Long-term cross-border hedging between Norway and Netherlands

A report for the Netherlands Competition Authority, Office of Energy Regulation (NMa) and the Norwegian Water Resources and Energy Directorate (NVE)

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1 Executive Summary

Netherlands Competition Authority Office of Energy Regulation (NMa) and the Norwegian Water Resources and Energy Directorate (NVE) have engaged Redpoint Energy (Redpoint), a business of Baringa Partners, to explore the options for long-term cross-border hedging on NorNed, a 580-kilometre (360 mi) long High Voltage Direct Current (HVDC) submarine power cable between Feda in Norway and the seaport of Eemshaven in the Netherlands, which interconnects both countries' electricity grids.

This study evaluates current needs and opportunities for long-term cross-border hedging between the two electricity markets, with the goal of identifying potential gaps and of evaluating the effects of potential remedies such as the introduction of alternative hedging instruments.

Background

A cross-border hedge is a derivative instrument that allows market participants to manage the risk associated with their exposure to price differences between two markets. This is relevant for companies with activities in connected electricity markets, such as vertically-integrated utilities that generate and sell electricity across borders. Managing price risks between two markets can also be of interest to other stakeholders such as pure suppliers or large consumers.

Currently, opportunities for hedging the cross-border price difference between the Netherlands and Norway (and the Nordic region more generally) exist in the form of financial derivative markets, such as NASDAQ OMX in the Nordic region and APX-ENDEX in the Netherlands. While there is no designated instrument for hedging the cross-border price spread, such a hedge can be at least partially replicated using other existing products in both markets.

Against this backdrop, a different vision for how cross-border hedging should function in the future has been proposed by the Agency for the Cooperation of Energy Regulators (ACER) in its Framework Guidelines for Capacity Allocation and Congestion Management (FG for CACM). ACER views transmission rights on interconnection capacity as the key cross-border hedging instrument to support an Integrated Electricity Market (IEM) in Europe. Transmission rights entitle the rights holder to the congestion revenues on specified interconnection capacity. Since congestion revenues are determined by the price difference between the two connected markets, transmission rights function as a direct derivative of the price spread. In this study the focus lies on Financial Transmission Rights (FTR), which are settled purely financially based on day-ahead price differences in coupled markets and as such do not involve the nomination of physical flows by right holders.

Although ACER mandates TSOs to “foresee that the options for enabling risk hedging for cross-border trading” are transmission rights, in its current draft guidelines the regulator also offers an exemption if “appropriate cross-border financial hedging is offered in liquid financial markets on both sides of an interconnector”.[1] This has prompted NMa and NVE to investigate if liquidity of financial forward electricity markets on both sides of NorNed is appropriate or whether FTRs would need to be implemented. For this project Redpoint has been engaged to provide evidence on three questions:

- What is the current state of market liquidity on both sides of the interconnector?
- What are the actual hedging needs and preferences of relevant stakeholders?
- What would be the effects of FTRs and other relevant options on market efficiency and stakeholders?

[1] ACER, Framework Guidelines on Capacity Allocation and Congestion Management: Draft for Consultation, 11 April 2011.

Our findings 1: current state of market liquidity

Our findings are based on the analysis of market data and a consultation with 15 stakeholders with operations in the Netherlands and/or Norway. We find that liquidity in financial markets is generally high on both sides of NorNed, but with challenges for some of the products required to construct a cross-border hedge. These limitations can combine to decrease the effectiveness of a cross-border hedge.

A hedge for the price spread on the NorNed interconnector could be constructed with financial derivatives in existing markets using three products: a forward contract in the Netherlands, a forward contract in the Nordic market and a Contract for Difference (CfD) to manage the area price risk between the Kristiansand price zone and the Nordic forward contract.

We find that for the Nordic forward contract there is a highly liquid forward market, with liquidity being offered along a hedging horizon meeting most stakeholders' requirements. However, no area price contract is available for the Kristiansand area. Liquidity for the Oslo area price contracts, a potential proxy, has historically been very low. This creates locational risk that cannot currently be hedged.

For the Dutch forward market we find that overall market liquidity has been falling substantially over the last three years, especially in yearly contracts used for long-term hedging. Our detailed analysis is limited to data for the Dutch power exchange, whereas larger trading volumes move through brokered transactions. For the power exchange, volumes have increased significantly again in recent months. However, we find that overall market liquidity across all channels has still decreased, in part as liquidity is migrating to the neighbouring German market. We find that liquidity in Germany is very high along the forward curve. If the Dutch leg of a cross-border hedge were placed on the German market, however, this would also introduce locational risk into the hedge.

The illiquidity of Norwegian area price contracts and challenged Dutch liquidity could limit the effectiveness of hedging the price difference between the Netherlands and Kristiansand (and Norway as a whole) in financial markets.

Our findings 2: stakeholder hedging needs

While we observe gaps in the supply of cross-border hedging instruments, we do not identify any market demand for hedging the price spread between Netherlands and Norway for cross-border risk management. This is because none of the stakeholders consulted for this study has physical activities leading to offsetting (long and short) positions in both markets, which could benefit from cross-border hedging. Stakeholders who do not have an interest in hedging the cross-border price spread were mostly indifferent, or opposed, to the introduction of an FTR.

Yet we do identify a limited market demand for hedging the price spread for other reasons. Some market participants have an interest in hedging their home market activities on a more liquid foreign financial market. A spread instrument on NorNed, or between the Netherlands and the Nordic region more generally, would allow these market participants to access more liquid markets at potentially lower costs. We refer to this type of hedging demand as a bridge-to-liquidity.

Our findings 3: effect of FTRs and other options on stakeholders and market

We evaluate three options in terms of their effect on present and potential gaps (as well as on market efficiency more broadly). The first option is not to introduce a new instrument, but rather to improve liquidity in existing markets where this is challenged. The second option is to introduce an FTR on NorNed. The third is to introduce a Contract for Difference on the price spread between the Netherlands and the Nordic market. A CfD is similar to an FTR from a financial perspective, but differs in that it would be directly offered by market participants in existing financial markets (rather than the TSOs who receive price spreads for physical flows).

We assess these options in regard to their impact on hedging effectiveness, hedging costs, market liquidity and efficiency, investment signals for additional interconnector capacity and market competition. Three findings are of particular importance

- **Ability to address gaps:** The only current gap identified is the lack of a spread product to facilitate a bridge-to-liquidity. For this hedging purpose, a CfD offers the advantage of directly connecting the "target" hubs, i.e. Dutch and Nordic forward markets. An FTR would not cover the area price risk between Kristiansand and Nordic forwards and market participants may have to carry those risks. However, stakeholders expressed concerns as to how CfDs transfer risks in the event of an interconnector outage to market participants. The extent to which CfDs would be offered is therefore uncertain. In contrast, FTRs have a natural supplier in the form of capacity owners (TSOs).
- **Implementation costs:** For implementing FTRs on NorNed we received a TSO cost estimate of €1,000,000 (noting that further research for validation is required) and point to New Zealand's current FTR implementation as a potential reference benchmark, with a cost estimate of €250,000 - €380,000. TSOs consulted for this study were cautious or resistant in regard to FTRs because of implementation concerns and pointed to fundamental impacts on governance and independence of TSOs from the market. A CfD would probably be a lower cost option, although the introduction of a new trading product also accrues system testing costs and may take several months.
- **Changes to liquidity in existing markets:** One concern expressed about FTRs is that they may split liquidity in existing products. In general, we recognise several potential dynamics with contrasting effects, rendering liquidity impacts on existing products uncertain. FTRs could change liquidity in the forward market by shifting hedging patterns, but the effect of this will be limited by the volume of allocated FTRs. Given that currently the Nordic market is more liquid than the Dutch market, it may not be unreasonable to expect that, if anything, Nordic market liquidity would increase through an inflow of hedging activity. Norwegian CfDs are mostly illiquid in any case and hence the potential for negative impact is limited.

Recommendation

While the market and stakeholder evidence provides an assessment of the status quo and available options, we recognise the difficulties in aggregating a range of different views into a single decision. We therefore develop a decision tree that considers three dimensions: preferences of market stakeholder, consumer interests (including implementation costs), and stipulations of the FG on CACM.

The stakeholder evidence in our view suggests that a new hedging product should be considered. Whilst there is no demand for a cross-border hedging instrument, there is some demand for a spread instrument for accessing liquidity in connected markets (bridge-to-liquidity). While recognising the upside of a spread product, we identify limited downside. Negative impacts were not commonly expected by stakeholders. Where hesitations were expressed, such as in regard to liquidity effects or implementation costs, we believe these are not prohibitive. We believe that concerns raised by TSOs about ramifications on TSO governance and TSO operations in the market could be addressed through an appropriate regulatory framework, if needed. This accordingly suggests the introduction of either FTRs or CfDs.

However, it is currently not possible to choose an unequivocally best option, for two reasons. First, the market uptake of a potential CfD on the difference between the Netherlands and the Nordic reference price, noting the allocation of outage risks, is unknown. Second, there is uncertainty around the direction of travel of the FG on CACM on transmission rights. Under the stipulations of the draft guidelines, we believe a liquid CfD product could meet the requirements for cross-border hedging. Yet the eventual specifications in the final network code for what constitutes appropriate financial cross-border hedging are uncertain.

We therefore recommend the introduction of a CfD to test market uptake, provided implementation costs are deemed acceptable following further scrutiny. We further recommend commencement in parallel to this of a process of product and regulatory design that would enable a potential FTR solution on NorNed to feed into the ENTSO-E and ACER processes.

2 Introduction

2.1 Background to this study

NMa and NVE have engaged Redpoint to explore the options for long-term cross-border hedging on NorNed, a 580 kilometre (360 mile) long HVDC submarine power cable between Feda in Norway and the seaport of Eemshaven in the Netherlands, which interconnects both countries' electricity grids.

The Dutch and Norwegian electricity markets have been interconnected by the 700 MW NorNed subsea cable since 2008. Market coupling between the Netherlands and Norway was introduced on NorNed in January 2010. As a result, capacity on the NorNed interconnector is now allocated implicitly via coupled energy market auctions at the day-ahead stage, with any congestion rents arising from hourly price differentials between the Dutch and Norwegian spot markets accruing to the two interconnector owners, TenneT and Statnett.

Currently there are no instruments on the NorNed spread with which market participants could hedge longer term exposure to the price differential between the Netherlands and Norway.

Under the EU target model, and particularly through the Framework Guidelines (FG) on Capacity Allocation and Congestion Management (CACM), the options envisaged for cross-border risk hedging are transmission rights, unless appropriate cross-border financial hedging is offered in liquid financial markets on both side of an interconnector. Previous consultations between regulators have identified Financial Transmission Rights (FTRs) as the preferred option, if transmission rights were to be introduced.[2]

On this topic, a regulator working group has specifically investigated long-term hedging between the Nordic market (Nord Pool) and Continental Europe within the framework of ACER Cross-Regional Roadmaps. For the purposes of the NorNed cable, NMa and NVE have considered that without further research it cannot be clearly ascertained whether the liquidity of financial forward electricity markets on both sides of NorNed is sufficient to rely on financial hedging, or whether FTRs would need to be implemented to be compliant with the target model.[3]

The first task of this study is to investigate current hedging opportunities offered in financial wholesale markets on both sides of the NorNed cable. The second task is to evaluate whether new products such as FTRs would better meet the long term cross-border hedging needs of NorNed stakeholders. Third, this report considers the potential impacts of introducing new hedging options between Norway and the Netherlands.

2.2 Outline of Terms of Reference

Three project objectives have been defined by the Request for Proposal issued by NMa and NVE:

1. Investigate liquidity in electricity derivative markets on both sides of the NorNed cable.

2. Investigate stakeholders' views on long-term cross-border hedging and their preferences and needs.

[2] ACER Cross-Regional Regulator Group, "Conclusions from the regulator group on LT Hedging between the Nordic and Continental Europe", 29 June 2012. Made available by NMa and NVE.

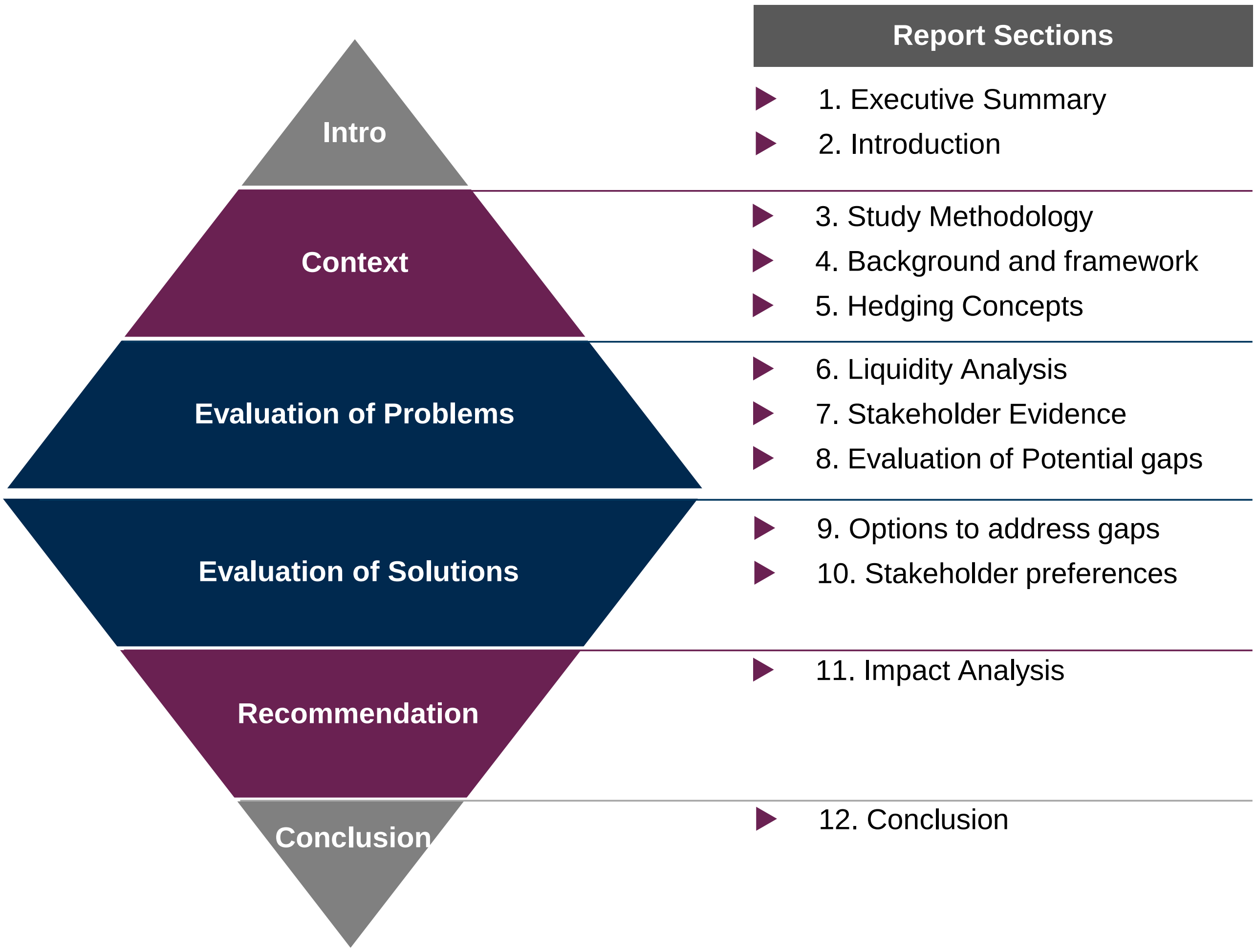
[3] Ibid.

3. Evaluate effects and consequences of different types of long-term hedging products or methods, including FTR options and FTR obligations, in terms of their impact on market efficiency and on stakeholders.

2.3 Structure of this report

Our report is structured as shown in the figure below:

Figure 2.1 Structure of the report



In summary, the content of each section is as follows:

- Section 3 introduces the methodology of the study and the supporting stakeholder consultation.
- Section 4 develops the context around the study objectives. It introduces the relevant regulatory framework and key drivers on the European level and elaborates on the concept of FTRs. It surveys previous studies with a similar scope and provides an overview of international experiences with transmission rights.
- Section 5 explains and defines long-term hedging requirements for cross-border applications. It also illustrates the types of cross-border exposures stakeholders could potentially encounter between the Netherlands and Norway.

- Section 6 analyses the current hedging opportunities and liquidity offered by financial wholesale markets on both sides of the interconnector.
- Section 7 presents the evidence from a stakeholder consultation with respect to stakeholders' hedging needs, views on current market opportunities and identification of potential gaps.
- Section 8 evaluates the materiality of potential gaps, in particular assessing the extent to which gaps impinge on the effectiveness of hedges for cross-border purposes and for other purposes.
- Section 9 introduces options for addressing potential gaps and qualitatively evaluates these.
- Section 10 presents the evidence from a stakeholder consultation on preferred options and instrument design.
- Section 11 assesses the impacts of options and develops a recommendation.
- Section 12 concludes our findings with respect to the project aims.

3 Study methodology and approach

As set out in the Request for Proposal, this study is based on a three-pronged approach corresponding to the aims of the study. The methods employed in this study comprise a data analysis to evaluate opportunities in financial markets, a supporting stakeholder consultation and an impact assessment of available options (summarised in Table 3.1). In this section we introduce the methodology in detail and define key terms and concepts.

Table 3.1 Summary of study approach in relation to project aims

Project Aim	Method	Tasks	Chapters
Aim 0: Provide context to study	Literature review	• Survey previous studies on cross-border hedging • Review international experiences with transmission rights	4
Aim 1: Investigate liquidity in financial wholesale markets	Data analysis	• Build framework for empirical evidence • Assess if current markets allow for long term cross-border hedging	5-6
Aim 2: Investigate stakeholders views on cross-border hedging	Stakeholder consultation	• Conduct targeted interviews to confirm the perspectives and hedging requirements of key stakeholders	7,10
Aim 3: Evaluate effects of different hedging products and methods	Internal analysis	• Define potential gaps • Evaluate options to address gaps • Assess impacts of options	8-9,11

Literature review

The objective of the literature review was to review relevant literature sources to contextualise the subsequent analysis. The review of current regulatory framework draws mainly from the publicly available FG on CACM and accompanying documentation such as official impact assessments. Previous studies and consultations that are surveyed have been selected following suggestions from NMa and NVE. A review of international experiences is the product of internal desk research.

Data analysis

The objective of the data analysis was to assess to what extent current financial markets on both sides of the interconnector offer hedging opportunities. A framework for analysis, considering product availability, market depth and costs, was developed for this purpose.

Market data has been made available by NMa for the Dutch market and NVE for the Nordic market and is complemented by data from other sources where appropriate. Data for the German market, which we consider as providing hedging options for Dutch exposures, was sourced through access to external data providers.

We note that data on trading activity is typically less transparent for the OTC markets compared to exchanges. This is not a problem for the Nordic market where almost all forward trading is routed through the exchange or reported for clearing. In the Netherlands the unavailability of detailed OTC data reduces the granularity of our analysis, but does not impair our ability to show relevant trends and assess their ramifications. For the German market, OTC data was also not available but this was of lesser importance due to the higher share of exchange-traded and cleared volumes.

Stakeholder consultation

We carried out targeted interviews with 15 NorNed market participants and stakeholders in order to understand their hedging requirements and views on long-term cross-border hedging.

The selection of stakeholders was carried out by NMa and NVE for the respective market areas. We interviewed 7 stakeholders with an activity focus in the Netherlands and 8 stakeholders with a focus in Norway.

Table 3.2 Interviews conducted by stakeholder type

	TSOs	Exchanges and Traders	Producers	Consumers	Total
Number interviewed	2	4	5	4	15

Interviews were conducted from a script of guideline questions to ensure comparability of feedback across interviews. The script was made available to interviewees in advance. All 15 interviews were attended by at least two Redpoint staff, one of which was the same for all interviews, in order to ensure continuity and consistency in interpretation.

Meeting notes and a summary of key points were produced for each interview. These provide the basis for the stakeholder evidence presented in sections 7 and 10. Interviewees responded confidentially and this report does not directly attribute any statements to individual stakeholders. Where appropriate comments are quoted for illustrative purposes but anonymised to the level of stakeholder type.

Internal analysis and impact assessment

We rely on the evidence from the data analysis and stakeholder consultations to define qualitatively potential gaps and quantitatively assess their materiality. We qualitatively assess the potential of three options to address gaps, including FTRs as the prescribed focus of this study and two alternative suggestions brought forward during the stakeholder interviews.

We then present our assessment of the alternative options identified against four criteria: hedging effectiveness, cost of hedging, market efficiency and competition. The assessment is largely qualitative in nature, with elements of quantitative assessment where appropriate data is available.

3.1 Terms and definitions

For some of the terms employed in this report, various conventions exist for their use and meaning. The overview below clarifies how certain terms and concepts are used in the report.

Financial markets

The term financial market is employed as in the FG on CACM, i.e. denoting all forward hedging opportunities available in current markets. This includes financial products traded on power exchanges, over-the-counter (OTC) transactions and bilateral markets. OTC trades are defined as brokered transactions whereas bilateral agreements, including long-term contracts, are directly agreed by the counter-parties.

Trading products

Note that the following convention is used throughout the document to denote forward products: a contract for delivery in the next calendar year (year-ahead) is denoted Y+1, quarter-ahead is Q+1 and month-ahead is M+1. Day-ahead is DA.

Hedging and risk

Exposure is the volume of a position whose value is subject to market price movements. A hedge is effective when the value of the hedging position is negatively correlated with the value of the original position. For the purposes of this study we consider relevant the hedging needs of large electricity consumers, producers and owners of interconnector capacity. In sections 9 and 11, we construct examples of market participants' exposures. We find the standard deviation in market prices/spreads and use one standard deviation as a metric for the value of a position that is at risk.

Firmness Risk

Firmness risk relates to the outage of a transmission asset for which capacity has been sold forward. If physical capacities are not available, the congestion income from day-ahead market transactions is insufficient to cover payments to holders of firm transmission rights. The unavailability of the asset will also remove its price convergence effects and hence may raise spreads to levels higher than those if capacity had been available. This risk of revenue shortfalls due to transmission outages is termed firmness risk.

4 Background, framework and drivers

4.1 Introduction

In this section we develop the context around the study objectives. We first introduce the relevant regulatory frameworks and key drivers at the European level. This is followed by an initial introduction to key concepts of FTRs. We then provide a summary of previous studies with a similar scope to allow us to set this study in context of previous work undertaken. We then provide an overview of international experiences with the definition and allocation of transmission rights in the context of hedging locational price differences.

4.2 Current regulatory background

The rationale for an evaluation of long-term cross-border hedging on NorNed is rooted in the context of greater European electricity market integration as envisioned in the EU Third Package. For the purposes of cross-border hedging, the enabling regulatory framework has emerged through the Framework Guidelines (FG) on Capacity Allocation and Capacity Management (CACM), which are to be implemented as network codes through ENTSO-E (see Box 1). The Framework Guidelines identify the efficient use of interconnector capacity as a necessary condition for the implementation of the EU Target Model and specify that forward markets for transmission capacity are required to achieve such efficient use.

The CACM set out to address what is identified as "the presently inefficient and sub-optimal use of transmission network capacity between and within the control areas in the EU".[4] The FG define the efficient use of cross-border interconnector capacity as instrumental in implementing the EU Target Model: "Since electricity needs to be transported over networks, non-discriminatory access to the networks and cross-border trade over interconnections between control areas is a vital precondition for establishing a competitive Integrated Electricity Market in the EU".[5]

One of the pertinent measures foreseen by the FG on CACM is defined as "To Achieve Efficient Forward Market" (Objective 3) for transmission capacity. The document suggests that efficiency can be achieved both by dedicated hedging instruments for transmission capacity and existing financial markets for power derivatives. The accompanying European Regulators' Group for Electricity and Gas (ERGEG) Impact Analysis sees forward products for transmission capacity as instrumental for at least two reasons:

- More transmission capacity will be made available if forward markets are available. It follows from the contention that capacity allocation mechanisms "at many interconnections have not enabled market liquidity and formation of reliable prices neither in day-ahead nor - consequently - in forward markets".[6] This lack of proper price signals is seen to lead to the sub-optimal utilisation of networks and to sub-optimal investment signals. A liquid market for long-term transmission products is suggested as a remedy because it provides "the capacity owner with an option of making unneeded capacity available to the market by receiving a fair price, and presents an additional way for market participants to acquire transmission capacity".[7]
- Long-term transmission rights, physical or financial, can also offer market participants hedging solutions against the uncertainty related to congestion costs between market zones and thereby

4 ERGEG, "Draft Framework Guidelines on Capacity Allocation and Congestion Management for Electricity: Initial Impact Assessment", 8 September 2010.
5 Ibid. P. 4.
6 Ibid.
7 Ibid. p. 51.

facilitate cross-border trading. The guidelines require TSOs to implement a single platform (point of contact) at the European level for hedging through transmission rights, and envisages two sets of harmonised rules for borders where physical transmission rights are sold and for borders with financial transmission rights. A secondary market for anonymous trading of transmission rights is also foreseen.

The first reason may be of lesser concern to this study as the efficient use of transmission capacity is a corollary of the existing market coupling, which ensures maximum flows when price differences present an arbitrage opportunity and the cable is physically available.[8] Hedging opportunities offered by transmission rights are therefore the central issue at hand.

Yet the FG recognise that market players may already be able to construct an equivalent hedge by using traded products available in financial forward markets. Under Objective 3 the FG accordingly state that the applicable network code "shall foresee that the options for enabling risk hedging for cross-border trading" are transmission rights, "unless appropriate cross-border financial hedging is offered in liquid financial markets on both side of an interconnector".

For the purposes of this study, the appropriateness of cross-border hedging is understood to refer to the availability of hedging products for the type of risks market participants would want to hedge and for demanded hedging horizons. Liquidity is generally understood as the degree to which a contract can be bought or sold in the market without materially affecting the price and without incurring significant transaction costs.

Box 4.1 Genesis of the FG on CACM with respect to Forward Markets

At the Florence Forum in November 2008, ERGEG was invited to establish a Project Coordination Group (PCG) of experts to develop a practical and achievable model to harmonise interregional and then EU-wide coordinated congestion management and to propose a roadmap. Participants included delegates from the EU Commission, Regulators, ETSO, Europex, Eurelectric and EFET. The working group proposed a target model for forward markets in which TSOs should issue transmission rights on a forward basis.[9]

At the Florence Forum in December 2009, it was agreed that ERGEG would continue the work by the PCG through the preparation of a draft framework guideline on capacity allocation and congestion management. In September 2010 ERGEG opened a public consultation on the draft FG on CACM together with an Initial Impact Assessment (IIA).

The initial ERGEG draft FG introduced the notion of mandatory transmission rights, with an exemption clause for interconnectors featuring liquid financial markets on both sides (clause 4.2.). It further noted that "financial derivatives can be considered as an adequate alternative … this is also clearly stated in Regulation (EC) 714/2009".[10]

The final draft FG were submitted to ACER in February 2011 and later adopted in July 2011. ACER then submitted the FG to ENTSO-E with the mandate to draft a network code. Subsequent versions of the FG have largely followed ERGEG's initial wording of clause 4.2.

In March 2012, ENTSO-E decided to parcel out the question of forward markets from the network codes on CACM and to address this in separate code for the forward market. The drafting process was scheduled to launch in October 2012, to be opened for consultation in Q2 2013 and submitted to ACER in September 2013. ACER in August 2012 has simultaneously launched a public consultation on transmission rights and forward hedging (consultation closed at the end of October 2012).[11]

8 It has been argued that transmission rights may still positively impact the availability of transmission capacity by providing additional incentives for the capacity owner to optimise maintenance and minimise outages. This was largely considered a theoretical consideration by stakeholders consulted. See e.g. W. Hogan, "FTR Incentives: Applications Beyond Hedging", Harvard Electricity Policy Group, 31 May 2002.
9 B. Hagman and J. Bjørndalen, "FTRs in the Nordic electricity market", ELFORSK, April 2011.
10 ERGEG, "Draft Framework Guidelines on Capacity Allocation and Congestion Management for Electricity", 8 September 2010.
11 ACER, "Forward Risk-Hedging Products and Harmonisation of Long-Term Capacity Allocation Rules: Consultation Document", 29 August 2012.

4.3 Introduction to Financial Transmission Rights

The potential use of FTRs on NorNed is assessed in detail in section 9. Since continuous reference to FTR characteristics and concepts is made throughout the report, however, a first detailed introduction is warranted at this point.

Transmission rights can help market participants such as producers and consumers to manage risks arising from the fluctuating price differences between two connected markets. Price differences between markets occur because of transmission congestion in situations when limited transmission capacity constrains the price equalisation effect between coupled markets.

Price differences between two connected markets create revenues for the owners of interconnection capacity in the form of congestion rents. In coupled markets using implicit auctioning, congestion rents are equal to the hourly price difference between the markets multiplied by the available transfer capacity. FTRs are equivalent to a financial product that transfers the rights to specific congestion rents from capacity owners to a third party, the FTR holder for a specified period. Because the FTR pay-out is by definition equal to the price difference between the two markets linked by the interconnector it allows market participants to hedge an exposure to this price difference (for example, arising from a short position in one market and a long position in the other). Section 5 elaborates on hedging and hedging instruments.

Physical transmission rights (PTRs) are not considered in this study. PTRs differ from FTRs in that they are settled physically, i.e. provide a right to use interconnector capacity to flow power. However, as coupled markets introduce use-it-or-sell-it provisions (USOSI) into PTRs these instruments become effectively equivalent to FTR options. A regulator group including NMa and NVE has already indicated that FTRs are preferable over PTRs and hence the latter are not considered in detail.

