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### **A history of electricity liberalisation**

Origins and evolution of the Nordic model

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# Oil, Gas & Energy Law Intelligence

## A History of Electricity Liberalisation: Origins and Evolution of the Nordic Model by R. Bolton

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# **A History of Electricity Liberalisation: Origins and Evolution of the Nordic Model**

Ronan Bolton\*

## **Abstract**

*Electricity liberalisation was a trend across western Europe from the early years of the 1990s. Britain and Norway are generally seen as the pioneering European nations in this move towards structural reform and competitive markets. They were amongst the first countries to pass legislation which ‘unbundled’ their electricity supply industries and introduced competition between generators. This paper focuses on the development and evolution of the Norwegian electricity market. The case is notable because it was the genesis of Nord Pool – the cross-border trade across the Nordic region – and later became an important influence on the design of wholesale power markets across Europe, and further afield. The paper begins with an introduction to the Norwegian power system and outlines the liberalisation reforms that were enacted in legislation in 1990. It then outlines how the Norwegian market was evolved and expanded across the Nordic region throughout the 1990s. The case shows the importance of understanding the political and technical system contexts within which liberalised power markets were developed during this early period of reform.*

## **I. Introduction**

The broad trend towards electricity markets and competition across western Europe from the early years of the 1990s was driven by a number of factors. Firstly, the experience of the two oil crises of the 1970s had prompted governments to intervene in energy markets by regulating energy prices and subsidising domestic energy sources to ensure national energy security. For example, Britain and Germany ramped up subsidies to their coal mining industries, France turned to nuclear power, and large hydro schemes continued to be constructed across the Nordic region. This was all as a means of reducing reliance on expensive imported fossil fuels – the EEC countries were importing 70% of oil supplies during this period. Oil-fired generators which had been constructed during the years of low energy prices were increasingly moved to the margin and only used in emergency situations. However, as the commodity cycle turned in the mid-1980s – oil prices fell by more than half in real terms between 1984 and 1986 – received wisdom about the need for strong government intervention to ensure energy security and cheap supplies began to be questioned.

As movements in oil and coal prices were linked, a key driver for electricity liberalisation across Europe was the increasing availability of cheap imported thermal coal. In Britain and West Germany, for example, suppliers were tied into long term contracts with monopoly generation and transmission companies who were, in turn, obliged by governments to contract with domestic coal producers. This vertically integrated structure created stability in the industry and enabled the costs of generating and supplying electricity from domestic sources to be passed on to captive consumers. As we will discuss, the Norwegian case was quite different on the supply side due to the country’s strong reliance on hydro-power and low utilisation of fossil fuels for electricity generation.

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On the demand side, a commonality across OECD countries was a general slowdown in economic growth relative to the period from the 1950s to early 70s. This, alongside investments in energy efficiency which were induced by the high energy prices of the 1970s, impacted electricity demand in many countries, resulting in excess capacity, further depressing prices. It also brought into question one of the key rationales for centralised control and vertical integration, which was the ability to plan for and meet long-term demand growth. It had been argued that a key benefit of suppressing competition in the electricity generation and supply industry was to centrally plan systems and make strategic long-term investments in the interests of economic growth and social welfare. However, by the late 1980s, excess capacity, combined with the availability of cheap energy imports, undermined the state-based electricity regimes across western Europe.

Britain and Norway are generally seen as the pioneering European nations in the reform of what had since middle of the twentieth century been a highly centralised and monopolistic industry. They were amongst the first countries to introduce legislation which structurally reformed their electricity supply industries, with competition introduced in 1990 and 1991 respectively. Although the European Commission had been pushing strongly for EEC member states to break-down barriers to cross-border electricity trade since the publishing of its study ‘The Internal Energy Market’ in May 1988,<sup>1</sup> it was not until 1996 that a directive on electricity liberalisation was finally agreed.<sup>2</sup>

This paper focuses on the Norwegian case, not only because it was one of the pioneering countries, but also because it was the genesis of the world’s first cross-border electricity market, *Nord Pool*. The first section begins with a brief overview of the history of Norway’s electricity system and continues by explaining how the state-based model of electricity governance which had underpinned it was replaced with a market-based approach, with reforming legislation passed in 1990 and implemented in early 1991. The paper then explains how the market was expanded across the Nordic region, by the early 2000s encompassing Sweden, Finland and Denmark.

## II. Cross-border Electricity Trade in the Nordic Region

### 2.1 Norway’s Distinctive Electricity System

Norway’s electricity system is distinctive for a number of reasons: On the supply-side it’s generation mix has been dominated by hydro-power with little use of fossil fuels and no nuclear power. On the demand-side, due to the availability of cheap power, the country developed into one of the most electro-intensive in the world due to high levels of electrification in industrial and heating sectors.<sup>3</sup> The distinctive system had its origins in the early part of the 20<sup>th</sup> century when hydro resources began to be exploited. The nature of the resource – the ‘excellent reservoirs in the mountains combined with very high waterfalls, often close to the seashore’<sup>4</sup> – meant that hydro-power schemes could be developed at a relatively small scale and close to

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<sup>1</sup> European Commission (1988) *The Internal Energy Market*. COM (88) 238, p. 6.

