Methodology for assessment of the Nordic forward market

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Introduction

The Nordic energy regulators in NordREG have a close cooperation on the development of a coordinated methodology for an assessment of the functioning of the Nordic electricity forward market. The assessment will be carried out following requirements in Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation (FCA GL).

NordREG finds it crucial that the assessment covers the most important indicators that are relevant for market participants in the Nordic electricity market. NordREG also finds it important to use indicators that are well-founded in economic theory and applicable considering the specific characteristics of electricity markets. Hence, NordREG engaged consultants in 2016 and organised workshops about the implementation of the FCA GL in order to gain more insights related to the methodology for evaluating the Nordic financial electricity market. In November 2016 EC Group delivered the report "*Methods for evaluation of the Nordic forward market for electricity*" which gave valuable input to the regulators on how to carry out the assessment following the FCA GL.

This document presents the Nordic energy regulators coordinated methodology for assessment of the Nordic forward market. The document is an update of the similar document published in 2016.

Background

The aim of the FCA GL is to establish common rules for Forward Capacity Allocation and provide market participants with sufficient hedging opportunities related to the area price risk. The FCA GL makes clear that the reference tools to allow for cross-border hedging are Long-Term Transmission Rights (LTTRs) auctioned by the TSOs. However, an exemption is possible, if cross-border financial hedging tools on both side of an interconnector exist and have shown their efficiency. In such a case, issuing of LTTRs is not mandatory, as long as the competent regulatory authorities of the bidding zone border have adopted coordinated decisions not to issue LTTRs. The guideline also provides for alternative products to be offered instead of LTTRs in order to support the functioning of the electricity market.

According to the FCA GL, the regulators` decisions on whether to introduce LTTRs or not, shall be based on an assessment "*which shall identify whether the electricity forward market provides sufficient hedging opportunities in the concerned bidding zones*". The assessment shall include at least "a) *a consultation with market participants about their needs for cross-zonal risk hedging opportunities on the concerned bidding zone borders*" and "b) *an evaluation*".

The aim of the evaluation is to "*investigate the functioning of wholesale electricity markets*". The FCA GL lists minimum criteria/indicators to include in the evaluation. The FCA GL does not exclude the possibility to add other indicators/criteria for the evaluation of the functioning of the market.

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Basic features of the Nordic electricity forward market

The Nordic countries constitute 12 interconnected bidding areas in the European day-ahead market coupling. Available transmission capacity is given to the market through implicit auctioning. Power exchanges[1]offer futures contracts for hedging the day-ahead system price in the Nordic market area. The system price is an index price of the Nordic market. It is the resulting power price of all bids and offers in the Nordic bidding zones if there was no congestion between the bidding zones.

Since the system price is an index of all Nordic bidding zones, it attracts liquidity from all Nordic market participants. This is a benefit in an electricity market with many, small bidding zones, as the system price may work as a more liquid hub for trading than any individual bidding zone would be able to.

Electricity Price Area Differentials (EPADs) are used for hedging the price difference between the specific bidding zone price and the system price. However, these contracts are traded to a much lesser extent than the system price contracts. In areas, where the area prices are highly correlated with the system price, there could be a relatively low demand for EPAD contracts also due to the transaction costs involved with buying EPADs.

The structure of an EPAD contract is different from an LTTR in several ways. One feature of the EPAD vs LTTRs is that the EPAD will hedge the remaining price risk that arises from a specific bidding zone price diverging from the system price, it will not transfer the risk exposure from one area price to another area price. This is an important feature and a benefit for market participants in a system with many bidding zones. Other important differences are that TSOs do not have any role in the EPAD trade and EPAD contracts cannot be subject to curtailment.

The assessment of the Nordic forward market should recognize the link between the system price contracts and the EPAD contracts. An EPAD without a system price contract would not give a fully firm hedge towards the area price risk. Just like an LTTR also needs to be complemented by a hedge for the local destination area price in order to give a fully firm hedge.

Further, the assessment should take account of the whole market, not only the forward market. The level of risk aversion among retailers can to a certain extent be explained by the contract types offered and demanded in the retail market. For example, in markets where there is a large share of retail contracts settled on the basis of the area spot price, or other forms of variable contracts related to the spot price, the area price risk for retailers is largely reduced and the need for hedging reduced accordingly. Hence, we can expect that the demand for hedging is higher in areas with a large share of fixed price contracts than in areas with a large share of variable price contracts in the retail market. However, it also depends on the production side in the area, and the demand for hedging amongst producers.