There are a number of different types of FTRs. The particular design features of FTRs have important ramifications for example for the distribution of risks between capacity owners and FTR holders, which may in turn lead to different levels of market demand. We consider five design dimensions especially important in considering the merits of FTRs for a specific application, each of which we explain further below:

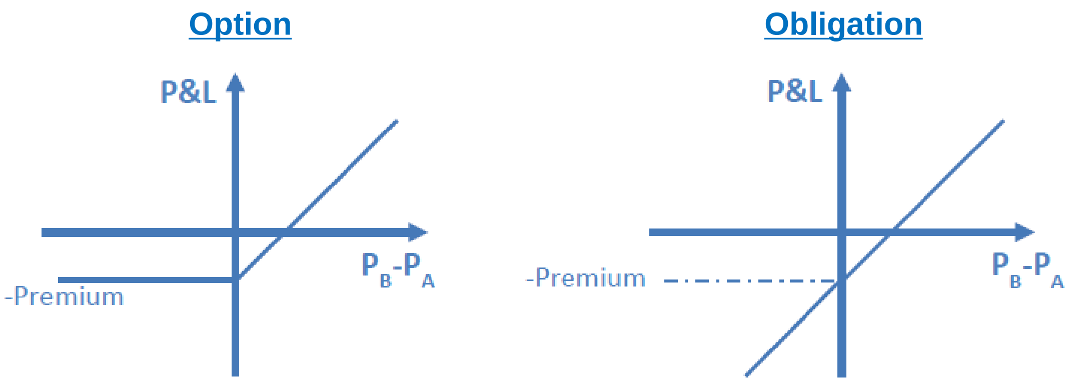
- Optionality – are FTRs offered as options or obligations?
- Tenor – for what time horizons are FTRs offered?
- Firmness – how is outage risk allocated between parties?
- Role of TSO – how do monopolists relate to the markets when issuing FTRs?
- Reserve price – how is capacity value distributed between parties?

Optionality

FTRs are either designed as options or as obligations. FTRs as options entitle their holders to receive a financial compensation equal to the positive market price differential between two price areas during a specified time period in a specific direction. Options are in this sense "one-way" FTRs and have a positive or zero pay-out. FTRs as obligations on the other hand entitle their holders to receive or oblige them to pay the market price difference during a specified time period and defined in a specific direction. Because obligations have a (negative) pay-out also when flows occur in the direction counter to the specified direction, obligations are "two-way" FTRs. Obligation can have a positive, negative or zero pay-out.

Figure 9.1 illustrates the pay-out structures of options and obligations. For hedging a simple (linear) cross-border position, options allow the holder to hedge the risk by limiting potential losses to the premium paid for the option, while capturing any upside. Obligations provide a perfect hedge in that they render the holder indifferent to price differences between the two markets, as any variation in physical exposure is offset by the pay-out of the FTR. The ENTSO-E educational paper on transmission rights describes this process in detail.[12]

Figure 4.1 Pay-out structure for FTR options and obligations



With FTR options the capacity that can be allocated to participants is limited to the actual physical transfer capacity of the asset. FTR options are effectively similar to existing PTRs with USOSI. PTRs are already in use on several European borders and demanded by a range of market participants. If FTRs are perceived as extensions of a proven product this may aid market uptake.

Obligations can provide perfect hedges for FTR holders with an underlying exposure to price variation in the spread between two markets. The capacity owner is able to net bids into opposing directions of flow and thus to increase the total transmission capacity that sold forward. However, this presupposes that market participants enter bids for transmission rights into both directions. Given that market expectations predict a primarily unidirectional flow across NorNed, expected willingness to pay for the expected counter-direction and hence the relevance of netting may be limited.

Tenor

Transmission rights can be issued for different time horizons. Most PTRs for example are issued as a combination of monthly and annual products, and this also the case for FTRs in many North American markets. PJM on the other hand also offers FTRs for three years ahead. For hedging purposes it may also be purposeful to align FTR tenors with those of forward products in financial markets for complementarity.

Selling FTRs for the year-ahead and within year period may be sufficient for participants who are using it to cover basis risk, if they are comfortable with a shorter hedging time horizon. From the perspective of the capacity owner, shorter tenors generally have the advantage that they reduce the risk of overselling capacity as availability becomes more predictable closer to the delivery period. Yet shorter tenors may disappoint participants seeking to align FTRs with their hedging strategy along the entire forward curve.

Considering that price spreads between Norway and the Netherlands are driven considerably by seasonal hydrological considerations, seasonal tenors may be useful from a market viewpoint.

Firmness

FTRs, as derivatives of the day-ahead spreads, are purely financial instruments. Revenues are identical to the congestion rent received by capacity owners as long as the capacity sold as FTRs matches the physically available capacity during the delivery period. If physical capacities are not available, however, the congestion

12 ENTSO-E, "Transmission risk hedging products – an ENTSO-E educational paper", 20 June 2012.

income from day-ahead market transactions is insufficient to cover payments to FTR holders. The unavailability of the cable will also remove its price convergence effects and raise spreads to levels higher than those if capacity had been available. This risk of revenue shortfalls due to transmission outages is termed firmness risk.

Full financial firmness indicates that this outage risk lies with the TSOs as capacity owners, i.e. physical availability and congestion rent are independent of the financial entitlements of FTR holders. Partial firmness indicates a level of risk sharing under which compensation payments are made to FTR holders in case of an outage, for example returning the bidding price or paying spreads up to a capped maximum level.

The major advantage of full financial firmness is clarity for market participants. Compensation arrangements under partial firmness increase the complexity of FTR products, making them difficult to value and introducing risks that are hard to measure. If outage risk is borne by TSOs, this could at least theoretically also serve as an additional incentive to maximise maintenance and availability. This latter point may be of reduced relevance for the case of NorNed, however, as the contractual agreements between the concerned TSOs include stipulations on maximising cable availability.

The downside of full firmness from the TSO perspective is that it can create situations in which revenues for the capacity owner are negative, when spreads during an outage exceed the auction price for this delivery period (whereas they would be zero in day-ahead market). This may lead to a requirement for TSOs to manage risks, for example by buying back sold capacity in secondary markets. It may also require cost-recovery arrangements with national regulators. In terms of maintenance incentives, it may skew TSO attention towards lines with FTRs.

Conversely, partial firmness limits risks for TSOs (and rate-payers). This may be especially appropriate where outage risks are high, especially subsea cables such as NorNed where outage periods can be prolonged. On the downside, partial firmness could reduce market demand and accordingly lead to significantly discounted bids for FTRs and potentially reduced auction revenue for TSOs.

Role of TSOs

When TSOs issue FTRs this usually follows an auction format. Primary auctions can be complemented by secondary markets that allow market participants to trade FTRs, and are strongly recommended by the FG on CACM. In theory, TSOs could also participate in secondary markets, for example to buy back capacity in case of an outage.

If TSOs were eligible to trade FTRs this would allow them to actively manage firmness risks. However, it raises significant challenges with respect to asymmetric information and the potential for gaming. TSOs will by default have superior information about transmission availability. If this information is not public prior to a market operation at the hands of TSO, then the TSO is acting on inside information. If it is posted before a buy-back, FTR holders will base their pricing on the knowledge the TSO will necessarily buy. A potential market participation of TSOs also requires additional regulatory oversight and changes to internal operations.

Reserve Price

The value of an FTR option is made up of an 'intrinsic' component, which can be objectively measured based on current forward curves, and a component associated with the optionality of the instrument. This is harder to value (and hedge), which raises the possibility that markets will under-price FTRs or factor risk premiums into of their bids, thereby systematically transferring value from capacity owners to FTR holders. Reserve prices set at the intrinsic value plus a mark-up could mitigate such concerns. Yet this also introduces the possibility that the auction does not clear. It would also have to be assessed how reserve prices relate to the harmonisation of auctions envisaged in the target model.

4.4 Cross-border hedging and FTRs – the evidence to date

Previous studies and consultations have discussed long-term cross-border hedging in general, and transmission rights in particular, both on the European level and with respect to connections within the Nordic market and between the Nordic and Continental markets, including NorNed.

Evidence on the European Level

Responses to the ACER consultation of June 2011 on the draft FG on CACM highlight strong disagreement over the question of whether transmission rights and liquid financial markets should be substitutive.[13] Several industry associations and energy companies responded with the view that transmission rights should be mandatory on all connections across Europe and that no exception for liquid financial markets should be made. (This was the view of EFET, Eurelectric, German Association of Energy and Water Industries, Austrian Energy Industry Body, E.ON, and EnBW.) Nordic stakeholders are generally more supportive of the adequacy of solutions offered by financial markets. Nordenergi emphasises that "some flexibility is necessary and an obligation should not be considered leading to replace hastily existing products if they suit marked needs better than FTRs".[14] Energy Norway pointed out that financial products, such as the CfDs currently used in the Nordic market, could be an additional option if well-functioning.

Evidence from within the Nordic market

In its April 2011 study "FTRs in the Nordic Electricity Market", Elforsk analysed the potential use of FTRs in the Nordic market against backdrop of the FG on CACM. It draws from a consultation workshop with 16 Nordic market stakeholders from Sweden, Norway and Finland.

From the consultations Elforsk reports that "most of the interviewed market players could not see that FTRs in itself would improve their risk management".[15] This is because Nordic market participants use the virtual system price (abbreviated SYS in this study) as the basic hedge and manage area price risk with CfDs. An FTR on the other hand gives a point-to-point hedge that is not sufficient if the basic hedge is done in system price contracts. Accordingly, no stakeholder wanted to replace the basic hedging in system price contracts with hedging in area price contracts. However, some market players believed that FTRs could give better risk management. E.ON and Vattenfall stated that FTRs would give a better hedge if production in one area is sold to a customer in another area, which presently requires two CfDs. Some players worried that introducing bilateral FTRs could result in reduced liquidity in Nordic system price contracts. Some players also worried that FTRs would split liquidity in CfDs, while others thought it may increase liquidity as CfDs are an interesting hedge for a buyer of FTRs. In respect to the role of the TSOs in the Nordic area, stakeholders expected TSOs to minimise the extent of transmission capacity reductions and move maintenance to periods of lowest impact on markets if FTRs were introduced. There were also concerns that while TSOs should be market-oriented, they should not necessarily be commercial profit-optimisers. Most respondents did not want to allow participation in secondary markets by TSOs.

Elforsk concluded that "it is hard to believe that FTRs will be popular hedging instruments in the Nordic region" and doubted that FTRs in the Nordic market area will be introduced as a result of a Nordic campaign.[16]

13 Responses are publicly available on the ACER website.
14 Ibid.
15 B. Hagman and J. Bjørndalen, "FTRs in Nordic market".
16 Ibid. P. 7.

Evidence between the Nordic and Continental markets

A cross-regional group of Nordic and Continental regulators in June 2012 responded to ACER's request for developing common criteria to assess how long-term hedging on interconnectors between the Nordic region and Continental Europe should be enabled in the future.

The regulators saw the stipulations under Objective 3 of the FG to "leave room for interpretation on what exactly constitutes a liquid market", recognising that "liquidity of financial markets is a difficult indicator to assess and different opinions prevail". It is also noted that the connections between the Nordic market and Continental Europe include "certain elements" that are quite different to other European regions, especially the fact that most connections are sub-sea cables. This is seen as relevant as "so far, there are only very limited experiences with long term products on sub-sea cables in Europe". It further notes differences in current market models, for instance the fact that within the Nordic market long-term hedging possibilities are separate from TSOs, while transmission rights require TSOs to take an active role. However, the regulator group agrees that FTRs as an instrument are preferable over PTRs, as these can lead to inefficient outcomes. In the case that long-term transmission rights were implemented, it was concluded that this should take the form of FTRs.

The regulators also conducted a stakeholder consultation resulting in 28 replies from seven countries. Differences in views were attributed both to regional groups and stakeholder types. Most interest in long-term hedging rights was apparent from traders and producers, whereas large consumers held indifferent or negative views. Responses from TSOs were mixed. In regards to current market opportunities, several respondents noted that cross-border positions can easily be hedged by taking opposite positions in financial markets. Other stakeholders believed that cross-border financial hedging at Nordic-continental borders is currently not possible, because of imperfect liquidity in CfDs and partially constrained long-term liquidity in the continental market. There were opposing views on the effects transmission rights would have on liquidity of existing products. If transmission rights were introduced a great majority of stakeholders saw no reason why a differentiation between AC and DC cables should be made in respect to firmness.

In concluding, the regulators note that a careful process is required before introducing novel mechanisms, especially for sub-sea cables. It consulted stakeholders and found varying degrees of support for hedging from producers and traders and less interest from consumers, and varying opinions from TSOs. The regulators agreed that a common solution for different interconnectors would not be feasible and that individual assessments on the level of specific interconnectors are required.

A 2009 report by Econ Pöyry provides a conceptual evaluation of FTRs and assesses potential usage on NorNed. The analysis was undertaken when explicit auctioning of capacity was still in place on the cable. Econ Pöyry argued that FTRs are redundant where liquid financial markets for power are available on both connected nodes. The paper does not analyse liquidity in the financial markets in depth but comments that traded volumes are "low, but increasing". At the same time Econ Pöyry also questioned the expected utility of FTRs even in the absence of liquid financial markets since "it may be optimistic to expect that liquidity will increase by introducing FTRs, especially since FTRs do not introduce an additional hedging opportunity".

Evidence on Nordic Financial Market and Hedging Requirements

On a related issue, NordREG in August 2010 published a review of the state of the Nordic financial electricity market. It finds that product availability and liquidity is generally well-developed for the hedging requirements of Nordic market participants. Some concerns existed about insufficient liquidity in peak hour trading and CfD trading. For these products the adequacy hinges more strongly on the individual requirements of particular stakeholders.

NordREG also surveyed the hedging needs of market participants. For the demanded hedging horizon it found that most producers and consumers are focussed on the present year and to some extent for coming years. One respondent emphasised the need of industry to hedge for ten years or longer for which recourse to bilateral trades has to be made. It also notes that the perceived liquidity in traded products beyond the year-ahead had increased towards 2010 and that standardized products with a longer horizon than five years were not uniformly desired by market participants.

NordREG found that participants hedge area price risk either through a combination of system price forwards and CfDs or with bilateral contracts between two price areas (usually in local currency and not traded on exchanges). It notes that retailers in southern Norway also have less incentive to hedge as they expect area prices to be generally lower than system prices.

It also notes a particularity in hedging requirements for Norwegian hydro producers. Norway has a tax on hydro plants which is in part indexed to electricity prices on the spot market. This tax effectively provides a partial hedge against price risk. Hydro producers in Norway could thus risk “overhedging” if the same level of forward hedging were used as by producers in other industries or markets.

4.5 International experience of FTRs

This section reviews international use of transmission rights products and relevant experiences where available. Internationally, FTRs have mainly been a feature of US electricity systems where, since the late 1990s, they have been implemented in a number of regional markets, including NYISO (termed TCCs), ISO-NE, PJM, MISO, CAISO and ERCOT (both termed CRRs). New Zealand recently decided to introduce FTRs and will hold its first auctions in 2013. In Europe transmission rights have been mainly of the physical variant connecting bordering markets, although financial rights have been used to some extent in Italy.

4.5.1 Financial transmission rights

US Markets

The East Coast markets of NYISO and PJM were early adopters of FTRs with New England following later. It is important to view the introduction of FTRs in the historical context of market development towards nodal markets and the introduction of locational marginal pricing (LMP). With LMP, prices are calculated for a number of locations on the transmission grid, with each node (or bus) representing the physical location on the transmission system where energy is injected by generators or withdrawn by loads. The nodal price combines the cost of the energy and the cost of delivering it. In PJM, FTRs were introduced in 1998 as an offset to congestion costs from the inception of LMP, allowing market participants to hedge against locational price differences.

This fundamental link to LMP makes the US experience quite different from the European situation. PJM for example composes more than 10,000 individual buses on its network for which prices are calculated hourly in the day-ahead markets and every five minutes in the real-time market. For the case of NYISO, which features eleven congestion zones, four neighbouring control areas and hundreds of buses for which NYISO calculates nodal prices, one study has estimated that there were approximately 120,000 potential permutations of points of injection and withdrawal.[17] NYISO employs so-called unbundling of nodes and introduces standardized components into FTR contracts to improve the tradability and liquidity of the FTR market. The notion that financial forward markets can offer hedging opportunities equivalent to FTRs, as is acknowledged by the FG on CACM, is therefore not directly transferable to US markets with hundreds or thousands of nodes, although trading does occur for several hubs.

17 Siddiqui cited in Frontier Economics, “Generator Nodal Pricing – a review of theory and practical application”, February 2009.

A second important difference between the US and Europe in the context of congestion rights is that in the US markets, FTRs are not necessarily allocated by capacity owners but by Independent System Operators (ISOs) who organize dispatch in the relevant control-areas. Congestion revenues are often allocated to firm transmission users under grandfathering arrangements.

This overview summarizes some of the design features of US FTR mechanisms and relevant experiences.

Products

Several of the ISOs use two related products to manage congestion risk. Auction Revenue Rights (ARR) are allocated to historical firm users of the transmission system for example in PJM and MISO under a grandfathering process. ARRs are effectively rights to the revenue from FTRs and can be used to hedge the cost of purchasing FTRs in the periodical auctions. FTRs on the other hand are available to all registered market participants and can therefore be used for hedging and speculative purposes.

The total supply of FTRs is usually limited to the so-called simultaneous feasibility test, i.e. the capability of the transmission system to simultaneously accommodate the set of requested FTRs and the numerous combinations of FTRs that are feasible. ISOs conduct simultaneous feasibility tests using power flow models to ensure simultaneous feasibility and hence the ability of congestion rents to adequately meet the revenues implied by FTR requests.[18] For a single transmission line such as a subsea cable or a system of few interconnectors such feasibility testing would of course be much less onerous.

PJM and ERCOT offer both FTR obligations and options, whereas New England, NYISO and MISO offer obligations only. In the PJM market, however, the vast majority of transactions are for obligations.

Secondary markets exist, for example for PJM, NYISO, New England, MISO, which are often administered by ISOs. In PJM, market participants can buy and sell existing FTRs through the PJM-administered, bilateral market, or market participants can trade FTRs among themselves without PJM involvement

Tenor

The New England ISO auctions FTRs for the month-ahead and the year-ahead. Approximately half of transmission capability is released for the annual auction of one-year FTRs and the other half is made available for the monthly one-month FTR auctions.[19] PJM offers FTRs for the month-ahead, year-ahead and three years ahead. NYISO offers monthly, six-monthly and year-ahead obligations.

Market Results

In PJM, the recent 2012 to 2015 long-term FTR auction for example cleared 260 GW (against installed generation capacity of about 190 GW), which represented 10.8% of buy bids being successful. During 2011, financial institutions held 60% of all FTRs in the prevailing direction and almost 80% of rights on counter-flows.

For NYISO, Hadsell and Shawky have analysed statistics for contracts from May 2006 to April 2008 from the 2006 to 2007 auctions. More than 2,000 contracts were awarded each year, covering roughly 18 GW of capacity mostly in monthly and six-monthly contracts. Overall, FTR contract holders made profits. The NYISO 2011 state of the market review again found that market participants who had purchased yearly rights from November 2010 to October 2011 received congestion rents in excess of what they had paid for FTRs and earned estimated net profits of $56 million.

18 In practice, the source named in the FTR bid would be modelled as an injection into the grid just like a generator with the injection level equal to the MW quantity of the requested FTR. At the same time the named sink would be modelled as a withdrawal just like a load with the withdrawal level equal to the MW quantity. The test is passed if no network constraints are violated.

19 Ibid.

Firmness

Financial firmness is addressed differently in the various East Coast markets. Generally, revenue shortfalls may arise where transmission outages occur that were not modelled in the simultaneous feasibility tests and collected congestion revenue is lower than expected pay-out to FTR holders. In NYISO, FTRs are fully firm and eventual shortfalls are charged to transmission owners and passed through to final customers. In PJM and New England, however, FTRs are not firm and if the ISOs do not collect sufficient congestion revenue to pay FTR holders then FTR payments are discounted on a pro-rata basis. NYISO for example had revenue shortfalls of 25% in 2010 and 2011.[20] PJM experienced a 15% revenue shortfall in the 2010-2011 period.[21]

Credit Risk

When market participants sell FTRs with positive value or buy obligations with a negative value this introduces credit risk. In PJM in eight cases participants defaulted during 2011, giving rise to twelve default events. The maximum default value was $2.55 million. Six of the eight defaulting participants were financial companies.

New Zealand

New Zealand is introducing FTRs in 2013. The scope will initially be limited to flows on a single point-to-point connection between the North and South islands. Both FTR options and obligations will be offered with monthly tenors and for volumes of multiples of 0.1 MW.

FTRs will be released for horizons that align with the New Zealand quarterly electricity forward contract. Blocks of 3 individual months to match the relevant futures quarter will be made available in the primary auction 23-27 months prior for 14% of capacity, 6% of capacity for 11-14 months ahead, 5% for 7-9 months ahead, 13% for the three- and two-month ahead and 50% in the month-ahead.

A division of the national TSO (Transpower) is managing the auctioning of FTRs.

Italy

The only current example of FTRs in Europe stems from the Italian market model introduced in 2004. Here the need for hedging arose from a zonal model in which producers where grouped into geographical zones and subject to zonal prices (whereas consumers face a single national price or SNP). With congestion between zones, the zonal prices differ from the SNP. This difference is collected as a congestion fee from the producers by the TSO (termed CCT). AN FTR-like product, termed CCC, has been introduced to allow for congestion hedging for producers.[22] The CCC model is similar to FTR obligations as the holder pays Terna a fixed price in exchange for the return of the value of the CCT.

FTRs (CCCs) are auctioned by the national TSO (Terna) in tranches of 1 MW and are available for the year-ahead and the month-ahead, split into base load and peak load. About 50 market participants bought FTRs in the annual base-load auctions in 2011, including producers and financial institutions.[23]

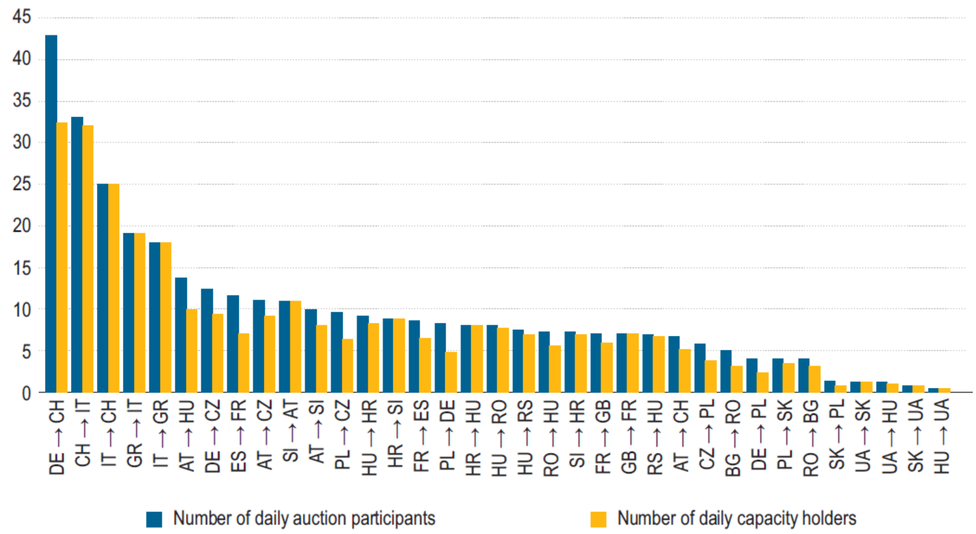
20 Potomac Economics, "2011 State of the market report for the New York ISO Markets", Market Monitoring Unit for the New York ISO, April 2012.
21 PJM, "FTR Revenue Stakeholder Report", 30 April 2012.
22 C. Dunthaler and M. Finger, "FTRs in Europe's Electricity Market", EPFL, November 2008.
23 See Terna website.

4.5.2 Experiences with PTRs

Continental Europe

Until today, cross-border transmission capacity allocation in Europe has mostly occurred within a framework of physical transmission rights (PTR) under explicit or implicit auctioning. Physical transmission rights have historically been available between national boundaries in the European electricity grid, i.e. over cables such as between Germany and Denmark or between Spain and Portugal or France, Belgium and the Netherlands.[24] The number of market participants active in long-term capacity auctions has varied between individual interconnectors and ranged between 5 and 29 for yearly auctions in 2011 (Figure 4.1).

Figure 4.2 Number of yearly auction participants and capacity holders per border (2011)[25]



On the French-British border, transmission rights have been auctioned for the 2,000 MW IFA interconnector since 2001 (although not termed PTRs). Auctions are held periodically for capacity rights with different time horizons, currently annual, seasonal (6 months), quarterly, monthly and in the day-ahead. The IFA Access Rules stipulate that "use-it-or-sell-it" rules apply to all long-term capacity made available in the day-ahead markets, whereas any unused daily capacity is made available to the intraday auction process, with the proceeds not being returned ("use-it-or-lose-it" or USOLI). Market participants include utilities and purely financial institutions.[26]

In the Central Western Europe region, comprising Germany, Belgium, Netherlands, France and Luxembourg, it is planned to introduce flow-based market coupling by mid-2013. As an intermediate facilitation, the five system operators in 2008 created a common auction platform with joint allocation and a harmonised set of rules in the form of the Capacity Allocation Service Company for the Central West-European Electricity Market (CASC-CWE). Table 4.1 provides an overview of available capacities and long-term allocation.

Capacities are auctioned on an annual, monthly and daily basis. For monthly and yearly capacities PTRs are of the "use-it-or-sell-it" variant, meaning that rights holders are free to either nominate capacity or to

24 Dunthaler and Finger, "FTRs in Europe".
25 ACER, "Annual Report on the Results of Monitoring the International Electricity and Natural gas Markets in 2011", 29 November 2012.
26 See National Grid website.

receive the market spread financially at the day-ahead market. This implies that transmission capacity that is not nominated is automatically resold on the day-ahead implicit CWE market coupling auctions.

Table 4.1 Use of Long-Term Allocation with PTRs in CWE region

Border	Average volume allocated at all timeframes (MW)	Average volume allocated long-term in PTRs (MW)	Percentage of products allocated long-term
BE-FR	890	579	65%
FR-BE	2,152	1,467	68%
BE-NL	1,008	781	77%
NL-BE	1,178	781	66%
FR-DE	3,796	1,468	38%
DE-FR	4,527	1,574	34%
DE-NL	2,351	1,368	58%
NL-DE	3,727	1,368	36%

Under CASC, partial firmness is applied to PTRs. Held transmission capacities are firm except "in the event of a force majeure or reduction for reasons linked to the safety of the power system".[27] For reasons of power system safety, a compensation arrangement is in place that pays 110% of the marginal price of the initial auction at which capacity was allocated. In the case of force majeure, a reimbursement equal to 100% is applicable. Once nominated (a maximum of two days before delivery), capacities become firm. Compensation after this firmness deadline then is "determined by the price spread of the relevant day-ahead, intraday or balancing markets (depending on the time when reduction was announced), thus providing financial firmness of nominated capacities."[28]

Between Nordic market and Continental Europe

In the Nordic region previous experience with PTRs is limited to the border connections to Continental Europe. PTRs have in the past been available on the NorNed cable between Norway and the Netherlands and are currently available on the link between Germany and Western Denmark (DK1).

PTRs are offered on a monthly and yearly basis for the Germany-DK1 border. The connection capacity is controlled and managed by Energinet.dk and TenneT, with a total transfer capacity on the link of 950 MW towards DK1 and 1,500 MW towards Germany. Of that 200 MW in each direction are available as PTRs under explicit auctioning both for monthly and annual auctions. Since January 201,1 the UIOSI principle is in place for allocated capacity rights and rights holders nominate capacities every morning with remaining capacity allocated through implicit auctions. Currently the national regulators and TSOs from both countries are planning to replace PTRs with FTRS in 2013 on the DK1-DE link. They also plan to introduce FTRs on the border between Eastern Denmark (DK2) and Germany, for which currently no transmission rights are available.

PTRs were also available on NorNed from 2008 to 2011. However, allocation was not for the long-term as all capacity was allocated entirely on a day-ahead basis with PTRs auctioned for each hour of the day.

27 ERGEG, "Draft benchmarking report on medium and long-term electricity transmission capacity allocation rules: An ERGEG Public Consultation Paper", 26 February 2010. P. 16.
28 Ibid. P. 17.

5 Hedging requirements and cross-border hedging on NorNed

5.1 Introduction

In this section we explain and define the scope and requirements of long-term cross-border hedging. We also assess and illustrate the types of cross-border exposures stakeholders could potentially encounter between the Netherlands and Norway. This will prepare the ground for the hedging products and markets considered in the liquidity analysis in the next section.

5.2 Hedging concepts

Hedging is way for market participants to reduce (or more generally manage) their business risks with respect to external drivers such as market fluctuations or disruptive events. A hedge reduces uncertainty in future revenue or cost for a portfolio. More technically, in the energy commodities market a market participant would execute a hedge to protect itself from price risks for a specific market exposure by entering into an offsetting position. Market exposure is the volume of a position, such as a contractual obligation to deliver electricity, whose value is subject to market price movements. A hedge is said to be effective when the value of the hedge is negatively correlated with the value of the original position. Hedging therefore enables market participants to manage their desired level of price risk exposure. For the purposes of this study we consider the hedging needs of large electricity consumers, producers and owners of interconnector capacity.

Large consumers with high annual electricity consumptions may wish to formulate a hedging strategy for their procurement, particularly if energy costs are an important driver of their profitability. The exposure of a large consumer is the volume of its consumption over a specific time period which is subject to market price movements. Variations in costs for committed consumption place the consumer's gross margin at risk. An industrial company with high electricity consumption could benefit from obtaining a hedge on its electricity consumption since its margin risk would be reduced in the case where it is either unable or unwilling to vary the price of its output in line with variation in the spot price of electricity. An effective hedge would be defined by a pay-out inversely related to movements in the electricity costs the consumer is facing. If electricity prices increase, for example, an effective hedge would provide a financial gain equal in value to the added costs of procuring physical energy at higher prices. A typical hedging strategy for a consumer of electricity would specify the share of its consumption that would be hedged, the time horizon of the hedge and the type of hedge to procure.

For thermal generation plants, the key risks are fuel and carbon price risk on the cost side and electricity price risk on the revenue side. The exposure of a gas generation plant is the volume of expected generation[29], which is subjected to movements in the clean spark spread (the result of a combination of price risks). Thermal generators accordingly formulate their expected generation schedule from the intrinsic value implied in the forward curves for electricity, fuel and carbon. If the expected margin for generation is positive, including the non-fuel variable costs of generators, this can be locked-in by selling forward power and buying forward the corresponding fuel volumes and carbon allowances.[30]

[29] We ignore the optionality for simplicity here.
30 The value of optionality, or extrinsic value, of flexible generation is not captured by a hedge on the intrinsic value.

Interconnector capacity owners can profit from consistent forward price differentials between two markets. The exposure of the interconnector owner is the expected interconnector flow profile[31], which determines revenues in the form of congestion rent. This flow profile is exposed to price risk as fluctuations in the price spread between markets move the price per MW in congestion rent that is received. The capacity owner can hedge price risk by locking-in the expected value by selling transmission capacity rights forward – for example through a FTR. As explained in section 4, the value of a FTR derives from the right to congestion rent in day-ahead markets. Because of this perfect correlation a short position in this contract, i.e. selling forward FTRs, is an effective hedge for fluctuations in congestion rents.

