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Nr. 6/2021

Investigation of Bilateral Hedging and Hedging Strategies

Thema Consulting Group

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Investigation of Bilateral Hedging and Hedging Strategies

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Abstract: This study is commissioned by the Swedish, Danish and Norwegian Energy Regulatory Authorities. The report contains useful insight into how market participants are using bilateral trading for hedging purposes, and their assessment of the sufficiency of the hedging opportunities.

Key words: FCA, Financial energy trading, LTTR, Transmission rights

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Preface

Together with the Swedish and Danish energy regulatory authorities, EI and DUR, NVE-RME have hired Thema Consulting Group to investigate the market participants use of bilateral trading, and their considerations of the sufficiency of the hedging opportunities in the areas where they are active.

As the Forward Capacity Allocation Guideline (FCA GL) will be implemented in Norway, the Norwegian Energy Regulatory Authority (NVE-RME) is preparing to investigate the efficiency of the hedging opportunities for market participants in the energy market.

The FCA GL aims at ensuring effective long-term cross-zonal trade with long-term cross-zonal hedging opportunities for market participants. If the cross-zonal hedging opportunities are not sufficient, it requires implementation of measures.

For NVE-RME the report will be used as input and background for the analysis which will be done in relation to the considerations whether the hedging opportunities are sufficient according to the FCA.

This study is commissioned by the Norwegian, Swedish and Danish Energy Regulatory Authorities and is conducted by Thema Consulting Group. The findings, analysis and recommendations of this report are those of Thema Consulting Group and do not necessarily reflect the official position of the Norwegian Energy Regulatory Authority.

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This document is sent without signature. The content is approved according to internal routines.

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Public

Investigation of Bilateral Hedging and Hedging Strategies

Commissioned by Ei, DUR and NVE-RME

February 2020

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About the project

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Project leader:	Julian Hentschel
Project participants:	Marius H. Rennesund, Eirik Aronsveen, Lars J. Berg Byenstuen, Sigrid Steinsli Austad

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Brief summary

Based on questionnaire responses from and interviews with Swedish, Danish and Norwegian market participants, this report:

1. Describes the approaches to power price hedging used by a broad range of market participants in the Swedish, Danish and Norwegian markets, the selection of instruments used and any changes to the approaches used over the past eight years;
2. Describes the scope, prevalence and efficiency of bilateral power price hedging in the Swedish, Danish and Norwegian markets; and
3. Summarises market participants' views of the sufficiency of current hedging opportunities, as well as how these opportunities might be improved.

The questionnaire finds that more than half of respondents believe that there are insufficient opportunities to hedge power price risk. Most of these respondents cited a lack of liquidity and depth in the EPAD market as the most serious problem faced.

On the basis of the evidence gathered, we conclude that bilateral hedging is widespread and used at least to some extent by the vast majority of study participants.

Study participants put forward a large number of possible options to improve hedging opportunities and these are summarised in the report.

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THEMA Consulting Group is a Norwegian consulting firm focused on Nordic and European energy issues, and specialising in market analysis, market design and business strategy.

Disclaimer

CONTENT

1 EXECUTIVE SUMMARY

This report summarises the responses of Swedish, Danish and Norwegian market participants on their approaches to hedging Nordic power price risk and the sufficiency of the opportunities they have to do so. It reflects the responses to a publicly accessible online questionnaire, covering 59 market participants, and 29 follow-up interviews. Collectively, the responses cover all Swedish, Danish and Norwegian bidding zones and a mixture of participants in terms of both their market role (consumer, generator, retailer etc.), the instruments used to hedge power price risk and the size of the organisation.

Bilateral hedging is widespread.

Only 2 out of 43 respondents hedged exclusively via the exchange. The remainder conducted at least some hedging activity bilaterally and a significant share (42% or 18 of 43) hedged exclusively using bilateral arrangements or Power Purchasing Agreements (PPAs).

Looking at the decomposition of these numbers, it emerges that bilateral hedging is common across all types of market participant and includes the bilateral trading of exchange-standard contracts.

Motivations for bilateral trade vary somewhat among participants. For smaller players, the administrative costs associated with direct exchange participation may be prohibitive and therefore bilateral trade, for example supported by a broker or a hedging services provider, is a preferable approach to hedge exposures. For those wishing to hedge long-term, a lack of market depth in longer-dated exchange contracts encourages the use of PPAs. Larger consumers with fairly stable consumption may also be attracted to PPAs because they imply lower administrative costs over their lifetime, while also dealing with area price risk and the regulatory risk of bidding zone redefinition. Large scale generators are more likely to combine exchange-based and bilateral trade and to explicitly contrast the option of trade via the exchange with Over the Counter (OTC) trades or the use of PPAs. Where the perceived depth or liquidity of the exchange is lacking, they may opt to hedge bilaterally.

More than half of questionnaire respondents believed that they have insufficient opportunities to hedge power price risk.

The questionnaire included two questions on the sufficiency of hedging opportunities in Danish, Norwegian and Swedish power bidding zones. Both gave similar results. For the first question, which covered respondents' ability to hedge their own power price exposures, 24 of 44 respondents stated that they had insufficient opportunities to hedge their power price risk. For the second question, which was shown to respondents that stated that they were 'responsible for supporting hedging activity by third parties', 17 of 29 responses stated that they believed that there were insufficient opportunities to hedge power price risk in general. In both cases, the majority of respondents considered the opportunities to be insufficient (see Figure 1 below).

Respondents that considered opportunities to hedge power price risk to be insufficient do not appear to be localised to a subset of bidding zones. Those respondents that stated that there were insufficient opportunities were asked to specify the zones in which they believed there were insufficient opportunities. The responses are distributed broadly across Danish, Norwegian and Swedish power bidding zones with no zone having fewer than nine organisations that feel hedging opportunities are insufficient there. Looking in greater detail at the pattern of responses, it is hard to discern a clear divide in opinion based on the organisation's role or size. Instead, opinion is divided among all groups and even among important institutional players within the current system. Rather, it is easier to characterise the sorts of organisations that were likely to consider hedging opportunities to be sufficient. These included:

- Large generator or trader organisations with trading desks and relatively sophisticated hedging operations (although there is not a consensus among such actors),
- Large consumers that have found success using PPAs, and
- Small retailers that are happy with the hedging solutions provided by brokers or hedging services providers

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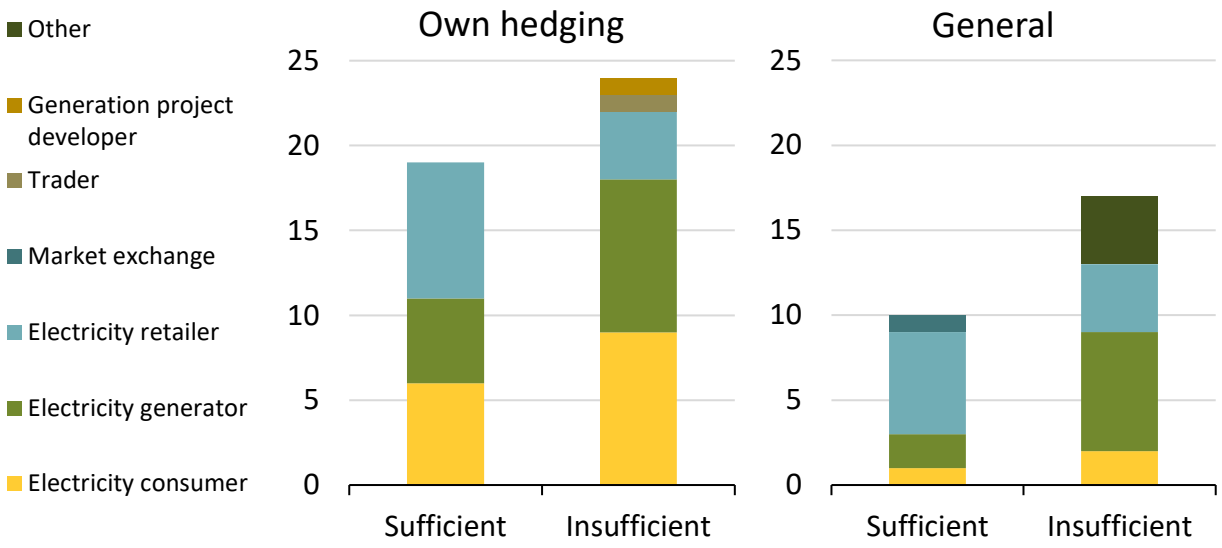
Figure 1: Sufficiency of hedging opportunities by respondent's primary role



Source: THEMA questionnaire

The biggest challenge raised was the hedging of area price risk and the lack of EPAD liquidity.

Although low liquidity for Nordic system price contracts was also mentioned, the vast majority of participants that believed hedging opportunities were insufficient cited a lack of liquidity and depth in the EPAD market as the biggest problem. We speculate therefore that a participants' desire to use or reliance on EPADs is a significant driver of their assessment of the sufficiency of hedging opportunities. Since expressing a view on the sufficiency of opportunities is costless, and does not provide insight into the severity of the problem, the dispersion of results across zones and participant types may therefore be seen to be a demonstration of concerns about the liquidity of EPADs more generally.

Many different factors were noted as potentially contributing to the lack of liquidity, both for the exchange in general and for EPADs specifically. It is clear that smaller hedging teams, including those used by large-scale consumers, consider the administrative burden of trading on the exchange to be a significant disincentive. This burden stems both from the management of collateral and from reporting requirements.

EPAD liquidity was thought to be undermined, in particular, by the small number of actors present in each zone as well as – in some zones – the asymmetry of generation and consumption volumes and the presence of market power. It was observed that the EPAD market is almost exclusively used by market participants with physical exposure to the underlying area price, since financial speculators are unwilling to trade in such illiquid products. Consequently, in zones with asymmetric generation and consumption, one side of the market is always lacking potential counterparties.

Study participants put forward a large number of possible options to improve hedging opportunities.

The study itself sought merely to capture these ideas, rather than to assess them. Many respondents noted that larger (and more balanced) bidding zones would help to address some of the structural causes of poor EPAD liquidity. However, any changes to bidding zone design need to be announced with long lead-times, given market participants' existing hedges referenced against the current bidding zone design. Short of redesigning the bidding zones themselves, a redesign of hedging products, such as the creation of EPAD-like products referenced to a basket of area prices, might help open up more liquid opportunities to hedge.

Enhancements to market making were also raised by several participants. Market makers support exchange liquidity directly and are given formal obligations to post bids and offers for a specific product or set of products. Although market makers already exist for most EPADs, the strengthening of the associated obligations or the introduction of additional market makers could be used to reduce

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bid-ask spreads and increase available volumes. However, more stringent market making is unlikely to be undertaken voluntarily without offering some financial incentives or imposing a regulatory obligation requiring the provision of these services, for example by TSOs or incumbent generators.

The sale of transmission rights between Nordic bidding zones, or alternatively the TSO provision of EPADs, was also raised, notably as a possible remedy to the asymmetry of generation and consumption in some zones. Smaller players, in particular, were concerned that the introduction of transmission rights would complicate an already complicated market and fail to offer a product relevant to their hedging needs. Others were concerned about the role of TSOs in the market. However, some of the more sophisticated market participants saw a potential opportunity to help bolster EPAD liquidity provided that the auctioning of such rights was competitive and not dominated by existing providers of area price hedging products.

Overall, the study highlights the broad range of interventions possible, with respondents caveating that they would need to consider the implications of any changes further before being able to conclude their position.

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2 PROJECT OBJECTIVES AND APPROACH

This project was commissioned by the National Regulatory Authorities (NRAs) of Sweden, Denmark and Norway and aims, among other things, to describe current approaches to power price hedging in these countries and to summarise market participants' views of the sufficiency of current hedging opportunities. The information used was gathered directly from market participants across these three countries via an online questionnaire, covering 59 organisations, and 29 follow-up interviews.

2.1 Project objectives

Future power prices are uncertain and this uncertainty poses a risk to a wide variety of stakeholders. The sufficiency and efficiency of opportunities to hedge this risk are important for several reasons. Opportunities to hedge this risk can help to avoid costly economic disruption, for example in the form of defaults. It can also support more competitive markets by limiting the benefits of integrating generation and consumption within the same business, thereby making entry into the relevant markets easier. Transparent hedging markets can also provide useful information about future prices that help support efficient decision-making, for example regarding the retirement of power plants or the future cost of energy-intensive products.

Given the importance of risk hedging opportunities, and the role of long-term transmission rights in the target European model for power price hedging, European regulation requires that, where such transmission rights do not exist, NRAs undertake regular assessments to "identify whether the electricity forward market provides sufficient hedging opportunities in the concerned bidding zones."[1] The Nordic NRAs have, through NordREG, approved a "Methodology for assessment of the Nordic forward market" as a means to support the consistent and transparent assessment of risk hedging opportunities in the Nordic power market. However, the data requirements of the methodology mean that it can only be readily applied to hedging conducted via an exchange. As such, using this methodology alone risks missing potentially important opportunities to hedge bilaterally.

