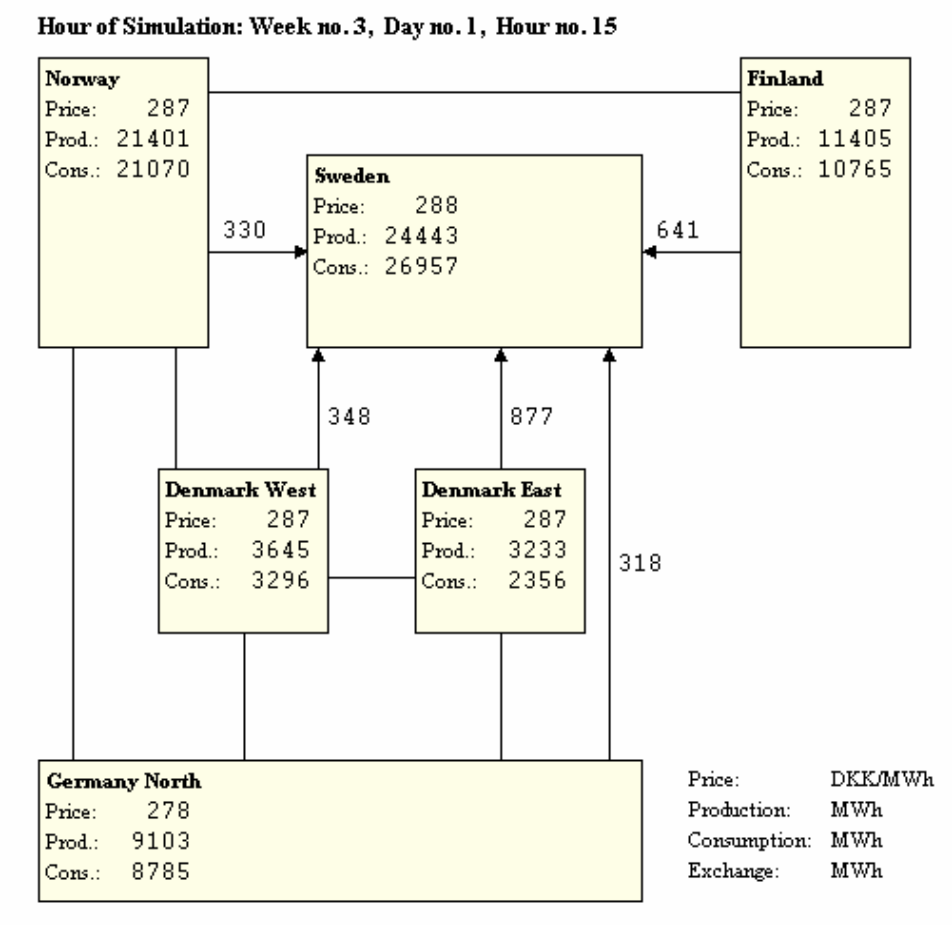


Figure 18 Flow map with results from market power simulation. Winter 2005, week no. 3, day no. 1, hour no. 15.

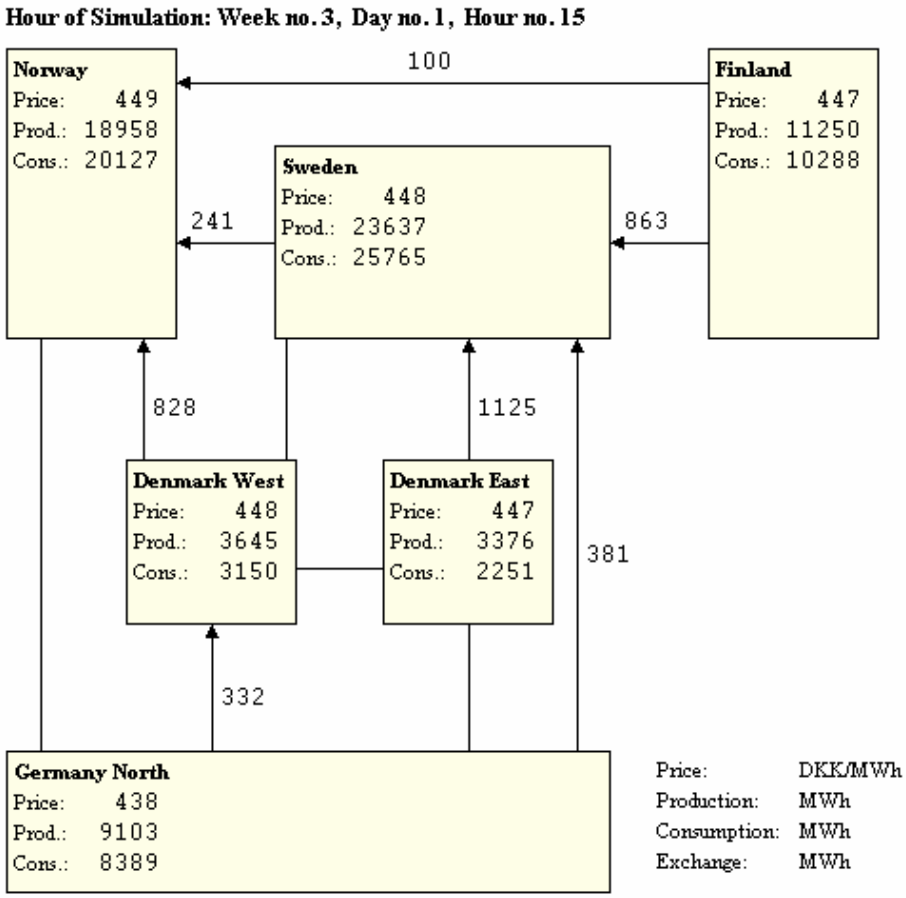


Figure 19 Flow map with results from simulation of merger. Winter 2005, week no. 3, day no. 1, hour no. 15.

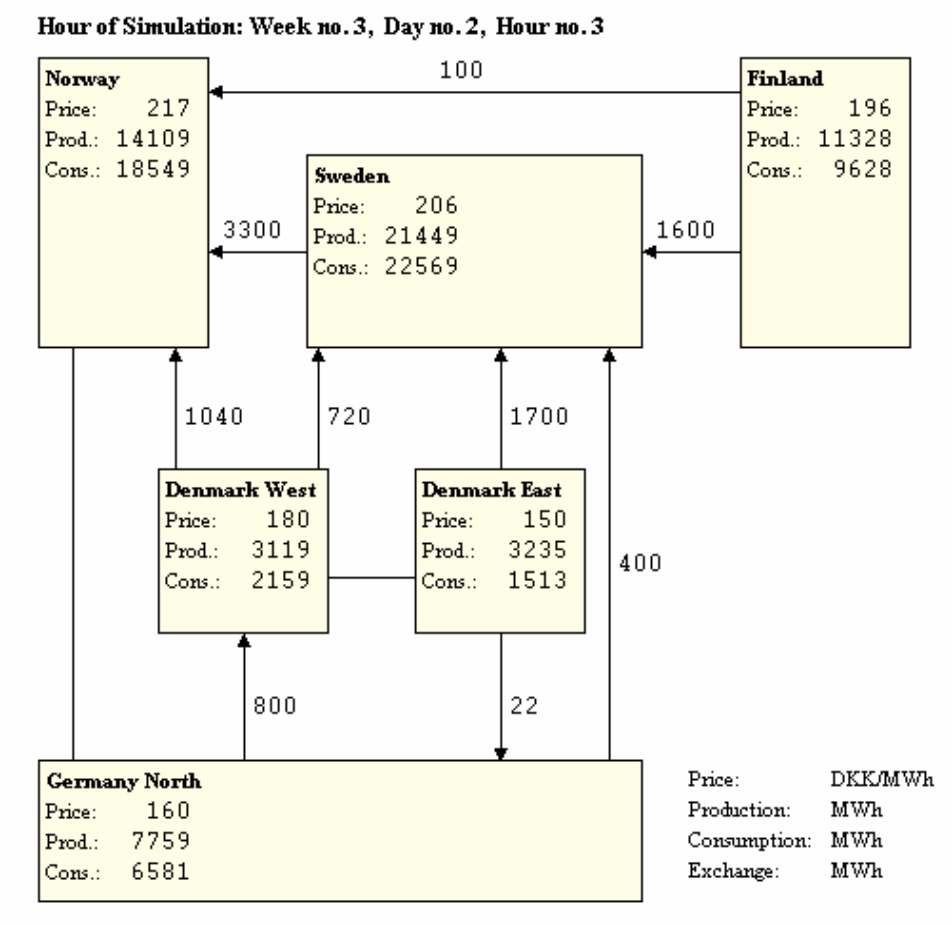


Figure 20 Flow map with results from perfect competition simulation. Winter 2005, week no. 3, day no. 2, hour no. 3.