<sup>2</sup> For a history of the entire period see: Bolton, R. (2022) *Making Energy Markets: The Origins of Electricity Liberalisation in Europe*. Palgrave Macmillan, London.

<sup>3</sup> c. 100 TWh/year by the late 1980s, with over 23,400 kWh per capita consumption, compared to 15,000 in Sweden and 6,000 in Denmark.

<sup>4</sup> Thue, L. (2013) *Connections, Criticality, and Complexity: Norwegian Electricity in its European Context*. In Högselius, P., Hommels, A., Kaijser, A. and Van Der Vleuten, E. (Eds.) *The Making of Europe’s Critical Infrastructure: Common Connections and Shared Vulnerabilities*. Palgrave Macmillan, Basingstoke, 2013, p.220.

load centres. This was unlike Norway's neighbours Finland and Sweden where the industry had to wait for the development of high voltage transmission technology later in the 1930s to exploit hydro-power at scale. Early schemes in Norway were developed by private industries and some local municipalities, leading to what Lars Thue has termed a 'dual regime'<sup>5</sup>; self-generation by energy-intensive industries and local municipal supply for cities and towns.

There was no discernible national regime for electricity supply in Norway in the early part of the twentieth century as electricity supply was composed of many distributed systems. While the country was slow to develop a centralised system in comparative European terms, the Norwegian state did play an important role in regulating the exploitation of hydro resources since the introduction of the 'Concession Laws' in 1909 and 1917. These laws obliged private developers to hold a licence if harnessing water power (above 1000 horse power) which, if granted by the state, entitled the holder to a property right over the resource for a limited period (sometimes up to 60-70 years). This was subject to conforming to strict regulations regarding how economic rents from the resource were to be allocated. Strong state intervention in this particular area of water resources was motivated by a concern about an invasion of big business and foreign capital, and was part of a broader approach to the development of a natural resource-based economy taken by the fledging state. This stable property rights regime provided an impetus for the distributed hydroelectric industry which became dominated by private and municipal actors. By 1924 '90-95% of investments in large scale industrial electricity generation were private, whereas 83% of investments in general supply were municipal, 7% were state investments and 10% were private'.<sup>6</sup>

Although direct state involvement in the power system was limited, there were efforts to construct a national regime which would improve the coordination and efficiency of the fragmented industry. In 1918 a national Electricity Supply Commission was established 'to work out a national plan for the entire electricity sector...with the mandate to provide in principle framework for the future electricity system, a general plan for the developments in each region, and a financial plan'.<sup>7</sup> Subsequently, in 1921, the Norwegian Water Resource and Energy Administration (NVE)<sup>8</sup> was created within the economics ministry to manage the state's licencing and regulation of water resources and to coordinate state investment in hydroelectric projects. This was the genesis of *Statskraftverkene* (Statkraft) – the Norwegian national generation and transmission organisation – which was formed as a division within the NVE in 1960, only becoming independent in 1986. A 1922 report by the Electricity Commission had advocated greater state coordination, consolidation and centralisation of the industry, but this was opposed vigorously by a strong coalition of local actors with interests in the existing fragmented industry structure. This has been characterised as a 'local-cooperative' coalition,<sup>9</sup> composed of 'local banks, municipal electricity companies and local enterprises' who were embedded in 'local politico-economic systems where financial resources, electrical power and political decisions supported each other'.<sup>10</sup> Due to strong opposition the proposals

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<sup>5</sup> Thue, L. (1995) *Electricity Rules: The Formation and Development of the Nordic Electricity Regimes*. In Kaijser, A. & Hedin, M. (Eds.) *Nordic Energy Systems: Historical Perspectives and Current Issues*. Science History Publications, Canton, MA, 1995.

<sup>6</sup> Olsen P.I., (2000) *Transforming Economies: The Case of the Norwegian Electricity Market Reform*. Dissertation for the Degree of Dr. Oecon. Norwegian School of Management BI, p.89.

<sup>7</sup> Olsen, P.I (2000) *Op. cit.*, p.95.

<sup>8</sup> *Norges vassdrags- og energidirektorat*.

<sup>9</sup> Olsen, P.I (2000) *Op. cit.*

<sup>10</sup> Magnus, E. & Midttun, A. (2000) *The Norwegian Model: Competitive Public Economy*. In: Magnus, E. & Midttun, A. (Eds.) *Electricity Market Reform in Norway*. Palgrave Macmillan, Basingstoke, 2000, p.3

were watered down, and partly as a result Norway was slow by western European standards in creating a centralised national grid – formed only in 1971.

