Electricity market needs fixing – What can we do?

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Preface

Electricity markets are at a crossroads. The structure of the electricity generation capacity is changing and the share of weather-dependent and thus variable capacity based on renewable energy sources has significantly increased in the European electricity market. This development has been speeded up by the various national support schemes for renewable generation.

The emphasis on climate target in national energy policies has left to less attention the other two energy policy goals of EU, namely security of supply and well-functioning electricity markets. A sharp increase in variable generation has weakened security of supply. In parallel to the increase in demand for regulating power capacity as a result of growth in variable generation, a lot of capacity that has the ability to regulate has been closed down.

An increase in the renewable generation and the resulting oversupply of energy at subsidized prices has pushed the electricity price at an artificially low level. The profitability of non-subsidized generation has deteriorated considerably, which has led the balancing capacity to exit the market. At the same time there is no business case for market-based investments in electricity generation capacity.

A well-functioning electricity market ensures a cost-efficient transition to a low-carbon power system and provides security of supply that is considered sufficient by the market. A precondition for the functioning of the electricity market is to abolish subsidies that distort the markets at least on a regional basis. The effects of subsidies are felt in the whole internal market. The most costefficient and technology-neutral way to incentivize a transition to a low-carbon energy system is emissions trading scheme.

Fingrid has assessed the functioning of the electricity markets and the Nordic electricity market model in a situation where the generation structure changes and the demand for flexibility increases.

The market model needs fixing as the current path threatens to lead to a situation where security of supply is at risk. We have identified areas for developing the electricity markets through which the current market model can be strengthened to sustain and to adjust to the change of power system in a market-based way. The review of market changes and the proposed measures have a time span of approximately the next five years.

This report is a complementary document to a Finnish discussion paper that we publish on this same date. The main attention is given to those measures that affect the flexibility and adequacy of the power system. Many proposed measures require or benefit from the fact that the solution is at least a Nordic one or covers the Baltic Sea area.

Discussion about the market model and how it needs to be developed is a topical one. The European Commission published in February 2015 a Communication on the Energy Union and launched a consultation on the market design in summer 2015. During 2016 the Commission works towards preparing a proposition on the improved market design, which would enable the transition to the low-carbon power system

We hope that this document is of interest and that we receive feedback on the proposed measures and other ideas for developing the market and its design. We kindly invite eventual comments by the 15th of September 2016 to the e-mail address markkinamalli@fingrid.fi.

Fingrid will use the document and the feedback received on it both in the Nordic and European cooperation when preparing positions and propositions on the further development of the market model.

Helsinki, 17 May 2016
Fingrid Oyj
Markets

Asta Sihvonen-Punkka
Senior Vice President

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1 Introduction

European Union's energy policy goals are defined by the interconnected triad of secure power system operation, market-based investments and clean electricity generation. Secure power system guarantees that the lights stay on, efficient investment should lead to affordable electricity provision to societies, and incentives for decarbonizing electricity generation should shape the development of the power systems. However, many recent policy endeavors have overemphasized renewable electricity as a means to decarbonize the power sector, putting the other two goals in jeopardy. Subsidies to promote renewable electricity have undermined the role of market-based investments, and maintaining power system security has become more and more challenging as large amounts of weather-dependent renewable electricity has been added to power systems.

The ongoing changes in the electricity generation mix would require innovations in flexible technologies. An important role of an infrastructure is to provide a platform for supply and demand side innovations that will promote secure power system operation during the transition to a low-carbon future. Flexibility will be an increasingly important characteristic of future power system. Flexibility here means the power system's capability to respond to rapid changes in consumption and production.

Intraday and balancing markets provide a natural place for flexible resources to trade in. In healthy markets, price signals would give incentives for economic behavior and for balancing supply and demand both in the short-term and long-term. In today's electricity markets, however, subsidies have largely crowded out market-based investments. A political decision would be needed urgently to put an end to the current vicious circle that risks achieving the goals of secure, sustainable and affordable electricity. In a healthy market, the price of a product should reflect its value. Among other things, it is important that prices signal whenever there is scarcity in the markets.

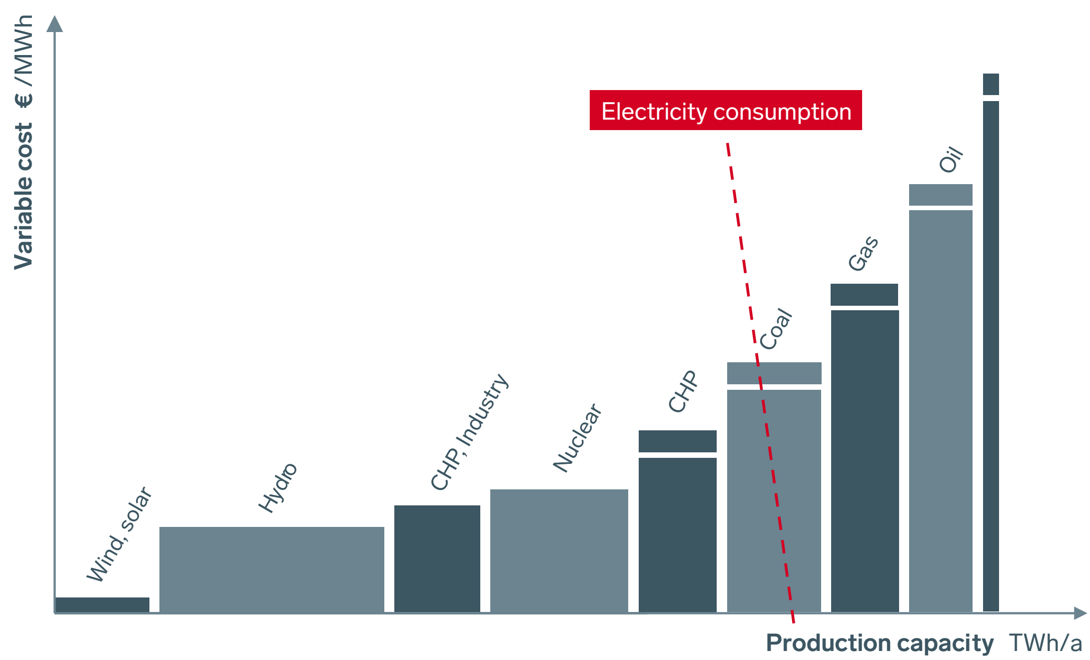
This paper identifies a number of development needs of the current Nordic electricity market design. It introduces two alternative development paths for the Nordic electricity markets. The essential question is will the price mechanism continue to be the primary means to incentivize economic behavior in electricity markets. And if not, what would be the alternative in organizing power system operation and development. In the end, the choice is either continuing to trust the markets or turning towards increased central control.