A trend that has developed since 2016 is the growing prevalence of power purchasing agreements (PPAs)[2]. These contracts - that are typically physical - allow sellers and buyers to agree fixed prices also for extensive durations. Since the contracts are bilateral and bespoke, and not standardised, it is up to the parties to the contracts to define the content.

PPAs exist in two forms: A developer of a wind / solar park (typically) selling to either 1) an end customer or 2) a utility company that merges the contract into its portfolio. The developer can gain access to a fixed price that extends further in time than the Nordic forward market or LTTRs can. The end customer gets certainty for origin of power production and can use this in marketing green solutions etc. However, PPAs do not contribute to the price formation, since prices are not necessarily published.

[1] Nasdaq Commodities and EEX are the main exchanges offering Nordic power futures.
[2] ICIS European Daily Electricity Markets 22 January 2020, p. 1, p.3-4.

In a Nordic context, Denmark is the only country to have issued LTTRs. This means that market participants seeking to relocate their price risk in Denmark to a more liquid hedging market in Germany can use these for that purpose – to the extent that there is capacity available for purchase and contracts that fit their portfolio.

Basic features of hedging strategies in the Nordic forward market

Theory and experience show that a complete elimination of risk is not necessarily optimal. The primary objective for market participants is normally to maximize profits at acceptable levels of risk. This leads to an objective for risk management to reduce risk to acceptable levels at acceptable costs, not necessarily to eliminate all risk. For the electricity market, the implication is that the more volatile the day-ahead prices are, the more expensive it would be for someone to guarantee a fixed price instead of the volatile day-ahead price. There are also transaction costs involved with risk hedging. Transactions costs should not be regarded as a market failure but rather a natural outcome of a forward market.

In a competitive market it is important that the hedging opportunities are *sufficient*, but it is not a goal in itself to eliminate *all* risk from the market participants. Hence, the regulators should carefully assess whether the market participants are able to reduce risk to acceptable levels at acceptable costs, before potential/possible measures to improve the situation are proposed. The Nordic energy regulators cannot see that the objective of the FCA GL is to remove all risk from the market participants related to the volatility of area prices, as this would not be a cost-effective measure in a competitive market.

A hedge portfolio of a market participant in the Nordic area naturally consists of different combinations of products. For example, system price contracts in combination with several EPADs and possibly also structured bilateral products. It can also include e.g. German or Dutch contracts. The regulators should try to identify potentially relevant proxies. One way to identify the relevant proxies can be to ask market participants which contracts they consider relevant in their hedge portfolios, and to analyse the most commonly used proxies.

Proposal for measures to use when assessing the Nordic forward market

Open interest*: Refers to all open positions with a clearing house at a given point in time. It corresponds to the total number of energy derivative contracts that have not yet been closed out by an offsetting trade. Open interest is a more dynamic measure of liquidity compared to e.g. traded volumes, because it reflects the decrease or increase of money brought into the futures market.*[3]

Electricity contracts used for hedging are normally kept until delivery. Often one can observe a drop in the open interest of a contract just ahead of delivery. This can be explained by the cascading effect, as yearly contracts are cascaded into quarterly contracts before year end, etc.

Data from the Nordic forward market between 2013 and 2015 shows that the yearly system price contracts have a much higher share of the open interest than e.g. quarterly contracts, even though they are traded in approximately similar volumes. This indicates that the yearly contracts are more used for hedging, while quarterly contracts tend to be used more by speculative traders. Further, the data also shows that the trade in EPADs is dominated by yearly contracts that are turned into open interest in quarterly contracts before the end of the year (the cascading effect).[4]

[3] *Bjørndalen, J. et al (2016)* Methods for evaluation of the Nordic forward market for electricity

[4] Ibid.

***Open interest in relation to physical consumption*:** This is a criterion in the FCA GL which regulators are obliged to assess in the analysis. Open interest shall be evaluated in relation to physical consumption.

Open interest may also be analysed in relation to physical production to provide further insight into the supply side of the market.

Trading horizon: *The trading horizon shows for different listed contracts which maturities that can be traded and cleared and is thus an indicator of hedging possibilities.*

By focusing on individual trading horizons over a period of time and across bidding zones when measuring traded volumes and open interest, greater insights into market behaviour and levels of market activity can be gained. This is not a specific method, just something to be aware of when collecting information about traded volumes and open interest.