NVE was successful in developing a number of large hydro schemes, a development trend which was increasingly important as many of the cheaper and more accessible sites had been exploited by private industry and municipalities. By the eve of the Second World War 10% of the country's electricity output of 12 TWh was from these projects, which tended to be located near the densely populated regions of the country in the south-east and which over time developed into integrated regional systems. For example, NVE's Nore power plant built in the late 1920s became the central node in a regionally interconnected system around Buskerud County near Oslo.<sup>11</sup> This involved a high voltage transmission link (100km) to the Rjukan plant and later municipalities around Oslo and Drammen were integrated after a 60km line was built from the plant to Oslo. The system incorporated 60 power stations by the mid-1930s, enabled by the Norwegian state taking a role in coordinating the system, along with ensuring cheap power for industry. This system was called *Samkjøringen for kraftverkene på Østlandet* which subsequently became the first of a number of such regional power pools ('*Samkjøringen Organisations*'), all of which included NVE as a member.<sup>12</sup> These power pools were the embryo a national electricity regime which became more established in later decades as a single national grid, control centre and regulated pricing structure came into effect. However, problems associated with fragmented systems and a weak national regime persisted. A number of the large investments which had been made by the state failed to exploit potential economies of scale as they could not access many adjacent towns and rural areas which were supplied by municipalities with protected monopolies. Although the regional power pools represented a closer alignment of local coalitions and the state, as we discuss later, tensions between various groupings within the industry persisted and formed the political backdrop to the liberalisation debates of the 1980s and 1990s.

## 2.2 Coordination of Fragmented Systems

By 1990, the system had 26,913 MW of installed capacity, with thermal power only a small fraction of this (278 MW). Just over half of the country's electricity capacity was owned by municipal authorities at the town or country level (55%); Statkraft had just under 30% and the remainder (c. 15%) was comprised of units owned by industry for self-generation. The Norwegian national grid had been established in 1971 following a long process of building up and linking the regional power pools. The system was operated by a member organisation called *Samkjøringen av Kraftverkene I Norge* and integrated the majority of the large power plants. Statkraft was the dominant actor; it owned 55% of the grid initially, which was expanded to 85% by the time of market reform in 1990/1991, and exerted a strong influence over the other members as it had contracts in place to operate the entire system.

The Norwegian electricity system was not entirely centralised therefore, rather it was organised around a three-tier structure: At the national level was Statkraft, below which operated regional-level utilities (c. 30) and local distributors (c. 230). Distribution companies tended to be publicly-owned and they managed risk by either integrating into generation, as was the case

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<sup>11</sup> Kaiser, A. (1995) *Controlling the Grid: The Development of High-Tension Power Lines in the Nordic Countries*. In Kaijser, A. & Hedin, M. (Eds.) *Nordic Energy Systems: Historical Perspectives and Current Issues*. Science History Publications, Canton, MA, 1995.

<sup>12</sup> Samkjøringen for kraftverkene på Østlandet (early 1930s), Nordenfjeldske Kraftsamband, established in 1947, Vestlandske Kraftsamband (1955), Samkjøringen Nord-Norge (1960) and Vest-Norges Samkjøringsselskap (1961). Olsen, P.I. (2000) *Op. cit.*, p.100 & 113.

with the large city utilities such as Drammen Kraft AS and Oslo Energi AS, or through a mix of own-generation and contracting with regional utilities.

Like the ownership model of the industry, the market structure was quite diverse. The main segment of the market was for selling bulk power to local distributors who had monopoly rights for supply to domestic and commercial customers in a particular area. About 60% of generation output was tied up in these long-term contracts which were typically for firm power, as local monopolies had a statutory obligation to meet demand in their particular monopoly areas. While these contracts were non-standardised, their prices were strongly influenced by Statkraft's administered price – the 'Statkraft price'<sup>13</sup> – which was agreed at the political level and, from the late 1970s, set according to the long-run marginal cost principle. So, although the system was fragmented, government, via its powers to control the key benchmark price for the entire market, was able to exert centralised control and work towards its macro-economic agenda of industrial growth.

A second segment of the market was a short-term spot market organised by *Samkjøringen av Kraftverkene I Norge* – the market for occasional power. This was introduced in the early 1970s as a means of trading surpluses and deficits at hydro reservoirs. It enabled the 120 or so producers who traded in the market to adjust their positions and meet the firm power obligations they had entered into with distributors. The market was designed around a liberal free-trade philosophy, originally proposed in the late 1960s by Vidkunn Hveding, a former engineering consultant and Director of NVE. While this played only a marginal role in the system, with only c. 10% of power traded in it, it became much more central after the liberalisation reform as economists used this spot price as a reference for long-term contracts, replacing the administered 'Statkraft price'. As discussed further below, this occasional market was the genesis of *Nord Pool*.