The first development path, the "Markets", is characterized as an evolutionary development of the Nordic market design. It consists of development steps that can help restoring the role of market-based incentives. However, the paper also introduces an alternative path for electricity sector development that builds on a stronger central control. In this case, distortive subsidies prevail and a more fundamental change is needed in how we think about the electricity sector development.

2 Challenges in the Nordic power system

Today's electricity markets are undergoing a tremendous change. The driver for change has been the desire to decarbonize the electricity sector by promoting renewable electricity. In the pursuit of this goal, targeted subsidy schemes for selected technologies have played a key role. This approach has had direct consequences to the electricity market functioning as excess subsidies have largely crowded out market-based investments in the sector. Furthermore, subsidized production that receives revenues outside the markets pushes conventional generators off the merit order (see figure 1). This causes conventional generators to leave the markets, which may put power adequacy and power system security at risk.

1 Merit order in electricity markets



Power inadequacy occurs when the available production capacity does not suffice to meet the demand. Reduced power system security, on the other hand, means that the power system becomes less capable of handling the rapid variations in consumption or production. To guarantee the power adequacy and power system security, subsidizing conventional electricity generation is increasingly deemed necessary in various European countries.

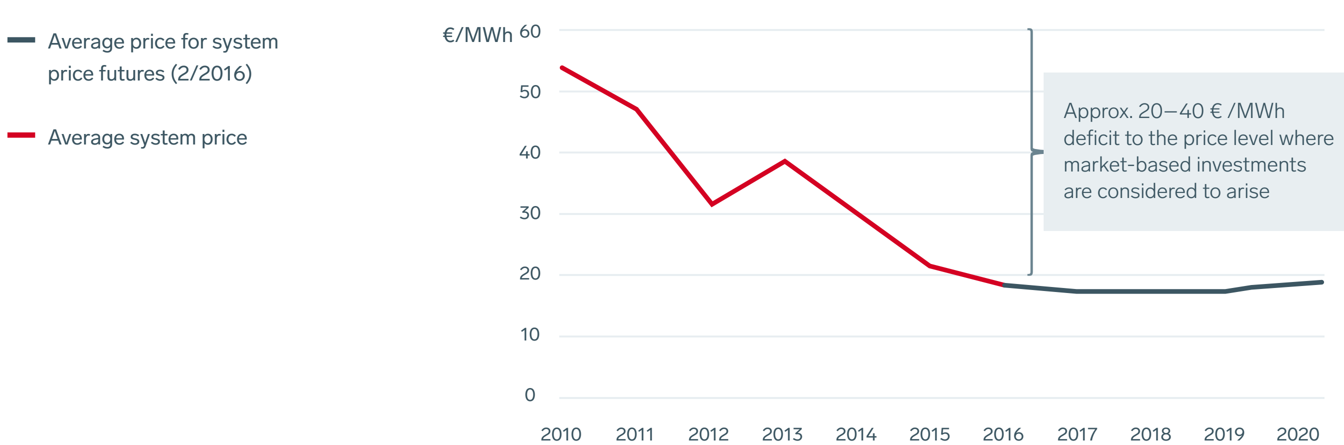
The approaches chosen by different countries to promote decarbonizing electricity generation vary hugely from one country to another. In Germany, for instance, renewable capacities have been added in large quantities to the existing power system. However, empirical evidence so far suggests that this road is likely to be paved with security problems and high electricity prices for end consumers. Security threat has triggered a discussion about the need to alter the prevailing electricity market design. In the UK, on the other hand, a more proactive approach has been adopted and significant market redesigns have been enacted ahead of a major addition of renewable capacity. The new market design in the UK encompasses market-wide capacity remunerations.

The Nordic electricity market also faces challenges. Reduced power adequacy and system flexibility are of concern. Vast subsidies have pressed the electricity prices to historically low levels. As a result, large amount of conventional thermal power plants have left the markets or are planning to do so. With the thermal power plant closures, some power system flexibility is lost. At the same time, significant increases of wind power are forecast to take place, which increases the need for flexibility. In addition, the thermal power plant closures will reduce the power system inertia in the Nordics. Lower inertia means an increased risk of large power system failures and blackouts.

2.1 Power adequacy

Vast amount of subsidized renewable electricity production causes price distortions in electricity markets (see figure 2). A clear gap has emerged between the market prices of electricity and the price level where market-based investments are considered to arise. In addition, the depressed day-ahead prices dampen the incentives for innovation. A change of subsidy policy would be required to solve the problem. On the other hand, failing to address the issue on political level will prolong the slump of market-based investments in the electricity sector.

