From national to regional grid planning

Differences and harmonisation opportunities in the operations of the Nordic TSOs

Fortum Energy Review, November 2019

Foreword

From national to Nordic transmission system operations

Fortum is a true Nordic electricity company with a presence in all Nordic and Baltic price areas through electricity production and/or consumption. We are a strong advocator for a fully harmonised Nordic regional electricity market, as we – through our geographical presence – are able to witness the Nordic benefit ("Nordisk Nytta") that the common electricity market delivers every day to our societies. The Nordic electricity market enables the implementation of the Nordic countries' high ambitions for climate neutrality, energy transition and electrification of industries at a lower cost than if each country were to optimise the electricity market from a national perspective.

Fortum favours an efficient, competitive and market-driven regional power market where producers and consumers have an equal level playing field relating to market operations and market access. Fortum's own experience and this report show, however, that this objective is currently not fully materialised. A level playing field is not always equal throughout the regional market because transmission infrastructure and system operations are often optimised differently in the various Nordic countries.

This report, written by Pöyry on Fortum's assignment, reveals that the Nordic Transmission System Operators (TSOs) have different historical and operational perspectives. Grid investments are primarily driven by national interests and prioritisation. Even in joint projects where Nordic cost-benefit methodology is used, national interests often take precedence over common benefits. There are also clear differences in the approach to the existence and management of congestion in the transmission grid. In addition, present balancing tools are not harmonised across the Nordic TSOs. Finally, the transparency of information about the market is not disclosed in a systematic way across the TSOs.

Many of the differences can be explained by the fact that the legislative framework for regulating TSO obligations is not the same across the Nordic countries, and hence there is room for national perspectives and interpretations.

Fortum's assessment, based on the findings of the report, is that there are still many harmonisation opportunities for Nordic grid operations and planning. Fortum believes that farsighted and transparent grid planning decreases the uncertainty of investment decisions for market participants as well as the overall cost of the energy transition and electrification of our industries. All Nordic countries aim to become climate neutral during the 2030s. This means thousands of megawatts of renewable energy investments requiring new grid infrastructure and better system operation so as to not endanger the energy transition.

Fortum encourages the Nordic TSOs and Nordic policy makers to accelerate the harmonisation of operation and planning and to increase the overall co-operation inside the region, in order to ensure that the underlying physical infrastructure facilitates efficient energy markets and a cost-effective energy transition.

Fortum thanks Pöyry for writing this report and all the people interviewed for taking the time to share their thoughts. Fortum hopes this report will provide a good basis for continued discussion on enhancing the Nordic Electricity Market and Power System.

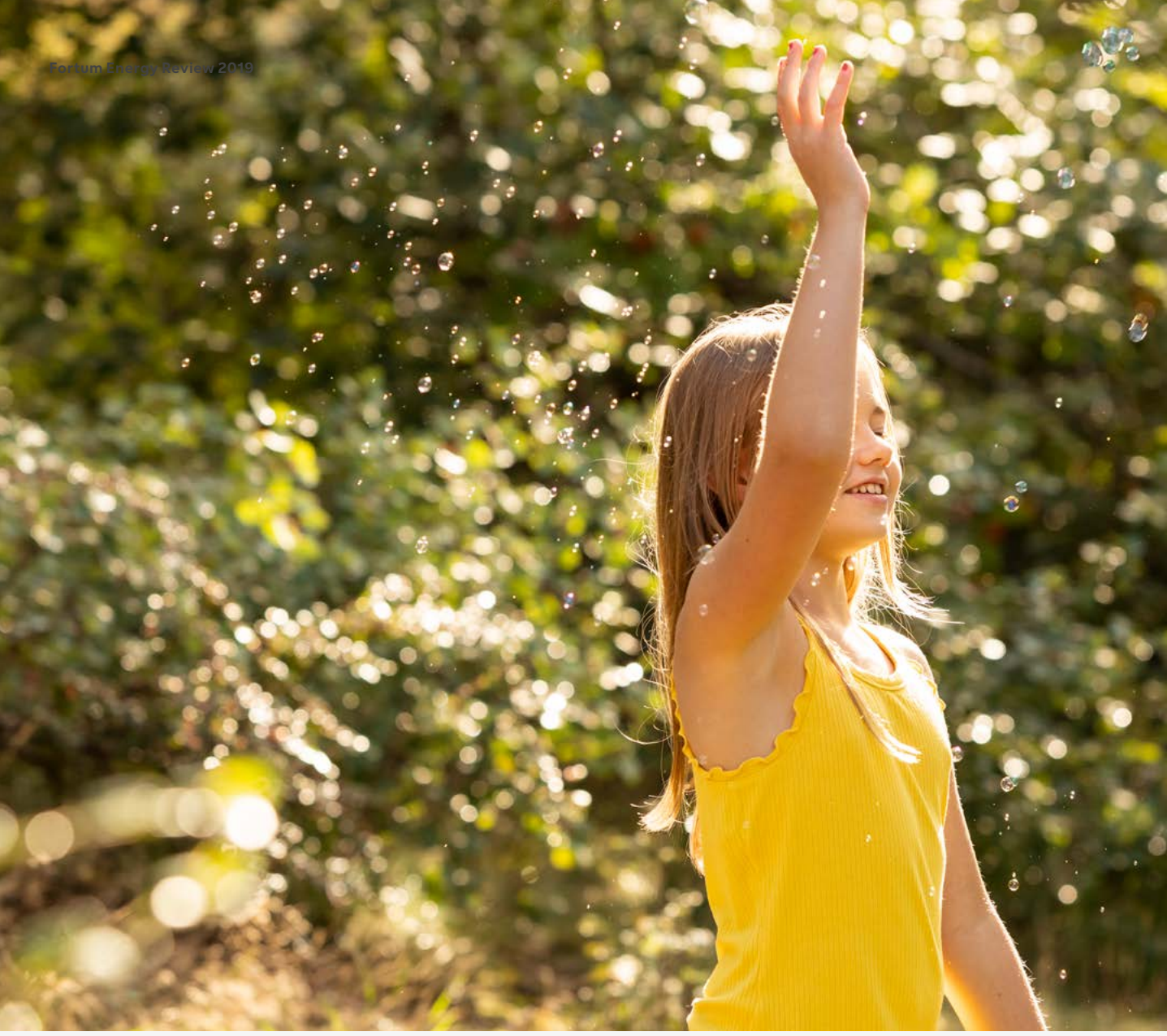
Key Fortum messages based on the findings of the Pöyry report:

The internal electricity market with well-developed grid infrastructure, both internal and cross-border, is a key enabler for reaching climate neutrality by 2050 through energy transition and electrification. How the co-operation of transmission system operators evolves in the coming years will be of crucial importance if we are to reach these objectives as cost-efficiently as possible.

Fortum believes that the regional Nordic electricity market is a key enabler for the Nordic countries' high ambitions for climate neutrality, energy transition and electrification at a lower cost than if each country were to optimise the electricity market from a national perspective. In order to realise the full potential of the Nordic electricity market, the Nordic countries should proceed from developing common market rules to harmonising the regional system operation and planning.

Our messages are primarily targeted to the Nordic policy makers, regulators, TSOs and other stakeholders, but they are equally applicable at the EU level.

- Energy transition and electrification will require significant strengthening of the regional grid transmission system.
- Farsighted and transparent grid planning decreases the uncertainty of investment decisions for market participants and the overall cost of the energy transition and electrification.
- Enhancing and harmonising the TSO operations and regulations at the regional level requires strong political backing.
- A co-ordinated regional approach in grid planning should be based on top-down optimisation of grid development. The regional plan should be more than a compilation of national plans.
- The socio-economic benefits of grid investments should be assessed from the regional perspective rather than from the national perspective.
- Congestion revenues should be invested in grid development to reduce existing bottlenecks.
- A separate regional financing hub should be established where congestion revenues would be collected. These pooled resources should be used to remove bottlenecks from the most congested areas.
- There should be a clear target to decrease the number of price areas in the Nordic power market.
- Nordic balancing markets should be harmonised and the number of balancing market places reduced. Market access to balancing market places should be equal and technology neutral.
- Market information should be disclosed in a systematic and transparent way across the Nordic TSOs.
- The Nordic Regional Security Co-ordination (RSC) should be strengthened to be the real co-ordination centre for Nordic system operations and planning.



Fortum Energy Review
November 2019

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About this publication: This report (pages 6-31) has been prepared by Pöyry Management Consulting for Fortum Oyj. It is an independent report by Pöyry and all the findings and views expressed in the report reflect the views of Pöyry as they were interpretable based on public information and interviews.

1 Introduction

Background

Nordic TSOs have a pivotal role in the electricity system, with responsibility for system operation and transmission grid development as well as key aspects of design of the electricity markets. Despite a strong history of collaboration, the organisational arrangements, governance structures and ways of performing statutory tasks differ significantly between the Nordic TSOs. These differences are due to the historical background and physical reality of the transmission systems as well as differences in national legislation and energy policy. Such differences may inhibit further steps to harmonise and integrate the Nordic and wider European electricity market, despite declared political intentions.

Harmonisation and integration of national electricity markets as a single Nordic regional market has so far been voluntary, and to date each step has provided benefits for each country fairly evenly. After the simple 'win-win' joint initiatives of the early days of cooperation, the benefits of further steps towards harmonisation may not be shared as equally. However, the economic benefits from further harmonisation and co-operation are still large and will increase further as the electricity systems continue to transform in support of decarbonised economies.