The third main market segment was the supply of large industrial users, one which was dominated by the state-owned producer. Almost half of Statkraft's output of 33.6 TWh was tied up in contracts which covered in the region of half of all industrial loads. After the Second World War the Norwegian state came to view low-cost electricity for heavy industry as a key enabler for its economic growth strategy. This saw the development of what has been termed a 'hydropower complex'<sup>14</sup>: heavy industries were offered state-backed long term supply contracts – often below the long-run marginal cost – which enabled them to compete in international markets, facilitating the further expansion of hydropower schemes. Contracts had been agreed in different rounds (1950, 1960, 1976 and 1983), with many of these running into the 1990s and 2000s. These contracts and their prices were politically sanctioned by the national parliament (Storting), and thus reflected political goals – industrial expansion and regional development policy.

Following efforts to use objective economic criteria – the LRMC rule – to determine the benchmark 'Statkraft price' in the late 1970s, Statkraft became vulnerable to competition from industry self-generation as their ability to sell at below cost prices was being limited. This was compounded by the fact that the historic over-investment which had taken place in the system had resulted in a significant surplus of capacity as the rate of growth of electricity demand had slowed from the late 1970s. This depressed prices on the occasional power market and,

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<sup>13</sup> Bye, T. & Hope, E. (2005) *Deregulation of Electricity Markets: The Norwegian Experience*. Discussion Papers No. 433, September 2005 Statistics Norway, Research Department.

<sup>14</sup> Midttun, A. (1988) The Negotiated Political Economy of a Heavy Industrial Sector: The Norwegian Hydropower Complex in the 1970s and 1980s. *Scandinavian Political Studies*, 11(2), pp.115-144.

following a number of unusually wet years in the early 1980s, some industrial consumers began to rely on this for their supplies, turning down contract offers from Statkraft.

By the late 1980s the pressures for industry reform were growing. Alongside the trend towards market-based pricing of industrial supplies, domestic and smaller scale commercial consumers were pushing for reform as they had historically suffered from price discrimination due to the subsidised nature of the industrial contracts. One study estimated that the unit price for the average household was four times higher than for industrial consumers.<sup>15</sup> Small and medium sized enterprises were also keen to break away from their ties to local monopoly suppliers and take advantage of cheap spot prices. These pressures had a regional element as there were significant variations in prices, depending on the nature of the local supply monopoly – whether it produced in-house or purchased from regional utilities. Proponents of reform, in particular the NVE, argued that greater consolidation would enhance fairness, whilst improving overall system efficiencies through exploiting economies of scale.

### *2.3 Reform and Design of a Market-Based Regime*

Microeconomic ideas became more influential in Norway's electricity policy sphere from 1978 following the creation of a Ministry of Petroleum and Energy. As already discussed, marginal cost pricing became the basis for the administered 'Statkraft price' from the late 1970s, and subsequently the shift towards market-based pricing in the oil industry during the 1980s influenced thinking within the department regarding electricity pricing and the role of competition. Such thinking was part of a broader policy shift in Norway during these years which saw the implementation of deregulatory measures across the economy, beginning with banking and finance. Market-based reform of the electricity supply sector drew heavily from an influential economic study which was conducted by a group of economists at the Center for Applied Research (SAF) based at the Norwegian School of Economics (NHH) in Bergen. Led by Professor Einar Hope, the group was asked by the Ministry of Finance to investigate measures to improve the efficiency of the electricity supply industry.

The resulting report – 'Market based power exchange in Norway' (1989)<sup>16</sup> – recommended a split of Statkraft into generation and transmission divisions and that the new independent transmission company (Statnett) would facilitate competition by acting as a common carrier, enabling new entrants access to the high voltage network on equal terms. The report also recommended a liberalisation of the market for occasional power. This spot market for trading of short-term surpluses and deficits which had been operating since 1971 was run by its members and did not involve end-users, rather it was producer-only. Their idea was to move away from administered pricing, rather contracts of physical delivery of power would be freely traded in the short-term spot market and via bilateral contracts, with both markets converging around a market equilibrium – the LRMC in the long-term. They also envisioned the development of a futures market for trading in financial contracts which would enable participants to hedge their risk. This would see the new electricity market operate along similar lines to a conventional commodities exchange – the genesis of the 'power exchange' model now common across Europe. Hope and his team also recommended a reduced role for NVE and a greater role for economic regulation of the sector. This was on the basis that NVE was

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<sup>15</sup> Bye, T. & Hope, E. (2005) *Op. cit.* (See Table 1).

<sup>16</sup> Bjørndalen, Jørgen, Einar Hope, Eivind Tandberg and Berit Tennbakk, 1989: *Markedsbasert kraftomsetning i Norge*, SAF rapport nr. 7. Olsen (2000) provides an extensive summary of the contents of the report from p.233.



primarily concerned with technical issues and staffed with engineers who were sceptical of the idea of competitive electricity markets.

The publishing of this report coincided with political changes which later enabled many of its recommendations to be implemented. In 1989 a minority coalition was elected which was led by the Conservative Party of Norway. This replaced the Brundtland-led labour government which had in April of that year tabled proposals to restructure the electricity industry by amalgamating many of the small distribution companies and creating 20 large vertically integrated regional utilities. The idea was to centralise and rationalise the industry, and to reduce pricing disparities across different parts of the country. Although not implemented due to the political change, one effect of these proposals was to shift opinion amongst the smaller distributors in favour of a 'free market' and decentralised reform as they were keen to preserve their independence.

