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European Electricity Forward Markets and Hedging Products – State of Play and Elements for Monitoring

Final Report

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Abbreviations and acronyms

ACER	Agency for the Cooperation of Energy Regulators (*or* "the Agency")
ARR	Auction Revenue Rights
ASX	Australian Securities Exchange
ATC	Available Transfer Capacity
CACM NC	Capacity Allocation and Congestion Management Network Code
CAISO	California Independent System Operator
CAO	Central Allocation Office
CASC	Capacity Allocation Service Company
CfD	Contract for Difference
CWE	Central West Europe
DAM	Day Ahead Market
DS Futures	Deferred Settlement Futures
EA	Electricity Authority (New Zealand)
ECA	Economic Consulting Associates
EEX	European Energy Exchange
EFET	European Federation of Energy Traders
EMIR	European Market Infrastructure Regulation
ENTSO-E	European Network of Transmission System Operators for Electricity
EPAD	Electricity Price Area Differentials
EU	European Union
FCA NC	Forward Capacity Allocation Network Code
FERC	Federal Energy Regulatory Commission
FPFV	Fixed Price Fixed Volume
FPVV	Fixed Price Variable Volume
FTR	Financial Transmission Rights
GME	Gestore dei Mercati Energetici (Italian Power Exchange)
GW	Gigawatt
GWh	Gigawatt hour
HHI	Herfindahl-Hirschmann Index
HROTE	Hrvatski Operator Trzista Energije (Croatian Energy Market Operator)
HUPX	Hungarian Power Exchange
ICE	Intercontinental Exchange
IDEX	Italian Derivatives Energy Exchange
LRMC	Long Run Marginal Cost

LSE	Load Serving Entity
MIBEL	Iberian Electricity Market
MIFID	Markets in Financial Instruments Directive
MS	Member State of the European Union
MW	Megawatt
MWh	Megawatt hour
NASDAQ OMX	NASDAQ Commodities Exchange
NordREG	Nordic Energy Regulators
NTC	Net Transfer Capacity
NWE	North West Europe
NYISO	New York Independent System Operator
NYMEX	New York Mercantile Exchange
Ofgem	Office of Gas and Electricity Markets (UK)
OMIP	Iberian Energy Derivatives Exchange
OPCOM	Operatorul pietei de energie electrica si de gaze naturale din Romania (Romanian gas and electricity market operator)
OTC	Over-the-counter (bilateral trading through brokers)
PJM	Pennsylvania New Jersey Maryland Interconnection
PPA	Power Purchase Agreement
PTR	Physical Transmission Right
PXE	Power Exchange Central Europe
REMIT	Regulation on wholesale Energy Markets Integrity and Transparency (EU Regulation No 1227/2011)
RES	Renewable Energy Source
SEM	Single Electricity Market (Ireland)
SWE	South West Europe
ToR	Terms of Reference
TR	Transmission Rights
TSO	Transmission System Operator
UIOSI	Use-It-Or-Sell-It

Executive summary

Introduction

The various products that are currently traded in the EU forward electricity markets offer market participants hedging opportunities against short-term price uncertainties, allowing them to stabilise their cash flows.

Realising the benefits of forward electricity markets, the EC is in the process of harmonising the regulatory framework in order to facilitate market integration, achieve effective competition and the efficient functioning of the market.

The differences in terms of forward markets at local or regional level create serious obstacles in the harmonisation process.

In that respect, this report aims to provide insights regarding the functioning of forward markets, the availability of hedging products in the EU and to investigate potential indicators for monitoring the impact of the FCA NC's implementation on transfer capacity forward markets.

Task A: Survey of forward markets and hedging products

In Task A we reviewed data published by multiple sources including the various market platforms in order to ascertain the extent to which market participants can effectively and cost-effectively hedge their positions in the prompt markets by using forward markets.

We found the following:

- **Market design**. With the exception of Greece and Ireland (Gross pool market design) and Croatia, Cyprus and Malta which are single-buyer monopolies all other EU countries have net pool arrangements.

- **Energy trading**. The majority (around 60%-80%) of forward/future contracts are traded through brokers, while the rest are traded across multi-country platforms. The main differences between exchange-traded futures and brokered forwards are the credit terms and price matching processes.

- **Liquidity**. We found weaknesses in liquidity in many forward energy markets with only Austria, Germany and the Nordic area exhibiting high levels of churn. Liquidity tended to be weakest in South-east Europe although Belgium also exhibited very low turnover.

- **Products traded in European electricity forward markets**. The most common financial and physical instruments used in the electricity sector to hedge underlying energy price risks are electricity forwards, electricity futures, electricity swaps, Contract for Differences (CfDs), Electricity Price Area Differentials (EPADs), Spreads and Electricity options. We have no information about secondary trade in cross-border transmission rights but these too are used as forward options although they are spatial hedging products rather than temporal hedges (the same can be said of EPADs).

Our analysis has demonstrated that hedging products are widely available in most markets but that there is limited demand for most of them, with the most popular being annual baseload products.

There is greater choice offered in financial products than physical ones, with the exception of transmission rights, which are predominantly physical at present (although, PTRs with UIOSI can be used as financial products if they are not nominated against). Larger traders with physical assets tend to prefer physical products (not least because they seek to avoid crossing financial regulation thresholds) whereas small traders like the greater tradability of pure financial products; in both cases, holding a physical option enables parties with physical assets to avoid exposure to spot prices (and in the case of PTRs, this is avoidance of exposure in two markets).

- **Impact on prompt market**. Anecdotal, rather than rigorous, evidence from traders suggests that there is clear linkage between forward and prompt markets, but at the same time the impact of intermittent renewables was weakening the link. Because of the increasing importance of intermittent generation, prompt markets are increasingly diverging from the underlying position that forward markets seek to represent.

- **Transmission rights:**

  - **Physical Transmission Rights (PTR).** Cross-border transmission capacity in Europe is primarily allocated through two main central auction offices: CASC.EU for Central Western Europe, Italy, Switzerland, and parts of Scandinavia, and CAO for Central Eastern Europe and Croatia.

  - **Financial Transmission Rights (FTR).** FTRs have historically been largely implemented in US markets, with a market also recently established in New Zealand. The two primary European experiences are for the Spain-Portugal border and within Italy.

  - **Nord Pool capacity allocation.** The Nordic market presents an alternative to the PTR or FTR models of capacity allocation. All interconnector capacity is allocated to the prompt market through Nord Pool. Market participants can hedge against congestion across zones by trading CfDs or EPADs on the NASDAQ OMX Commodities exchange.

Task B: Methods to evaluate efficiency

In order to identify specific methods to evaluate the 'efficiency' of forward markets we examined from first principles why forward markets might warrant particular regulatory attention and be subjected to market monitoring and ascertain what 'efficiency' might imply in this regard. In doing so we analysed the following issues:

- **Importance of forward markets** relates to two main reasons – hedging and price discovery. Hedging is a mechanism that allows market participants to offset their exposure to the price volatility, while price discovery, provides an indication of where prices in the prompt markets are moving to. Additionally:

- **Avoidance of market dominance in prompt markets**. Forward contracting and trading could conceivably have procompetitive effects on prices in the prompt markets. This is because, if suppliers have an effective option to trade in the forward market, then they are less exposed to trading in the prompt market, denying dominant parties market power.
- **Facilitation of contestability**. Forward markets are universally seen as important in facilitating new entry in generation and supply by allowing new entrants to buy and sell electricity to match their output and customer base.

- **Features characterising a well-functioning forward market**. Generally, we would expect that effective forward markets would:
  - Provide effective hedging opportunities and be sufficiently liquid
  - Facilitate price discovery
  - Allow market access (at reasonable cost)
  - Otherwise support contestability in the wholesale and retail electricity markets
  - Be characterised by effective competition.

After analysing the features of an efficient market, the second part of Task B provides an overview of the theoretical literature in the field including that relating to three markets namely Nordic, PJM and New Zealand, in order to extract lessons and make suggestions for how forward markets and their products can be evaluated and monitored.

Our analysis of the three markets has shown the following:

- **Nordic market**. The Market Surveillance unit (MSU) within NASDAQ OMX and NordREG, an organisation comprising all the Nordic energy regulators, have been successful in monitoring the efficiency of the market and the market conduct of trading participants, respectively, and in providing confidence in the pricing mechanisms, the transparency of price relevant information and the integrity of the market.
- **PJM**. In PJM there is a notable lack of monitoring of forward markets beyond the day-ahead market. Independent monitoring reviews are regularly conducted by Monitoring Analytics (the independent market monitor of the PJM market) but their reviews are largely focused on the markets directly administered by PJM, including the spot, day-ahead, capacity, and FTR markets.
- **New Zealand**. Regular monitoring is ‘light handed’, focusing more on ‘spotlight regulation’, where they investigate a matter thoroughly and then shine a light for all to see on particular activity by participant(s) that may be considered out of the ordinary.

Our analysis has shown that the literature tends not to provide solutions for overall market efficiency and most of the studies make the general assumption that markets will be efficient provided that they are liquid enough and so the only role for monitoring seems to be for detection of market abuse.

Metrics and monitoring methods that have been employed in the literature to assess the efficiency of forward electricity markets include:

- ❑ **Liquidity**. Volume/value turnover, number of transactions, 'open interest', churn rates, bid-ask spread, volume of bid and sell offers (MW), futures volumes, by timeframe.
- ❑ **Product availability**. Share of long term hedging products in total open interest.
- ❑ **Product transparency**. Demand and supply transparency, reporting of all trades.
- ❑ **Low transaction and entry costs**. Percentage of OTC contracts with force majeure and/or suspension clauses, entry/exit activity as a % of the number of suppliers/market participants.
- ❑ **Level of granularity.** Standard product clip size, diversity of products.
- ❑ **Diversity of counterparties**. Number of market players/ new entrants per year, number of active traders, volume by trader type: retailer, financial, market maker, percentage of FTRs held by financial entities versus physical entities.
- ❑ **Low market concentration**. Minimum number of companies that are needed to reach 50 % of the market volume, Herfindahl–Hirschman Index (HHI), the combined share of the five leading producers of total buy volume and total sell volume, concentration ratios (CR3).