This project is intended to provide greater insight into hedging activity more broadly. It aims to:

1. Describe the approaches to hedging used by a broad range of market participants in the Swedish, Danish and Norwegian markets, the selection of instruments used and any changes to the approaches used over the past eight years;
2. Describe the scope, prevalence and efficiency of bilateral power price hedging in the Swedish, Danish and Norwegian markets; and
3. Summarise market participants' views of the sufficiency of current hedging opportunities, as well as how these opportunities might be improved.

2.2 Project approach

This study has been primarily informed by direct input from a variety of stakeholders in Sweden, Denmark and Norway gathered via an online questionnaire and 29 follow-up interviews. Summary information on the sample of stakeholders involved is provided in section 3.

2.2.1 Questionnaire

Data from market participants were initially gathered via an online questionnaire. The questionnaire included a variety of questions covering the nature of the respondent, their approach to hedging, the efficiency of the markets in which they hedge, their views on the sufficiency of hedging opportunities and any proposals they might have to improve these opportunities. A full list of the questions included

[1] Article 30 of Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation (FCA GL) places specific obligations on NRAs in this regard.

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in the questionnaire is attached to this report. Note that the questionnaire adapted the questions displayed based on the respondent's answers to previous questions, such that questions deemed irrelevant to the respondent were not displayed. As such, not all respondents saw every question. In particular, the questions covering 'own hedging' activity were only shown to respondents that stated that they were 'directly exposed to power price risk'. Questions on 'others' hedging' were only shown to respondents that stated they that were 'responsible for supporting hedging activity by third parties'. This distinction was considered important given the diversity of respondents to the questionnaire and the fact that responses relaying information about others' hedging activity might be less reliable than direct accounts. Only some questions were mandatory and these are marked with an asterisk in the attachment.[2] Respondents were given the option to skip questions to avoid biasing the responses with potentially spurious answers.

An indication of the structure and content of the questionnaire is provided below. Note that far more questions are included in the actual questionnaire than are shown below.

Questionnaire structure

Organisation Details

Example questions:

- What organisation do you represent?
- Is your organisation:
  - directly exposed to power price risk
  - responsible for supporting hedging activity by third parties
  - both
  - neither
- What best describes your organisation's primary role with respect to power price hedging? (electricity consumer, electricity generator, etc.)
- Approximately what total volume of power does your organisation consume in the combined Norwegian, Swedish and Danish markets in a typical year? (MWh)

Own Hedging

Example questions:

- Please summarise where your organisation is a net consumer or generator of power by selecting the relevant bidding zones below. (DK1, DK2, etc.)
- Which of the following instruments does your organisation use to manage power price risk? (Please check all that apply) (Nordic system price-linked futures, Electricity Price Area Differentials (EPADs), etc.)
- Please briefly describe your organisation's hedging strategy noting, if relevant, how instruments are combined to manage the relevant exposure.

Efficiency of the Markets in which Your Organisation Hedges

Example questions:

- Please describe the types of transaction costs that your organisation faces when hedging using Nordic system price-linked futures.
- Approximately how large are each of these costs (i.e. the transaction costs associated with hedging using Nordic system price-linked futures)?

[2] Mandatory questions were mandatory only for those respondents for which they were deemed relevant (see the footnote above).

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- Do market participants in the market for Nordic system-price linked futures have access to the information necessary to price/value these contracts?
- Do market participants in the market for Nordic system-price linked futures systematically fail to appropriately factor available information into the price/value of futures?

Sufficiency of Current Hedging Opportunities - Own Risk

Example questions:

- Does your organisation have sufficient opportunities to hedge its power price risk in the Danish, Norwegian and Swedish power bidding zones?
- In which bidding zones do you think there are insufficient opportunities to hedge power price risk?
- Why do you believe that there are insufficient opportunities?
- How could hedging opportunities be improved? If you make proposals, please explain why you think they would be beneficial.

Others' Hedging

Similar to the 'Own Hedging' section above, but with questions related to the hedging activities of third parties.

Exchange and OTC trade

Similar to the 'Efficiency of the Markets in which Your Organisation Hedges' section above, but with questions related to the hedging activities of members/clients.

Sufficiency of Current Hedging Opportunities - General

Similar to the 'Sufficiency of Current Hedging Opportunities - Own Risk' section above, but with generalised questions not specific to the hedging opportunities available to the respondent specifically. For example:

- Do you believe that there are sufficient opportunities to hedge power price risk in the Danish, Norwegian and Swedish power bidding zones?

The questionnaire was published on November 11th, 2020 and publicly accessible. The last response was received on November 25th.

Information about the questionnaire was published on the regulators' websites, as well as on THEMA's website.

In addition, we reached out directly to stakeholders expected to have an interest to encourage their participation. The main interest organisations representing generators and large-scale power consumers in Sweden, Denmark and Norway were asked to inform their membership of the questionnaire and invited to provide contact information for interested organisations. The organisations for which we were given contact details were invited to participate directly. THEMA also invited a range of additional organisations deemed to have a potential interest, including exchanges and trader and broker organisations.

2.2.2 Interviews

Following the questionnaire, some respondents were invited to interview. The selection of organisations invited to interview sought to:

- Include organisations that had provided relatively detailed or thought-provoking answers to the questions on their hedging strategy, on the reasons for a lack of hedging opportunities or on opportunities to improve such opportunities;
- Maintain a broadly even distribution of interviewees across countries;

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- Ensure a variety of different organisation types (generators, consumers, suppliers etc.); and,
- Ensure a variety of perspectives in terms of the size of the organisation.

Not all organisations invited to interview accepted and additional invitations were sent out to try and ensure that the final selection of interviews met the objectives above.

In total, 29 interviews were conducted.

These were approximately an hour in length and transcripts were provided to the regulators.

The interview structure was free to focus on the areas most relevant to the interviewee and to draw on information from the questionnaire. As such, the structure varied somewhat between stakeholders. However, in general, each interview covered the areas below.

- The organisation's hedging needs or role,
- The approach(es) taken to hedge power price risk, including the determinants of hedging decisions,
- Any changes in the approach since 2012,
- The extent to which hedging is conducted bilaterally and, where relevant, the reasons for this,
- The extent to which hedging markets are well-functioning and, in particular, whether market participants can make informed judgements on the right price,
- Whether there are gaps/deficiencies in the market's ability to meet hedging needs, and
- How hedging opportunities could be improved.

2.2.3 Analysis

The information gathered through the questionnaire and interviews described above was then reviewed with reference to the project objectives set out in section 2.1. This review sought to pull out the relevant information submitted and highlight any relevant patterns among the set of responses. The results of this analysis form the basis for the remainder of this report. Section 3 provides some summary information on the organisations covered by the questionnaire and the interviews used to inform this analysis.

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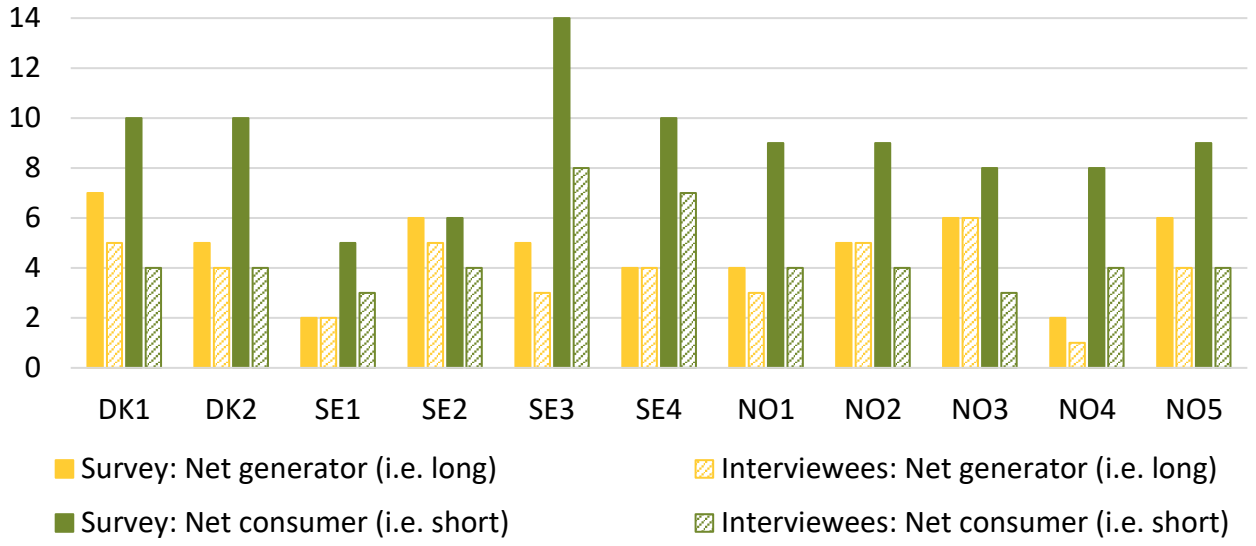
3 STUDY PARTICIPANTS

In total, 61 organisations provided input into the study. They reflect a diverse set of market participants and cover a mixture of market roles including, among others, generators, retailers, consumers, exchanges, brokers and traders. The group also includes organisations of vastly differing sizes, from small local utilities to large international energy companies. There are multiple net generators and net consumers for each bidding zone in Sweden, Denmark and Norway present among the set of organisations that participated. As such, we are confident that the views expressed reflect the diversity of opinion among all relevant stakeholders.

The study was informed by input from 59 market participants in Denmark, Sweden and Norway via an online questionnaire. 27 of the questionnaire respondents were also invited to interview according to the criteria mentioned in the previous section. Two further market participants that did not respond to the questionnaire were also invited to interview, making a total of 29 interviewees.

Questionnaire respondents were asked to specify the Nordic bidding zones in which their organization is a net consumer or net generator of power. Figure 1 summarises the zonal distribution of both the questionnaire participants and interviewees and shows that organisations with exposure in all the Nordic price zones were represented in the study.

Figure 2: Zonal coverage of the questionnaire respondents and interviewees



Source: THEMA questionnaire and interviews

The questionnaire respondents were also asked to identify their organisation's primary role and all other roles relevant for hedging. Figure 2 summarises the responses and shows that the questionnaire covered a broad range of market participants. Apart from exchanges and traders, most of the respondents defined their primary role as either an electricity consumer, retailer or generator. When given multiple options, however, several of these organisations also stated that they were actively involved in trading and generation project development. The "Other" category includes, among others, branch organisations and portfolio managers.

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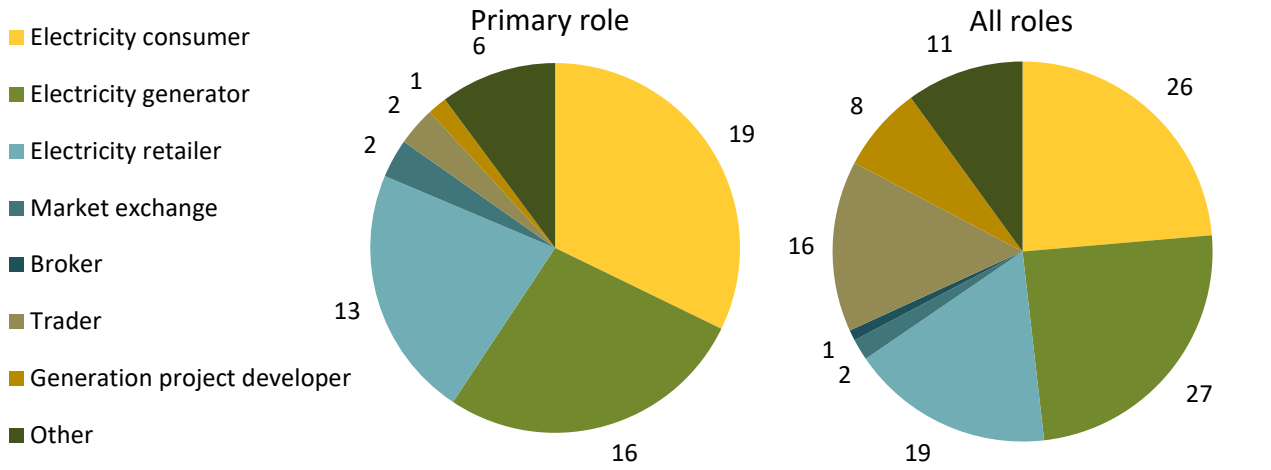
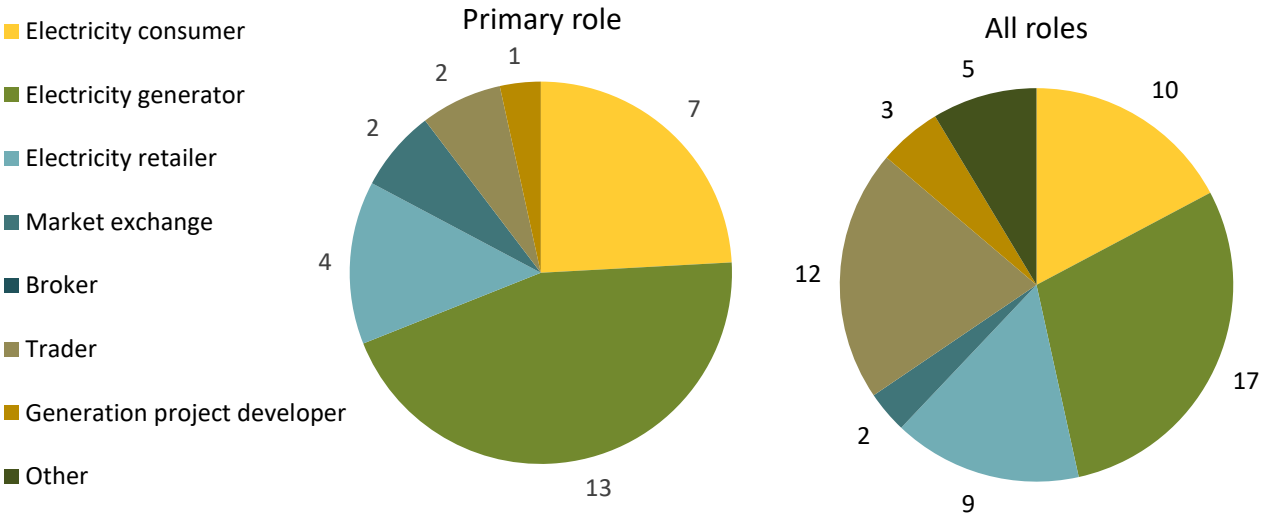
Figure 3: The questionnaire participants' primary role (left) and overall roles (right) relevant for hedging



Source: THEMA questionnaire

As noted above, the selection of interviewees sought to ensure representation of all the different market participant types. Figure 4 summarises interviewees' primary and overall roles relevant for hedging and shows that the interviewees covered a broad range of market roles. As for the questionnaire, the majority of the interviewees defined their primary role as either an electricity consumer, retailer or generator. When given multiple options, several interviewees stated that they also had other relevant roles in the market.