Hedging instruments to manage exposure to electricity price risk that are relevant to this study comprise at least five types of instruments.[32] The first set of instruments relates to contractual agreements that specify future delivery of an asset at a fixed price set in the present. To this group we can count:

- **Long-term contracts** for physical delivery of electricity in future periods. This generally involves bilateral agreements between suppliers and consumers.
- **Futures or forwards,** which are financially settled contracts referenced to a wholesale electricity market price. Futures are exchange-traded contracts but standardised products with the same characteristics are also traded Over-the-Counter (OTC).
- **Options** are a variation of such contracts for future delivery**,** representing the right but not the obligation to buy or sell an underlying asset at a specified price. Options can be traded on exchanges or traded OTC.

A second set of instruments are financial contracts that swap a reference index for a fixed price. These include:

- **Contracts-for-Difference (CfDs)** are financial contracts under which payments are made between counterparties on the basis of the difference between two market reference prices. These instruments can be traded on exchanges or traded OTC.
- **Financial transmission rights,** as introduced in section 4, are financial instruments which grant the holder of these instruments the right to a share of the congestion revenue on an interconnector, i.e. the price difference between two connected markets multiplied by the volume of transmission (minus transmission costs).

For completeness it is worth mentioning that market participants are also subject to other types of risk.

- **Credit risk** denotes the exposure to non-payment by a counterparty in the delivery of payment for settlement, and to mark-to-market valuation prior to that. Mark-to-market risk concerns the need to replace a position at current prices, which may have adversely changed from the time when the hedge was entered initially, if the previous counterparty defaulted on this position. Credit risk is primarily relevant when participants enter non-cleared OTC transactions or if a transmission capacity owner auctions transmission rights.
- **Availability risk (firmness risk)** denotes the exposure to losses arising from failure to meet contractual obligations because of physical unavailability of the asset. For the purposes of this study, the main application concerns FTRs over interconnector capacity that is not available for delivery at a given period because of an outage. In this context outage risk is termed firmness risk.
- **Basis risk** is present when a hedge relates to an asset that is not identical to the actual position. This is often the case when a proxy is used as the only or next-best option. More technically,

[31] We again ignore optionality here for simplicity.

32 PTRs and options are not considered in this study. PTRs fall outside the scope of this study because NMa and NVE as part of the ACER cross-regional regulator group concluded that FTRs are generally preferable over PTRs, since the latter can lead to inefficient outcomes. Options are not considered because of their limited use in the concerned markets and the relative complexity of their profile.

basis risk applies when changes in the value of a hedge do not match changes in the value of the underlying asset, i.e. correlation is imperfect. In other words, basis risk is the residual risk under an imperfect (not perfectly effective) hedge. Types of basis risk include:

- Locational risks, e.g. when the underlying asset and the hedge are located in different price areas;
- Maturity risks, e.g. when delivery dates differ between the hedging instrument and the underlying exposure; and
- Shape risk, e.g. when the delivery profile of the hedge across time does not match the underlying exposure in this regard.

5.3 Conceptual framework – why might cross-border hedging be required?

A cross-border hedge is a derivative instrument or a set of instruments that allow the buyer to offset exposure to the price difference between two wholesale markets. There are several circumstances in which a market participant may have such an exposure.

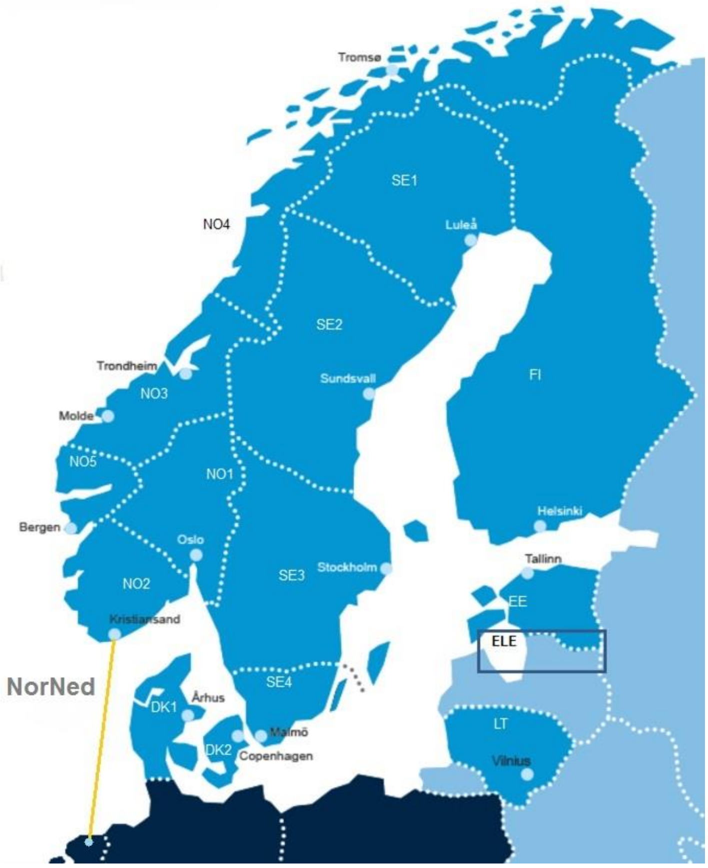
- **Physical cross-border position:** A market participant has a physical position in two markets and is long in one market and short in the other. A typical example is a vertically integrated utility with surplus production in one market and uncovered supply position in the other. By selling forward in one market and buying forward in the other, the producer can effectively lock-in the price difference and hence its margin. This could also apply to large consumers with excess self-generation in one market and a deficit in the other.
- **Financial cross-border position:** A market participant wants to conduct their forward hedging in a more liquid financial market in a different price area compared to their exposure. This creates locational basis risk if markets are not fully correlated. Hedging cross-border price differences, i.e. locking-in the price difference at a future point in time, can eliminate this basis risk and thus provide access to the out-of-area financial market.
- **Cross-border congestion rent**: The congestion rent of an interconnector is determined by price differences between the connected markets and interconnector flows. Revenues of transmission capacity owners are therefore exposed to the fluctuations of price spreads. Hedging cross-border price differences can lock-in the congestion rent for the owners of interconnector capacity.

While this does not qualify as a hedging requirement, for completeness, it should also be noted that traders may have an interest in derivatives on the price spreads between two markets for speculative reasons.

5.4 Hedging on the NO-NL border

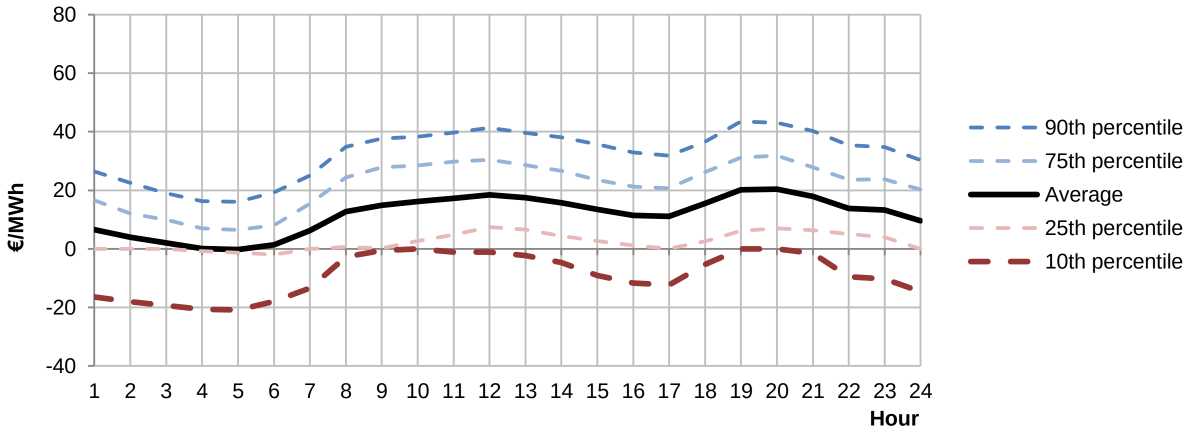
NorNed connects the Dutch market with the Norwegian Kristiansand area (currently within the NO2 price area of the Nord Pool market) as shown by Figure 5.1

Figure 5.1 NorNed cable and Nordic price areas



Historically, hourly prices have differed substantially between Norway and the Netherlands due to differences in the generation mix (thermal system in the Netherlands versus hydro system in Norway). Figure 5.2 shows average within-day price spreads on that border since market coupling on NorNed on 11 January 2011. A positive price spread indicates that the NO2 price is lower than the price in the Netherlands. There is considerable variation in the price spreads, with negative spreads in the lower 10th percentile of daily average spreads.

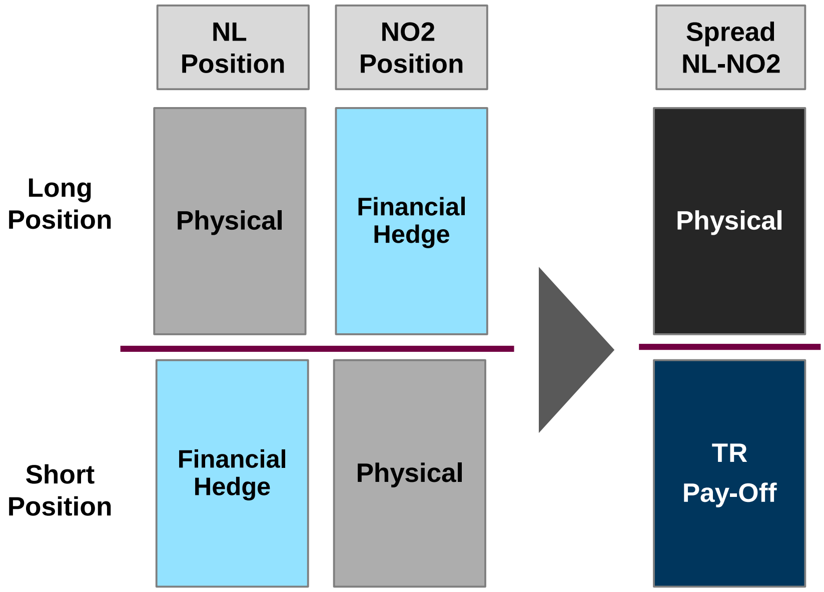
Figure 5.2 Average Price Spread NL-NO2 post market coupling



Hedging of the price spread between two markets can be carried out in at least two ways. Firstly, market participants can buy forward products for the transmission capacity linking the two markets, where the payoff will be equal to the price spread between markets (minus transmission losses). This represents the right side of the diagram in Figure 5.3. The current arrangements for allocating NorNed transmission capacity do not provide an opportunity for market participants to buy rights to transmission capacity between Norway and the Netherlands.

Alternatively, market participants can purchase financial derivatives in the financial markets on both sides of the interconnector. This represents the left side of the diagram in Figure 5.3. In this example a market participant is hedging a long position in the Netherlands with an offsetting short financial position, and vice versa for its short position in the NO2 area. Financial derivatives can serve as building blocks to construct a hedge with similar properties to transmission rights for the NL-NO2 interconnector. Such a hedge is likely to comprise multiple instruments on different platforms and on both ends of the interconnector. The effectiveness of the hedge would be determined by the correlation between the value of the hedge and value of the position that it is designed to hedge. Financial markets in the Netherlands and in the Nordic market offer forward power derivatives.

Figure 5.3 Cross-border hedging in financial markets and spread product



On the Norwegian side, forward products are traded with the Nordic system price as the underlying reference price. However, the convergence between the Nordic system price and Norwegian area prices is imperfect. The blue line in Figure 5.4 shows the percentage of hours in a month where Nordic system prices and Kristiansand area prices (NO2) converged to parity. Using a Nordic forward product therefore introduces basis risk for a Kristiansand-based market participant in the form of the price spread between their NO2 area price and the system price. Basis risk similarly applies to market participants located in other price areas such as NO1.

This locational basis risk can be covered by a financial derivative such as a CfD. However, there is no CfD offered for the Kristiansand price area (NO2). CfDs for the neighbouring Oslo area (NO1), which could function as a proxy, are listed. Figure 5.4 shows that NO2 and NO1 area prices converge more frequently (yellow line). Yet there are times when the convergence breaks down and basis risk is present between NO1 and NO2. This means that a CfD for NO1 would serve to replace the basis risk between NO2 and the system price with the basis risk for NO2 and NO1.

On the Dutch side, forward products are traded with reference to the single Dutch system price, hence here, there is no additional locational basis risk introduced by seeking to hedge a cross-border position on the NL-NO border. If the liquidity in the Dutch market is deemed to be insufficient to construct this hedge, forward products traded with reference to the German system price can be used as a proxy. The introduction of market coupling has increased price correlation between neighbouring markets. In 2011, prices in the Netherlands and Germany were the same in nearly 90% of all hours. This means that a forward position in the German market could be a proxy for a forward position in the Dutch market, subject to the basis risk relating to hours in which Dutch and German prices are different.

However, in the first nine months of 2012, the level of price convergence was far lower, dropping below 50% in some months. Price spreads were almost exclusively the result of Dutch prices exceeding German prices. At these lower levels of convergence, the basis risk becomes more significant.

Figures 5.5 and 5.6 illustrates the degree of hourly price convergence and the level of price spreads before and after coupling of the Dutch and German markets.

Figure 5.4 Convergence of Norwegian area price and Nordic system price

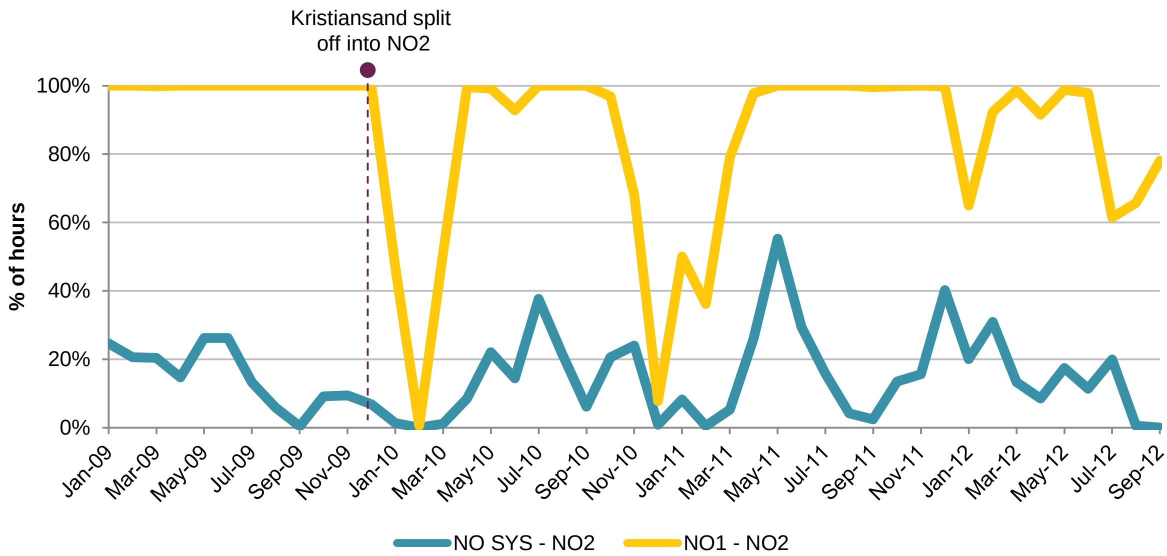


Figure 5.5 Convergence between Dutch and German wholesale prices

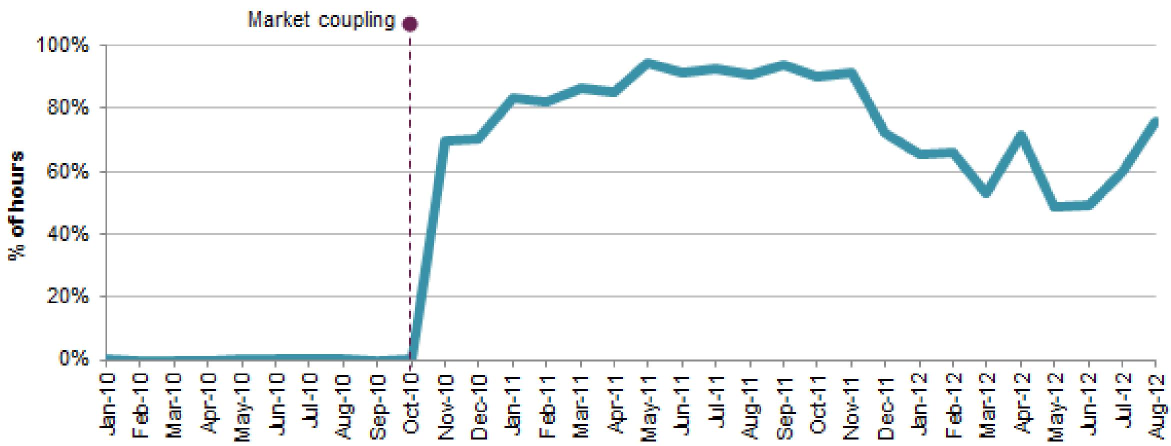
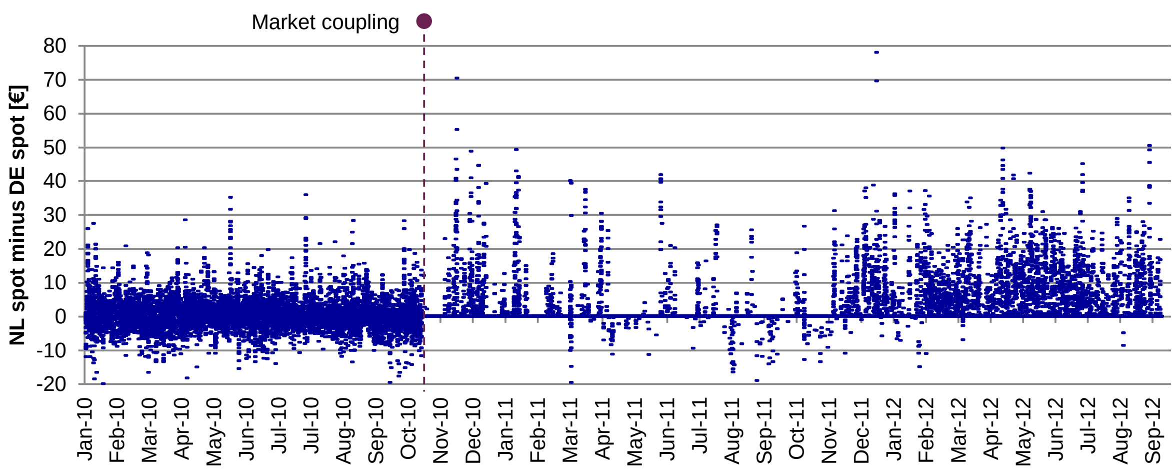


Figure 5.6 Hourly spreads between Netherlands and Germany



In summary, a hedge for the NL-NO2 price spread that closely mimics the properties of financial transmission rights can be constructed with three currently available products: a forward position in the Nordic market, a CfD between the Nord Pool system price and relevant area price, and a forward position in the Dutch market. With market coupling in the NWE region, forward products in the German market may also serve as proxies for forward products in the Dutch market, provided that basis risk is either acceptably low or manageable through other products.

The suitability of financial derivatives for cross-border hedging is subject to a precondition that financial markets on both sides of the interconnector offer sufficient opportunities for market participants to conduct hedging. Current hedging opportunities and market liquidity are analysed in the next section of this report.

6 Analysis of current hedging opportunities and liquidity in financial electricity markets

6.1 Introduction

This section analyses the current hedging opportunities and market liquidity in financial wholesale markets on both sides of the interconnector. Financial markets that offer appropriate cross-border hedging opportunities are considered substitutes for transmission rights in the draft FG on CACM. The draft document does not specify criteria for evaluating the appropriateness of opportunities and hence a definition for the purposes of this study is required.

Cross-border hedging opportunities are understood to be appropriate if financial derivative products in the forward markets are commonly available for the types of risks, volumes and horizons that market participants demand and at reasonable costs. This is not necessarily synonymous with narrowly-defined market liquidity, which is typically measured against objective criteria such as churn rates and, for example, benchmarked against financial markets that are considered highly liquid. This is because objectively liquid financial markets can, in principle, still fail to offer appropriate cross-border hedging opportunities for participants, e.g. if there is a mismatch in product horizons or liquidity is concentrated in only a few products. For the purposes of evaluating the suitability of an instrument for hedging, liquidity in forward markets is therefore seen as a relative measure expressing the market's ability to serve the hedging needs of market participants. In this section, we use common measures of liquidity to evaluate markets for the products that participants may demand before directly matching current opportunities against participants' actual needs derived from stakeholder interviews in section 8.

6.2 Criteria for Liquidity Analysis

Previous studies that have assessed the liquidity of financial markets for power derivatives have used a range of metrics in their assessment.[33] Frequently used indicators include market concentration (number of sellers and buyers), volumes and churn rates (ratio of traded volume to underlying consumption), price volatility, bid-offer spreads, number of trades and the range of products available.

In the stakeholder interviews conducted for this study, the most frequently mentioned metrics were bid-offer spreads, to indicate the cost of hedging, and the depth of traded volumes for different products, particularly for hedges beyond a one year horizon. The framework used in this analysis is constructed from the viewpoint of market participants and considers three indicator categories: **product availability**, **market volumes** and **trading costs** (summarised in Table 6.1).

For availability, we assess the range of products offered for different underlying assets (base load power, peak load power and CfDs). A mix of these products would likely be required to construct a cross-border hedge on the NO-NL border and stakeholder needs are likely to differ depending on their hedging strategy, location and demand curve. We also compare tenors and time horizons of contracts offered, noting that market participants have different hedging requirements and definitions of what constitutes long-term hedging. Note that the following convention is used throughout the document to denote products: a

33 See for example Ofgem, "GB wholesale electricity market liquidity: summer 2010 assessment", 29 July 2010, esp. pp. 5-6; NordREG, "The Nordic financial electricity market", August 2010, esp. pp. 15-17; CEPA, "Market Power and Liquidity in SEM", 13 December 2010, esp. pp. 44-45.

contract for delivery in the next calendar year (year-ahead) is denoted Y+1, quarter-ahead is Q+1 and month-ahead is M+1.

For market volumes, we focus on relative total trading volumes in the form of churn rates and consider absolute volumes for specific products. Churn rates are an indicator of overall hub liquidity, offering comparisons across markets and showing longer-term trends. Traded volumes for individual products give an indication to market participants of how easily a particular hedge can be placed on the market at any time.

Several participants in the stakeholder interviews cautioned that quantitative metrics, especially traded volumes, may not perfectly capture market liquidity. Traders in particular noted that liquidity in the sense of the effort and cost required to find a counterparty and to enter a trade is only observed in practical application. It may still be possible to enter a trade at reasonable costs even where trading volumes are low. However, generally, volumes are considered to provide a reasonable if not a perfect indication of expected liquidity.

For trading cost, we consider fixed and variable exchange costs as well as transaction costs in the form of bid-offer spreads. Exchange costs are useful in evaluating the current trading costs of hedging, e.g. against expected trading costs for acquiring FTRs. Lower bid-offer spreads make instruments more accessible as they indicate lower risks and lower transaction costs. We define transaction costs of a forward transaction as half of the spread between the bid and the ask price plus exchange or trade fees apportioned to that transaction.

Bid-offer spreads are also commonly used as a direct indicator of liquid markets and narrow spreads suggest the presence of a large number of participants. When expressed as a percentage of the average clearing price, bid-offer spreads also make it possible to benchmark liquidity. For example, bid-offer spreads for the NBP gas hub, widely regarded as a liquid market, have in recent years ranged between 0.25% and 0.5% for monthly forwards and between 0.4% and 0.75% for forwards with delivery two years ahead.[34] Feedback from one trader suggests that spreads for standardized products of between 0.5% and 0.75% are at the higher end of what is considered to be acceptable.

34 Ofgem, “GB liquidity”.

Table 6.1 Summary of indicators considered in Liquidity Analysis

Indicator	Example / Definition
Availability	
Products	Base load, Peak load, CfDs, etc.
Product categories	Monthly, Quarterly, Yearly, etc.
Tenors and horizons	Y+1, Y+2, Y+N
Depth	
Churn rate	Traded volume / Demand in underlying asset
Volumes traded	MW x applicable time
Costs	
Exchange and broker costs	Fixed (entry and membership fees) + variable (transaction fees)
Transaction costs	Bid Price – Ask Price

6.3 Liquidity Analysis of the Nordic Market

The Nord Pool electricity market began with the joining of the Norwegian and Swedish markets in 1996. The Danish market joined Nord Pool in 1999/2000. Estonia and Lithuania joined Nord Pool in 2012. The Nord Pool markets are coupled with central clearing and implicit auctioning of available interconnector capacity. Whenever the overall market balance can be achieved without a need to utilise all available capacity between linked bidding areas, the market price is the same in all regions. However, at times when interconnector capacity becomes constrained across two or more areas, the market will split into regions, with local pricing representing the cost of incremental supply on either side of the constraint. Congestion is priced with reference to an unconstrained virtual hub, the Nord Pool system price.

NASDAQ OMX Commodities provides an exchange for trading of power derivatives through Nord Pool ASA. Forward contracts are settled against the Nord Pool system price. NASDAQ OMX also lists CfDs which settle against the price difference between a specific area price and the system price. NASDAQ OMX also lists German, UK and Dutch forward contracts. However, there is hardly any liquidity in these products. Traded volumes of German products in 2011 were only 1.7% of those in Nordic products. Power trades on other markets were below 0.1% of Nordic trades.[35] For NASDAQ we therefore only consider liquidity in Nordic market products.

NASDAQ OMX hosts the world's largest power derivative exchange and provides clearing for OTC transactions for standardized products. NordREG has estimated that more than 90% of total OTC trading in the Nordic market is cleared on NASDAQ OMX.[36] Market liquidity for NASDAQ OMX derivatives is thus representative of the Nordic market as a whole.

35 NASDAQ OMX, Market Report December 2012.
36 NordREG, "Nordic market".

6.3.1 Availability

Available products include month, quarter and year forwards for both base load and peak load power (Table 6.2). For forward contracts mark-to-market valuation applies, i.e. profits or losses are accumulated daily. Margin calls require trading parties to provide guarantees for changes to the value of their position, but for forwards these can be met with non-cash guarantees. On its last trading day, the year future cascades in to equal positions in the corresponding four quarter futures. Similarly, the quarter future cascades on its last trading day to the corresponding three month forwards.

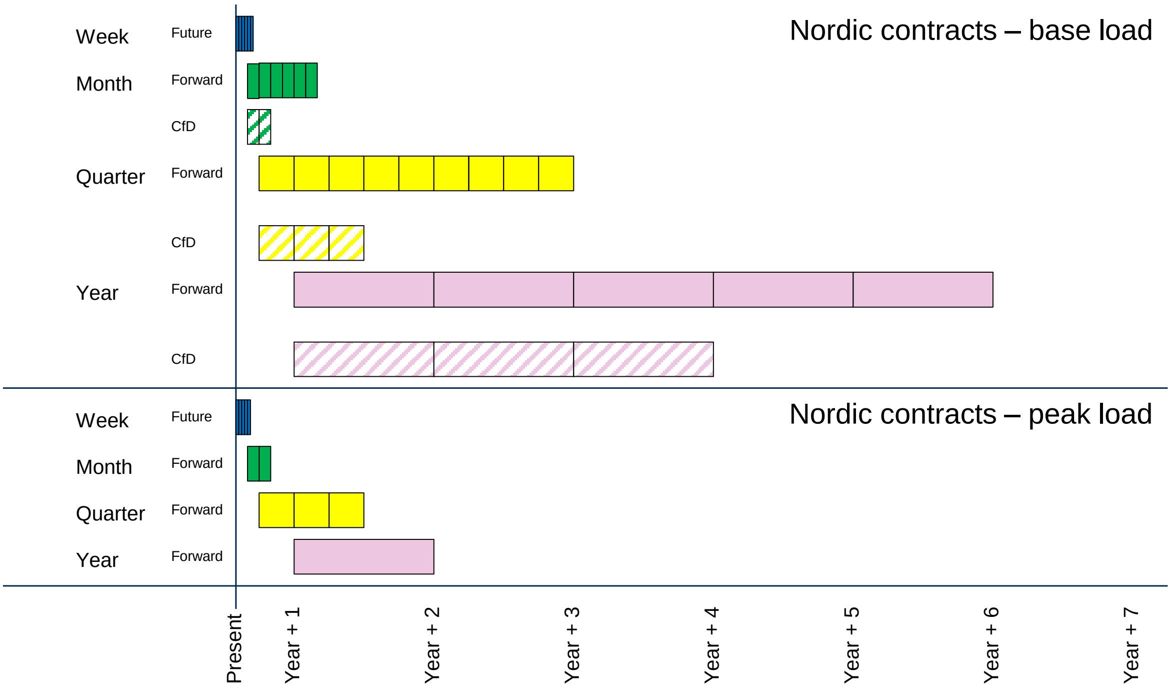
Forward CfDs are also available for monthly, quarterly and yearly tenors. However, CfDs are only offered for 9 out of the 15 price areas that make up Nord Pool. Kristiansand and the NO2 price area, which is connected to the Netherlands by the NorNed cable, does not have a listed CfD. The unavailability of a CfD for NO2 is a barrier to the construction of the previously defined hedge that would replicate the properties of an FTR on NorNed. The CfD for the NO1 area price could, in theory, act as a proxy if the correlation between NO1 and NO2 area prices is considered sufficiently high.

Table 6.2 Overview of relevant products on NASDAQ OMX

	Type	Periods	Trading Hours	Contract Size	Cascading	OTC
Base load						
Future	Day	2-9	0000-2400 Mon-Sun	1MW*applicable hours	None	N/A
Future	Week	6	0000-2400 Mon-Sun	1MW*applicable hours	None	Yes
Forward	Month	6	0000-2400 Mon-Sun	1MW*applicable hours	None	Yes
Forward	Quarter	8-11	0000-2400 Mon-Sun	1MW*applicable hours	3 Months	Yes
Forward	Year	5	0000-2000 Mon-Fri	1MW*applicable hours	4 Quarters	Yes
Peak load						
Future	Week	5	0800-2000 Mon-Fri	1MW*applicable hours	None	Yes
Forward	Month	2	0800-2000 Mon-Fri	1MW*applicable hours	None	Yes
Forward	Quarter	3	0800-2000 Mon-Fri	1MW*applicable hours	3 Months	Yes
Forward	Year	1	0800-2000 Mon-Fri	1MW*applicable hours	4 Quarters	Yes
Contracts for Difference						
CfD	Month	2	0000-2400 Mon-Sun	1MW*applicable hours	None	Only
CfD	Quarter	3	0000-2400 Mon-Sun	1MW*applicable hours	3 Months	Only
CfD	Year	3	0000-2400 Mon-Sun	1MW*applicable hours	4 Quarters	Only

The maturities of contracts that are listed at a given point in time are illustrated in Figure 6.1 below. For base load power, forward contracts are available for the next five years and forward CfDs are available for the next three years. The time horizon for peak load contracts is significantly shorter, with only one year-ahead forward offered and no CfD contracts available. The limited availability of peak load derivatives should be seen in the context of the relatively limited relevance of peak load pricing in the Nordic region. Traditionally, the shape of the Nord Pool daily price curve is much flatter than in continental European markets, as the supply side is characterized by a significant share of flexible hydro generation.