2 **Development of system and futures price in the Nordic electricity market**



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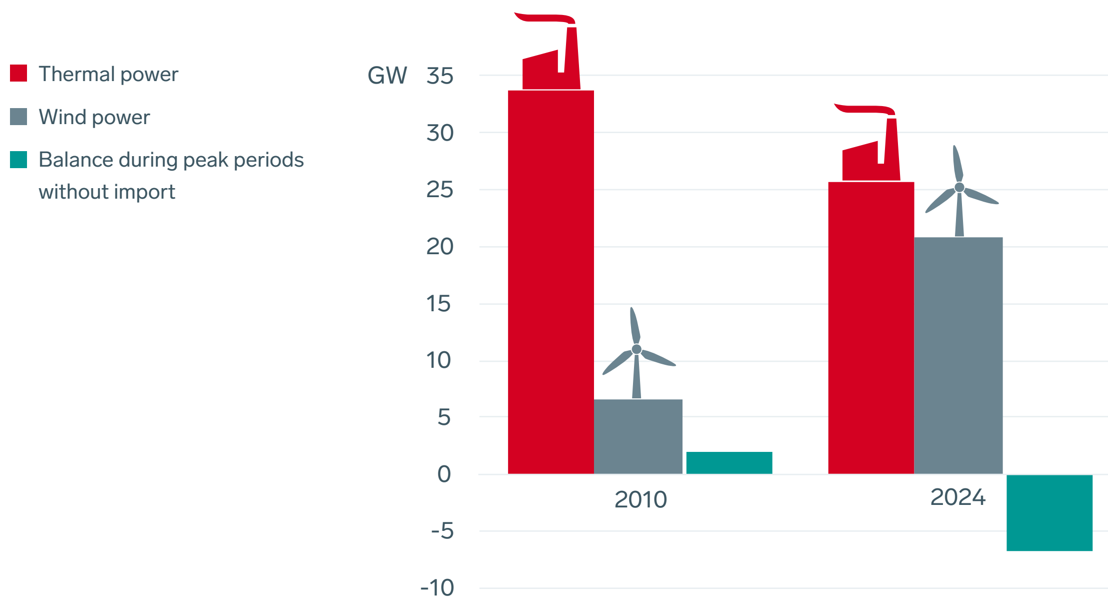
Subsidized renewable electricity shapes the operating environment in the Nordic electricity market. A large amount of wind has been added to the system in recent years, and the trend is expected to continue. For example, according to plans, there will be over 22 GW of wind power in total in the Nordic power system in 2025. At the same time, the closures of condensing power plants in Finland and Denmark and the early decommissioning of nuclear power plants in Sweden suggest emerging power adequacy challenges, thus suggesting an increased risk of power shortages and load shedding. If the trend continues, it will affect power adequacy during the highest demand in the Nordic region, as shown in figure 3.

3

Forecast changes in production structure in the Nordic electricity markets



2.2 Flexibility

In the Nordic power system, flexibility has generally not been an issue due to a large amount of hydropower. In the Finnish power system in particular, an important source of flexibility has also been the condensing power generation. However, the current low prices in the day-ahead market have pushed condensing power plants off the market, which has resulted in a reduction of supply also in the balancing power markets. However, especially the prevailing balancing market design may not adequately encourage flexible resources to enter the markets. For example, market participants do not know the cost of imbalances in real time. Thus, they may lack incentives to actively search for any additional sources of flexibility in case of system stress.

Finland is an area where scarcity in the balancing markets occasionally occur. For instance, since September 2015 there have been four instances when all the market-based balancing power offers have been used. Although the list of up-regulation offers has occasionally been exhausted in previous years as well, the increased frequency of the incidents signals that the market is tight. After the market-based offers run out, Fingrid has to use its own system reserves. Since these are meant to be used only in fault situation, using them in normal operating conditions means lower preparedness to handle large disturbances such as a tripping of a large power plant or an interconnection. Risks of blackouts would thus increase.

On the positive side is that amount of demand side resources that are active in the balancing markets has increased in recent years. In addition, demand side participation has also increased in other reserves markets and this trend is expected to continue. Figure 4 illustrates the amounts of demand side offers in the day-ahead, intraday, and balancing power markets, and in the reserves markets in Finland. In the future, the demand side will be an increasingly important source of flexibility in the power system.

4 The demand side participation in the day-ahead, intraday, balancing power and reserves markets in Finland

Hourly based metering and tariff in place!

Different technical requirements in different market!

Dissimilar market, diffrent requirements → different compensation

2.3 Inertia

Supply and demand in a power system have to be in balance at every instant. When in balance, the power system frequency is 50 Hz. Any imbalance between the supply and demand is reflected in the power system frequency. In order to maintain a secure operation of the power system, that is, to avoid blackouts, frequency must remain within a predefined range. When this balance is lost, for example because of a failure of a large power plant, frequency falls outside of the predefined range. In such situation, frequency containment reserves are activated to bring frequency back to normal range. In case of very large frequency drops, notable amount of demand may have to be disconnected to restore the system balance.

Inertia is a measure that indicates how large a drop in frequency follows a tripping of a large power plant. Having a lot of inertia in the system slows down the drop of frequency. Low inertia, on the other hand, means faster and larger drops in frequency, which increases the risk of blackouts. Largest providers of inertia in the Nordic power system are nuclear power plants and large thermal power plants. Figure 5 illustrates the current division of inertia within the Nordic power system and an estimated development trend for future inertia. Low inertia situations occur, for example, during summer time when the demand is low and consequently the number of dispatched large power plants is at its smallest.

Several ongoing trends challenge the adequacy of inertia in the future. For example, the new investments in power generation are increasingly made in wind and solar power, which do not provide inertia. In addition, closures of nuclear power plants in Sweden and condensing power plants in Finland significantly reduce the amount of existing inertia in the Nordic power system. Moreover, also the inertia provided by the large electrical motors of the energy intensive industries is decreasing. This results from the reduced industrial electricity demand and the increased use of power electronics. The latter means that the motors nowadays increasingly rotate at a frequency that is independent of the grid frequency.