Our key observations on the results of the review are:

- ❑ **Liquidity as expected is a major focus** of the assessments and the metrics used are consistent with those we propose: churn rates, bid-ask spreads, volumes of transactions. The indicators also attempt to distinguish between types of product and their period of delivery.
- ❑ Although the price discovery function of forward markets is acknowledged and many papers examine the relationship between forward and spot prices, we were **unable to identify explicit measures of how effective price discovery is** in the various markets/countries (other than the liquidity of different and longer-dated products).
- ❑ Particular attention is given to the **various facets of contestability and competition**, so that indicators of entry/exit activity, the number and variety of market participants and market concentration measures feature prominently.

Based on the evaluation of each metric, our recommendations regarding essential metrics that should be monitored in the forward electricity markets include:

- **Turnover**. This is a measure of liquidity. We recommend that it be applied to a whole national forward energy market and should apply to energy volumes.

- **Churn rates**. A measure of liquidity. It can be used for individual products or for whole markets; we recommend the latter and that it be mainly applied to all forward products as a proportion of physical throughput. Interpretation should best be as annual.

- **Bid-Ask Spreads**. Although not a good market metric because it must apply to specific instruments, it is a well-recognised measure of market competitiveness and cost of getting into or out of a position. This should be calculated daily with potential to recommend that market policy should be to require all bids and offers to be reposted on a daily basis. We recommend ACER to encourage a market policy for each exchange to publish the Bid-Ask spreads on a consistent and daily basis.

- **Reporting of trades**. Most exchanges will already provide this information to members. Exchanges and markets could be rated according to level of transparency with public availability on a live basis (or within 15 minutes of trades being struck) being a gold standard.

- **Minimum number of companies needed to reach 50% market share**. This measure is more normally used with respect to physical market shares. However, it can be adapted to forward markets as a whole or to individual time periods. For interpretation, we recommend (i) annual time trends or (ii) comparison with the number of players in the physical generation and supply market.

- **Herfindahl-Hirschman Index (HHI)**. As this is a well-recognised metric, it should be adapted for monitoring forward markets. Although it is more commonly used to measure concentration in generation or supply, it can be used to measure concentration over a year in trades in forward products. We recommend the established benchmark of 2,500.

Task C: Methodology for assessing impact of FCA NC

The Forward Capacity Allocation Network Code (FCA NC) was delivered by ENTSO-E as a revised draft to ACER in April 2014.

In our evaluation we have identified the following key issues within the FCA NC:

- **Products offered**

  The FCA NC mentions splitting NTC into time tranches including the possibility of time of day products but there is no assessment of likely demand for such products. More clarity on what products to offer and criteria for offering them would be useful as the demand for time-of-day transmission rights products will likely be small.

- **Splitting criteria**

The FCA NC only includes general guidance on the criteria for splitting NTC between time periods. How an auction platform determines what products the market requires is not clear. Regulators may need to offer specific guidance and processes for making such determinations.

- **TSO revenue risks**

  With both physical and financial transmission rights, the provider is exposed to the markets' assessments of congestion rent between adjacent markets and may face over- or under-recovery in auction revenues.

- **Firmness**

  When rights are curtailed (generally in relation to a transmission failure) the FCA NC is relatively generous in that it allows compensation to be capped at the value of congestion revenues. However, all curtailed transmission rights are treated as FTRs with full payout guaranteed up to the price spread cap. After the firmness deadline, TSOs are exposed to the full imbalance cost due to guaranteed contractual throughput.

The FCA NC does well to ratify existing practices in forward capacity allocation. For most of the EU the main provisions that may have an impact are as follows:

- Increased available capacity with the application of the flow based capacity calculation method

- Improved access through a co-ordinated platform.

- Improved criteria for splitting of NTC across the forward curve.

The FCA NC is less effective in the translation of price signals into development of transfer capacity. Although the current regulation sets that TSOs should maximise the cross-border capacity available to the market under the constraints of the network, NRAs have limited resources to monitor this complex calculation. This leaves the possibility for TSOs to favour other objectives such as solving congestion inside their own control area or maximising the congestion rent.

In selecting monitoring methods the criteria need to look at some or all of the following attributes:

- **Market accessibility and contestability**

  Neither FTR nor PTR capacity products can directly hedge a movement in energy price levels. This creates a need to look at how improved access to transmission rights impacts the trade of hedging products in the energy forward markets.

- **Liquidity**

  The concern is how the FCA NC intends to promote liquidity in forward energy markets as trade in transmission rights will depend on the trader being able to trade out of any position.

- **Impact on energy prompt markets**

  This impact is a subset of the accessibility and liquidity criteria as efficient access to prompt energy markets is facilitated when hedging products used in local energy markets are complemented by hedging products for energy markets outside the local bidding zone.

- **Impact on TSO revenue adequacy**

  In an efficient market, the auction revenues derived from selling forward access rights should be equal to expected overall payouts by TSOs for price spreads between coupled markets, which is a feature of both FTRs and PTRs with UIOSI provisions (used by many participants who do not nominate against the PTRs they hold).

The following areas were assessed against the above criteria:

Auction revenue reduction

Transmission rights auction revenues are based on expectations of congestion revenue. Therefore, revealing more transfer capacity in the forward timeframe will lead to a reduction in expected congestion and so a fall in average auction prices.

Evaluation against criteria	Calculation methodology	Interpretation of results
Improvements in the calculation of capacity available for sale as transmission rights will: ❑ Improve accessibility to the markets for more players ❑ Improve liquidity by widening the market and lowering initial costs ❑ Have a potentially negative but limited impact on system development by reducing TSO auction revenues.	The sum of volume of transmission rights sold at each border between bidding areas times the average price of those rights, summed for all borders in the wider area where flow based method has been implemented, is divided by the volume of rights sold; this is compared to .the value calculated in the previous year.	An increase in auction revenues over time indicates inefficiencies in the calculation of available transfer capacity and therefore the ineffectiveness of the FCA NC to reveal available capacities. However, this should be interpreted very cautiopusly as there are many reasons why auction revenues might increase and so this should only be viewed as a starting point for investigation.

Churn rates and Net Transfer Capacity		
If a participant sells electricity forward across a border, but cannot secure an appropriate price spread coverage at the time of delivery, they must purchase electricity in that country's domestic market which exposes them to cross-border price differential risk. To cover a position in a forward energy market there is a need for forward instruments to match cross-border forward energy contracts. Churn rates in forward energy markets can therefore be used to indirectly indicate if there is sufficient transfer capacity where such transfer capacity is serving to allow cross-border participation in the forward markets. Also, the pattern of churn rates across timeframes indicates if NTC splitting has been allocated appropriately. The pattern should be fairly uniform across the EU to the extent that each market should have similar drivers towards need for forward products over different timeframes. This approach can also show if TSOs are efficiently investing in the grid.		
Evaluation against criteria	**Calculation methodology**	**Interpretation of results**
The availability of transfer capacity across different timeframes will contribute to liquidity as market participants are enabled to cover cross-border price risks. High liquidity allows trades in and out of positions easily, making trade more accessible to all types of participants.	The key measure is comparing the curve of churn rates across the forward market timeframes to an EU benchmark. The churn rates assessed need adjusting for the amount attributable to imports. This will better indicate if a break from the EU standard is due to a misallocation of NTC splitting.	If the curve is out of line with the EU, it could indicate a misallocation of cross-border transfer capacity. Insufficient transfer capacity products in one timeframe may force players to purchase longer or shorter timeframe products, or drop out of the market altogether which would hamper market development.

Efficient pricing of long-term capacity		
Revenue from transmission rights auctions should equal congestion rents. Calculated congestion rents will be compared to actual auction revenues (in a manner already applied in the most recent ACER Market Monitoring Report). Trends on each border could be monitored although absolute discrepancies should be investigated regardless of the time trend.		
Evaluation against criteria	**Calculation methodology**	**Interpretation of results**
Efficient markets should fully capture anticipated congestion rents within auction revenues. The proposed measure looks at market efficiency defined as the extent to which auction revenues equate to expected rents. This only indirectly indicates that the market is accessible and contestable.	Calculate annual revenues from auction of transmission rights on a border (AAR). Compare to annual congestion rents (ACR –sum of hourly price spreads between coupled markets over the year). Divide (ACR-AAR) by AAR. Result should be close to zero.	For an efficient market, the result should be close to zero. No target range of values but an initial arbitrary range of ±10% could be tried. Trend over time could be monitored but there is no definite benchmark for monitoring this.

Market efficiency of EPADs		
TSO revenue adequacy does not cover the Nordic market where EPADs are traded independently of the TSOs. Nevertheless, the basis for valuation of EPADs is similar. The methodology seeks to determine if EPADs provide a correctly priced hedge against spatial price differences in the Nordic market.		
Evaluation against criteria	**Calculation methodology**	**Interpretation of results**
The proposed measure looks at market efficiency defined as the extent to which EPAD prices equate to expected rents.	Calculate the value of the EPAD as the difference between the traded price and the average price spread in the market over a year A Nordic benchmark can be derived from the same data; this should be used to adjust the EPAD value for each area to remove any year-on-year variation affecting the whole market.	A net EPAD value per MWh should be close to zero once adjusted by subtracting the regional benchmark value from the area value. Trends over time in area EPAD values can then be assessed with changes investigated. Issues such as hydrology can affect the year-on-year values and so results are only a prima facie assessment.

There is a lack of coverage in the literature concerning market monitoring methodologies for the efficiency of forward capacity allocation. The above methods have therefore been partly adapted from first principles in order to suggest usable tools for testing whether the FCA NC will deliver the required improvements in forward capacity allocation that will help to make both forward and prompt energy markets more contestable and efficient.

1 Introduction

This report has been prepared in response to the Request for Proposals (RFP) issued by the Agency under the Framework Contract ACER/OP/DIR/08/2013, Lot 2 Economic assistance in the field of energy regulation. The report provides an analysis of European Electricity Forward Markets and Hedging Products – State of Play and Elements for Monitoring (Ref. ACER/OP/DIR/08/2013/LOT 2/RFS 05).

1.1 Role of electricity forward markets

Forward electricity markets offer market participants hedging opportunities against short-term (e.g. day-ahead) price uncertainties, in order to improve stability of their cash flows. The different performance of competition and liquidity across the various forward markets operated in the European Union (EU) determines whether market participants are able to hedge the short-term price risks sufficiently well and at a competitive price. Various financial products (e.g. forwards, futures, options, swaps, contracts for differences, etc.) have been developed and are traded on various platforms.