Figure 6.1 Tenors of power derivatives and CfDs on NASDAQ OMX



6.3.2 Volumes

In terms of trading volumes, NASDAQ OMX is the most liquid power exchange in the world. The exchange reports consistently high volumes both in PX trading and in cleared OTC transactions, though in recent years, aggregate volumes have visibly decreased as purely financial traders have exited the market and utilities curbed their risk appetite in the wake of the financial crisis. Yet in 2011, the market still registered 1,750 TWh in combined PX and OTC transactions, the equivalent of trading the annual physical electricity demand of Nord Pool 4.6 times over. A noticeable trend has been a gradual decline of the share of OTC-cleared volumes, which have reduced their share from over 55% in 2007 to less than 40% in 2011.

Figure 6.2 Volumes traded and cleared on NASDAQ OMX

Figure 6.3 shows the breakdown of trade volumes (PX and OTC) according to product type. It shows that yearly and quarterly contracts are by far the most traded derivatives on the Nordic market. CfDs account for only around 10% of traded volume, but have much higher share of open interest at over 30%. Open interest describes the total volume of outstanding contracts that are held by market participants at the end of a trading period. A relatively higher open interest indicates a stronger focus on hedging and long-term trading strategies for this product. Positions are not quickly closed but held until the delivery period. Another visible trend is the decline of options trading, which have lost half of their share between 2006 and 2010.

Figure 6.3 Break-up of product turnover (left) and open interest (right) on NASDAQ OMX

One important observation is that the underlying asset for these volumes is almost exclusively base load power (and area price differences for base load power for CfDs). There is no significant volume in peak load power and all of the analysis that follows refers to base load power only. This follows from the relatively flat shape of the daily price curve in Nordic markets, which lowers the perceived importance of peak load products for market participants.

Aggregate volumes are a useful indicator of overall market liquidity and recent trends. From the perspective of an individual market participant, however, it will relevant that liquidity also lies in the specific products required to construct a particular hedge. If a participant would seek a hedge at a certain point in time, what options would be available to them? Figure 6.4 and 6.5 below show a snapshot of PX-traded and OTC-cleared derivatives on NASDAQ OMX for the month of March 2012. Traded volumes indicate the monthly sum of capacity (MW) traded on the power exchange for each product and respective applicable hours (i.e. 8760 for yearly contracts etc.). For PX-traded volume, open interest shows the monthly average of MW outstanding for delivery at maturity. Trading volumes are highest for the most immediate delivery period in all contract types and decline for products with a later delivery period. For yearly contracts, the ratio of traded volume over open interest is smaller than for quarterly contracts, suggesting that yearly contracts are purchased more for hedging purposes, whereas quarterly contracts are traded more frequently.

All five year-ahead contracts have open interest on the exchange, which indicates that they are actively traded, but liquidity halves for each additional year between trade date and start of delivery. In March 2012, there were very few traded contracts beyond a three-year horizon. For the Y+3 contract, there were 250 MW traded on the PX, increasing to over 2,000 MW for the Y+2 contract. OTC-cleared transactions added similar volume to yield a combined volume of 4,527 MW for Y+1 contracts, 1,628 MW for Y+2 contracts and 553 MW for Y+3 contracts. While OTC transactions for quarterly and monthly contracts are also significant, they contribute a lower share of total volume vis-à-vis exchange trades.

The representative nature of these snapshots is supported by Figure 6.6, which depicts the sum of monthly trading volumes for year-ahead products from January 2009 until September 2012 in MW. Volumes have stayed broadly similar over time, arguably with the exception of reduced liquidity in Y+1 contracts.

Figure 6.4 March 2012 PX-Traded Volumes and Open Interest on NASDAQ OMX

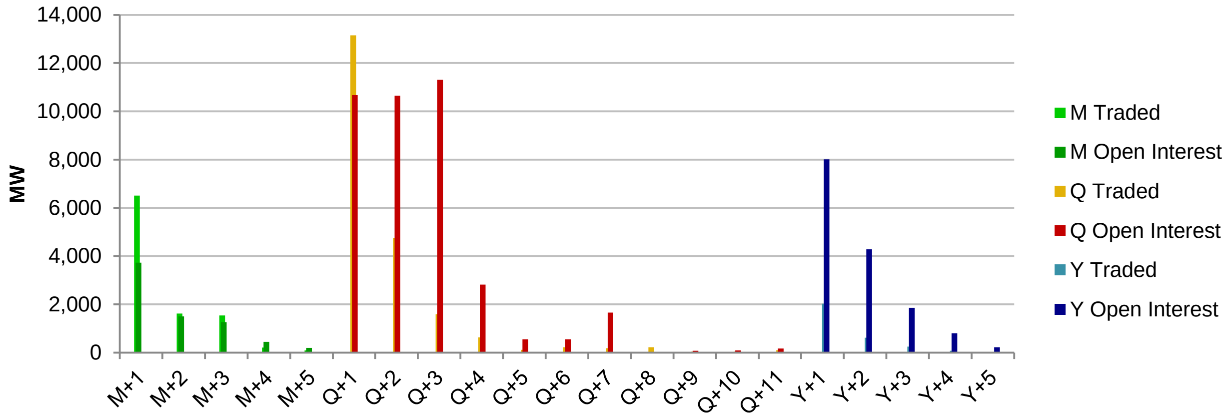


Figure 6.5 March 2012 OTC-Cleared Volumes on NASDAQ OMX

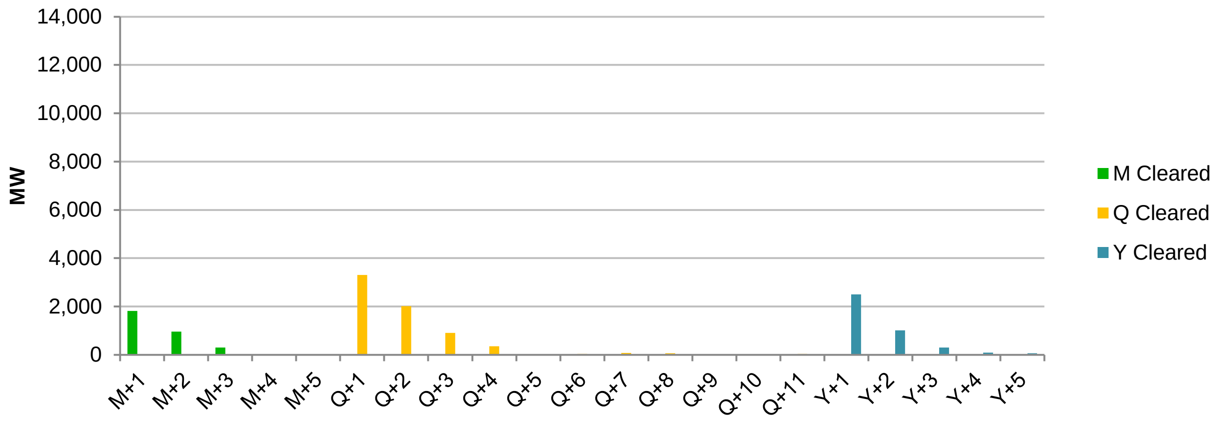
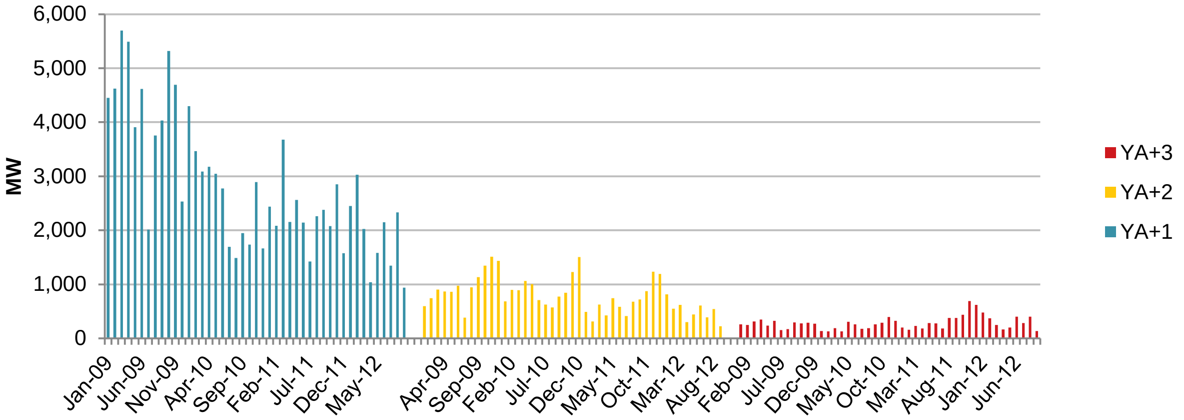


Figure 6.6 Monthly profiles of trading in yearly contracts on PX 2009-2012



CfDs are available for 9 price areas in the Nordic market, including two Norwegian price areas, but not for NO2 (Kristiansand) where NorNed connects. As shown in Figure 6.7, CfD contracts are largely traded OTC in the Nordic market, with OTC transactions accounting for more than 75% of total volume. Traded volumes have been fairly constant over recent years.[37] As was noted earlier, trading volumes alone may understate the significance of CfDs because contract positions are held for longer time periods. Participants enter a long-term position for hedging purposes and hold this until delivery, for example to match a physical position with the same delivery period. This contrasts with trading where contracts are quickly turned over for trading purposes and turnover volumes are naturally much higher. Elforsk noted that the coverage ratio of CfDs for forward derivatives is inversely related to the hedging horizon. In February 2011, CfD trading volumes covered 75% of power trading for monthly delivery, 42% for year-ahead contracts (delivery 2012) and 31% for contracts going two years out (delivery 2013).[38]

While aggregate volumes for the Nordic CfD market appear to be significant, there are fundamental differences in their regional distribution. In reference to NorNed, it is notable that the Oslo price area records very low CfD trading activity in comparison to total CfD volume. In 2010, OTC clearance for the Oslo CfDs in yearly and quarterly contracts for delivery in 2011 amounted to 1.7 TWh, or 1% of total CfD OTC volume, compared to Norway's 32% share of total Nordic power demand.[39] A recent Elforsk study similarly noted the low trading volumes in Norwegian CfDs, citing that open interest of monthly CfD in January 2011 was less than 6% of total monthly CfD volume.[40] Figures 6.8 and 6.9 show that trading volumes for yearly NO1 contracts for delivery in 2011 and 2012 and quarterly contracts for delivery in 2011 have not been traded heavily, perhaps with the exception of the Q1 2011 contract.

37 Note that data for 2011 was not available to us.
38 B. Hagman and J. Bjørndalen, "FTRs in Nordic market".
39 This is expected to be a major share of total Oslo volume considering that almost all CfDs are traded OTC and that the period-ahead contracts are the most traded in derivative markets.
40 B. Hagman and J. Bjørndalen, "FTRs in Nordic market".

Figure 6.7 CfD Trading Volumes on NASDAQ OMX (2004-2011)

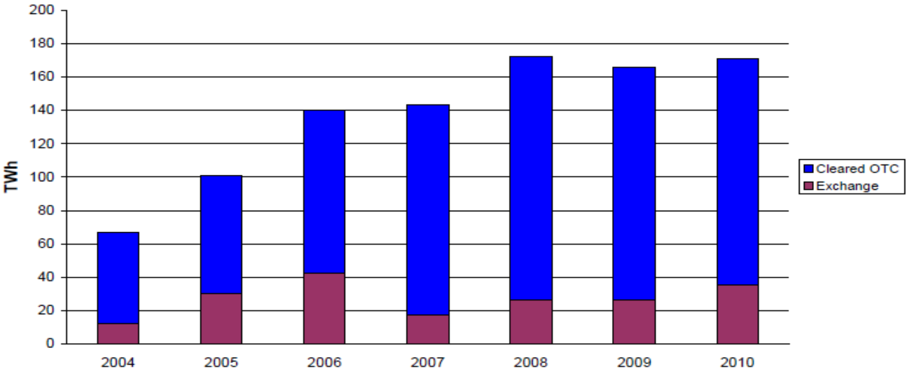


Figure 6.8 OTC-clearing for yearly CfD Oslo for delivery in 2011 (left) and 2012 (right)

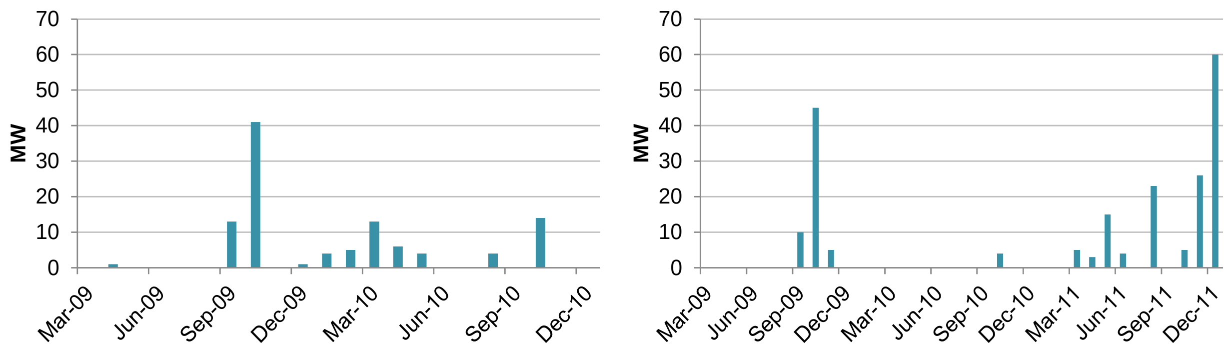
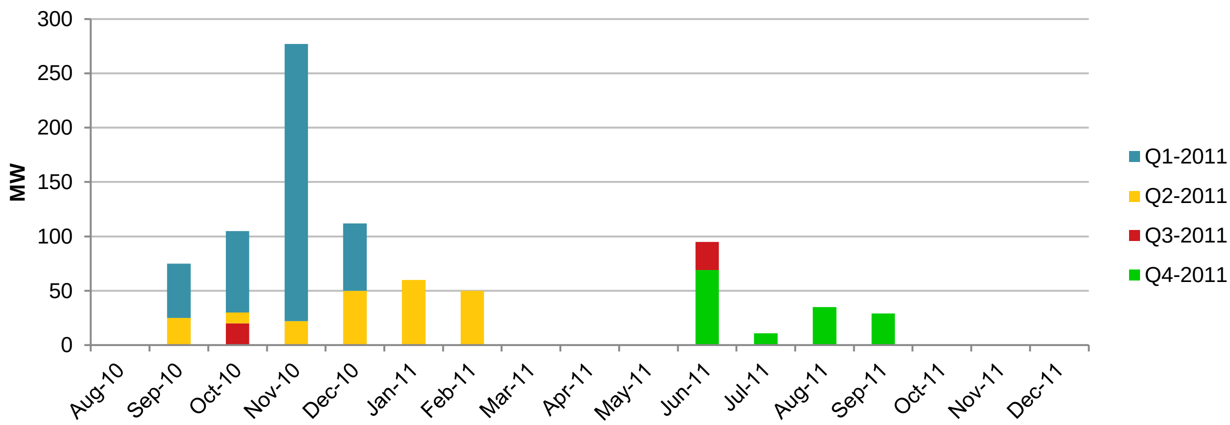


Figure 6.9 OTC-clearing for quarterly CfD Oslo for Delivery Q1-Q4 2011



Elforsk and interviewees for this study have suggested several explanations for the low trading levels in Norwegian CfDs:

1. Norwegian practice of changing demarcation of price zones inhibits liquidity

- Price areas are set dynamically in Norway and change over time together with grid congestion profiles. This is a significant concern for power exchanges as it effectively eliminates the possibility of long-term CfDs because bidders cannot be sure which price area a specific delivery point will belong to until close to delivery.

2. In Norway area price risk is mainly managed bilaterally and contracts are not cleared

   - According to two Nordic market stakeholders, there is a legacy of hedging area price risk through long-term contracts bound to a specific point of delivery. . This has the immediate advantage that the uncertainty created by changing area price zones is circumvented. It was also mentioned that, historically, long-term contracts were supported by the government and presented tax advantages.

3. Similar to the previous point, Norwegian firms perform internal hedging between generation and retail units in different price areas.
4. Perception of area price risk may be lower

   - Interviewees have suggested that market participants in Norway are comfortable with the area price risk given their view of a high correlation between Norwegian price zones and the Nordic system price that is introduced by flexible profile of Norwegian hydro generation. Existing price differences to the system price also tend to be on the side of lower prices in Norwegian zones, a factor that is favourable to consumers in these zones.

5. Higher share of variable price contracts in Norway

   - Producers with variable price contracts in place can pass on price increases to their consumers and are thus less exposed to price risk.

6.3.3 Costs

Fixed fees of trading on NASDAQ OMX include a membership fee for the exchange of €13,500 p.a. or €12,500 as client of an OTC broker. There is a reduced fee of €750 for broker clients with annual volumes smaller than 2 TWh. Variable fees for trading are billed at €0.004/MWh and for clearing at €0.0035-0.0085/MWh.

Historic data on bid-offer spreads was not available. A sampling of bid-offer spreads for dates between October and November 2012 suggested the spreads summarised in Table 6.3. The finding that spreads for Y+3 contracts are smaller than those for Y+2 contracts is counter-intuitive and may be related to the limited size of the sample.

Table 6.3 Bid-Offer Spreads for Nordic forwards according to sampling results

Average spreads (%)	Oct/Nov-2012
Y+1	0.22%
Y+2	0.40%
Y+3	0.25%
Y+4	0.46%

6.3.4 Summary

Current product availability and market liquidity on NASDAQ OMX should sufficiently enable market participants to take forward positions in the Nordic market. Base load products are available for up to five years ahead and actively traded for at least three years. Volumes trading at 4.6 times the underlying electricity consumption are a testament to overall market liquidity.

Two significant limitations apply:

- A qualification is made for peak load power, which is currently available but not actively traded in the forward market. However, peak load products do not seem to be currently demanded (as confirmed by stakeholders consulted for this study).
- Also, volumes for Norwegian CfDs are very low and it is generally considered an illiquid market. Again, this may not be an issue as the product is not actively demanded or bilateral substitutes are available.

6.4 Liquidity Analysis of the Netherlands market

Since 2006, the Dutch day-ahead spot power market (APX) has been coupled with the day-ahead markets in Belgium (Belpex) and France (EPEX). In November 2010, market coupling was extended to Germany and Luxembourg, and in January 2011, the NorNed connection to Norway was also coupled. Market coupling involves handling each market's supply and demand curves jointly according to an overall merit order regardless of location unless transmission constraints between markets are binding, in which case the market clearing prices in the constrained markets 'split'.

In the Dutch forward markets, electricity can be traded through a number of channels, namely the bilateral market, OTC or through the APX-ENDEX power exchange. Most trading is traditionally conducted OTC, where standardised amounts of electricity are traded through the use of brokers. In 2011, over 70% of forward market volume moved through OTC channels.[41] In the bilateral market, producers, major buyers and suppliers enter into agreements not facilitated by a broker and potentially involving non-standardised products. Bilateral trading accounted for about 20% of the forward market in 2011. ENDEX Power NL, a subsidiary of APX-ENDEX, is the market for standardized futures contracts and provides OTC clearing services and accounts for less than 10% of the forward market. (Figure 6.11 summarises total forward market volumes by channel.)

A recent NMa survey found that market participants consider OTC trading to be less transparent than trading on APX-ENDEX. However, respondents also regarded administrative costs of trading on exchanges as higher than via OTC. This has been confirmed by one interviewee to this study, who particularly cited the financial burden of imposed margin calls on ENDEX as a reason for widespread use of OTC brokers.

6.4.1 Availability

Available products include month, quarter and year forwards for both base load and peak load power (Table 6.4). Contracts are futures and margin calls apply.

41 NMa, "2012 Liquidity Report: Wholesale markets for natural gas and electricity", July 2012.

Table 6.4 Overview of relevant products on APX-ENDEX

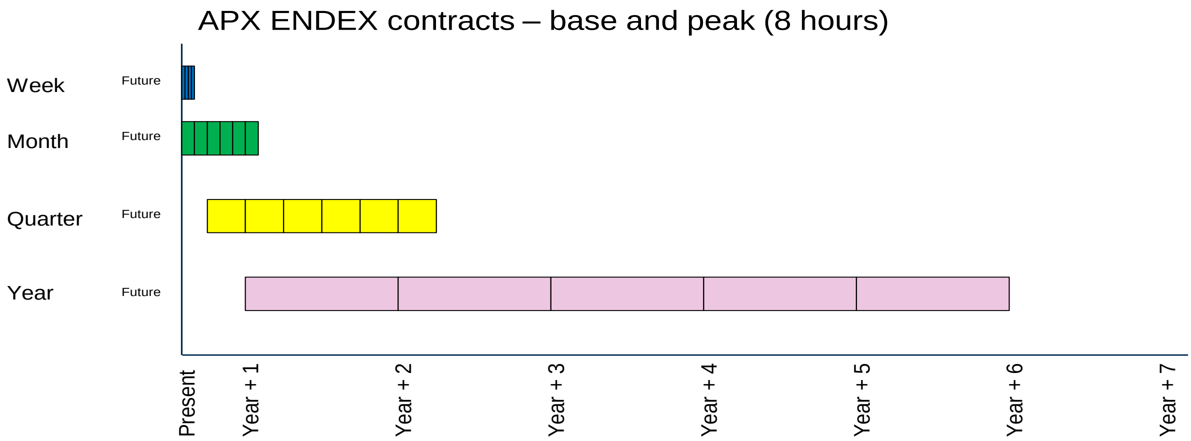
	Type	Periods	Trading Hours	Contract Size	Cascading	OTC
Base load						
Future	Week	4	0000-2400 Mon-Sun	1MW*applicable hours	None	Yes
Future	Month	6	0000-2400 Mon-Sun	1MW*applicable hours	None	Yes
Future	Quarter	6	0000-2400 Mon-Sun	1MW*applicable hours	3 Months	Yes
Future	Year	5	0000-2000 Mon-Fri	1MW*applicable hours	3 Months + 3 Quarters	Yes
Peak load 8 hours (from April 2009)						
Future	Month	6	0800-2000 Mon-Fri	1MW*applicable hours	None	Yes
Future	Quarter	6	0800-2000 Mon-Fri	1MW*applicable hours	None	Yes
Future	Year	5	0800-2000 Mon-Fri	1MW*applicable hours	3 Months + 3 Quarters	Yes
Peak load 16 Hours (until December 2013)						
Future	Month	6	0700-2300 Mon-Fri	Clearing Only	-	Only
Future	Quarter	6	0700-2300 Mon-Fri	Clearing Only	-	Only
Future	Year	3	0700-2300 Mon-Fri	Clearing Only	-	Only

Contracts traded include delivery up to four weeks ahead, six months ahead, up to six quarters ahead and up to five years ahead, for both base and peak load. ENDEX previously offered peak load products for 16 hour periods, but these are only cleared and no longer traded under a phase-out to shift to 8 hour peak load contracts. All contracts are futures and margining rules apply.

On its last trading day, the year future contract cascades into three quarter futures and three months. Similarly, the quarter future cascades on its last trading day to the corresponding three month futures. The maturities of contracts that are listed at any given time are illustrated in Figure 6.10.

A product overview for OTC traded products could not be obtained and this section thus only considers products available on APX-ENDEX. However, given that brokered OTC products are frequently standardized, it is likely that availability of products is similar. This is less certain for the bilateral market, where non-standard trades such as long-term supply agreements may differ considerably.

Figure 6.10 Tenors of power derivatives on APX-ENDEX



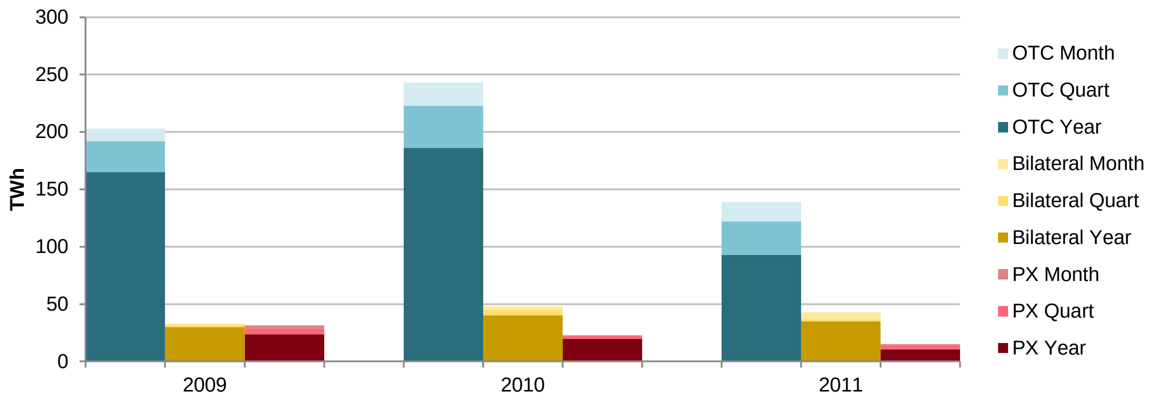
6.4.2 Volumes

The picture for liquidity in terms of trading volumes is more nuanced for the Netherlands. In the last few years, forward trading volumes were more than double the underlying electricity consumption (i.e. churn rates of 2 and higher), but in 2011, this dropped to a multiple of 1.3. It is important to note that this computation includes brokered OTC transactions that are not cleared on APX-ENDEX.

Moreover, the Dutch power forward market has been seeing significantly declining volumes in recent years. This is especially noticeable for volumes in annual contracts, which are key for longer-term hedging and traditionally accounted for the bulk of forward trading. Volumes in the relatively lesser-traded quarterly and monthly contracts have remained more or less stable. Four developments have been cited as possible drivers for reductions in trading volumes. First, according to a recent NMa report, traders indicate that liquidity in these contracts is increasingly concentrating on the German wholesale market. Responses from stakeholders for this study have confirmed this view. Second, ownership changes, including the acquisitions of Essent by RWE and Nuon by Vattenfall, have led to a market consolidation. Third, the retreat of purely financial players has further contributed to consolidation reducing number of trading participants. Fourth, underlying fundamentals of low or negative spark spreads may have reduced generator demand for locking in future margins for long tenors and shifted hedging activity to the short-term in the form of quarterly and monthly contracts.

In 2011, total trading volumes for forward products registered approximately 200 TWh, down from 315 TWh in 2010 (including bilateral trading, see Figure 6.11). This decrease was mostly driven by a sharp reduction in OTC transactions. Detailed data for the brokered OTC market was not available.

Figure 6.11 Forwards Power NL traded OTC, bilaterally and on PX



Exchange traded volumes on APX-ENDEX also declined considerably, although these represent only a small share of the market. It is noticeable that on APX-ENDEX, the decline in volumes was most dramatic for OTC-cleared transaction and especially for yearly contracts. In the first three quarters of 2012, volumes on the power exchange have bounced back considerably. However, OTC clearance is still registering very low volumes and the impact on overall market liquidity is thus limited.

A snapshot of monthly trading and clearance volumes on APX-ENDEX suggests that opportunities to enter larger hedging transactions on the exchange are very limited. For example, for the base load calendar year 2013 contract, only 17 MW were traded on the exchange in March 2012 and a further 56 MW reported for clearing. If a market participant wanted to enter a transaction to hedge only a few MW in the month of March, it would have represented a significant share of the market and may have moved the market price as a consequence (Figure 6.12). Two OTC-cleared transactions for the quarter-ahead almost doubled volumes of all other trades in March 2012 (Figure 6.13). At this level of traded volumes, it may take a long time to complete a hedge larger than a few MW. Of course, it is crucial to note that such low volumes should be expected given the relatively small market share of APX-ENDEX of all trades in the Dutch forward power.

The majority of stakeholders interviewed for this study held the view that liquidity in the Dutch forward market was declining significantly. One large producer explicitly stated that the current trading volumes are preventing them from hedging in the Netherlands exclusively. However, one large consumer stated that, although volumes are declining, it expects sufficient activity to meet its needs in the foreseeable future.