Figure 4: The interviewees' primary role (left) and overall roles (right) relevant for hedging



Source: THEMA questionnaire and interviews

Figure 5 and Figure 6 show the distribution of questionnaire respondent roles across countries based on where respondents were judged to have their main exposure. Respondents with significant exposure in all three countries are defined as Nordic market participants.

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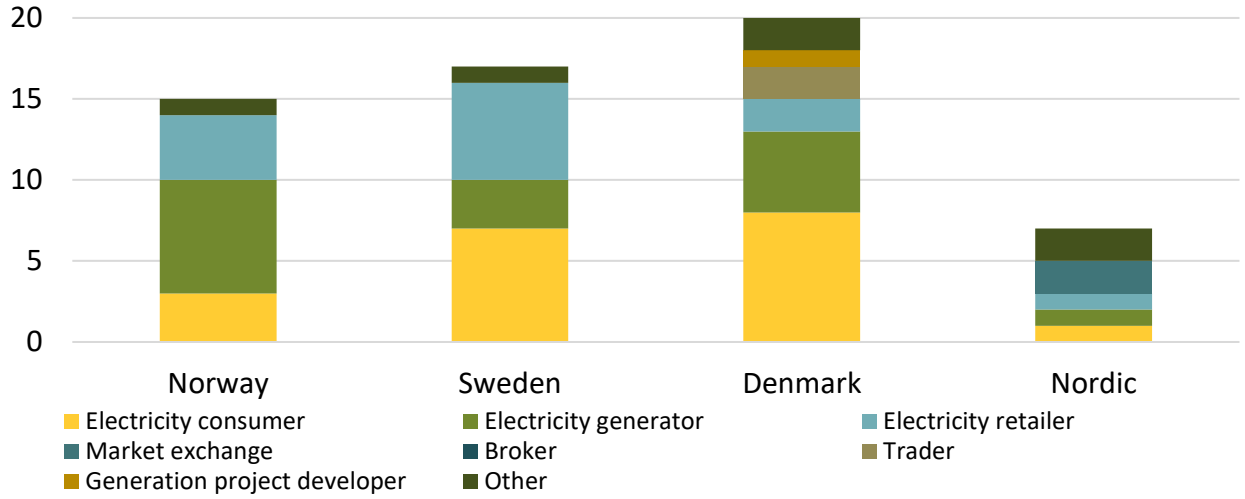
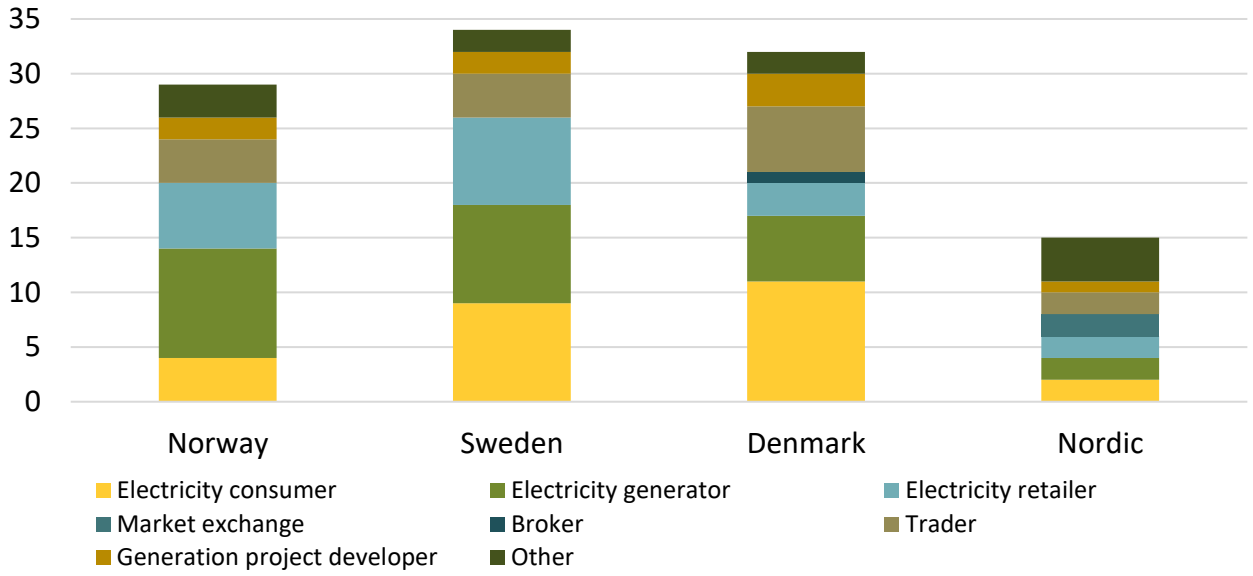
Figure 5: Questionnaire respondents' primary role by country



Source: THEMA questionnaire

Figure 6: Questionnaire respondents' overall roles by country



Source: THEMA questionnaire

In addition to ensuring representation of different types of market participant, the distribution per country was also considered for the interviewee selection. Figure 7 and Figure 8 show the market participant type coverage of the interviewees per country.

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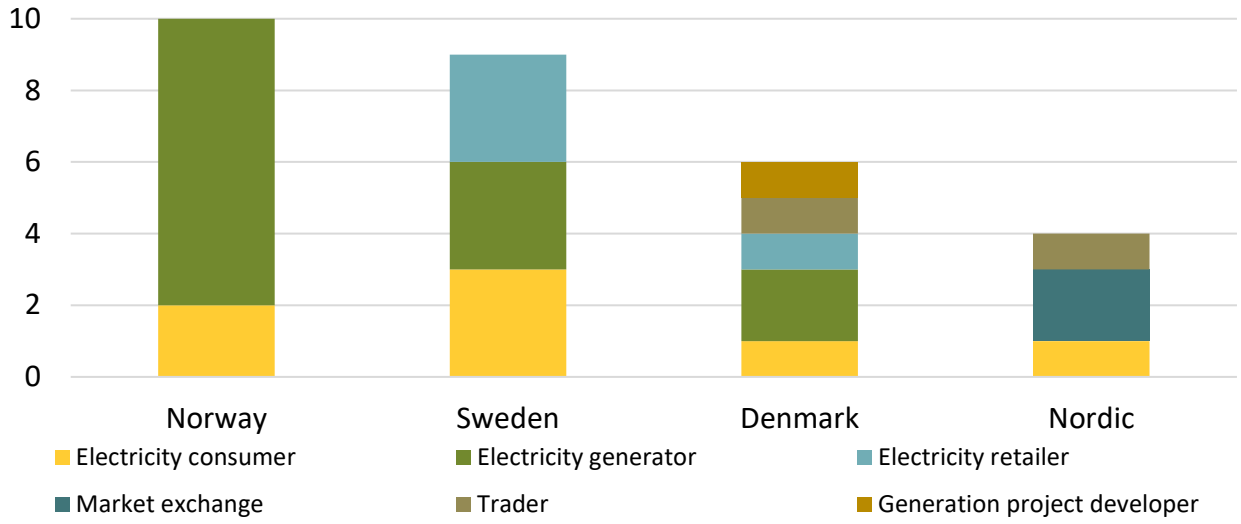
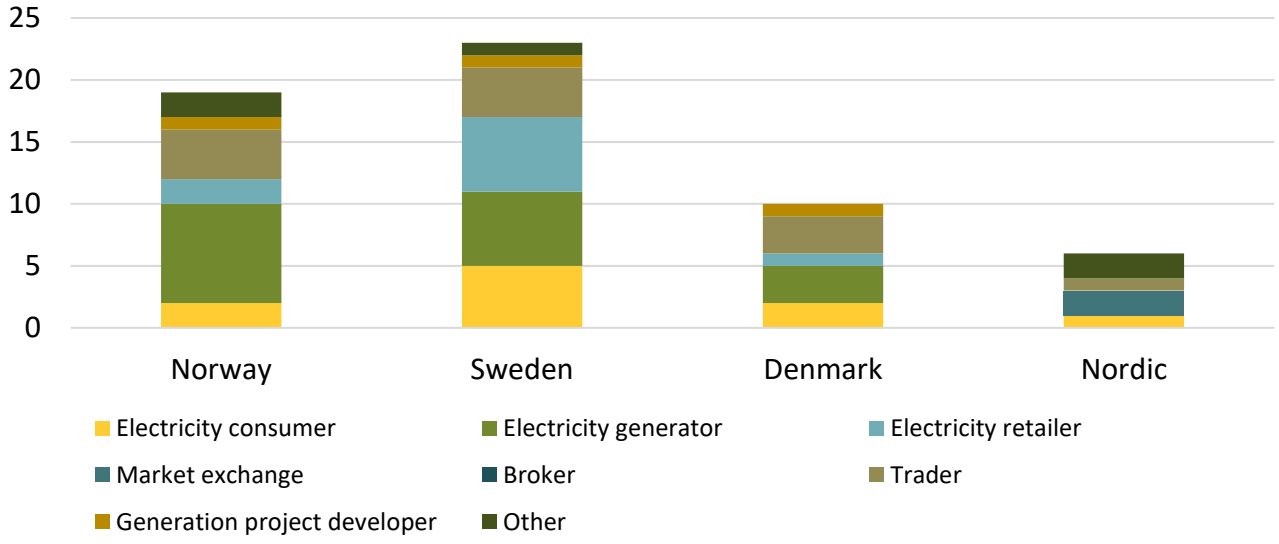
Figure 7: Interviewees' primary role by country



Source: THEMA questionnaire and interviews

Figure 8: Interviewees' overall roles by country



Source: THEMA questionnaire and interviews

Study participants were also asked what instruments they use for hedging. The responses from both the questionnaire respondents and interviewees are summarised in Figure 9 and show that the study covers a broad range of instruments. Most of the market participants which manage their own risk exposure use system price-linked futures or EPADs as part of their approach to power price risk management. Participants were also asked whether they hedge via the exchange or bilaterally with a counterparty when trading Nordic power futures and EPADs. Those participants which stated that they trade bilaterally for at least one of the hedging instruments (with or without a third-party broker) are included in the “Bilateral” column. The vast majority (39 of 44) of questionnaire respondents managing their own power price risk do at least partly via bilateral trade excluding PPAs.