This is a criterion in the FCA GL which regulators are obliged to assess in the analysis. It may be relevant to compare the trading horizon for the financial products with the trading horizon in LTTR contracts.

Traded volumes: *A number of MWh sold and bought for a given derivative during a specified period, provide information on liquidity and demand for a particular hedging instrument*[5].

Trading volume is mostly linked to market breadth. Contracts in high demand are traded more and can be easily sold or bought, whereas contracts with low traded volumes can be difficult to sell or buy.

To allow for greater detail in the analyses, trading volumes for each product should be structured along trading horizons and bidding zones over a number of time periods, such as years and months. Additional granularity may be gained by disentangling traded volumes by marketplace, such as OTC and exchange. Traded volumes of EPADs may be relevant to compare with traded volumes of system price contracts and of LTTRs.

Traded volumes in specific contracts may also be visualized over their trading horizons to track market activity. A low market activity could indicate less liquidity, regardless of the overall traded volume. This could also be visualized by presenting the number of days without any trade in each contract.

Bid-ask spreads: *The best quoted bid-ask spread is the difference between the highest bidding (buying) price and the lowest asking (selling) price at any given time or during any given time period*[6].

The bid-ask spread is a direct measure of liquidity/transaction cost. Generally, the smaller the bid-ask spread, the more liquid is the market. Conversely, large spreads can cause high search and delay costs. While market makers generally commit themselves to ensure bid-ask spreads are within agreed limits, the actual market spread may vary both within each day and over time. Also, there may be a large discrepancy between the quotes of market makers and the market participant`s willingness to pay or accept, especially when the market is particularly thin.

Most of the trading of EPADs in the Nordic market is done OTC (over the counter), or "Off Orderbook", through brokers. Most of these deals are done through voice brokering, and thus complete data on bid/ask spreads cannot be obtained in a reliable manner. The analysis should

[5] *Bjørndalen, J. et al (2016)* Methods for evaluation of the Nordic forward market for electricity
[6] Ibid.

use the bid-ask spreads reported by the exchange with caution, as these do not represent all of the market. To have a more complete picture of the real bid-ask spreads in the market, brokers and market participants should be interviewed. For this analysis, the differences between the bidding zones should be outlined.

This is a criterion in the FCA GL in which regulators are obliged to assess in the analysis.

Traded volumes in relation to physical consumption/Churn rate: *A ratio between the total traded volumes of a power derivative and the total electricity consumption in a given period.*

Churn rate can be understood as a number showing how many times a megawatt hour is traded before it is delivered in real time. One challenge with using the churn rate in Nordic bidding zones is that the actual traded volume for a specific bidding zone consists of both EPADs and system price contracts. It is not possible to split the system price contract volume on bidding zones, as several market participants have physical positions to hedge in numerous bidding zones and do not have to specify for which zone a particular trade is made. Also, if only the EPAD volume is covered in the churn rate, this would give a misleading picture of the whole market.

Hence, if churn rate is used on the Nordic market, the number for the system prices contracts for the Nordic region should be seen in relation to the physical consumption in all the Nordic countries, as this is difficult to divide on bidding zones. Possibly, the churn rate per EPAD contract could be analysed and compared with the consumption in the relevant bidding zone, but this would not give the whole picture of the relevant market. Such a churn rate could however be compared to a similarly calculated churn rate for LTTRs. Also, the evolution/trend in the long run could be of interest although shorter term variations might lack reasonable explanations.

This is a criterion in the FCA GL which regulators are obliged to assess in the analysis.

Traded volumes may also be analysed in relation to physical production to provide further insight into the supply side of the market.

Ex-post risk premiums*: The ex-post differential between the futures prices and the realized delivery date spot prices*[7].

Forward risk premiums are relatively easy to calculate with readily available data and is commonly used in the forward and futures pricing literature.

Contracts in the financial forward market are listed for trading for a given period of time. In the Nordic market the majority of the trading activity in a contract takes place during the final period before delivery. This is also described in academic literature and is often called "Time-to-maturity" (Benth et al (2006), Diko et al (2008))[8]. The prices that are actually traded towards the end of the trade period (close to delivery) are often at a different level than the prices in the beginning of the trade period. Further, the bid-ask spreads often tend to be tighter closer towards the delivery time compared to in the beginning of the trading period. Hence, in the calculation of ex- post risk premiums the regulators should preferably use last recorded trading prices for individual contracts because it represents the best estimate of the expected price just before

[7] Redl, C., Haas, R., Huber,C. & Böhm, B. (2009): *Price formation in electricity forward markets and the relevance of systematic forecast errors*. Energy Economics, 31.