Figure 6.12 PX-traded contracts in March 2012 on APX-ENDEX

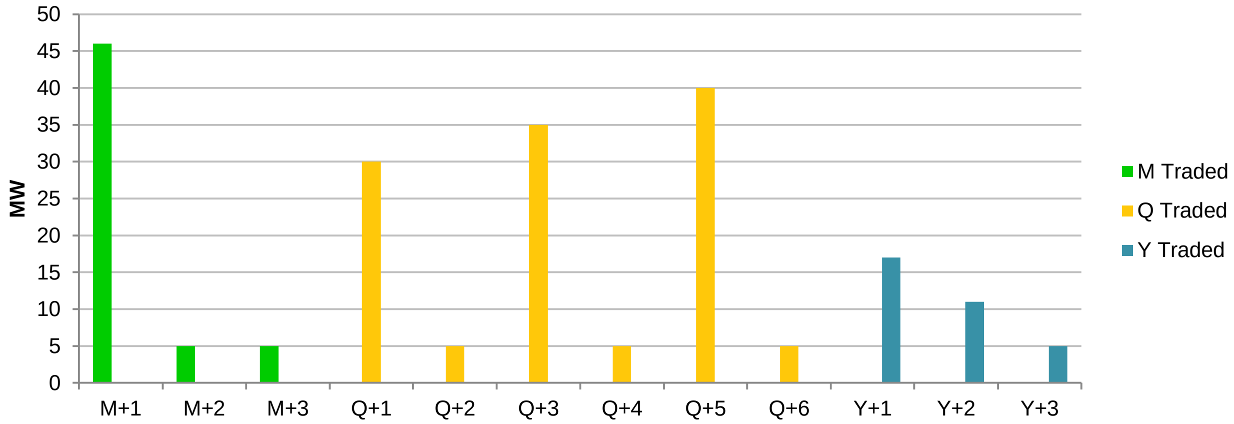
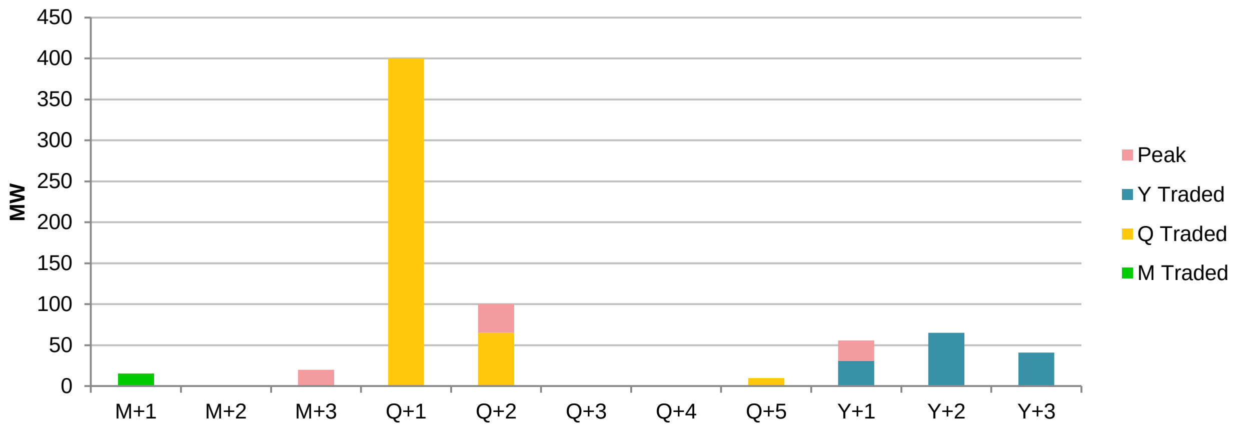


Figure 6.13 OTC-cleared contracts in March 2012



6.4.3 Costs

Fixed trading costs on APX-ENDEX include a membership fee for the exchange of €10,000-20,000 p.a. or €5,000 as client of an OTC broker. Variable costs accrue for trading on the exchange at €0.01/MWh and at €0.01-0.02/MWh for clearing. Traded derivatives on the power exchange are futures and margining applies. One stakeholder interviewed for this study has cited margin calls as the primary reason for not wanting to use the power exchange for hedging purposes.

Data reviewed for this study indicates bid-offer spreads for brokered OTC trades have decreased in recent years, notwithstanding the drastic decline in traded volumes (Table 6.6). Another counter-intuitive result is that for some products, spreads are lower for products with a longer time to start of delivery. A possible explanation could be that the overall number of trades and therefore the sample size is limited, and hence differences in spreads between products are less statistically reliable.

On the power exchange, spreads have shrunk significantly over the course of 2012, which is likely to be related to the observed resurgence of trading volumes (Table 6.7). Spreads in early 2012 were considerably greater than what could be expected in a liquid market. By September 2012, however, bid-offer spreads reduced to levels typical of a liquid market (for standard products).

Table 6.5 Bid-offer spreads for OTC-cleared transaction on APX-ENDEX

Average spreads (%)	2009	2010	2011	2012
Y+1	0.55%	0.59%	0.45%	0.48%
Y+2	0.44%	0.59%	0.48%	0.50%
Y+3	0.55%	0.79%	0.54%	N/A
Q+1	0.75%	0.62%	0.58%	0.50%
Q+2	0.73%	0.66%	0.56%	0.43%
Q+3	0.89%	0.71%	0.59%	0.46%
M+1	0.86%	0.59%	0.60%	0.67%
M+2	0.95%	0.74%	0.60%	0.63%
M+3	0.93%	0.83%	0.60%	0.65%

Table 6.6 Bid-offer spreads for PX trades on APX-ENDEX

Average spreads (%)	Feb-2012	Sep-2012
Y+1	1.11%	0.50%
Y+2	1.16%	0.62%
Y+3	1.90%	0.74%

6.4.4 Summary

The current features of the Dutch power forward market are difficult to assess without an in-depth understanding of the dominant but not very transparent market comprising brokered OTC transactions. In general, a significant decline in trading volumes has been observed very recently, especially for year-ahead contracts frequently used for long-term hedging purposes. Churn rates, including brokered OTC volumes, have declined from more than 2 in recent years to 1.3 in 2011.

On APX-ENDEX, forward products are available for up to five years out for both base load and peak load power. However, trading volumes are low and have been declining further. At the observed level of traded volumes, it may be either infeasible or likely to take a very long time to complete base load hedges larger than a few MW. Peak load is barely traded on APX-ENDEX.

Bid-offer spreads on the brokered OTC market fall within the expectations of a liquid market. It seems counter-intuitive that spreads have narrowed as volumes have decreased in recent years. Spreads on the power exchange were fairly high at the beginning of 2012 but have narrowed significantly over the course of the year to a level which is likely to be consistent with a liquid market.

6.5 Liquidity Analysis of the German market

The German market is of relevance to NorNed stakeholders by virtue of the fact that it is coupled with the Dutch market and the significant price convergence that has followed market coupling (see section 5). NMa has suggested in a previous study that trading activity, especially for long-term hedging purposes, is shifting from the Dutch forward market to the German forward market.[42] Possible reasons for this could include lower transactions costs in the larger and more liquid German market and the opportunity to hedge over longer time horizons. However, hedging a position in the Netherlands against the German market introduces some level of area price risk as price convergence is imperfect. Any liquidity transfer would thus indicate that realized transaction benefits outweigh any additional price risks.

EEX Power Derivatives provides an exchange traded market in forward power contracts and also offers OTC clearing. Over the last five years, EEX has more than doubled total volumes and secured a sizeable share of forward trading at around 25-30%. Yet around 70% of German forward trading continues to be conducted as non-cleared OTC. The underlying index for EEX forwards is the Phelix index, which is calculated as the average of all auction prices of the appropriate hourly contracts (base, peak, and off-peak) for the German and Austrian market as traded on the EPEX Spot Market. Day-ahead trades on EPEX spot in 2011 accounted for around 40% of consumption in 2010 for the combined market area of Germany and Austria.

6.5.1 Availability

EEX offers week, month, quarter and year futures for base, peak and off-peak periods (Table 6.8). At a given moment in time, futures are listed with maturities as summarized in Figure 6.14 below. On its last trading day, a year future cascades into equal positions in the corresponding January, February and March delivery month futures, and Q2, Q3 and Q4 delivery quarter futures. Similarly, a quarter future cascades on its last trading day to the corresponding three month futures.

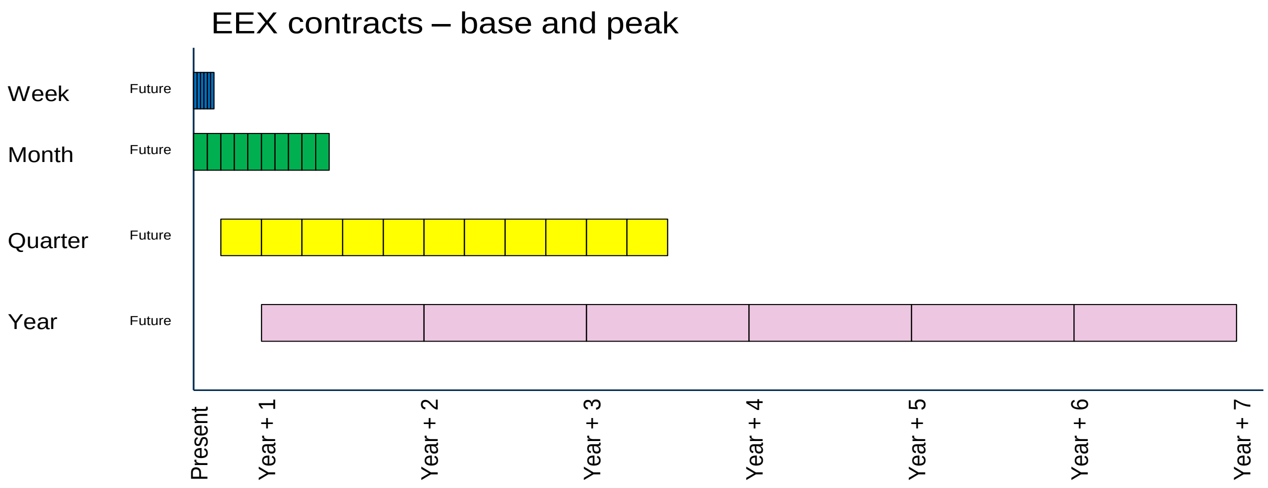
42 NMa, "2012 Liquidity Report".

Table 6.7 Overview of relevant products on EEX

	Type	Periods	Trading Hours	Contract Size	Cascading	OTC
Base load						
Future	Week	5	0000-2400 Mon-Sun	1MW*applicable hours	None	Yes
Future	Month	10	0000-2400 Mon-Sun	1MW*applicable hours	None	Yes
Future	Quarter	11	0000-2400 Mon-Sun	1MW*applicable hours	3 Months	Yes
Future	Year	6	0000-2000 Mon-Fri	1MW*applicable hours	3 Months + 3 Quarters	Yes
Peak load						
Future	Week	5	0800-2000 Mon-Fri	1MW*applicable hours	None	Yes
Future	Month	10	0800-2000 Mon-Fri	1MW*applicable hours	None	Yes
Future	Quarter	11	0800-2000 Mon-Fri	1MW*applicable hours	N3 Months	Yes
Future	Year	6	0800-2000 Mon-Fri	1MW*applicable hours	3 Months + 3 Quarters	Yes
Offpeak						
Future	Month	7	0000 – 0800, 2000 – 2400 Mon-Fri; holidays	1MW*applicable hours	None	Yes
Future	Quarter	7	0000 – 0800, 2000 – 2400 Mon-Fri; holidays	1MW*applicable hours	3 Months	Yes
Future	Year	6	0000 – 0800, 2000 – 2400 Mon-Fri; holidays	1MW*applicable hours	3 Months + 3 Quarters	Yes

The nominal availability of power derivatives for trading on EEX extends beyond the horizons offered on NASDAQ OMX and APX-ENDEX. As on APX-ENDEX, the monthly, quarterly and yearly contracts for peak load match the maturities for base load. It also offers a different product category in the form of off-peak derivatives.

Figure 6.14 Tenors of power derivatives on EEX



6.5.2 Volumes

While EEX only accounts for a part of the forward market, transaction volumes are considerable in absolute terms. The total traded volume of power derivatives contracts amounted to 1,018 TWh in 2011, of which 55% were cleared OTC contracts. Since 2008, OTC clearance has lost a significant amount of volume but this has been mitigated in part by strong growth in trading on the exchange. Most of OTC and exchange trading occurs in year-ahead contracts.

A snapshot of trading in March 2012 (Figure 6.16) shows that large volumes are traded for monthly and quarterly contracts. Trading volumes in monthly contracts are noticeably high in relation to quarterly and yearly contracts. High volumes are also recorded for the Y+1 contract, but volumes are significantly lower for Y+2 and Y+3 contracts. Figure 6.18 shows monthly sums of trades in yearly base load contracts on the EEX power exchange, largely corroborating the monthly snapshot. Since January 2011, volumes for year-ahead contracts have been around 4,000 MW a month, around 1,000 MW for two years ahead and 500 MW for three years ahead. This does not include OTC-cleared trades.

Peak load is traded heavily in month-ahead contracts with almost 3,000 MW traded. Volumes for quarter-ahead and year-ahead contracts are lower (Figure 6.17).

Figure 6.15 Volumes traded and cleared on EEX

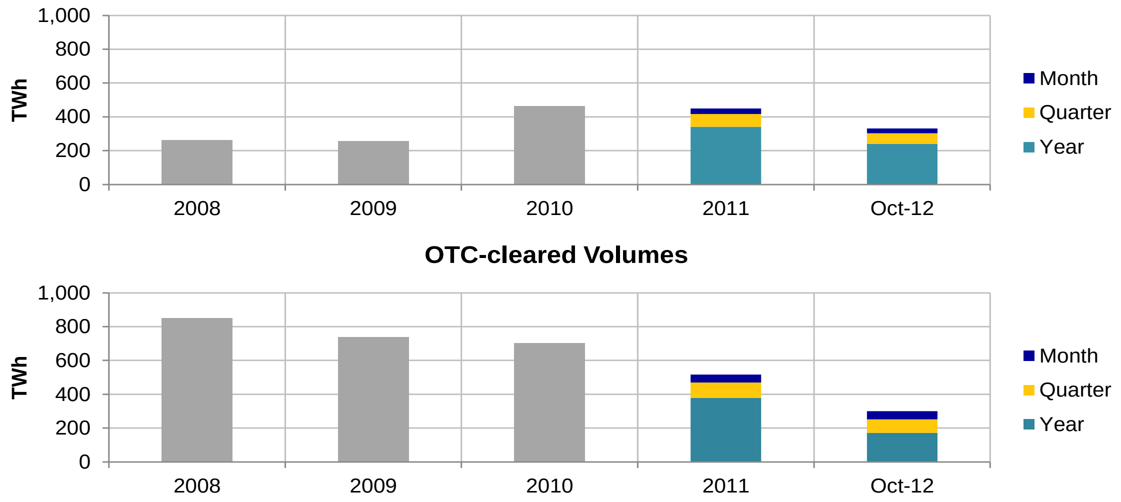


Figure 6.16 March 2012 PX-traded base load contracts on EEX

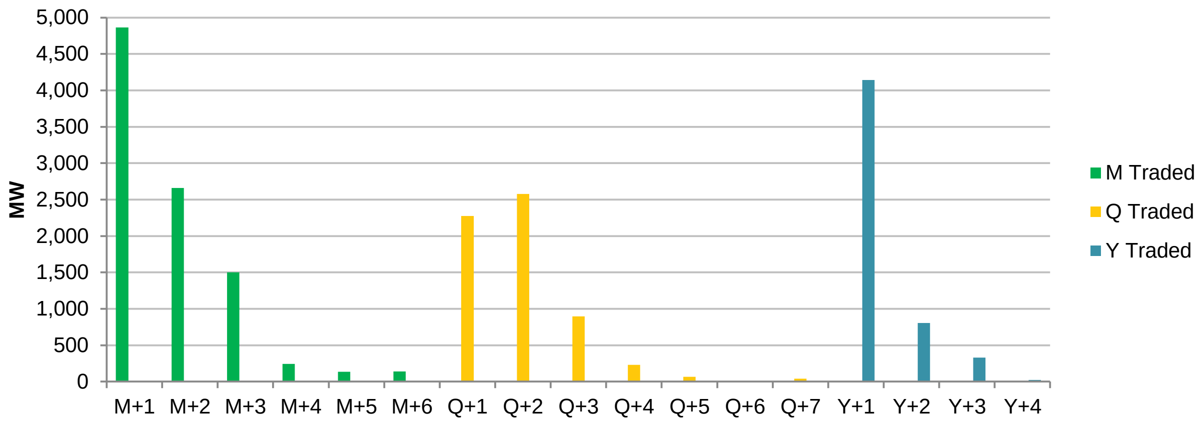


Figure 6.17 March 2012 PX-traded peak load contracts on EEX

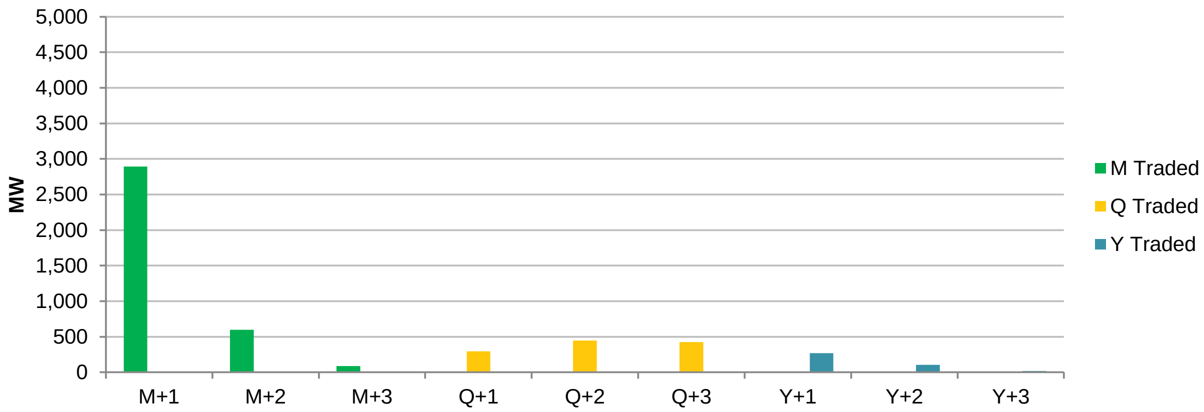
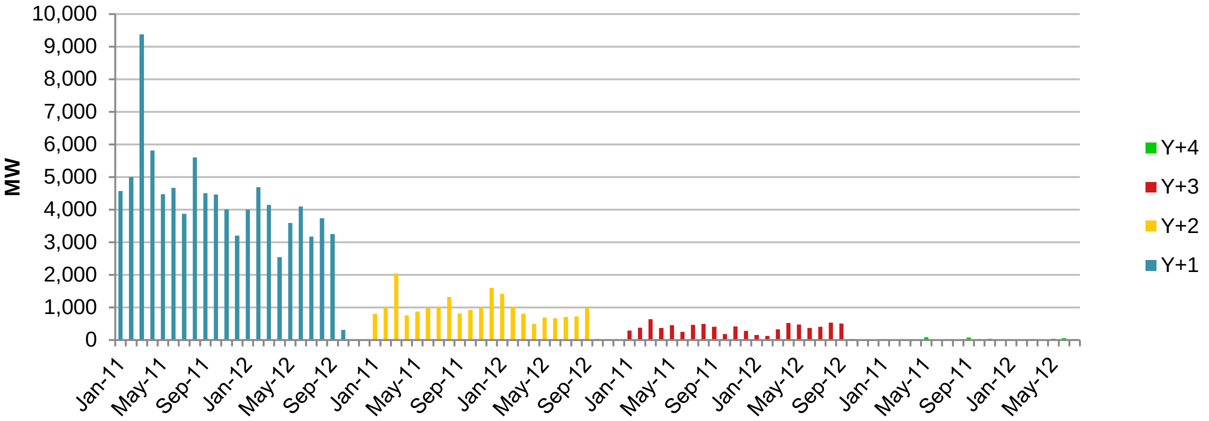


Figure 6.18 Monthly profiles of trading in yearly contracts on PX 2011-2012



6.5.3 Costs

Fixed trading costs on EEX include a membership fee for the exchange of €25,000 p.a. (and additional participation costs related to technology). Variable costs accrue for trading on the exchange at €0.0075/MWh, for registering OTC at €0.0075/MWh and for clearing OTC at €0.005/MWh.

Data on bid-offer spreads was not available for review. Anecdotal evidence from stakeholder interviews has suggested spreads between 0.1% and 0.2% for standard products such as year-ahead contracts.

6.5.4 Summary

Over the last few years, EEX has carved out a considerable position in the German forward market. Volumes on the power exchange have developed more strongly than OTC-clearing and now account for almost half of all trades. Total trading on the forward market has exceeded demand by multiples of between 1.7 and 2.0 in recent years. Given the relatively large volume of underlying consumption, this means that monthly depth for base load contracts can be expected to reach several thousand MW for Y+1 contracts, around 1,000 for Y+2 contracts and 500 MW for Y+3 contracts on the power exchange alone. Peak load volumes are concentrated on the month-ahead contract with smaller volumes for quarterly and yearly contracts.

Anecdotal evidence suggests that transaction costs incurred through bid-offer spreads are significantly lower than in the Dutch market and within the expected bounds of a highly liquid market.

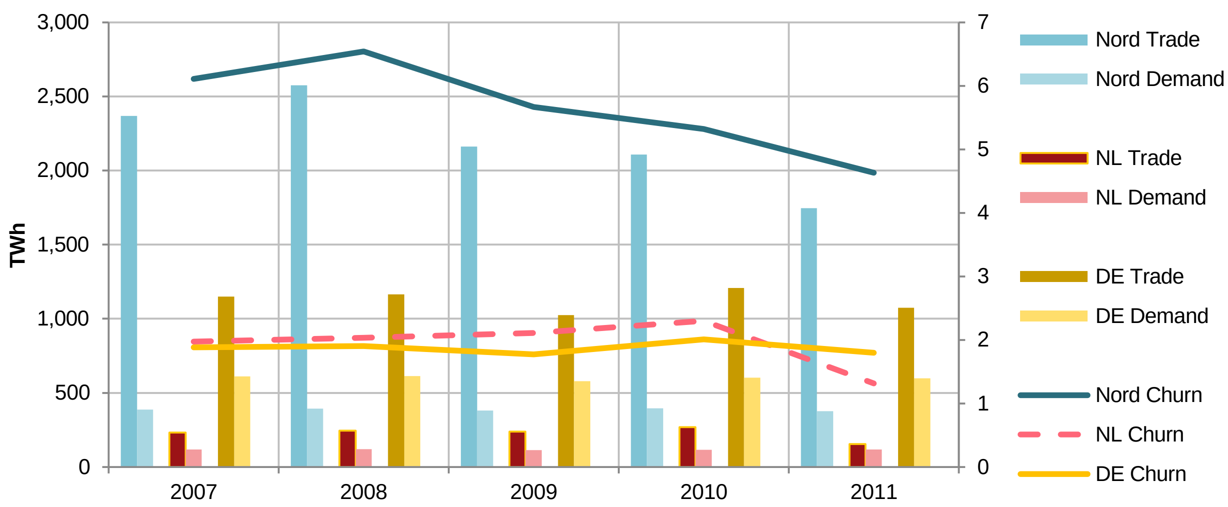
6.6 Conclusion

Appropriate hedging opportunities are deemed to be offered by markets if derivatives are commonly available for the types of risks, volumes and horizons that market participants demand and at reasonable costs. The analysis of financial markets in the Nordic region, Netherlands and Germany correspondingly considered three broad indicators of availability of appropriate hedging opportunities. These are product availability, market liquidity and trading costs.

In terms of product availability, all three markets offer base load and peak load products. Base load can be traded up to 5 years ahead in the Nordic market and 6 years ahead on EEX. The release schedule of peak load periods is aligned with that of base load periods in the Netherlands and Germany for the full horizon. On NASDAQ OMX availability of peak load products is limited to the year-ahead and within-year products. CfDs on NASDAQ OMX are not available for all price areas, NO2 being one of them, but CfDs for other price areas can be seen as a proxy. EEX and APX-ENDEX offer futures with daily settlement and margin calls whereas NASDAQ OMX offers forward contracts (beyond week-ahead), with non-cash guarantees for margining.

The depths of the markets vary. Figure 6.19 shows total traded volumes on the power exchanges including OTC clearing and brokered OTC for the Netherlands only. These are graphed against the market churn rates for comparison. While trading volumes shown in the graph represent the majority of forward market transactions for Nord Pool and the Netherlands, about 70% of the German forward market is not captured through EEX and hence actual churn rates for that market are likely to be much higher.

Figure 6.19 Traded volumes and churn rates for Nordic, Dutch and German forward markets



At this level of aggregation, the Nordic market can be considered liquid in terms of depth, at the very least for the one year-ahead contract, and, depending on the scale of a participant's hedging requirements, for contracts traded up to three years before start of delivery. Monthly volumes for the Y+1 contract in the Nordic market have in recent years varied between 1,000-3,000 MW and have approximately halved as the start of delivery period moves out by a year. Norwegian CfDs are not considered liquid because of their very low trading volumes. . Volumes for peak load contracts have been found to be negligible.

In the Dutch market, the picture is more nuanced. Overall volumes in the forward market have declined significantly in recent years, both on the large brokered OTC market and the smaller APX-ENDEX exchange including OTC clearing. On APX-ENDEX, monthly volumes for base load are generally limited to a few dozen MW per contract, and larger transactions would accordingly represent a large share of the market. Volumes for peak load contracts are very small. While stakeholders generally agreed that liquidity in the Dutch market is low, views varied on whether the prevailing volumes are sufficient to meet hedging needs.

The German forward power market is included in this study since strong convergence between German and Dutch power markets has made it possible to hedge positions in the Dutch market with forward instruments referenced against the German power price, noting that some locational price risk is introduced in the process. The German forward power market can be considered liquid in terms of depth to a similar extent as the Nordic market. Traded volume of base load contracts has reached several thousand MW for the Y+1 contract, around 1,000 MW for the Y+2 contract and 500 MW for the Y+3 contract on the power exchange alone. Peak load volumes are high compared to the Dutch and Nordic markets for the monthly and to a much lesser extent for quarterly and yearly contracts.

7 Stakeholder Evidence

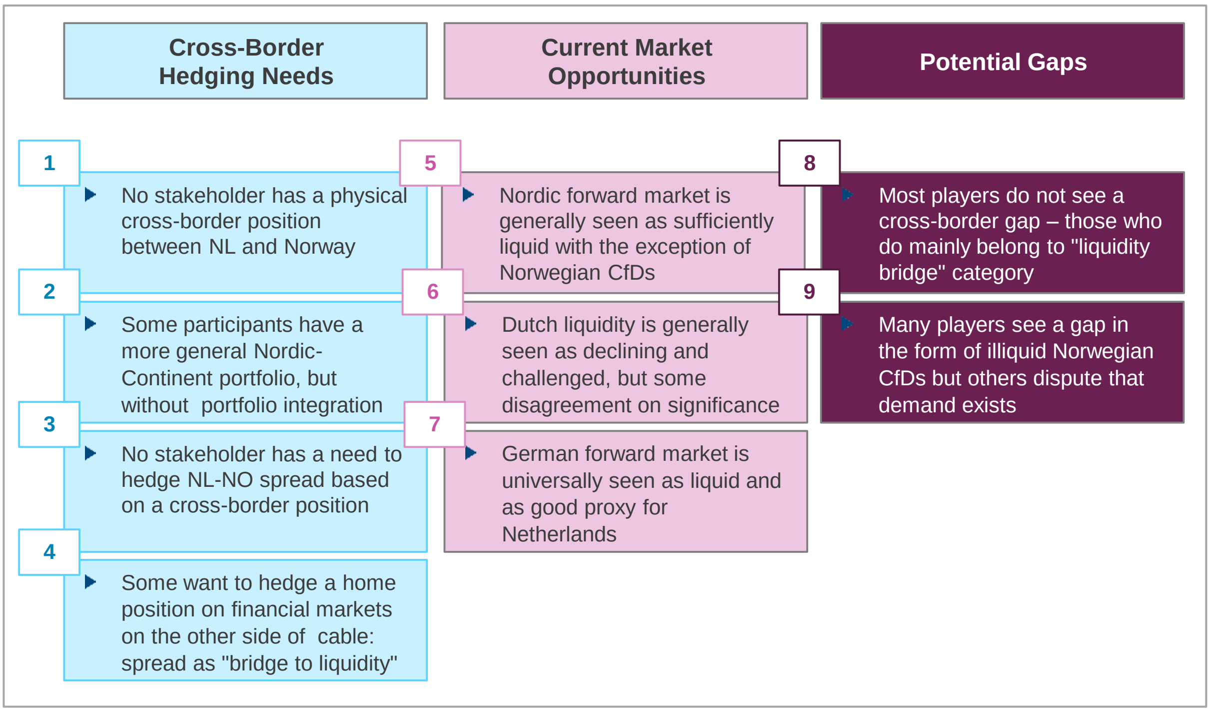
7.1 Introduction

For the purposes of our study, 15 stakeholders were interviewed on their long-term cross-border hedging activities, preferences and needs. The interviewed parties were chosen on the basis of being the most likely to be impacted by the introduction of FTRs on NorNed. The group of interviewees consisted of two TSOs, one trader, three exchanges, five producers and four consumers. All stakeholders were participants in the energy markets of the Netherlands, Norway or both.

Interviews generally covered the current hedging activities of participants, their cross-border hedging needs, if any, and their views on the adequacy of hedging opportunities currently offered by financial markets. Based on these views, the stakeholders were also asked to consider potential gaps in the hedging strategies that are currently available and whether FTRs or other instruments could be useful in addressing these gaps.

This section presents key findings from stakeholder interviews. In presenting the evidence we replicate the structure followed in the actual interviews, i.e. we first summarise stakeholder comments on their hedging needs, followed by their views on current hedging opportunities and finally their comments on potential gaps. Figure 7.1 below summarises key messages from stakeholders for each sub-section.

Figure 7.1 Overview of Stakeholder Evidence



7.2 Current hedging activities, exposure and requirements

None of the nine producers or consumers interviewed has a physical cross-border position between the Dutch and Norwegian markets, in the sense of being long in one market and short in the other. Two stakeholders have a cross-border position between the Dutch market and the Nordic market area more generally, but these positions were either long or short in both markets.[43] A few stakeholders have positions between the Nordic market and the Continental European market more generally, especially in Germany for the latter. The TSOs in the Netherlands and Norway, as the capacity owners of NorNed, do have a cross-border position in the sense that congestion rent is directly exposed to the price spread between the two markets.

The stakeholders' assessment of need largely echoes the lack of fundamental cross-border positions. Ten stakeholders did not see any need for hedging on NorNed. Of the three respondents that did identify a need, one expressed the view that the observed fluctuations in the price difference between the two markets should create a natural demand to hedge that spread if appropriate products are available. Two producers expressed the desire to use a cross-border hedge to bridge a liquidity constraint in the home market and access liquidity in a neighbouring financial market.

Table 7.1 Stakeholder responses on cross-border hedging

Strong Trend	Trend	No Trend	N/A

	Yes	No	Unsure	No Opinion	No statement
Cross-Border Hedging					
NL-NO cross-border position	0	8	-	-	6
NL-Nordic cross-border position	2	6			6
NL-DE cross-border position	4	5	-	-	6
Nordic-DE cross-border position	3	6	-	-	6
See hedging need NL-NO (producers & consumers)	2	5	1	1	-
See hedging need NL-NO (all stakeholders)	3	10	1	1	-

Consumers

Four large industrials with annual electricity demand of several TWh were consulted, including two Norwegian and two Dutch consumers. Two consumers hedge their consumption chiefly by use of bilateral contracts, with contract periods ranging from 2 to 20 years. One consumer uses long-term bilateral contracts in one part of its value chain and actively manages hedging in another on financial markets with a

[43] As discussed in section 5, asymmetric positions are required to take full advantage of locking-in margins through hedging the price spread (such as a net generation position in one market and a net supply position in the other).

horizon of several years. One consumer has a large self-generation position in its core market but hedges consumption in part with calendar year products on the OTC market. Both of the Norwegian consumers have generation assets in Continental Europe but source power locally in each case.