The new conservative-led government was short lived, only being in office from October '89 to June of the next year. They withdrew the labour bill and new legislation was passed in this short period which fundamentally reformed the industry along free market principles.<sup>17</sup> Many of the proposals contained in the SAF report were implemented, in particular the splitting of Statkraft, a move away from administered pricing and the liberalisation of the occasional (spot) market. A close dialogue was developed between pro-market economists, senior civil servants and politicians. Particularly influential was Eivind Reiten, the Minister for Petroleum and Energy in this government. Reiten had prior to this been a director at Norsk Hydro, a key competitor of Statkraft, and was critical of what he saw as the inefficiencies of the industry, in particular the extent of price discrimination between different consumers. In order to gain political support for the liberalisation bill proposals to structurally reform the distribution sector were shelved but customers were given the right to choose between competing suppliers.

Implementation of the act was left largely to the subsequent government led by the Norwegian Labour Party. A particularly controversial aspect of this was the split of Statkraft which ultimately saw the creation of the TSO Statnett SF. Its role was now to act as a common carrier and to organise the spot market – determining a daily market equilibrium from the bids and offers submitted. This market operator function was performed by Statnett Marked, a division with the broader Statnett organisation which essentially replicated the role of the old *Samkjoeringen av Kraftverkene I Norge*. Statkraft – the generation company – was then designated as a 'semi-autonomous state company', tasked with achieving commercial objectives under the direction of the Ministry of Petroleum and Energy, with the change coming into effect from 1 January 1992. This designation of Statkraft and Statnett as commercial entities but under state direction, enabling national objectives such as industrial competitiveness and regional economic development to be part of their mandate, distinguished the Norwegian reform from the British case, where the nationalised electricity companies were transferred wholly to the private sector in 1990 and 1991. While the overall shift towards market-based pricing and liberalisation was a radical departure, important aspects of the Norwegian reform – state ownership, adapting pre-existing market institutions – were gradual and incremental regime reconfigurations. As Magnus and Midttun noted, the reforms had a 'negotiated character'.<sup>18</sup>

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<sup>17</sup> The Norwegian Energy Act, approved on 29 June 1990 and came into force on 1 January 1991.

<sup>18</sup> Magnus, E. & Midttun, A. (2000) *The Norwegian Model: Competitive Public Economy*. In: Magnus, E. & Midttun, A. (Eds.) *Electricity Market Reform in Norway*. Palgrave Macmillan, Basingstoke, 2000, p.5.

## 2.4 Towards a Multinational Electricity Regime

During the 1990s, the new Norwegian power exchange was expanded as neighbouring countries participated; first Sweden (from 1996), then Finland (1999), Western Denmark (1999) and Eastern Denmark (2000), creating the first multinational electricity market in the world. This was enabled by a number of important technical complementarities across these systems; most notably between the hydro plants located in Norway, northern Sweden and Finland (60% of total output across the region in 1990), the nuclear capacity in southern Sweden and Finland (24%) and the thermal – coal and oil – in Denmark, Sweden and Finland (15%). Figures 1 and 2 illustrate the different supply-side and ownership features of the power systems across the region.

