Fortum Energy Review

MARCH 2015

Focus on Nordic electricity market

The Nord Pool area is a rare example of a true regional energy market, bringing notable benefits for the societies in the Nordic and increasingly also the Baltic region. The integrated market provides competitive energy for customers in seven countries, good short-term generation adequacy and one of the world's lowest emission levels per produced kWh. The Nordic electricity market also sets a very important example of the notable benefits of power market integration for the rest of Europe when building the Internal Energy Market.

The success of the Nordic electricity market is not at all self-evident; achieving the success has required farsighted policy makers and stakeholders over a long time period. Developing the market further will require even more farsighted and continuous policies. The increasing role of renewable generation and changing consumer behaviours have increased intermittency in the electricity system, while poor economic performance has decreased electricity demand, pressed power prices and weakened the overall energy investment climate. This all raises questions on how to secure sufficient investment signals and encourage more flexible consumption behaviour to secure long-term generation adequacy in the Nordic electricity system.

This is the second report in the Fortum Energy Review series. This time we focus on advancing the Nordic electricity market. We want this report to further contribute to the discussion on energy production and consumption in our society. Through its everyday work, Fortum creates energy that improves life for present and future generations with sustainable solutions for society and excellent value to our shareholders.

The first section of the report presents characteristics of the Nordic and Baltic electricity market, the power generation structure, and the operation of the wholesale and retail electricity markets. The second section addresses the current challenges of long-term generation adequacy and offers proposals for future development of the wholesale and retail electricity markets. The third, concluding section suggests measures to be taken when ensuring development towards a low-carbon economy on a European scale.

"Developing the market further will require even more farsighted and continuous policies."

Fortum Corporation

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"Developing the market further will require even more farsighted and continuous policies."

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"Generation adequacy to be assessed at a Nordic level, not a national level."

SECTION 1

Executive summary

The integrated Nordic and increasingly also Baltic electricity market provides affordable energy for consumers, good short-term generation adequacy and one of the world's lowest emission levels per produced energy. It is, so far, a success story on power market liberalisation and integration. The Nordic power system is, however, facing increasing challenges to integrate growing intermittent generation in the power system and to secure long-term generation adequacy. Without determined actions to develop the Nordic markets further, the success is endangered.

It is crucial to develop both the Nordic electricity wholesale and retail markets at the same time. The Nordic electricity wholesale market is today regional, with the various generation types competing with each other on a least marginal cost basis. These markets should be treated as one power system also from the generation adequacy point of view. The generation needs to be assessed and agreed on jointly by the Nordic regulators, instead of nationally as it is today.

The Nordic power market is also well connected internally and with its neighbours, but further grid enforcements – both internally within the system as well as to neighbouring countries – are crucially needed to smooth price area differences further and to manage the integration of the growing renewable energy generation in the system. The third interconnector between northern Sweden and Finland should be a high priority.

The growth of renewable generation in the power system is very necessary in order to succeed in the decarbonisation of the power sector. However, as the competitiveness of mature renewables has improved and they are able to compete on their own merits, various sorts of generation subsidies should be phased out, and the EU Emissions Trading System should become the primary driver of decarbonisation.

"It is crucial to develop both the Nordic electricity wholesale and retail markets at the same time."

With increasing intermittent generation in the Nordic power system, power price volatility will grow and efficient price signals will be even more crucial. Wholesale prices should always be based on scarcity pricing, and retail markets need to be better integrated with the wholesale markets. The ambitious investments in smart metering today

provide the basic infrastructure, while real-time offerings to customers are still limited. Much more customer participation should be enabled through dynamic hourly pricing alternatives and better services for customers.

The key to activating demand-side management is to further develop the retail market. In the retail market, the supplier centric market model should be implemented in all Nordic countries. This model will simplify the customer interface, enable retailers to develop their services and offerings, and further enhance market efficiency.

It is also important to develop a common response on securing Nordic market success further as part of the integrating European internal energy markets. If the Nordic stakeholders are not able to correspondingly defend and develop the Nordic electricity market and adapt to increasing price volatility, then also the Nordics may have to consider an implementation of capacity markets to secure long-term generation adequacy.

- The Nordic power system is facing increasing challenges to integrate growing intermittent generation in the power system and to secure long-term generation adequacy.
- Customer participation should be enabled through dynamic hourly pricing alternatives and better services.
- The EU Emissions Trading System should become the primary driver of decarbonisation.
- The supplier centric retail market model should be implemented in all Nordic countries.

SECTION 2

Nordic electricity market

2.1 Basics about the Nordic electricity market

The Nordic electricity market is a true regional power market, covering Sweden, Norway, Finland and Denmark, and now includes also the Baltic countries of Estonia, Latvia and Lithuania. The Nordic power market enables efficient and optimal utilisation of the Nordic natural and technological resources in hydropower, nuclear energy, biomass, combined generation of heat and power, wind power and emerging solar power.

Today power generators compete with each other, allowing the power system to always utilise the lowest cost power generation in the whole region, limited only by the occasional limitations in the transmission grid capacity. The Nordic market brings notable benefits both for customers and producers as well as for the environment.

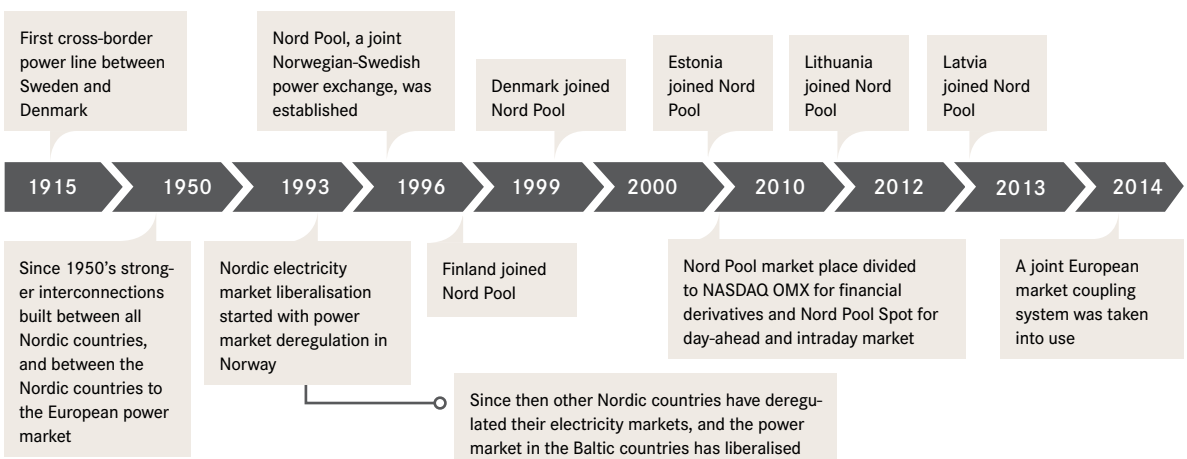
Our electricity market also sets an important example of the benefits that a well-functioning regional electricity market can provide in terms of efficiency gains. Indeed, there has been strong political support for creating a well-functioning pan-Nordic electricity market.

The power system has been formed from interconnected national power systems. The first cross-border power line was built already in 1915 between Sweden and Denmark. Since the 1950s, stronger interconnections have been built between all Nordic countries based on mutual cooperation[1]. Interconnectors have been built to Continental Europe as well, connecting the Nordic area to an integrated European power market.

Technically, the Baltic power system is operating together with the Russian power system. Commercially, the Baltic market is linked to the Nordic electricity market[2].

"About 90% of the Nordic power generation is traded through power exchanges."

Nordic electricity market liberalisation was started with power market deregulation in Norway in 1993 when Statnett Marked was established as a day-ahead trading platform for the Norwegian power system. Also other Nordic countries deregulated their electricity markets, and power markets have been liberalised during



recent years in the Baltic states as well.

In 1996 a joint Norwegian-Swedish power exchange was established under the name Nord Pool, with Finland joining in 1999. Denmark joined in 2000, which made the market thoroughly Nordic. Estonia joined Nord Pool in 2010, Lithuania in 2012 and Latvia in 2013[3].