Nordic consumers did not find shape risk to be relevant given the limited differences between peak and base load power prices in the Nordic market. Both of the Norwegian consumers found hedging basis risk through CfDs desirable. One consumer stated that they would have "demand for more CfDs if these were more easily available". A Dutch consumer managed shape risk through bilateral contracts with a service supplier to balance consumption in deviation of base load contracts with a main supplier.

None of the consumers see any cross-border exposure between the Nordic and Continental markets. One consumer mentioned that because the underlying differences in the two electricity markets were highly pronounced, they expected little gains from integrating operations between the Nordic market and Continental Europe. A Dutch stakeholder noted that the primary objective of cross-border market integration should be to maximise efficient flows across the NorNed cable and they welcomed market coupling for having achieved this. They also expected that the market in the form of suppliers "will find the most efficient route" to use cross-border capacities.

Producers

Of the five interviewed producers, none has a direct physical cross-border position between Norway and the Netherlands. One vertically-integrated utility has positions between the Nordic market and the Dutch and Continental market more generally and another has assets both in the Nordic market and in the German market. The producers are either long on both sides and/or did not treat their cross-border positions as an integrated portfolio from a hedging perspective (but may engage in cross-border trading).

Three interviewed producers have generation assets in the Netherlands. Two of the three use brokered OTC markets and APX-ENDEX in the Netherlands and EEX in Germany to hedge their Dutch positions. Another noted that they mainly seek to hedge generation spreads without specifying the used instruments. Producers named hedging horizons of 2-4 years. As noted above in the liquidity analysis, producers seem commonly to hedge part or most of their Dutch positions in Germany. One producer stated that it mainly uses the German market and only sometimes hedges in the Netherlands. The other producer referred to the Netherlands as the first point of call for hedging Dutch positions but noted that it is increasingly necessary to hedge in Germany or Belgium because of liquidity. One producer manages locational risks between Germany and the Netherlands with PTRs and the other does not. One producer also questioned the reason behind coupling Dutch and Norwegian markets because of their structural differences and noted that hedging opportunities on NorNed are not very relevant given the expectation that flows are predominantly unidirectional from Norway to the Netherlands.

Three producers have generation assets in the Nordic market area. All consider the Nordic system price forwards on NASDAQ OMX their primary hedging instruments. The time horizon for hedging was varyingly named as 2-3 years, several years, and "along the forward curve". The Norwegian producers are using CfDs only to a limited extent. One producer covers a small share of its forward position with CfDs and conducts most area price hedging through long-term contracts. It also viewed correlation of the Norwegian area prices to the system price as very high. Another Norwegian producer stated that it tries to use CfDs when it can find a counterparty. More generally, one producer remarked that basis risk is generally carried to large degree but if costs were low it would always be interesting to hedge.

None of the producers saw a hedging need on NorNed originating from a physical cross-border position. However, two producers noted a desire to hedge a physical position on one side of the cable on a financial market on the other. An FTR would in this case provide a bridge to liquidity in the sense that a forward position in an adjacent market and a hedge for the price difference to the home market combine to provide a forward hedge for the home market. One producer noted a desire generally to hedge its Dutch positions on the most liquid financial markets, including the Nordic financial markets. A product to hedge the price spread between the Netherlands and Norway, or the Nordic system price directly, would combine with a forward position on NASDAQ OMX to yield such a hedge. Conversely, a Nordic producer indicated a desire to hedge a Nordic position on the German EEX for liquidity reasons and use an FTR on NorNed partially to cover locational basis risk.

TSOs

TSOs have a cross-border price exposure since the congestion rents on NorNed are determined in the day-ahead markets. One TSO mentioned that it does not have a need to hedge this risk and the other did not comment. In terms of other market participants' cross-border exposure, one TSO does not see a hedging need from market participants in its network zone and the other was unsure.

Traders and Exchanges

A Nordic trader holds the view that there is no market demand to hedge the NL-NO price spread, because there are not many players with a corresponding physical cross-border position. Two exchanges likewise do not see a need for cross-border hedging, with one noting that "nobody has ever asked us to trade the NorNed spread – and we usually hear if there are requests". However, a third exchange holds the view that the obvious price difference between the Dutch and Norwegian markets in itself creates a clear need to hedge this price risk.

7.3 Current opportunities in financial markets

The stakeholders' perceptions of liquidity and hedging opportunities in financial markets are predominantly congruent with the results of the liquidity analysis. Yet some more nuanced differences are noticeable between stakeholder groups. Overall, stakeholders regard the Nordic forward market as reasonably liquid, with the exception of Norwegian CfDs. Liquidity in the Dutch market is generally seen as declining and challenged, but stakeholders disagree on significance of this. The German forward market is universally seen as relatively liquid and as a good proxy for the Netherlands.

Table 7.2 Stakeholder responses on current market opportunities

Strong Trend	Trend	No Trend	N/A

	Yes	No	Unsure	No Opinion	No statement
Current Market Opportunities					
Appropriate liquidity in Nordic forwards	7	-	1	-	7
Appropriate liquidity in Norwegian CfDs	1	6	-	1	7
Appropriate liquidity in Dutch forwards	3	4	2	1	5
Appropriate liquidity in German forwards	10	-	-	-	5

Consumers

On the Norwegian side, statements from consumers generally confirmed the available market evidence. Liquidity in the Nordic market is seen as very good for the year-ahead, acceptable for two years out and more challenging beyond. One stakeholder mentioned difficulties in placing a large long-term position on the market and that it eventually resorted to a bilateral solution. One consumer with experience in the CfD market noted that it is possible to find a counterparty but at high cost and that because of low liquidity it has to approach producers via OTC or a bilateral agreement to hedge area price risk.

On the Dutch side, consumers agree with a general decline in market liquidity but so far do not see this as infringing on their hedging needs. One consumer said it was "not worried about liquidity in the Netherlands disappearing". Another consumer noted sufficient availability in OTC forward markets for 3-4 years out. It also pointed out that brokers and traders may in turn hedge out these transactions on the German market, but that this was for the market to decide and not directly of its concern. One consumer also noted that next to bilateral contracts it exclusively considers the brokered OTC market, because required margin calls for futures traded on APX were seen as very risky from a financial standpoint.

On the German financial market, one consumer saw sufficient liquidity for first two years, acceptable for three years and for smaller hedges beyond four years. One consumer also mentioned that financial products for the spread between the German and the Dutch market are readily available and offered by large financial institutions active in both markets.

Producers

On the Norwegian side, a producer found that it can contract base load forwards up to 3 years "if you have some time with a company of our size". Another noted that despite the exit of purely financial players from the Nordic market liquidity was still "good enough".

Two producers with Dutch activities noted that liquidity in the Netherlands is "drying up" and is currently not meeting their hedging needs. Another producer was more positive and saw hedging possibilities along the forward curve for three years.

Germany was considered a liquid market by four producers (no comment from fifth producer), based on perceived hedging horizons of five years and low bid-offer spreads.

TSOs

Regarding the Nordic market, one TSO considered NASDAQ OMX a liquid forward market but noted low volumes in CfDs. Regarding the Dutch market, one TSO considered liquidity as established by virtue of the additional opportunities offered on the German market.

Traders and Exchanges

Two exchanges considered the Nordic market as sufficiently liquid. A trader noted that there is hardly any liquidity in Norwegian CfDs.

A trader also noted that the Dutch market is becoming more short-term, with long-term transaction moving across the border to Germany. Looking into the future, the trader saw the Netherlands as a power exchange ranking somewhere in between Germany and France. All three exchanges also noted the shrinking volumes, with one stakeholder noting a recovery of exchange based trades in 2012.

Traders and exchanges considered the German market as very liquid. One exchange noted that Dutch physical positions are being traded in Germany as market liquidity lowers price risk, and that the basis risk is perceived as very small due to convergence. It also noted that basis risk hedging for up to one year is also possible with PTRs.

7.4 Potential gaps

Most stakeholders do not see a gap in cross-border hedging opportunities between Norway and the Netherlands. Yet three stakeholders do identify a demand to trade the cross-border spread for hedging purposes. This is in line with the previous finding that most stakeholders do not see a demand for hedging the NL-NO spread.

When asked whether financial markets would sufficiently address a hypothetical need, there was some variations in the answers. There is a tendency to view the low liquidity of Norwegian CfDs as a gap, although some stakeholders were unsure of the demand for this product. Likely users of CfDs however indicated a gap. Dutch liquidity was generally seen as declining, but a gap was only noted by producers and not consumers. Two of the four stakeholders that did not see Dutch liquidity as a gap cited the vitality of the neighbouring German market as a reason.

Table 7.3 Stakeholder responses on potential gaps

Strong Trend	Trend	No Trend	N/A

	Yes	No	Unsure	No Opinion	No statement
Potential gaps					
Gap in cross-border hedging opportunities	3	8	1	2	1
Gap in Norwegian CfD liquidity	4	1	3	1	6
Gap in Dutch liquidity	2	4	4	1	4

Consumers

Consumers did not see any significant gap between their hedging requirements and current market opportunities, with the exception of the restricted availability of Norwegian CfDs. One consumer also noted that more liquidity towards the end of the forward curve on Nordic forwards would be desirable. One consumer noted that the option of hedging its home position on the other side of the cable would be interesting if liquidity were constrained in its home market, but did not see this as currently a problem. The same consumer also noted that it would always price a product at or below the difference in the forward curves, because it does not have a risk appetite for speculation.

Producers

Four producers see at least one gap in current hedging opportunities. A specific instrument to hedge the NL-NO spread is desired by two producers, both with the motivation to access financial forward markets on the other side of the interconnector. One of these noted that "on most other borders you see more [hedging] products and this should be no different for NorNed" and they would like such a product to hedge Nordic positions on Continental markets. A second producer finds hedging the NL-NO spread similarly desirable but for the reverse route, i.e. for accessing Nordic liquidity.

Two producers point to low liquidity in Norwegian CfDs as a gap. One of these producers specifically referred to this as a gap in cross-border hedging opportunities, while the other was more concerned about hedging within the Nordic market. Another producer disagrees, stating that they had "never heard that a consumer was unable to get a CfD if they wanted to".

Two producers active in the Dutch market noted that liquidity in the Dutch forward market does not meet their needs.

TSOs

One TSO did not see a market need to hedge the NL-NO spread and also viewed existing financial markets as capable of serving such a need if it existed. Another TSO was unsure about the actual market need for hedging the NL-NO spread but cautioned that this should only constitute a gap if there is a broad demand from more than just a few players.

Traders and Exchanges

A trader noted that current markets cannot offer a full hedge for the NL-NO spread because the missing liquidity in Norwegian CfDs constitutes a weak link in the chain. However, this shortcoming was not viewed as relevant because there is no identified demand for hedging the spread. Two exchanges considered the low liquidity of Norwegian CfDs a potential gap but cautioned that this may not be a problem for the Norwegian stakeholders concerned.

One exchange considered the unavailability of a hedging instrument for the NL-NO spread a gap per se. It reasoned that since the expectations of market participants about the direction of flow on NorNed converge, there is no likely counterparty to stand on the other side of the transaction. Only the capacity owner is in a position to issue such a hedging opportunity by making available transmission rights.

7.5 Conclusion

On the issue of current hedging needs stakeholder views strongly converged. We did not identify any stakeholder with a need to conduct cross-border hedging on NorNed. Many stakeholders also commented that the reason for this is the lack of market participants who have offsetting physical positions in both regions. Two producers, however, indicated a desire to hedge the NorNed spread for other reasons that hedging a physical cross-border positions. Both producers cited an interest in accessing forward markets on the other side of the interconnector, with the goal to access a more liquid financial hub with lower transaction costs and deeper trading volumes along the forward curve. We have termed this motivation "bridge-to-liquidity". A third stakeholder suggested that hedging needs for the NL-NO2 price spreads could only become visible once a suitable trading product was introduced.

In reference to current market opportunities, stakeholders generally confirmed the evidence from the previous section on market liquidity. The Nordic market was generally seen as sufficiently liquid, with a caveat being the low volumes seen in Norwegian CfDs. Dutch liquidity was viewed as declining and several stakeholders found it to be insufficient. Consumers however seemed unperturbed by the level of liquidity contraction. German forward markets were generally considered as liquid and a good proxy for hedging positions in the Netherlands.

Most players did not see a gap in cross-border hedging, consistent with their view that there is an absence of demand for such hedging. The two producers who did consider the unavailability of a spread product a gap are not primarily interested in hedging physical cross-border positions but in accessing financial markets on the other side of the interconnector. Several stakeholders also considered the limited liquidity of Norwegian CfDs a gap, but mainly for hedging their positions within the Nordic area.

8 Evaluation of Potential Gaps

8.1 Introduction

In terms of hedging opportunities, the previous two sections have analysed existing opportunities for long-term hedging on NorNed and summarised the needs of relevant stakeholders. This section reviews potential gaps between the status quo and the FG on CACM target objective of providing appropriate long-term hedging opportunities. Potential gaps are informed by evidence from the liquidity analysis and stakeholder interviews. The review focusses on the materiality of the gaps.

We consider a gap to be present if there is no or limited supply for a hedge that is actually demanded by the market participants. It is important to note that a single hedging product may be able to serve multiple hedging purposes. In section 5 we have already introduced the idea of cross-border hedging with the purpose of locking in the value of physical positions held in each of the markets. From the stakeholder evidence the bridge-to-liquidity concept, i.e. hedging a physical position in the home market on a financial market in a foreign market, emerged as a second relevant hedging purpose. For completeness we can also consider hedging a home position in the home market as a separate hedging purpose. Gaps are therefore present where instruments are not available while a demand for them exists for any of these three hedging purposes.

This means that the presence of gaps depends on which hedging purpose is considered. For example, the unavailability or illiquidity of Norwegian CfDs would reduce the effectiveness of a hedge for the spread between the Kristiansand area and the Netherlands – yet since no demand has been identified for hedging a cross-border position this does not constitute a gap. However, the illiquidity of Norwegian CfDs also reduces the effectiveness of a “domestic” hedge of a Norwegian participant against the Nord Pool system price. A demand for such a hedge has been communicated by several stakeholders and hence a potential gap for this purpose is present.

Based on evidence in the two previous sections, Table 8.1 summarises market liquidity (the supply side) and stakeholder demand for the three hedging purposes. There is no direct potential gap for hedging a cross-border position, as there has been no demand identified for such a purpose. Yet if a cross-border hedging demand arose (e.g. unidentified present demand or future demand), then a potential gap would be present. Hedging a home position across the border is currently not possible because a designated spread product, which would make recourse to the home financial market redundant, is currently not available. For hedging within the home market the unavailability of Norwegian CfDs and declining Dutch liquidity could be considered gaps. The relative low liquidity in peak products could also give rise to a gap if these were actively demanded. Yet we found only limited or no stakeholder demand for peak products. For completeness we review all potential hedges where a gap could be present.

Table 8.1 Overview of potential gaps by hedging purpose

Hedge	Liquid Markets[44]	Demand	Potential Gap
For hedging a cross-border position			
TSO congestion rent	Limited	Remit of regulators[45]	Remit of regulators
Norwegian CfDs	No	No	No
Dutch forwards	Limited	No	No
Shape risk	Limited	No	No
For hedging a position within own market			
Norwegian CfDs	No	Yes	Yes
Norwegian forwards	Yes	Yes	No
Dutch forwards	Limited	Yes	Yes
Shape risk	Limited	Limited	No
For hedging a position across the border			
Spread NL-NO/ NL-SYS	No	Yes	Yes

8.2 Exposure of TSOs to price risk

The congestion rent on NorNed is set by the outcome of the implicit auction in the coupled day-ahead markets. Capacity owners, and in the case of TSOs ultimately rate-payers, are therefore exposed to price risk for the spread between the Netherlands and the Kristiansand price area. Annual revenues for NorNed are accordingly uncertain and expected to vary with market movements. Financial transmission rights that entitle the holder to future congestion rents can swap floating for fixed revenues and therefore provide a hedge for the capacity owner. Because this consideration assumes a TSO perspective it is qualitatively different from cross-border hedging considerations, which focus on the needs of market participants. However, for TSOs as stakeholders this is a relevant category, especially if changes to current hedging arrangements are considered.

One stakeholder TSO found that it was best placed to bear the price exposure to day-ahead variations and that consumers would in fact be negatively affected by transferring price risk and associated risk premiums to FTR holders.

The price of FTRs at issuance of course cannot be known. Generally, however, the value of transmission capacity is driven by the structural price differentials between markets (intrinsic value), and the volatilities and correlation of prices in those markets (extrinsic value). The expected intrinsic value can be quantified based on the difference of the forward curves for the respective markets and represents the minimum value that market participants should be willing to bid for a (fully firm) FTR. The capacity owner could in

44 Liquidity carries the meaning defined in the liquidity analysis in section 6, i.e. comprising factors pertaining to product availability, market depth and costs.

45 Whether there is demand from TSOs for hedging their congestion revenue depends significantly on the regulatory view as to risk allocation, i.e. if consumers or markets are best prepared to carry revenue risk due to price volatility.

theory already hedge the intrinsic value by taking opposing forward position in financial markets (and carry the Norwegian locational basis risk in the case of NorNed), subject to liquidity constraints in forward markets. (In practice, of course, this would be a severe change from current practices in the Netherlands and Norway, where TSOs are strictly separated from commercial market activities.) However, this will not capture the extrinsic value of capacity. A competitive auction for FTRs might be expected to set prices that reflect this extrinsic value.

The intrinsic value, however, is the minimum revenue expected to be generated by FTRs, and we have used this to perform a simple analysis comparing revenues with no FTRs to those with FTRs on a historic basis. Table 8.2 shows the hypothetical congestion rent of a 700 MW interconnector between Kristiansand and the Netherlands from 2008-2011. Congestion rents from implicit auctions are simply the sum of historic price spreads multiplied by the transmission capacity assuming no losses and full availability. Rents are split between the direction of flow, i.e. rent arising from flows to Norway to the Netherlands (NO-NL) and vice versa.

For the case of transmission rights, some simplifying assumptions are made. It is assumed that the capacity owner would issue an FTR option for a third of capacity as a year-ahead product and another third on a monthly basis, and continue to market the remaining third in the day-ahead markets. A similar splitting of transmission capacity is for example practiced for PTRs on the Dutch-German border. Horizons of course depend on the objective and transmission rights could also be sold in for longer terms, for example if TSO revenue hedging was the primary objective. For the present example, in Table 8.2 the revenue from FTRs is expressed as the value of the spread in forward curves for the respective delivery period. For example, the revenues under FTRs for the year 2009 represent the average spread in the Dutch and Nordic year-ahead forwards traded during 2008. The forward curve for the Nordic market refers to the system price and for NorNed a further adjustment in bids would be expected for the Kristiansand area price.

The results of this simplified analysis are noticeable for several reasons. First, it is clear that year-on-year revenues fluctuate considerably with this pattern of FTR allocation. Moreover, while the proportion of revenues that are certain a year in advance exceed the share of capacity allocated to year-ahead products in 2010, it falls well below in 2008 and 2011 – driven of course by the movement in prices between forward and outturn. Second, the revenues under FTR allocation vary considerably from actual congestion rent arising in the day-ahead, between 56%-121% for the example period. Again, this is a result of the movement between the forward curve and outturn prices. For example, in 2009 the forward curve indicated expected flows from Norway to Netherlands but outturns favoured the reverse direction.

Table 8.2 Indicative revenues under Day-Ahead and Forward allocation [€m]

	NO-NL	NL-NO	Sum	SYS-NL			NL-SYS			Sum	Ratio
Year	DA	DA	DA	Y+1	M+1	DA	Y+1	M+1	DA	FW	FW/DA
2008	195.89	5.96	201.85	30.75	54.01	65.23	0.00	0.00	1.98	151.98	75%
2009	48.28	15.06	63.34	44.09	11.50	16.08	0.00	0.00	5.02	76.68	121%
2010	11.58	44.99	56.57	29.27	0.00	3.86	0.00	13.13	14.98	61.23	108%
2011	59.67	23.25	82.92	8.89	9.53	19.87	0.00	0.00	7.74	46.03	56%

8.3 Norwegian CfDs and basis risk

The analysis of current hedging opportunities has demonstrated that CfDs for NO2 are unavailable and largely illiquid for NO1. Stakeholders confirmed this finding. The question of Norwegian CfDs for hedging purposes within the Nordic market is outside the scope of this study. However, the unavailability of this product would limit the effectiveness of a hedge on the NorNed spread constructed in financial markets, because the area price risk between the relevant Kristiansand price area and the Nordic system price remains exposed.

This shortcoming in hedging effectiveness was noted by several stakeholders but not all agreed this was a gap because of lack of hedging demand. One producer specifically referred to the unavailability of CfDs as a cross-border hedging gap, whereas two consumers and one other producer were more concerned that this illiquidity represented a gap in their hedging opportunities within the Nordic market.

Without holding a Norwegian CfD a market participant wishing to hedge the price spread between NL and Kristiansand (NO2) is exposed to the price variation between the Nordic system price purchased in the forward market and the NO2 area price. Market participants based in the Oslo area are similarly exposed to the price difference between NO1 and the system price (and other market participants to the spread to their respective price area). Participants from Kristiansand have the option to replace the NO2-system price basis risk with a NO2-NO1 basis risk by purchasing a NO1 CfD. This may be warranted as Kristiansand is correlated more strongly to Oslo than to the virtual system price.[46] However, there also have been short periods of very high divergence between NO2 and NO1, for example averaging around €23/MWh in February 2010.

The magnitude of the exposure to area price risk can be illustrated by way of example (results summarised in Table 8.3). From January 2010 (when NO2 was split off from NO1) to September 2012, the average hourly price difference between the Nordic system price and the NO2 area price was €1.91 (SYS-NO2). Monthly averages however varied between -€2 and €13 over the same period, with a monthly standard deviation of €3.30/MWh. For a large consumer with a monthly demand of 100 GWh this translates to a risk of monthly cost variation in the amount of €330,000 (at one standard deviation). Given that the average hourly price of NO2 was €42.72 over the same period, the unhedged area price exposure towards the system price would represent about 7.7% of electricity costs. The same unhedged area price risks can be calculated for participants located in other price areas.

Similarly, if the NO2 participant had purchased a NO1 CfD, substituting area price risks, the monthly standard deviation would have been €4.51/MWh or 10.5% of energy costs. This would mean that the basis risk for the NO2 participant would have actually increased by holding a NO1 CfD. However, the standard deviation may not be a good measure for the NO2-NO1 relationship since the distribution of spreads is characterised by extreme outliers.

It is therefore not currently possible to hedge the area price risk between NO2 and the system price. This reduces the effectiveness of a cross-border hedge. If NO1 CfDs were sufficiently liquid, it would be possible to replace this basis risk with another, NO2-NO1, which historically is characterised by a higher correlation but with significant divergences in some periods.

[46] Since NO2 split off from NO1 in January 2010, the correlation with NO1 has been 0.974 compared to 0.956 with the system price.

Table 8.3 Basis risk for hedge without Norwegian CfD

Basis risk	Average Spread	Monthly STDEV	Monthly exposure at 100 GWh	Average Home area	Percentage of Cost
SYS-NO2	€1.91/MWh	€3.30/MWh	€330,000	€42.72/MWh	7.7%
NO2-NO1	€-1.52/MWh	€4.51/MWh	€451,000	€42.72/MWh	10.5%

8.4 Dutch forwards and basis risk

The analysis of current hedging opportunities has illustrated that liquidity in the Dutch market is declining. Stakeholders confirmed this finding but disagreed about its significance. Limited liquidity in the Dutch market would limit the effectiveness of a hedge on the NorNed spread constructed in financial markets, because the availability of products on one side of the interconnector may not match the needs of market participants.

Stakeholders have suggested that hedging in long-term hedging products is migrating across the border to Germany, which offers higher liquidity. However, although market coupling is in place between the Netherlands and Germany, price correlation is not perfect and accordingly basis risk would apply.

An example similar to Norwegian CfDs can therefore be constructed for the basis risk between Germany and Netherlands (results summarised in Table 8.4). The mean price difference between the Netherlands and Germany has been €2.10 (NL-DE) since market coupling took effect in November 2010 with a monthly standard deviation of €1.78. For a large consumer with 100 GWh monthly demand this translates into a risk of monthly costs varying by €178,000, or, considering average Dutch prices of €50.19, the equivalent of 3.5% of energy costs. As illustrated in Figure 5.17, recently price convergence has been challenged especially by price collapses in Germany. Basis risk may therefore represent a challenge if a short Dutch position is hedged by buying forward in Germany and price collapse for example through excess renewable generation during the delivery period imperfectly translates onto the Dutch day-ahead market.

It is currently possible to manage basis risk between the Netherlands and Germany with PTRs. Limitations apply in the form of restricted time horizons and capacity constraints. Currently PTRs offered through CASC are auctioned for the year-ahead and the month-ahead. Capacity offered for the year-ahead 2013 is 416 MW in each direction and for the month of December 2012 another 377 MW for Germany to the Netherlands and 252 MW in the reverse direction.

Table 8.4 Basis risk for hedging a Dutch position in Germany (post-coupling)

Average Spread NL-DE	Monthly STDEV	Monthly exposure 100 GWh	Average NL	Percentage of Cost
€2.10/MWh	€1.78/MWh	€178,000	€50.19/MWh	3.5%

8.5 Spread product unavailability (Bridge-to-Liquidity)

Two producers mentioned a desire to hedge a physical position in one market using products available on financial markets in another, citing a motivation to hedge their positions on the most liquid markets within the region. This would for example be beneficial if it allowed participants to hedge out for longer time horizons than is possible in their home markets or generally lowered the costs of a hedge. A product deriving from the spread between the home market and the pertinent reference price at the target financial hub can in this sense serve as what we term a “bridge to liquidity” for participants.

Such a hedge represents a trade-off between lower hedging costs and the effectiveness of the hedge. A participant would benefit from lower bid-offer spreads on the more liquid market (ignoring exchange fees). Consider a consumer with an annual demand of 1 TWh and a hedging strategy to hedge 100% of its year-ahead demand, 50% of its demand two years in the future and 25% for three years. In the Dutch market, the consumer would have encountered bid-offer spreads on APX-ENDEX of €0.26/MWh for the year-ahead (0.5%), €0.31/MWh for two years ahead (0.62%) and €0.37/MWh for three years ahead (0.74%) (all values as of September 2012). If we consider half of the spread as transaction costs for the consumer then this would amount to €150,000. Had this hedge been placed in February 2012, when bid-offer spreads ranged from 1.1-1.9%, the same transaction would have incurred costs of €620,000. On NASDAQ OMX, the consumer would have encountered €0.08/MWh for the year-ahead (0.2%), €0.16/MWh for two years ahead (0.40%) and €0.10/MWh for three years ahead (0.25%) (as of November 2012). For the same hedge this amounts to transaction costs of €52,500, equivalent to 35% of the costs on APX-ENDEX.

Table 8.5 summarises these results. The example shows that hedging in a more liquid market lowers the cost of hedging for a market participant.

Table 8.5 Cost savings from hedging in more liquid market

Hedge	Quantity	Spread APX	Transaction Cost APX	Spread OMX	Transaction Cost OMX	Ratio OMX/APX
Y+1	0.5 TWh	€0.26/MWh	€65,000	€0.08/MWh	€20,000	31%
Y+2	0.25 TWh	€0.31/MWh	€38,750	€0.16/MWh	€20,000	52%
Y+3	0.25 TWh	€0.37/MWh	€46,250	€0.10/MWh	€12,500	27%
Sum	1 TWh	-	€150,000	-	€52,500	35%

However, hedging in a financial market referencing to a different underlying physical electricity price than that to which the market participant is exposed also introduces basis risk. If a Dutch producer for example hedged their home generation on the Nordic financial market this would introduce locational basis risk, lowering the effectiveness of the hedge. This can again be expressed in terms similar to the previous two examples (results summarised in Table 8.6). From January 2008 to September 2012, the average hourly price difference between prices in the Netherlands and the Nordic system price was €8.40 (NL-SYS). Annual averages however varied between -€7.68 in 2010 and €25.32 in 2008, with a monthly standard deviation of €13.88 over the five-year period. For a producer with 100 GWh of monthly generation, revenues are at risk to vary by €1,388,000 per month (at one standard deviation). Given that the average hourly price in the Netherlands was €50.90 over the same period the unhedged area price exposure would represent about 25% of electricity revenue.

A hedging instrument that would increase the effectiveness of the hedge by removing the locational risk would be worthwhile if the costs of acquiring it were less than the savings from hedging in the more liquid market.

Table 8.6 **Basis risk for hedging a Dutch position in the Nordic market**

Average Spread NL-SYS	Monthly STDEV	Monthly exposure 100 GWh	Average NL	Percentage of Cost
€8.40/MWh	€13.88/MWh	€13.88m	€50.90/MWh	27.3%

8.6 Shape risk

A gap in shape risk would occur if participants were unable to access peak load products where needed to hedge their consumption/production profile. In the Nordic market, stakeholders confirmed that the illiquidity in peak load forwards corresponds to a lack of demand and hence no gap is present. On the Dutch side, participants did not mention shape risk as a concern or managed peak supply through bilateral contracts. Peak load products are also largely unavailable on the Dutch market but more available on the German market, especially in the shorter term. Dutch participants looking for shaped products may therefore find these on the German market, with basis risk applying.

In other words, shape products are provided only to a limited extent. Yet shape risk was not identified as a gap in our stakeholder interviews. We therefore do not carry it forward beyond a brief assessment in considering the impacts of options in section 9.

8.7 Conclusion

In this section we reviewed the materiality of potential gaps. The first potential gap referred to the current unavailability of an appropriate instrument to hedge TSO congestion revenue (other than financial markets in which TSO involvement is currently not practiced). Whether the lack of hedging opportunity constitutes a gap depends on the viewpoint of the TSO and regulators. The analysis however showed that revenue certainty is limited even if FTRs with similar terms to PTRs (and the international examples of FTRs) were introduced.

We also quantified the expected materiality of basis risk that would apply if gaps were present for Norwegian CfDs and Dutch forwards. In both cases locational basis risk would apply.

If cross-border hedging between NL and NO2 were demanded, it would currently not be possible to construct a perfectly effective hedge between NL and NO2 in financial markets. This is because it is currently not possible to hedge the area price risk between NO2 and the system price. Holding a NO1 CfD would potentially reduce this risk exposure but our example showed that while correlation is historically higher, large divergences in some periods still lead to significant exposure to area price risk.

If Dutch forwards were not available at acceptable liquidity then basis risk ensues if hedges are transferred to the German market, whose reference price is not perfectly correlated with Dutch prices.