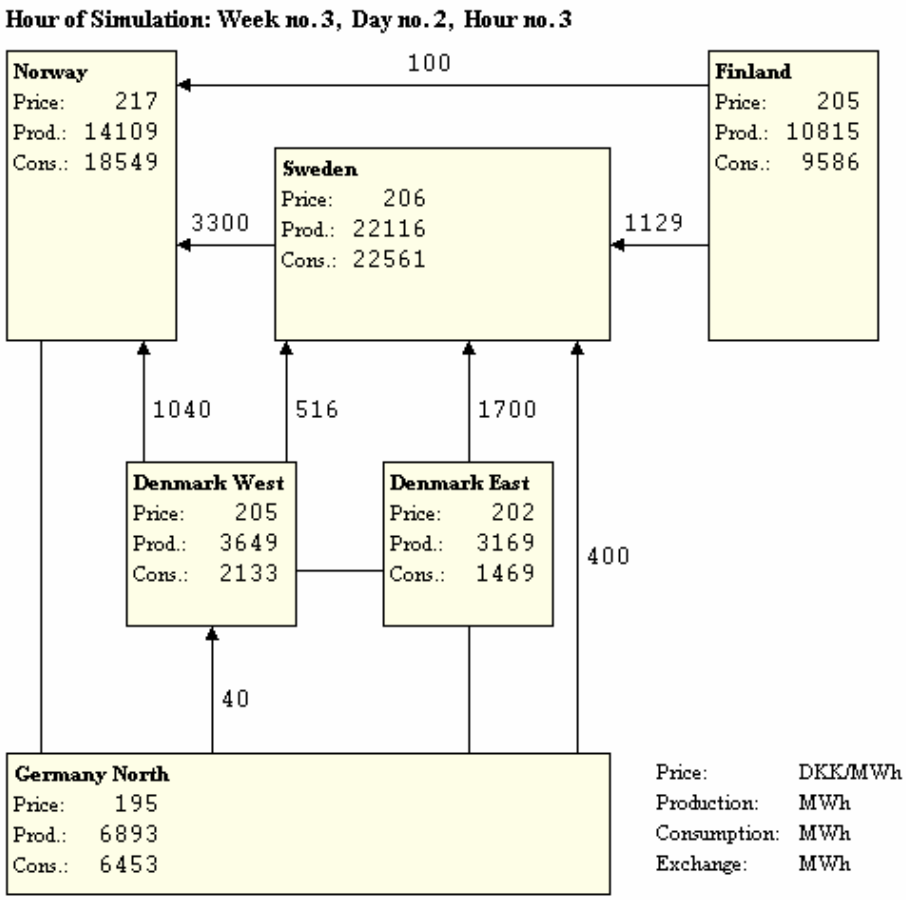


Figure 21 Flow map with results from market power simulation. Winter 2005, week no. 3, day no. 2, hour no. 3.

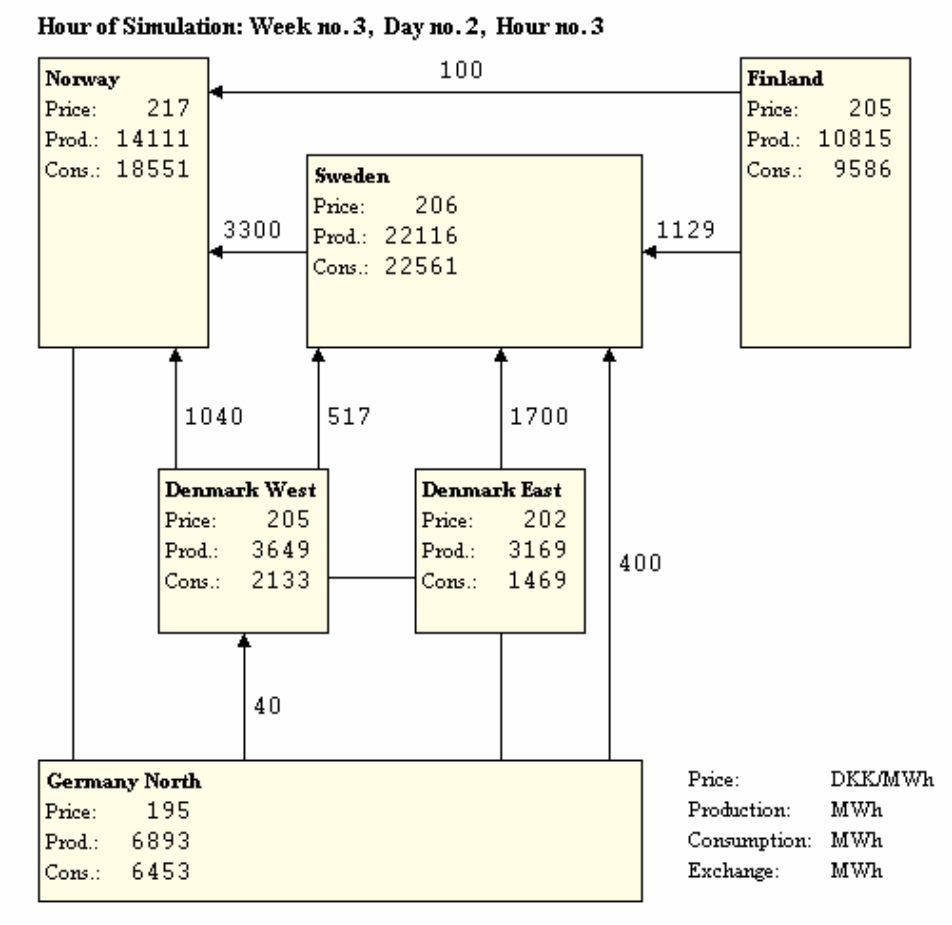


Figure 22 Flow map with results from simulation of merger. Winter 2005, week no. 3, day no. 2, hour no. 3.

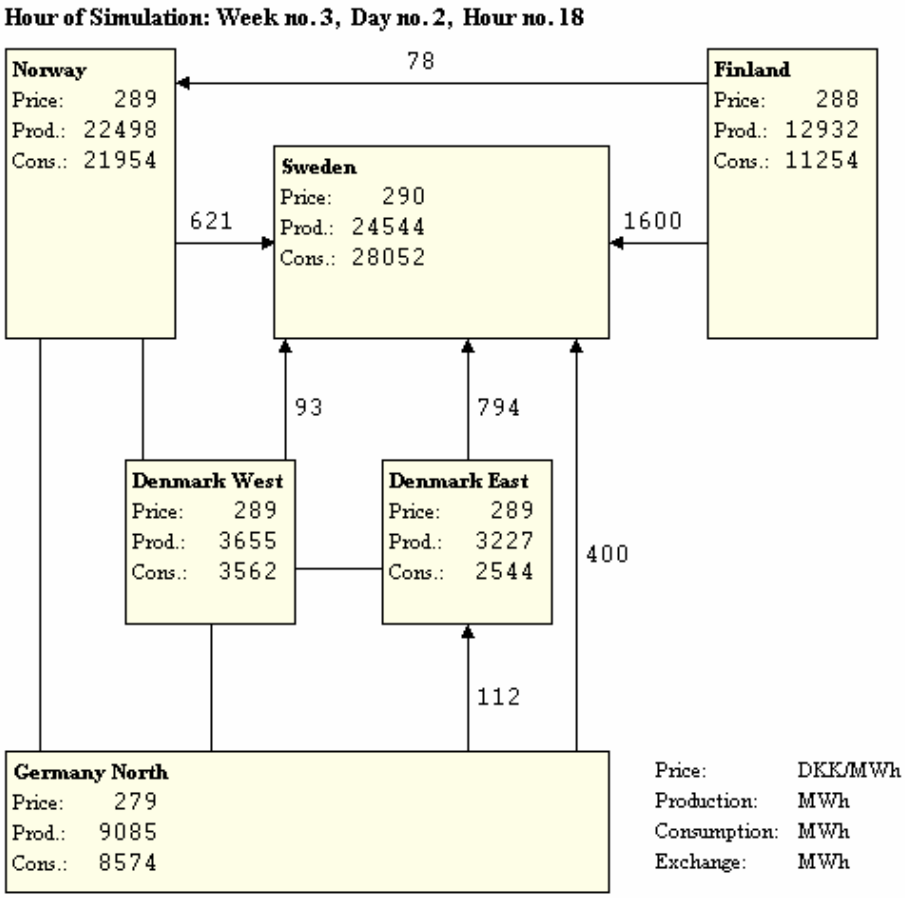


Figure 23 Flow map with results from perfect competition simulation. Winter 2005, week no. 3, day no. 2, hour no. 18.