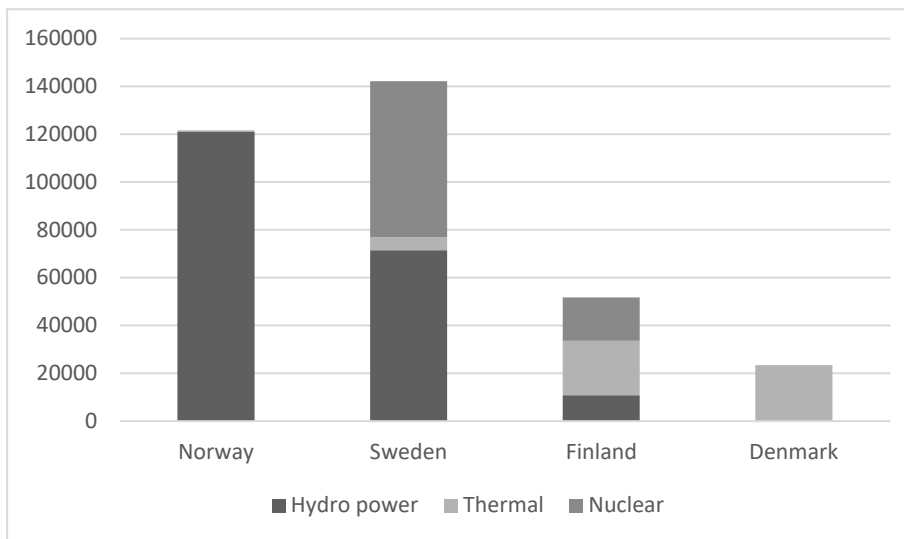


Figure 1: Electricity production in Nordic countries in 1990 (GWh)<sup>19</sup>

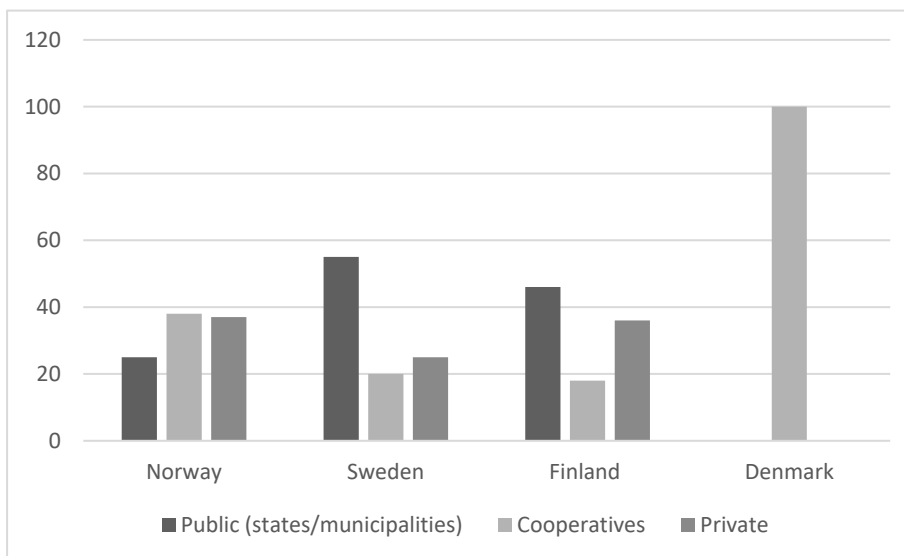


Figure 2: Ownership of generation as a percentage share of the market in the Nordic countries (1990).<sup>20</sup> (In the Danish case municipal ownership was via larger cooperatives)

<sup>19</sup> Bolton, R. 2022. Data from Nordel Annual Report 1990.

<sup>20</sup> Bolton, R. 2022. Data from Table 4.1 of Hjalmarsson, L. (1996) *From Club-Regulation to Market Competition in the Scandinavian Electricity Supply Industry*. In Gilbert, R.J., Kahn, P. (Eds.) *International Comparisons of Electricity Regulation*. Cambridge University Press, Cambridge, 1996, p.133.

Optimising across the entire region, as opposed to just at each national level, would mean, for example, that high marginal cost thermal plant in Denmark and Sweden could be displaced by excess hydro production in wet years, while in dry years the hydro dominated system in Norway would have additional security of supply, thus avoiding the need to build thermal plant. However, achieving this ‘optimal’ system had political consequences, particularly in Norway as prices would rise for those who had benefited from cheap power in the past, most notably heavy industries. Conversely, the production-side logic of more rational pricing of export power from Norway was clear as low prices on the spot market were undermining Statkraft’s business model. An alliance of pro-reform economists and politicians argued that higher prices for industries in Norway would reflect the fundamentals of the market, while those arguing against cited the benefits of cheap power for energy-intensive industries and regional development, along with the energy security risks of entering into firm power contracts, e.g. if hydro output was lower than expected.

Short-term spot market exchanges to aid with system balancing and emergency situations were common and had been organised via Nordel – the association for electricity co-operation between the Nordic countries. Formed in the late 1960s, Nordel provided a forum through which the large vertically integrated transmission operators developed ideas around regional trading mechanisms in a way which would protect their monopolies and the stability of their systems. This cross-border trade did not extend to ‘firm power’ contracts however.

Prior to the liberalisation reform, a long running point of contention in Norwegian energy policy was the export of cheap power across the border to Sweden during times of excess owing to high rainfall. In order to protect Statkraft, government permission was required for any exports and, despite the liberalisation reforms following the 1990 Energy Act, Statkraft retained its monopoly on international trade and exports of power from Norway under long term ‘firm power’ contracts. Statkraft’s monopoly on power exports was coming under pressure however as a number of Norwegian municipalities close to the border were lobbying strongly for permission to enter into bilateral contracts for firm power delivery to neighbouring Swedish municipalities. There was a strong political discourse in Norway that the benefits of the infrastructure assets which had been paid for by Norwegian consumers and taxpayers were being gifted to the Sweden in the form of low-priced power exports. There was an incentive therefore on government and Statkraft to organise and regulate this cross-border trade.

It is in this context that *Nord Pool* came into being. The market was created under Norwegian law on 1<sup>st</sup> January 1996 when the Swedish national electricity utility – Vattenfall – bought a 50% equity share in the Norwegian exchange and fees on cross-border flows were abolished, hence creating a common market in power trade. The technical work for this integration had begun in 1994 as part of Nordel’s *Nordic Exchange Study Group*. To some extent there was a natural evolution towards the integration of these markets. As the Norwegian spot market became increasing liquid and reliable it began to be used as a benchmark for power contracts throughout the region. The influence of the market grew and the existing trading arrangement organised via Nordel was largely replaced as Danish and Swedish producers traded with Statkraft with contracts linked to the Norwegian spot price. Imports into Norway were less controlled than exports, so at times inward flows would further depress prices, creating the need for a more robust framework to value international trade in electricity across the region.

