The power market

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The power supply sector in Norway is regulated by the Energy Act. Market-based power trading is one of the principles incorporated in this statute. Similar legislation is found in Sweden, Denmark, Finland and the other EU countries. The Nordic countries today form a common power market, which also has links to Russia, Germany and Poland.

7.1 How the power market functions

All generating companies supply electricity to the transmission grid. Once delivery has been made, it is no longer possible to separate supplies from different generators. When a consumer turns on the electricity, it is impossible to say where the power was generated.

When electricity is transmitted, some energy is lost. This loss depends on such factors as consumption and transmission distance. At any given time, the amount of electricity supplied to the grid is equal to the amount tapped from it after allowing for transmission losses. Accounts are kept of how much each generator is delivering to the grid at any given time and how much each consumer takes out.

If a consumer changes power supplier, this will not in itself affect the physical flow of electricity in the network. The transmission tariff payable by the customer is therefore unchanged. See chapter 6. It makes no difference whether the customer buys electricity from a power supplier on the west coast or in the far north of Norway. They merely conclude a new contract which may specify different prices and terms.

The amount of electricity a generator sells at any time need not correspond to their output. To maximise income, generators manage the use of water in the reservoirs on the basis of the spot price at any given time and expectations about what it will be in future. See chapter 7.2 on power trading. To ensure that output corresponds to sales commitments, generators can buy and sell power in the market, Nord Pool, for instance, which is the Nordic power exchange.

The market price for power varies reflecting changes in consumption, generation and transmission conditions in the Nordic power market. Variations in precipitation and temperature can result in large swings in the spot price. This means that the economic risk associated with electricity trading is high. To reduce this risk, generators, consumers and other players in the market can enter into long-term contracts. Households can obtain fixed price contracts, for example.

7.2 Power trading

The power market is often divided into wholesale and end user segments. The latter is described in more detail in chapter 7.2.4.

The wholesale market embraces generators, suppliers, big industrial enterprises and other large undertakings. Electricity is traded bilaterally between different market players and in the markets organised by the Nord Pool Nordic power exchange. A number of companies broker standard bilateral contracts, but a growing proportion of contracts are traded in Nord Pool's markets. Bilateral contracts still have the largest market share.

Physical trade between the Nordic countries is based on Nord Pool Spot's electricity spot market. However, financial contracts may also be concluded bilaterally between players in the various countries.

7.2.1 Nord Pool – the Nordic power exchange

Trading and clearing of physical and financial power contracts in the Nordic region are conducted by the Nord Pool Group – the Nordic power exchange. About 330 players currently trade in one or more of Nord Pool's markets.

The Nord Pool Group comprises the parent company, Nord Pool ASA, and its affiliated companies. These are Nord Pool Clearing ASA and Nord Pool Consulting AS. Nord Pool ASA is owned 50-50 by the system operators in Norway and Sweden – Statnett SF and Affärsverket Svenska Kraftnät respectively. With its head office in Oslo, the group has operations in Stockholm, Helsinki and the Danish city of Fredericia. Offices are being established in Berlin and Amsterdam.

Nord Pool Spot AS also belongs to the Nord Pool group, and is owned by all the system operators in the Nordic region as well as 20 per cent by Nord Pool ASA. This company sets the electricity spot price on an hourly basis in the physical market for Norway, Sweden, Finland and Denmark and lists prices in Germany to serve as a reference price for other power trading.

The Nord Pool Group also has holdings in Germany's European Energy Exchange (EEX) and an operational collaboration over information technology systems with the French Powernext exchange.

Nord Pool has 93 employees, and contracts worth NOK 399 billion were traded and cleared over the power exchange in 2005. The total value was NOK 443 billion in 2005 including the value of physical trading.

Nord Pool's products are divided into three principal categories: the physical market, the financial market and clearing.

The physical market

Electricity spot (Elspot) is a common Nordic market for trading physical power contracts hour by hour with delivery the following day. Prices are determined on the basis of the total quantity of electricity which the players announce they wish to buy or sell. The spot market price provides the basis for the system operators when balancing the flow of power between the Nordic countries.

The system price in Elspot serves as a reference for determining prices in Nordic financial power trading. This price reflects generating and consumption conditions in the region. In addition, area prices take account of possible bottlenecks in the Nordic transmission network. See chapter 7.2.2.