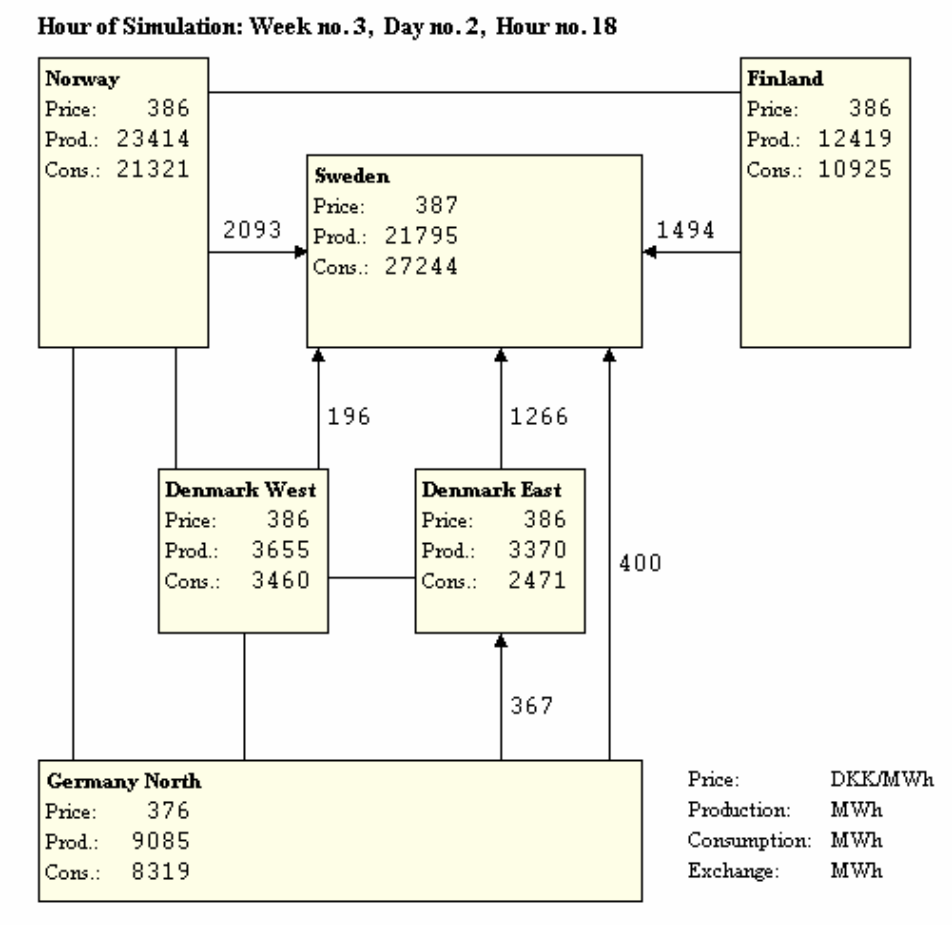


Figure 24 Flow map with results from market power simulation. Winter 2005, week no. 3, day no. 2, hour no. 18.

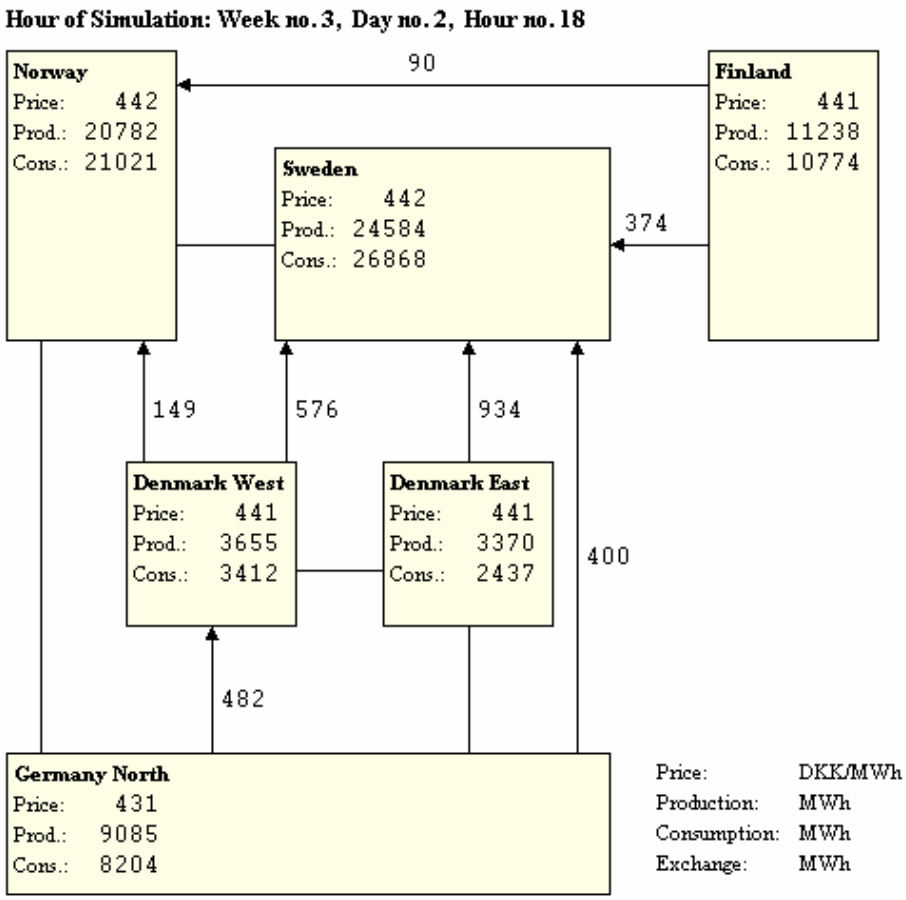


Figure 25 Flow map with results from simulation of merger. Winter 2005, week no. 3, day no. 2, hour no. 18.