The financial power derivatives marketplace of Nord Pool was sold to NASDAQ OMX in 2010 to operate now under Nasdaq Commodities. Nord Pool Spot operates the day-ahead Elspot and intraday Elbas markets. In 2014, a joint European market coupling system was taken into use.

About 90% of Nordic power generation is traded through the Nord Pool power exchanges Nord Pool Spot and Nasdaq Commodities. The rest is covered by bilateral contracts or by industrial and municipal own production.

- About 90% of the Nordic power generation is traded through power exchanges.
- Power generators in the Nordics compete with each other, allowing the power system to always utilise the lowest cost power generation in the whole region.
- There has been strong political support for creating a well-functioning, efficient pan-Nordic electricity market.

[1] The Nordic cross-border power system cooperation was formalised in 1963 with the establishment of the Nordel organisation that developed common rules for the interconnected Nordic power system. In 2009, ENTSO-E, the European-wide organisation of electricity transmission system operators, took over the tasks of Nordel.
[2] In synchronously connected power systems, power plants operate with exactly the same frequency (speed of electrical rotation). Different synchronous systems, like Nordic (excl. western Denmark), Continental Europe, CIS (incl. Russia) & Baltics, can be connected with each other by DC (direct current) links.
[3] Estonia has been a part of the financial power market since 2012 and Latvia since 2014.

2.2 Nordic power generation characterised by optimal generation mix

Total electricity demand in the Nordic and Baltic countries has been around 400 TWh in recent years[4]. Electricity is used mainly in industry (41%), households (28%), and services (21%), while agriculture uses 2% and traffic 1%. Network losses account for 7% of the total power demand. On the retail markets side, there are about 14 million Nordic retail customers and about 3 million in the Baltics as a whole.

Nordic and Baltic power demand in 2000–2008 grew on average 0.6% p.a. Since the 2008 financial crisis, industrial demand has moderately declined, mainly due to structural changes in energy-intensive industries. Household demand has cautiously grown through increasing electrification of energy consumption. Nordic and Baltic power demand in 2008–2014 declined on average by 0.8% p.a.

Over a half of the Nordic and Baltic electricity demand is covered by **hydropower** in an average year. Most of the hydropower plants are located in Norway and Sweden. Hydropower generation can be swiftly adjusted according to demand variations, but, on the other hand, the annual hydropower volume varies by as much as +/-20% depending on the rain and snow situation.

Nuclear power covers over 20% of the Nordic and Baltic electricity demand. There are now ten nuclear units in Sweden and four in Finland. They were all built between 1972–1985 and have gradually been modernised and upgraded. In Finland, the new Olkiluoto 3 unit is under construction, and two additional reactor projects have valid decisions in principle[5].

Combined heat and power (CHP) generation covers about 14% of the power demand. CHP plants have high efficiency, as electricity is produced in combination with thermal energy used for industrial processes or district heating. In CHP, biomass and waste are increasingly replacing fossil energy as fuel.

Fossil condensing generation covers about 5% of the power demand. Most of the condensing power is generated in Estonia, Finland and Denmark.

Wind power has shown the biggest increases during recent years and today covers about 7% of the electricity demand in the Nordic area. Most of the wind power is generated in Denmark and Sweden. Both the common Swedish-Norwegian certificate system and the national support schemes in Denmark, Finland and the Baltic states have strongly contributed to the growth of renewable power generation.

Due to its **healthy generation mix**, the Nordic and Baltic power system is low emitting, with one of the world's lowest emission levels per produced electricity. The Nordic average emissions are 80 gCO_2/kWh, compared to 400–500 gCO_2/kWh in Germany and in the UK[6].

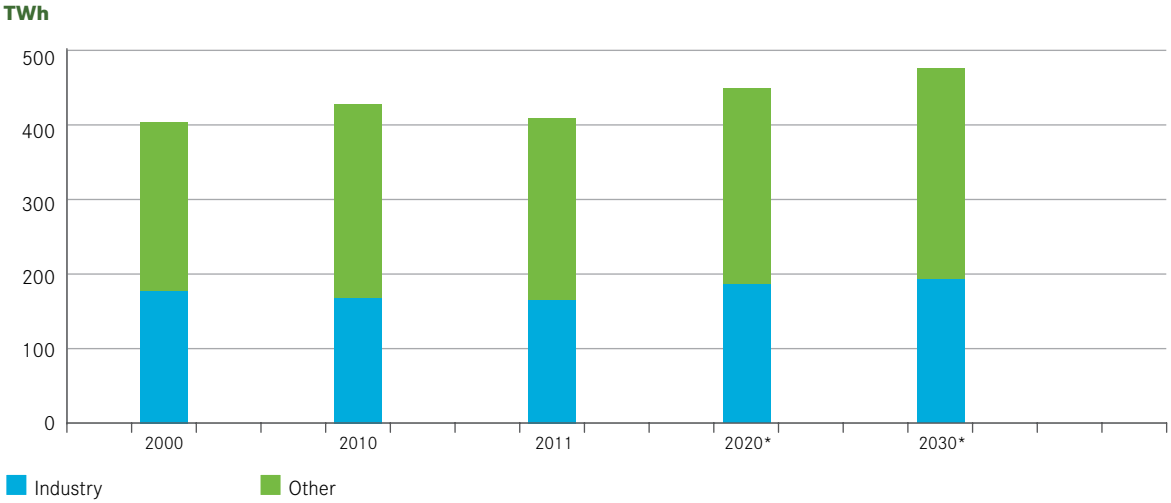
The Nordic and Baltic power system has more generation capacity than demand, and the reserve margin of the system is currently about 13%[7]. There are also many connections to neighbouring countries (Germany, the Netherlands, Poland, Russia and Belarus), and thus power exports and imports can balance surplus and deficit situations. Nordic flexible hydropower is also well-suited for covering the variability of the growing Continental wind and solar power.

"The Nordic and Baltic power system has one of the world's lowest emission levels per produced electricity."

- Generation mix:
  - Over 50 % of the Nordic electricity demand is covered by hydro.
  - Nuclear power covers over 20%.
  - Combined heat and power (CHP) generation covers about 14%.
  - Fossil condensing generation covers about 5%.
  - Wind power has shown the biggest increases during recent years and today covers about 7%.
- The Nordic and Baltic power system has more generation capacity than demand, and the reserve margin of the system is currently about 13%.
- Due to its healthy generation mix, the Nordic and Baltic power system is low emitting, with one of the world's lowest emission levels per produced electricity.

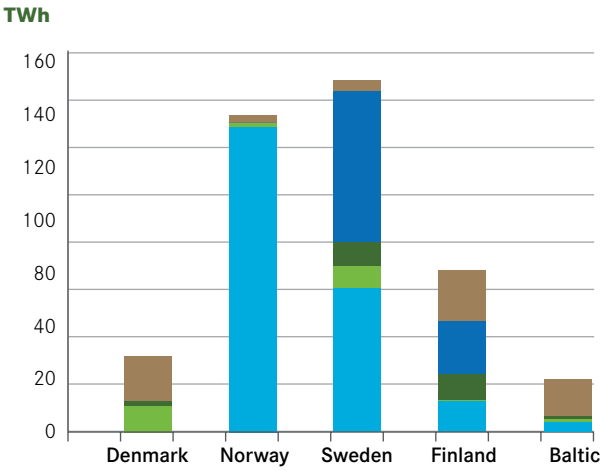
[4] According to ENTSO-E in 2013, in total 409 TWh (139 TWh in Sweden, 128 TWh in Norway, 84 TWh in Finland, 32 TWh in Denmark, 11 TWh in Lithuania, 8 TWh in Estonia and 7 TWh in Latvia).
[5] The Finnish parliament granted decisions in principle for two reactors in 2010. One of the decisions in principle was amended in autumn 2014. Both decisions in principle require that the construction licenses for the reactors are applied for by June 2015.
[6] The Nordic and Baltic region average emissions are 110 gCO_2/kWh.
[7] ENTSO-E: 2015 remaining capacity/winter load.