One key area is grid development and investment, which is frequently driven by national legislation and politics, when a regional approach could yield better outcomes. The Nordic grid development plans are compilations based on national plans and consensus, not (solely) on integrated analysis and common socio-economic trade-off. Previous cross-border investments have given mutual benefit; but increasingly the benefits of additional investments are asymmetric; and within the range of plausible future outcomes one of the countries may actually face welfare losses arising from the investment.

Investments are considered individually and despite the TSOs having considerable freedom to share costs and congestion revenues in innovative ways, there tends to be limited support from the country with less to gain (and more to lose).

Nordic TSOs are the key enablers of Nordic electricity market harmonisation. Ultimately, their operations are governed by the set of European and national legislation, statutory license obligations, and a number of regulatory priorities and incentives – topped with the national political expectations. This may lead to the situation where transmission infrastructure and system operations are optimised differently in the various Nordic countries. This report aims to shine a light on the differences between Nordic TSOs, their underlying drivers of behaviour, and to highlight the issue that the Nordic energy system would benefit from a more harmonised regional perspective.

Objectives

The purpose of the study is to understand the behaviour, and underlying obligations and incentives of the Nordic TSOs; specifically how and in what circumstances these support Nordic regional (or wider European) interests, or give precedence to national requirements. Our aim is to support an open discussion on the differences in Nordic TSOs' operations in a way that makes it possible to help stakeholders better understand the situation of the TSOs and their behaviours and also to identify areas where TSOs could align more closely to deliver Nordic (and European) benefits. More detailed objectives of the study are as follows:

- to bring up the main differences in Nordic TSO operations, rules and practices as-is;
- to understand and explain differences and the underlying drivers behind the differences;
- to understand how the differences may be explained by TSOs' national or regional interests; and
- to make high level recommendations for opportunities to witness and obtain Nordic socio-economic benefit ("Nordisk Nytta").

Our purpose is to support constructive debate around the activities of the Nordic TSOs and how the differences are reflected in the Nordic cooperation. While differences are discussed, we do not assess or compare the ways in which Nordic TSOs are executing their statutory tasks. Neither do we suggest solutions for the issues where the differences may lead to unoptimised solutions.

For the market parties, the study is intended to increase the understanding of the perspectives of Nordic TSOs. Sometimes there is criticism on the TSO operations and the pace of Nordic harmonisation from the market parties, even though a lot of good development has happened over the years. We have observed this perception in our own multi-client work on Nordic market design. In order to understand the whole, the reader has to understand the national and Nordic context.

For the TSOs, the study provides material to discuss opportunities for harmonisation that result in Nordic socio-economic benefit. The report also

brings up the views of key stakeholders on the further cooperation and harmonisation of Nordic TSOs operations.

Public authorities such as ministries and national regulatory authorities (NRAs) can benefit from the study by understanding better their vital role in promoting cooperation and harmonisation in the Nordic electricity market.

The study is based on public information and a series of interviews. Public information has been collected from many data sources such as financial statements and presentations of TSOs, network development plans, and studies, reports and statistics by ENTSO-E and other international and national organisation and regulatory authorities. Interviews were conducted with TSOs, ministries and NRAs in each of the Nordic countries and also with the Nordic Regional Security Coordinator during June and July 2019. A list of interviewees can be found in Annex A, and we are very grateful for their supportive cooperation.

2 Physical and political context

The Nordic electricity market consists of four integrated power markets: Norway, Denmark, Sweden and Finland. Together they share a population of around 26.5 million. Due to its northern location, widespread use of electric heating and the presence of power-intensive industry, the Nordic electricity market presents relatively high level of consumption by European standards, relative to its population.

Nordic TSOs have different historical and operational perspectives which influences their behaviour and approach

- **There are significant differences in the physical structure across the Nordic markets**
- **The challenges faced by the TSOs in operating the system now and in the future are different across the Nordics due to differences in generation structure, available resources and the gap to meet decarbonisation targets**

National energy policies

The Nordic countries pursue a broadly similar energy policy agenda, but can differ in terms of policy prioritisation due to factors such as resource endowments, consumption patterns and political priorities. Over the last ten years, the following dimensions have prevailed:

- Security of supply – Power supply and demand should continuously be in equilibrium.
- Economic efficiency and value creation – Society's overall benefits of power generation should outweigh costs.
- Sustainability – Power generation should be as environmentally sustainable as possible.

National energy policies include also national interests and priorities such as low energy prices for consumers and industries, national competitiveness, and maximising the value of common energy markets.

Power generation mix

The Norwegian power mix is dominated by hydro power. Of the 35GW of total installed capacity, hydro accounts for 32GW[1]. The electricity production is almost emission-free in contrast to other Nordic countries which are investing heavily in decarbonisation of their electricity systems. The large water reservoirs, located mostly in south-western Norway, are instrumental in providing system flexibility. Norway is also blessed with good wind resources, especially in the north but public opinion on wind power development is not very positive[2] at the moment.

The Swedish generation mix is dominated by nuclear (42%) and hydro (39%) power. Wind generation is growing fast and its capacity exceeds that of thermal generation. Vattenfall has decided to close two nuclear reactors by 2020, which will impact on the power generation mix and increase the share of intermittent wind production.

Finland and Denmark are net importers of electricity. The Finnish electricity supply consists mainly of nuclear, CHP, hydropower and a high share of imports. Finland has benefited from cheap hydropower in Sweden and Norway. Thermal plant profitability has been challenging, with low Nordic electricity prices leading to early plant closures. The commissioning of a new nuclear plant at Olkiluoto in 2020 will contribute to improve significantly the Finnish security of supply.

The Danish power market is quite different from the other Nordic markets. It is a smaller market, dominated by wind power and CHP rather than hydro or nuclear power. In 2018, wind served more than 40% of total electricity consumption.

Table 1 summarises the key characteristics of the Nordic electricity markets.

Nordic transmission system operators

Until 1986, Statnett's operations were part of the Norwegian Water Resources and Energy Directorate (Norges vassdrags- og energidirektorat, referred to as NVE hereafter). In 1986, NVE was split into two parts: the Statskraftverkene and a directorate (NVE). In 1992, Statskraftverkene was further split into one entity responsible for the grid and the other for power production. The former thus came to be known as Statnett, the Norwegian TSO and the latter is known as Statkraft. As of end of 2018, Statnett is a state enterprise, fully owned by

the Ministry of Petroleum and Energy (OED). The OED has a double role with Statnett; that of an owner and a regulator. Statnett's revenues are regulated by NVE, which is a directorate under the OED.

Energinet was founded in 2005 through a merger of power grid operators Eltra, Elkraft System and Elkraft Transmission, as well as natural gas TSO Gastra. It belongs under the Danish Ministry of Climate, Energy and Building, and is fully owned by the Government of Denmark. Energinet owns the Danish central grid and all significant interconnectors with border countries. Danish law requires Energinet to keep its electricity and gas related operations financially separate.

Svenska Kraftnät (SvK) was created in 1992, ahead of market liberalisation in 1996. It was split from the Government owned joint generation-transmission-supply entity Vattenfall that existed at the time. SvK operates as a state-owned enterprise that is legally part of the Swedish Government (a so called "affärsverk"). That is, this differs from a Government owned, but separate legal entity. It receives written instructions ('Regulatory Letter') from the Swedish Parliament each year.

Fingrid Oyj is a company responsible for electricity transmission in the high-voltage transmission system in Finland. It was established in 1996 when the Finnish state owned power company Imatran Voima Oy (currently: Fortum), industry power company Pohjolan Voima Oy (PVO) and the Finnish state agreed to concentrate all transmission network infrastructure and operations into one company. Fingrid is currently a public

Table 1 – Key characteristics of the Nordic electricity market, 2018	Norway	Denmark	Sweden	Finland
Demand, TWh	136	34	141	87
Total generation, TWh	146	29	158	68
Hydro	95%	0%	39%	19%
Nuclear	0%	0%	42%	32%
Thermal	2%	47%	10%	39%
Wind and solar	2%	51%	9%	9%
Share of renewables	97%	51%	56%	47%
Net export, TWh	9.9	-5.2	17.3	-19.9
Export	18	10.4	31.6	3.4
Import	8.1	15.6	14.2	23.4
Installed capacity, GW	35.0	16.1	39.9	17.4
Peak demand, GW	24.1	6.1	27.4	14.2
Bidding zones	5	2	4	1
Day-ahead price, EUR/MWh	43.05-44.08	44.05, 46.20	44.23-46.36	46.80

Source: Nord Pool, ENTSO-E

Table 2 – Key financial figures of Nordic TSOs, 2018 (MEUR[1])	Statnett	Energinet[2]	SvK	Fingrid
Revenues	961.9	462.4	1138.7	863.6
Operating profit	328.4	50.3	-9.1	241.6
Balance sheet	7398	4413	2614	2110[5]
Dividend	34.3	0	12.9	171.4
Rating	A2/A+	AA-	AAA[4]	AA-/A+
Personnel	1461	470[3]	616	380

1) Average exchange rate 2018, 1 EUR = 9.5 NOK, 7.45 DKK, 10.26 SEK
2) Figures for electricity TSO (TSO-EL), excludes gas TSO (TSO-GAS) and other subsidiaries of the group
3) Estimated from the total personnel in the group (1264) and the division of personnel costs (TSO-EL MDKK 241 and group MDKK 642)
4) State rating
5) Consolidated balance sheet

Source: Statnett, Energinet, SvK, Fingrid

[1] Statistics Norway and NVE
[2] https://e24.no/energi/vindkraft/turistforeningen-mener-vindkraft-rammer-truer-verdifull-natur/24593877

limited liability company in which the Finnish state has a controlling stake. The majority of the shares (53.14%) are owned by the Finnish state and the National Emergency Supply Agency. The rest of the shares are held by Finnish financial and insurance institutions.