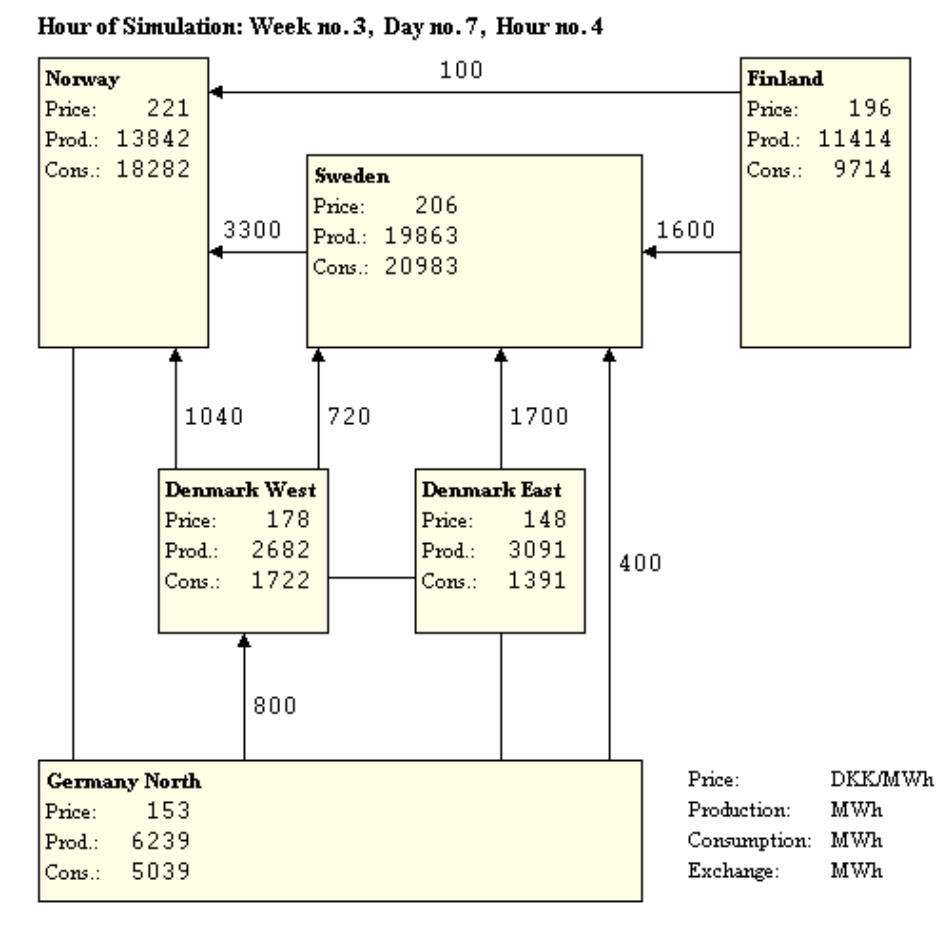


Figure 26 Flow map with results from simulation of perfect competition. Winter 2005, week no. 3, day no. 7, hour no. 4.

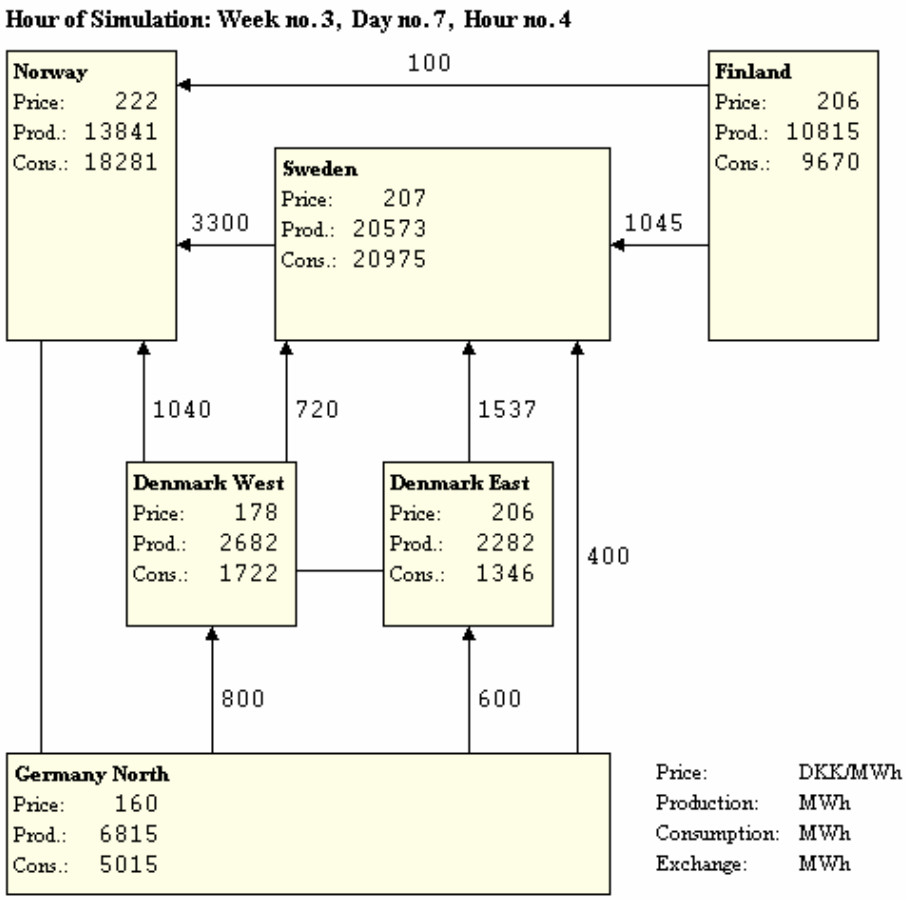


Figure 27 Flow map with results from simulation of market power without merger. Winter 2005, week no. 3, day no. 7, hour no. 4.

Results from simulation of week no. 32, 2005 (summer):

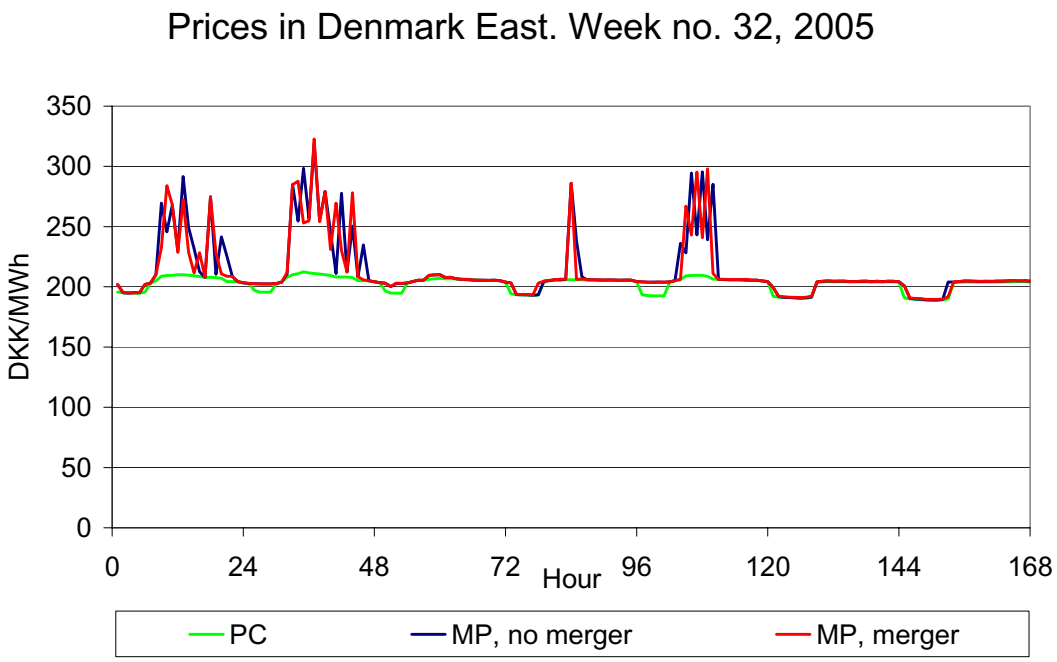


Figure 28 Prices in Denmark East in week no. 32, 2005 (summer).

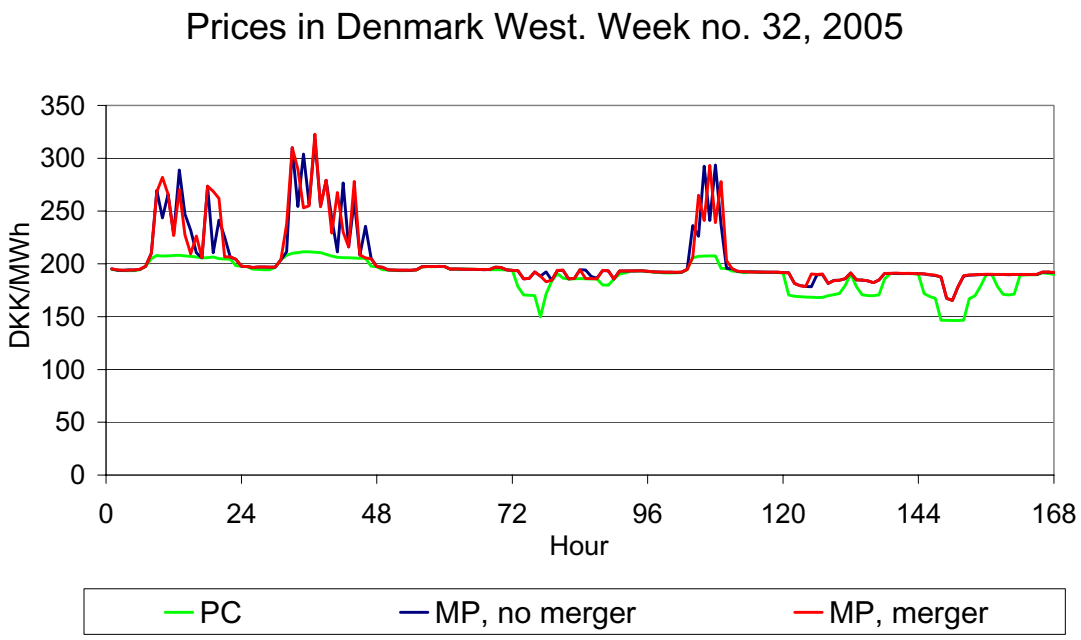


Figure 29 Prices in Denmark West in week no. 32, 2005 (summer).