Figure 1: Nordic and Baltic power demand development 2000–2030, TWh



* Forecast
Source: Eurelectric Power Statistics & Trends 2013

Figure 2: Power generation structures in the Nordic and Baltic market, TWh

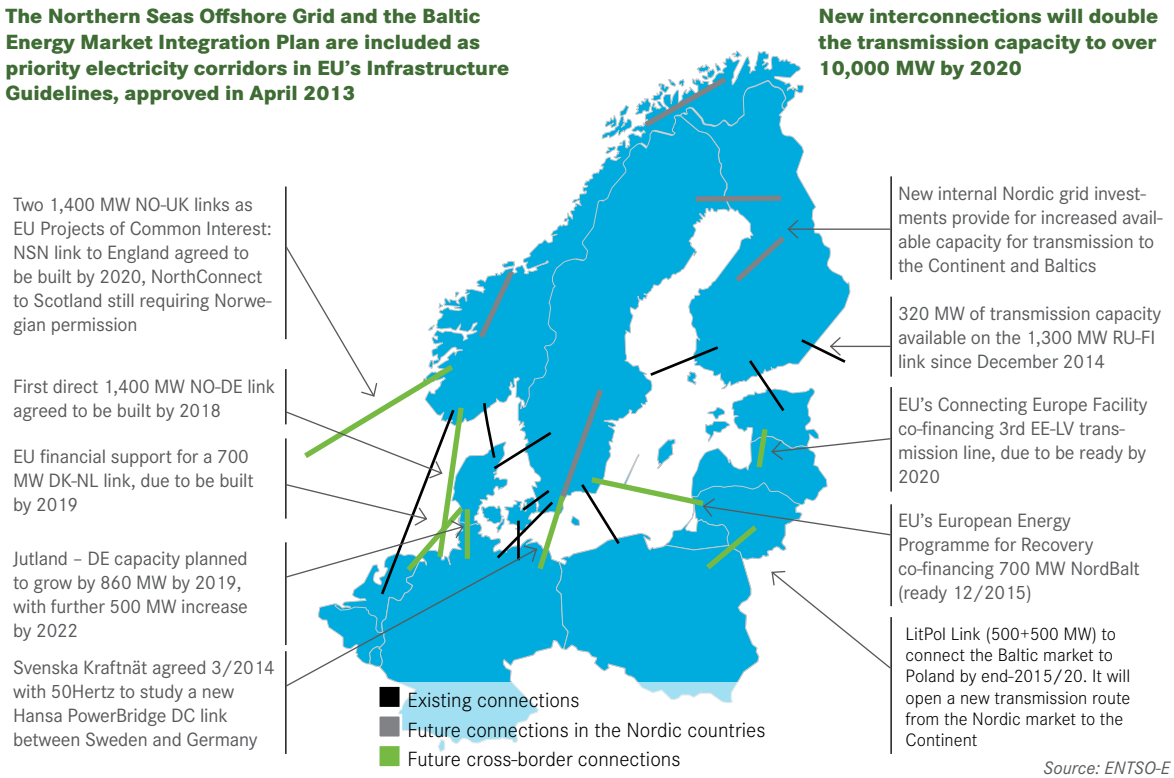


Total generation in 2013	Nordic 383 TWh		Baltics 22 TWh	
	TWh	%	TWh	%
Fossil fuels	48	13	16	72
Nuclear	86	23	–	–
Biomass	23	6	1	5
Wind	23	6	1	5
Hydro *	203	53	4	18

Nordic net export in 2013: 0.4 TWh
Baltic net import in 2013: 4.8 TWh

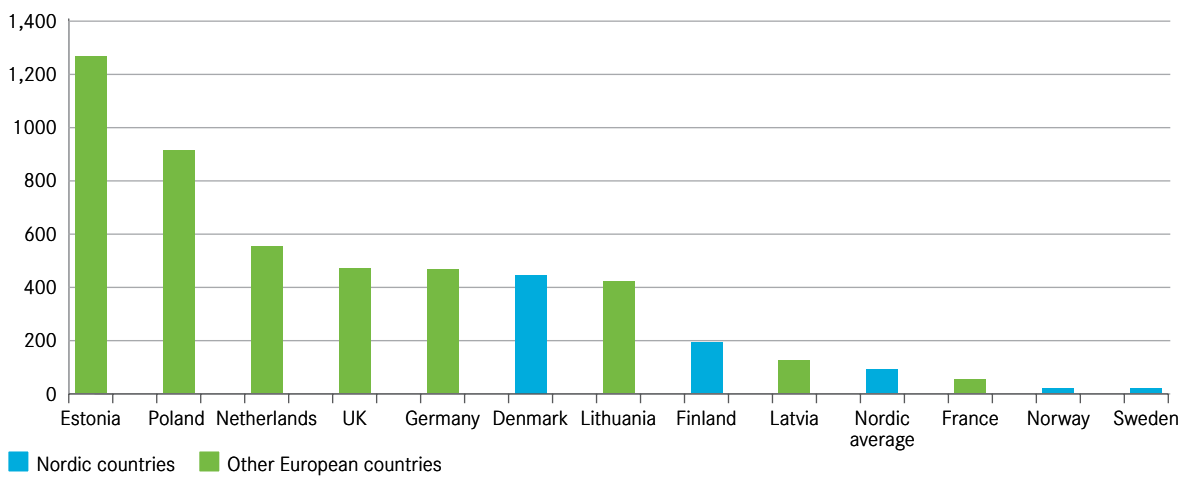
* Normal annual Nordic hydro generation 200 TWh, variation +/- 40 TWh
Source: Eurelectric Power Statistics & Trends 2013

Figure 3: The Nordic, Baltic and Continental markets are integrating – interconnection capacity will double by 2020



Source: ENTSO-E

Figure 4: European CO_2 emissions (g/kWh) per country per power generation, 2011*



*) Estonia year 2000

Source: Eurelectric Power Statistics & Trends 2013

2.3 Nordic electricity wholesale and retail markets

The Nordic market consists of wholesale and retail sectors. The wholesale power market is based on tight physical and commercial integration. Market legislation has evolved from national rules to common principles based on EU directives. Also the development of EU energy market legislation has been strongly influenced by the already existing competitive Nordic market principles[8].

Nordic commercial power trading is based on hourly physical trades made in the power exchange Nord Pool Spot. In addition, financial hedging trades are made both in the derivatives exchange Nasdaq Commodities and in the OTC[9] market but cleared at the exchange. Currently, Nord Pool Spot operates the common Nordic and Baltic day-ahead Elspot marketplace and the continuous intraday Elbas marketplace[10].

The Elspot day-ahead marketplace determines daily for each hour of the following day both the Nordic system price, which is calculated without any grid restrictions, and the area prices, which take into account the transmission grid capacity between the countries and between the Norwegian, Swedish and Danish internal price areas.

When the grid capacity is insufficient, the area prices differ in order to get enough bids accepted in each area. The daily average Elspot prices serve also as a price reference for the financial market of both system price hedges and hedges for the difference between an area price and the system price (called EPAD, Electricity Price Area Differential). System price hedging products are available through Nasdaq Commodities for up to ten years forward.

The commercial power market closes before each operational hour. The transmission system operators (TSOs[11]) take care of the operational system balancing (ensures that supply always equals demand) by using their own and contracted reserves and voluntary balancing bids by market participants[12].

In order to guarantee the functioning of the power system, rules are needed for both normal and exceptional situations. The first European-wide network codes are currently in the final approval phase and will be implemented during the coming years[13]. The Nordic market is well prepared for adapting to the rule changes.

The deregulation of the Nordic retail markets started soon after liberalisation of the wholesale markets. In the first stage, the large customers had the opportunity to choose their supplier. Gradually, also the smaller consumers were made eligible and, since the beginning of the century, the supplier switching process has been free of charge and reasonably easy to execute also for all customers in the Nordic countries.