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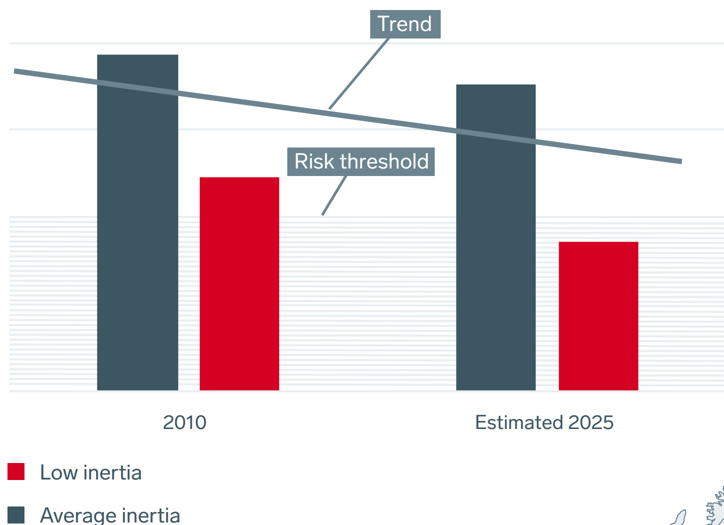
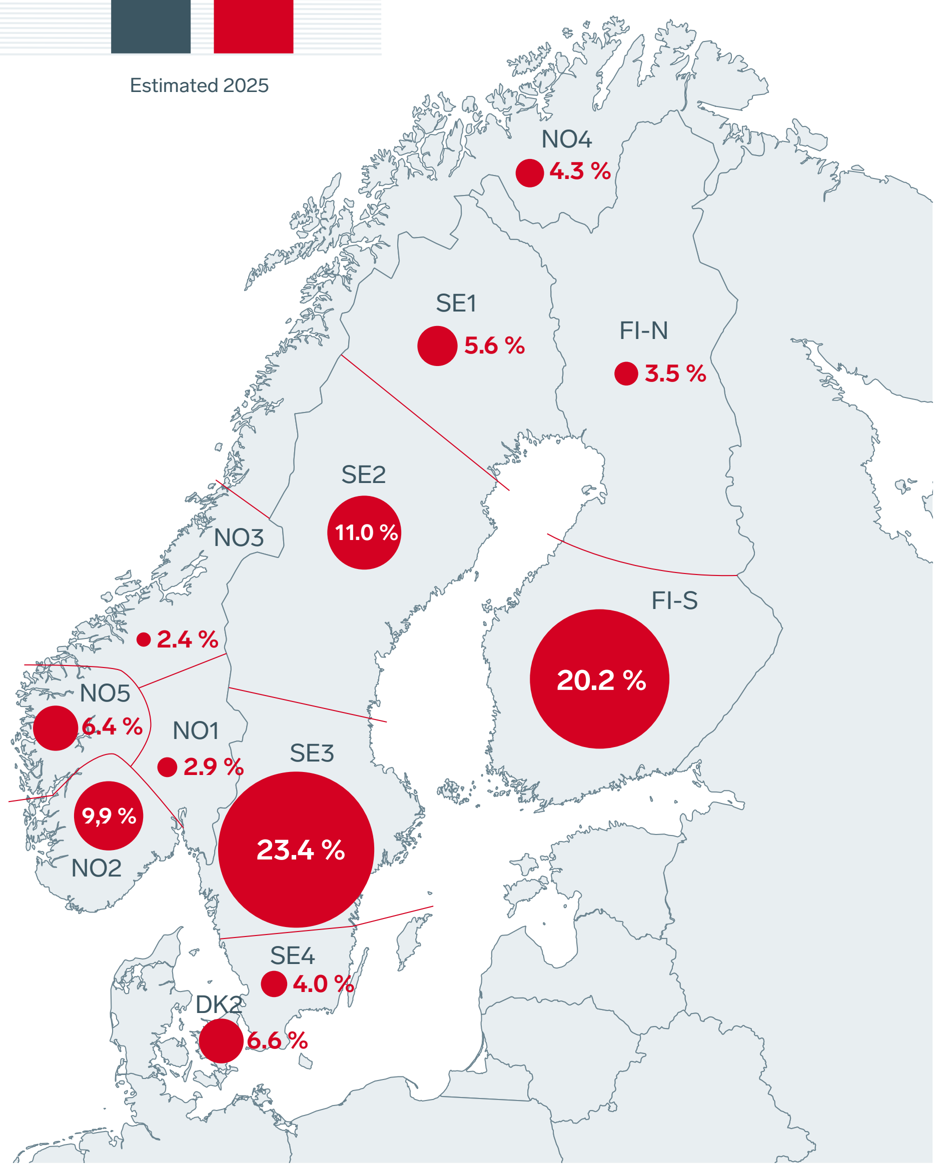
Inertia in the Nordic power system





3 Two alternative development paths

The current dilemma in the Nordic electricity market is twofold. On the one hand, the low market prices do not enable profitable operation of conventional generators, thus causing them to leave the markets. On the other hand, in some parts of the market, there is already occasional scarcity of flexible resources within the operating hour to balance supply and demand in real-time. The first problem is a political one and follows from excessive subsidies to targeted technologies. It thus falls within the political framework to solve it. The second one is partly a market design issue that can be alleviated by making the balancing prices to better reflect the real costs of system balancing. For example, at present the costs of reserves are not fully allocated to those that cause the need of reserves in first place. Instead, the costs are largely socialized. TSOs can contribute to solving the second problem by developing the balancing regime.

This paper presents two rather different alternatives to alleviate some of the identified problems in the electricity market in the Baltic Sea region. The general objective of both development paths is that they should enable a controlled shift to a low-carbon energy system without risking power adequacy and system security, the latter of which requires sufficient flexibility and inertia from the power system. The first alternative, “Markets”, builds on an evolutionary development of the Nordic electricity market. The second alternative, “Centrally controlled power system”, in contrast, envisages a future where power system challenges are solved increasingly through central control.

3.1 “Markets”

The “Markets” path depicts an evolutionary development of the Nordic electricity markets. Market design changes would be needed to facilitate and incentivize the participation of flexible resources in multiple timeframes. Taking this path would mean alterations especially in the current balancing regime. Changes would concern especially the following areas: balancing power markets, imbalance settlement model, the principles of using and financing the strategic reserve, and incentives for demand response in the balancing markets. The objective of the changes would be to strengthen the market mechanism through increased transparency and wider market entry, to sharpen price signals and adequately reward flexibility. A more targeted allocation of power system balancing costs and the reserve holding costs would be adopted. Price caps in different market timeframes should reflect the system stress and the value of lost load (VOLL).

A key success factor in the “Markets” path would be that low-carbon power system is pursued by using the markets. This would mean phasing out the existing targeted subsidy schemes and abolishing the plans for new schemes. Political commitment would be needed to allow the markets to work in order to restore incentives for market-based investments. An essential political choice would be to commit to the CO_2 emission reduction goals but leave it to the markets to decide how to achieve them. Emissions trading is an efficient and technology neutral way to reduce CO_2 emissions in the energy sector without disturbing the markets.