In both cases a lack of demand for Norwegian CfDs and Dutch forwards for cross-border hedging purposes prevents them from presenting a gap.

Hedging a NL position on NASDAQ OMX under a bridge-to-liquidity would reduce the costs of hedging but also introduce high locational basis risk. The availability of a spread instrument could hedge this basis risk and allow for hedging across the border. Because such an instrument was demand by two producers we consider a gap present for these purposes.

9 Options for Addressing Identified Gaps

9.1 Introduction

The previous section has identified potential gaps in current hedging opportunities. In this section we introduce options for addressing these potential gaps and provide a chiefly qualitative evaluation.

Where financial markets do not provide appropriate hedging opportunities, the FG on CACM foresee the introduction of transmission rights. More generally, however, gaps in current opportunities could be addressed in at least two ways, namely by either improving existing instruments or introducing new instruments. The following options for intervention are considered in detail:

- **Liquidity intervention:** A direct intervention to raise liquidity where this is not adequately provided by existing financial markets.
- **FTRs on NorNed:** A financial derivative of the price spread between Netherlands and Kristiansand issued by the NorNed capacity owners.
- **CfDs on NorNed:** An exchange-listed financial derivative of the price spread between Netherlands and Kristiansand (or the Nord Pool system price) traded between market participants.

This section will accordingly introduce these options and describe their effects on the hedging gaps identified in the previous section. A high level impact assessment weighing costs and benefits follows in the next section.

9.2 Description of options

9.2.1 Liquidity intervention

Where the potential gap is related to a lack of liquidity in an existing product, direct intervention to raise liquidity is a potential option. In the case of Norwegian CfDs, this may also include the introduction of a NO2 CfD accompanied by a liquidity intervention.

A common technique to stimulate liquidity is that of a designated market maker. Market makers commit to maintaining bids and offers for a particular product on a continuous basis. Commonly, exchanges facilitate market making by tendering for a market maker, which can be remunerated through bid-offer spreads and trading discounts. Another means would be a market arrangement or regulation under which market participants, for example large producers, offer a minimum amount of contracts. Finally, incremental changes to the specification of traded products, or means of execution, may also increase their attractiveness. If for example a hedge involves multiple legs, “combo” products with simultaneous execution of two transactions (i.e. opposing forwards in two markets) can lower execution risk and transaction costs.

Potential effects of intervention

TSO congestion rent

Overall the application of a liquidity intervention to the hedging of congestion rent is very limited. There is no existing product to hedge the extrinsic value of the interconnector capacity and hence no opportunity for an intervention. Current opportunities to hedge the intrinsic value in forward markets could improve, but these opportunities are currently not available to TSOs.

Basis risk and hedging effectiveness

A liquidity intervention does not create any additional hedging products. Hence it can only increase hedging effectiveness if it permits market participants to purchase additional products by lowering cost of hedging and improving product availability.

Cross-Border Hedging

A liquid market for CfDs on the spread between NO2 and the system price would allow participants to cover area price risks in replicating a cross-border hedge in the financial markets. This would require the listing of a Kristiansand CfD and consequent market making.

More generally, the decision whether to hedge a risk is determined by the materiality of the risk and the costs of hedging it. At the current costs of NO1 CfDs, for example, many market participants seem prepared to accept a partially effective hedge for domestic hedging and to carry the locational basis risk (as implied by the low trading volumes).

If elevated liquidity levels were to reduce the costs of hedging, a higher uptake of more effective hedges comprising CfDs can be expected.

Low liquidity in forward products in the Netherlands may reduce a participant's ability to hedge out several years in advance. If Germany is used as an alternative this reduces hedging effectiveness by introducing basis risk. A liquidity intervention in Dutch forward products would address this problem directly and may remove the need for a bridge to liquidity. However, any intervention would need to involve a very wide range of products to be effective, which may not be feasible.

Bridge-to-Liquidity

In order to hedge the spread between Netherlands and Norway, it is currently necessary to take financial market positions on both sides of the interconnector. This of course would contradict a hedging strategy with the objectives of using the non-home financial market only. Increasing liquidity in existing markets is therefore not necessarily relevant. However, if liquidity were increased in the home market more generally then this would lower the advantage of hedging elsewhere.

In sum, options to improve existing instruments are mainly relevant to potential gaps in Norwegian CfDs and shape products, and to a lesser extent for liquidity in the Dutch market. Existing instruments are insufficient to address potential gaps related to the hedging of extrinsic congestion rents by TSOs and hedging of home positions in foreign financial markets.

Shape risk

A similar liquidity intervention as described above could also be considered for shaped products.

9.2.2 FTRs on NorNed

An alternative to hedging on existing financial markets are financial transmission rights, which are currently not available on NorNed.

FTRs are purely financial products and give the holder the right to the revenue generated by the congestion rent on the interconnector for the amount of capacity purchased. The instrument thus provides a direct derivative of the price spread between the markets connected by the transmission link. The characteristics of FTRs vary with different design formats, which were evaluated in detail in section 4.

Potential effects of intervention

TSO congestion rent

A distinguishing feature of FTRs is that they are issued by the original holder of the capacity and congestion rent, chiefly TSOs or subsidiary entities. FTRs would accordingly allow TSOs to hedge the expected value of transmission capacity. However, if participants calculate a risk premium into their bids then the price received by TSOs for revenue certainty may be lower than expected revenues in the long-term.

Assuming that power markets on both sides of NorNed are competitive, without any hedging by TSOs, both the upside and the downside risk to NorNed revenue would ultimately be faced by consumers in the Netherlands and Norway. Since the exposure of the two sets of consumers is mostly to their domestic market's power price, the benefit to the consumer of hedging NorNed revenues would be determined by the correlation between NorNed revenues and power prices in the two connected markets.

We have checked the linear correlation between the NorNed congestion revenue and the market positions of consumers in the Netherlands and Norway, which we define as a short position in the local market spot power price. This was done for the period between May 2008 and September 2012 and ignores interconnector outages and thermal losses. The correlation coefficients are -0.66 for the Netherlands and -0.43 for Norway. Given the large sample size with thousands of observations and the relatively high correlation coefficient this finding can be seen as statistically significant.[47]

The finding suggests that congestion rent on the NorNed interconnector provides a partial hedge for the market position of both sets of consumers in the connected markets. This is because higher congestion rent for TSOs will lower the amount of network costs to be recovered through network tariffs. This is ultimately a financial benefit to market participants. In other words, the risk of a market price increase is partially offset by lower network charges that would ensue from such a price increase (because of higher congestion revenues).[48] This effect will be larger for FTRs with longer time horizons and smaller for short-term FTRs as the frequency of price adjustments increases. While we have not quantified the magnitude of potential network tariff savings, this result suggests that the benefit of hedging of NorNed revenues (i.e. TSO revenues) for Dutch and Norwegian consumers may be limited. We note however that market participants gain the ability to replicate this natural hedge by purchasing an FTR and therefore are not worse off than before.

Basis risk and hedging effectiveness

Cross-Border Hedging

A derivative of the congestion rent on NorNed would allow market participants to directly hedge any cross-border exposure between the Netherlands and Norway without recourse to financial markets. This can increase hedging effectiveness as the potential gaps related to Norwegian CfDs and Dutch forwards, which may introduce basis risk to the cross-border hedge, are avoided.

FTR obligations can offer a full hedge for the purposes of cross-border hedging between the Netherlands and the Kristiansand NO2 price area. A full hedge in this sense means that obligation holders would be indifferent to any changes in the spread between the two price areas as any losses in the underlying physical cross-border position are offset by financial gains from the FTR obligation and vice versa. Basis risk would

47 In a two-tailed test with 1000 observations, a correlation coefficient of greater than 0.08 is statistically relevant at a 99% confidence level.

48 This assumes that congestion revenues from interconnection are at least in part eligible to offset other system costs. There may be time lags also.

apply for hedges from participants outside the NO2 price area. While not limiting the effectiveness of an individual hedge, the fact that FTRs are constrained by the underlying physical capacity of the asset (plus netting effects in the case of obligations) can limit the overall impact on the market.

FTR options could also be used to replicate a full hedge but this requires a more complex arrangement. FTR options can only provide a full hedge for a cross-border position if market participants, other than the owners of interconnector capacity, are allowed to take a short position in FTR options. This is likely to be possible in secondary markets only where market participants enter a financial trade that mirrors the properties of an FTR option issued by TSOs. Having purchased an FTR option from the TSO, a market participant could sell a financial option with the inverse payoff structure to another market participant. Combined, the two option products replicate the payoff structure of an obligation. Note that the TSO risk exposure is unchanged as the second option is traded between market participants only. There are several reasons why a market participant may want to fully lock-in his underlying position, combining two options, rather than simply hedging the downside risk. One reason is that FTR options are likely to be more costly as they incur a premium. Selling a financial option may offset these costs as the market participant also earns a premium. A second reason is that, once the FTR option is in place, the expected outcome is now higher (ignoring the cost of the premium), and there is downside risk against this that participants may wish to hedge.

Replicating an FTR obligation with options is therefore more complex. However, other market participants may be perfectly content with the partial hedge against downside risk offered by FTR options.

Note that there can still remain some downside risk with an FTR option when a hedge is desired for the direction against the usual flow of the interconnector. For example for a position that is long in the Netherlands and short in Norway the appropriate hedge would be an option defined to pay out for flows from NL to NO2. However, this option would not pay out until the price differential reverses. If there is a structural or normal price difference between two market areas than the higher price area cannot fully hedge this difference by buying a FTR option, as there is still exposure to movement in the spread above zero. Consider a case where the expected price difference NL-NO2 is €10/MWh and an FTR option is bought for congestion rent from NL to NO2 direction (the reverse of the implied flow). If the price difference reduces to €5/MWh, the market participant (long in NL and short in NO2) makes a loss on his physical position. However, the flow direction is still the same and his FTR option does not pay out. The downside risk between the structural spread (€10/MWh in this example) and the reversal of flow trigger a payout of the option is uncovered.

Bridge-to-Liquidity

An FTR on NorNed can serve as bridge to access liquidity in the financial markets on either side of the interconnector. However, it would of course only be a perfect hedge for positions in the Kristiansand price area. For positions in other locations there would still be a locational basis risk to the Nordic system price (without a matching CfD).

Shape risk

Assuming that FTRs are settled hourly, FTR options allow participants to manage separately peak and off-peak price differentials for the specified direction of flow. Present examples of FTR obligations function in a similar manner to CfDs in that they capture the daily average spread (even if settled hourly) and would thus not allow for managing shape. However it should in principle be possible to offer shaped FTRs, especially in secondary markets where participants can re-cut the rights held by them.

9.2.3 CfDs (NL-Nordic System price)

CfDs are very similar to FTRs in that they constitute derivatives of the price spread between two markets (but without the need for a physical connection). The key difference is that CfDs are bought and sold by market participants whereas FTRs can only be issued by the capacity owner.

CfDs are in essence listed spreads traded on exchanges or OTC. The underlying asset is the price difference defined in one direction with one party agreeing to pay the positive or negative average daily price difference to the other during the delivery period. CfDs are currently the main instrument to hedge area price risk in the Nordic market.

The concept, however, is in principle applicable to any price area, including the Netherlands as a price area. A CfD for the price difference between the Netherlands and Kristiansand, or between the Netherlands and the Norwegian system price, could for example be introduced as a listed financial product on an existing exchange (such as NASDAQ OMX or APX-ENDEX) as a type of "virtual FTR".

A combination trade for Dutch and Nordic forwards offered on the same exchange would be similar. A combination would join two offsetting trades in a single transaction (thus removing execution risk and reducing transaction costs). Yet because there is no single liquid market for both Dutch and Nordic forwards at either exchange, a CfD appears to be the more relevant variant.

A key difference between a CfD and an FTR is that the counterparty to the basis risk hedge would be a market participant and not the transmission capacity owner. This is an important caveat since price volatility related to transmission outages may be outside the comfort zone of market participants, as firmness risk arising with outages can be considered outside their control or understanding. Whereas with FTRs there is a natural seller of capacity in the form of the transmission owner, with CfDs capacity availability depends on market views of the instrument and its risks. The flipside of this is the potential for a deeper market in CfDs since the financial product is not constrained by the asset capacity.

An extension of this approach would be to introduce CfDs on a European level. This would be akin to exporting the Nordic model to the Continent in that it would engender a small number of price hubs, tied to a specific central location or virtual point. Liquidity would concentrate on central hubs for forward hedging, with CfDs assuming the role as area price hedges. For example, in such a model a Dutch stakeholder could hedge against a Northwestern European reference price and manage area price risk with a CfD for the spread to the Netherlands. However, such a solution would not seem to be consistent with the spirit of the draft FG on CACM which envisages transmission rights as the primary solution.

Potential effects of intervention

TSO congestion rent

In principle a CfD on NorNed would enable TSOs to hedge congestion rent by selling forward the instrument on financial markets (in both directions). Therefore, if TSOs could sell CfDs between the Netherlands and Kristiansand, this would hedge congestion rent from the perspective of the capacity owner. However, CfDs as financial contracts are expected to be fully firm, which would introduce availability risk from the TSO viewpoint. Moreover, selling CfDs would require direct TSO participation in financial markets which significantly deviates from current arrangements.

Basis risk and hedging effectiveness

Cross-Border Hedging

For cross-border hedging, a CfD on the price spread between the Netherlands and Kristiansand would have the same effects as an FTR obligation, i.e. providing a perfect hedge. For market participants based in other price areas, locational basis risk would apply.

A CfD, as currently used in the Nordic market, is functionally equivalent to an obligation. Yet theoretically it is also possible to think of a CfD that was designed as an option product. Two such CfD options (one sold short) could similarly replicate the payout structure of an obligation, as discussed for FTRs above.

Bridge-to-liquidity

Considering that stakeholders in this study desiring a spread instrument were chiefly interested in building a bridge to liquidity, arguably the most appropriate CfD would directly connect the physical price in the home market and the financial reference price in the target hedging market. For stakeholders with physical positions in the Netherlands this would be a CfD on the spread between the Nord Pool system price and the Dutch market price (CfD SYS-NL). For stakeholders in the NO2 area, this is a CfD NO2-NL (equivalent to the NorNed spread). For Nordic stakeholders outside the NO2 area, the ideal CfD accordingly depends on the relative correlation of their respective area price to the system price and NO2 price.

A system of European CfDs around central liquidity hubs would also be congruent with the motivation for a bridge to liquidity, as it permits both hedging outside the home area and managing area price risk with a spread product. Hedging transactions could for example focus around a Continental hub and a Nordic hub (potentially with CfDs linking spreads between hubs).

Shape risk

CfDs for NorNed could also be listed for different time blocks, allowing hedges to account for curve shape. Since CfDs are obligations, shaped products become more relevant if spreads are very variable.

While it would be possible to design a shaped CfD NL product, the lack of liquidity in existing peak load products in both the Nordic and Dutch markets suggest that liquidity would be challenging.

On a European level, a highly liquid hub for forward trading would potentially also generate liquidity in long-term shape products. Area price basis risk would remain if CfDs are settled against base load prices, however.

9.3 Summary of options

In summary, a liquidity intervention can increase hedging effectiveness indirectly if it improves the liquidity of existing products. It does not relate to TSO hedging of congestion rents as no additional product is introduced. It cannot provide a bridge-to-liquidity but theoretically removes the need for this if liquidity in the home market were increased to the levels found elsewhere.

The impacts of an FTR on existing products, whilst important for other reasons, are not relevant for cross-border hedging. This is because an FTR would in fact remove the very need to use financial markets for this purpose. A FTR in this sense renders potential gaps in financial markets redundant because it substitutes these instruments. It provides a bridge-to-liquidity but only to the NO2 price area. Basis risk to the Nordic system price would apply.

CfDs between the Netherlands and the Nordic area (NO2 or SYS) can theoretically aid TSO congestion hedging, but such market transactions would change the current TSO governance significantly. Such a CfD would also replace cross-border hedging in financial markets and render gaps related to Norwegian area price CfDs and Dutch forwards redundant. It can provide a bridge-to-liquidity, but, as a financially firm contract, places firmness risks with the market participants issuing such CfDs.

FTRs would enable TSOs to hedge congestion rent.

Table 9.2 summarises the ability of different options to address hedging gaps.

Table 9.1 Overview of Potential Options against Hedging Gaps

Hedging Gap	Liquidity Intervention	FTRs on NorNed	CfDs on NorNed
TSO congestion rent	No	Yes	Limited
Norwegian CfDs (basis risk)	Yes	Redundant	Redundant
Dutch forwards (basis risk)	Limited	Redundant	Redundant
Shape risk	Yes	Limited	Limited
Bridge-to-Liquidity	Limited	Yes (with basis risk)	Yes (with outage and potentially basis risk)

10 Stakeholder views on options

In the previous section we introduced three options In this section we present evidence from the stakeholder consultation with reference to preferred options and instrument design.

Stakeholders were also consulted on the possible introduction of FTRs on NorNed, including potential design elements. Only three responses indicated active support for introducing FTRs. If FTRs were introduced, stakeholders would favour options with tenors up to three years. There were diverging views on the firmness of FTRs and the related question of TSO market participation.

Support for FTRs generally hinged on the views market participants held on current hedging gaps. In fact, the opinions in favour or against FTRs exactly align with views on existing gaps, with three market participants supporting the introduction of FTRs and eight opposing (see section 7).

Four stakeholders also made suggestions for alternative instruments to be introduced instead of FTRs. This included suggestions for introducing a listed spread for the NorNed cable (in the form of a CfD). An exchange commented that, "if there was a demand for the NL-NO spread you could easily create a CfD for Netherlands to the Nordic system price, a virtual FTR". Two consumers from the Netherlands and Norway also argued that the introduction of a European-wide CfD variant around central reference prices was generally preferable to FTRs for hedging purposes. One consumer commented that it was "not sure if FTRs are the best instrument compared to CfDs with European price hub ... the most attractive model is to have a European reference price to hedge long-term, supplemented by area CfDs that are used to hedge basis risk more short-term."

Figure 10.1 Stakeholder views on options and FTR design

Strong Trend	Trend	No Trend	N/A

	Yes	No	Unsure	No Opinion	No statement
Options					
In favour of introducing FTRs on NorNed	3	8	3	1	-
Proposed other new instruments	4	11	-	-	-
FTR Design					
Favour options (no for obligations)	6	2	1	1	5
Tenors should exceed 1 year	4	2	2	-	7
FTRs should be fully firm	6	4	-	-	5
Comfortable with TSO participating in market	4	6	5	-	-

We asked stakeholders to indicate their preferences on FTR design elements even when they opposed them generally. Most participants would favour options over obligations, but cited varying reasons. One producer commented that "options as a hedge against losses are the concept most generators are familiar with, and use of obligations would be limited." An exchange suggested that "options are preferable because of limited risk involved".

Of the stakeholders with an opinion on FTR tenors the majority favoured an alignment with forward markets, i.e. tenors of up to three years. A TSO viewed FTRs limited to a year-ahead product as more feasible. A producer commented that one year is adequate from a hedging perspective but that longer periods may be interesting for trading.

Firmness was a contentious issue. A fully firm model was generally supported by traders and exchanges but TSOs took the opposite view. An exchange noted that "full firmness is crucial from a trading standpoint". A TSO disagreed, stating that "it is usual that firmness is never 100% in the long-term … firmness should only apply to intraday with a compensation arrangement applying before the firmness deadline". Producers generally saw firmness as desirable, but had split opinions about the applicability for a subsea cable such as NorNed. Some were willing to accept partial firmness whereas others said they would not consider a product that was not fully firm. One producer for example commented that "products that are not fully firm are not interesting to financial players and thus new players will not be attracted to market." Another commented however that "subsea cables are different and you cannot ask for a guarantee that's impossible to give".

Many stakeholders held strongly negative views on any market participation by the TSOs, grounded in concerns about asymmetric information problems, complex regulatory requirements and the organisational independence of TSOs. One producer commented that "TSO trading in secondary markets or buy-back is definitely not something you want to have … either the TSO games the market or the market games the TSO". Others felt that TSO market participation can be regulated and their participation is necessary for TSOs to manage their own exposure to firmness risks. One producer held the view that "TSOs should be allowed to manage the risks arising from issuing FTRs, for example by inserting buy-back options from the start or if necessary operating in the secondary market … Transactions should be transparent and monitored".

11 Impact Assessment of Options

11.1 Introduction

In this section, we present our assessment of the alternative options identified in section 9 against the following criteria:

- cost of hedging (cost savings and implementation costs);
- market efficiency and liquidity; and
- competition.

The assessment is largely qualitative in nature, with elements of quantitative assessment where appropriate data is available for this purpose.

11.2 Assessment of options against principles

11.2.1 Cost of hedging

Change in hedging cost for market participants

Changes in the cost of hedging as a result of new cross-border hedging instruments can occur for two reasons.

- Savings can accrue from lowering the costs of hedging cross-border positions. This is primarily applicable to new instruments for direct cross-border hedging, i.e. FTRs or CfDs, which would replace other hedging instruments.
- Introduction of new hedging instruments can change liquidity of existing financial instruments, which may change transactions costs for participants who do not trade the new instruments.

If purchasing an FTR or CfD for a certain hedge is cheaper than taking two or more financial positions on the relevant exchanges or OTC markets, a saving would be realized if these additional instruments are introduced.

Example:

Consider the case of a Norwegian producer wishing to hedge a supply contract with a Dutch consumer for the delivery of 1 TWh of base load power for the next calendar year. The producer has a short physical supply position in the Netherlands and a long generation position in the Kristiansand area in Norway. To hedge the exposure to price spread risk between the two markets, the producer correspondingly buys 1 TWh forward on APX-ENDEX and sells 1 TWh forward on NASDAQ OMX (OTC markets are not considered for simplicity).

Transaction costs are determined by exchange fees and bid-offer spreads. Fees of €0.004/MWh on NASDAQ OMX and €0.01/MWh on APX-ENDEX yield a cost of €14,000. Bid-offer spreads for the year-ahead (€0.26/MWh on APX-ENDEX and €0.08/MWh on NASDAQ OMX) add €170,000 to costs (see section 8). Note that the basis risk between Kristiansand and the Nord Pool system price would remain unhedged.

A CfD for the spread between the Netherlands and Nord Pool would likely incur similar transaction costs to an existing product as it would be exchange-listed and subject to fees and bid-offer spreads. However, since the CfD would be the only product required for the generator to complete the hedge, transaction cost savings would result. If the CfD for NorNed were listed on NASDAQ OMX then this hedge could be placed for transactions costs of €44,000, i.e. realize cost savings of 76% on variable costs. Note that this assumes that the CfD would have similar liquidity to year-ahead contracts and have similar bid-offer spreads. For bridge-to-liquidity hedging the market participant would hold both a CfD and a forward product for the non-home market and thus face higher transaction costs than for cross-border hedging only.

FTR obligations would be similar to CfDs for hedging purposes in that they require only a single transaction. This is different for a long/short combination of FTR options. Assuming that trading and participation costs are similar to trading CfDs on exchanges, reduction in the cost of hedging for market participants can also be expected to be similar. With FTRs, cost savings arise also from the fact that there are no applicable bid-offer spreads – the clearing price of the FTR auction is by definition at or below a successful bid. However, given that auctions occur periodically, a large part of hedging is likely to be routed through secondary markets to match the timing of a hedge to hedging needs.

Change in liquidity and transaction costs

Changes in liquidity of existing financial markets as a result of introduction of new instruments can affect transactions costs for market participants that do not trade the new instruments. This effect can be positive or negative.

The potential for cost saving by hedging on more liquid financial markets outside of the home area (bridge-to-liquidity) has been assessed in section 8. However, the introduction of FTRs or CfDs may have additional effects on market liquidity. Substitution would occur if market participants who had previously hedged on one market, e.g. in the Netherlands or Germany, shift their hedging activity to another market, e.g. the Nordic market, raising liquidity in the latter and reducing it in the former. This additional influx of liquidity will likely have an impact on transactions costs through reduced bid-offer spreads.

It is difficult to assess what effect the introduction of new instruments is likely to have on the liquidity of existing instruments. Given the possibility of constructing a bridge to liquidity using cross-border hedging instruments, it appears likely that liquidity would shift to markets which are currently liquid with the introduction of such instruments. In the case of instruments relating to the NL-NO border, liquidity in the NL market may fall further and liquidity in the Nord Pool market would increase. However, this does not necessarily have a negative welfare impact on participants in the Dutch market if they are able to achieve their desired hedges in other markets.

Costs of implementation

CfDs on NorNed

A CfD between the Netherlands and the Nordic system price represents a new trading product. Preceding an introduction on the exchange platform this new product requires system testing and testing costs apply. Such testing costs can also accrue for market participants. An exchange commented that the implementation time for a new CfD requires several months or longer. A combination (of Netherlands and NO SYS trades) could be immediately introduced at no cost. Yet for a combination margining requirements are higher than with a CfD solution and the limitations discussed in section 9.2.3 apply.

Market making is a common procedure in support of newly introduced products. On-going costs could apply for market making if liquidity is not forthcoming spontaneously. The processes for designating market makers can differ. If specific stakeholders have an interest in a product being available then they may naturally have an interest in supporting this product. Tendering is also an option to designate a market maker but more difficult for small markets, as expected transactions and thus revenues for the market maker will be lower.

FTRs on NorNed

Depending on how the market prices FTR products there is also the potential for a value transfer from TSOs to FTR holders.

As described in section 8.2, the value of transmission capacity is driven by the structural price differentials between markets (intrinsic value), and the volatilities and correlation of prices in those markets (extrinsic value). For selling transmission capacity forward, the difference between market forward curves yields the intrinsic value and provides a price signal for the minimum price, whereas pricing for the mark-up for optionality and volatility is more uncertain. Moreover for the Kristiansand area prices, there is no clear market forward price. The Nordic forward price (potentially adjusted for NO1 CfD values as a proxy) yields only an imperfect estimate of the intrinsic value. It is therefore uncertain how market participants will price an FTR. If bids for example only consider the intrinsic value, or discount the expected extrinsic value by a risk premium, there could be a value transfer from TSOs to FTR holders over the long-term. A reserve price could limit the risk of such a value transfer.

For the issuing TSOs, FTRs on NorNed will carry implementation costs. These depend in part on the complexity of the design of the instrument and how auctions are administered. Generally, FTR implementation entails organisational changes on the part of the issuing party, the introduction of an auction platform with appropriate IT infrastructure and other costs such as system testing, technical documentation or auditing.[49] Costs for these items would vary between a stand-alone implementation of FTRs on NorNed and an embedded solution in a European process with standard processes and a common auction platform.

If a NorNed FTR were to be implemented on a stand-alone basis, one of the stakeholder TSOs expressed the view that costs would comprise the implementation cost at the auction office and a system to jointly determine available capacity between TSOs. It would also require TSOs to establish agreements on auction rules with market participants. A TSO gave a cost estimate of €1,000,000 for these one-off implementation costs but cautioned that further research would be necessary to verify this figure.

Under an embedded solution in the European context implementation costs could be lower. Savings could include the opportunity to link in to a common auction platform, as the FG on CACM stipulate that "TSOs shall provide a single platform (single point of contact) for the allocation of long-term transmission rights (PTR and FTR) at European level".[50] This can also reduce participation costs on the side of market participants. However, at the moment, neither the specifics nor the timetable of a Europe-wide implementation are certain. Also, in the case that a harmonized European solution disallows flexibility in FTR design, conformance costs for example with respect to regulatory changes resulting from firmness rules could arise.

International benchmarks can serve to illustrate previous experiences on implementation costs, although structural differences in market and FTR design limit comparability. New Zealand's planned introduction of FTRs in mid-2013 is perhaps the most appropriate international example. FTRs will be made available on a single line only to connect the North and South Islands of the country, thus limiting the complexity and scope of any required IT and auction infrastructure to a level comparable to a stand-alone solution on the NorNed cable. As FTRs will be made available both as options and obligations in both directions, four products will be available for auction. A differentiating factor is that both ends of the FTR fall within the grid area of the same TSO whereas two TSOs are jointly operating NorNed through a subsidiary. New Zealand's Electricity Commission has estimated one-off development and implementation costs at around

49 See e.g. New Zealand Electricity Commission, "Managing locational price risk proposal", 13 September 2010.
50 ACER, "FG on CACM", 29 July 2011.

€250,000 - €380,000.[51] It further estimates annual operation costs for system maintenance, invoicing, auction support and annual auditing at around €200,000-€300,000.[52] For market participants wanting to take part in auctions, the Electricity Commission estimates one-off costs of around €65,000 and running costs of around €50,000-80,000 per annum.[53]

A second data point for possible implementation costs is available from the US Midwest Independent System Operator (MISO) market. In 2008, MISO contemplated expanding its existing FTR scheme to include additional products and more complex product designs. For offering FTR options next to the existing obligations, requiring software enhancements and external and internal reporting, MISO estimated project costs of approximately €300,000 ($386,000). For the auctioning of FTRs beyond the one year horizon, requiring a feasibility study, software enhancements and reporting updates, MISO estimated costs of approximately €720,000 ($936,000). A crucial difference to NorNed of course is the higher requirements on a system supporting locational pricing with a large number of nodes and an even larger number of feasible flow combinations.

11.2.2 Market Efficiency and Liquidity

The three options impact on traded market efficiency through their effects on market liquidity. They may for example enable market participants to construct appropriate hedges where a lack of liquidity prevented them from doing so previously.

A liquidity intervention, if successful, would be expected to bring these benefits. Likewise, the introduction of new hedging instruments, i.e. FTRs or CfDs, would have a beneficial effect on market efficiency if their introduction would be complementary to liquidity in existing products. Yet it is also possible that FTRs and CfDs could compete with existing products and thus reduce liquidity in the latter. This occurs when FTRs or CfDs are used to substitute existing financial market products.

Liquidity intervention

Increasing the liquidity in existing products is the very objective of a liquidity intervention. This could for example be achieved through market making or, in the case of Norwegian CfDs, with arrangements under which large producers offer a minimum amount of contracts. Nordic forward contracts are not in need of an intervention and are thus not directly affected.

Since the potential gap of declining liquidity in the Dutch market transcends the specifics of individual products, stimulating liquidity through intervention may not be feasible. However, market developments may naturally reverse this trend, for example if market fundamentals move to support the locking-in of gas generation spreads (which are currently negative). Also, the higher the price correlation with a liquid German market grows, the lower the importance of market liquidity in the Netherlands to offer appropriate hedging opportunities becomes. Additional interconnection capacity on the Dutch-German border would for example contribute to that effect, whereas differences in installed renewable generation will likely have adverse impacts.

FTRs on NorNed

For the purposes of cross-border hedging, FTRs could replace any recourse to financial markets for FTR holders and hence diminish the relevance market liquidity in existing products.