A cornerstone of the liberalised retail markets is the functional unbundling of the regulated distribution and the sales business. The grid tariffs are independent of the electricity seller, and the Distribution System Operators (DSO) are obliged to provide all retailers services at equal terms, in order to create a level playing field for the competitive players[14].

The Nordic retail market is scattered, with more than 350 retailers in total. Most retailers purchase their electricity from the Nordic wholesale exchanges, but there are also some vertically integrated companies that do not apply a market based interface between the production and the sales.

The retail electricity markets have been fairly stable for many years, with mostly traditional offerings. In recent years, there has been an increasing interest in new electricity-related services, thanks to more frequent and detailed reporting and new service offerings utilising information from smart meters.

The implementation of smart meters has also enabled hourly pricing, giving customers the possibility to optimise their electricity use, and that has triggered new demand response offerings[15]. In general, however, the innovations and modern customer services in electricity retailing have not kept pace with peer industries, such as telecom and banking.

The development path of the Baltic retail markets follows the Nordic example, but, so far, only Estonia has carried through the retail liberalisation in full.

Wholesale prices in the Nordic market are the same, unless there are bottlenecks in transmission, but retail prices for households and industries can vary considerably due to national taxes, subsidies, and transmission and distribution costs. In the Nordics, household end-user prices are about 3–4 times more expensive than wholesale prices in the Nordics.

"In general, the innovations and modern customer services in electricity retailing have not kept pace with peer industries, such as telecom and banking."

Electricity wholesale market in brief

The Nordic electricity wholesale market determines the amount of electricity produced and the wholesale market price, as well as the imports and exports of electricity. Electricity producers sell, and large electricity users and retailers buy electricity on the power exchange. The retailers sell electricity to consumers.

The Nord Pool Spot market determines both intraday and the next day's wholesale prices for electricity. On the electricity derivates market (Nasdaq Commodities) the producer or retailer can agree on the price of electricity up to ten years ahead. Supply and demand determine the price of electricity as well as the production volumes on both markets.

Changing weather conditions, peaks in industrial demand or disruptions in electricity production can affect the balance between production and consumption of electricity, hence the price. If the demand for electricity increases temporarily, the electricity must to be produced with more expensive methods. In this case, the price of electricity rises. Similarly, when electricity demand is low, the prices will decrease. Wholesale price of electricity is also affected by prices of fuel and emission allowances as well as electricity connections within countries and between them.

Figure 5: Power market structure, from financial to physical

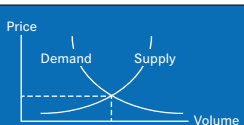
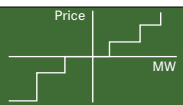
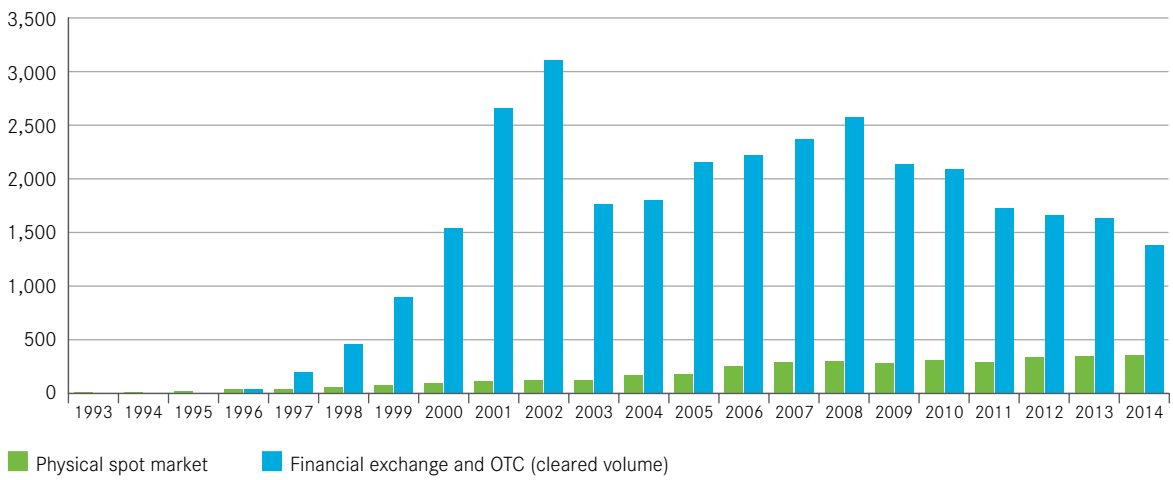
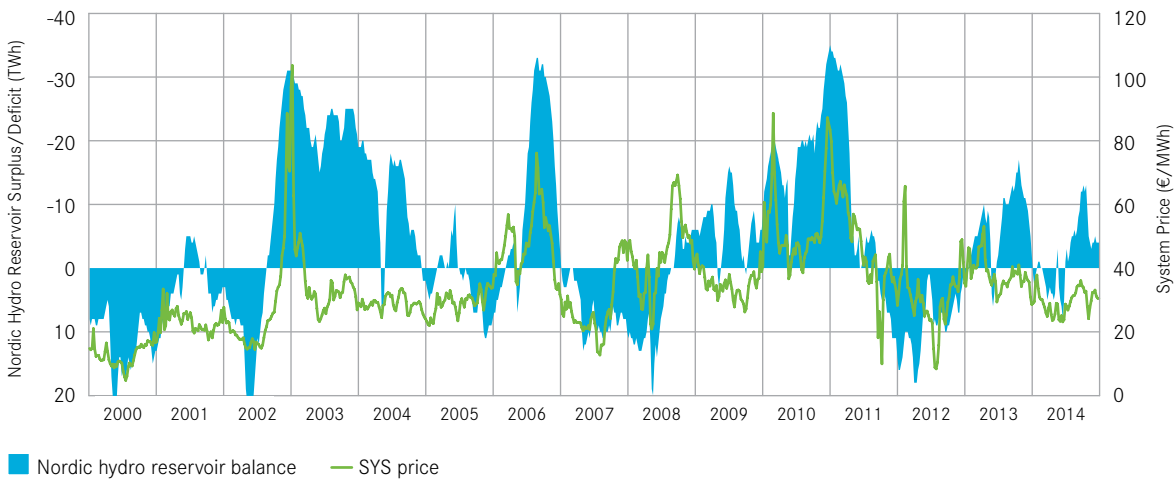
	Electricity derivatives	Physical-delivery contracts Nord Pool Spot AS		Balancing market and reserves
	Nasdaq Commodities/OTC	Elspot (day-ahead)	Elbas (intraday)	System operators
	Futures: days, weeks  Forwards: months, quarters and years • continuous trading • system spot as a reference price • EPADs for hedging area price differences • clearing service	 Elspot market: • one daily round, 365 days in a year • area price division when grid congestions • European market coupling	Elbas market: • continuous market • 24 h/day, 365 days in a year • trade until 1 h before delivery • cross-border trade up to the available free grid capacity • European coupling under development	 Balancing reserves: • contracted capacity for operational use Balancing energy market: • bids for regulation with 15 minute notice Balance settlement: • economic settlement based on imbalances
Time period	10 years.... 1 day ahead	Daily auction for all hours of the following day	After Elspot closure until 1 hour ahead	• Various reserve contracts • Energy bids until hour start • Settlement afterwards

Figure 6: Annual Nordic and Baltic* power market volumes in 1993–2014, physical and financial, TWh