3.1.1 Day-ahead and intraday markets

Day-ahead markets form an important part of electricity markets. For example, the day-ahead price is used as a reference price for many financial electricity contracts, and as a starting point for deriving the balancing and imbalance power prices. The day-ahead prices are formed in a single price coupling process that covers most of the European countries. The price coupling algorithm makes an efficient use of the transmission capacities between the bidding zones of the coupled market.

The power exchanges in the coupled market, including Nord Pool in the Nordic and Baltic markets, have agreed that the price floor and the price cap used in the algorithm are -500 €/MWh and 3000 €/MWh, respectively. The regulators have approved these limits. During 2016, the maximum and minimum prices will be assessed as a part of the European electricity legislation development. It is important that the price caps reflect the value of lost load and do not distort price formation.

After the day-ahead price calculation, the unused cross-border transmission capacities are given to the intraday markets where the market participants are able to continue to trade and to balance their portfolios. The trading takes place as continuous trading and it can continue until one hour before the operational hour.

To respond to the changing generation mix, electricity trade will move closer to real time, and the role of intraday and balancing power markets will increase. The revenue streams from these short-term markets should also adequately reward flexible generators for their timely contribution to power system security, thus making it easier for them to stay in the markets. Possibilities to reserve some of the cross-border capacities to intraday and balancing markets could be investigated, within the limits set by the European electricity market legislation.

Market design changes can mean increased volatility and higher price spikes. New hedging possibilities may be needed. Financial or physical energy options are one alternative. Financial options can be exercised against any underlying product in the day-ahead and intraday markets. Options are most straightforward to implement in the day-ahead markets because the day-ahead price provides a clear reference price. In the intraday markets, no such a natural reference price currently exists. In intraday markets, the market participants can face many different prices because the buy and sell bids are matched as they come and no single intraday price is formed for the market time unit.

Fingrid

- considers it important that price caps do not distort price formation in electricity markets and that the levels of price caps reflect the value of lost load
- proposes for consideration whether some of the transmission capacities between bidding zones could be allocated in a market-based way to intraday or balancing power markets
- considers it important to review whether the intraday trading gate closure could be moved closer to the operating hour.

3.1.2 Strategic reserve

Finland currently has a strategic reserve in place. The purpose of this reserve is to guarantee power adequacy especially during wintertime (from December until end of February). The targeted level of power adequacy has not been explicitly determined. The Energy Authority decides the total amount of the strategic reserve. Fingrid is responsible for contracting the requested capacity and decides on the use of strategic reserves. In the winter period, the strategic reserve is kept in 12-hour readiness to produce.

The strategic reserve mainly works as transitional measure to keep in the reserve power plants that would otherwise be mothballed. Such measures can form a bridge, for example, in situations when market design changes are underway or new generation is expected to enter the markets in near future. The strategic reserve is unlikely to trigger investments in new generation. It should not be considered as an enduring long-run solution to guarantee power adequacy.

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Strategic reserve can be dispatched in the day-ahead market if the market fails to clear. In such a case, the dispatching price of the strategic reserve is currently determined by adding 0.1 euros to the offer price of the highest commercial offer. The problem is that if the strategic reserves are dispatched at any price below the price cap (currently 3000 €/MWh in the Nordic day-ahead market), they diminish especially the peak power producers' ability to recover their costs in the day-ahead market. These are producers that are typically dispatched only for a very limited amount of time in a year and their revenues and profitability essentially depend on the prices during the few scarcity hours when they are dispatched. In addition, the implicit price caps caused by the strategic reserves also prevent the other producers from earning scarcity rents that are expected to form part of their revenues in an energy-only electricity market. Hence, in order to minimize the distortions, the strategic reserve should be dispatched at a price that equals the price cap and reflects the value of lost load. In addition, the dispatching principles for strategic reserve across the Baltic Sea region should be harmonized to support efficient cross-border trade of electricity.

Fingrid

- proposes that the target level of power adequacy is determined for Finland
- proposes that the dispatching price of the strategic reserve is determined based on the day-ahead market price cap
- proposes that in Finland the strategic reserve holding costs would be collected from the electricity consumption only during the wintertime so that the fee would be targeted to the working days and daytime hours during the period of December-February.

3.1.3 Balancing power markets

The TSOs are responsible for maintaining the frequency in the Nordic power system. For this purpose, the Nordic TSOs organize a balancing power market, where market participants can place their offers. The balancing power market currently applies a marginal pricing principle and one-hour resolution. Balancing power offers are accepted until 45 minutes before the operating hour and a merit order list is constructed from all the offers. In Finland, the minimum offer size is 10 MW. In the autumn of 2016, Fingrid will reduce the minimum offer size to 5 MW. The capability requirement is that the resources can be activated in full in 15 minutes. During the operating hour, the TSOs activate the balancing power offers from the merit order list in order to maintain power balance.

With respect to balancing power prices, a current problem is that they do not fully reveal the true value of electricity during scarcity. For instance, many of the power system balancing costs are currently socialized. In addition, when the list of commercial up-regulation offers is exhausted, Fingrid's own reserves are dispatched at the offer price of the highest commercial offer. The dispatching may create an implicit price cap to the balancing power markets that prevents the price from reflecting the scarcity value of electricity. The current price cap in the balancing power markets is 5000 €/MWh.

Another problem in the prevailing balancing power market design is that the market participants do not know the value of balancing power in real time because the balancing prices are known and published in retrospect. The all-time highest balancing power price in Finland was seen in 22 January 2016 at 6-7 in the morning when the price was 3000 €/MWh. When looking at the accepted offers after every 15 minutes during this hour, it can be seen that only in last quarter of the hour the very high prices occurred (see figure 6).