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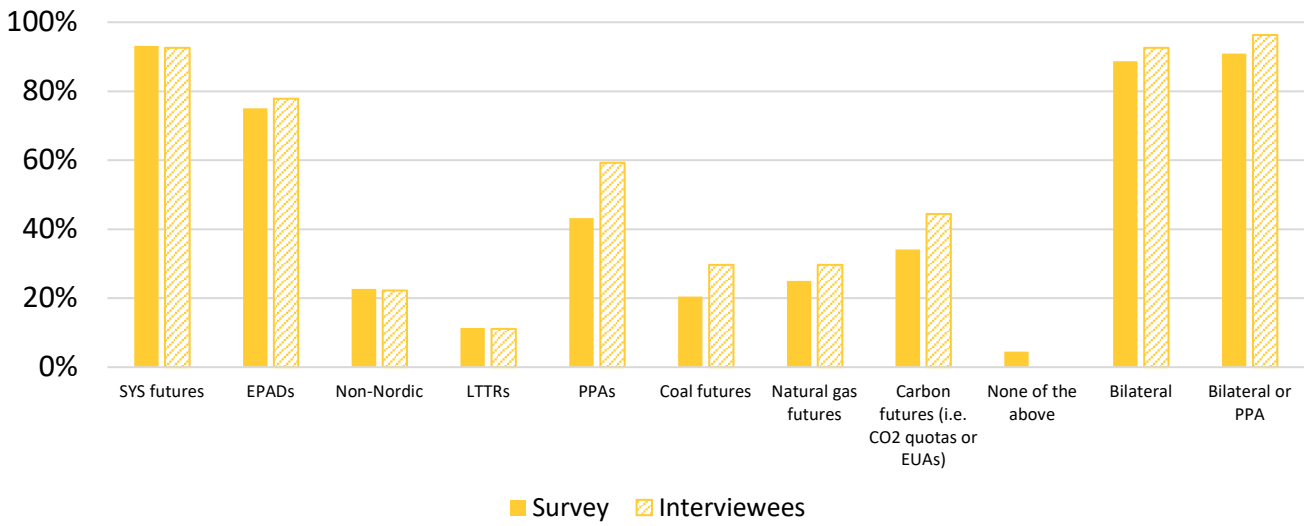
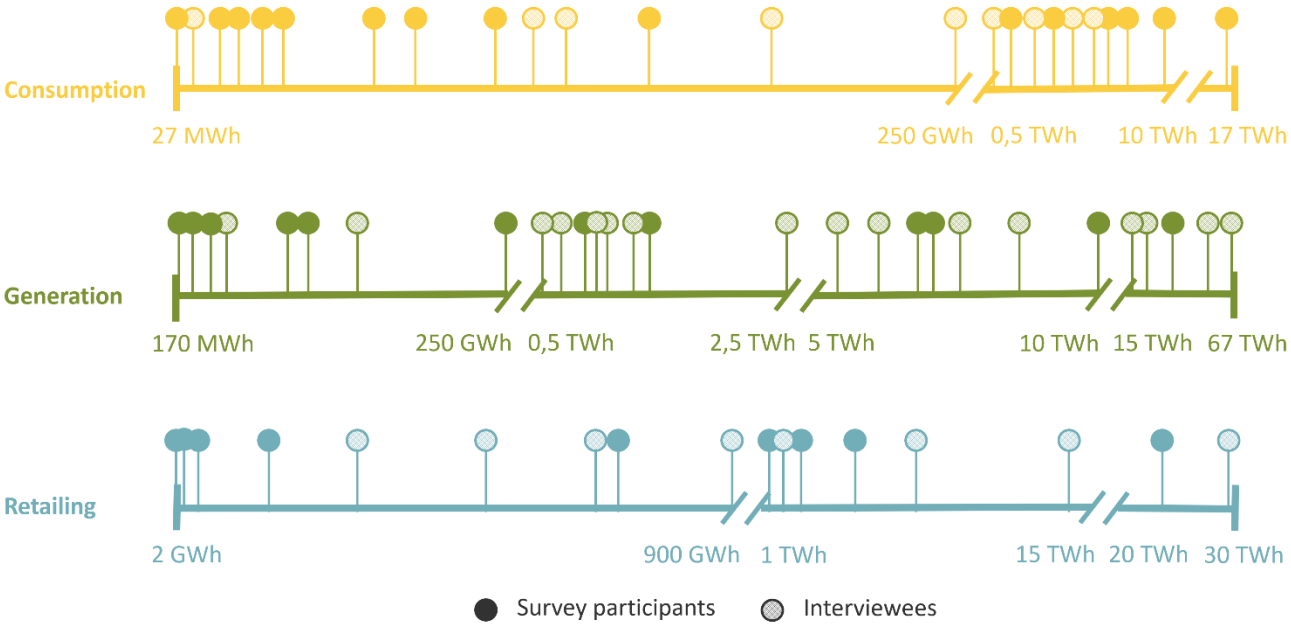
Figure 9: Share of questionnaire respondents and interviewees using different hedging instruments



Note: Numbers out of 59 questionnaire respondents (whereof 44 manage their own risk exposure) and 29 interviewees
Source: THEMA questionnaire and interviews

Market participants that stated that they were an electricity consumer, generator or retailer were asked approximately what total volume of power they consume, generate or sell in the Norwegian, Swedish and Danish markets combined in a typical year. Figure 10 summarises the responses from both the questionnaire participants and interviewees and shows the range of the study participants' size. As can be seen, the responses cover a diverse range of organisation sizes across all categories.

Figure 10: The consumption, generation and sales of the study participants



Source: THEMA questionnaire and interviews

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4 HEDGING STRATEGIES

There are many mechanisms used to hedge power exposures among the study's participants. These include the trade of financial derivatives via the exchange and Over the Counter (OTC), the use of bespoke hedging services or products and the use of Power Purchasing Agreements (PPAs). Hedging strategies differ. In general, however, most suppliers seek to fully hedge fixed-price supply contracts. In contrast, generators and consumers will frequently hedge on the basis of a mandate from the board that specifies a minimum and maximum share of future exposures that should be hedged. We do not find strong evidence of trend changes in organisations' approaches to hedging since 2012. However, the evidence provided at interview does suggest that administrative constraints influence the range of products or services used to hedge.

In this section we describe the different approaches to hedging reported among study participants, as well as the factors that appear to influence the choice of approach. We provide an overview of the different products or arrangements used and comment on changes over time. Further information on bilateral mechanisms used for hedging, i.e. those products and arrangements used to hedge power price risk outside of the exchange, can be found in section 5.

4.1 Products and arrangements

Market participants hedge themselves using several different mechanisms as described below.

Exchange-based financial derivatives

Exchange-based futures contracts are standardised financial contracts that effectively allow market participants to lock in a price for power delivered in future periods. Financial futures contracts do not entail any physical power supply. Rather, during the delivery period specified by the relevant contract, cash is exchanged between the market participant and the exchange such that these payments make up for any difference between the future contract's price before delivery and the power price during the delivery period. Changes in the value of the futures contract between the time of a trade and delivery will also be settled between the exchange and the market party, with the timing of this settlement varying between different contract types.

All trade conducted via the exchange is cleared, such that those trading via the exchange do not need to worry about counterparty risk, i.e. the risk that the counterparty will be unable to meet its payment obligations under the contract.

In the Nordic market, power futures are referenced against the Nordic system price, rather than the price of a specific bidding zone. The system price is calculated as the clearing price that would obtain if clearing the entire Nordic region as a single bidding zone, ignoring transmission constraints between Nordic bidding zones.

Futures contracts can cover different length delivery periods and may also be profiled within that period, for example covering only certain peak settlement periods.

Since Nordic futures are referenced against the Nordic system price, they cannot be used directly to hedge the power price of a specific bidding zone. EPADs are similar financial contracts that reference the spread between a specific Nordic bidding zone and the system price. They are available as baseload contracts (i.e. with no profiling). Combining an EPAD for a specific bidding zone with a system-price futures contract effectively produces a futures contract referenced to the specific area price. Combing the purchase of an EPAD for one zone with the offsetting sale of an EPAD in another zone produces a financial contract (a so-called EPAD Combo) that hedges the price between the two zones.

Exchange-traded EPADs do not exist for all Nordic bidding zones and do not currently cover NO2 and NO5.

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Trading at the exchange requires exchange membership. In general, larger generators, banks and hedging service business, as well as some suppliers will be direct exchange members. Smaller market actors do not typically have direct access to the exchange.

Over the Counter (OTC) trade in exchange-standard contracts

The same contracts that are traded at the exchange are also traded bilaterally among market participants. These trades may be cleared, such that the outcome is essentially identical to trading at the exchange, or not. If not, the parties involved will be responsible to one another for settlement and for the risk that one or another of them defaults on their payment obligations.

Structured hedging products / services

Hedging can also be achieved through structured or tailored hedging products and services. These products can encompass a variety of bespoke arrangements, for example allowing combined heat and power asset owners to hedge the spread between their fuel and emissions costs and the relevant power price. However, some hedging services are fairly standardised offerings aimed, for example, at supporting suppliers wishing to hedge fixed price supply contracts, as discussed further on page 22.[3] Such services bundle risk management of the variety of factors relevant to suppliers, covering system and area price risk alongside currency risk, elcertificate price risk and volume profile risk. These risk management services are sometimes provided alongside other relevant services such as balancing management.

Power Purchase Agreements (PPAs)

Power Purchase Agreements are bilateral agreements for the sale of power. They typically cover periods of 5-15 years and are often, though not necessarily, physical contracts, resulting in the provision of power rather than cash settlement. As bespoke contracts, the specific terms can vary from contract to contract. The contract will specify the profile and volume of power to be delivered, the delivery location and the agreed price. The contract may also include covenants designed to ensure the credit-worthiness of the parties involved and may require that the counterparties have guarantees provided by banks or parent companies.

PPAs may be sold by specific generation projects or by utilities. In the latter case, the power is generally supplied by a portfolio of sites. Where power is sold by a variable generator, such as an onshore wind site, the volume of power sold under the PPA will often be ‘shaped’ or ‘sleeved’ by a third party that takes responsibility for correcting any mismatch between the generation project’s output and the volume of power that must be supplied under the PPA.

PPAs allow the parties involved to agree on the future price of power in advance and therefore reduce their exposure to changes in the spot price of power for the delivery period specified in the PPA.

4.2 Approaches to hedging

Market participants in the Swedish, Danish and Norwegian markets employ a variety of strategies to hedge their exposure to power price risk, as described further below. Based on the questionnaire and interviews conducted as part of this study however, we conclude that most participants use some form of:

1. A tracker hedging strategy, or
2. Back-to-back hedging.

[3] See for example the ‘Axpo Price’ tool (https://www.axpo.com/no/en/business/power/pricing-and-hedging-tool.html)

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Large generators with multi-national portfolios tend to both have more complicated power price hedging exposures and to operate more flexible or dynamic hedging strategies than those described below.

Tracker hedging strategy

A tracker hedging strategy essentially involves buying/selling forward a share of expected total purchases or sales in such a way that the share of expected trade that remains unhedged declines as one moves closer to delivery. In general therefore, at any point in time, an organisation operating such a strategy will have hedged a greater share of next year's exposure than its exposure two-years out and so on.

Such a strategy is common among generators and consumers and often formalised in a hedging mandate from the board that defines a minimum and maximum share of exposure that should be hedged over different time horizons. The duration of these horizons differs among participants, as does the degree of discretion provided to the hedging team.

The limits set by the board are in part an expression of the board's own hedging preferences but the maximum share hedged by generators is often influenced by some common features. Hydro generators may seek to ensure they do not hedge more than they might produce in a dry (low-generation) year. Norwegian hydro generators will also account for the fact that their tax liabilities under the tax system are inversely related to the spot price and therefore they are, in effect, already partially hedged via the tax system.

The staff responsible for hedging in the organisation will typically have flexibility to hedge within the limits defined by the board mandate, although some mandates may be more proscriptive as to hedging activity. Judgements about the share of exposure to hedge within the limits imposed by the board are made with reference to multiple factors. Generally however, these staff take at least some view of expected future power prices and compare futures prices to these expectations. For more sophisticated market players, notably those whose core business is electricity, particularly generators, these assessments may be informed by their own fundamental analysis of the market. Other players may rely on external market forecasts and purchased analysis.

Manufacturing companies that are hedging the costs of electricity as an input into their production process will generally also consider end-market competitiveness when judging the share of exposure to hedge. For example, they will also consider whether their power costs will be competitive if they purchase ahead given potential developments in their competitors' energy costs. They will hedge a larger share of their exposures, effectively locking in future costs, where they are confident that they can remain competitive in their end market given these power costs and their expectations of their competitors likely costs.

Although fundamental analysis is the most commonly cited basis of discretionary hedging decisions cited by interviewees, various stakeholders also note that their decisions are informed by technical analysis of trading activity and prices, a consideration of the credit rating implications of altering their hedging position and information on market sentiment gleaned from interaction with other players.

Back-to-back hedging

Back-to-back hedging entails attempting to fully hedge any future exposure and is typically employed by suppliers looking to lock-in the margin to be earned on a fixed-price supply contract. The suppliers interviewed emphasised that the retail margins on such supply contracts are typically small in comparison to potential changes in the underlying power price. Consequently, suppliers seek to simply pass on this underlying power price risk via back-to-back hedging. If they can hedge accurately for a cost below the fixed-price premia charged to the end-user, they can secure a profit margin on the volume sold.

Where this is the intention, the emphasis is on having hedging options that can be implemented quickly after the supply agreement is entered into, so that the supplier is not forced to hold the risk, as well as profiling the hedged volume to match the expected consumption pattern of the end

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consumer. The hedge profile is never perfect and the supplier will accept some degree of mismatch between the hedge and the expected consumption profile. A typical solution might involve a hedge with differing volumes month-to-month, but formed of baseload contracts.

Given the emphasis on rapid implementation and profiled volumes, such hedging is more likely to be achieved either through the use of hedging services or trade in exchange-standard contracts.

Area price risk

The structure of financial products used to hedge Nordic power price risk means that organisations often face a choice about whether they wish to hedge area price risk, namely the spread between the Nordic system price and the specific bidding-zone power price to which they are exposed.