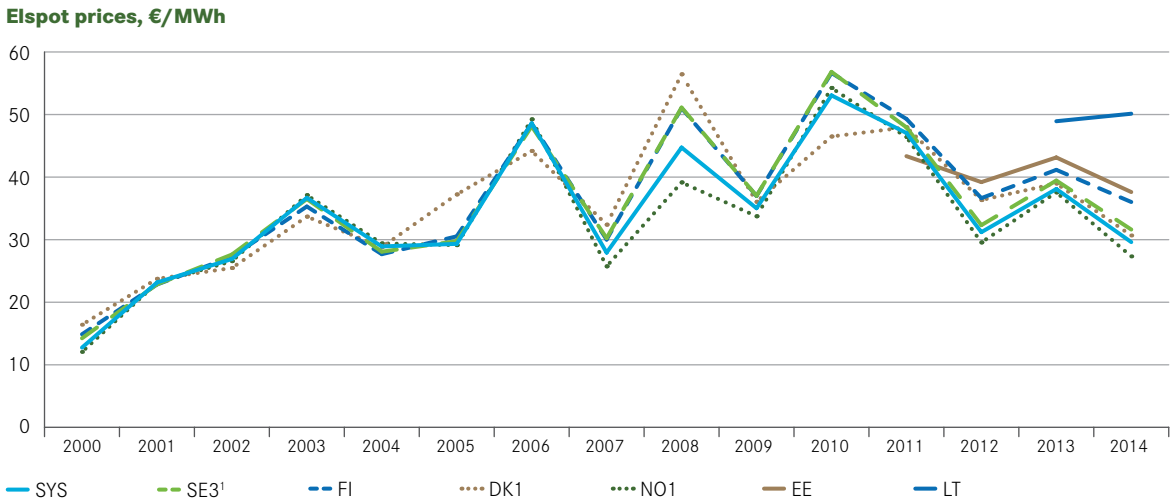
*Baltic volumes in physical spot market since 2010 (Estonia 2010, Lithuania 2012 and Latvia 2013) and financial market since 2012 (Estonia)
Source: Nord Pool Spot, Nasdaq Commodities

Figure 7: Nordic power prices and hydro reservoir levels 2000–2014



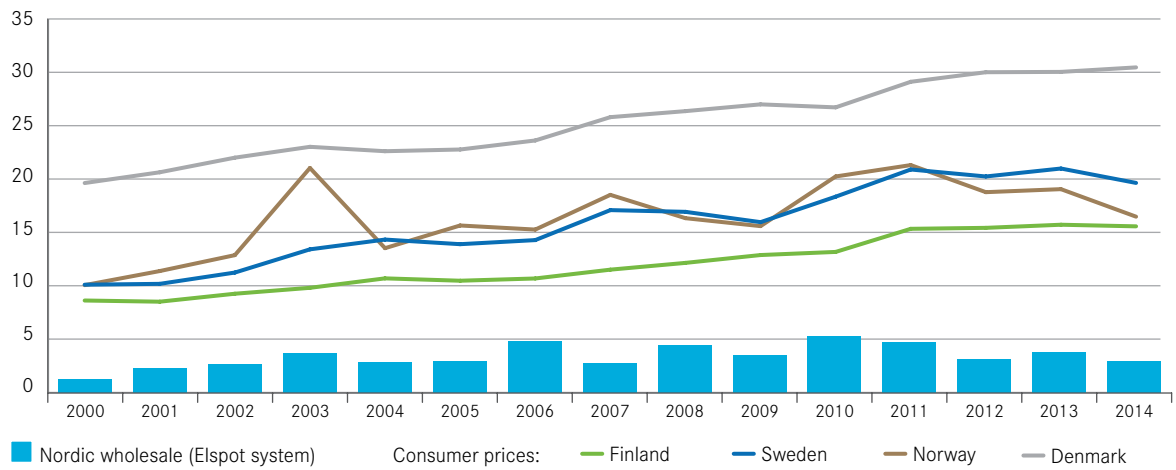
Source: Nord Pool Spot

Figure 8: Nordic area price development in 2000–2014



[1] SE price for 2000–Oct 2011, SE3 price for Nov 2011–2014
Source: Nord Pool Spot

Figure 9: Nordic wholesale and end-consumer prices in 2000-2014 (incl. taxes and levies), €c/kWh



Source: Nord Pool Spot, Eurostat

- The wholesale power market is based on tight physical and commercial integration.
- In order to guarantee the functioning of the power system, rules are needed for both normal and exceptional situations.
- A cornerstone of the liberalised retail markets is the functional unbundling of the regulated distribution and the sales business.
- There has been an increasing interest among household customers in new electricity-related services, thanks to more frequent and detailed reporting and new service offerings utilising information from smart meters.

[8] The third energy package adopted in 2009 sets the framework for the EU internal energy market of electricity and gas. The package aimed for establishing the internal energy market by 2014.

[9] In an over-the-counter (OTC) market, participants trade with each other directly or through brokers, using various communication modes such as the telephone, email and electronic trading systems.

[10] The Elbas market is extended to Germany, the Netherlands and Belgium, too. Since February 2014, a common Euphemia algorithm is used for the day-ahead market by all Western European power exchanges, which optimises the hourly cross-border power flows. For the intraday market, a common European platform is also under development.

[11] The Nordic and Baltic TSOs are Svenska Kraftnät (SE), Statnett (NO), Fingrid (FI), Energinet.dk (DK), Elering (EE), Augstsprieguma tīkls (LV), and Litgrid (LT).

[12] Afterwards, the hourly imbalances of all market participants are financially settled. Settlings are currently done by the TSOs, but a common Nordic balance settlement company will take over the responsibility in 2015–2016.

[13] Network codes are a set of rules currently drafted by ENTSO-E to facilitate the harmonisation, integration and efficiency of the European electricity market. Their role is to technically enable the internal energy market for electricity.

[14] Distribution System Operator (DSO) is the local grid operator between the end customer and the Transmission System Operator (TSO).

[15] The Fortum Fiksu product family, e.g., comprises a range of services that automatically steer the customer's load based on the spot price. Additional home automation features are available in the same platform, integrating the services into one user interface.

SECTION 3

Future challenges of the Nordic electricity market

3.1 Increasing intermittency and declining firm capacity

The growth of renewable generation in the power system is necessary to decarbonise the electricity sector. However, it also forces the energy system to develop. The strong growth of renewable generation in Europe in recent years has, by itself, contributed to the technological learning and decreased the cost of these technologies. It has also resulted in entirely new kinds of challenges for the electricity market and the technical system.

Firstly, the growth of subsidised renewable generation with low marginal costs has replaced commercial generation and lowered average wholesale power prices all around Europe, including in the Nordic power market.

Secondly, the growth of intermittent renewable generation has increased price volatility and made balancing the power system more challenging and expensive, as the availability of wind and solar power is very weather-dependent and only confirmed some hours prior to delivery. This, in turn, has increased retail prices considerably.

The increase of renewable generation, combined with poor general economic performance, weak power demand and low emission allowance prices, has depressed wholesale electricity prices. For these reasons, much of the commercial flexible power generation, which is able to balance the increasing intermittency in the power system, is barely profitable (or even unprofitable) and has been closed down[16]. Consequently, some European countries are considering introducing various sorts of capacity remuneration mechanisms for firm conventional capacity in order to guarantee adequate capacity in the power system at all times[17].