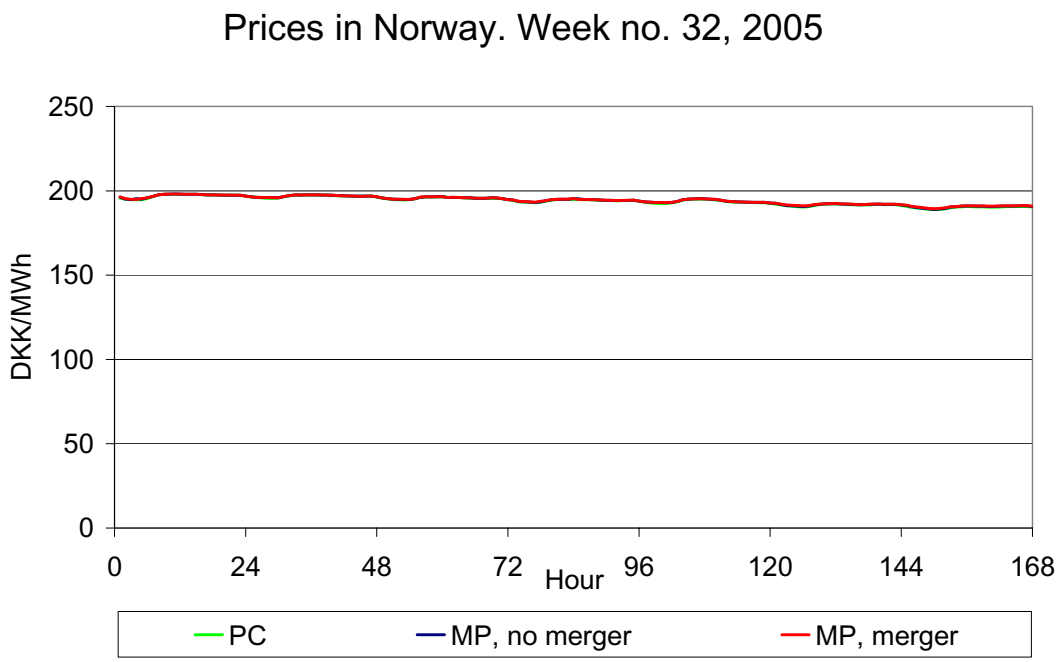


Figure 30 Prices in Norway in week no. 32, 2005 (summer).

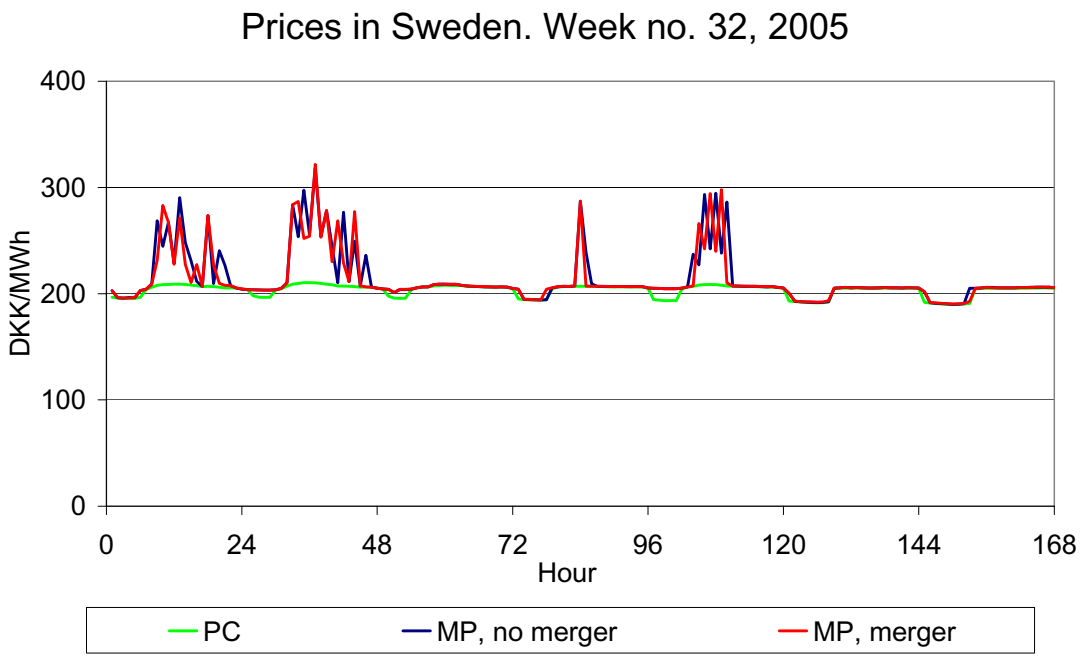


Figure 31 Prices in Sweden in week no. 32, 2005 (summer).

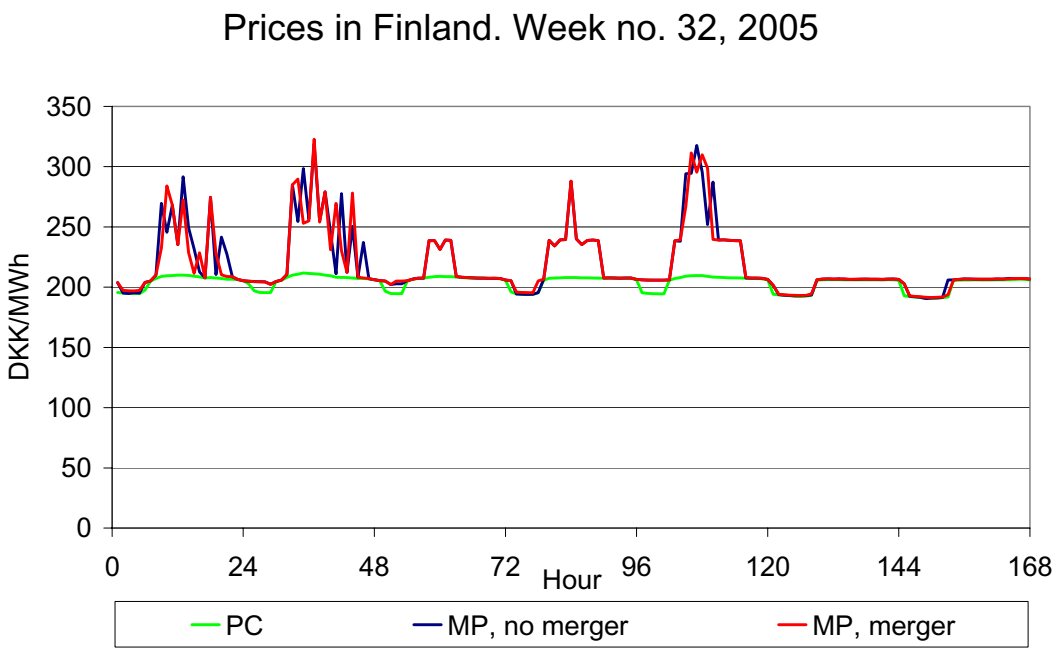


Figure 32 Prices in Finland in week no. 32, 2005 (summer).