6 Balancing power price, 22.1.2016 at 6–7 (€/MWh)

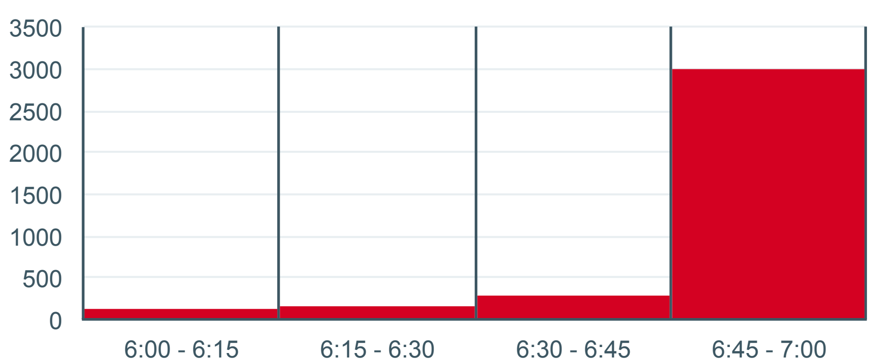


Figure 6. Balancing power price development during the hour 6-7 am on 22 January 2016. The balancing price for the whole hour was the highest up-regulation activation price of 3000 €/MWh that was reached during the last quarter of the hour.

It is important to increase transparency and access to market information in the balancing market. However, the increase in transparency should not weaken the production plans of market actors. Production plans and consumption forecasts that are reliable and of good quality are the central tool for the Nordic TSOs to maintain balance during the operating hour.

As a part of this work Fingrid prepares a pilot for publishing balancing price information in the operating hour. During the pilot the activated bids and their prices would be published on Fingrid's website in the operating hour as soon as it is technically possible after the activation. The price would be published when there would be scarcity in the balancing market, for example when the remaining up-regulation bids amount to 100 - 150 MW and Finland is decoupled from the Nordic regulation area into a separate regulation area.

Developing the balancing regime to better reveal the true value of electricity and reward flexible resources requires market design changes. Facilitating flexible resources to participate in the balancing markets would require that right incentives be in place, and that there are no entry barriers. Setting price caps in the balancing markets to reflect the scarcity value of electricity could incentivize new flexible resources to discover new profit opportunities in the balancing markets and add competition in the markets.

Fingrid

- will lower the minimum size of the balancing power market offers in the autumn 2016 from the current 10 MW to 5 MW
- will prepare a test period to study the possibilities to increase the transparency of the balancing power markets
- will look into the issue of lowering the minimum offer size requirement under 5 MW, combining the small offers from more than one balance, and assessing the real-time measurement requirements to enable wider participation in the balancing power markets.

3.1.4 Imbalance settlement model

According to the current Nordic imbalance settlement model, the balance responsible parties are expected to balance their portfolio on an hourly basis before the operational hour. Portfolio balance can be managed by trades in the day-ahead and intraday markets, and by bilateral trades between balance responsible parties in the same bidding zone. The prices of imbalance power are derived based on the balancing power prices. Different imbalance pricing models are applied to production and consumption.

For production, a two-price system for imbalance settlement is applied. This means that separate prices are calculated for the purchase and sales of imbalance power. The price depends on whether the producer's individual imbalance helps to restore the system balance or makes it worse. Producers have to submit their preliminary production plans to Fingrid after the day-ahead markets are cleared and their binding production plans 45 minutes before the start of the operating hour.

For the hours when there is an overall deficit of supply

- Producers that produce too little are making the system imbalance worse. They have to pay for their deficit the up-regulation price, which is always higher than the day-ahead market price.

- Producers that help to restore the system balance are paid the day-ahead market price for the excess power.

For the hours when there is an overall excess of supply

- Producers that produce too much are worsening the system imbalance. They are paid for their excess production the down-regulation price, which is always lower than the day-ahead market price.

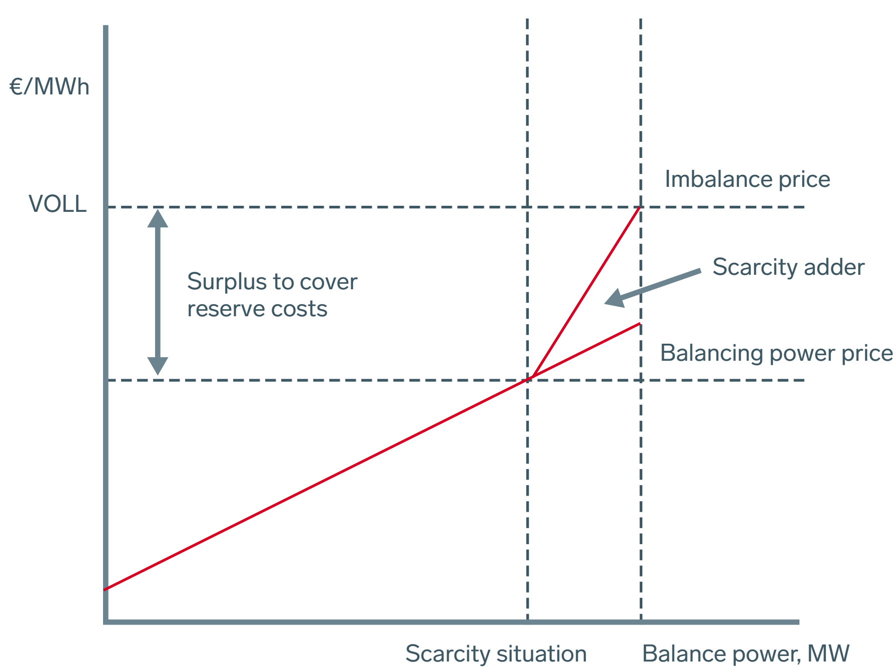
- Producers that have produced too little have to pay the day-ahead market price for the deficit.

For consumption, a one-price system is used. It means that the consumers pay the same imbalance price regardless of whether their individual imbalances help or worsen the system balance. During an up-regulating hour, the price of imbalance power is the up-regulating price, and during a down-regulating hour, the price of imbalance power is the down-regulating price. If no regulations have been carried out during the hour, the price of imbalance power is the day-ahead price.

The current imbalance settlement model incentivizes market participants to balance their individual portfolios but not to work towards helping to restore the system balance. For example, producers who could help the system balance during an up-regulation hour by exceeding their planned production, would only get the day-ahead market price instead of the higher balancing power price. They would have a stronger incentive to help to restore the system balance if they would get the balancing power price. With increasing amount of weather-dependent generation, all means to alleviate imbalances will become more and more important.