Table 2 shows key financial information of the Nordic TSOs.

Nordic transmission system

Nordic transmission grids are physically very different, as can be seen in **Figure 1**. The Swedish main grid is characterised by long north-south transmission lines. Most hydro capacity is located in northern areas, and nuclear capacity in the mid- and southern parts of the country. There are very few east-west transmission lines. The Swedish main network is old, with investment needed to replace assets that are reaching the end of their lifetime, provide capacity for renewable energy production and minimise bottlenecks.

A distinctive feature of the Finnish transmission grid is also transmission lines running from the hydro power plants in northern Finland to the cities and industrial centres in southern Finland. It is also characterised by the 'atom ring' around southern Finland. Faster than expected growth in the wind power in northern Finland increases the north-south transmission need which puts added pressures on so called P1 cut. Cut P1 splits Finland into two areas: the north, with its focus on hydro and wind power, and the south, where nuclear and thermal power are predominant.

The Norwegian transmission grid reflects the fact that most parts of the electricity supply in most parts of the country were developed through the regional development of hydropower. The Norwegian transmission grid has developed by connecting local or regional radial grids built around the largest cities and production units over the course of time. Originally, most of these grids were self-sufficient, and in spite of strong development efforts, there is still a lack of internal north-south capacity crossing the 62nd and 67th parallels. A major effort is being made to strengthen the internal capacity linked to the cables to the Continent (incl. Jutland) and Great Britain.

Denmark has two separated transmission systems, of which the eastern one is synchronous with the Nordic region and the western one with the synchronous grid of Continental Europe.

The Nordic day-ahead/intra-day market consists of 15 bidding zones including the Baltic countries. Historically, Norway has had a policy of market splitting since before the creation of the Nordic market in the 1990s, and has a policy of dynamically

Figure 1 – Nordic transmission system map

Source: ENTSO-E[1]

[1] https://docstore.entsoe.eu/Documents/Publications/maps/2019/Map_Northern-Europe-3.000.000.pdf

changing the zones as a response to changes in regional supply situations. This is at odds with the EU policy, but there is temporary a Norwegian exemption. Market splitting is used to deal with major and long-term congestions in the regional and central grid system, or possible lack of energy in defined geographical areas. At the moment Norway is divided into five day-ahead/intraday areas[1].

SvK divided Sweden into four bidding zones in 2011. The aim of introducing bidding zones was to delimit congestion points within the Swedish electricity system and allow electricity trading to adjust to effectively available transmission capacity through market prices, rather than through arbitrary curtailment measures at the borders[2]. The commitments set by the European Commission in 2010 are binding on SvK for ten years[3].

Finland has opted for another approach. Based on the electricity market act, Fingrid shall plan and construct the main grid in a way that the transmission capacity is sufficient to keep the whole country as a single bidding zone. Two exceptions to the obligations are specified in the act.

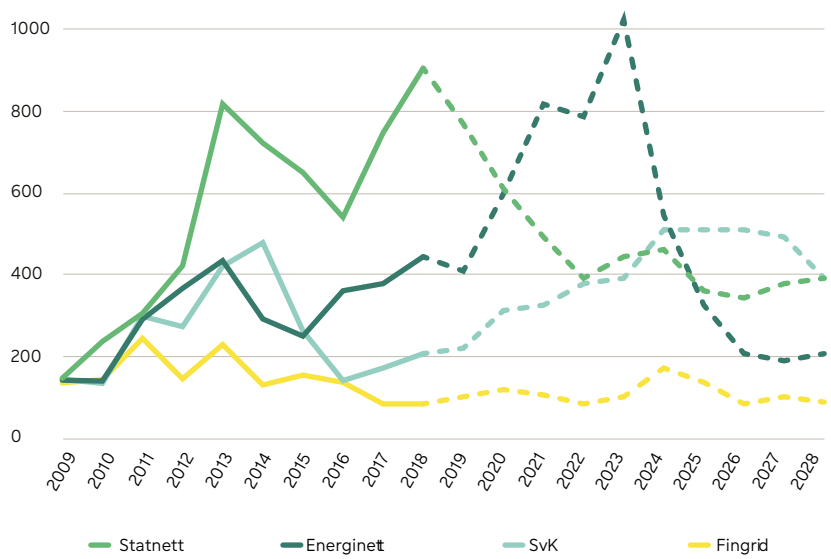
Eastern Denmark and Western Denmark are always treated as two different bidding zones because Denmark belongs to two synchronous areas.

Nordic TSOs have jointly launched a regular review of existing bidding zone configuration as required in regulation (EU) 2015/1222 on establishing a guideline on capacity allocation and congestion management[4]. In the proposed configuration regarding Sweden, a modified SE4 is introduced in the Stockholm Metropolitan Area. The current SE3 is expanded to include the remaining area of current SE4. In Norway a split of NO4 is proposed, and a new NO6 is introduced. No cross-border bidding zones have been suggested. For Denmark and Finland no alternative configuration will be assed at this stage.

Investments in main grid

As can be seen in **Figure 2**, Statnett has invested heavily during the last few years. Large investments are partly explained by the construction of cross-border interconnectors to Germany and to the UK. The cross-border interconnectors currently under construction align well with Norway's energy policy to enable closer integration with neighbouring markets and increase the value of Norwegian renewables and foster closer co-op-

Figure 2 – Investment of Nordic TSOs, 2009–2028 (MEUR)



Note: 2009–2018 realised investments, 2019–2028 planned investments. The period 2016-2028 is as reported in the NGDP 2019 and the other historical data is from the TSOs' annual reports.
Note: Energinet's historical figures are corporate level investments excluding acquisitions, but include smaller investments to the gas grid infrastructure on top of the transmission infrastructure.
Source: Statnett, Energinet, SvK, Fingrid

[1] https://www.nordpoolgroup.com/globalassets/download-center/day-ahead/elspot-area-change-log.pdf
[2] https://europa.eu/rapid/press-release_IP-10-425_en.htm?locale=en
[3] https://ec.europa.eu/competition/antitrust/cases/dec_docs/39351/39351_1223_4.pdf
[4] https://www.statnett.no/contentassets/f4a33c4dd9504acbb44399298d8aa822/nordic-bzrr-alternative-configuration.pdf

eration. Investments are expected to decline in the coming years.

A distinctive feature of SvK's and Energinet's investments is a great annual fluctuation. As the Swedish transmission network is old, large investments are planned in the coming years. In total, SvK's investment plan for 2018-2027 includes investments of SEK 45 billion (around EUR 4500m).

Fingrid's investments in the main grid have been quite stable in recent years and there are no major changes expected in the near future. During the period 2019-2028, Fingrid intends to invest EUR 1200m to ensure the sufficiency of the grid capacity and system reliability. One of the main objectives of the plan is to keep Finland as a single bidding zone which requires strong connections in order to balance variations in production and consumption.

Table 3 – Congestion income (MEUR)	2014	2015	2016	2017	2018
Statnett	96.6	119.2	125.9	110.4	100.1
Energinet	71.6	74.0	55.5	72.3	75.4
SvK	128.8	221.1	115.6	135.5	158.1
Fingrid	51.2	90.9	39.9	25.8	29.7
Total	**348.2**	**505.2**	**336.9**	**344.1**	**363.3**

Source: Statnett, Energinet, SvK, Fingrid

The majority of this investment will therefore be used to reinforce cross-border connections and north-south transmission capacity.

Congestion income is one metric for the adequacy of transmission capacity and market efficiency. In the Nordic countries, congestion income has totalled EUR 300-400million in recent years (**Table 3**). There has been some yearly variation depending on the production surplus in the Nordic area among other things. SvK and Statnett are the Nordic TSOs with the highest yearly congestion income. The use of congestion income is discussed in **chapter 3.1**.

3 Transmission grid investment

Grid development and Investment

During the interviews it was mentioned by many that grid planning and investment is probably the least coordinated activity between the Nordic TSOs. A variety of reasons were given for this view despite the fact that Nordic TSOs are involved in preparing grid development plans on many different levels:

- The ENTSO-E Union-wide ten-year network development plan is published biennially (TYNDP). A separate regional investment plan for the Baltic Sea region is also published. In addition, the European Commission publishes Baltic Energy Market Interconnection Plan (BEMIP) focusing on the Nordic and Baltic Sea region.
- The Nordic Grid Development Plan describes the ongoing and future investments in the Nordic grid[1]. The plan is published by the Nordic TSOs at the request of the Nordic Council of Ministers.
- National grid development plans developed by each TSO.

The planning and investment processes described above are linked and feed into each other, to some extent. For example, the Nordic grid development plan is supposed to function as a complementary bridge between the national planning processes and the ENTSO-E TYNDP. When Nordel was integrated into ENTSO-E in 2009, the existing structures for planning and operations were transferred to ENTSO-E (i.e. Regional Group Nordic) as opposed to markets which were kept as a Nordic structure (i.e. Market Steering Group). Based on the interviews there were some issues relating to the roles and coordination in Nordic grid planning processes vis-à-vis European processes. The common Nordic Planning Group (NPG) was re-established in 2014 and uses the ENTSO-E scenarios as a starting point for deeper Nordic analysis. NPG is a joint grid planning group consisting of members from the four TSOs.