Different types of participant will want different benefits from forward markets:

- Established players will already have various forms of physical options (which will include generating units, captive or semi-captive customer bases, and long-term physical transmission rights), which can act as hedging instruments to protect against future price changes; such players will see forward markets as additional tools in their risk management arsenals.
- New entrant generation businesses will be looking to lock in long run prices to match their fixed cost exposure to investment sunk costs; such players will look for hedging instruments that lock in prices over the investment timeframe (up to 15 years) and are unlikely to be able to procure such instruments from liquid markets trading so far out but will still seek to hedge as far as they can. It should be noted that generators using gas or other traded primary fuels will look for cross-product hedges.
- New entrant supply businesses will be looking to lock in prices mainly up to two years ahead to match likely fixed price retail contracts in the industrial and commercial markets as well as limiting price changes in the residential market. These businesses will additionally be seeking forward access to energy without having to pay much upfront for the right of access because they may have limited capital to back up their cashflows.

These are all requirements to lock in energy prices at a reasonable cost.

Additionally, pure traders, trading arms of larger utilities and financial intermediaries will use both physical and financial products (both energy and transmission rights) as speculative instruments. Such players perform a vital role in developing liquidity, price discovery and price formation in forward markets but should not directly influence price fundamentals.

1.2 Summary background

European markets have evolved separately and at different speeds. The predominant early model was the vertically integrated utility. In the early days, the driving force (from the end of the Second World War) was reconstruction and electrification and the command-and-control method adopted by nationally-owned utilities suited this effort. However, from the earliest days, the need to integrate was increasingly felt. This was addressed in Continental Europe on mainly security and continuity of supply grounds but in Scandinavia – with a lower burden of reconstruction – the emerging case for traded markets began much earlier. In the UK, the push for privatisation and the development of a spot market led much of European thinking.

EU legislation towards competition began with the **1996 Electricity Directive**. This concentrated on separation of transmission from integrated utilities, with separation of generation and distribution. It was, to an extent, modelled on the UK privatisation of 1989, which created a day-ahead pool market. However, competition was also developing in Norway with the enactment of a new law in 1991. At this stage, trading was essentially spot although bilateral contracts (in the UK, mainly through Contracts for Difference) were already in use for covering spot price risk.

The **second EU Energy Package dates from 2003**. This looked for more separation between transportation and trading and more access for third parties. It was accompanied by opening up of several markets but with continued dominance by the incumbent utilities. The Sector Enquiry launched in 2005 sought to investigate the slow evolution of competition and lack of cross-border trade. The exceptions to this story were the UK and the emerging Nord Pool market that by now encompassed Sweden, Denmark and Finland.

The **Third EU Energy Package was adopted in 2009**. It sets out the current competition structure and institutions and has led to a process for cross-border competition. The belief is that cross-border access to markets will challenge incumbency effectively and lead to an integrated single market.

The key points to derive from this narrative is that the evolution of competition in prompt energy markets has been slow in most cases but that certain markets are far more mature and competitive. The development of forward markets has been similarly slow with markets evolving to meet the developing needs of trading participants. Therefore, the competitive nature and deep trading on the Nord Pool spot and forward markets has evolved over time, with other markets being much slower to develop.

As noted in our Terms of Reference (ToR), two forward market designs have emerged in the EU:

- The first design, which is implemented in the Nordic countries (i.e. Denmark, Finland, Norway and Sweden), purely relies on the market and a variety of products developed through the various market platforms (forwards, futures, options, swaps, contracts for differences, etc.). In this design, the hedging tools developed and traded by the market serve for both trade internal to a zone and cross-zonal trade.

- The second design, which is implemented in nearly all Member States of the European Union (MSs), also relies on the market but gives an additional and specific role to Transmission System operators (TSOs) with regard to cross-zonal trade. In this design, TSOs are responsible for calculating the cross-zonal capacity on which long-term Transmission Rights (TRs) are issued and allocated, enabling market participants to hedge against the specific risk of short-term zonal price differentials.

1.3 Motivation for the assignment

The Agency is concerned primarily with facilitating contestable energy markets that will allow parties to access cross-border markets in order to enhance competition in each market. This is in line with the Third Energy Package objective of creating a (geographically) single set of liquid tradable electricity markets through harmonisation of rules between domains.

However, many of the instruments available relate to the prompt physical market. It is in this context that the Forward Capacity Allocation Network Code (FCA NC) has been developed as part of a suite of codes to ensure competitive energy delivery in the energy markets. The FCA NC is designed for allocation of Transmission Rights on cross-border interconnections in forward markets (from month ahead to, potentially, several years ahead although most such rights will be no more than one year ahead) and mainly ratifies existing practice.

There is an inherent contradiction between forward allocation of physical access and the need for liquidity in day-ahead and intraday markets. This is because, if there is too much capacity allocated in the forward market, it will be less available for use in prompt markets although the use-it-or-sell-it (UIOSI) clause and the netting of firmly declared schedules alleviate this problem. Forward Financial Transmission Rights do not have this problem but require market coupling in order to be effective

Clearly, in looking at forward markets and the impact of the FCA NC, we need to be able to assess whether the current and potential products in the forward market promote contestability in both the forward market and the prompt markets and that this liquidity is accessible to small and/or independent players.

1.4 Overview of report

This report has been developed in stages sequentially in line with the development of the tasks. It is divided up as follows:

- In section 2 we report on Task A, which covers a survey of forward markets and hedging products and identifies gaps in coverage or other potential defects in particular areas. The questionnaires used are provided in the Annexes.

- Section 3 reports on Task B, which looks at the literature and different market examples and aims to determine specific methods to evaluate efficiency and/or the effectiveness of forward markets.

- Section 4 looks at methodologies for assessing the future impact of the Forward Capacity Allocation Network Code (FCA NC).
- Section 5 provides conclusions and key lessons.

2 Task A: Survey of forward markets and hedging products

2.1 Approach

The objective of Task A is to review the functioning of forward markets and the availability of hedging products. The following main aspects apply to this:

- Availability of hedging products:
  - Product availability
  - Market liquidity, transparency and economic efficiency
- Transaction costs.

Our terms of reference highlight the need to gather factual information on most of these. However, an important aspect of this will be the extent to which these factors convert into effective contestability for new entrants. There are additional elements that also need exploring related to the actual dynamics of the markets:

- The interaction between prompt and forward markets: a market participant will need to weigh the costs of forward trading (including cashflow and margin requirements) against short term price exposure costs
  - The cost of hedging at the 'wrong' price is also an issue if the trader cannot easily trade out of a forward position.
- The interaction between OTC and exchange traded products: again, cashflow considerations apply and margin coverage is a bigger issue on exchanges.
- Measuring liquidity: a trader needs to be able trade out of a position and so liquidity both along the forward curve and between times of day will be an issue.

For the reasons above, we developed questionnaires to more broadly ask opinions on market evolution because qualitative information is as useful as quantitative. Additionally, the views of market participants were sought in order to better cover the understanding of market dynamics.

Most trading in forward markets is in energy. However, the predominant model for trading between geographic areas requires acquisition of transmission capacity. Forward risk-hedging products between geographic markets tend to be allocated by TSOs: Physical Transmissions Rights (PTRs) or Financial Transmission Rights (FTRs). These rights are auctioned; the auction markets are similarly canvassed.

In summary, therefore, our approach was to examine both quantitative and qualitative information regarding the trading of energy and transmission rights in the forward market in order to establish the extent to which market participants can effectively and cost-effectively hedge their positions in the prompt markets by using forward markets and to identify gaps in these markets that impede efficiency and contestability.

2.1.1 Questionnaire

It soon became clear that separate questionnaires would be required for market providers (exchanges, brokers and transmission rights auctioneers) and market users (generators, suppliers and traders).

The questionnaires needed to encompass both factual information – geographic scope, products, throughput, liquidity, design, costs and revenues – and qualitative information – trends and issues. In the case of exchanges, much of the information is published (although not always easily accessible). Therefore, our approach was, as far as possible, to ask qualitative, value-added questions that would assist in understanding market dynamics and liquidity. There also needed to be a degree of trade-off between comprehensiveness and user-friendliness to assist with securing broad cooperation from busy interviewees.

The focus of the questionnaires was forward markets (defined as anything more than a couple of days ahead) but questions on availability of day-ahead and intraday products were also required in order to understand the balance between prompt and forward markets; this especially applied to the Users questionnaire where an understanding of the whole trading portfolio is possible.

The results of the questionnaire exercise were very disappointing. There are many possible reasons for this. Possibly, with preparations for REMIT, market providers did not see the need to make an effort to provide information in this survey exercise. Similarly, users of the markets saw limited benefits to themselves in responding. **Therefore, we have given some limited tentative conclusions in this report based on answers we did receive but caution use of the results because they are not necessarily representative.**

2.1.2 Tabulation of results

The purpose of tabulation is to give ACER a comparative overview of forward trading across the EU. With 28 markets and the restrictions of the A4 page, this is obviously challenging. Our approach to tabulation is therefore to list each country by row and with attributes covered by the different columns.

Our approach is to aim for consistency of presentation with limited data on each table in order not to overload the information. This means that several tables are needed with information grouped by relevant headings.

Another issue is the differences in sizes of markets. This means that tables need to include comparator statistics, which are mainly a measure of the size of the physical market.

Although many comparisons can effectively be shown graphically (e.g. forward trade as % of physical throughput, or % OTC), there is a need to present raw data; therefore, graphs are presented as additional to tables and never as substitutes.

Maps are recognised as a useful graphical tool. These are actually of limited value in most cases because trading is predominantly within national markets. However, it is useful, for example, to map out exchanges that are linked or have specific or overlapping areas, and to compare non-volumetric parameters; graphs are also useful for coverage of data related to forward capacity allocation.

2.2 Results summary

2.2.1 Underlying markets - energy

The underlying physical markets of individual countries or regions divide into:

- Gross pools
- Net pools
- Single buyer monopolists.

The different markets of Europe are covered below. Although this mainly covers the physical spot market, it does affect the types of forward products that may be available. Physical products can be readily sold in the prompt markets.

Gross pool

The following physical markets can be classed as gross pools:

- Ireland (SEM)
- Greece.