Apart from power generators and industrial companies, players in Nord Pool's spot market include distributors, electricity suppliers and power brokers.

Elbas is a physical balancing market for trading in Sweden, Finland and Eastern Denmark, with hourly contracts which are traded continuously throughout the day. These contracts begin to be quoted when trading in Elspot for the following day has concluded, and they can be traded up to an hour before delivery begins. Elbas is administered by Nord Pool Finland.

The financial market

Nord Pool offers trading in forward contracts and settlement to exchange members in the financial market. These are financial power contracts used for price hedging and risk management in electricity trading. They can be traded for four years into the future, divided by days, weeks, months, quarters or years. Futures have a daily market settlement in both trading and delivery periods, while forwards accumulate

the results of price changes during the trading period and have daily settlements during the delivery period.

Contracts for difference (CfD) provide opportunities for adjusting and hedging portfolios in terms of differentials between the system price and the various area prices in Elspot.

Nord Pool's options contracts are European options with forward contracts as the underlying product.

In the spring of 2004, Nord Pool began spot market trading in Swedish electricity certificates. Nord Pool also has a licence to offer forward trading in electricity certificates.

As the first exchange in the world, Nord Pool opened on 11 February 2005 for trading in release rights (CO_2) From the opening and to the end of the year, 27.95 million tonnes of CO_2 were traded in Nord Pool (13,207 tonnes on the exchange and 14,744 in the bilateral market). At the end of the year, 64 players from 11 countries had become members.

Clearing

Nord Pool Clearing acts as the middleman in financial power contracts. Providing daily security to cover future settlements reduces the financial risk for the contracting parties. Nord Pool automatically becomes a party to all contracts traded on the power exchange. In addition, Nord Pool Clearing offers clearing of standardised contracts traded off the exchange.

Nord Pool turnover in 2005

All the Nord Pool Group's areas experienced growth in 2005. Traded volume in the physical market increased from 2004 to 2005 by a little above 5 per cent. Trade volumes totalled 176 and 167 TWh in 2005 and 2004 respectively. The value of traded volume in the physical market rose by around 11 per cent from 2004 to 2005 and had a value of approximately NOK 44 billion in 2005.

Traded volume increased in the financial market by 33 per cent from 2004 to 2005. Trade volumes totalled 786 and 590 TWh in 2005 and 2004 respectively. The value of traded volume in the financial market increased from NOK 149 billion in 2004 to 189 billion in 2005.

Clearing, both of bilateral trades and the financial market, has had a signifi-

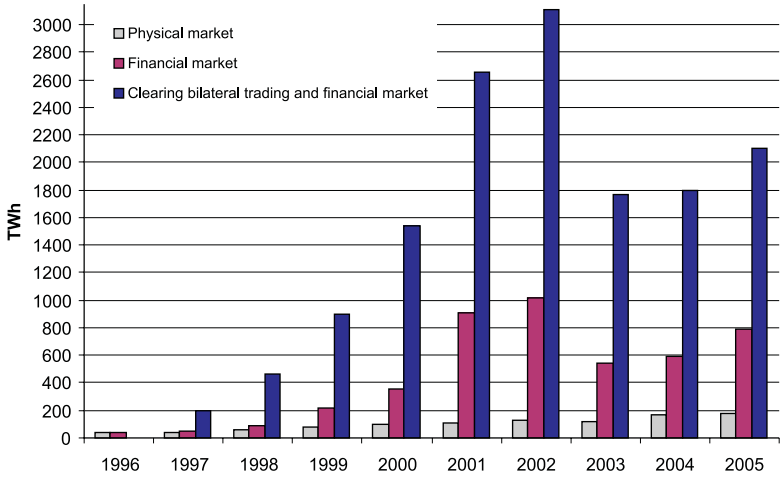

Figure 7.1 Developments in the physical and financial markets and in clearing since 1996
Source: Nord Pool

cant increase in recent years and after a fall in 2003, clearing activities have experienced an increase measured in volume in 2005 of around 17 per cent in relation to 2004. Total clearing volume in 2005 and 2004 was 2,102 and 1,797 TWh respectively. Values traded and cleared in 2005 and 2004 were NOK 399 and 350 billion.

Figure 7.1 shows the development of the physical and financial market and clearing from 1996.