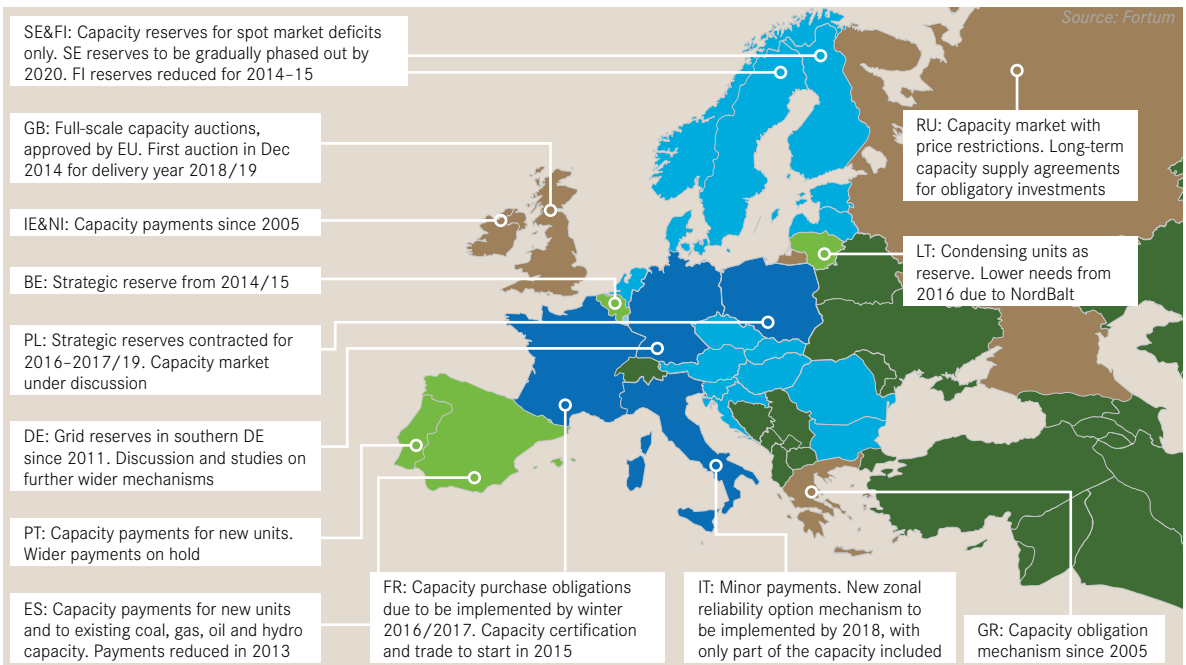
"The Nordics are supported by a favourable generation mix with large hydro assets, which easily absorb the current intermittency."

Just as frequently, there are two types of generation adequacy challenges: short-term and long-term. Short-term generation adequacy refers to the current system's technical availability to meet supply and demand at every hour, while long-term generation adequacy refers to the electricity market's capability to incentivise enough long-term investments in supply, cross-border transmission and in-demand response to meet future peak demand[18].

So far, the Nordic electricity market has been very successful in managing the short-term generation adequacy situations and in integrating the growing renewable generation in the power system. The Nordics are supported by a favourable generation mix with large hydro assets, which easily absorb the current intermittency. The regional Nordic firm generation reserve margin remains at good levels, but it is not certain that the situation will prevail and long-term generation adequacy can be secured without developing the power market further.

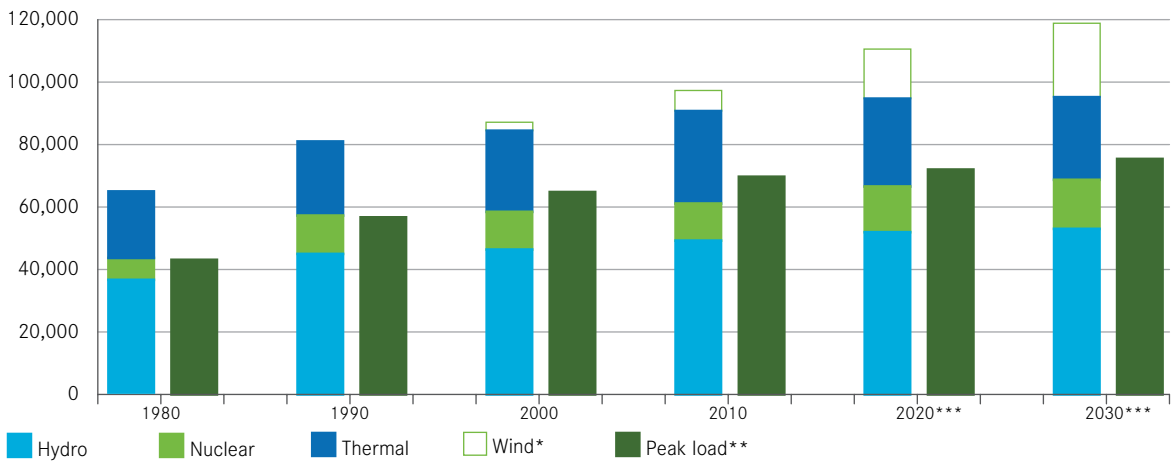
Some coal and gas power plants in the Nordics have already been taken out of operation prior to the end of their technical lifetime, due to poor profitability. In addition, some older power plants must be gradually closed, due to stricter emission limitations, and the oldest nuclear reactors are approaching their end of lifetime[19]. Meanwhile, the current wholesale electricity prices are still too low as such to incentivise investments in new power plants in the Nordics. This raises the question of long-term generation adequacy in several Nordic countries.

Figure 10: Capacity remuneration mechanisms in Europe



*No capacity payments to power plants in the day-ahead and intraday markets, but balancing market reserve capacity is contracted in advance.

Figure 11: Nordic capacity and peak load development 1980-2030, MW



*Available wind power is weather-dependent **Estimated highest temporary demand in 2020 and 2030 *** Forecast

Source: Eurelectric Power Statistics & Trends 2013, ENTSO-E

- The growth of renewable generation in the power system is necessary to decarbonise the electricity sector. However, it also forces the energy system to develop.
- The growth of subsidised renewable generation with low marginal costs has replaced commercial generation and lowered average wholesale power prices.
- The growth of intermittent renewable generation has increased price volatility but also the retail prices. Balancing the power system has become more challenging and expensive.

[16] Fortum Energy Review 1/2014, published in August 2014, extensively addresses the current European power market challenges.

[17] In some European countries, the market deficits for firm capacity have led to the introduction of capacity markets. Full-scale capacity markets are, so far, being set up in Great Britain, France, Italy and Spain. National capacity markets can exacerbate the situation in neighbouring countries, if the supported generation is exported and thus leads to lower revenues and closures of power plants operating in neighbouring energy-only markets.

[18] Also called the "missing money" dilemma in economic literature on power markets.

[19] The Swedish and Finnish nuclear generation retirements start in the second half of the 2020s, and a major part of the existing nuclear base-load generation retires in the 2030s.

3.2 Securing sufficient investment certainty for long-term generation adequacy

As all power generation in the Nordics competes with each other on the least marginal cost principle, the long-term generation adequacy challenge should also be assessed and solved on a Nordic regional level. Credible investment climate and stable energy and climate policy signals today – both in the Nordics and more widely in the European Union – are essential for future investments. Just as essential is the credibility of the power market design over time.

There are no doubts about the need for decarbonising in the energy sector. Policy steering should be towards the lowest cost alternatives and incentivize investments in decarbonisation with minimum market distortion[20]. Consequently, further growth of mature renewable generation should be primarily incentivised through a credible CO_2 price in the EU Emissions Trading Scheme (ETS).

The European Council agreed in October 2014 on the following energy and climate targets for 2030:

- a 40% reduction target for domestic greenhouse gas emissions,
- at least 27% share of renewable energy as an EU-level binding target,
- and at least 27% improvement in energy efficiency as an EU-level indicative target.

This approach, with a clear focus on the CO_2 target, is welcomed and helps to put also the emissions trading system back into the focus. However, other measures are needed to restore the steering effect of the EU ETS. The early adoption of the proposed Market Stability Reserve mechanism is the necessary first step to restore credible CO_2 price signals already before 2020 and to avoid more costly decarbonisation solutions in the future[21].

Costs of mainstream renewable generation technologies, such as on-shore wind and solar generation, are decreasing and becoming cost-competitive with conventional generation technologies that are facing increasing CO_2 emission costs. Consequently, renewables support schemes are no longer needed and should be phased out, as they distort the efficiency of the electricity markets. Support for the immature generation technologies should preferably be implemented through innovation funding, not generation subsides.

It is also important that the general investment climate remains supportive towards all generation technologies that can meet the societies' requirements for environmental performance and energy efficiency. An open and safe investment climate for energy infrastructure is a prerequisite for new-build generation also in the Nordics. It is equally important not to burden the existing fleet with unreasonable environmental and safety requirements or various taxes and levies, whether national or EU driven.

"Policy steering should incentivize investments in low-carbon technologies."

The Nordic electricity market success has very much been based on good co-operation and farsighted stakeholders. Guaranteeing sufficient generation adequacy in the long term and developing the market model in the Nordic and Baltic system requires further strengthening of the regional co-operation among TSOs and regulators[22]. The Nordic electricity

market should be treated as one single market and system, also from the regulation point of view.