In a gross pool market, the system operator will schedule all generation based on a least cost algorithm seeking to minimise the cost of dispatch over the day. Generators bid their price curves into the market and loads are allocated energy based on offtake. A single pooled price is paid for energy.

The predominant contract to cover costs in such a market is the CfD, which some consider to be a two-way option contract[1] using the pool price as a reference. In the old England and Wales pool, ex post CfDs were available where the volume was decided by reference to actual offtake of the energy buying counterparty. More common CfDs in contemporary markets fix the energy volume ahead of time, leaving the buyer exposed to the residual volumes bought at the pool price.

These markets lend themselves to financial futures trading with the dominant CfD being a forward contract.

[1] A brief discussion of this characterization is contained further below in section 2.2.5 (after page 23).

Net pool

The following markets use the net pool arrangement on which the EU target model is based.

- Austria
- Belgium
- Bulgaria
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Hungary
- Italy
- Latvia
- Lithuania
- Luxembourg
- Netherlands
- Norway
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- UK.

In the net pool arrangement, physical contracts to notify are made ahead of time. Many of these contracts will be long-term bilateral physical contracts or internal contracts made within vertically integrated parties.

Many net pool markets also operate a market-clearing DAM setting a reference price for energy settlement. Forward contracts referenced against the DAM price can be either financial or physical.

Effective monopoly (single buyer)

The following markets are effectively single-buyer monopolies where offtake is overwhelmingly dominated by a single public supplier:

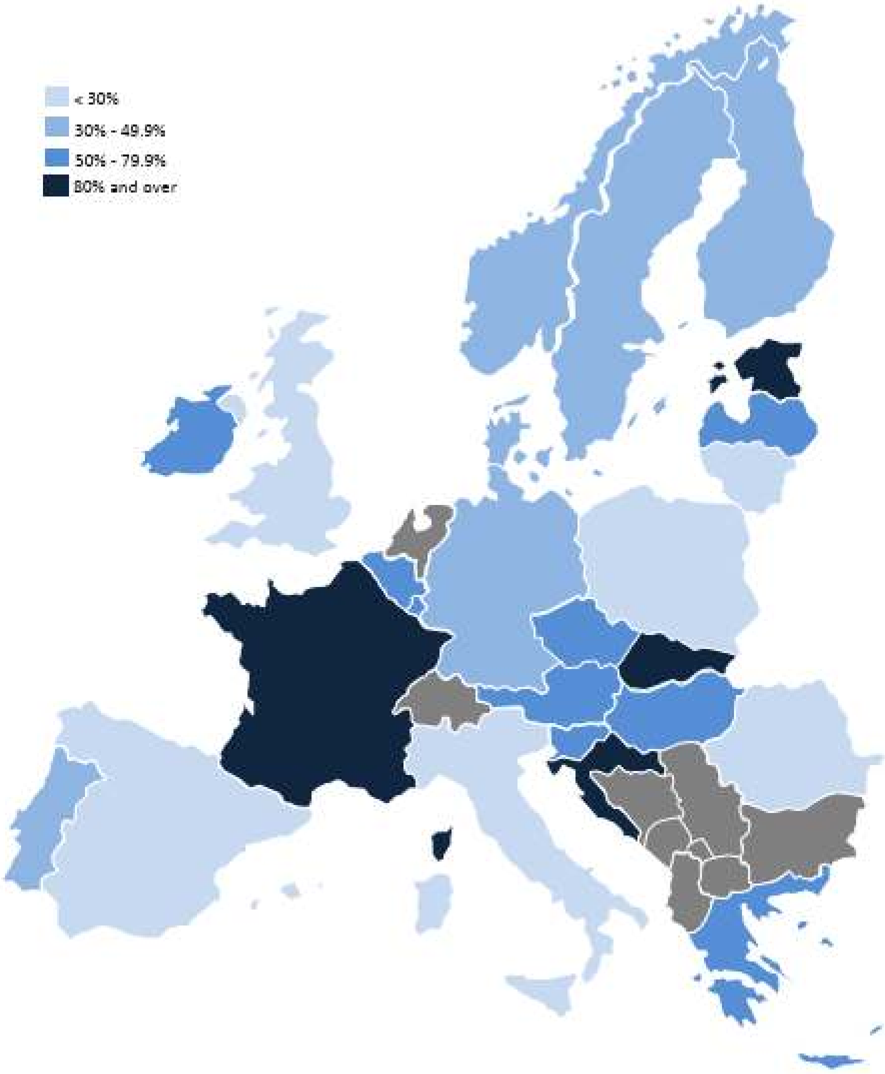
- Croatia
- Cyprus
- Malta.

Independent generation will exist in these markets but will either seek a long-term PPA with the main supplier or will be renewables with some form of price guarantee.

Although, in some circumstances, renewables will want some form of price protection, the lack of competition in the prompt market reduces the demand for forward products.

Level of competition

Figure 1 Share of supply by largest generator



Source: Eurostat

Figure 1 shows a very approximate measure of the degree of competition in the underlying prompt energy market (data for Bulgaria and the Netherlands are missing). This gives an indication of expectations for liquidity: where there is a large number of parties competing, liquidity in all markets is likely to be greater; the reality of this needs to be tested.

Coupled exchanges

Increasingly, day ahead markets are coupled. This means that an optimisation algorithm is used between the coupled markets to optimise energy flows based on clearing prices so that, unless there is congestion between markets, the clearing prices are equal in both markets.

With coupled markets, transmission rights are implicitly allocated to the exchanges for effecting net physical transfer. This can run alongside allocation of PTRs in forward markets (see below).

2.2.2 Underlying markets – transfer capacity

The dominant form of forward capacity allocation is in the form of PTRs sold with UIOSI terms. These are mainly allocated by auction, with a mix of products dominated by annual capacity sales. However, quarterly, monthly, day ahead and intraday products are also sold. There will also be secondary trading of PTRs.

In a few cases, all on-the-day capacity is allocated implicitly[2]; the capacity provider is remunerated for congestion through payments from the exchanges based on the price spreads between the markets – such payments will be offset by pay outs under FTR contracts auctioned as long-term rights such that the main net revenue to the FTR provider will be auction revenues from FTR sales. On the following borders, capacity is allocated mainly through FTRs:

- Portugal-Spain
- Estonia-Latvia
- Within Italy.

In the Nordic market, all physical capacity is allocated implicitly at the day-ahead timeframe. As for the other coupled markets, Nordic TSOs receive a daily congestion rent generated by the implicit allocation of capacity through market coupling. This daily congestion rent is equal to the market spread multiplied be the allocated volume. In this area, TSOs do not offer users any transmission rights that would allow holders to receive a part of daily congestion rent equivalent to the bought capacity. For hedging against market spread, market players have access to CfDs also called EPADs offered by trading platforms and traded by market players (no TSO involvement).

Although transmission rights across some borders is sold by specific TSOs (or by the interconnector owner if not a TSO), increasingly, PTRs are being allocated by auction platforms covering several borders. CAO and CASC operate these auctions; CAO auctions both directions simultaneously, clearing when Net Transfer Capacity is used up, while CASC uses determinations of capacity in each direction and auctions these volumes.

2.2.3 Products overview

Products traded in European electricity forward markets

The most common financial and physical instruments used in the electricity sector to hedge underlying energy price risks are:

- **Electricity forwards**: Forward contacts are bilateral contracts between a buyer and a seller to make/take a physical delivery of electricity at some time in the future at a specified price. The price might be fixed or floating and the contracts are usually traded OTC (self-regulated). They are usually offset and cash settled.

[2] On nearly all borders, PTR capacity not explicitly nominated will be used for implicit allocation through market coupling; within the Nordic area and on the Spain-Portugal border, all capacity is allocated implicitly – this full implicit allocation is set to be applied on more borders in future.

The liquidity of the market depends on the willingness of the buyers and the sellers to enter into a forward contract and the most significant risk is the counterparty/ credit risk.

- **Electricity futures**: A futures contract is a legally binding agreement on a recognised exchange to make or take a specified commodity or instrument at a fixed date in the future at a price agreed upon at the time of dealing. When buying and selling futures, buyer and seller operate under the standardised terms and conditions of the exchange, making transaction simple and easy to execute. Additionally, futures contracts have low commission charges in comparison to other traded instruments. Futures transactions are made anonymously and provide price transparency to buyer and seller. Limited availability of contracts introduces basis risk. Exchange margins secure profit and loss but introduce cash flow issues.

- **Electricity swaps**: A swap is paper exchange of a fixed price for a floating price. A swap allows a client to lock in a fixed price for its purchase or sale of a commodity for an agreed quantity, over an agreed period of time. Swap transactions tend to be OTC; they are financially settled and provide limited price transparency to the buyer and the seller. Diversity of floating price quotes minimises the basis risk. There is no upfront premium and physical losses are offset by hedging gains and physical gains are offset by hedging losses.

- **Contract for Differences (CfDs)**: A type of swap which is very common in the electricity industry and especially between generators and suppliers is the Contract for Differences. CfDs are forwards on the spread between an area price and the system price. Together with the system price forwards, these products are used to hedge the area price risk in the Nordic electricity market. CfDs allow a client to fix the differential between quoted price assessments - typically between an assessment used for physical pricing and one used for hedging.

- **Electricity Price Area Differentials (EPADs)**: Perfect hedges using futures contracts on the Nordic market are only possible when there is no transmission grid congestion, meaning area prices equal the Nordic system price. Hedging in futures implies a basis risk equal to the difference between the area price at the market participant’s physical location and the system price. EPADs allow market participants to hedge against this price area risk.

- **Spreads**: EEX has recently introduced Inter-Product-Spreads. These products allow trading participants to trade price differences between the different markets traded on EEX. The products pair up locational futures offered on EEX and allow market participants to hedge against any resulting differences.