7.2.2 Managing bottlenecks in the grid

Nord Pool Spot sets a system price for each hour which takes no account of any transmission restrictions in the Nordic grid. However, such restrictions may arise between geographical areas.

Restrictions in the Nordic transmission grid, often termed bottlenecks, are managed by specifying price areas on either side of the bottleneck. Nord Pool determines such price areas in addition to the system price. Regions with a power surplus have an area price lower than the system price. The position is reversed in areas with a deficit. Area prices help to balance supply and demand within each area while taking account of the bottleneck.

Norway uses price areas as the main tool for dealing with bottlenecks within its borders and at the frontiers with Sweden, Denmark (Jutland) and Finland. As a general rule, Norway uses price areas to deal with major or long-lasting bottlenecks in the grid and counter purchases when smaller adjustments are needed. In the event of bottlenecks internally in Norway, these will be divided into two price areas, in general south and north of Dovre. Sweden and Finland only use price areas to deal with external bottlenecks and counter-purchases to deal with domestic ones. Counterpurchases involve the system operator paying generators to increase or reduce output in order to balance the market. Denmark is divided into two price areas, Jutland and Zealand.

The difference between area and system prices is called the capacity fee. The capacity component of volume which is transported over bottlenecks is an income for distribution companies. Nordic system operators share the income from capacity fees arising in the Nordic power market. Bottleneck income is included into the central grid's income and therefore contributes to reducing tariffs for users of the network, as specified in chapter 6.2.1.

7.2.3 The balancing market

The balancing (or regulatory) market is a tool which the Norwegian system operator, Statnett SF, uses to maintain a stable frequency and balance between generation and consumption in Norway. See chapter 5.4. The balancing market opens after prices and quantities have been determined in the electricity spot market.

Statnett receives quotes from major generators or consumers who are willing to alter their power output and/or consumption plans at short notice. In this way, Statnett ensures that it can adjust the amount of power in the grid either up or down right until the hour of delivery. This may be necessary, for example, in the event of the sudden failure of a power station or transmission line, or sudden unexpected changes in demand. In addition, Statnett exchanges power in the balancing market with other system operators in the Nordic countries. A joint Nordic balancing power listing was established in 2002. Elbas is also used for short-term regulation of the market in Sweden and Finland, and East Denmark.

Statnett also concludes contracts for power reserves with generators

and major consumers in the balancing options market. These deals help to make sufficient reserves available in the balancing market so that the balance between generation and consumption can be maintained even when this comes under pressure. The contracts contribute to ensuring adequate reserves are made available in the power market, so that the balance between production and consumption can be maintained even when the power balance is under pressure. The power reserve contracts specify how much capacity each individual player can make available to the regular power market, which period is included and the charge made to make and retain the offered capacity available. The minimum volume for an offer is 25 MW, within the specified network area in the specified time period, as described in 7.2.2. The contracts however do not specify which the price the individual supplier who receives the energy is finally to use. This is determined in accordance with the ordinary rules of the balancing market, and bidders are free to determine their own bid price in this market. When Statnett has determined which offers in the capacity options market to accept, all bidders which have made the same type of bid – in other words, within the same grid area and for the same period – receive the same price per MW. This price is equal to the highest price accepted for this type of bid. These contracts were first used in November 2000.

7.2.4 The end user market

Anyone who buys electricity for their own consumption is an end user. Small end users normally buy power from an electricity supply company. Larger end users, such as industrial enterprises, often buy directly in the wholesale market. All end users are free to choose which electricity supplier they wish to use.

An electricity invoice has several components: The electricity price, the payment for transmission, the consumption tax (electricity tax), VAT and a levy on the transmission tariff earmarked for the Energy Fund. See chapter 2.5.