The preparation of network development plans is statutory at the first two levels described above but the plans by themselves are not binding on TSOs. The next step in the investment process is that each case is studied in detail by the respective TSOs. At this stage additional analysis and sensitivities are carried out but the process for agreeing inputs for the analysis is not clear. In addition, more local aspects related to investments including local grid reinforcements are assessed.

All of this means that the position of a TSO on investments can change as the process develops. Any final recommendations on investments are made on a bilateral basis before being submitted to relevant national authorities for approval. In this way investment decisions can ultimately be seen as national and unilateral.

The responsibility for decision making is ultimately political. Each Nordic TSO has its own national regulatory framework and processes to prepare the national grid development plan and approve grid investments to be implemented. The final decision making power of cross-border interconnectors is outside the Nordic TSOs. In Norway, for major grid decisions, the decision making authority is, due to high level of conflict, sometimes elevated from the NVE to the Ministry and to the Government (Council of Ministers), and in some cases even to Parliament (in particular related to major cross-border cables). In Denmark, the Ministry of Climate, Energy and Utilities has the decision making authority. In Finland, Ministry of Economic Affairs and Employment is responsible for decision making of cross-border interconnectors. In Sweden, the Parliament takes decisions on TSO investments.

As a result, TSO by itself or NRA or ministry can stop analysis for interconnectors that might not be a priority. During the interviews, it was mentioned that Nordic TSOs are now more focused

Grid investments are subject to national interests and prioritisation

- Grid planning is seen as the least coordinated Nordic TSO activity
- Grid initiatives do not always progress. TSOs are good in making long range plans but not so good in implementing them
- Prioritisation of Nordic grid investment is a vague subject
- Investment decisions are ultimately always national
- One or several bidding zones – national or TSO objective? Do the bidding zone differences reflect the structural congestion?

[1] https://www.fingrid.fi/globalassets/dokumentit/fi/tiedotteet/lehdistotiedotteet/stet0126_nordic_grid_dp_2019.pdf
[2] Shall be applied from 1 January 2020. Regulation (EC) No 714/2009 is repealed.

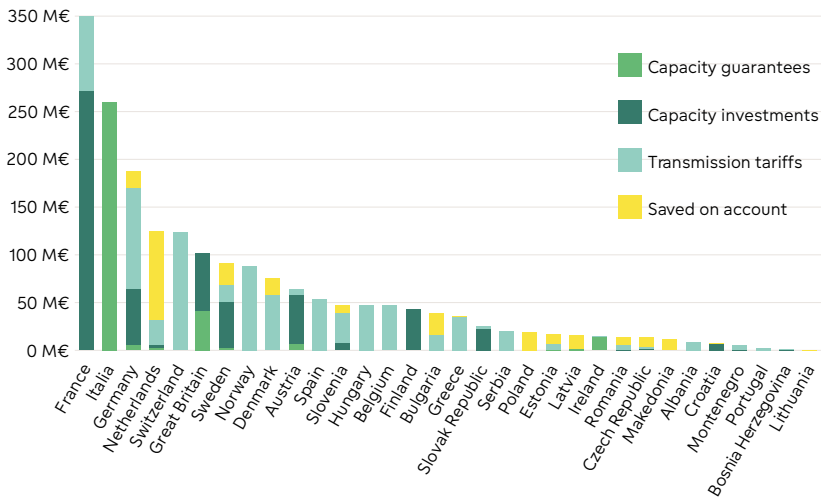
on internal investments in grid and interconnectors to the continent than new interconnectors between Nordic regions. Part of the reason was due to prioritisation. That is, new connections e.g. for new data centres were seen to bring more benefit than building new interconnectors, for which the benefits were seen as small. It can also be the case that one border is prioritised over another. E.g. it was also mentioned that a previous Danish minister had prioritised cross-border connections with Germany more than with Sweden.

It was also noted that new investments are often delayed and are not always in line with Nordic market development. Access to capital was not seen as an issue for TSOs regarding new investments. A more relevant issue was seen to be around availability of the supply chain e.g. construction companies, resources etc. It was also noted that Nordic TSOs are also in different phases of grid investment.

The use of congestion income

As shown in the **Figure 3** the Nordic countries have different approaches to accounting and using the congestion income. In Finland, since 2016, Fingrid has not presented congestion income as turnover in profit and loss statement. The congestion income is included in the balance sheet. Fingrid has been using congestion income only to fund grid investments. Statnett has no separate account for congestion income. All investment is made by spending tariff income and all of the congestion income has been spent to lower transmission tariffs. Sweden and Denmark have used larger shares of congestion income on lowering transmission tariffs or save revenues in a separate account. In addition to the different approaches, also the significance of the matter is seen in different ways.

Figure 3 – Spending of congestion revenues, 2011-2015 (annual average)



Source: ENTSO-E, Study supporting the impact assessment concerning transmission tariffs and congestion income policies, 2017

Table 4 – Unit Transmission Tariffs in 2019	Statnett	Energinet	SvK	Fingrid
Unit transmission tariffs €/MWh				
- 330 kV and above	6.21	11.05	3.37	5.26
- 220-150 kV	6.21	11.05	3.37	5.26
- 132-50 kV	6.21	11.05	0.00[1]	5.26
Sharing of network operator charges, %				
- Generation	29.0	4.3	36.0	18.6
- Load	71.0	95.7	64.0	81.4

[1] Not fully comparable with other due to network structure

Source: ENTSO-E (June 2019)

The forthcoming internal electricity market Regulation (2019/943[2]) states the procedure for the distribution of congestion income and directs TSOs to use congestion income to make sufficient cross-border capacity available and when this criterion has been fulfilled revenues can be used to support tariffs.

Based on the recent study by ENTSO-E, the unit transmission tariffs of Statnett and Fingrid are low compared to most European TSOs (**Table 4**). SvK's tariffs are one of the lowest in Europe but they are not fully comparable due to different network structure.

Cost benefit analysis for grid investments

Nordic TSOs have agreed on a common harmonised framework for cost benefit analysis (CBA). The framework is used in all bi-/multilateral studies for the Nordic Grid Development Plan[1]. In the interviews it was mentioned that the Nordic TSOs have developed their own CBA approach to try and capture uncertainty in a way that is better suited to the Nordics than the standard European CBA approach. In practice this means the TSOs develop a number of scenarios and sensitivities to test the profitability of a proposed interconnector.
The common CBA takes into account all relevant costs and benefits, from a Nordic socio-economic standpoint. The levels of detail in the assessments depend on the given stage of the actual project under investigation and all factors listed in **Figure 4** are not relevant to assess in each project.

The CBA shall be based on at least one scenario that is commonly accepted by the Nordic TSOs and at least two time steps shall be used in accordance with the scenario. A sensitivity analysis can be performed to capture the changes and uncertainty in key parameters.

Common standard Nordic CBA methodology is avalaible but the power market scenarios, uncertainties and other inputs cause controversy

- **There is a question whose welfare is optimised and how wider Nordic benefits are included in national approval processes**
- **Different views on economic uncertainties and risks can be used as a means of justifying different prioritisation of grid investments**

The common Nordic CBA framework is not intended to be use as basis for final investment decision. This should be done by the TSOs themselves. It was mentioned that the selection of inputs for scenarios can cause controversy and the process is not always clear. In case of projects of common interest (PCI), the CBA assessment shall follow the methodology prepared by ENTSO-E.

While national electricity market legislation and TSO's investment guidelines do not limit the scope of CBA to the national standpoint, in principle, the national interests and socio-economic benefits are prioritised over those of the other countries.

Grid investments must therefore have a higher national socio-economic benefit that socio-economic cost. In addition, there is a question around whose social welfare is maximised (market versus country). For example, it was noted in the Danish case that the socio-economic optimisation starting point is Denmark. In addition, the general formulation written into the Energy Act is for the benefit of (Danish) consumers with a softer formulation of Nordic needs.

Figure 4 — Monetised and non-monetised costs and benefits in the common CBA

	COSTS	BENEFITS	
Monetised indicators	Investment costs	Market benefits	Transmission losses
	Operation costs	Integration of renewable energy	
Non-monetised indicators		CO_2 emissions	Security of supply
			Flexibility and trade balancing

PROJECT ASSESMENT

[1] https://www.statnett.no/contentassets/61e33bec85804310a0feef41387da2c0/nordic-grid-development-plan-2019-for-web.pdf

Cost and benefit sharing in grid investment

The history of Nordic cooperation has been successful as it has been based on mutual benefit. With deeper integration, the mutual benefit is not always so clear to see or benefits are not shared as equal anymore and this can be a barrier for investments. There are examples where there is conflict between national and Nordic interests.
The point was made that if there are asymmetric costs and lots of uncertainty, there could be a real risk that one country actually loses rather than gains and that forecast uncertainty is also a barrier to investment in schemes with very asymmetric benefits.