Many organisations choose not to hedge this risk. As discussed further in section 7, many organisations consider that the costs of hedging area price risk are sufficiently high, partly due to insufficient EPAD liquidity, that it is not commercially rational to do so.

For those organisations that consider hedging area price risk to be important, a lack of EPAD liquidity on the exchange often encourages them to explore bilateral hedging options. These include the use of hedging services covering areas price risk, OTC trade in EPADS with local counterparties or PPAs that ensure local delivery. It should be noted that even though several bilateral trading options may be available in theory, finding counterparties with which to hedge area price risk is not necessarily easy.

Administrative constraints

It should be noted that an organisation's approach to hedging is often heavily influenced by what is feasible given the size and sophistication of the team responsible.

For generation companies, the power market is their core business and there is a tendency to have larger teams responsible for hedging activity. Such organisations may also have dedicated power trading desks.

In contrast, even manufacturers that are large consumers of power often have relatively small teams, comprising a few individuals, responsible for all aspects of energy procurement.

The size of the staffing resource dedicated to hedging activity also tends to scale with the overall size of the organisation.

As a generalisation, small teams are unable to consider a broad range of alternative products or services but will instead have a preferred approach to hedging that is used repeatedly. Often this approach will help to limit the administrative burden placed on them. Again, as a general rule, the smallest teams will forgo direct exchange membership and rely on a broker or hedging services provider to help them meet their needs. Larger consumers with fairly small teams may seek to secure power using periodic PPA tenders.

Larger teams, notably among generators, will have the administrative capacity to engage with multiple different products and arrangements and will proactively trade-off opportunities to hedge via the exchange against bilateral trading options. Such teams are more likely to be direct members of the exchange.

Combining instruments

There is significant diversity among participants in the way that hedging instruments are combined. Not all market participants use a variety of instruments. Those that do are the organisations with larger teams.

Unsurprisingly, those actors using EPADs also use system price contracts and these are frequently combined to hedge the area price. However, it also common for participants to hedge area price exposures using system price contracts only, or to maintain only a relatively small position in EPADs relative to system price contracts – thereby leaving some of the area price expsoure uncovered.

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Indeed, the use of EPADs is generally more opportunistic and based on the presence of favourable prices. This may reflect the presence of a reasonable strong correlation between area and system prices in some zones and the lower liquidity of EPAD contracts relative to system price contracts. Together, these factors tend to make EPADs both less important as a means to hedge overall price risk and a more costly relative to system price contracts. They are therefore used to a lesser extent.

Several participants use both system price contracts and PPAs, but often one of these will be the default route to hedging and will be clearly dominant in terms of the share of risk exposure covered. For example, a large consumer may seek to hedge the bulk of its overall consumption using PPAs but trade system price contracts for closer-dated periods in order to adjust the volume hedged. This flexibility can be used, for example, to respond to changes in expected consumption or the attractiveness of futures prices. In this case, system price contracts are used primarily to adjust the overall position and the relative scale of trades reflects this. Conversely, some generators may hedge primarily using system price contracts and enter into PPAs only opportunistically, for example in response to a request for an offer. In this case, PPAs will cover a relatively small share of total price exposure.

Large generators and traders will tend to be more flexible in considering a variety of options for achieving hedging needs. As noted elsewhere, PPAs will often be considered where longer-term exposures (>5 years) need to be managed, given a perceived lack of liquidity in exchange products.

The most sophisticated hedging strategies observed involve the use of proxy hedges constructed using combinations of non-Nordic power futures, fuel commodity futures and carbon futures. As shown earlier in Figure 9, a small number of participants also use transmission rights in the construction of such proxy hedges.

The use of complex proxies is more prevalent among organisations that have trading desks. In these cases, a portfolio of instruments will be traded that collectively work to hedge Nordic power price exposures. These proxy hedging strategies will be based on the explicit comparison of a variety of different potential hedges, considering the costs and potential outturns, with a view to selecting the hedge that best meets to organisation's objectives. The specific combination of instruments selected will reflect this analysis, favouring those instruments that are favourably priced, cheap to trade and highly correlated with the organisation's fundamental exposure.

Trends

Many stakeholders have not changed their approach to hedging since 2012 or else have made changes that are the result of changes in their own industry, rather than developments in the power market or their opportunities to hedge. As such, it is difficult to conclude that there is a strong trend change in approaches to hedging over the period since 2012.

That said, where the party is concerned about hedging area price risk or has become concerned about hedging area price risk since 2012, there is perhaps an increasing trend to seek hedging solutions outside the exchange. This is due to a lack of liquidity and depth in the relevant EPAD products, an issue that is explored in more detail in section 7.

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5 BILATERAL HEDGING

Bilateral hedging appears to represent a significant share of overall hedging activity. 95% of the 43 questionnaire respondents that submitted information on the instruments used to hedge power price risk use bilateral trading or PPAs. Participants have a variety of motivations for seeking to hedge outside the exchange. For smaller players, the administrative burden of exchange membership is seen as prohibitive. For market participants wishing to hedge power beyond five years, the liquidity and depth of exchange contracts makes them unattractive relative to the use of PPAs.

In this section, we discuss:

- the prevalence of bilateral approaches to hedging among the stakeholders covered by the questionnaire,
- participants' stated reasons for choosing to hedge bilaterally, where they do so, and
- the structure of costs that they face when doing so.

5.1 Prevalence

The prevalence of bilateral hedging among questionnaire respondents is summarised in Figure 11, which shows that most of the study participants hedge bilaterally at least to some extent. This information is based on responses to questions on the types of instruments used to hedge and how these instruments are traded. Specifically, respondents that stated that they used exchange-standard products (Nordic futures, EPADs and Non-Nordic futures) as part of their own power price risk management were presented with the following question:

[Organisation name] trades [hedging instrument] (please check all that apply)

- *Via a market exchange*
- *Over the Counter via a third-party broker*
- *Bilaterally without a third-party broker*

They were also asked whether or not they hedge using PPAs.

Based on participants responses to these questions (one for each of the various instruments), questionnaire participants were categorised as organisations which hedge

- Only via the exchange,
- Only bilaterally (OTC or other bilateral options including the use of PPAs), or
- Using both bilateral and exchange-based options (i.e. for those organisations that traded both via the exchange and hedged bilaterally).

Using this approach, questionnaire participants which exclusively traded exchange-standard products at the exchange but also reported using PPAs would therefore be placed in the final category.

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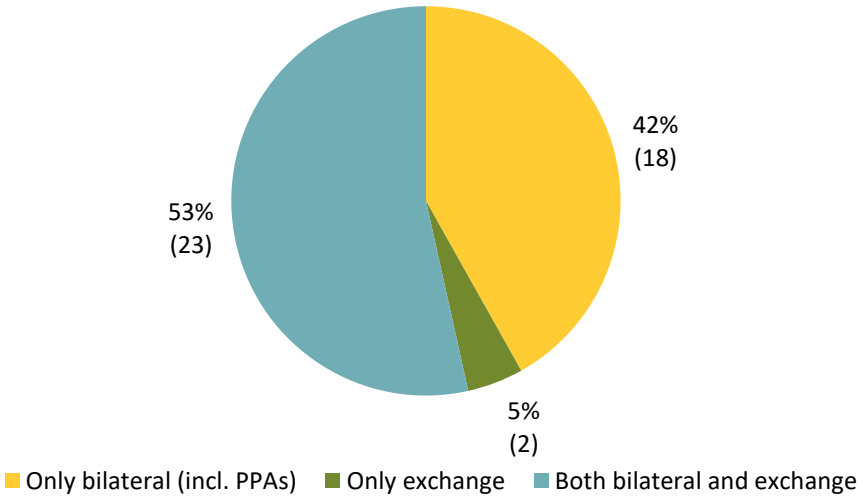
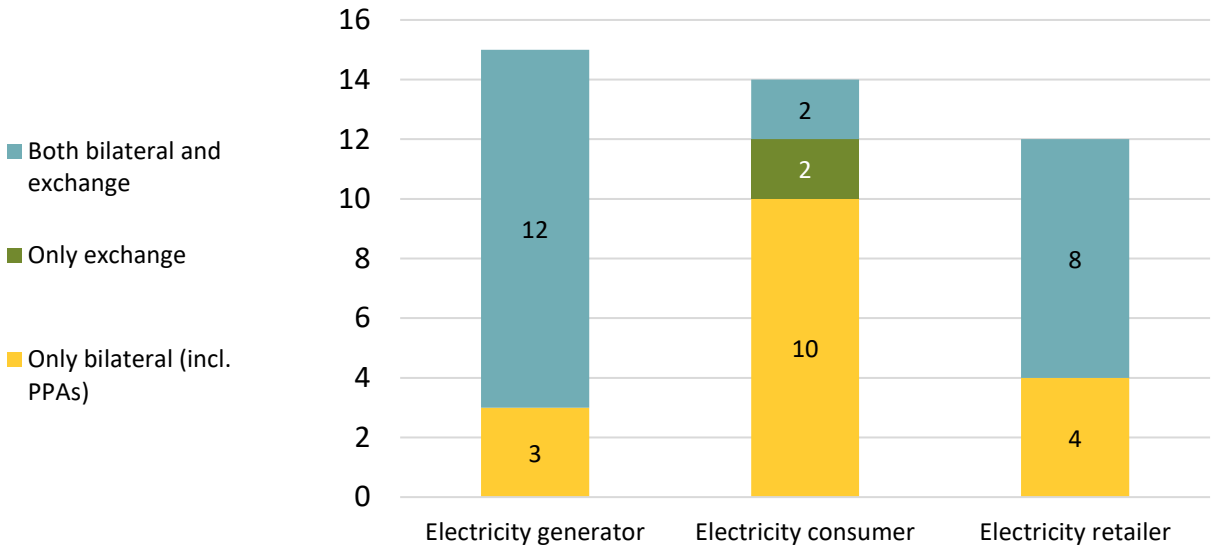
Figure 11: Prevalence of bilateral hedging among the study participants



Note: Total number of respondents: 43
Source: THEMA questionnaire and interviews

The prevalence of bilateral hedging among questionnaire respondents for different market participant types is summarised in Figure 12. Overall, few of the study participants hedge exclusively via the exchange. Most electricity generators trade exchange-standard products both bilaterally and via the exchange, while the majority of the electricity consumers hedge exclusively bilaterally.

Figure 12: Prevalence of bilateral hedging among the study participants based on market participant type



Source: THEMA questionnaire and interviews

Looking at individual hedging products in Figure 13, we see a similar story. Few study participants hedge products exclusively via the exchange. Instead, most respondents hedge using either a combination of the exchange and bilaterally, or else exclusively bilaterally.

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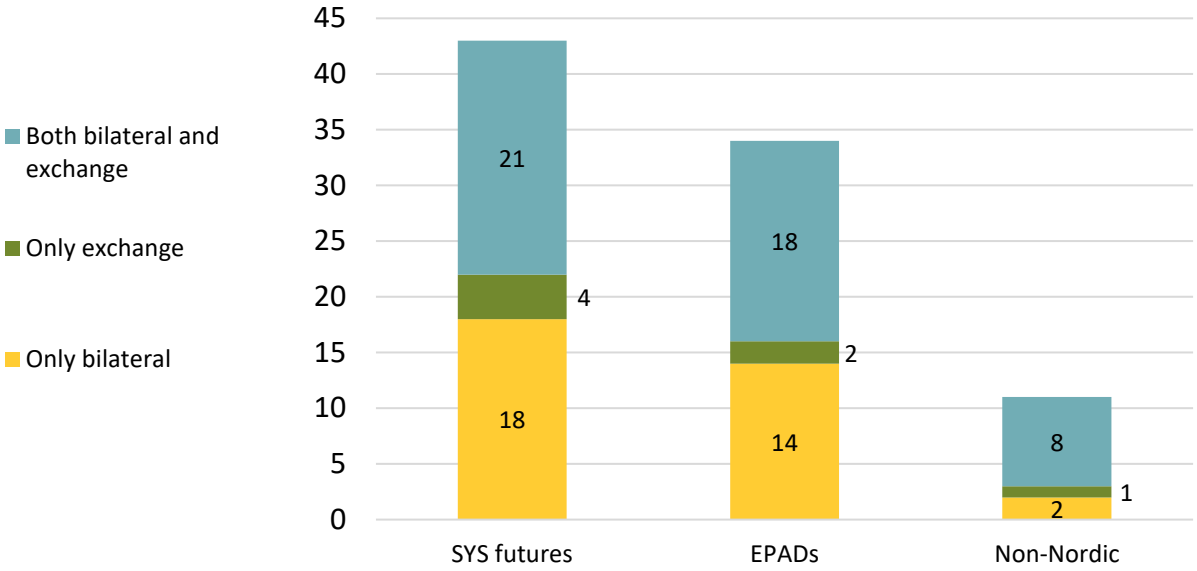
Figure 13: Prevalence of bilateral hedging among study participants for different hedging instruments



Source: THEMA questionnaire and interviews

The figures above provide no indication of the share of total volumes traded bilaterally versus on the exchange and it is not possible to use the questionnaire responses to provide a robust breakdown of total volumes. Based on the information obtained via the interviews however, we believe it is safe to conclude that bilateral volumes are not trivial, but represent a significant share of the overall market.