[8] Benth, F. E.;Cartea, Á.;& Kiesel, R. (2008). Pricing forward contracts in power markets by the certainty equivalence principle: Explaining the sign of the market risk premium. *Journal of Banking & Finance, 32*, 2006-2021. https://core.ac.uk/download/files/153/6244108.pdf

Diko, P.; Lawford, S.; Limpens, V. (2006): "Risk premia in Electricity Forward Prices" *Studies in Nonlinear Dynamics and Econometrics Volume* 10, *Issue 3*
http://quantlabs.net/academy/download/free_quant_instituitional_books_/[Diko]%20Risk%20Premia%20in%20Electricity%20Forward%20Prices.pdf

delivery starts.

The regulators should also consider testing the statistical significance of the quantified risk premium, for example by a t-test.

Recommendation on how to calculate risk premiums in the Nordic market:

- The analysis should preferably consist of actual transaction prices, for example last traded price or the average of traded prices the 10 last trading days or similar. Alternatively, the closing prices of the last traded day (or the average of the 10 last trading days or similar) can be used. However, it is important to be aware that the closing prices are sometimes set by the exchange, and it occurs that no trades actually found place for that specific closing price. Hence, the closing price should be used with caution.

- The average risk premium can hide large variations, the regulators should consider including at least the standard deviations. Further, the analysis should preferably say something about statistical significance, for example by performing a t-test.

- In order to illustrate dynamic development, the ex-post risk premia could be shown over a certain time span. This would shed light on variations over time.

- Ex-post risk premiums for System price contracts and EPADs may also be compared to ex-post risk premiums of LTTRs.

Correlation: *a measure of linear association between two variables.*

The FCA GL art 30.3 states that forward "*products or combination of products shall be considered as an appropriate hedge against the risk of change of the day-ahead price of the concerned bidding zone where there is a sufficient correlation between the day-ahead price of the concerned bidding zone and the underlying price against which the product is settled*".

In the Nordic market, a combination of a system price and an EPAD contract would, by definition, give a 100 percent correlation with settlement price of a specific bidding zone. The correlation between the area prices and the system price shows the degree of which the area prices move in the same direction as the system price, and to what degree the system price contract can be used as a proxy for hedging purposes.

For hedging purposes, what matters is the correlation between the average delivery price of the hedging horizon and the average price of the underlying for the hedging contracts over the same period.[9]

Amihud Illiquidity ratio (Optional): *An average of ratios between daily absolute return of a power derivative and its daily traded volume in Euro, over a certain time period*[10].

The illiquidity ratio aims to show the price impact of each traded euro and is a commonly used measure of liquidity. In an illiquid market a large buyer will drive up the market price while a large seller will lower it. The premium the buyer and seller have to pay is called the price-impact cost, and this is what this ratio tries to capture.

The illiquidity ratio can be calculated for each power derivate over its trading period using daily data on returns and traded volumes. The development of the ratio for different types of

[9] *Bjørndalen, J. et al (2016)* Methods for evaluation of the Nordic forward market for electricity

[10] *Amihud, Y. (2002)* Illiquidity and stock returns: cross-section and time-series effects. *Journal of financial markets*, *5*(1), 31-56.

derivatives (e g monthly EPAD-contracts) can then be shown graphically over time, to look at the evolution of liquidity. One weakness of this measure is that the daily return could be zero even after a day with high trading volume and large price variations. Such a day would not contribute to increase the illiquidity ratio. However, the ratio should be assessed as one liquidity measure among others, having this weakness in mind and also taking into account that trends over time might give more information than discrete values at random intervals. This is included as an optional measure for each regulator to use if they see fit.

Additional qualitative assessments

When assessing the existing opportunities for market participants to hedge, it is important to also have a qualitative assessment of their needs and possibilities. This is motivated since the full depth of the market might not be accessible to analyse quantitively due to data being unavailable. For example, it is not possible for the Nordic regulators to access trade data on bilateral trade in contracts such as PPAs.

However, it is of interest to the regulators to understand the combined effect of the Nordic forward market, LTTRs and bilateral contracts on hedging opportunities. This could therefore be assessed via consulting market participants or regulators conducting potential further interviews.