Asymmetric costs and benefits between countries complicate cross-border investments and is a new normal

- Simple win-win investment cases have been completed and new projects are more complicated with uneven and uncertain benefits and costs. E.g. triggering additional investments within a country or that the original conditions assumed when assessing interconnector income change.
- Some projects with asymmetric benefits have been realised in the Nordics. TSOs have the freedom to negotiate and agree cost and benefit sharing on a case by case basis. However, the procedures and principles are not so clear. That is, there are no standard procedures and projects do not always proceed despite positive CBA results.
- One factor complicating the cost and revenue sharing agreements is the threat of challenges from regulators to take retrospective actions on revenue sharing schemes that TSOs have agreed.

Case study

Danish-German border and Skagerrak 4

Denmark and Norway are linked by 4 cables – Skagerrak 1-4 that run between DK1 and NO2 price areas. Skagerrak cables 1-2 were laid in 1977 and Skagerrak 3 in 1993. The combined capacity of SK1-3 is 1000MW. In 2009, the fourth cable (Skagerrak 4 – "SK4") of 700MW capacity was agreed to be developed in partnership between Energinet and Statnett. Licenses were approved in June 2010 (Norway, OED). Commercial operation began at the end of 2014.

The costs of SK4 were split equally between Energinet and Statnett. But, as the benefits of the cable were seen to fall mostly to Denmark then two revenue sharing mechanisms were introduced.

The first revenue sharing mechanism was an ancillary service agreement, the structure of which reflects the sale of Norwegian aFRR to Energinet over the first 5 years of operation i.e. 100MW of capacity on SK4 is reserved for aFRR[1]. The Danish Energy Authority provided conditional approval for the arrangement and then based on the results of an investigation into the social benefits after the first year of operation, cancelled the arrangement from 1 January 2018 and requested the TSOs to put a more dynamic reservation mechanism in place. Statnett and Energinet appealed to the Danish Energy Board of Appeal who then decided that the reservation for exchange of aFRR could continue until the end of 2019. During the appeal, the TSOs cited the importance of the arrangement as a prerequisite for Statnett's investment in SK4[2].

The second part of the revenue sharing agreement is that Statnett receives congestion income from DK-DE border. In practice this means there is an agreement between Energinet and Statnett that links congestion income on the DK-DE border to a payment to Statnett. This is because when decisions about SK4 investments were made, the alternative for Statnett was to build a cable between Norway and Germany. In addition, at that time cross-border capacity to Germany was assumed to be available. The outturn has shown lower availability of cross-border capacity and a mechanism has been introduced to increase cross-border capacity to the market between Denmark and Germany.

Historically, availability of interconnector capacity to the day-ahead market on the DK1-DE border has been low due to internal bottlenecks in the German system. In 2017 the Danish and German Ministries and Regulators issued a joint declaration stating the aim of gradually increasing the cross-border capacity allocated to the day-ahead market between West Denmark and Germany. There is a stepwise target (to 2020) to reach certain minimum capacities of cross-border capacity that will be made available to the market in each hour. The respective TSOs (Energinet and Tennet) are responsible for implementing the declaration. The requirement to open capacity to market participants is addressed in the Clean Energy Package (minimum of 70% capacity).

In times where physical congestion restricts cross-border capacity, the Danish and German TSOs will carry out countertrading to secure the minimum capacities (in the case of DK1 mostly down regulation using special regulation). This releases virtual capacity to the day-ahead market rather than physical capacity and so impacts financial trading rather than physical flows.

A design feature of special regulation is that it should not impact the balancing market. Special regulation is selected after bids for normal balancing have been selected. Energinet submitted a report to the Danish regulator in early Spring 2019 on possible evidence of gaming and monitoring is ongoing[3].

1 https://www.statnett.no/contentassets/ee224b0a208b4814a4c0f047a2257feb/interconnector-license-applications.pdf
2 https://www.statnett.no/en/about-statnett/news-and-press-releases/News-archive-2018/danish-authorities-rule-to-continue-capacity-reservation/
3 https://en.energinet.dk/-/media/BE76CDEDF65D47B287006B256F2DD440.pdf?la=en&hash=CC2809B3F4910EDC84087DD094C512F04A279EF5

4 System operation

System operation is a TSO activity with the most effective Nordic cooperation excluding times of disturbances. This is because the operational area is less political and focuses on the need for control as an essential part of operating the Nordic system. However, at times of concern for system security, there is less collaboration and a perception that the TSOs will act conservatively to protect their own national consumers.

There is no common approach to dealing with congestion in the main grid

- **The philosophy of planning for and dealing with congestion is not consistent**
- **A common merit order for managing re-dispatch on a Nordic basis is missing**
- **There is limited transparency towards the market around how congestion is dealt with in the short and long run**

Congestion management

Congestion management covers the following circumstances:

- a situation where capacity made available to the market between zones cannot be physically realised;
- a situation in which limited intrazonal capacity (essentially assumed to be unlimited in spot markets) cannot accommodate the scheduled patterns of generation and demand; and
- how the TSOs deal with grid constraints due to disturbances or forced outages.

In the Nordic market the TSOs use various measures to relieve internal bottlenecks within price zones. Congestions also occur between price zones and are managed using countertrade.

The approach for countertrade used by Energinet on the German border is to use special regulation (as described in the case study). Six different countertrade approaches were assessed during an impact assessment. Nordic TSOs also held a workshop on the possibility of extending the special regulation to include other Nordic bids which fed into the impact assessment. SvK and Statnett did not agree that it was possible to extend the market area for special regulation to include other Nordic market areas. The reasoning was that additional imbalances from Germany would pose operational challenges to manage frequency quality and security of supply due to internal constraints in both the Norwegian (generally) and Swedish system (West Coast Cut)[1].

Due to the physical difference in grid structure between areas in the Nordic grid, it is clear that not all TSOs have the same problems with congestion management, nor the same tools to deal with the problem[2]. For example, in Finland and Denmark the grid is strong resulting in fewer congestions than e.g. Norway or Sweden but the system does not have the same level of flexible resources leading to a focus on developing demand side response. Norway has many internal grid constraints and must deal with congestions despite having flexible reservoir hydro assets leading to low re-dispatch costs to deal with internal congestions. The Swedish grid has systematic constraints in the West Coast Corridor which is often cited as a reason why interconnector capacity is restricted[3]. As a whole the Nordics have adopted an active balancing philosophy that is structured around the need to deal with internal congestions[4].

[1] Section 4.3 of impact assessment: https://energinet.dk/-/media/Energinet/Presse-JNR/DK-Nyheder-dokumenter-2017/DK1-DE-Countertrade-models-Collected-Impact-Assessment.PDF
[2] https://www.nordpoolgroup.com/message-center-container/newsroom/tso-news/2016/q4/no.-332016---updated-routine-for-congestion-management-for-the-west-coast-corridor-in-sweden/
[3] https://www.svk.se/siteassets/om-oss/rapporter/2018/transmission-capacity-available-to-the-market-q1_2018.pdf
[4] https://www.svk.se/contentassets/bc60c82ceaec44c0b9ffbf3ee2126adf/nordic-balancing-philosophy-160616-final_external.pdf
[5] https://nordic-rsc.net/
[6] ENTSO-E. Available at: https://www.eles.si/Portals/0/News/ENTSO-E_PowerFacts_2019.pdf
[7] http://forsyningstilsynet.dk/fileadmin/Filer/0_-_Nyt_site/EL/Sekretariatsafgoerelser/2018/OEvrige_afgoerelser/CCM_Norden/Bilag_6_-_DUR_EV_Ei_CCR_agreement_on_future_RfA_10_July_2018.pdf

Contingency management

The following comments were made during the interviews related to contingency management:

- During the interviews it was noted that TSOs work very closely in supporting one another at times when there is not a crisis: 'the control rooms would give their little fingers for each other'.
- Cooperation and transparency between neighbouring system operators during critical system situations was seen as important as it sets the conditions on how TSOs can rely on the availability of cross-border capacity in times of scarcity and as a result capacity allocated to the market or national measures such as strategic reserve.
- TSO control rooms in the Nordics cooperate very well in times of normal system operation. In times of a critical system situation it was mentioned that this is one area where national interests are present and where European regulations pushes for a more regional approach.

An operational example given was the situation in which a cross-border capacity would be curtailed to avoid a brownout within a TSO national perimeter. There are few public regulations written about the practice in this situation. Some of the interviewees said that political alignment on this topic (a set of solidarity principles that covers the region) would be a helpful step. Other interviewees saw that the security of supply is ultimately always a national topic although the solutions can be pan-Nordic or European wide. In Denmark, a recent amendment to the Electricity Act placed more responsibility for security of supply with the Ministry relative to the TSO.

EU regulation forsees a move towards a regional approach for capacity calculations with probabilistic modelling for security of supply analysis. The Nordic RSC is the joint office for the Nordic TSOs[5]. Nordic RSC supports its owners, the national TSOs, in maintaining the operational security of the power systems in the Nordic region. The core tasks and responsibilities of RSC are defined in the Commission Regulation (EU) 2017/1485 on establishing a guideline on electricity transmission system operation (System Operation Guideline).