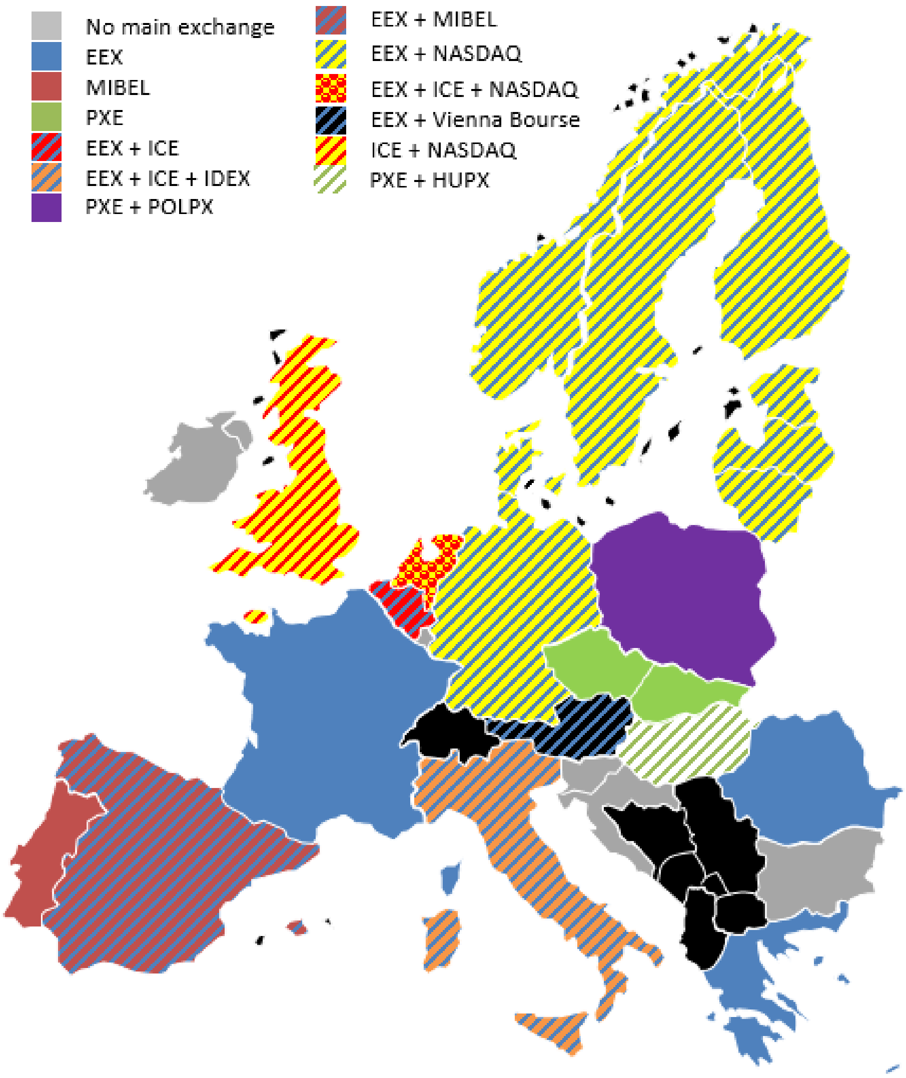
- **Electricity options**: An option gives the buyer of the option the right, but not the obligation, to purchase (“call option”) or sell (“put option”) a specific quantity of the commodity at a fixed price in the future. The buyer of the option pays a premium for the right to exercise the option. All options are composed of a strike price, a pricing period, settlement methodology, and a premium. Options are traded at exchanges or they can be private bilateral deals OTC. Energy exchanges primarily offer *plain vanilla options*, which give the purchaser the right, but not the obligation, to buy or sell a fixed amount of underlying electricity at a pre-specified strike price by the option expiration time. More exotic options, such as *spark* or *dark spread options* or *swing options*, may be traded OTC.

More exotic products such as weather derivatives or fuel price linked derivatives are not actively traded in European electricity markets.

Energy trading

The majority of forward trades are brokered rather than being settled on exchanges. Without REMIT, it is difficult to fully quantify the volume of brokered trades. The main price reporters (Argus, ICIS and Platts) offer comprehensive snapshot reports on prices in several markets but do not provide comprehensive information on the volumes behind those prices. Therefore, Figure 2 gives a picture only of the formalised part of energy trading on multi-user platforms.

Figure 2 Coverage of energy trading by the main exchange platforms



Source: various

Additional to traded volumes through exchanges and brokers, vertically integrated parties will self-supply, relying on internal hedges to protect their positions. Other parties will engage in longer term bilateral contracts agreed without support of exchanges or brokers. Therefore, the picture on transfer volumes agreed in forward timeframes is by no means clear.

Although a general preference has been expressed by traders for the flexibility of product that can be offered through brokering, in practice, most brokered products are standardised and will usually be substantially (or completely) based on standard terms agreed within EFET. Therefore, the main differences between exchange-traded futures and brokered forwards are the credit terms and price matching processes.

Futures platforms

Our survey results showed reasonably comprehensive coverage of exchange-traded futures. Most futures are traded across multi-country platforms; Figure 2 summarises coverage of the main exchanges; Table 1 summarises available data on these main exchanges and gives available data on OTC trading.

Table 1 Forward exchange platform summary

Name	Countries covered	Annual turnover (GWh)	Exchange terms		
			Fixed costs	Variable costs	Other
European Energy Exchange (EEX)	AT, BE, CH, DE, ES, FR, GR, IT, LU, NL, Nordic, RO	1,548,797[1]	Annual fee: €15,000	€0.0025-0.015/MWh	Delivery rate: 1 MW Tick size: €0.001-€0.01/MWh Liable equity of at least €50,000
Gestore Mercati Energetici (GME)	IT	30,341	Access fee: €7,500; Annual fee: €10,000	€0.01-0.045/MWh	-
Hungarian Power Exchange (HUPX)	HU	4,162	Participation fee: €15,000; Monthly fee: €1,000	€0.05/MWh	-
Intercontinental Commodities Exchange Europe (ICE ENDEX)	BE, DE (AT, LU), IT, NL, UK	135,642	Annual fee: €0; Monthly fee: €75	€0.005-0.025/MWh	-
Italian Derivatives Energy Exchange (IDEX)	IT	15,046	Annual fee: €2,500; Subscription fee: €8,000-26,000	€0.006-0.03/MWh	Spread: €2-3/MWh Delivery rate: 1 MW
NASDAQ OMX Commodities	DE (AT, LU), NL, Nordic, UK	927,000	Annual fee: €13,500; Fee per contract type: €1,500	€0.0039-0.0094/MWh	Minimum contract: 1 MW; Tick size: €0.01/MWh
The Iberian Energy Derivatives Exchange (OMIP)	ES, PT	92,779	Participation fee: €10,000; Monthly fee: €125-833	€0.0025-0.0075/MWh	-
Polish Power Exchange (POLPX)	PL	162,937	Application fee: €488; Annual fee: €4,879	€0.01/MWh	-
Power Exchange Central Europe (PXE)	CZ, HU, PL, SK	21,653	Participation fee: €15,000 Monthly fee: €1,225	Standard fee: €0.015/MWh Market maker fee: €0.005/MWh	Margin using SPAN ® Minimum contract: 1 MW/hr

Name	Countries covered	Annual turnover (GWh)	Exchange terms		
			Fixed costs	Variable costs	Other
Over-the-counter (OTC)[2]	AT	243,365			
	BE	5,518			
	CZ	123,362			
	DK	53,561			
	EE	16,180			
	FI	79,586			
	FR	785,601			
	DE	2,019,712			
	HU	143,563			
	IT	205,262			
	LV	11,485			
	LT	14,805			
	LU	24,229			
	NL	204,935			
	NO	228,808			
	PL	77,850			
	RO	13,315			
	SK	0			
	ES	184,106			
	SE	225,386			
	UK	300,679			

[1]Excludes Netherlands, Nordic, Romania, and Switzerland volumes. Belgium and Greece turnover included, extrapolated from volumes reported in August 2014 and March 2015 press releases, respectively. [2]Extrapolated from ICIS and Argus daily reported data. Hungary OTC data includes TFS trades.
Source: Table 14 (Annex A1)

Forwards

Forward contracts are essentially bilateral agreements between trading participants. Some of these contracts are registered through the medium of futures exchanges (this is the legal case in Romania for example) but others are, as noted above, reported by the dedicated price reporters. However, the information available on volumes is far from comprehensive. When REMIT data are fully collected and analysed, a more comprehensive picture may emerge.

Transmission rights

PTRs

Holders of Physical Transmission Rights (PTRs) have the exclusive right to use a particular interconnection in one direction to transfer a predefined quantity of energy from one market hub to another. Responsibility for determining capacity and the allocation of transmission rights is carried by TSOs (or an entity acting on behalf of the TSO, such as Auction Offices). PTRs are allowed under the Target Model with a Use-It-Or-Sell-It (UIOSI) provision, where PTR owners can decide to use the PTR as an FTR, or if the holder chooses not to nominate the right it is resold in the day-ahead market. TSOs have to ensure the availability of issued PTRs. Should PTRs issued exceed actual available transmission capacity, either the TSO guarantees the firmness of the PTRs through operational measures (re-dispatching, countertrading) or PTRs must be curtailed with the holders compensated. The firmness risk of PTRs creates a risk exposure for TSOs.

Cross-border transmission capacity in Europe is primarily allocated through two main central auction offices: CASC.EU for Central Western Europe, Italy, Switzerland, and, Denmark, and CAO for Central Eastern Europe and Croatia. Table 16 (Annex A1) presents the most recent allocation results for CASC and CAO. Higher prices identify interconnectors with higher congestion. TSOs, in their efforts to meet the EU Target Model, have proposed a merger of CASC and CAO into a single allocation platform to be up and running by 2016.[3]

FTRs

Financial Transmission Rights (FTRs) are financial contracts entitling the holder to a stream of revenues based on the day-ahead hourly congestion price difference across the particular interconnection. FTRs are tradable financial entitlements that do not give the holder the right to physically transfer power between zones. FTRs provide price certainty and are thus an effective hedge against price spread volatility. TSOs are required to issue either PTRs or FTRs under the Target Model, unless appropriate cross-border financial hedging is offered in liquid financial markets on both sides of an interconnector.

FTRs as *options* entitle holders to financial compensation equal to the positive market price differential between two areas during a specified time period in a specific direction. FTRs as *obligations* additionally oblige holders for any negative market price differentials.

FTRs have historically been largely implemented in US markets, with a market also recently established in New Zealand. The two primary European experiences are for the Spain-Portugal border and within Italy. OMIP, the Iberian power derivatives exchange, ran its first FTR option auction for the first quarter of 2014. Italy's energy market employs a zonal model where producers/sellers pay the zonal price, while consumers/buyers pay the national average price. With the gap between the zonal price and national average price, market participants implicitly pay a fee for the assignment of rights to use transmission capacity. An instrument, CCC, has been in place since 2004 to hedge against congestion cost volatility, effectively serving as an FTR obligation. Table 17 (Annex A1) summarises the most recent results for these FTR markets.