The importance of bilateral hedging activity suggested by these results is corroborated by data in the ACER-CEER Market Monitoring Report (MMR). Data provided in this report on the decomposition of churn ratios for the Nordic region suggests that OTC volumes are similar to those for exchange futures.[4] Importantly, these volumes exclude PPAs.

Overall, the evidence provided by respondents suggests that bilateral hedging activity represents a significant share of overall hedging activity. Given the information obtained in the interviews, bilateral hedging is likely to be especially important as a means of hedging area price risk.

5.2 Participant motivations and the structure of costs

As noted in section 4.1, bilateral hedging covers:

- OTC trade in exchange-standard derivatives,
- The trade in structured hedging products and the provision of hedging services; and
- Power Purchasing Agreements

We discuss each of these options in further detail below, including participants' stated motivations for their chosen approach.

Over the Counter (OTC) trade in exchange-standard contracts

OTC trade in exchange-standard contracts is common both among participants with direct exchange access and participants that do not have access to the exchange.

[4] ACER-CEER, Market Monitoring Report (MMR) 2019, Volume 1, Figure 16
https://aegis.acer.europa.eu/chest/dataitems/196/view

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Exchange members will often explore OTC trading options in parallel to possible exchange trades with a view to securing the best possible price. For those participants wishing to trade large volumes of power over longer periods of time, the perceived lack of depth in the exchange encourages some participants to seek counterparties bilaterally, possibly with the help of a broker. For EPAD contracts where liquidity is very limited, OTC trading may be seen as necessary to find a counterparty.

For those organisations that trade exchange-standard contracts exclusively OTC, they note that this approach is cheaper and less administratively burdensome than trading via the exchange. Many participants note the desire to avoid the collateral costs associated with exchange-based trade, the administrative burden of managing collateral and the cash flow risk associated with doing so. They also point to the administrative burden associated with ensuring regulatory compliance. One respondent noted that management of collateral for exchange trades can be outsourced to banks and that the high quoted cost for this service underlines the significant costs of taking on collateral management independently.

OTC trade is sometimes conducted through existing bilateral relationships between participants and sometimes supported by brokering. For consumers or smaller players, unbrokered trades may be conducted with a banking partner. In these cases, the costs of the trade may be fully reflected in the bid-ask spread, with the participant paying a premium of perhaps 2-10 eurocents/MW relative to the exchange mid-price. This spread will include, though usually not explicitly, a margin to account for the credit risk involved. Again, for those using this approach, paying this premium was considered to be more attractive than bearing the costs of trading directly at the exchange.

Generators and organisations with larger teams may rely on a network of existing bilateral relationships to trade. They will contact potential counterparties by phone or chat services to see if they are interested in trading at a specific price. Again, there are rarely any explicit additional costs beyond the power price agreed to.

For brokered deals, the broker will be entitled to a specific fee or set of fees. The structure of brokerage fees varies among participants, but frequently the broker receives a fee that scales with the transaction volume. The brokerage market is generally seen to be relatively competitive and brokerage costs were not identified as an issue by any participant.

OTC trade volumes for exchange-traded products may be transmitted via intermediaries to the exchange. Banks conducting OTC trade may, for example, simply replicate those OTC trades in the exchange, locking in a margin when doing so. However, it is also possible that intermediary organisations seek to net offsetting positions internally to some extent, such that purchases by one client are offset by sales by another. To the extent that such netting occurs, not all OTC trading volumes, even in exchange-standard products, will result in trading at the exchange.

Structured products and hedging services

Among participants that hedge OTC without using exchange-standard products, it is worth distinguishing between somewhat standardised hedging solutions that are not exchange-traded, such as those offered to electricity retailers, and more bespoke, one-off solutions.

Some market participants are looking for genuinely bespoke products that reflect the unique combination of risks to which they are exposed or that enable them to realise an intricate mechanistic hedging strategy. For these players, the use of exchange-standard contracts would be cumbersome and they will therefore typically tender for providers of a structured hedging product, which they specify, to meet their hedging needs. The specific nature of such products makes it difficult to generalise as to the nature of the market. However, it is worth noting that a couple of the participants interviewed do hedge using such structured products.

On the use of standardised hedging services, it is worth noting that there are some groups that effectively face standard hedging needs and for whom relatively standardised hedging solutions exist outside the exchange. Perhaps the best example of this sort of hedging activity concerns the hedging needs of retailers seeking to supply fixed-price contracts. However, small-scale hydropower

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producers might be seen as another group of participants with sufficiently similar hedging needs to enable standardised services.

For these groups, fairly standardised hedging services exist. For example, Axpo offers a tool (Axpo Price) targeting the needs of retailers, which allows them to get quotations for the combined hedging of system and area price risk, currency risk and Elcertificate price risk. This allows retailers, for example, to buy a specific profile of power that varies month-to-month, for a specific price zone in Swedish krone. Such solutions package risk management opportunities that might technically be achievable through a combination of exchange-traded derivatives in a way that is convenient for the relevant group, in this case smaller-scale retail companies. Users of such products often cite their administrative ease as being an important reason for why they are preferred to other hedging alternatives. The price of the combined product will be built up of the costs associated with managing the different risks involved and therefore will likely reflect the prices of the exchange-traded products useful in managing the associated risks. The price will also reflect a margin for the provider.

The cost structure for the provision of such hedging services differ. In addition to any margin in the cost of electricity quoted, it is also common to pay a trading fee per MWh and possibly a fixed fee, which may be bundled with other services like the provision of market analysis.

Power Purchasing Agreements

The volume of PPAs signed in the Nordics increased significantly in the run up to 2020, driven in part by the use of PPAs to support project finance for new wind capacity. Data at the European level shows that this upward trend in signed PPAs has continued to the present, with very significant growth between 2018 and 2020. However, slowing wind project development in the Nordics may imply that growth in PPA volumes has slowed regionally.

Figure 14: New European PPA Capacity Signed each Year

Source: ICIS Power Perspective Outlook for corporate PPAs in the Nordic region

Participants using PPAs cite many different reasons for their attractiveness. For those wishing to hedge power price exposures beyond five years, the financial market is not considered a viable option due the lack of depth and liquidity in longer-dated contracts. As such, PPAs become a natural choice. They are frequently used by large-scale consumers with long-term certainty over demand, as well as generation project developers that need to demonstrate long-term cashflow certainty to financial investors. Existing generators may also choose to use PPAs where they wish to cover risk over a longer horizon. Norwegian hydro generators noted that, for PPAs with a duration over seven

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years, the tax regime allows them to be taxed based on the PPA contract price rather than the spot price, thereby allowing long-term PPAs to help manage the risk of a mismatch between power revenues and tax liabilities.

Shorter-term PPAs are also used by large power consumers as an alternative to exchange-based contracts. For these players, PPAs have the advantages that they can be accessed without the administrative burden of exchange membership, are priced attractively relative to the exchange and can be used to hedge not just area price risk, but also the risk of bidding zone redefinition. PPAs may also be attractive to consumers wishing to evidence the origination of their electricity supply, notably as a means to demonstrate their commitment to supporting new renewable generation capacity.

Large consumers seeking to buy power ahead will typically run tendering rounds for PPAs to meet their expected demand. For generators and large-scale consumers, the set of potentially interested parties is generally relatively small and well-known, such that these parties can be approached directly.

There are generally few if any explicit costs associated with the PPAs outside the negotiated price of electricity, however there can be significant administrative and legal costs associated with establishing the contractual terms of the agreement in the first place. There may also be some relatively small administrative costs associated with implementing the agreement, for example monitoring credit risk.

Like other forms of uncleared bilateral trade, PPAs leave the parties exposed to the risk of counterparty default. The cost of this counterparty risk is rarely explicit. Some contracts include covenants intended to address these risks, which may impose an explicit or implicit cost on the parties involved. For example, parties may be required to provide a bank or parent company guarantee covering their liabilities. In other cases, internal measures to control counterparty risk may result in the imposition of volume or tenor limits intended to ensure a diversification of counterparties. These limits may require the use of counterparties with less attractive prices.

The agreed power price combines the parties' own assessments of a variety of underlying risks. An assessment based on the alternative costs of hedging using financial instruments will consider the cost of hedging the relevant system and area price risk, the risks of rolling forward the hedge if the PPA extends beyond the horizon for which financial contracts are available, the profile risk if relevant, and the credit risk of the counterparty.

The administrative and legal costs associated with finalising a deal can be significant in relation to other hedging options, notably where bespoke arrangements are put in place, but are still estimated to be less than 1% of the total value of contracts. The size of upfront transaction costs means that it is often beneficial to do repeat business where possible, for example when seeking to buy power, since such repeat deals generally require relatively small additional administrative effort.

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6 EFFICIENCY

In an efficient market, prices for hedging products should reflect all publicly available information on the value of the commodity. The information gathered via the questionnaire and interviews does not suggest to us that pricing fails to reflect all available information. However, market participants did highlight some areas that could give rise to inefficiency more generally. Specifically, inaccurate or incomplete public information, notably in relation to transmission capacities, had potentially harmed the accuracy of pricing. In addition, a lack of transparency on PPA pricing might be preventing useful information on price expectations from informing a variety of other decisions and potentially harming overall efficiency as result.

The questionnaire and interviews also sought to consider whether the hedging markets examined by the study operated efficiently. In this section we briefly set out both what is meant by the efficiency of hedging markets and the relevant responses from market stakeholders.

6.1 The meaning of hedging market efficiency

Power price hedging is effectively conducted via a commodity market for power, as well as markets for a series of associated derivatives. The efficiency of such markets is typically assessed in relation to what extent the market price for these products fully and accurately reflects all publicly available information relevant to the expected price of the underlying commodity. We follow this approach here, i.e., considering to what extent the price at which hedging products are traded fully and accurately reflects all publicly available information relevant to the expected price of power.

The concept of financial market efficiency is developed from the theoretical consideration of a perfect market in which:

- There are no transaction costs,
- All information is costlessly and immediately available to all participants, and
- All participants have a common understanding of the implications of information for both current and all future prices of the commodity.

However, it is important to note that these conditions are not required for market efficiency as described above. Consequently, the obvious failure of real-world markets to meet these strict conditions does not imply that efficiency is unobtainable in imperfect markets. For example, just because there are transaction costs in the financial power market does not prevent the transactions that do occur from having prices that are fully reflective of all publicly available information on the value of the commodity. Here therefore, we consider the extent to which imperfections in the market are liable to prevent pricing from accurately reflecting the information that is available.

6.2 Responses on market efficiency

Market participants were asked about whether they felt market pricing was accurate and, in particular, whether market participants have access to the information needed to assess the appropriate price, as well as an ability to assess the implications of this information for the price. In general, most respondents felt that the availability of information was good, notably in comparison to other markets. Some did note the presence of various problems however. These are described further below. Overall, we consider that these problems are unlikely to imply that pricing in any of the associated markets is inefficient, although there may be other reasons to seek to address the problems identified.

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Information on transmission capacities

Most of the comments related to the availability of information focused on information about transmission capacities. Some participants noted that the availability and accuracy of this information could be further improved. Complaints included that:

- TSOs failed to inform the market early when capacity investments were delayed. Repeated delays to the timing of internal Swedish reinforcements that are notified just months ahead of planned commissioning were given as an example.
- Urgent Market Messages (UMMs), for example in response to a fault, were sometimes inaccurate and should be more thoroughly checked to avoid misinforming the markets.
- The current system of UMMs results in the issuance of multiple related messages on a single subject. This makes it unnecessarily difficult for traders to find relevant information quickly, since the resultant data is not structured in a meaningful way.

The first two of these complaints suggest that the publicly available information on transmission capacities is not as accurate as it could be. Strictly speaking, this doesn't harm the efficiency of the market for hedging products directly, since pricing in the market may still be fully appropriate given this inaccurate information. Clearly however, providing more accurate information to the market should ensure that pricing better reflects the true state of the power system, thereby supporting more efficient decision making in general.

We assume that the final point, though potentially worth addressing, does not significantly impede the accurate formation of prices.

Complexity of assessment

Smaller players noted that, even though ample information might be available, for example on transmission capacities, they cannot independently assess the implications of this information on the power price given the complexity of the system and the administrative cost involved.

The inability of some participants to assess the implications of relevant information on the price does not necessarily undermine the efficiency of prices in the market, provided that a sufficiently large number of participants can do so and their valuations are reflected in market prices as a result of their market activity.

It is worth noting that, where exchange traded products are available and actively traded, which is not the case for all zones, the listed prices for such products are used by market participants, and especially smaller market participants, to assess the reasonableness of bilateral hedging costs. In this way, exchange pricing supports pricing transparency for a set of actors and products beyond the exchange itself.

PPA pricing

A lack of public visibility on PPA pricing was noted by some participants as a current feature of the market. Some service providers have begun to support participants in the monitoring of PPA prices. However, the anecdotal evidence available to us suggests that market participants that are not routinely involved in PPA transactions have fairly poor visibility of the prices at which power is traded via PPAs.