The protocols regarding capacity calculations for contingency management appear unclear to market participants and to some degree, to neighbouring TSOs

- **It is not clear under which circumstances cross-border capacity will be reduced and by how much (both day to day operations and in times of scarcity)**
- **RSC rules suggest that capacity calculations should be done by the RSC but there are specific complexities in the Norwegian grid that make this task necessary to perform in Norway according to NVE and Statnett**

The tasks of the RSC include: coordinated capacity calculation, coordinated security calculation, outage planning coordination and short and medium term adequacy. While the RSC cannot take actions to control the grid it can use the results of the calculations to make recommendations on how the TSOs act to optimise results for the region.
The clean energy package amends the system operation guideline and adds additional service responsibilities to RSCs, who should become Regional Coordination Centres (RCCs) at the latest by 1.7.2022[6]. The role of RCCs is also defined in Regulation (EU) 2019/943 on the internal market for electricity. The tasks and responsibilities of the RCC consist of the following:

- carrying out the coordinated capacity calculation and security analysis
- creating common grid models
- supporting the consistency assessment of transmission system operators' defence plans and restoration plans
- carrying out regional week ahead to at least day-ahead system adequacy forecasts and preparation of risk reducing actions
- carrying out regional outage planning coordination
- regional sizing of reserve capacity
- facilitating the regional procurement of balancing capacity

In approving the Nordic TSO proposal for capacity calculation methodology (CCM), the regulators (CCR Nordic) noted that the proposal did not provide sufficient clarity on the roles in the capacity calculation, especially around dynamic stability calculation. The regulators asked for the Nordic TSOs to work towards enabling the coordinated capacity calculator to handle dynamic stability calculations at a regional level[7]. During the interviews it was reported that NVE did not agree with the decision, proposing that Statnett should do the calculations and provide the inputs to the RSC. The reasoning was based on the immaturity and cost of the dynamic grid model compared to the existing expertise at the TSO.

Table 5 – Reserve products offered by the TSOs	Statnett	Energinet	SvK	Fingrid
FCR-N				
- bid size	Usually min 1MW	Max 3MW for aggregated portfolios	Min 0.1MW	Min 0.1MW
- activation	Automatically at 49.9–50.1Hz. For loads 50% 5s and 100% 30s	DK2: 100% 150s	Automatically at 49.9–50.1Hz. 63% 60s and 100 % 3min	Automatically at 49.9–50.1Hz. 100% 3min
FCR-D				
- bid size	Usually min 1MW	Max 3MW for aggregated portfolios	Min 0.1MW	Min 1MW
- activation	Automatically when frequency below 49.9Hz. For loads, 50% 5s and 100% 30s	DK2: 50% 5s and 100% 30s	Automatically when frequency below 49.9Hz. 50 % 5s and 100% 30s	Power plants: If below 49.5Hz 50% 5s and 100% 30s
aFRR				
- bid size	Min 5MW	Max 10MW for aggregated portfolios	Min 5MW	Min 5MW
- activation	100% 2min	DK1: 100% 15min	Automatically at 49.9–50.1Hz. 63% 60s and 100 % 3min	Automatically at 49.9–50.1Hz. 100% 3min
mFRR				
- bid size	-	Max 10MW for aggregated portfolios	Min 10MW (5 MW in SE4)	Min 5MW
- activation	-	100% 15min	100% 15min	100% 15min
Strategic reserves	**None. 647MW RKOM and an agreement of a capacity of 215MW in critical situations.**	**Currently none. Considering a temporary one to Eastern Denmark**	**752MW**	**729MW**
TSO's own production capacity	**180MW gas turbines to decommissioned**	**-**	**690MW gas turbines**	**953MW**

Source: Statnett, Energinet, SvK, Fingrid

[1] Nordic Market Design Forum – Feasibility study. Final report September 2017. https://www.poyry.com/sites/default/files/media/related_material/nordicmarketdesign_finalreport_v200.pdf

[2] BRS for Nordic trading system: A market model for data exchange. November 21st, 2018. https://www.ediel.org/SiteAssets/Sider/NEGCommonDocuments/Nordic%20Trading%20System%20BRS%201r6C%20-%2020181121.pdf

Balancing model and tools

Balancing was seen as one area where there are clear national, Nordic and European views that confront each other. In general, progress with Nordic balancing was seen as a success story from an operational perspective and the creation of common merit order lists. It was also seen that balancing was now largely being driven by European platforms and projects for the exchange of balancing energy such as MARI and PICASSO were seen as important drivers of the Nordic balancing.

National views emerged when discussing allocation of the costs of balancing the system between countries. The starting point was that the Nordic TSOs are in different positions with regard to the availability and cost of balancing resources within national perimeters. Under the old model, this has led to the view that TSOs in Finland and Denmark are benefiting from cheap balancing resources in Norway and Sweden. This led Statnett to raise concerns about free-riding. In addition, it was mentioned that as Statnett and SvK take responsibility of system frequency control they have a greater exposure of the challenges in balancing the Nordic system and hence competence for balancing the system.

Some issues around governance could be seen during the discussions between Nordic TSOs on the common balancing project where Statnett and SvK proposed a governance model with an unequal distribution of voting rights between the Nordic TSOs. The model was rejected by Fingrid on the basis of Finnish and European legislation and subsequently the proposal was modified with Nordic TSOs as equal partners in the project.

The new balancing model (MACE) and Nordic balancing concept was seen as an important step forward to manage the Nordic system in the future. One impact that was noted was that the process of discussion around the new balancing model led to a much better shared understanding of the challenges of each TSO.

Although a new Nordic balancing model is being developed, at present, balancing tools are not fully harmonised across Nordic TSOs

Table 6 – Reserve costs included in the calculation of the unit transmission tariffs	Statnett	Energinet	SvK	Fingrid
Primary reserves	C (est)	C (est)	C	N
Secondary reserves	C (est)	C (est)	N	N
Tertiary reserves	C (est)	C (est)	N	C
Cost of reserves, 2018 (MEUR)	26.3[1]	107.9[2]	150.5[3]	56.7[4]

C = A given cost item is included in the calculation of the Unit Transmission Tariff
N = A given cost is not considered in the calculation of the Unit Transmission Tariff
C (est) = The cost item is not invoiced by the TSO and estimated values are provided for comparability purposes
[1)] Primary reserve MEUR 11.9 (FCR-N, FCR-D), secondary reserve MEUR 3.3 (aFRR) and tertiary reserve MEUR 11.0.
[2)] Energinet: primary, secondary and tertiary reserves.
[3)] SvK: primary reserve MEUR 130.1, secondary reserve MEUR 11.8 and tertiary reserve which included disturbance reserve MEUR 8.6. Strategic power reserve costs MEUR 6.8 (net income MEUR 0.5) are not included in reserve costs.
[4)] Fingrid: Primary, secondary and tertiary reserves. Tertiary reserve costs include manual frequency restoration reserve mFRR (balancing energy and balancing capacity) and fast disturbance reserves (Fingrid's reserve power plants and leasing reserve power plants). Strategic reserve costs (i.e. peak load capacity) MEUR 13.7 (net income MEUR 0.3) are not included in reserve costs.

Source: ENTSO-E Overview of Transmission Tariffs in Europe: Synthesis 2019 (June 2019); Statnett, Energinet, SvK, Fingrid

Another key issue would be that under the new balancing model (MACE), each TSO would be responsible for balancing supplies in its own country and also provides a way for allocating reserve costs between TSOs. It was mentioned that the IT systems to support the new balancing model are more complex than expected and this is resulting in delays in the implementation as well as being a significant task for the TSOs from a capability and task perspective. Another important element was the introduction of the TSO-DSO interface for balancing using more distributed resources.

The harmonisation of balancing platforms and tools is taking place both at the Nordic and European level. As it can be seen in the **Table 5**, the technical requirements of balancing tools are not fully harmonised yet. More importantly, there are major differences in the market rules and procurement procedures for ancillary services relating to, among other things, the remuneration principles (pay-as-bid v. pay-as-clear/ marginal pricing), contract types (long-term contracts v. daily/hourly market), and operational schedules. E.g., in Sweden and Denmark the price setting in FCR markets follow pay-as-bid principle, while Norway is using marginal pricing[1,2]. In Finland, marginal pricing is used in hourly market. In the yearly market the price is constant during the entire calendar year and all market participants receive the same compensation for maintaining reserve capacity based on the yearly auction. Different technical requirements and market rules together constitute an impediment to demand response to participate in the reserve markets.

There are also differences in the principles how the TSOs cover the reserve costs as can be seen in the **Table 6**.

5 Transparency

All the Nordic TSOs have statutory obligations to develop and facilitate electricity market, and they are committed to this task. Transparency of the electricity market information is a key element in improving the functioning of the electricity market. ENTSO-E has introduced a European-wide transparency platform to facilitate access to information by all market participants and stakeholders in promoting the transparency goals of the EU's internal energy market[1]. ENTSO-E transparency platform is based on the regulation (EU) 543/2013 on submission and publication of data in electricity market.

Transparency in situations where capacity on interconnectors is changing leaves room for improvement, as does the overall calculation of transmission capacity. This can be due to planned events (maintenance) or unplanned events e.g. congestion management. It can also be due to TSOs contingency planning. For example, congestion in the West Coast Corridor in Sweden is the main reason for limited availability in interconnectors between Sweden and Denmark (SE4-DK2), Sweden and Norway (SE3-NO1), and Sweden and Germany (SE4-DE) – this is partly because congestion in this area cannot be solved using countertrade[2].

The approach to transparency and trust in the market in critical market situations (e.g. scarcity) varies across the TSOs. One main difference between Nordic TSOs relates to the availability of real-time market information. For example, since 2016 Fingrid has been publishing balancing power price information (the last balancing price) in times of system scarcity where Finland is decoupled into a separate region, subject to volume limits on the remaining number of up and down regulation bids. In summer 2019 the pilot was extended and the limit on remaining MW bids was removed meaning that the last activated balancing power bid will be published in Finland when the Finnish area is decoupled[3]. Other examples include 6 months pilot that enables intraday gate closure time of 0 minutes in Finland[4] and the publication of names of reserve suppliers by reserve products. In the past, the Nordic TSOs have had a common strategic initiative to "set data free" but it didn't progress. Now each TSO has developed own open data accesses based on national starting points and needs.