Nord Pool capacity allocation model

The Nordic market presents an alternative to the PTR or FTR models of capacity allocation. All interconnector capacity is allocated to the prompt market through Nord Pool. Market participants can hedge against congestion across zones by trading CfDs or EPADs on the

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3 http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Regional%20Initiatives%20Status%20Review%20Report%202014.pdf

NASDAQ OMX Commodities exchange. In contrast to the firmness risk inherent to PTRs and FTRs, TSOs do not have any liability exposure to these exchange-issued derivatives. If appropriate cross-border financial hedging is offered in sufficiently liquid financial markets on both sides of an interconnector, then TSOs do not necessarily need to issue forward transmission rights at all. This distinction has been acknowledged and accepted by the EU target model.

2.2.4 Questionnaire responses – some anecdotal points

As noted, specific responses to the questionnaires have been patchy. This sub-section gives a few responses where interesting points were made but we caution reliance on the opinions expressed. Some opinions expressed were:

- Financial regulation could make brokering uneconomic
- For less liquid products or markets, a single trader can make a substantial difference to turnover and volumes; illiquidity in many products and markets was a recurring theme, with many products seeing less than 1 trade per day
- Market structure was a key factor in overall liquidity and trading
- Standard products are an important component of dynamic hedging because they are liquid and enable the trader and counterparties to trade out of positions as their physical balance position becomes clearer closer to real time
  - Even in the OTC market there is a tendency to use standardised EFET contracts
  - RES generators and large consumers use more structured arrangements to hedge rather than relying on market trading
- Country fundamentals are the biggest driver of underlying prices – variances in regulatory uncertainty will affect this:
  - The effects of coupling reducing spreads in the prompt market has been noticed
  - Liquidity in one market increases liquidity in adjacent markets
- FTRs are only better than PTR if they can guarantee full firmness (current proposals under the FCA NC do not require this firmness).

In general, traders had well-defined opinions about markets and market dynamics. Some of the issues raised are discussed below.

2.2.5 Key issues discussion

Liquidity

Several factors affect market liquidity. Some of these are discussed under subsequent headings below. The key factors identified include:

- **Market structure**. A major driver of liquidity in the forward markets is market structure in the physical world: the greater the number of actors in the prompt market, the greater the need for hedging in the forward market, and the less the availability of natural hedges to certain market players (such as through vertical integration), the more the need for forward hedging. However, this is far from the whole picture and several other factors come into play.

- **Transparency**. This is partly the purpose of REMIT in providing market information on volumes and prices but it was also noted that other factors such as the language of the website and the degree to which it is kept up to date can also play a role.

- **Costs of participation**. In several markets in the east, set-up costs can be significant including registration and licensing requirements. Added to this will be taxes and licence fees that make transaction costs high. Taxes on exports have also been a feature in some places. In Croatia, the need to trade through a Croatia-registered entity has been a major obstacle to market entry.

- **Cross-border contestability**. The ability to import or export will increase options for traders in a market. This serves to increase liquidity in adjacent markets.

Participants

The number and type of participants in a market will affect contestability. From the point of view of a small trader in any market, forward coverage is improved by:

- **Market Makers**. Larger parties prepared to offer a price in a broad range of circumstances will allow a small party to both enter and exit from forward positions, which makes hedging more feasible. Several exchanges offer lower dealing fees to designated Market Makers; this is a feature of NASDAQ operating the Nordic markets, as one example of conscious attempts to support liquidity. This affects both physical and financial products.

- **Financial Intermediaries**. A feature of recent developments is continued uncertainty for some industry participants as to the extent to which they can offer hedging products to other parties before hitting the threshold set out in the financial regulations (there is no threshold for using hedging products, hence the uncertainty). For financial intermediaries, the threshold rules can be more onerous and is one of the reasons why banks have recently reduced activity in the electricity forward markets.

Role of different trading platforms and products

The bulk of forward trading is undertaken using brokers or direct contracts. In a few cases this allows for non-standard risk products to be offered but, in general, the preference is for standardised contracts (usually EFET-based). Therefore, the preference for brokered products is based on lower cost and lower margin/credit requirements; even here, it is a marginal difference in that parties can pool their trading on exchanges allowing for savings in credit provisioning. It should be noted that inclusion of brokers within REMIT will raise broker costs, reducing their advantage over exchanges.

Physical or financial

Two broad categories of product are offered on exchanges: physical and financial. In some cases, it is not feasible to offer physical forward products but financial products should theoretically always be feasible. Table 15 (*on page 107 below, which is, in turn, based on information in Table 14 below*) lists available information on the split of products. This split is summarised on Table 2.

Table 2 Distribution of countries by availability of products and liquidity

Physical only (or no exchange identified)		Physical and financial		Financial only	
	% of country demand		% of country demand		% of country demand
Bulgaria	0.0%	Hungary	432.5%	Austria	635.0%
Croatia	0.0%	Italy	127.5%	Belgium	23.2%
Cyprus	0.0%	Netherlands	304.3%	Czech Republic	248.9%
Malta	0.0%	Poland	194.1%	Denmark	408.2%
Slovenia	0.0%	Portugal	12.9%	Estonia	563.7%
		Slovakia	3.9%	Finland	236.9%
		Spain	105.0%	France	197.7%
				Germany	635.0%
				Greece	0.1%
				Ireland	n.a
				Latvia	415.0%
				Lithuania	392.9%
				Luxembourg	635.0%
				Norway	497.6%
				Romania	33.2%
				Sweden	428.4%
				Switzerland	265.0%
				UK	96.3%

Source: Table 15

Figure 3 Physical and/or financial product availability across European exchanges

Source: various

Figure 3 illustrates the availability of financial and/or physical forward products across European exchanges. The key points to note with regard to Table 2 are:

- This is exchange data only and does not cover brokered contracts that may be considerably more physical
- The countries listed as physical only are mostly countries with lack of contestability and so no forward markets
- There seems no correlation between type of contract offered and degree of liquidity.

Types of financial product

Another issue with products is the types of product available. Some of these will be dictated by the nature of the market. In the Nordic area, the products are predominantly of the CfD type. Some people refer to these as 2-way options although this is not really a valid use of the term "option" because, once the contract is struck, there is no flexibility for either party to not exchange differences in revenue based on the spot price relative to the contract price; in an option contract, the buyer of the contract has a choice whether to exercise the option.

Again, based on Table 15, we can look at where different types of financial contract are available on European exchanges. Table 3 shows what types of products are available on exchanges. The predominant feature of the table is that, with the exception of countries in the Nordic region served by NASDAQ OMX, there are very few instances of products other than straightforward energy products being offered. The situation is more complex with regard to brokered products (although most are standardised contracts) and direct bilateral contracts will presumably offer a greater degree of optionality.

Table 3 Types of forward financial contracts available in different countries

Country	Simple forwards	CfDs, EPADs, Spreads	Other swaps	Options
Austria	✓	✓		✓
Belgium	✓			
Bulgaria				
Croatia				
Cyprus				
Czech Republic	✓			
Denmark	✓	✓		✓
Estonia	✓	✓		✓
Finland	✓	✓		✓
France	✓	✓		
Germany	✓	✓		✓
Greece	✓			
Hungary	✓			
Ireland		✓		
Italy	✓	✓		
Latvia	✓	✓		✓
Lithuania	✓	✓		✓
Luxembourg	✓	✓		✓
Malta				
Netherlands	✓			
Norway	✓	✓		✓
Poland	✓			
Portugal	✓			
Romania	✓			
Slovakia	✓			
Slovenia				

Country	Simple forwards	CfDs, EPADs, Spreads	Other swaps	Options
Spain	✓	✓	✓	✓
Sweden	✓	✓		✓
UK	✓			

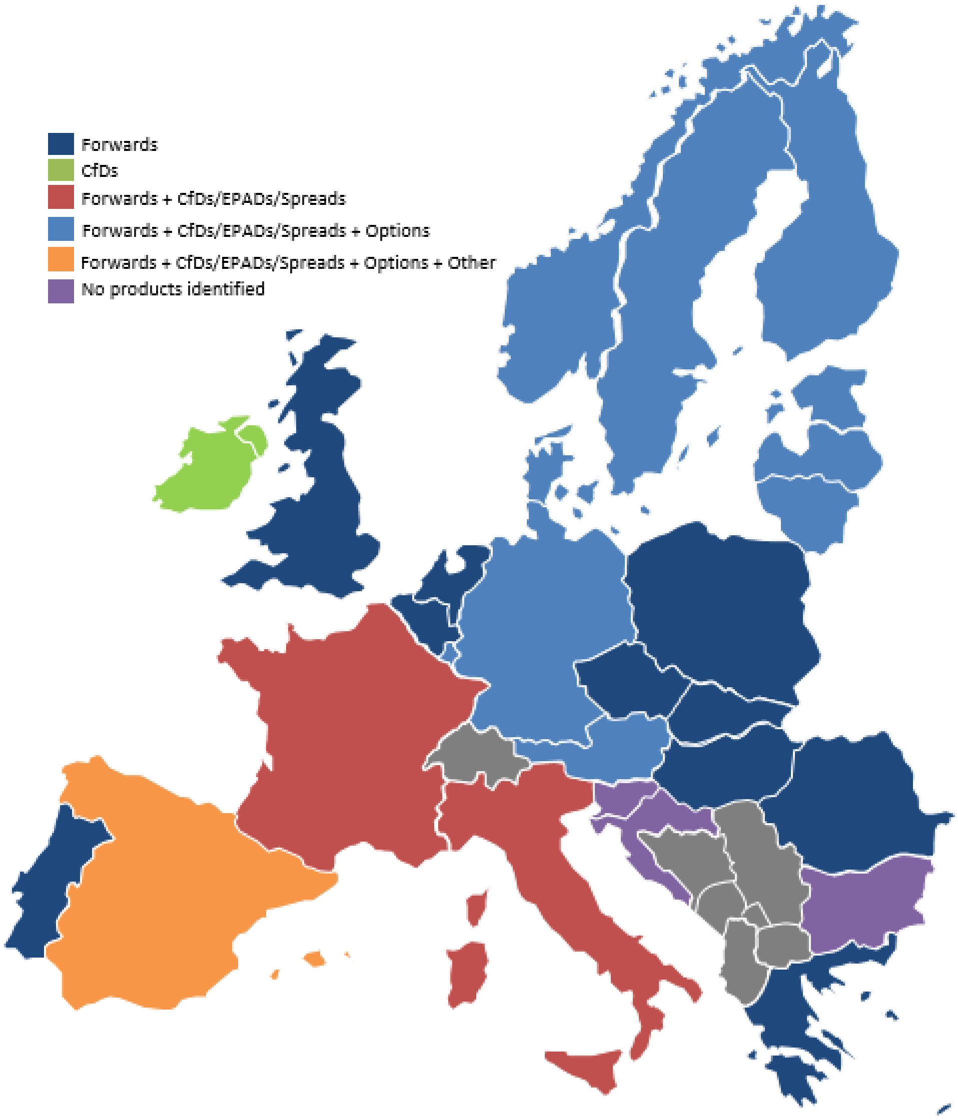
Source: Table 15

In Figure 4, we have amalgamated OTC-traded forwards with exchange-traded futures contracts. Similarly, we have amalgamated general CfDs with the more specific EPADs traded in the Nordic market.