All end users must pay a transmission tariff to the local grid company to which they are connected. See chapter

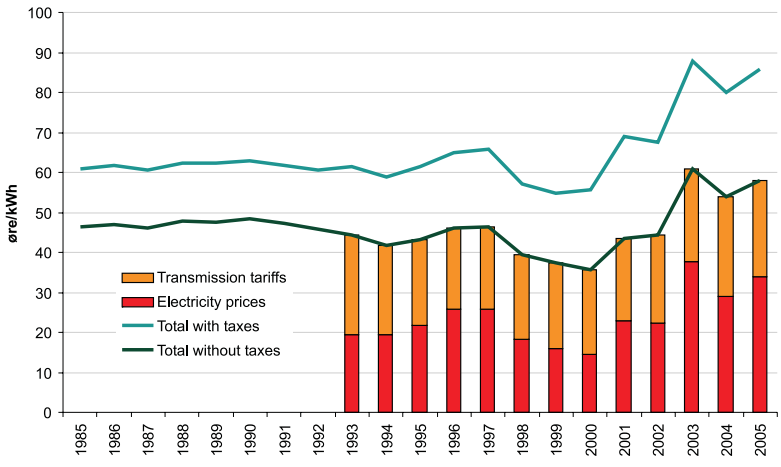

Figure 7.2 Electricity prices for households 1985 – 2005. Fixed 2005 NOK
Source: Norwegian Water Resources and Energy Directorate

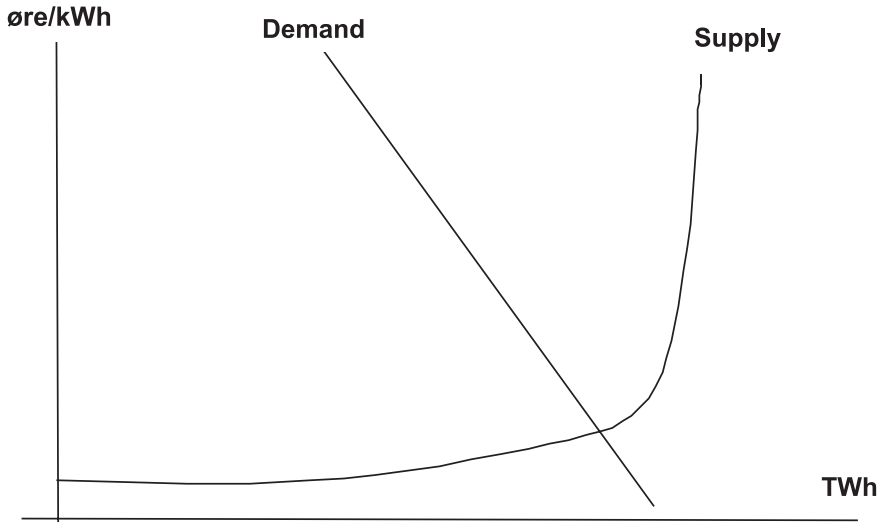

Figure 7.3 Principles for short-term variable costs of power generation in the Nordic region
Source: Ministry of Petroleum and Energy

6.2.2. If transmission and electricity supply are handled by different companies which are not members of the same group, the end user will normally receive two invoices - one from the grid company and one from the electricity supplier. However, most end users buy their power from a company or a group which embraces both functions. They usually therefore receive only one invoice which specifies the transmission tariff and electricity price as separate items.

A consumption tax (electricity tax) is levied on power used in Norway, irrespective of whether it is produced in the domestic or foreign market. In 2006, the consumption tax was NOK 0.1005/kWh and has since 2004 been paid together with the transmission tariff, as described in chapter 2.5.

Large customers normally have meters which measure electricity use by the hour, so that a precise settlement can be made. From 2005, all consumers with an annual consumption of more than 100,000kWh should have hourly metering. Smaller consumers receive invoices based on a predetermined load profile, but can opt to be metered by the hour.

Household customers, as other consumers, can also choose between different types of contracts for the purchase of electricity. The most common contracts for households have prices which vary according to market conditions. As at the fourth quarter of 2005, 60.5 per cent of households had contracts with variable price, which means that power suppliers can change price. Elspot-based contracts, such as ones which charge the Elspot price plus a fixed mark-up, were held by 22.7 per cent. The remaining household customers had various types of fixed-price contracts. A fixed price, for example for one year, means that the power supplier cannot alter the price during the contract period, even if market prices change. As at the fourth quarter 2005, 16.8 per cent of household customers had this type of contract.