The current price cap of 5000 €/MWh of the balancing power markets sets the upper limit to the imbalance price. In scarcity situations, this may dampen the price if it fails to reflect the value of lost load (VOLL). During scarcity situation, some of the costs of those reserves that are needed to handle the imbalance could be allocated to those market parties that cause the imbalance. Figure 7 illustrates a mechanism, a scarcity adder, through which this could be done.

7 **Imbalance price and the scarcity adder that allows allocating some of the reserve costs to those responsible for the imbalance**



The scarcity adder may increase imbalance price volatility and the need of price hedging. Energy options that are settled against the imbalance power price could be used as a hedging instrument.

Another problem with the current imbalance settlement model is that the one-hour resolution used in the imbalance settlement does not correlate very well with the continuous changes in consumption or variations with the weather dependent generation during the hour. To comply with increasing amount of weather dependent generation, also the trade in electricity markets should shift closer to real-time. Unless the market participant are allowed to balance their portfolio in a way that reflects the changes in the generation mix and the consumption variations, the TSOs balancing actions during the operating hour will increase.

Fingrid

- will review the possibilities of stronger application of "polluter pays" principle regarding the imbalance prices.
- will develop in cooperation with the stakeholders and the Nordic TSOs an imbalance pricing model that would take into account the full costs of power system balancing.
- will prepare, together with the other Nordic TSOs and in the European cooperation, a proposal for the imbalance settlement period.

3.1.5 Linking the wholesale and retail markets

Prices give incentives for economic behavior. The price of a product signals its value to the market at a given moment in a given place. The price thus contains information, for instance, about scarcity. However, in the European electricity markets, the incentives are often blurred because of the poor link between the wholesale and retail market prices. In addition, the value of electricity is not fully reflected in the prices especially in scarcity situations. This is caused, for example, by the price caps, the flat tariff structures used in the retail markets, and the socialization of the costs of reserves. Improving the pass through of price signals is important to facilitate a more active demand side participation in the electricity markets. Active demand side participation is necessary to complement the increased amount of weather dependent generation.

Market design changes, however, do not solve the problems caused by extensive subsidies. Changes in energy policy would be needed to solve this issue.

The increase of weather-dependent electricity generation increases the risks of unpredictable temporary scarcity situations, which may also occur after the gate closure of the day-ahead markets. As a result, the need for flexible resources grows. As trade moves closer to real-time, the value of flexible resources will be highest in the short-term markets.

At present, the demand side in Finland can already actively take part in the day-ahead and intraday as well as in the balancing and reserves markets. Especially the large industrial electricity users have undertaken this opportunity. Next step would be to incentivize also households and other small electricity users to offer their demand response potential to the markets. In Finland, the current distribution network tariff structures may stand as a barrier for household consumers' cost optimization through active demand response.

To sharpen the price signals to adequately reward active demand side participation in multiple timeframes in electricity markets, imbalance charges should reflect the full marginal costs of balancing. In addition, revising the requirements for entry, and the removal of barriers when necessary, are needed. This could mean, for example, relaxing the real-time measurement and the minimum size requirements for aggregated demand side resources in the balancing markets. From a technical point of view, a platform that enables adequate control and aggregation of appliances could facilitate the participation of small electricity users. Data security and privacy are of extreme importance when implementing such solutions.

Fingrid

- considers important that the practices followed in distribution network businesses do not hamper the development of retail and wholesale markets
- proposes that the benefits and drawbacks of two-time network tariff and the related demand control are assessed in terms of the overall efficiency of electricity market
- proposes to review what kind of changes would be needed to the electricity retail market model to increase active consumer participation and demand response.

3.2 “Centrally controlled power system”

Generation mix in future power systems will be different from what it is today. Increased amount of weather-dependent generation calls for increased power system flexibility and pushes trade from day-ahead market closer to real time. A market-based approach would be to make use of entrepreneurial discovery in finding solutions to the identified problems. However, the markets cannot work if the majority of investments are subject to political decision-making. In addition, the depressed market prices do not incentivize innovation.

The “Centrally controlled power system” is an outcome of a development path in which targeted subsidies for renewable electricity persistently distort the electricity price formation. Market-wide capacity payments are implemented to prevent premature closing of conventional power plants that are needed to secure power adequacy. Capacity payments reward producers for availability and offer additional sources of revenues for producers that suffer from price distortions (i.e. the artificially low prices that result from the large amount of subsidized production in the markets). In such case, approval would be needed to confirm that the support systems are in line with the EU state aid guidelines.

Extensive subsidies for both renewable electricity and conventional electricity crowd out market-based investments. Giving up the markets also means that the decisions on the power system operation and planning have to be taken centrally. These concern, for example, central control on which power plants should run and how they should run. In a well-functioning electricity market, the price system optimizes the merit order. Lastly, in the absence of competition that would give incentive for efficiency, regulation is needed to take care of this. In addition, regulatory oversight is needed to monitor that the decisions of the central power system operator and planner are socioeconomically optimal.

3.2.1 Centralized decision-making

The use of capacity mechanisms centralizes decision-making. This is in contrast to the markets, where the issue of power adequacy is mostly left to the markets. When using capacity mechanisms, a central decision has to be made on how much capacity is needed. In addition, the capacity mechanisms often involve also an explicit decision on what kind of capacity is needed to safeguard the power system operation.

To support the centralized decision-making, TSOs are typically assigned with the task to forecast the energy and capacity balance for several years ahead. The forecast also takes into account the maximum cross-border capacity contribution. Based on the forecasts, the regulators or TSOs can decide to contract the necessary amount and type of capacity. The contracts are typically made for a few years ahead and for one year at the time. The costs are allocated to the demand side usually based on the actual or forecast demand during system stress.

The targeted security level is a political decision. It sets the limits to how many hours of lost load is acceptable to the society. This target forms the starting point for planning a power system that fulfils the security requirements. Capacity mechanisms are means to achieve the political target.

3.2.2 Capacity product design

Product design is at the heart of capacity mechanisms. Whether the mechanisms deliver the targeted power adequacy, flexibility and inertia depends on the characteristics of the acquired capacity. Depending on the product design, the demand side's curtailment offers may also be accepted as one form of capacity. Capacity prices can be fixed centrally or auctions can be arranged.