Figure 4 illustrates product availability across Europe. It is not certain why so few product types are really offered on exchanges. The following are potential explanations:

- **Lack of trade**. Given the poor level of liquidity in many products in many countries, exchanges cannot support liquid trade in more exotic products
- **Lack of demand**. Given the predominant need to lock in pricing using forward products (i.e. a need to avoid exposure to spot price volatility), there is limited market appetite for options and swaps, etc. on exchanges.
- **Lack of flexibility**. The demand that there is for more exotic products cannot be satisfied by the degree of flexibility that exchanges could design into their products; more exotic products are therefore offered by brokers or by specialist bilateral forward contracts that can be more tailored to the buyer's requirements and risk profile.

Figure 4 Forward financial contract availability across Europe



Source: various

Time of day coverage of forward products

Given the dominance of simple products on exchanges, these products can be further divided into timescale coverage (monthly, quarterly, seasonal, annual) and time of day coverage (baseload, peak, off-peak).

The most actively traded products are annual baseload contracts. The relative lack of liquidity in peak load products is prima facie surprising. It is not certain whether this is purely down to lack of need for the product or due to a relative disadvantage in the prices being offered for such products. It seems most likely that there is a lack of demand for peaking products because traders' biggest worry is not access to price shape in the prompt market but fear of basis change in underlying prices leaving the trader exposed to fixed price retail contracts.

Impact on prompt market

Our analysis has not captured the volume of data necessary to establish the linkage between forward and prompt markets. Anecdotal evidence from traders suggests that there is a clear linkage. This is hardly surprising as a major reason for trading in forward markets is to buy a hedge against changes or volatility in prompt markets. A trader will establish a price position in the prompt market and will use that as a basis for contracting forward in retail markets (or, in the case of generators, contracting forward in the primary fuel markets) and will therefore need to lock in a position for these physical contracts with a primary fear that underlying prices will change.

What has also emerged is that prompt markets are increasingly diverging from the underlying position due to the increasing importance of intermittent generation. Nobody has been able to suggest how traders can insure against exposure to such volatility in the forward markets other than engaging in CfD or other option-type contracts. Indications are that such contracts are not particularly popular or liquid in most markets (with the exception of the Nordic market), suggesting that other ways of covering volatility risk are preferred.

2.2.6 Gap analysis (theory from previous section against outcomes of what is offered)

Liquidity

Our analysis has demonstrated that hedging products are widely available in most markets but that there is limited demand for most of them, with the most popular being annual baseload products. Product liquidities therefore vary enormously even within the same market. Because there is a large degree of selection on products by market players we have chosen to view liquidity at the market level rather than at the product level. Market liquidity is variable with a tendency for more trading in the north and west than in the east. We have reasonable information on level of liquidity in exchanges. Results for the factors discussed affecting liquidity are as follows:

Market structure

Figure 1 on page 9 shows one measure of the variability of competition depth in physical energy markets across Europe. While this has been considered a major factor in considering liquidity in forward markets, there seems to be only a weak correlation between concentration in the market and degree of trading in forward markets.

Transparency

Our evidence on this was more anecdotal. The established major exchange platforms make a large amount of information on forward market trades available although in some cases, this is either sold or only available to market participants. The ease of analysis of the data is also variable. Furthermore, in many cases product definitions and methodologies can be difficult to find.

Information on brokered trades is confined to price reporters and is variable between markets. While actual prices are comprehensively recorded, volumes traded and methodologies can be difficult to find. The information is available on subscription and can be quite costly.

Anecdotal evidence suggests that the more actively traded markets in North-West Europe are more diligent in transparency than markets in South-east Europe (Croatia, Romania and Bulgaria) – limited reliance can be placed on this claim. A major issue for traders is access to information on trading rules in English with some websites not being kept up to date.

Although evidence is mainly anecdotal, there seems no substantive evidence that this constitutes a major barrier to trading and liquidity.

Cost of market access

Market access costs fall into two categories:

- Exchange costs or broker costs
- Regulatory costs (licensing, taxes, legal presence).

In the case of pure trading costs, the charges vary by platform but sometimes considerable upfront fees are required. With the exception of ICE, all major platforms apply an annual or upfront fee in excess of €10,000. In addition, the main revenues for platforms are usually derived from throughput fees per MWh. This requires a fair volume of trade to make costs containable. However, we have not had reports that this is an impediment to trade.

Brokers are funded through throughput fees and these are usually modest.

To the extent that throughput fees are reasonably standard and modest across most markets, we have not had reports that they are impeding trade in forward products. Reports from one trader regarding Croatia, Bulgaria and Romania suggest that regulatory barriers (licensing fees, need to establish an office in country) and taxes are more of a problem and these are impeding trade profitability leading to illiquidity.

As noted, evidence in this area is anecdotal rather than comprehensive because, although we have access to published trading costs, we do not have substantive evidence of the impact of these costs on trading volumes and liquidity: we have not found evidence that these costs constitute a barrier to trading.

Participation

Our evidence suggests that participation rates are generally not inconsistent with liquidity levels in different markets but we do not have much in the way of comprehensive numbers to back up this assertion. We have therefore looked at types of participation.

Financial regulation also plays a potential role affecting the extent to which certain parties would enter markets as market makers. The following exchanges offer specific market maker opportunities:

- EEX – Austria, Belgium, France, Germany, Greece, Italy, Netherlands, Nordic market, Romania, Spain
- IDEX – Italy
- NASDAQ OMX – Germany, Netherlands, Nordic, UK
- OMIP (MIBEL) – Portugal, Spain
- POLPX – Poland
- PXE – Czech Republic, Hungary, Poland, Slovakia.

However we do not have any information on the extent to which market making is offered. Equally, we have no information as to the extent to which certain players take on a market-making role within the OTC markets.

Platforms and products

We only have comprehensive details on exchanges. As already noted, there is a preference for annual fixed volume contracts on exchanges. While we do not have the same detail with regard to OTC markets, it would seem odd if there were a significant difference in demand for products with different durations and time-of-day coverage in forward markets. This is not to say that there is not a role for more exotic products that would be more tailored through brokered or direct bilateral contracts. However, to the extent that the main demand for hedging contracts is to lock in prices for the buyer, then simple products will cover general price movement risk adequately.

We found that the majority of products offered on exchanges were financial rather than physical. It was suggested to us that this was for one of two main reasons:

- The market design prevented physical products – this applies in the Nordic region and in the gross pool Irish and Greek markets, where the market cannot become physical until the day ahead stage (or, in the Nordic market, there seems a preference to not become physical earlier)
- Purchasers of options wanted the advantage of not having to take delivery (even though sellers preferred to sell physical due to potential restrictions from financial regulations).

However, we have not got a definitive explanation for this.

In contrast to energy markets, in most cases, cross-border forward trading of capacity is in physical product (PTRs) – in this case, we were told that traders prefer having a physical option because they are then less exposed to spreads between markets. However, with regard to cross-border exchange, there is increasing movement to market coupling, which means that transfer rights are effectively allocated to exchanges sufficient to cover the demand for cross-border transfer of energy between coupled exchanges; in the Nordic area, this transfer is complete so that all cross-border transfer rights are used for the day ahead market.

We do not have definitive answers for:

- Why there is lack of demand for time-of-day products such as peak products
- Why there is a dominance of financial products in energy markets but not in transmission rights markets
- Whether OTC markets are more physical than exchange markets in countries where physical forward trading is feasible.

Other gaps in the analysis

Information on the OTC market has been limited. The main price reporters offer information on prices but much less on volumes traded. Lack of response from brokers also weakened our results. Therefore, while we have reasonably comprehensive data on some OTC markets, not all trades in all markets are covered. Therefore:

- We have reasonable information on: Austria, Belgium, Czech Republic, France, Germany, Hungary, Italy, Luxembourg, Netherlands, the Nordic markets, Poland, Romania, Slovakia, Spain, UK
- We have no information on: Bulgaria, Croatia, Cyprus, Greece, Ireland, Malta, Portugal, and Slovenia (although in some cases, there will be negligible OTC trading in forward markets).

We received information from a couple of traders who, however, gave us a reasonable indication of their business trading, which is predominantly via brokers or direct bilateral trading.

2.3 Tabulated results

2.3.1 Forward energy markets

Table 14 below (in Annex A1) shows the strengths of the different platforms and their trading terms, highlighting the most prominent exchanges and generally less developed regional exchanges. Table 4 below shows the relative impact these exchanges have on each EU country's energy market, including EU countries for which no forward energy markets have been identified; the figures in the final column of the table are illustrative because, as the table notes make clear, some fairly strong assumptions have been made due to the limitations of available data. The figures highlight how a country's presence on one or multiple forward market exchanges and/or having multiple different forward products to choose from does not necessarily equate to a sufficiently deep forward energy market.