Some 25,2 per cent of household cus-

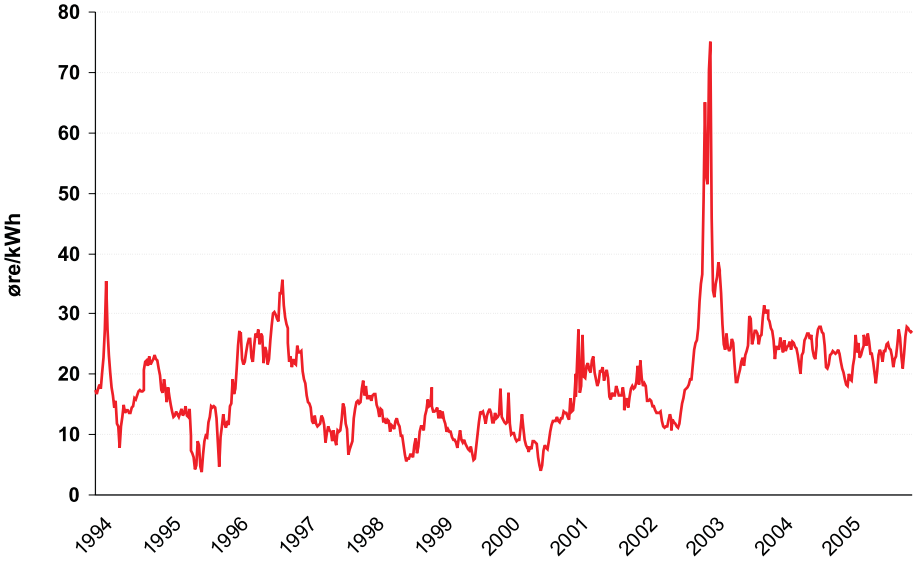

Figure 7.4 Prices in Nord Pool's spot market 1992 - 2005
Source: Nord Pool

tomers, including cabins and holiday homes, had a different electricity supplier than the main one for their area in the fourth quarter of 2005.

Figure 7.2 shows trends in average prices for households from 1985 to 2005. The electricity price and transmission tariff were separated in 1993. The figure also shows the total end user price including VAT, consumption tax (electricity tax) and Energy Fund tax. Prices for private households were relatively stable from 1985 to 2002. However, the cold winter in 1995-1996, combined with low inflow in 1996, resulted in a sharp rise in wholesale prices which in turn led to an increase in prices charged to households. These accordingly rose from 1996 to 1997. Precipitation was above normal for every year in the 1997-2000 period, with relatively high hydropower output. This was reflected in a general decline in prices over the whole period. Inflow to the reservoirs declined substantially in the autumn of 2002. This resulted in a significant increase in household prices for many at the start of 2003. A more normal reservoir situation gave falling prices later in the year. At the start of 2004, the levels in Norwegian reservoirs was still 14.8 per cent lower than normal for the time of year. However, the reservoirs returned to normal levels in the course of the year. Household prices were relatively stable in 2004. In 2005, household prices increased in relation to 2004, in line with increases in prices in the power market.

7.3 Price formation

Norwegian electricity prices are determined by supply and demand in the Nordic power market and by the power balance in countries outside this region. Figure 7.3 provides a simplified outline of how electricity generating costs in the Nordic region influence electricity prices. The rising curve shows the availability of power capacity in the Nordic region as short-term generating costs rise. The

falling curve shows the demand for power in the Nordic region. Generating costs are lowest for hydropower and nuclear energy. Precipitation and inflow to reservoirs determine how much hydropower can be generated, and are therefore also important for the overall output potential and for prices.

The closer the Nordic market is tied to the continental European market, the more strongly price signals from continental Europe will affect the Nordic market. Power production on the continent is dominated by thermal power plants, such as coal and gas fired power stations, which have higher production costs. Given the current level of demand, coal-based facilities often serve as the swing generator to balance the market, and therefore determine the price. In a year with average hydropower output, electricity prices will therefore be largely determined by the cost of generating electricity from coal. Important factors here are price development for coal and the development in quota prices for CO_2.

Temperatures and weather conditions affect demand in Northern Europe and influence power prices in the short term. Periods of cold weather and high consumption in particular can give high power prices. In periods of increased demand, power stations with higher generating costs – such as oil condensate or pure gas turbine units – will determine the price. These peak-load stations are used only to generate electricity for short periods at a time. In Figure 7.3, they would lie on the steeply rising part of the supply curve.