Again, strictly speaking, the absence of such information does not imply that the deals that are made are priced inappropriately, such that PPA pricing is inefficient. However, pricing transparency can bring wider potential efficiency benefits and these benefits may be limited by the lack of publicly available information on prices. For example, where economic actors are seeking to make decisions affected by longer-term power prices, the lack of good information on the market's price expectations in later years increases the likelihood that such decisions well be ill-informed and therefore potentially inefficient.

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7 SUMMARY OF PARTICIPANTS' VIEWS

The majority of respondents to the questionnaire believe that there are insufficient opportunities to hedge power price risk. This belief is not restricted to a subset of bidding zones, nor is there an obvious differentiation in responses among different participant types. Among those that believe that there are insufficient opportunities to hedge power price risk, the vast majority cite a lack of liquidity and depth in the EPAD market as the most serious problem. Many different factors were noted as potentially contributing to the lack of liquidity. Among these, participants pointed to the small number of actors present in each zone and – for some zones – the asymmetry of generation and consumption volumes. Participants put forward a large number of possible options to improve hedging opportunities and these are summarised below. These options include, among many others, the use of larger, more symmetric bidding zones, enhanced support for market making and the introduction of TSO obligations to sell transmission rights or EPADs.

In this section we seek to summarise market participants' stated assessment of the sufficiency of hedging opportunities and their proposals for options to improve these opportunities.

7.1 Sufficiency of hedging opportunities

The online questionnaire contained two separate questions related to the sufficiency of hedging opportunities. The first covered the sufficiency of opportunities to hedge the participant's own power price risk. This question was given to those participants that stated that they were 'directly exposed to power price risk'. The wording of the question was as follows:

Does [organisation name] have sufficient opportunities to hedge its power price risk in the Danish, Norwegian and Swedish power bidding zones?

- *We have sufficient opportunities to hedge our power price risk in the Danish, Norwegian and Swedish power bidding zones.*
- *We have insufficient opportunities to hedge our power price risk in some or all Danish, Norwegian and Swedish power bidding zones.*
- *I cannot answer.*

The second question was presented to participants that reported that they were 'responsible for supporting hedging activity by third parties' and intended to cover this activity.

These participants were presented with the following question:

Do you believe that there are sufficient opportunities to hedge power price risk in the Danish, Norwegian and Swedish power bidding zones?

- *There are sufficient opportunities to hedge power price risk in the Danish, Norwegian and Swedish power bidding zones.*
- *There are insufficient opportunities to hedge power price risk in some or all Danish, Norwegian and Swedish power bidding zones.*
- *I cannot answer.*

Those participants that stated that they were both 'directly exposed to power price risk' and 'responsible for supporting hedging activity by third parties' were presented with both questions.

In all cases, where these questions were shown, a response was required.

The summary of responses is shown in Figure 15 below, with the answers to the first question (own hedging) shown in the left chart and the results of the second question (general) in the right chart.

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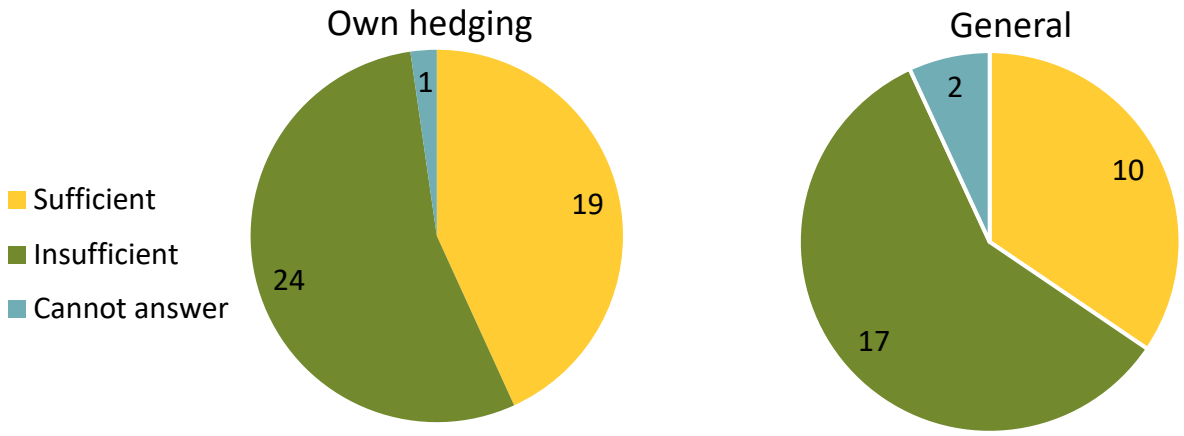
Figure 15: Participants' view of hedging sufficiency

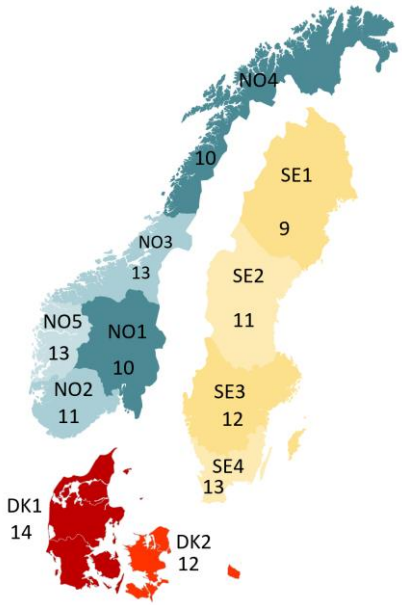


Source: THEMA questionnaire

As can be seen, opinion is divided about the sufficiency of opportunities but the majority of respondents believe that there are insufficient opportunities to hedge power price risk.

Respondents that reported insufficient hedging opportunities were also asked to specify in which bidding zones there were insufficient opportunities and to explain why there were insufficient opportunities. Looking at these responses, it is clear that respondents' belief that there are insufficient opportunities is not restricted to a subset of bidding zones. Nor is there an obvious differentiation in responses among different participant types. Figure 16 below shows the number of questionnaire responses that specify the presence of insufficient liquidity in each bidding zone. As can be seen, each zone is mentioned by several responses.

Figure 16: Number of responses pointing to insufficient hedging opportunities in a bidding zone



Source: THEMA questionnaire

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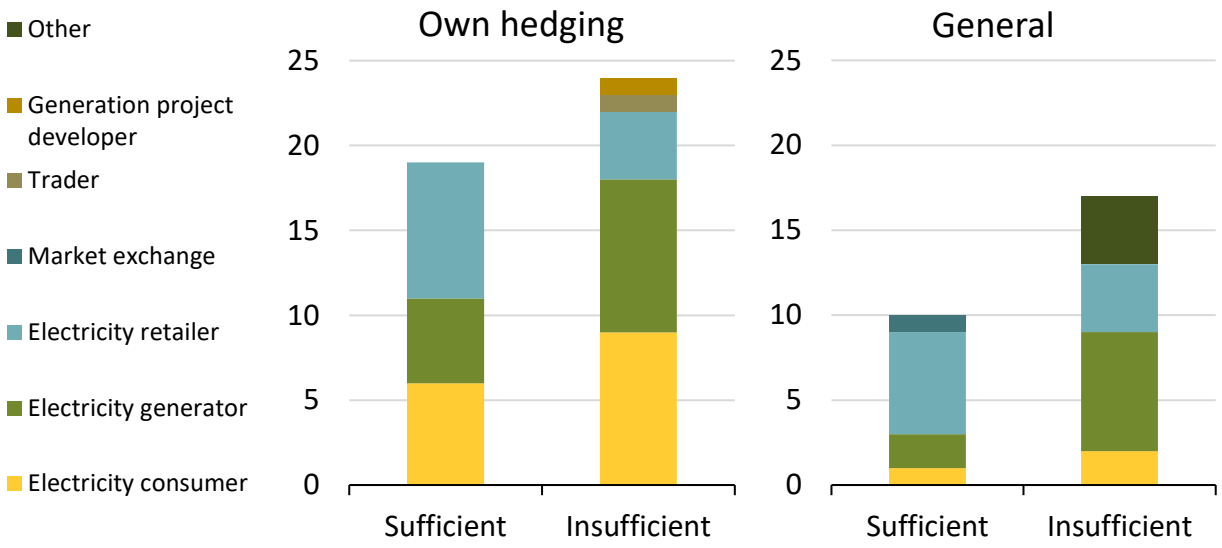
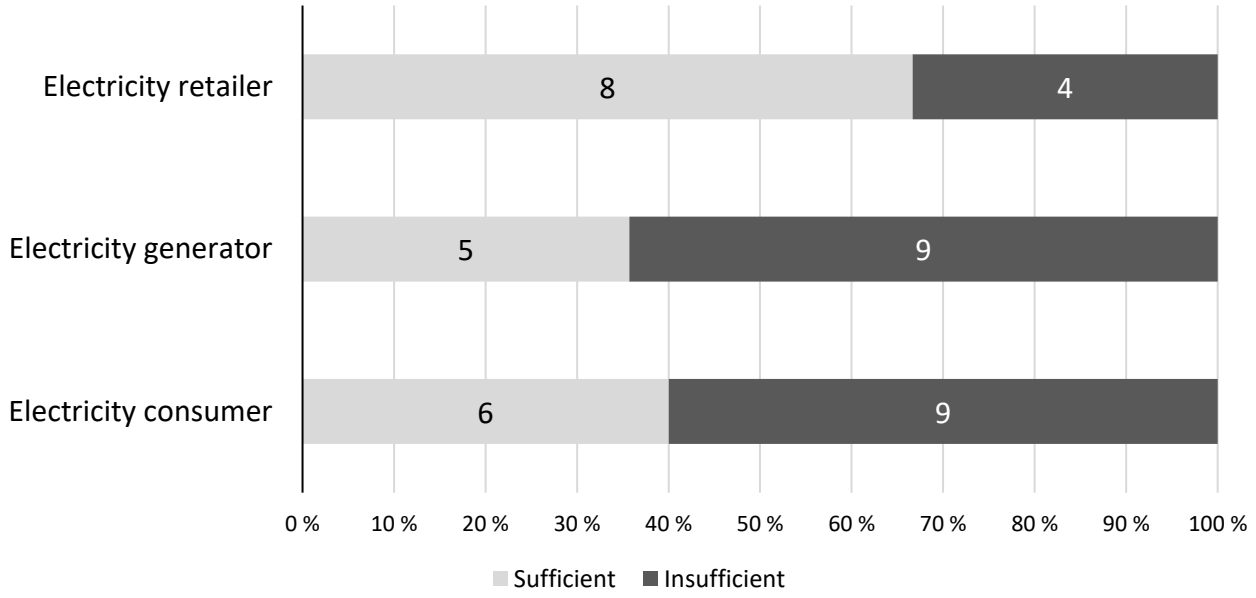
Figure 17: Sufficiency of hedging opportunities by respondent's primary role



Source: THEMA questionnaire

Figure 18: Share of respondents with sufficient hedging opportunities to hedge own risk by respondent's primary role



Source: THEMA questionnaire

Figure 17 and Figure 18 above show the decomposition of responses by the respondent's self-reported primary role. There is a diversity of opinion among all roles. However, retailers appear somewhat more likely to consider hedging opportunities to be sufficient than generators or consumers. This may reflect the fact, as noted by some retailers, that hedging costs can be passed on to consumers. Provided hedging opportunities are available, even at high cost, retailers can pass these costs on to consumers and still make a margin. In contrast, consumers and generators must ultimately bear the costs of the hedging they wish to undertake.

Looking at the sizes of the respondents, it is hard to discern a very clear divide in opinions based on organisation size. Perhaps contrary to expectations, larger retailers appear to be somewhat more likely to conclude that hedging opportunities are insufficient than smaller retailers. As discussed, further below, EPAD liquidity is the primary concern among those citing insufficient opportunities.

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Consequently, this size effect may reflect the fact that smaller retailers are less likely to be trading EPADs directly – often relying instead on the use of a hedging services provider.

There may also be a tendency, albeit not a very clear one, for larger generators to conclude that hedging opportunities are sufficient. This potentially reflects the presence of larger, more sophisticated hedging teams that can use a wider variety of potential approaches to hedging.

7.2 Factors underlying participants' assessment of sufficiency

The interviews covered a variety of respondents and offered an opportunity to explore the rationale behind these assessments in more detail. It should be noted that the text below is an attempt to summarise the views expressed, rather than present the consultant's own assessment. In some cases, the description below expands on the thinking expressed via the questionnaire or the interview in an attempt to make the relationships involved more explicit without altering the main idea or sentiment.