A further increase in power transmission capacity is essential for securing the continuous and efficient flow of electricity and an adequate power supply in the Nordic and Baltic power market in the future. In addition to the current connections to the Continental and Russian markets, new interconnectors are being built between Sweden and Lithuania (with an additional new link from Lithuania to Poland) by 2016, between Norway and Germany in 2018, between Denmark and the Netherlands in 2019, and between Norway and England in 2020. Strengthening the connections from Denmark and Sweden to Germany is also planned.

Adequate investments are needed also in the internal Nordic grid. For example, building the planned new third interconnection from northern Sweden to Finland should be started as soon as possible. The interconnection would offer better market integration and increased security of supply both in Finland and in Sweden through power transits via Finland to southern Sweden.

"A further increase in power transmission capacity is essential for securing the continuous and efficient flow of electricity and an adequate power supply."

- Credible investment climate and stable energy and climate policy signals today are essential for future investments.
- The early adoption of the proposed Market Stability Reserve mechanism is the necessary first step to restore credible CO_2 price signals already before 2020 and to avoid more costly decarbonisation solutions in the future.
- It is also important that the general investment climate remains supportive towards all generation technologies that can meet the societies' requirements.

[20] As technological competitiveness of wind and solar evolves and current subsidies harm the commercial power markets, renewable generation subsidies should be phased out when current support periods end. Also indirect subsidies should be avoided. For example, self-consumers (consumers with own electricity generation) should pay grid charges reflecting their use of the grid.

[21] The European Commission proposed in February 2014 to enhance the EU ETS with a Market Stability Reserve (MSR) mechanism to address the surplus of emission allowances that has built up and to improve the system's resilience to major shocks by adjusting the supply of allowances to be auctioned. The MSR would operate entirely according to pre-defined rules that would leave no discretion to the Commission or Member States in its implementation.

[22] Nordic energy market regulators work together closely through their joint organisation NordREG. Governmental energy policies are discussed in the Nordic Council of Ministers, supported by the Nordic Committee of Senior Officials for Energy Policy.

3.3 Developing the Nordic market to secure short-term generation adequacy

The development of the energy markets forces the Nordic countries to consider the next steps in the power market model itself. Some EU countries outside the Nordic area are considering the introduction of capacity remuneration schemes. This is to remunerate the availability of firm capacity in increasingly intermittent power system. And it is not necessarily the right solution.

Any capacity remuneration mechanism is a market intervention that limits market-based options for balancing supply and demand. A capacity remuneration scheme is like additional payments to secure a sufficient, selected form of capacity. It is more expensive and comes with higher costs for the society and the electricity customers than fully competitive energy-only markets. Hence, the Nordic region should primarily explore other ways to manage the increasing intermittency.

The current Nordic energy-only model can deliver sufficient short- and long-term price signals, if the spot and balancing market price signals are free of price regulation and the consumers can react to high prices[23]. Market prices and dispatching should always be on market-based bids, reflecting the true cost of dealing with imbalances. Thus no price caps or restrictions on bid prices should be allowed, as such restrictions would distort the scarcity signals[24].

Power price volatility will inevitably increase, but at the same time it will incentivise the demand side to participate more actively in price formulation[25]. Further integration of the retail and wholesale power markets is also crucial to enable better services to customers and to motivate increasingly required demand-side participation in the power market.

It is also important to develop a common Nordic response to the emergence of the capacity mechanism debate and, at the same time, to avoid national mechanisms inside the Nordic market, which distort the efficiency of the current system. If capacity mechanisms are introduced in neighbouring Continental European countries, it is vital to ensure cross-border participation allowing Nordic generators to access these mechanisms. Otherwise, there is a risk that neighbouring capacity markets will only distort further long-term investment certainty in the Nordic market[26].

It is also important to bear in mind that if the Nordic and Baltic power market is not able to develop the power market model sufficiently, stimulate demand-side participation and accept increasing price volatility, the Nordics might need to consider moving towards a more capacity-based market design in order to guarantee security of supply.

"It is important to develop a common Nordic response to the emergence of the capacity mechanism debate and to avoid national mechanisms inside the Nordic market."

Currently, strategic reserves for avoiding spot market deficit situations are contracted in Sweden and Finland and are planned temporarily in eastern Denmark[27]. The current Swedish reserves are planned to be phased out by 2020, and in Finland the current scheme will be reviewed this year. The strategic reserve system is a kind of capacity remuneration system operated by the transmission system operator

to provide support in emergency situations. Often the strategic reserve is made up of old plants otherwise retired as uneconomical. The strategic reserve is withheld from the market or only bid into the market at extremely high prices. With the current high oversupply and high reserve margin in the Nordic system, the current strategic reserve arrangements are practically unnecessary.

- Securing efficient and real-time price signals will be even more crucial in the future, when supply is more intermittent, customers more active and markets larger.
- Further integration of the retail and wholesale power markets is also crucial to enable better services to customers and to motivate increasingly required demand-side participation.
- The Nordics might need to consider moving towards a more capacity-based market design in order to guarantee security of supply.
- **Energy-only market model:** Power plants are remunerated based on the electricity they produce and sell.
- **Capacity market model:** Power plants are remunerated based on the electricity they produce and sell, but also on the capacity they commit to have available. This is due to the fact that low wholesale electricity prices do not remunerate sufficiently power plants that have high variable cost. Such plants would nevertheless be needed to cover the situations when intermittent renewable sources are not producing (e.g. no wind or sun available).

[23] The main energy market, i.e. the spot (day-ahead) power, should always be able to match the supply and demand if there are enough price-dependent demand bids. For household consumers, hourly pricing is so far fully available only in Finland and soon will be introduced in Sweden and Norway. In many European countries, household prices are still regulated, which distorts the real-time price signals.

[24] Today technical price limits are € -500/+3,000/MWh in the Nordic day-ahead market, and the market can be expected to reach a balance with industrial users actively participating in the market by offering their demand response in tight situations. If the technical price cap would be reached often, it should be increased in order to avoid unnecessary curtailments of the purchase bids. Increased market integration and cross-border deliveries can, however, effectively cover national deficits during high spot prices.

[25] Demand-side participation refers to a situation where consumers (both industrial and retail customers) reduce their electricity costs and consumption by reacting to wholesale power market prices.

[26] Some EU member states plan to introduce capacity markets. Although the drivers are different for each country or region, it is crucial that the introduction of a capacity mechanism does not distort the efficiency of the energy market, or distort market-based prices in the neighbouring regions. The need for any capacity market scheme should be justified by a generation adequacy assessment made on a regional, not national, level, and the assessments should follow some common criteria (in line with the state-aid guidelines), including technology neutrality, equal treatment of existing and new capacity and openness for cross-border participation.

[27] The Danish TSO plans to implement approx. 300 MW of strategic reserves in eastern Denmark in a five-year period from 2016 to 2020.The strategic reserves are considered an interim solution to be in force prior to the new interconnector between eastern Denmark and Germany becoming fully operational in 2020.

3.4 Changing customer behaviour and retail markets

In the Nordics, recent years have seen notable investments in real-time metering and smart grids, which should be utilised. For adequate retail market flexibility, hourly metering of customer consumption, national data hubs and supplier centric customer interfaces should be realised in all Nordic countries. This would incentivise customers to become active market participants. New opportunities also arise through automatic optimisation of the charging of electric cars. Also future technologies, such as battery storages and power-to-gas installations, can provide further flexibility to the power system.

Today's Nordic retail market framework does not meet the customers' nor the energy system's future needs with respect to flexible demand response, small-scale solar electricity production and other offerings. The present retail market model does not even support today's needs sufficiently. The present model and the supporting IT systems are based on the principles and solutions of past decades. In order to get all the benefits from the extensive investments into hourly metering, the retail market arrangements should substantially change.

The so-called supplier centric market model[28] has the retailer as the primary point of contact for customers instead of having an interface to both the retailer and the grid company, as it is today in the Nordics. The supplier centric market model is customer-oriented and very efficient. It would ensure a market-driven approach in the services and offering development for customers. The consumers, too, perceive one interface as logical, and the model is used in similar sectors, such as telecom.