Figure 7.4 shows variations in nominal electricity spot prices in the period 1992-1995. As the figure shows, the spot price for power in Norway has been stable from the middle of 2003 up to the end of 2005. At the start of 2006, the spot price was NOK 0.20/kWh. The price rose through the winter as a result of higher consumption and rising fuel prices. The weekly power price reached NOK 0.27/kWh in week 19, before it gradually fell towards the spring. The price fall can be attributed to good water inflow through snow melting and reduced consumption. In week 25, the price was down to NOK 0.185/kWh. In the second half of 2005, the price rose gradually as a result of increasing fuel and CO_2 prices combined with high consumption. At the end of the 2005, the price was around NOK 0.27/kWh. Despite increasing prices in the second half of the year, the average price in 2005 was NOK 0.234/kWh. This was the lowest average price since 2002. At the beginning of 2006, the trend towards increasing prices continued. Low precipitation levels in the first months of the year combined with cold weather in Norway, Scandinavia and Europe have been important factors. High fuel prices and rising quota prices for CO_2 have contributed to the high power price.

How great this power price change is for the individual consumer is to a large extent dependent on what type of contract the consumer uses. Consumers can chose between contracts with fixed prices and contracts which follow market price changes. The majority of Norwegian households have today contracts which follow market prices. Furthermore power supplier procedures linked to the point in time of invoicing has a certain degree of effect.

7.4 International power trading

Norway was traditionally a net exporter of power. But it has been a net importer since the late 1990s because consumption continues to rise while hydropower development has been limited in recent

times. In certain years, however, high precipitation and inflow to reservoirs mean that the hydropower utilities can help exports to exceed imports. Net Norwegian power exports in 2002 totalled 9.7 TWh, for instance, while net imports came to 7.8 TWh in the following year. In 2005, the net export to Norway was around 12.2 TWh. Figure 7.5 shows imports and exports of power by Norway from 1970 to 2005.

International power trading is determined by generating and consumption patterns in each country, in addition to the capacity of the transmission grid linking countries and the conditions for its use. One basis for power trading is the opportunities it offers countries to derive mutual benefit from differences in national generating systems.

Exchanging power this way is important for Norway because it reduces the country's vulnerability to variations in precipitation and inflow and makes use of the regulatory capacity of hydropower. Good opportunities for power exchange moderate the need to maintain a large domestic reserve capacity as an insurance against dry years.

Most of the countries with connections to Norway base their power output largely on thermal sources – coal, oil, gas and nuclear. This normally ensures stable energy supplies. The opportunity to import electricity in dry years provides a reserve for the Norwegian system. In years when water inflow is good, the transmission grids make it possible to export power from Norway. This way, opportunities for power exchange will mitigate price fluctuations in the Norwegian energy supply system. In a closed Norwegian system, electricity prices would be much more sensitive to variations in climate.

Power exchange between Norway and other countries exploits the advantages of interconnecting hydro and thermal power systems. In countries based on thermal sources, power station capacity determines how much electricity can be generated, while the limiting factor in Norway today is the amount of energy available in the form of water in reservoirs. The energy sources used in thermal power countries – oil, coal, natural gas and uranium – can generally be

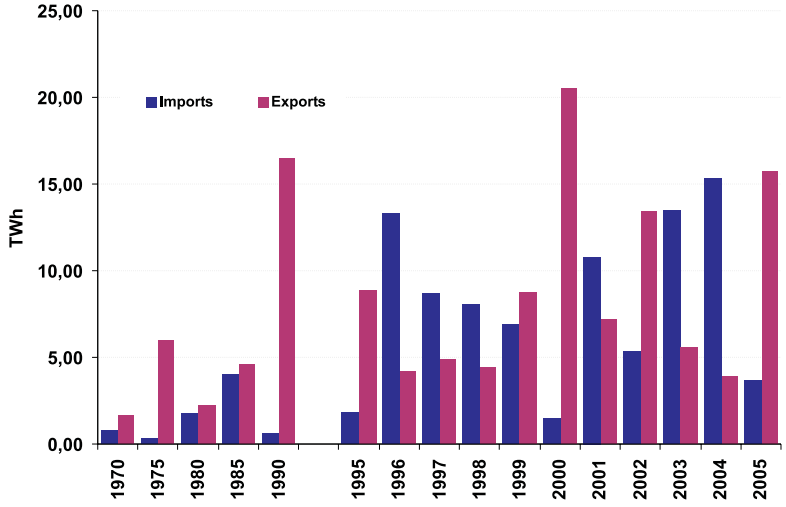

Figure 7.5 Norway's imports and exports of power in 1970 - 2005
Source: Ministry of Petroleum and Energy

acquired in whatever quantities needed and accordingly impose no restrictions on output.