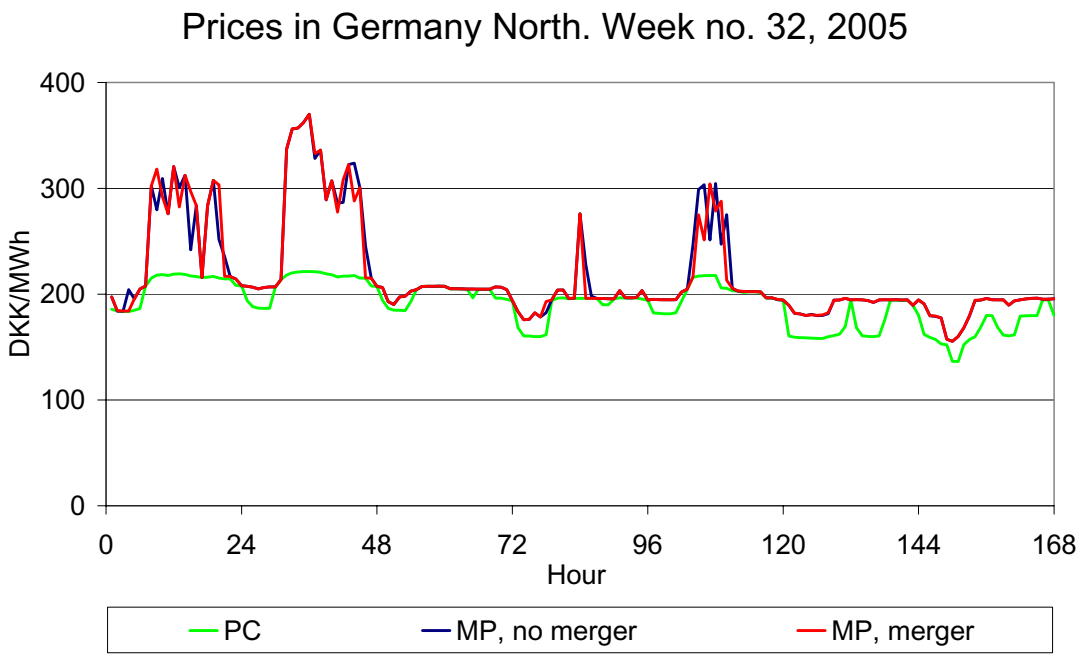


Figure 33 Prices in Germany North in week no. 32, 2005 (summer).

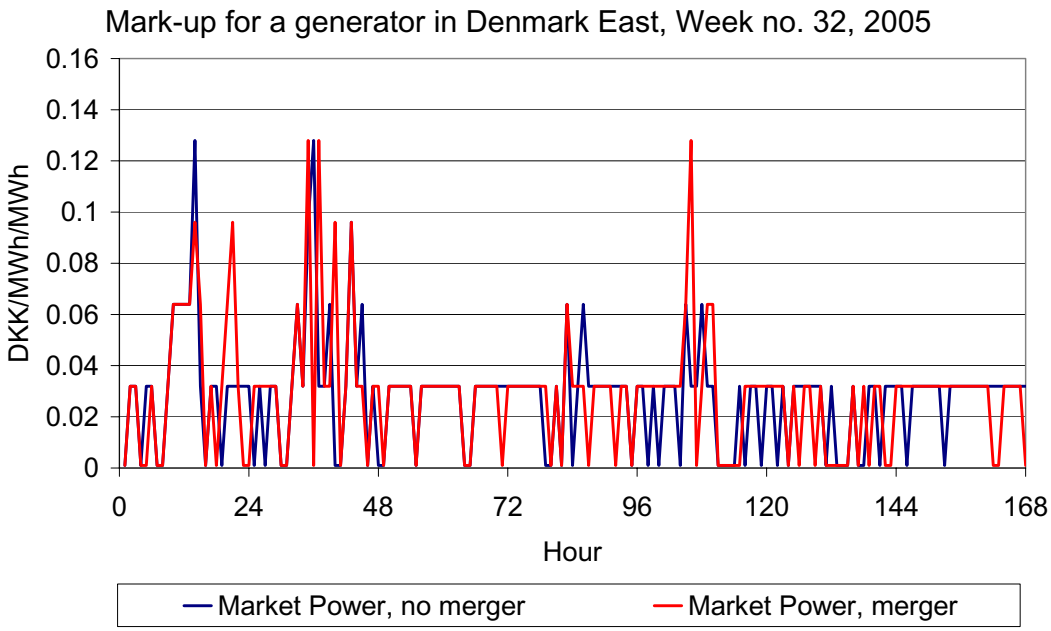


Figure 34 *Mark-up of dispatchable production of a generator in Denmark East. Week no. 32, 2005 (summer).*

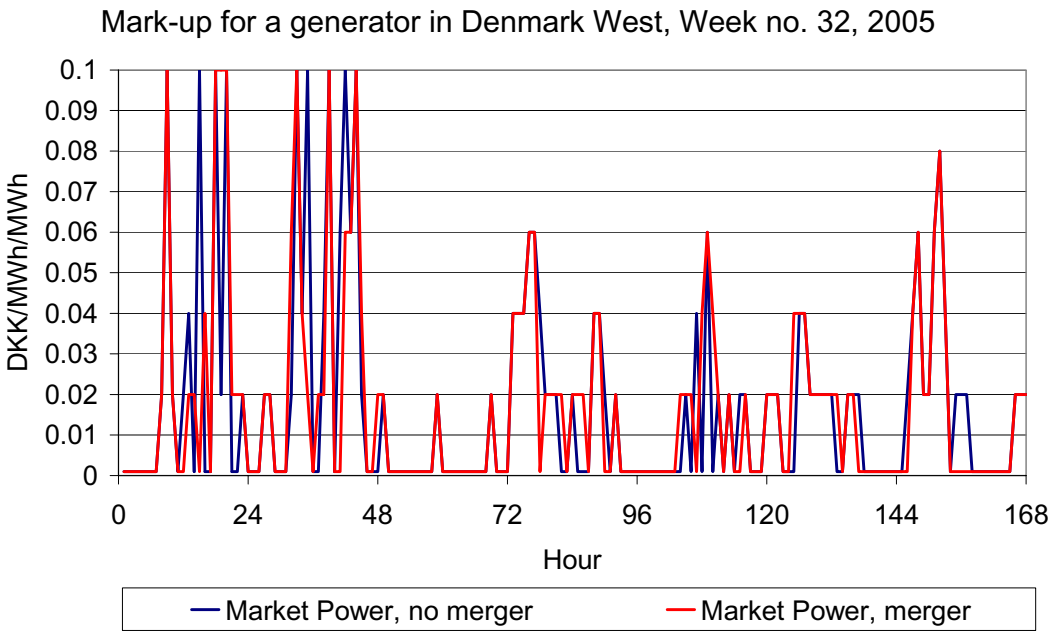


Figure 35 *Mark-up of dispatchable production of a generator in Denmark West. Week no. 32, 2005 (summer).*

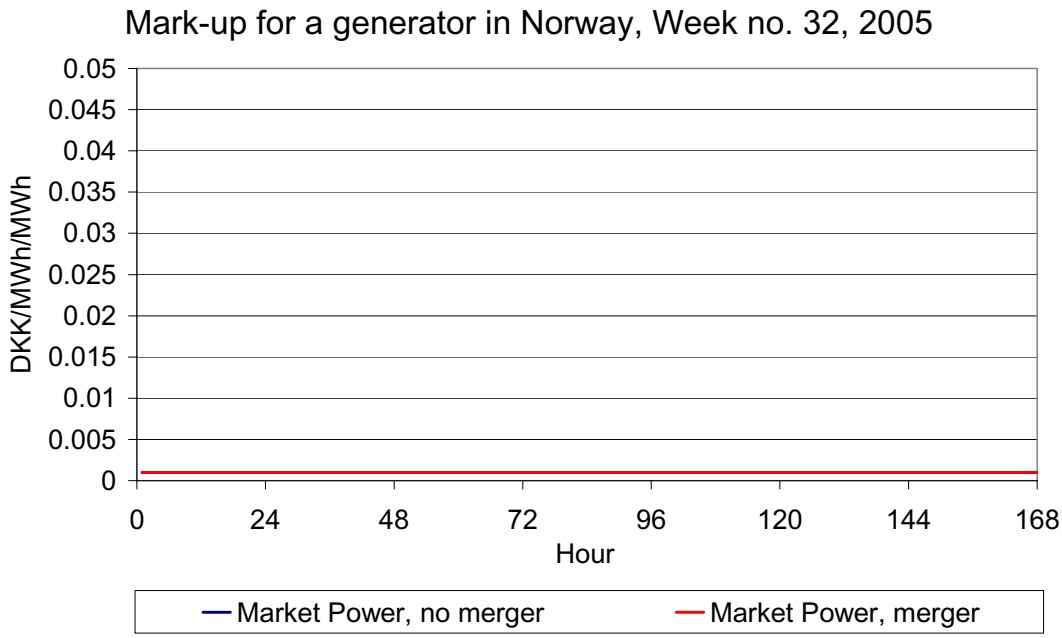


Figure 36 *Mark-up of dispatchable production of a generator in Norway. Week no. 32, 2005 (summer).*