This is because Fingrid views that the price generated in the electricity market effectively guides the short-term electricity generation and consumption decisions as well as long-term investments of the market players.

It was clear that not all TSOs see the need to publish balancing prices in times of scarcity. The reasons given include other priorities (such as ongoing IT projects) or then that the publication of balancing prices raises the potential for self-balancing actions which can cause complications for system operation in weaker grid areas.

Two drivers that were taken as a positive sign for transparency development in the future were the development of the RSC and also the Nordic balancing model via the new IT vehicle for developing the balancing model, Fifty IT and also the common discussions on the balancing model that the TSOs would have. The lack of transparency is not always due to TSOs protecting their own system and data but simply a lack of data.

Information about the state of the market is not revealed in a systematic way across the TSOs

- Common Nordic conditions about transparency in critical situations of supply and demand are lacking
- Capacity calculation at borders is unclear, especially in times of scarcity

[1] https://transparency.entsoe.eu/dashboard/show
[2] https://www.svk.se/siteassets/om-oss/rapporter/2019/swedish-interconnectors-monitoring-report-no15.pdf
[3] https://www.fingrid.fi/en/pages/news/news/2019/fingrid-increases-real-time-market-information-about-balancing-power/
[4] https://www.fingrid.fi/globalassets/dokumentit/fi/sahkomarkkinat/reservit/reserve_suppliers.pdf

6 Politics and governance

The interviews highlighted clear differences of approach on issues with a strong national dimension: e.g. topics such as security of supply and grid investments not always being economically driven. Some interviewees highlighted differences in the political oversight and governance of the TSOs as key drivers for the national approaches. As an example, each of the countries has recently published its own national energy vision. However, it was also frequently stated that common Nordic vision and solutions are increasingly important to support the energy transition.

The legislative framework for regulating TSO obligations and tasks is similar in many but not all areas across Nordic countries and there is room for national perspectives and interpretations

- **The roles of TSO, NRA and ministry are broadly the same, but the responsibilities, decision making power and political influence may differ**
- **Governance structures give room for national perspectives and decision-making processes to emerge as a means of control**

Regulation and governance model

As Nordic Member States of the EU, the legislative framework for TSO responsibilities and tasks is broadly similar in Denmark, Sweden and Finland. Norway is not an EU member but it has adopted the EU's Third Energy Package and therefore complies with the terms set in it. While EU/EC regulations have a direct application in the EU, in Norway, they must be enforced through the EEA (European Economic Area) process and the Norwegian law. Under the EEA treaty, Norway has also the right to refuse the adoption of EU rules.

The primary legislation governing TSO's operation is inherently general in nature giving room for national perspectives to emerge as a means of control. Issues around security of supply, national welfare and energy policy are the most nationally driven topics and highly political issues. Secondary legislation, on the other hand, is typically more detailed, giving further room for national differences.

All the Nordic TSOs have statutory responsibility for the transmission grid and system operation as well as electricity market development. TSOs' responsibilities are expanding also to the retail market development through operation of centralised information exchange systems ('Data Hubs"). On the other hand, there are also many differences in TSO's responsibilities and operations. For example, SvK is responsible for the supervisory guidance for the local authorities in dam security issues. Statnett owns a transportation company responsible for transport of heavy and valuable components to the Norwegian energy and power industry. Energinet operates also as a gas TSO for Denmark.

National regulatory institutions governing TSO operations are comparable at a general level in Nordic countries: the Ministry or government/parliament issues and approves the laws and the NRA is responsible for regulatory methods and tariff setting principles, and supervises that the TSO operations comply with the law. However, some differences exist in NRAs' rights to issue secondary legislation. E.g. NVE has the authority to issue regulations on economic and technical reporting, network revenues, market access and network tariffs, non-discriminatory behaviour, customer information, metering, settlement and billing, system responsibility, quality of supply and the organised physical power exchange (Nord Pool). Some of these responsibilities are directly under the Ministry in other Nordic countries.

There are also major differences in the TSOs' governance structures. Statnett is a state enterprise fully owned by the OED. The Ministry has a double role with Statnett; that of an owner and a regulator through NVE. NVE was seen to be growing more independent from the Ministry albeit with some notes about acceptance of EU requirements.

Energinet is a public company belonging under the Danish Ministry of Climate, Energy and Utilities, and is fully owned by the Government of Denmark. Energinet recently had roles separated into system operator and transmission operator. The transmission operator has a relatively simple price control regulation while the system operator has socio-economic objectives. The system operator is responsible for forward planning and orders services from the transmission operator when investments are

needed. In this way the system operator decides on the 'market v grid'. This approach was developed to overcome suspected bias towards capex solutions and clarify roles and responsibilities. SvK is a part of the state directly, not just owned by the state. Every year, SvK receives regulation letters from the government setting out tasks set out by the government (rather than the Minister). The regulatory letter also includes economic targets, including return, maximum leverage and the share of return that SvK provides to Government.

Fingrid is a public limited liability company in which the Finnish state has a controlling stake. As a public limited liability company Fingrid's operations are regulated also by the Limited Liability Companies Act (624/2006) and other applicable legislation, as well as the articles of association.

During the interviews it was commented that under a common high level structure the differences in the governance model between TSOs can have an effect on the way TSOs act and make decisions. These differences relate to the political influence, way of developing common national view, decision making power, and the involvement of the ministries and NRAs in TSOs' operating activities, i.e. how independent TSOs are.

Nordic cooperation and political cohesion

The Electricity Market Group (EMG) is a working group under the Nordic Council of Ministers, where Nordic Energy Research acts as a secretariat. The group commissions analyses and provides advice to the Energy Ministers of the Nordic countries and has e.g. acted as coordinators of the harmonisation process in the Nordic electricity market on behalf of the Nordic Council of Ministers.

There are also a number of discussion groups that have been set up to raise topics and discuss challenges on the Nordic level; e.g. directors of regulators, TSOs and Ministries meet every year. At the same time some commented that there was some underwhelming support for the Nordic Forum and for the RSC.

The Energy Regulators Regional Forum (ERRF) is cooperation and coordination platform established by NordREG in 2017 to facilitate common and consistent national decisions to be made by each Nordic energy regulator, according to network codes and binding guidelines.

The Nordic Electricity Market Forum is a new cooperation platform initiated by Nordic Council of Ministers for closer dialogue between the different types of stakeholders within the Nordic electricity market . The first forum was held in November 2018 in which a new vision for the Nordic electricity market was initiated together with a roadmap to 2030. The vision was discussed and endorsed by the Nordic Energy Ministers at the Nordic Energy Ministerial meeting in June 2019. At the forum, a list of long-term-objectives and medium- and short-term targets in five key areas were identified for achieving the common vision. In addition, many concrete immediate (2019-2020) and further (2021-) action points were depicted, the most important of which relate to the following areas:

- Development of transparent grid planning process taking into account fair distribution of costs when Nordic projects in the region are highly beneficial from a Nordic perspective ("Nordic welfare"), but less beneficial from a national perspective;
- Implementation of Nordic Balancing model and other market reforms, and the upgrading of the market rules and procedures to enable that all flexible assets can actively contribute to function of the Nordic power system;
- Increased transparency on (close to) real-time system operation and reporting on major incidents to the markets, and clear and efficient price signals guiding grid investments and internalising the risk of inadequacy;
- Strengthening of the one common Nordic voice in interacting and influencing in the EU; and
- Coordinated and transparent Nordic processes to implement EU/EC regulation and rules.

In addition to the cooperation platforms above, Nordic TSOs are cooperating with each other at many levels, e.g. the Nordic RSC is the joint office for the Nordic TSOs established 2017 (see 4.2).

There are a number of platforms and processes to support and promote Nordic cooperation and harmonisation but there are different views on their effectiveness and the underlying development needs

- **Some are pleased with the current state of cooperation; others see that Nordic cooperation cannot live on historical merits**
- **Nordic TSOs are reacting to EU requirements and there is an emphasis on common interpretation of European requirements**
- **There are different views on the current level of political commitment to Nordic cooperation**
- **There is a general lack of political cohesion across the Nordic market regarding energy policy**

From the interviews, there was a general view that Nordic cooperation is better than in many other parts of Europe and in recent years Nordic cooperation has been good in market development and is improving in the area of grid investment. Many significant steps toward improving the cooperation and solving the common challenges have been achieved since a Nordic Roundtable Conversation in December 2015[1] and several essential solutions and initiatives are underway such as Nordic Balancing Model, Nordic Grid Development Plan 2019 and Nordic Regional Security Coordination[2].

On the other hand, it was also seen that the traditional Nordic position as forerunners in Europe has changed – the Nordics are no longer in the driving seat of European market design. The EU and the countries in Central Western Europe are increasingly seen as the driver – for example the Clean Energy Package and the Network Codes where it was commented by interviewees that Nordics are implementers and the focus is on interpretation not original design. On a related note, during some of the interviews it was also stated that some of the European regulations are more suited for the core of Europe rather than the challenges faced in the Nordic region. Cooperation in the area of network investment and development was less than hoped for by some of the interviewees. Reasons for this included national positions with the observation that there could be a misalignment between statements of Nordic ministers on Nordic cooperation and the national decisions on grid investments which is coupled to the relationship between the TSO, regulator and government.