Building new thermal capacity to meet short-term peaks in demand in countries with thermal-based systems is expensive, and adjusting output up and down in existing generating facilities is both time-consuming and costly. But thermal power stations can deliver relatively inexpensive electricity outside peak consumption periods – in other words, at night and on weekends.

Capacity in Norway's hydropower stations exceeds the level normally required to meet domestic daytime consumption. Output from such facilities can be adjusted up and down rapidly and at low cost to meet fluctuations in consumption or unexpected short-term changes in power supplies.

Interconnecting a hydropower-based system with ones based on thermal power also makes it possible to reduce the need for new power stations and multi-annual reservoirs in Norway. When the Norwegian electricity price rises sufficiently above the marginal cost of thermal power output, it becomes profitable for neighbouring countries to export to Norway. Conversely, it is profitable for Norway to export power when the price at home is lower than in neighbouring countries.

Norway has transmission connections with Sweden, Denmark, Finland and Russia, as shown on the map in Appendix 4. Transmission capacity to Finland and Russia is small, and the connection with Russia is used only for imports to Norway. Transmission capacity is largest between Norway and Sweden, at about 3 600 MW, while capacity in the other direction is rather smaller. Capacity between Norway and Denmark is about 1 000 MW. The specified transmission capacity is what the various system operators consider to be realistic for large parts of the year. However, estimates indicate that, were this capacity to be fully utilised, it would be theoretically possible to exchange almost 20 TWh per year between Norway and neighbouring countries. In practice, operating and market conditions limit the amount which can be transmitted at any time.

Transmission capacity from Sweden to Denmark is normally assumed to be about 2 000 MW, while capacity from Denmark to Sweden is generally about 400 MW higher. The figure from Sweden to Finland is just over 2 000 MW, and about 1 500 MW in the opposite direction. Transmission capacity in and out of a country differs because of internal factors related to electricity generation, transmission and consumption in each country.

Statnett and the Dutch company (TenneT) responsible for the Dutch grid are to build a cable for power transfer between Norway and the Netherlands. The cable, which has a capacity of around 700 MW, will increase the transfer capacity between Norway and other countries by around 20 per cent. The cable should be on line at the start of 2008.

The map also shows transmission capacity out of the Nordel area – in other words, capacity between the Nordic region and neighbouring countries. Transmission capacity is available to Germany, Poland and Russia.

7.5 Electricity output in the Nordic countries

Power production in the Nordic countries in 2005 was around 391 TWh. This is an increase of 2.3 per cent for the year. Norway and Sweden are the largest power generators among the Nordic countries.

Hydropower and nuclear energy are the two most important energy sources for Swedish electricity generation, and together account for about 90 per cent of total output. Most of the remainder comes from power stations based on bioenergy, gas and coal. Electricity output totalled just under 150 TWh in 2005, while gross consumption was roughly 143 TWh. Almost all available Swedish generating capacity based on oil condensate has been closed down in recent years. The Swedish government has decided to shut down nuclear power stations, including capacity at Barsebäck. However, new generating capacity is also planned. This includes two new gas-fired power stations in Gothenburg and Malmö respectively.

Danish power output is based mainly on fossil fuels, particularly coal as well as some gas. Total output in 2005 was 36 TWh, with total consumption almost 37.4 TWh. Cogeneration stations, which generate both electricity and heat, account for about 80 per cent of Danish power output. Wind power accounted for roughly 18,5 per cent of electricity generated in 2005. Electricity prices to consumers are relatively high in Denmark at present compared with the other Nordic countries, partly because of heavy taxes on consumption.

Finland's system includes hydropower, nuclear energy and cogeneration. The country generated almost 68 TWh in 2005. Thermal power accounted for 40 per cent of production, nuclear power 33 per cent while renewable energy sources such as wind and water accounted for 21 per cent. Total Finnish consumption in 2005 was 84,9 TWh. The bulk of Finland's power imports come from Russia, with the rest mainly supplied by Sweden – the only Nordic country with significant transmission capacity to Finland.