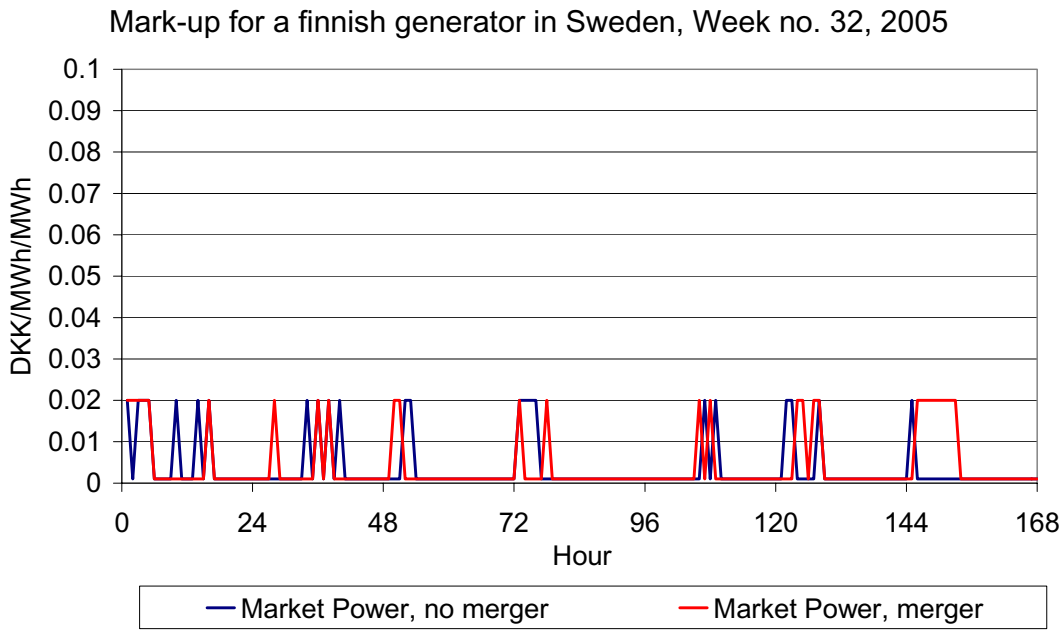


Figure 37 *Mark-up of dispatchable production of a Finnish generator in Sweden. Week no. 32, 2005 (summer).*

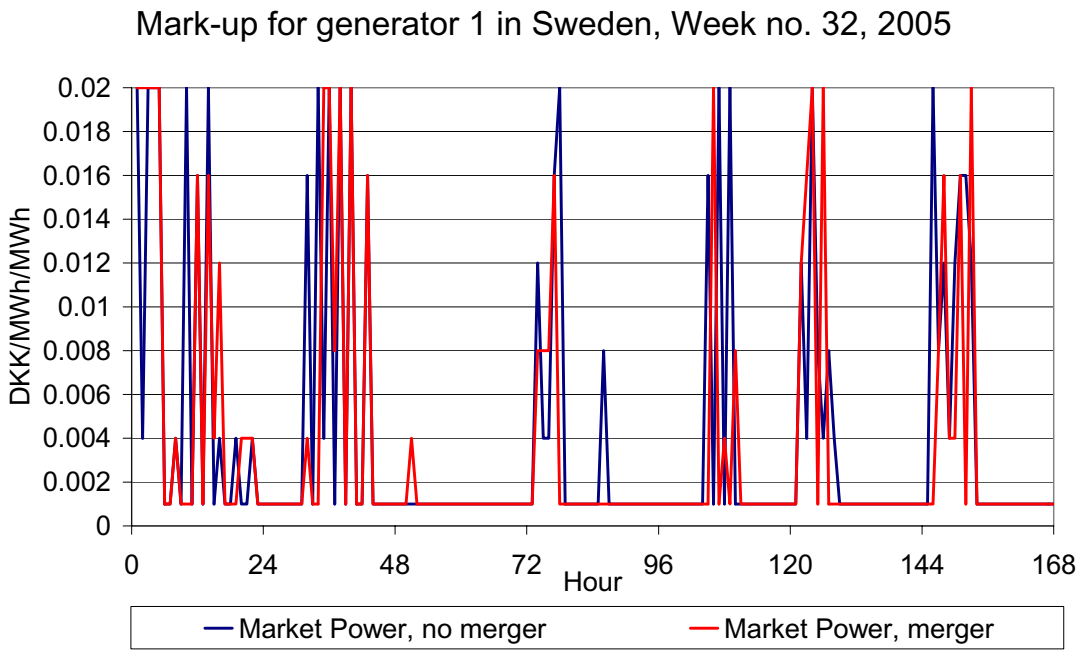


Figure 38 *Mark-up of dispatchable production of generator 1 in Sweden. Week no. 32, 2005 (summer).*

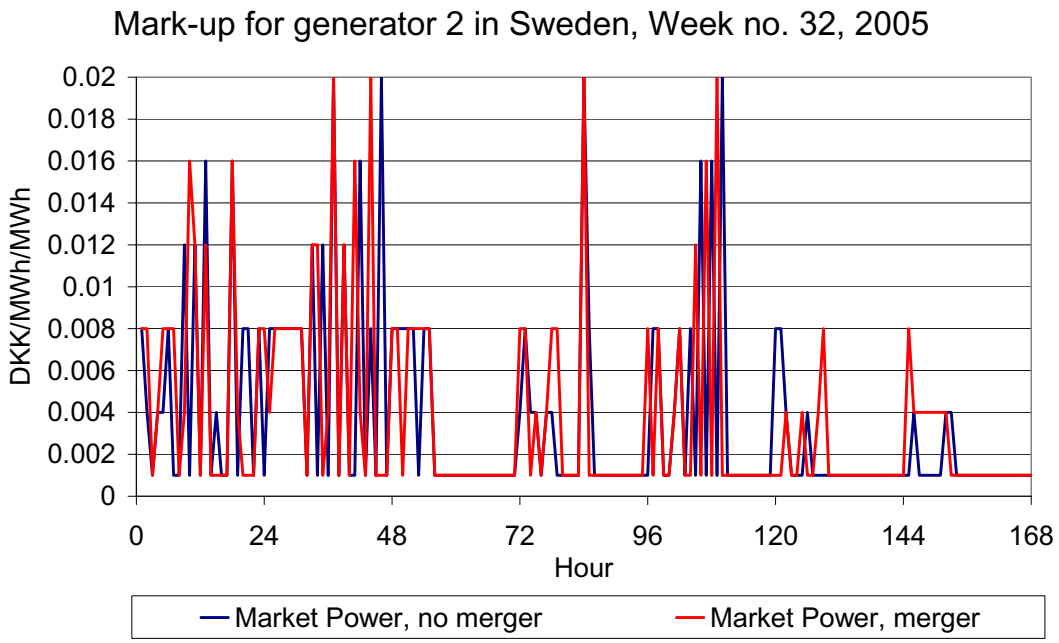


Figure 39 *Mark-up of dispatchable production of generator 2 in Sweden. Week no. 32, 2005 (summer).*