Those participants that considered hedging opportunities to be sufficient often pointed to the opportunities available for bilateral trade as the rationale for their response. For these respondents, the absence of an exchange-listed EPAD for a zone or low trading volumes for such EPADs was not evidence of insufficient opportunities, because quotations for EPADs could be provided by a broker. Similarly, a lack of liquidity in longer-dated futures would not result in insufficient opportunities to hedge long-term price risk because there was an active market in PPAs. Examples of the sorts of organisations that consider current hedging opportunities to be sufficient include:

- Large generator or trader organisations with trading desks and relatively sophisticated hedging operations (although there is not a consensus among such actors),
- Large consumers that have found success using PPAs, and
- Small retailers that are happy with the hedging solutions provided by brokers or hedging services providers

In contrast, examples of the sorts of organisations that consider current hedging opportunities to be insufficient include:

- Retailers attempting to conduct back-to-back hedging via the exchange, and
- Large consumers with hedging strategies more focused on the use of financial hedging products

Among those stating that there were insufficient opportunities to hedge power price risk, the vast majority cited a lack of liquidity and depth in the EPAD market as the most serious problem, with the result that it was difficult for them to effectively hedge area price risk. The importance of being able to hedge area price risk clearly depends on the extent to which area and system prices may diverge. We suspect that a participants' desire to use or reliance on EPADs is a significant driver of their assessment of the sufficiency of hedging opportunities.

One market participant noted that for a consumer in southern Sweden wishing to purchase a fixed-price retail contract, the cost to hedge the area price risk could make up about 20% of the price charged for power given the enormous difficulty of finding counterparties there. The implication was that the share of the total cost associated with area price hedging was evidence of the insufficiency of hedging opportunities.

Some of these respondents also noted that liquidity in Nordic system price contracts was lacking, but concerns about system price contracts were less frequently expressed among participants and participants' own assessment of the severity of the problem was that it was far less of an issue than EPAD liquidity.

Several factors were noted as contributing to the lack of liquidity and we divide them below into those that might affect exchange liquidity in general and those that are specific to EPAD liquidity.

Factors affecting liquidity on the exchange:

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- Collateral requirements – In discussing participants' motivations for selecting different approaches to hedge power price risk, it was clear that the posting and management of collateral associated with trading directly via the exchange was a significant turn-off for many, especially among smaller participants. This was true of generators, consumers and retailers. Importantly, this covered not just the direct financial costs of the collateral, but also a desire to avoid the administrative costs and cashflow risk associated with managing an open position. These costs were deemed to be particularly large when taking longer-term positions via the exchange. Overall, these factors drove a preference for managing risk bilaterally.
- Reporting requirements – Exchange trading was perceived to bring with it a range of other administrative requirements, for example related to reporting under the EMIR and MIFID regulation, which again made avoiding exchange trading preferable in terms of administrative complexity and ease of ensuring compliance.[5] Again, this disproportionally affected smaller players.
- The attractiveness of PPAs – Some participants noted that, to the extent that new generation capacity was being hedged via PPAs, the associated capacity would largely bypass the exchange and therefore might limit total volumes. This is not to say that such projects would never be associated with trade on the exchange and, in particular, exchange trades might be used, for example, to cover the difference between volumes covered by a PPA and actual output. Nevertheless, to the extent that PPAs were an attractive substitute to hedging via the exchange, this might reduce the volumes traded in the exchange and potentially the depth of the exchange market.
- Vertical integration – Some participants also noted the significant presence of vertically integrated players in some areas, covering both generation and supply. The structure of these organisations allows them to hedge internally via their supply arrangements and, again, limits the total volumes that might be alternatively hedged through use of the exchange.

Factors affecting EPAD liquidity:

- Small number of market actors – Some participants noted that there were typically only a few organisations potentially interested in trading any individual EPAD product, namely the major generators and consumers with direct exposure to the relevant zone. This was a consequence of relatively small bidding areas, no transmission rights between areas and little to no interest from speculative traders. The value of a public exchange, relative to bilateral trade, is therefore fairly limited since the set of potentially interested counterparties is small and their identities are known in advance.
- Market power – Related to the above, some participants felt that the presence of market power in the provision of area price hedging encouraged hedging outside the exchange. Specifically, it was felt that large incumbent generators were, in some cases, dominant providers for hedging area price risk given their large share of local generation and lack of competition from non-physical players. One respondent speculated that such firms might prefer to sell power forward bilaterally, rather than via the exchange, because doing so enabled them to secure the best possible price for the power and the implied hedging service. Another suggested that, even where a dominant provider might not be actively seeking to exploit its position, it might be reluctant to trade actively on the exchange due to concerns about (i) the exchange's depth and ability to absorb its large volumes and (ii)

[5] MiFID II, for example, standardises regulatory disclosures in relation to financial instruments, which include power futures. Whether a hedging instrument is covered by MiFID II depends on whether the instrument falls within the regulatory definition of a 'financial instrument'. Non-standardised, physically-delivered contracts will, for example, generally fall outside the relevant definition, whereas exchange-standard products traded Over the Counter will generally be covered by the regulation.

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making overly explicit its own expectations of future prices via the exchange given its dominance in the market.

- Asymmetry in local supply and demand – Several participants, including generators, consumers and retailers, pointed to a structural imbalance between generation and consumption within a zone as a reason for poor EPAD liquidity. Low EPAD liquidity discourages participation in the market by speculators, given the liquidity risk involved. As such, supply and demand for EPADs in most zones reflect the positions of players with physical exposure to the relevant area price. In some zones, there is a structural imbalance between generators and consumers such that one side of the market simply cannot find counterparties to hedge the area price risk. The absence of transmission rights prevents these actors from hedging this risk with counterparties in neighbouring zones, which provide the other side of the physical market. Meanwhile, poor liquidity stops financial players from stepping in to meet the unmet demand for area price hedging.
- Risk of bidding zone redefinition – Some participants pointed to the regulatory risk of zone definition as a potential reason for avoiding the use of EPADs as means to hedge area price risk. EPAD contracts are tied to specific locations and so the risk of bidding zone redefinition is limited for participants close to the reference location. For market participants that face a plausible risk of bidding zone redefinition however, it may be preferrable to manage this risk through the use of PPAs tied to their own offtake point, thereby effectively transferring this risk to the counterparty.

7.3 Options to improve hedging opportunities

Participants also raised a wide variety of possible options that might be considered further to improve hedging opportunities. Again, the discussion below seeks to summarise and clarify these proposals and, except where explicitly noted, does not reflect the consultant's view as to the options' feasibility or effectiveness.

Bidding zone redesign

As noted above, small bidding zones and zones with asymmetric supply and demand for power were seen to contribute to the lack of EPAD liquidity and to difficulty in hedging area price risk. As such, many participants of varying types suggested that (longer-term) market design seek to move towards larger and more balanced bidding zones.

Changes to derivative reference prices

Some participants also raised the possibility of using a different configuration of reference prices for hedging products as a means to support liquidity. Splitting the system price to create a series of regional reference prices that more closely resembled price exposures in different parts of the Nordic power system was mentioned and has been previously considered. This might make an inability to hedge area price risk less problematic, provided a regional price hedge were possible, since the regional price would be a better proxy of local area prices than the current system price. Opinions differed as to the value of such an approach and many participants were concerned that this would split already poor liquidity in system price contracts, further worsening the situation. The overall impact would depend on how attractive hedging against these regional reference prices was. There was also some doubt expressed as to the permanence of the solution, given that transmission bottlenecks might change over time.

Alternative approaches included the effective pooling of EPAD liquidity into EPAD-like contracts based on a regional price reference. Again, these contracts would allow market participants to hedge something closer to their area price exposure, but critically would avoid splitting system price liquidity. A final option was the redefinition of the system price to reflect volume-weighted area prices. This would alter the extent to which specific area prices were correlated with the system price, improving the correlation in some areas while worsening it in others.

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Enhanced market making

A market maker is an exchange participant with formal obligations to post bids and offers for a specific product or set of products. The presence of market makers helps to support pricing transparency and liquidity by ensuring that some volumes are always available for trade. The obligations imposed on the market maker typically specify a permissible maximum bid-ask spread and minimum volume, to ensure that the market maker cannot simply offer volumes at totally unreasonable prices or else offer negligible volumes.

A market maker is already in place for those Swedish, Danish and Finnish EPAD contracts listed on the exchange, and for limited hours for the Trondheim EPAD contract.

Enhanced market making would involve increasing the number of market makers and/or placing stricter requirements on the market maker, for example in the form of tighter bid-ask spreads or larger minimum volumes.

Existing market makers provide this service voluntarily in exchange for incentives provided by the exchange. Enhancing market making, as described above, would likely require paying the market maker to provide the relevant service or else imposing a new, costly obligation on one or more organisations to either provide market making directly or else tender for the provision of market making services.

The use of market making would directly reduce bid-ask spreads for EPADs and expand the volumes available but is unlikely to come about without regulatory intervention given the cost involved. Some stakeholders noted that there are only a relatively small number of organisations that, given their scale and physical exposures, are natural market makers. As such, it may be challenging to find multiple organisations suited to the role.

Transmission rights and TSO obligations to sell EPADS

As noted above, small and asymmetric (or imbalanced) bidding zones were seen by some participants as a reason for their inability to hedge area price risk. For these participants, the auctioning of transmission rights between Nordic power zones was seen as a possible solution to the underlying structural problem. An obligation on TSOs to sell EPADs was also mentioned as a possible option, notably one that would avoid the use of new products, and the sale of EPADs across bidding zone borders could be seen as a potential alternative to the provision of transmission rights, for example.

The sale of transmission rights was principally seen as a way to resolve structural imbalances between buyers and sellers in imbalanced zones. In effect, rights to transmission capacity could be used to link-up future buyers in one zone with future sellers in a neighbouring zone in much the same way that the implicit sale of transmission capacity in the day-ahead market helps resolve the power imbalance between these zones. The presence of transmission rights would also enable participants in one bidding zone to hedge their area price risk using EPAD products for neighbouring zones, assuming that they can purchase the relevant transmission capacity covering the price spread between these zones. This could support the pooling of liquidity in certain EPAD products and allow the market to compensate for a lack of actors in particular areas. In this way, transmission rights might also help to address some of the market power concerns raised above.

Other potential benefits for the use of transmission rights mentioned, but not explored, in the interviews included the possibility that such rights would strengthen TSO incentives to make transmission capacity available to the market and allow a broader set of actors to participate in the North Sea Link auction through access to the NO2 area price.[6]

[6] The North Sea Link cable links NO2 with Great Britain. A separate electricity market auction is expected to be run before the wider European price coupling process to support the determination of flows on this cable. This auction will be based on bids and offers collected from those bidding zones directly connected to the

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That said, some participants were opposed or sceptical to the use of transmission rights. Smaller players, in particular, were opposed to a further complication of the product set, especially where they had no direct exposure to the price spread between neighbouring zones and therefore no direct interest in the transmission right itself. It was noted by one participant that comprehensive coverage of all the borders in the Nordics by transmission rights would create a very large number of additional products given the large absolute number of cross-zonal connections. Again, this would tend to argue for obligations on TSOs linked to EPADs in preference to the use of transmission rights directly.

We should note that smaller players often relied on more sophisticated players to meet their hedging needs anyway, for example through the use of bilateral hedging services, and that the providers of such services were more likely to see a potential benefit from the use of transmission rights. It is possible therefore that smaller players might benefit indirectly from the presence of transmission rights, if these rights enable hedging services providers to hedge at lower cost and these cost savings are shared with their clients in the form of lower-cost services.

One actor was concerned that auctions for transmission rights would simply become dominated by those firms that already have market power in the forward sale of electricity and therefore do little to address the current lack of EPAD liquidity. However, if this concern could be addressed, they considered transmission rights to be potentially useful.

Many actors expressed general concern about the involvement of the TSO in the financial market, presumably based on a concern that the TSO might use its other powers to gain some unfair advantage or otherwise have its incentives perverted by direct market involvement.

Finally, there was some concern that transmission rights, if listed as a separate product, might cannibalise the existing use of EPAD Combos, thereby removing some existing liquidity from the market. This point would only be relevant in the event that transmission rights were listed as a separate product.

Limiting options outside the exchange

Some of the interviews discussed the possibility of limiting options to hedge the power price outside of the exchange. Of these, one option would be to restrict the ability of very large vertically-integrated organisations from hedging internally between their generation and retail businesses. Under this approach, such organisations would be required to split their activities between two independent trading desks and to trade their forward sales and purchases publicly on the exchange. This would potentially allow other actors to pick up these volumes through the exchange.

Product design

Some of the interviews discussed the possibility of changes to the design of exchange-traded products to better meet hedgers needs.

Some actors noted that the use of physical forward contracts, rather than the use of financial futures, might be helpful in reducing the regulatory burden involved and thereby potentially attract the involvement of smaller players.

A supplier noted that the listing of longer-dated monthly contracts might help suppliers to achieve profiled hedges for longer-term fixed price contracts, although they also made clear that such changes, by themselves, were unlikely to have a marked effect on total market liquidity.

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cable (i.e. NO2 and GB). Participants from zones neighbouring NO2 might potentially be able to involve themselves directly in this auction if they had a (physical) transmission right on the border with NO2 and, consequently, could influence the power balance in NO2. However, the trading process for the North Sea Link is still in development and the possible implications of transmission rights linked to NO2 are therefore far from clear.

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Altering exchange membership requirements and contract sizes

Some changes were suggested with a view to encouraging more exchange trading by smaller players. One stakeholder noted the potential value associated with further reviewing exchange membership requirements with a view to supporting exchange trading by smaller entities. Another suggested reducing the minimum volume that could be traded on the exchange.

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