Significant development initiatives have been taken in all Nordic countries to proceed towards a supplier centric market model. An efficient data exchange between the market participants is one of the prerequisites. A national data hub was established in 2013 in Denmark and a second one is under construction in Norway. In Sweden and Finland, the energy regulators have recommended to start the concrete specifications of national data hubs, but the implementations are still pending.

A combined invoice covering both electricity sales and infrastructure fees is a key component in the supplier centric model. Today, customers receive separate invoices, one from the electricity sales company and one from the local grid company (DSO). Integrated energy companies - such as some municipal energy companies - are an exception –they have the possibility to send a combined invoice to their local customers. A single invoicing contact with the customer simplifies the interface for the customer.

"Active customers should be offered easy-to-use and personalised services that also help to save money and reduce the environmental footprint."

However, we are not yet there, especially not in Finland, where a recent study showed that more than 40% of customers would likely decline a competitive offer if it led to separate invoices[29]. In the longer perspective, service offering development and market efficiency are outweighing the combined invoice as reasons for implementing the supplier centric model.

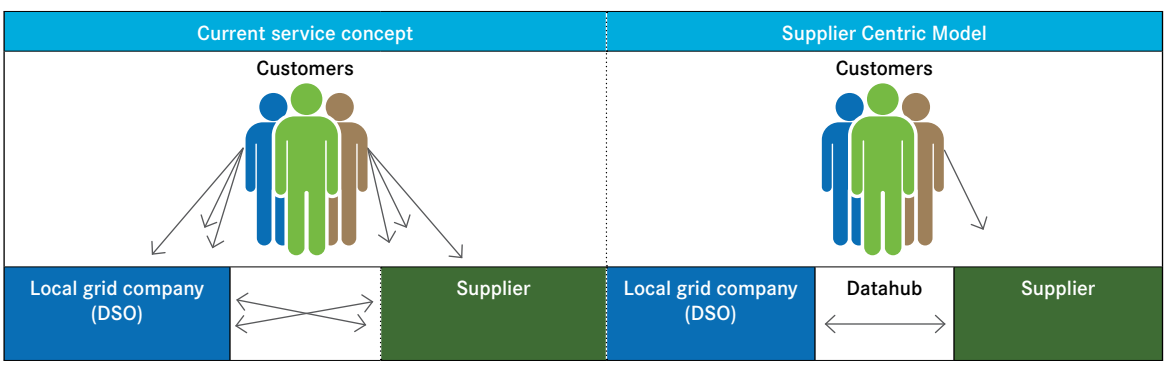
In the Nordic countries, major investments have been made in smart meters that feature hourly metering. In order to fully utilise the innovation and the service and product

development potential linked to these "best-in-class" smart meters, it would be important to abolish barriers from retail market development and to implement reforms to facilitate market development.

Increasingly, active customers should be offered easy-to-use and personalised services that also help to save money and reduce the environmental footprint. At the same time, the need for smarter use of energy increases the complexity in the processes. A market-driven, supplier centric model would drive competition and develop the services for customers. In Finland, too, the steps towards a more modern and efficient electricity retail market should be supported in the regulatory framework and with the prompt support of the authorities.

Figure 12: Supplier centric model (SCM) vs current model

In the SCM, suppliers are responsible for most customer interaction and provide a combined bill for electricity and grid. This improves the suppliers' prerequisites to offer customer oriented products and enhanced customer service.



- In the Nordic countries, major investments have been made in smart meters and networks that should now be fully utilised.
- For adequate retail market flexibility, hourly metering of customer consumption processes with national data hubs and supplier centric customer interfaces should be realised in all Nordic countries.
- An efficient data exchange between the market participants is one of the prerequisites.
- A combined invoice covering both electricity sales and infrastructure fees is a key component in the supplier centric model.

[28] The Nordic energy regulators, NordREG, recommended in 2012 the supplier centric market model with combined billing for the Nordic retail markets.
[29] "Customer survey about the electricity bill", Finnish Energy Industries/YouGov, October 2014.

SECTION 4

Conclusions and recommendations

The Nordic electricity market has been, to date, a true success story, providing notable benefits for the societies in the Nordic region and increasingly also in the Baltic region. The integrated market provides affordable energy for customers, good short-term generation adequacy and one of the world's lowest emission levels per produced energy.

"The Nordic electricity market has been, to date, a success story, providing benefits for the societies in both the Nordic and Baltic regions."

The Nordic electricity market was one of the first liberalised electricity markets in the world. As a true regional market it has been for a long time the role model for building the European internal electricity market.

The Continental European nations are struggling with integrating their growing intermittent generation in the power system. The current Nordic-style energy market model is increasingly being questioned. Is it, in its current form, able to integrate all the growing intermittency in the system? Can it, at the same time, secure short- and long-term generation adequacy?

The current Nordic market model can still today deliver sufficient price signals for short-term generation adequacy, but the price signals for long-term generation adequacy are increasingly distorted. Hence, it is crucial to simultaneously develop both the Nordic wholesale and retail electricity markets.

"It is crucial to simultaneously develop both the Nordic wholesale and retail electricity markets."

We have identified some general principles on the further development of the Nordic electricity market:

- **Generation adequacy to be assessed at a Nordic level, not a national level.** The Nordic electricity market is already a regional market, with the various generation types competing with each other on a least marginal cost basis. These markets should be treated as one power system also from the generation adequacy point of view. The generation adequacy needs assessed and agreed jointly by the Nordic regulators.

"Generation adequacy to be assessed at a Nordic level, not a national level."

- **Power infrastructure to be enhanced further.** Nordic power markets are well connected internally and with neighbouring markets, but further grid enforcements are needed to smooth price area differences further and to integrate the growing renewable generation in the system. The third interconnector between northern Sweden and Finland should be a priority.

- **CO_2 price to drive decarbonisation and the growing use of renewables.** The growth of renewable generation in the power system is necessary in order to succeed in decarbonisation. Since the costs of mature renewable technologies have decreased, their competitiveness has improved and they can compete on their own merits. Generation subsidies should be phased out. The EU Emissions Trading Scheme should be the primary driver of decarbonisation and market-based growth of renewable generation.

"Retail and wholesale markets must be integrated."

- **Unconstrained scarcity in pricing of electricity.** Power prices and dispatching should be based on market-based bids, and prices should reflect the true cost of dealing with imbalances. No price caps are needed. Price volatility will grow and efficient price signals will be even more crucial in the future system, where decentralised sources of flexibility from demand, transmission exchange and energy storage must play a key part.

- **Integration of the retail and wholesale market.** There is a strong need to integrate the price signals also in the retail market. In the Nordics, the smart meters provide the infrastructure, while real-time offerings to customers are still limited. Customer participation should be enabled through dynamic hourly pricing alternatives and better services to customers to motivate their demand response.

- **All Nordic countries to implement the supplier-centric retail market model.** In this model, the retailer is the primary contact point for customers instead of having an interface to both the retailer and the grid company. Such a model will improve customer service, simplify the customer interface, enable retailers to develop their services and offerings, and enhance market efficiency.

- **Nordic response to capacity market development.** It is important to develop a common Nordic response on further securing the Nordic market success in the integrating European energy markets. If the Nordic stakeholders are not able to correspondingly defend and develop the Nordic electricity market and adapt to increasing price volatility, then the Nordics may have to consider the implementation of capacity markets to secure long-term generation adequacy.

FORTUM ENERGY REVIEW AUTHORS:
Pirjo Jokinen, Simon-Erik Ollus, Pekka Vile and Anders Wickström

FORTUM INDUSTRIAL INTELLIGENCE:
Simon-Erik Ollus, Chief Economist and Vice President, Industrial Intelligence
Tel.: +358 10 452 0966

FORTUM CORPORATE RELATIONS:
Esa Hyvärinen, Senior Vice President, Corporate Relations
Tel.: +358 10 453 2244

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