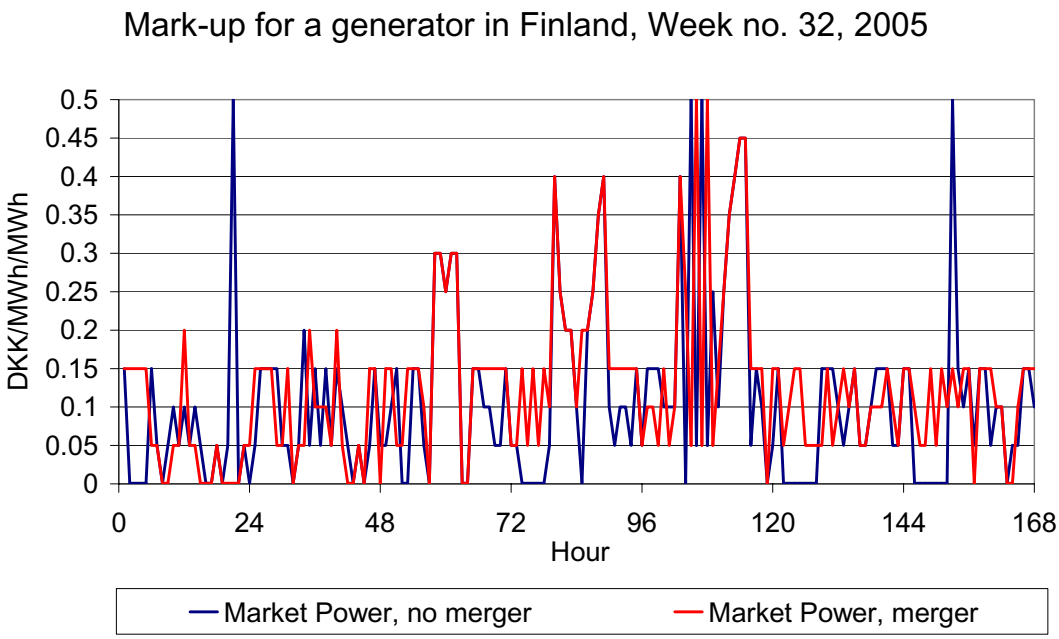


Figure 40 *Mark-up of dispatchable production of a generator in Finland. Week no. 32, 2005 (summer).*

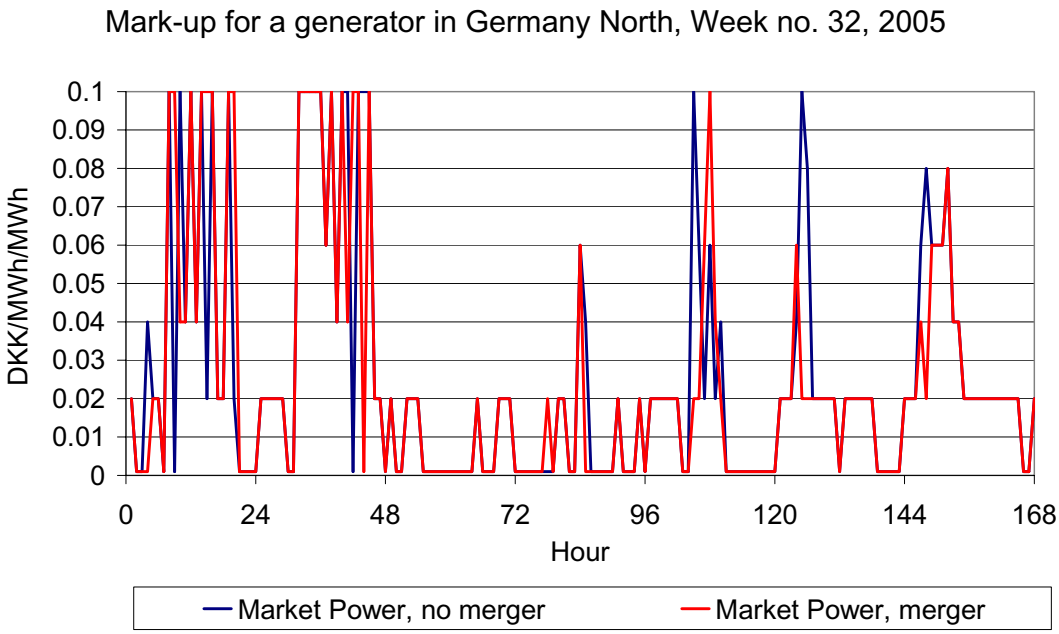


Figure 41 *Mark-up of dispatchable production of a generator in Germany North. Week no. 32, 2005 (summer).*

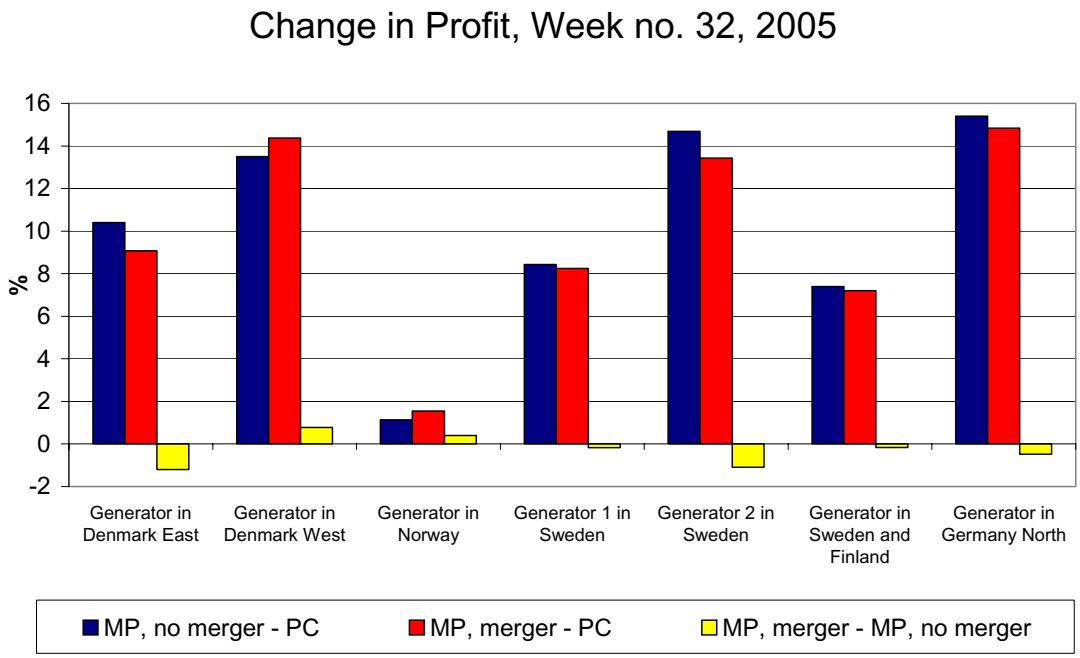


Figure 42 Profit changes due to market power and merger. Week no. 32, 2005 (summer).

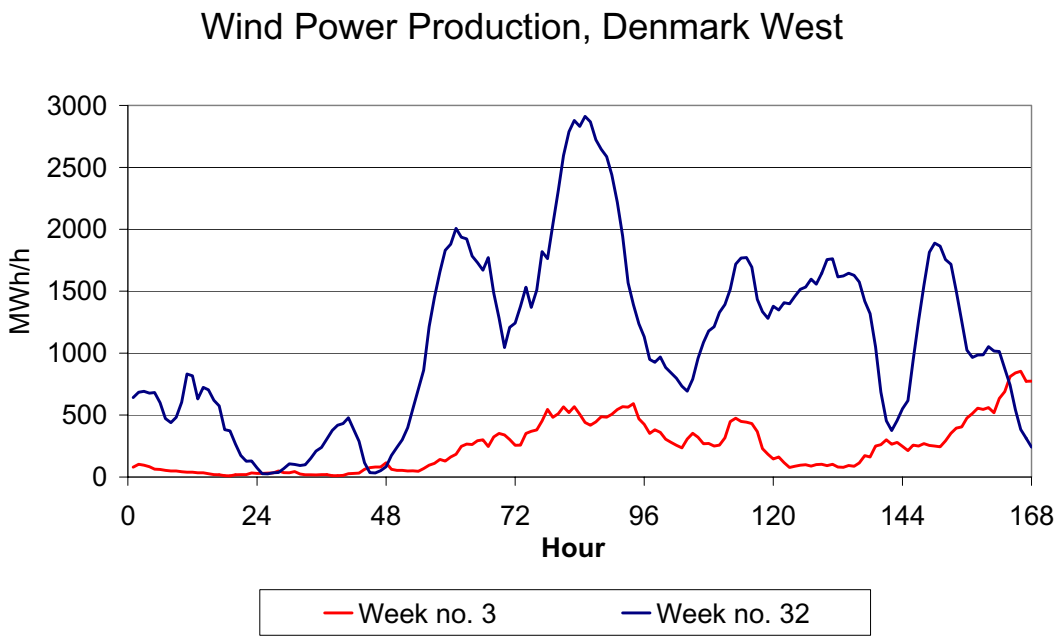


Figure 43 Wind power production in Denmark West. Weeks no. 3 and 32, 2005.

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