The Swedish government had a number of years previously – in 1992 – made a decision to split the state-owned Vattenfall along similar lines as Statkraft, creating the TSO *Svenska Kraftnät*, and following a politically fraught process undertook liberalisation reforms of its

electricity market in 1995.<sup>21</sup> Due to the dominance of Vattenfall and the high level of concentration in the Swedish market, a Swedish-only power exchange was deemed not to be viable. Integrating with the Norwegian market provided an attractive solution. Similar to liberalisation processes across Europe during this period, the combination of national market liberalisation with internationalisation of energy markets enabled incumbents, Vattenfall in this case, to reinforce their position and expand their operations. In subsequent years a similar process saw the inclusion of the Finnish TSO, Fingrid, as an equity partner in Nord Pool and later the two Danish systems – east and west – were incorporated.

## 2.5 Configuring the Market and the National Systems

A key design feature of the Nord Pool market has been the ability of each national TSO to retain operational autonomy over their high voltage systems whilst participating in the common market. This accommodation between national control of power systems and participation in a wider market was built into the technicalities of the market through a procedure known as ‘market splitting’. While the ‘systems’ retain their historical national roots, the ‘market’ is delineated into distinctive pricing zones, as illustrated in figure 3 below. In some cases these correspond to the national system, with a single price zone for a country (e.g. Finland), whereas for others there are multiple zones within a national ‘market’. The approach of segmenting the market had been in operation in Norway before its liberalisation as the original *Samkjøringen* computer programme could calculate separate prices for ‘sub-pools’ which were created around likely zones of congestion on the grid. This enabled Statkraft to balance the system in the event that an influx of hydro power created bottlenecks on the grid.

The technique developed in Norway was adapted to the new circumstances after *Nord Pool* was created in 1996. Early on it became apparent that fluctuations in seasonal weather conditions would require a managed approach to grid congestion at the Norwegian-Swedish border: in both 1996 and 1997 low rainfall on the Norwegian side led to a significant inflow from its neighbour, while the opposite occurred in 2000. This coincided with a temporary shutdown of one of Sweden’s nuclear plants, creating a supply shortfall in the demand-intensive southern part of Sweden and putting pressure on grid capacity at the Norwegian border along with the north-south links within Sweden.

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<sup>21</sup> Högselius, P. & Kajiser, A. (2010). The Politics of Electricity Deregulation in Sweden: The Art of Acting on Multiple Arenas. *Energy Policy*, 38(5), pp.2245-2254.

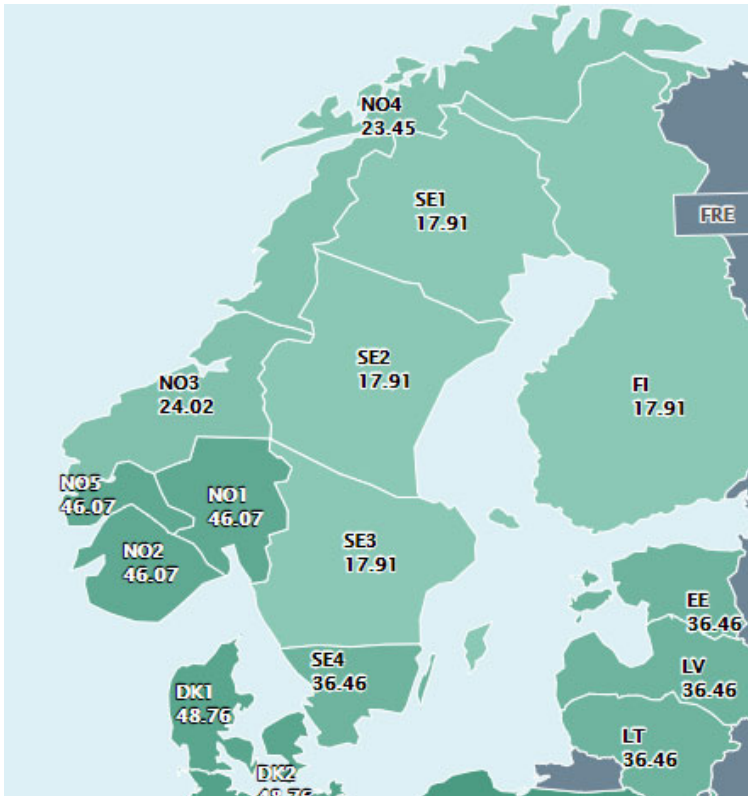


Figure 3: An example of a price zone configuration in the Nord Pool day-ahead (Elspot) market (Bolton, 2022. Courtesy of Nord Pool).<sup>22</sup> The Baltic TSOs became integrated into the market in the early 2000s, also taking equity stakes in the market operator.