There are different levels of political commitment to change the existing market due to the different structures of the market and future challenges to decarbonise. This can lead to conflicting priorities when considering investments and system development for the future Nordic market. In addition, there is a clear difference in perspective on the integration of the Baltic markets between the four countries. The main reason for this was seen to be the impact on the current power balance between the TSOs when contentious issues need to be decided on; adding more TSOs to the decision-making

[1] http://www.pfbach.dk/firma_pfb/pfb_will_nordel_rise_again_2015_12_12.pdf
[2] See e.g. https://www.svk.se/siteassets/om-oss/rapporter/2018/the-way-forward---solutions-for-a-changing-nordic-power-system_with-appendices.pdf, and http://nordicbalancingmodel.net/wp-content/uploads/2019/05/Challenges-and-Solutions-in-the-Nordic-Grid-Stakeholder-Workshop.pdf

process would mean a majority voting system, meaning that each TSO would lose its veto. Examples included the rule on making 70% of capacity available to the market, another was 15min imbalance settlement period. Therefore some saw the value of Nordic cooperation as being able to form a common negotiating front with Brussels.

Strong political will and commitment is seen as a more plausible way for pushing Nordic cooperation rather than common Nordic regulation

- **Harmonisation of Nordic regulation is challenging. Differences in national legislation exist as well as in implementation of EU regulation. Moreover, there is often some freedom to interpret the national legislation to favour or disfavour Nordic interest or initiatives.**
- **Future cooperation could be built around a common vision based on mutual benefit**

Legislative framework

Nordic cooperation and harmonisation has been founded on the principles of voluntary and mutual benefit. The Louisiana Declaration in 1995 took the first step towards the Nordic market. In 2004 the Akureyri Declaration called for enhanced cooperation between Nordic TSOs. By the Copenhagen Declaration in 2010, the prime ministers in the Nordic countries made a declaration to strengthen Nordic cooperation in the field of electricity and grid investment planning[3].

As already stated before, cooperative actions taken to date have provided benefits for each country. In the future, however, the benefits (and costs) of further harmonisation may not be shared as equally. Most of the low-hanging fruit are already captured. At the same time EU is taking a lead in electricity market development and as noted in the Ollila report[4], "developments in European regulation serve as the umbrella under which the Nordic electricity market is structured". In a way this also means that decisions affecting the Nordic TSOs are taken elsewhere and not always in the Nordic mutual interest.

The national regulations give room for national perspectives and interpretations. There are also differences across the Nordic countries how the Nordic cooperation has been incorporated into the national legislation. National interests are visible also in the national energy visions and policies which impact on the Nordic cooperation. E.g., in the roadmap for reaching the Nordic electricity market vision it is stated that the roadmap does not necessarily reflect the priorities of each national government.

There is no such a thing as common Nordic regulation. Neither there are any institutions to enact pan-Nordic regulation. In practice, the harmonisation of the Nordic regulation takes gradually place through implementing EU legislation. EU legislation is common to all TSOs but the degree of implementation may differ to some extent, except for EU regulation that becomes immediately enforceable as law in all member states immediately[5]. ERRF is an example of a Nordic cooperation platform to facilitate common and consistent interpretations of EU legislation as emphasised in the roadmap for reaching the Nordic electricity market vision.

During the interviews it was commented that there are differences in Nordic regulation and regulatory views: some are more competition oriented, others are more from the energy regulation perspective. There was also a view that harmonised Nordic regulation was not needed or even possible due to the different national perspectives.

Harmonisation of Nordic regulation was seen by some to take place through EU regulation. A complicating factor was related to the interpretation of EU legislation by different regulators and the multi-layered nature means directives can be interpreted in a way that enables national interests to be secured. There was a view that the Nordic way is more around interpretation whereas the Brussels approach was more prescriptive (i.e. to enforce the wording of what was agreed). NordREG was seen as quite weak in implementing cross-border regulations. In this situation is was also noted that ACER can be used to play the role of enforcer when there is disagreement between national regulators meaning that the European view (that happened to be in line with national views) would prevail. It was also mentioned that as Norway is not a member of the EU then EU legislation needs to be written into Norwegian law which sometimes takes more time than expected.

[3] Statsministermøde i Nordisk Ministerråd (NMR) om elmarkedet den 2. november 2010.
[4] https://www.nordicenergy.org/wp-content/uploads/2017/08/Nordic-Energy-Co-operation-Strong-today-stronger-tomorrow.pdf
[5] Position of Norway, see 6.1.

Summary

The Nordic countries formed the world's first integrated cross-border electricity market in 1996, founded on the sharing of mutual benefits. Its design formed the blueprint for the European Target Model, which is the basis for electricity trading and transmission access across the entire EU. The Nordic energy vision was refreshed in 2010 with a series of political statements. However, in recent years, Nordic collaborative activities have visibly slowed, and European electricity market design has been led by other countries with different drivers. The Nordic TSOs – previously forerunners in cross-border market collaboration – have been dealing with very different priorities from each other, and at times their discussions have spilled into public argument.

To meet the challenges of the energy transition towards a zero-carbon economy, even deeper partnership will be needed; to resolve topics with less straightforward win-win outcomes than previous joint initiatives. If the Nordic energy transition is to be a success, collaboration between TSOs in all aspects of system planning and operation must be at the heart of it.

Nordic TSOs have common denominators but they also differ from each other in many respects such as physical and political context, energy policy, legislation, and their ownership and governance structure. The purpose of the study is to understand obligations and the incentives of the Nordic TSOs, and how and in what circumstances their observed behaviour supports Nordic regional interests or gives precedence to national requirements. Our aim is to support an open and constructive debate around the Nordic TSOs and how the differences are reflected in the Nordic cooperation and harmonisation.

The key findings of the study can be summarised in the following points:

Physical and political context

- Nordic TSOs have different historical and operational perspectives which influence their behaviour and approach.

Transmission grid investment

- Grid investments are subject to national interests and prioritisation;
- for future shared investments, the asymmetric distribution of costs and benefits between countries is a new normal and complicates discussions: there are few simple 'win-win' cases;
- in evaluating shared investments, a common Nordic cost-benefit methodology is used but freedom over data inputs for risk analysis permits national interests to take precedence over common benefits.

Congestion and contingency management

- there are national differences in approach to the existence and management of congestion in the main transmission grid;
- the protocols regarding network capacity calculations for contingency management appear unclear to market participants and (to some degree), to neighbouring TSOs;
- although a new Nordic balancing model is being developed; at present, balancing tools are not fully harmonised across Nordic TSOs.

Transparency

- information about the state of the market is not revealed in a systematic way across the TSOs.

Politics and governance

- the legislative framework for regulating TSO obligations and tasks is similar in many but not all areas across Nordic countries and there is room for national perspectives and interpretations;
- there are a number of platforms and processes to support and promote Nordic cooperation and harmonisation but there are different views on their effectiveness and the underlying development needs;
- strong political will and commitment is seen as a more plausible way for pushing Nordic cooperation rather than common Nordic regulation (which is considered unachievable), but there is doubt whether it is enough to drive deep collaboration.

Despite many challenges and further harmonisation needs, Nordic cooperation is better than in many other parts of Europe and is improving in many areas. Many significant steps toward improving cooperation and solving the common challenges have been achieved including initiatives such as Nordic Balancing Model, Nordic Grid Development Plan 2019 and Nordic Regional Security Coordination. On the other hand, the traditional Nordic position as forerunners in Europe has been challenged – the Nordics are no longer in the driving seat of European market design.

Nordic cooperation and harmonisation continue to have a significant role in the electricity market development regionally and European-wide. Common Nordic solutions are essential to supporting the energy transition. Nordic cooperation is also becoming increasingly necessary as being able to form a common negotiating front with Brussels.

Nordic cooperation and harmonisation has been founded on the principles of voluntary and mutual benefit. New tools and a lot of political commitment are needed in an environment of uneven and uncertain benefits and costs, as each further commitment considered in isolation has the potential to benefit one country at the expense of another. It is only with a view of the wider perspective that the mutually beneficial actions can be taken towards a future energy alliance.

ANNEX A

Interviewees

Norway

Statnett

- Gunnar G. Løvås, Executive Vice President Market and System Operation

NVE

- Ove Flataker, Director – Energy Market Regulation Department
- Vivi Mathiesen , Head of Section – Wholesale market

Denmark

Energinet

- Søren Dupont Kristensen, CEO Energinet Elsystemansvar

Energistyrelsen

- Markus Hüber, Special Advisor
- Lars Nielsen, Head of Division
- Sharissa Funk, Advisor

Forsyningstilsynet

- Carsten Smids, Director

Sweden

Svenska Kraftnät

- Niclas Damsgaard, Chief strategist, System Operator Division

Regeringskansliet

- Magnus Blümer, Enhetschef på Regeringskansliet, Infrastrukturdepartementet

Energimarknadsinspektionen

- Anne Vadasz Nilsson, Director General

Finland

Fingrid Oyj

- Jukka Ruusunen, President & CEO

Ministry of Economic Affairs and Employment

- Riku Huttunen, Director General

Energy Authority

- Simo Nurmi, Director General
- Jarno Lamponen, Chief Specialist, Markets, Market Development

Nordic RSC

- Jens Møller Birkebæk, Daily Manager