When designing the capacity purchasing, requirements are often set for power plant characteristics. This includes, for example, specifying the start-up times and ramping rates for the power plants. In addition, methodologies to validate the plant characteristics have to be put in place.

In principle, capacity mechanism can be technology neutral. This, however, depends on the criteria defined for the capacity products. In practice, detailed criteria may unintentionally favor one technology over the other. Moreover, they may result in a technology lock-in if the costs of developing new technologies are not compensated for.

Capacity product requirements usually demand that the capacity is made available on request. To check this, methods to verify the availability during the contracted period are needed.

As a general principle, the capacities provided through interconnectors are not to be discriminated in capacity purchasing. However, a penalty for non-delivery cannot be enforced on interconnector owners/operators or foreign producers. In case such a penalty existed, explicit reservation of cross-border capacity would be needed. This would violate the idea of the Internal Electricity Market that builds on implicit allocation of cross-border capacity in day-ahead and intraday timeframes.

3.2.3 Regulatory oversight

The central decision-making within the “Centrally controlled power system” framework has impacts on people and society. The decisions made by a central body concern, for example, the amount of capacity that is purchased, the allocation of costs to electricity users, and the product design and eligibility of market participants. Suitable institutional framework and governance methods are needed to ensure that the centrally made decisions are efficient and comply with the goals of society. This includes adequate and appropriate regulatory oversight over the central planner.

4 Which path to choose?

The previous chapter introduced two alternative development paths for the Nordic electricity markets. A major difference between the two was that the “Markets” path builds on using the markets and gradually abolishing subsidies whereas the “Centrally controlled power system” is based on subsidies and central control.

This chapter presents the results from comparing and contrasting these paths to each other. When doing the comparison, the following questions were considered:

- How effectively and efficiently do they ensure power system security?
- Do they incentivize low-carbon generation?
- Do they treat different technologies in a non-discriminatory manner?

- How complicated are they to set up and administer?
- How much regulatory intervention do they require?
- What is the degree of perceived regulatory risk?
- Can they adapt to changing market environment without regulatory intervention?

- Do they incentivize market-based behavior?
- Do they increase or decrease competition in electricity markets?
- Do they minimize barriers to entry and exit, for different market participants?
- Are they credible to investors?
- Do they provide transparency and liquidity?
- How easy are they to understand and operate within?

4.1 Safeguarding power system security

Both development paths are required to safeguard power system security in the Nordic power system. In addition, they should incentivize low carbon production technologies.

The “Markets” can deliver power adequacy and the right kind of capacity if appropriate market-based incentives are in place and the markets are allowed to work. In addition, it is a costefficient solution to achieve power system security. Nordic cooperation and shared goals add to the effectiveness and efficiency of the markets. Critical for success is to have political support to the balancing regime changes that aim to increase the flexibility of the power system. Temporarily high prices during scarcity situations can put pressure on the political commitment, especially until adequate hedging possibilities emerge. However, a political intervention in such situation would mean an increased regulatory risk that would discourage investments in flexible resources.

If designed correctly, “Centrally controlled power system” can provide a more secure system than the “Markets”. The downside is that the overall impacts depend heavily on the details of the capacity product design. With appropriate product design, the capacity mechanisms can bring forward flexible capacity needed and demand response to cope with increasing amount of weatherdependent renewable electricity in the power system. However, if designed badly, they promote overall capacity increase rather than the capability to meet the performance criteria that is necessary in future power system. In addition, they may push aside the balancing regime reforms that would be needed to reveal the value of flexibility to support renewable electricity.

4.2 Compliance with the principles of the Nordic electricity markets

The “Markets” path is in line with the market-friendly philosophy of Nordic electricity market design. It also complies with the objectives of the Internal Market for Electricity of the European Union. It does not include elements that would distort cross-border trade of electricity. Administrative burden is likely to be moderate. Regulatory risks could emerge in case administrative price caps were set to limit prices in scarcity situations.

“Centrally controlled power system” means abandoning the markets. It may bring certainty in investments but the tradeoff is reduced efficiency and increased regulation. Administrative burden is likely to be heavy. In addition, the capacity mechanisms easily come to suffer from quite a narrow national approach. Furthermore, a real threat is that the capacity mechanisms distort cross-border trade. A regional approach would add to the efficiency of this development path but may be difficult to achieve in practice. However, even with the regional approach the regulatory risks are high. Administrative decisions that affect prices and revenues entail an inherent regulatory risk.

4.3 Economic efficiency

The “Markets” approach builds on making use of market-based incentives, which is assumed to bring efficiency. It aims to promote competition and incentivize active demand-side participation. Entrepreneurs decide on which technologies to invest in and administrative picking of technologies is avoided. Overall costs to consumers should be lower in the long run if the markets work. Hedging products form an important part of the “Markets”. This may add complexity. In addition, higher price volatility of market-based solutions may make it harder for small players to enter the markets until sufficient hedging opportunities emerge.

In “Centrally controlled power system”, the capacity mechanisms provide more certainty to investors. For example, the long-term capacity contracts can reduce uncertainty and may increase the bankability of investments. This certainty comes at cost. Consumers may be protected from price spikes but may instead face increased overall costs from inefficient capacity mechanisms. The capacity mechanisms entail a risk of lock-in by promoting generation capacity beyond what is necessary and may lead to higher-cost power system than what the markets would yield.

5 Conclusions

Electricity markets are at a crossroads and continuing in the current path is not an option. As the structure of electricity generation is changing rapidly the functioning of the current market mechanism and power adequacy are under threat.

In this report, we have outlined two alternative development paths for electricity markets. One relies on the use markets as a means to take us to a low-carbon future. The other pursues the same end goal but the method to get there builds more on central control.

We have concentrated on the “Markets” path and reviewed market-based measures to carry out the transition of the power system. To be successful, the “Markets” path requires changes in current energy policies and a political commitment to let the markets do their job. The markets incentivize new solutions and innovations to handle the challenges of future power systems. An essential political choice is to commit to the CO_2 emission reduction goals but leave it to the markets to decide how to achieve them.

With the proposed measures Fingrid will help the electricity markets and the power system during the transitory stage towards a low-carbon future. We act openly and responsibly to the benefit of the society.

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