The function of the power exchange within this market architecture is to aggregate the bids and offers of buyers and sellers of power and calculate clearing prices for each trading period. The national TSOs submit information about likely grid congestion, and based on this a decision is made whether to ‘split’ the market, resulting in a separate price for each zone, or to leave it ‘unconstrained’, with a single price for the entire market, thus maximising liquidity, and hence economic efficiency. In a ‘constrained’ situation scarce transmission capacity at the borders of each zone is then allocated by each respective TSO, with a fee for utilising the grid determined based on the price differential between each zone. The greater the price differential the higher the fee. The idea behind all of this is that power flows to the high-priced zone and signals are given about where investment in transmission lines to alleviate these constraints should be made. This situation approximates the economic ideal of a single market price whilst factoring in the physical constraints on trade.

The national TSOs play thus a central role in the market, both in terms of providing information to the power exchange and in collecting and reallocating the use of the transmission charge. This charge is in effect a tax on inter-zonal trades which is subsequently used to reinvest in the network. TSOs also ensure that the national systems remain in balance and have autonomy to intervene in the market in different ways to ensure the integrity of their systems. This is done through ‘countertrading’ and ‘redispatch’: the former involves the TSO actively trading in the market to even out price differentials and alleviate constraints – buying in the low-priced zone

<sup>22</sup> From Nord Pool: <https://www.nordpoolgroup.com/Market-data1/#/nordic/map> (Accessed 5.5.21. Reproduced here courtesy of Nord Pool). This market configuration is included for illustrative purposes only. Price zones are occasionally redefined. Sweden, for example, originally started as a single price zone now separated into due to transmission constraints arising from imbalances between the north (excess production) and south (a capacity shortage) of the country.

and selling in the high-priced zone – while the latter involves bilateral contracts with generators for reserve and response services.<sup>23</sup>

Market splitting was designed to operate according to technical principles, in particular with respect to the delineation of zonal boundaries – these should correspond to physical constraints rather than national system boundaries. However, the realities of the market illustrate the persistence of national systems with a strong degree of path dependency in how the zones were configured. In the Danish and Finnish cases market zones correspond to the original national system boundaries, while in the Swedish case there was initially a single national zone but was subsequently split following accusations that Svenska Kraftnät, the Swedish TSO, was limiting exports to Denmark in order to alleviate constraints on its system boundary. Efforts to reform zonal boundaries according to a market logic – with zones configured around areas of persistent grid congestion rather than historic system boundaries – have been hampered by a reluctance on the part of TSOs to cede control to the market. The original logic of the market was to have boundaries changing frequently based on demand forecasts and weather conditions. However, experience of implementing such a system in Norway in 1998 and 1999 led to a situation where trading ‘in some areas could also vary greatly over the course of 24 hours, so that bottlenecks arose for parts of the day in one place, only to disappear at other times of the day. Information about price area division over the course of a week became very complicated’.<sup>24</sup> Following this, what was intended to be a ‘flexible zonal pricing system’ was changed to ‘a system with a few a priori determined zones’.<sup>25</sup> The issue of price zone delineation and revision in light of changing market conditions has proved to be highly politicised and a problematic aspect of the *Nord Pool* market model.

### III. Final Remarks

This paper focused on the development and evolution of the Norwegian electricity market. It is in the early legislative reforms introduced in Norway that the concept of electrical power as a commodity which can be traded in organised markets has its origins. The case is notable because it was the genesis of cross-border trade in the Nordic region, with *Nord Pool* later becoming an important influence on the design of wholesale power markets across Europe and wider afield. With the breakdown of national monopolies and technological developments in IT systems and high voltage power transmission technologies, cross-border markets have become an important feature of the electricity industry globally. While technology has been a key enabler for this system evolution, the Nordic case shows that the institutional foundations of such markets are equally, if not more, important for the development of successful cross-border markets based on liberal principles.

An understanding of the history of the market as embedded in national systems reveals that an important feature of these cross-border markets is the need to find an accommodation between national policy and the benefits of wide and liquid power markets. While the idealised market would dispense with national systems, it has not been possible to decouple market trading from the specificities of national systems – both their technical configurations and embeddedness in political institutions. *Nord Pool*’s success as a model of electricity liberalisation and market

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<sup>23</sup> For a full explanation see: Bergman, L. and von der Fehr, N.H.M (1999) *The Nordic Experience: Diluting Market Power by Integrating Markets*. In: CEPR. *A European Market for Electricity? Monitoring European Deregulation*. Centre for Economic Policy Research, London, 1999, p. 127.

<sup>24</sup> Nordel Annual Report, 2000.

<sup>25</sup> Bjørndal, M. and Jørnsten, K. (2001) *Zonal Pricing in a Deregulated Market*. *The Energy Journal*, 22(1), p.72.

reform which could be transferred across national borders is based on an accommodation between economic theory and electricity system history.