51 Ibid. Quoted as $400,000-$600,000 New Zealand Dollar.
52 Quoted as $320,000-$480,000 New Zealand Dollar.
53 Quoted as $100,000 New Zealand Dollar for initial participation and $75,000-$100,000 for on-going costs.

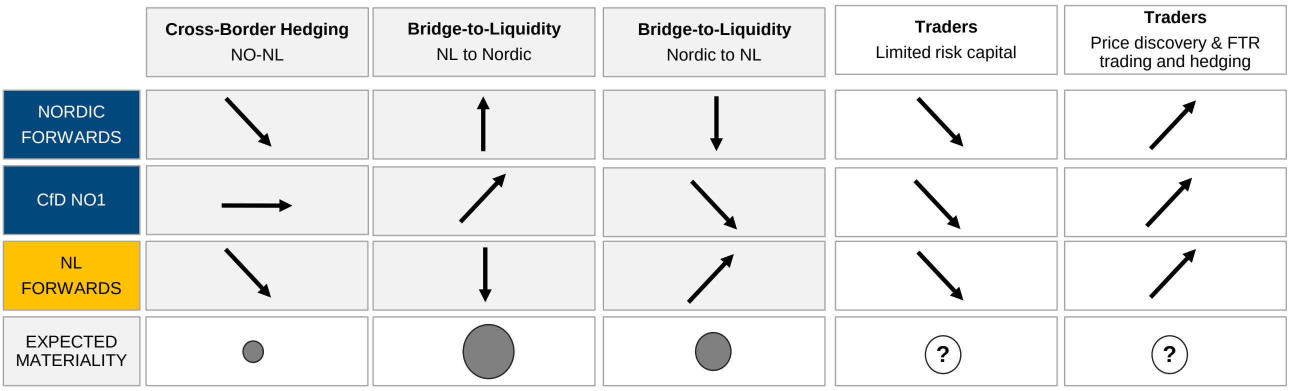
However, available hedging volumes are limited by the underlying transmission capacity backing the FTR. Moreover, the liquidity impacts of FTRs on existing products may still be relevant to market participants demanding such products for other hedging purposes, including hedging within their own market.

The impact of FTRs on NorNed on liquidity on existing products in the Nordic and Dutch financial markets is uncertain, and stakeholders have presented different arguments. In principle we can distinguish between four effects:

1. **Cross-border substitution effects can affect liquidity.** If FTRs are used to hedge the spread between Kristiansand and the Netherlands, there is no further need to replicate this hedge with financial products in the forward markets. Hence, liquidity in Nordic and Dutch forwards would decline. The impacts on Norwegian CfDs depend on the location of the market participant. Participants located outside NO2 could use a combination of two area price CfDs to exchange the basis risk between their price area and NO2 with that between NO2 and NO1, for example. Overall, the liquidity effects from cross-border hedging shifts are expected to be limited since we have not identified market demand for such a hedge.
2. **Shifts in hedging patterns following a bridge-to-liquidity can affect liquidity.** Here the net impact depends on the direction of flows, i.e. the net effect of Dutch participants moving their hedging to the Nordic market and of Nordic participants moving their hedging to the Dutch or continental markets. For example, a Norwegian stakeholder could transfer hedges from Nord Pool to the Dutch forward market and cover the locational basis risk with an FTR on NorNed. In this case liquidity could reduce in the Nordic system price and Norwegian CfDs, at least from NO2 participants, but increase liquidity on the Dutch forward market. Nordic stakeholders could also move their hedging to the German market and carry the basis risk to the Netherlands or hedge with existing PTRs. This would limit the increase of liquidity on the Dutch market. Given that the Nordic forward market is significantly more liquid than the Dutch market, however, the reverse direction of flow may be more material. In this case liquidity in the Nordic forward market would rise and decline in the Netherlands. If the Dutch participants would further want to cover the locational risk between the Kristiansand price area and the Nordic system price then demand in Norwegian CfDs may increase.
3. **FTRs could split liquidity in existing products.** According to this argument, the amount of risk capital brought to the market by traders and financial institutions is finite and the introduction of new products tends to split liquidity. This effect will be less relevant for products with limited financial participation, i.e. CfDs and possibly Dutch forwards. The materiality of this effect is uncertain.
4. **FTRs could aid price discovery, attract new players to the market and encourage hedging of FTR positions, which all increase liquidity.** An influx of liquidity into a spread product aids price discovery and transparency. If price discovery provides a signal for future prices in the NO2 area this may also aid CfDs with a high correlated (such as NO1) or a newly introduced NO2 CfD. FTR holders may also want to hedge their open positions in the financial markets. For example, if a financial player holds an obligation on the counter-flow, expected to pay out negatively, it may want to hedge this by taking an offsetting position in the forward markets (and potentially carry the basis risk). The materiality of this effect is uncertain. Several stakeholders have made the argument that FTRs on NorNed would aid price discovery and thereby catalyse liquidity both for FTRs and related products such as forwards and CfDs.

All of the impacts described above are constrained by the volumes of available FTRs, which cannot exceed the physical asset capacity plus netting effects in the case of FTR obligations. Figure 11.1 summarises the expected liquidity effects of an FTR and the expected materiality. The arrows indicate the expected change in liquidity for each considered existing product. Angular arrows indicate that expected effects are more uncertain.

Figure 11.1 Effects of FTR on liquidity in existing markets



CfDs

Similar liquidity considerations apply as with an FTR. While for cross-border purposes liquidity effects are secondary (as a CfD replaces recourse to other financial forward products), these may be relevant for other hedging purposes. A crucial difference between FTRs and CfDs, however, is the fact that with CfDs volumes are not constrained by the actual physical transfer capacity of the transmission assets.

Net effects on the liquidity of Norwegian CfDs and Dutch forward markets are contingent on the shifting patterns that result, again similar to an FTR. However, since a CfD would be exchange-listed, the trading location would likely influence the use. For example, if a NorNed CfD were listed on NASDAQ OMX, it would be more attractive for a Dutch company to build a bridge to liquidity to the Nordic market than the other way around. If the CfD would be a derivative of the spread between the Netherlands and the Nordic system price, catering to the objectives of a bridge-to-liquidity, then demand for Norwegian CfDs would stagnate or decrease for either direction of flow.

Under a broader European CfD solution, the emergence of a central Northwestern European reference price would likely drain liquidity from long-term Dutch forwards. However, hedging in the Netherlands would then also be relegated to the second best-option as higher long-term liquidity is available at the hub and short-term liquidity can be managed with CfDs. Effects for the Nordic market are less obvious.

11.2.3 Investment signal for links on the NO-NL border

The market clearing price of long-term FTRs or CfDs is a clear indicator of the market value of an increment of interconnection capacity on the same border. It could therefore be argued that FTRs and CfDs provide a market signal for whether additional interconnection capacity is required on a given border and may improve the efficiency of future investment in interconnection capacity.

Any investment signal of FTRs and CfDs would be limited to the horizon of their product tenors, and possibly even shorter if low traded volumes in future years weaken the price signal. It is not expected that FTRs will be available for tenors beyond those of forward electricity products that are currently available. Since subsea cables have an associated investment horizon of upwards of 20 years from the year of commissioning, and their construction often takes several years, it is likely that the economic signal provided by the market price of FTRs or CfDs whose tenor mirrors energy markets would be limited.

11.2.4 Competition

Impact on market entry and exit

In this section, we consider the likely effect of the options on market competition both in the wholesale and retail markets. The competition effects of the options are considered through their effect on market entry and exit.

Liquidity intervention

Liquid wholesale markets can be expected to be beneficial to competition in both the wholesale and retail markets. Since higher liquidity in wholesale markets is generally associated with lower market participation costs and more effective hedging, it can be expected to enhance competition by encouraging market entry. This would apply to both wholesale and retail markets since lower transaction costs in the wholesale market make it easier for new entrant suppliers to hedge their short retail positions in the wholesale market.

Also, since hedges are easier (take less time) to obtain in a liquid market, the risk of temporary unhedged exposures is lower on market participants, which is likely to make it easier for new players who have only limited funds for collateral to enter the market. Hence a liquidity intervention, if successful, could enhance competition in both wholesale and retail markets, although the materiality of the effect is uncertain.

NorNed FTRs or CfDs

As discussed above, the introduction of new cross-border hedging instruments is likely to reduce the cost of cross-border hedging. Although stakeholder feedback received in the course of this study suggests a lack of genuine cross-border positions, it is not clear whether the current cost and difficulty associated with cross-border hedging is partly a reason for that. By reducing the cost of cross-border hedging, these instruments may encourage existing players to expand beyond their home markets, thus increasing cross-border competition. This would be consistent with the vision of a competitive pan-European power market as targeted under the EU Third Energy Package.

In terms of international benchmarks, New Zealand is one example of a market where generators and suppliers have chosen to hedge their respective market positions through vertical integration.[54] This market structure has limited competition between different price zones and serves as a barrier to new entry since there are no liquid forward markets in which new entrants may hedge their positions. The lack of availability of FTRs between different price zones may arguably have contributed to New Zealand's current market structure, although this is in the context of a different underlying trading arrangement based on locational marginal pricing.

Impact on potential interconnection investment

It can be argued that the availability of a market for FTRs on the Norway-Netherlands border may encourage further interconnection investment by independent merchant developers, thus enhancing competition in interconnection. The ability of developers to sell long-term FTRs would be likely to make it easier for them to raise debt finance in order to finance the construction of new interconnector capacity. Although developers could, in theory, establish their own process and platform for selling FTRs, doing so on an established platform is likely to be less costly and therefore reduce a barrier to entry.

54 See for example Bertram, G., 2005, "Restructuring the New Zealand Electricity Sector 1984-2005", in: Sioshansi F. P. and Pfaenberger W. (Eds), Electricity Market Reform: An International Perspective. Elsevier.

12 Conclusion

In this concluding section we first summarise key findings for the three project objectives. We then offer a potential decision framework for moving forward and detail further considerations.

12.1 Summary of key findings

Aim 1: Investigate liquidity in financial wholesale markets

In section 6, we constructed an evaluation framework for market liquidity, which defines current market opportunities as appropriate if derivatives are commonly available for the types of risks, volumes and horizons that market participants demand and at reasonable costs. We accordingly considered product availability, market liquidity and trading costs.

We showed that constructing a hedge with similar properties to those of transmission rights for a NL-NO2 link requires multiple instruments on both ends of the interconnector. We considered forward products in Nord Pool, Netherlands and Germany (as a potential proxy for the Netherlands).

Based on the evidence, we found that potential gaps in terms of product availability arise for NO2 CfDs. This introduces basis risk in a cross-border hedge constructed in financial markets. Availability of peak load products is also limited in Nord Pool but given the relatively flat profile of Nordic price curve this does not translate into a gap as of today.

Limited market depth is an issue for Norwegian CfDs and possibly for Dutch forwards. CfDs for NO1 are available for trading and may be a proxy, because the Oslo price area offers a higher correlation to NO2 than the system price. Yet this still replaces one basis risk with another and, despite nominal availability, NO1 CfDs are barely traded and considered illiquid. There are several reasons why this may be a result of the particular features of the Norwegian power market (see section 6.3). On the data made available to us, Dutch market liquidity has been declining[55]. If this leads to market participants hedging one leg of a cross-border position in Germany than basis risks is retained.

Basis risk related to locational risk in Norway (to the system price) and potentially in the Netherlands (to Germany) reduces the effectiveness of a cross-border hedge.

Aim 2: Investigate stakeholder's views on cross-border hedging

We conducted interviews with 15 NorNed stakeholders and presented the results in sections 7 and 10. We consulted stakeholders on their hedging needs, current market opportunities and preferences on FTR design.

In reference to current market opportunities, stakeholders generally corroborated the evidence from the liquidity analysis. Nordic forwards were seen as largely liquid for the first few years. Norwegian CfDs were not considered liquid and several stakeholders expressed a desire to see higher liquidity. Dutch liquidity was widely considered to be in decline, but stakeholders had different views as to the implications. Producers were concerned about the ability of the Dutch forward market to meet their hedging needs, whereas consumers using the brokered OTC market did not feel constrained. The traded markets in Germany were generally considered as more liquid and an effective proxy to the Netherlands.

[55] In-depth data for the larger OTC market was not available to us.

We did not identify any stakeholder with a need to hedge a physical cross-border position on NorNed. Twelve of the 15 stakeholders did not see a hedging need between Norway and the Netherlands (either their own needs or perceived market needs). Two producers, however, wanted to hedge the NorNed spread in order to access forward markets on the other side of the interconnector. One producer expressed a desire to hedge Nordic market positions on the Continental market. A second producer wanted to be able to hedge Dutch positions in the Nordic market. This hedging motivation is distinct from cross-border hedging in that the physical position is located only in one market. Hedging across the border is here driven by the prospects of accessing a more liquid financial market with lower transaction costs and deeper trading volumes along the forward curve. We have termed this motivation "bridge-to-liquidity". A third stakeholder saw a dormant hedging need for the NL-NO2 spread, which could only manifest once a suitable trading product was introduced. All three stakeholders stated that an FTR on NorNed would be their preferred hedging instrument for this purpose.

If FTRs were introduced, stakeholders would favour options with tenors of up to three years. There were diverging views on the firmness of FTRs. A fully firm model was generally supported by traders and exchanges, noting financial firmness as a key driver of tradability. Producers generally saw firmness as desirable, but had split opinions about the applicability for a subsea cable such as NorNed. Some were willing to accept partial firmness whereas others said they would not consider a product that was not fully firm. TSOs expressed concerns over bearing the full potential liabilities associated with firmness under a fully firm solution. They advocated the need of partial firmness, limited to the intra-day, with pre-specified compensation arrangements applying before the firmness deadline. Market participation of the TSO, for example under a buy-back of capacity in the secondary market, was viewed critically or with caution by most participants.

Aim 3: Evaluate effects of different hedging products and methods

We have evaluated three options to address the potential gaps: a liquidity intervention, FTRs on NorNed and CfDs between Netherlands and Nord Pool (CfD SYS-NL).

We evaluated options for hedging effectiveness (section 9) and effects on hedging costs, current market liquidity, investment signals and competition (section 11).

The options could increase hedging effectiveness by providing tools for hedging remaining basis risks. A liquidity intervention can increase hedging effectiveness indirectly if it improves product availability, including affordability. For cross-border hedging, FTR obligations offer a perfect hedge between Netherlands and Kristiansand, improving hedging effectiveness over current levels, as Norwegian CfDs are currently illiquid. Yet basis risk would remain for hedging positions outside the NO2 price area. Basis risk would also apply for hedging using a bridge-to-liquidity that seeks to connect Nord Pool forwards with the Dutch or Continental markets. A CfD on the spread between the Dutch market price and Nordic system price would provide a bridge-to-liquidity free of basis risk but contain basis risk for cross-border hedging between Netherlands and Kristiansand.

Savings in the costs of hedging, including for cross-border and bridge-to-liquidity purposes, can arise for all three options. Changes in the liquidity of existing financial markets can affect transactions costs and thus hedging costs. With FTRs and CfDs SYS-NL, savings can accrue from lowering the costs of hedging a cross-border position by replacing existing financial market instruments with new instruments, which require a fewer number of transactions and with potentially lower aggregate fees. For bridge-to-liquidity hedging, FTRs and CfDs allow market participants to shift their hedging to the most liquid hub and thus realise transaction cost savings.

Implementation costs arise for all three options. For a liquidity intervention and CfDs SYS-NL these combine system testing costs and market-making as required. For implementing FTRs on NorNed we cited a TSO cost estimate of €1,000,000 (but noted that further research would be required) and provided a benchmark from New Zealand's FTR implementation which was estimated at €250,000 - €380,000. We expect that the burden of implementation costs can be partially mitigated by acceding to the planned harmonised European auction system for FTRs. Depending on the pricing of FTRs by market participants, and level of competition in the auctions, there is also a risk of value transfer from TSO (and thus consumers) to FTR holders. This risk can be in part mitigated through a reserve price.

The liquidity impacts of FTRs and CfDs SYS-NL on existing products are uncertain. FTRs could change liquidity in the forward market by shifting hedging patterns, but the effect of this will be limited by the volume of allocated FTRs. Given that currently the Nordic market is more liquid than the Dutch market, it may not be unreasonable to expect that, if anything, Nordic market liquidity would increase through an inflow of hedging activity. Norwegian CfDs are mostly illiquid in any case and the potential for negative impacts is therefore limited.

The market clearing price of long-term FTRs or CfDs SYS-NL is a good indicator of the market value of an increment of interconnection capacity on the same border. However, the price signals provided by these instruments are limited by the horizon of their tenors, which on the basis of stakeholder feedback are expected to be significantly shorter than interconnection investment horizons or the likely tenor of debt financing which might support such investments.

If FTRs and CfDs SYS-NL can decrease the costs of cross-border hedging this can lower barriers to entry for players to expand beyond their home markets, thus increasing cross-border competition. This would be consistent with the vision of a competitive and integrated pan-European power market (EU Third Energy Package).

12.2 Decision framework

While the market and stakeholder evidence provides a detailed assessment of the status quo, we recognise the difficulties in aggregating a range of different views into a single decision on potential measures. Several factors complicate this decision. Costs and benefits are distributed unequally across stakeholder groups. There is uncertainty over the final outcome of the process for a European network code on forward markets and the stipulations for cross-border hedging, especially in respect to financial markets. Experiences and evidence on the costs of FTRs and potential value transfer are limited.

To guide strategic thinking, we therefore find it useful to distinguish between three dimensions of the question by asking how any decision will relate to:

- Evidence from market stakeholders
- Provisions of the FG on CACM
- Expected costs and consumer interests

Each of the options relates differently to these dimensions.

A liquidity intervention aligns with the majority opinion of the consulted stakeholders that no dedicated spread instrument is required, but disregards minority demands for tools to provide a bridge-to-liquidity. It may serve to meet the formal obligations of FG on CACM by increasing hedging effectiveness (making available products to hedge basis risk), depending on the way in which this requirement is specified and measured. It would allow regulators to monitor legislative progress and first experiences with FTRs on other borders, while keeping the option to introduce other instruments at a later stage. It incurs implementation costs depending on the scale of intervention.

It is not clear how the market would respond to the introduction of a CfD SYS-NL. Demand for a cross-border spread product is present but limited. It is not driven primarily by pure cross-border hedging needs but by an interest to shift hedging patterns to the most liquid hub. In theory, a CfD SYS-NL would provide an effective hedge for this purpose, avoiding the basis risk that would remain with FTRs. Yet the producers who expressed interest in such a bridge-to-liquidity supported FTRs rather than CfDs. It is not clear how the risks associated with underlying interconnector outages, and corresponding movements in price spreads, would affect the willingness of market participants to offer financially firm contracts. Stakeholder responses to this study indicate that this willingness may be limited. Viewed from a different angle, however, a CfD SYS-NL would avoid most of the concerns TSOs voiced about an FTR. In terms of the FG's provisions on forward markets, a CfD SYS-NL would arguably qualify as appropriate cross-border hedging in financial markets, if it were liquid (although there would be residual basis risk where hedging positions in the NO2 price area). A CfD SYS-NL would also leave open the option to introduce FTRs on NorNed at a later stage. The costs of a CfD SYS-NL in part depend on the level of any accompanying market-making.

The market evidence we have gathered suggests that FTRs would meet a minority demand. They are met with caution or objection by other stakeholders, notably TSOs. FTRs meet both the formal stipulations of the FG on CACM and would appear to follow the wider travel of direction towards transmission rights on European borders, although there is still uncertainty as to how this will develop in practice. From a cost perspective, implementation efforts are not insignificant and there is a risk of value transfer from TSOs and consumers to traders. We expect that an introduction of an FTR as part of a wider European roll-out with a common auction platform will reduce implementation costs. The flipside of such an accession to a Europe-wide platform may be limited flexibility in FTR design. Design flexibility may be especially relevant for the treatment of firmness, where NorNed may have special requirements as a sub-sea cable with a complex outage risk. This could therefore lead to a benefit in early implementation. However, it is not guaranteed that a bespoke design will be compatible with a subsequent European roll-out under a common network code (nor that design flexibility is a prerogative of first-movers only).

Apart from these three options it is of course also possible to decide not to intervene at this point in time. This implicit fourth option would include monitoring the drafting of a network code on forward markets and engage through consultations where applicable. First experiences with FTRs, for example on the German-Danish border, could also be studied to further gauge the potential implementation costs and benefits. This "monitoring developments" option would align with the current majority view of stakeholders that there is no need for intervention, but would disregard minority wants. Depending on the final treatment of financial markets for cross-border hedging and the definition of appropriateness, the stipulations of the FG on CACM may or may not be met without intervention.

In sum, an interpretation of the evidence against wider considerations is required. We suggest using the three dimensions of market stakeholders, FG on CACM and costs and consumers as helpful yardsticks. Annex 1 summarises these considerations in the form of a decision tree.

12.3 Recommendation

The evidence presented in this report can provide guidance along the decision tree. Annex 2 illustrates our recommendations for the individual decision points based on the findings from this report.

The stakeholder evidence in our view suggests that a new hedging product should be considered (answering decision points 1 and 2 on the tree). There is no demand for a cross-border hedging instrument, but some demand for a spread instrument for other hedging purposes (and in particular what we have termed bridge-to-liquidity). If this type of market demand is considered to be relevant in considering potential options, then a rationale for introducing a spread product is present. This rationale is further strengthened when considering dormant or unidentified market demand and the potential effects of a spread product on competition and market integration.

This accordingly suggests the introduction of either FTRs or CfDs.[56] However, we believe there is currently insufficient evidence to determine clear answers around the decision points thereafter (decisions 3, 4 and 7; highlighted with red borders in the graph). First, a CfD SYS-NL would provide an effective hedge for bridge-to-liquidity purposes and avoid the partial locational basis risk that remained with a FTR to Kristiansand only. Yet the market uptake of CfDs between the Netherlands and the Nordic system price, noting the firmness risks, is unknown (decision 3). If implementation cost requirements for system testing and market-making are considered proportionate, it may therefore be warranted to test this option in practice.

Second is the question on the direction of travel of the FG on CACM on transmission rights (decision 4). Under the stipulations of the draft guidelines, we believe a liquid CfD product could meet the requirements for cross-border hedging. Yet the eventual specifications for financial cross-border hedging in the final network code are uncertain. Also, in a scenario in which FTRs are in practice implemented on most European borders, there will be strong incentives and pressure to harmonise the treatment of NorNed. Evidence for this decision point will emerge as the CACM process advances, most notably through the ENTSO-E consultation process planned for Q2 2013. Considering that this could influence the appropriate hedging instrument, we believe this warrants the commencement of a process that could enable later FTR implementation, in particular addressing questions of implementation such as ideal FTR design and introduction costs. We believe this would also aid regulatory engagement with ENTSO-E and ACER in the consultation process.

Decision points 5 and 6 explore the feasibility of FTRs in detail. The evidence of this report would suggest that there are no prohibitive obstacles to introducing FTRs. At the market level, negative impacts were not commonly expected by stakeholders. Where stakeholders were not in favour of introducing FTRs this mostly reflected their perceived lack of need. But a number of stakeholders expressed stronger reservations or objections about the potential of TSOs participation in secondary markets for FTRs. A few Nordic stakeholders also raised concerns. In part these were based on concerns about the potential impact of FTRs on existing market liquidity. While there could be a range of outcomes we believe any negative impacts are likely to be limited.[57] A small number of stakeholders also based concerns on an interest in the broader defence of the "Nordic model" of forward hedging around a virtual hub, complemented with area CfDs. However, we see no direct negative impact of FTRs on NorNed on the viability of the Nordic model. TSOs were cautious or resistant, expressing concerns over implementation costs, impacts on governance and the role of the regulator. However, while acknowledging the need to address these concerns, we believe these can be tackled with the appropriate regulatory framework. In terms of implementation costs, given the non-binding cost estimate of one TSO and international benchmarks, we consider costs significant but not prohibitive. We expect that the burden of implementation costs can be partially mitigated by acceding to the planned harmonised European auction system for FTRs. A risk of value transfer through FTRs away from capacity owners cannot be excluded but no pertinent evidence is available. A reserve price may be a partial mitigant to value transfer risk. Monitoring early experiences from the Danish-German border may also be useful in this regard.

56 Accordingly, on the left side of the decision tree, decision points following the counterfactual line of answers are not considered and greyed out in the illustration.
57 Negative impacts could for example include reduced liquidity in forward markets or CfDs. FTRs can indeed influence liquidity in the forward market by shifting hedging patterns, but the effect of this will be limited by the volume of allocated FTRs. Given that currently the Nordic market is more liquid than the Dutch market, it may not be unreasonable to expect that if anything Nordic market liquidity would increase through an inflow of hedging activity. Norwegian CfDs are mostly illiquid and the potential for negative impacts is therefore limited.

Decision point 7 is similar to decision 4 in that it hinges on the eventual network code stipulations. The FG on CACM envisions a harmonised roll-out of transmission rights, with one single set of rules for FTRs. Yet it is uncertain how much flexibility will be provided for under these rules. The decision as to whether to introduce an FTR independent of the wider European roll-out in this sense represents a trade-off between FTR design flexibility and implementation costs.

Given these considerations, we recommend the introduction of a CfD NL-SYS to test market uptake if implementation costs are acceptable, and to simultaneously commence the process of product and regulatory design that would enable a potential FTR solution on NorNed to feed into the ENTSO-E and ACER processes.

12.4 Further considerations

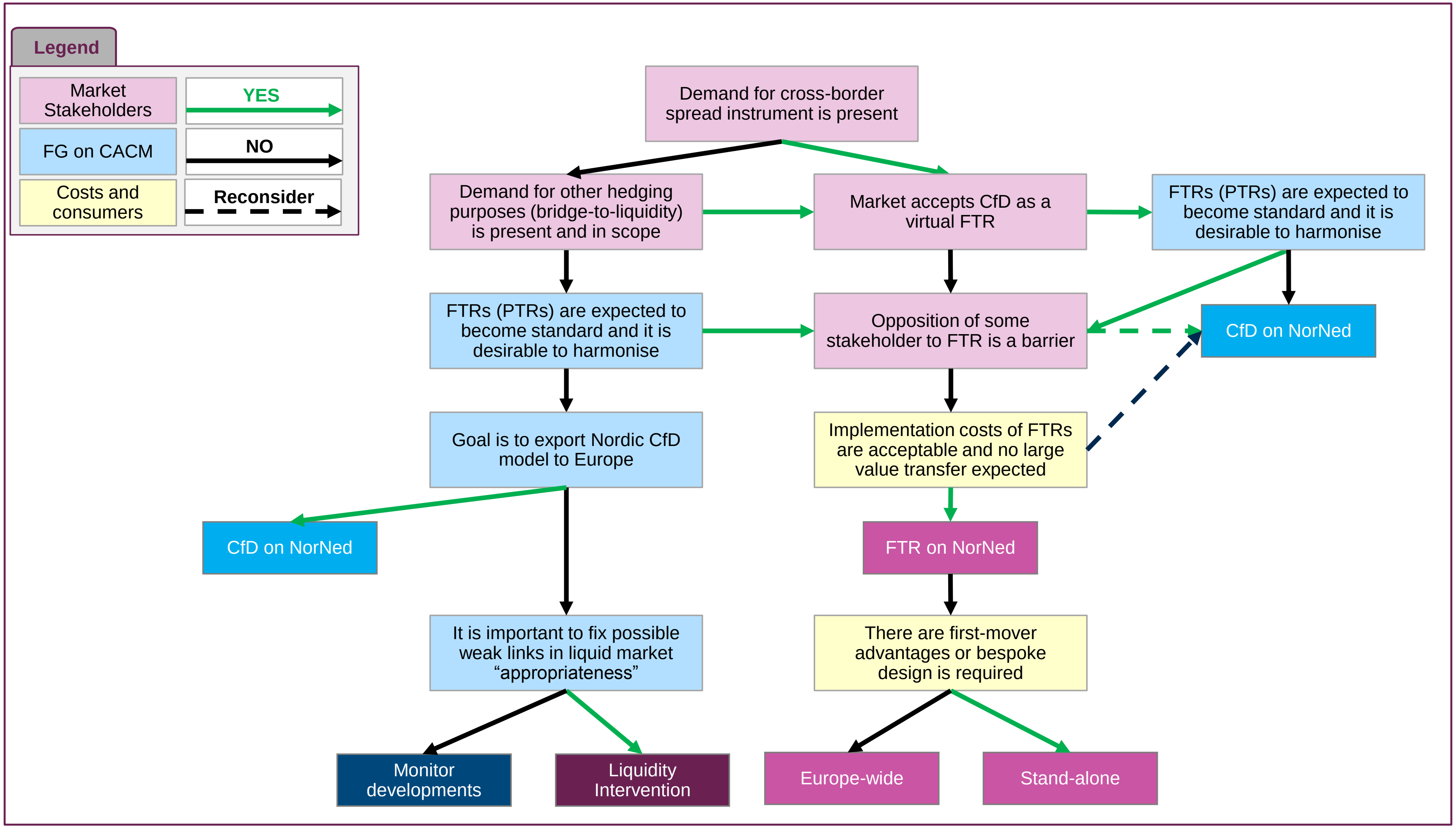
If the decision were to introduce an FTR, we suggest that the chosen FTR design will have significant implications for impacts on stakeholders. The ideal FTR design for NorNed will therefore depend on regulatory objectives and consideration over implementation issues. Of particular status is the heightened importance of firmness risk on NorNed as a subsea cable.

FTR design can cater for different objectives. For example, FTRs could be designed maximise market demand. An alternative design could follow from the objective to mitigate TSO and consumer costs through implementation or value transfer. Figure 12.1 summarises the proposed design specifications for both objectives.

Figure 12.1 FTR design specifications under different regulatory objectives

	Maximum market demand	Mitigate TSO and consumer costs
Product structure	▶ Options and potentially also obligations ▶ No reserve price	▶ Options or obligations (one product) ▶ Reserve price
Tenor	▶ Aligned with forward markets, i.e. up to 3 years ▶ Within year products	▶ 1 year-ahead ▶ Within year products
Firmness	▶ Full firmness ▶ Regulation for TSO cost pass-through / risk management ▶ No compensation cap for outages	▶ Partial firmness (intra-day) ▶ Regulation for TSO cost pass-through ▶ Compensation cap in place for outages
TSO market participation	▶ No TSO market participation	▶ No TSO market participation
Approach	▶ Harmonized EU design (ease of access and participation costs)	▶ Harmonized EU design (minimise cost)

Annex I Decision tree for selecting between options



Annex 2 Decision tree with recommendations