Table 4 Forward trade by country

Country	Exchanges available	Annual forward trade volumes (GWh)			% of country demand[1]
		Exchanges	OTC	Total	
Austria	EEX, ICE, NASDAQ	153,520	246,126	399,645	635.0%
Belgium	EEX, ICE	13,447	5,518	19,168	23.2%
Bulgaria	No coverage identified				
Croatia	Only bilateral contracts				
Cyprus	No coverage identified				
Czech Republic	PXE	17,723	123,362	141,085	248.9%
Denmark	EEX, NASDAQ	73,837	53,651	127,488	408.2%
Estonia	EEX, NASDAQ	22,267	16,180	38,447	563.7%
Finland	EEX, NASDAQ	109,530	79,586	189,116	236.9%
France	EEX	82,701	785,601	868,302	197.7%
Germany	EEX, ICE, NASDAQ	1,263,695	2,025,976	3,289,671	635.0%
Greece	EEX	315	-	315	0.1%
Hungary	HUPX, PXE	7,111	143,563	150,673	432.5%
Ireland	SEM				
Italy	EEX, GME, ICE, IDEX	161,021	205,262	366,283	127.5%
Latvia	EEX, NASDAQ	15,806	11,485	27,291	415.0%
Lithuania	EEX, NASDAQ	20,375	14,805	35,180	392.9%
Luxembourg	EEX, ICE, NASDAQ	15,159	24,304	39,463	635.0%
Malta	No coverage identified				
Netherlands	EEX, ICE, NASDAQ	118,126	204,935	323,061	304.3%
Norway	EEX, NASDAQ	314,897	228,808	543,704	497.6%
Poland	POLPX, PXE	162,945	77,850	240,795	194.1%
Portugal	OMIP (MIBEL)	5,837	-	5,837	12.9%
Romania	EEX	58	13,315	13,374	33.2%
Slovakia	PXE	974	0	974	3.9%
Slovenia					
Spain	EEX, OMIP (MIBEL)	72,069	184,106	256,175	105.0%
Sweden	EEX, NASDAQ	310,187	225,386	535,573	428.4%
Switzerland	EEX	1,229	155,013	156,242	265.0%
United Kingdom	ICE, NASDAQ	5,030	300,679	305,709	96.3%

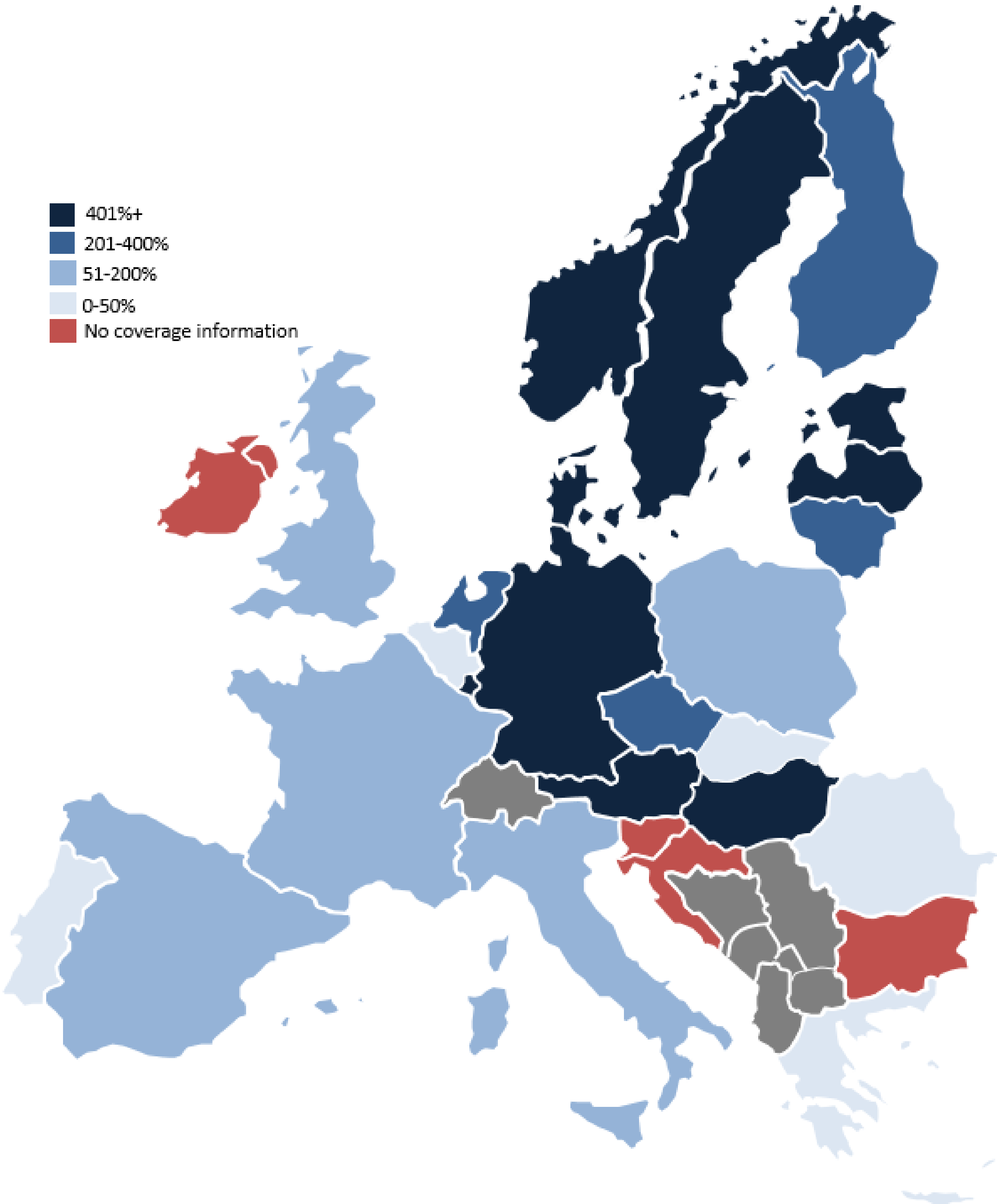
[1]*Consumption drawn from Eurostat*
Source: Table 15 *in Annex A1*

Arbitrary tiers of markets have been inferred from this survey of available data with a view to demonstrating **relative** liquidity subject to the qualifications discussed below:

- **Above 400%**

- 201% - 400%
- 51% - 200%
- 0% - 50%
- **No coverage information:** Bulgaria, Croatia, Cyprus, Ireland, Malta, Slovenia.

Figure 5 Approximate forward and OTC market volumes



Source: ECA calculations.

Figure 5 maps out these tiers. This review is necessarily incomplete due to the partial nature of available data. The percentage of country demand figure is therefore only an approximation. However, it does provide a snapshot of the extent of relative forward market liquidity across Europe and for the most part illustrates relatively insufficient market depth[4].

2.3.2 Forward transmission rights markets

Table 5 aggregates the allocation of PTRs and FTRs across the CAO and CASC platforms, as well as FTR allocations on the Portugal-Spain border. The weighted export and import prices give an indication of the extent of congestion for exporting and importing electricity for each country. The data in the table are for comparison purposes rather than strict accuracy as volumes have been extrapolated.

Table 5 Summary information on European capacity allocation by country

Country	Borders with	Type of allocation	capacity (MWh)[1]		capacity as % of consumption		Weighted price (€/MWh)[2]	
			Export	Import	Export	Import	Export	Import
Austria	Czech Republic, Hungary, Italy, Slovenia, Switzerland	PTR	17,335,909	24,639,830	28%	39%	6.12	0.11
Belgium	France, Netherlands	PTR	12,491,375	22,820,361	15%	28%	0.53	5.63
Croatia	Hungary, Slovenia	PTR	19,272,000	21,024,000	128%	140%	0.08	0.27
Czech Republic	Austria, Germany, Poland	PTR	18,036,840	7,892,760	32%	14%	1.70	0.14
Denmark	Germany	PTR	2,102,400	3,504,000	7%	11%	3.41	2.12
France	Belgium, Netherlands, Spain, Switzerland	PTR	47,495,056	18,811,005	11%	4%	7.25	0.74
Germany	Czech Republic, Denmark, Netherlands, Poland, Switzerland	PTR	24,115,772	54,612,880	5%	11%	6.28	0.70
Greece	Italy	PTR	4,380,000	4,380,000	9%	9%	0.56	3.82
Hungary	Austria, Croatia, Slovakia	PTR	14,892,000	17,520,000	43%	50%	0.25	3.19
Italy	Austria, France, Greece, Slovenia,	PTR	23,566,546	61,135,996	8%	21%	0.80	6.30

[4] See Section 3.3.3 for a brief discussion of views on what is considered adequate in terms of churn rates in different markets

Country	Borders with	Type of allocation	capacity (MWh)[1]		capacity as % of consumption		Weighted price (€/MWh)[2]	
			Export	Import	Export	Import	Export	Import
	Switzerland							
Netherlands	Belgium, Germany	PTR	19,472,569	19,786,939	18%	19%	2.26	6.38
Poland	Czech Republic, Germany, Slovakia	PTR	6,132,000	0	5%	-	0.05	-
Portugal	Spain	FTR	4,821,700[3]	4,821,700[3]	11%	11%	0.14	0.17
Slovakia	Hungary, Poland	PTR	6,132,000	4,012,080	25%	16%	5.74	0.30
Slovenia	Austria, Croatia, Italy	PTR	20,095,440	17,642,333	160%	140%	1.62	2.13
Spain	France, Portugal	FTR, PTR	10,690,900[3]	10,515,700[3]	5%	5%	1.14	6.97
Switzerland	Austria, France, Germany, Italy	PTR	59,318,174	17,231,095	101%	29%	2.26	2.28

[1]Sum of volumes of products allocated on CAO and CASC platforms, [2]Weighted by each product's share of total volume, [3]Includes FTR allocations on the Portugal-Spain border.

2.4 Summary conclusions

Our analysis has given a reasonably comprehensive picture of certain areas such as products available and relative liquidity. Our data on forward cross-border exchanges is relatively comprehensive.

Our questionnaires gave a few insights but reliance should not be placed on these results.

Some key results are:

- Liquidity on exchanges is relatively weak in many markets. The weakest markets tend to be in South-east Europe although Belgium, Portugal and Slovakia also exhibit low turnover (<60% of annual demand). In contrast, the block of Austria, Germany, Luxembourg, the Netherlands and the Nordic area have a turnover of 300% or more of annual demand, with Austria and Germany exceeding 600%. Several different reasons have been advanced including dominance in the prompt markets and, especially in south-east Europe, due to regulatory and cost impediments imposed on trading. Liquidity may also be a simple matter of market maturity.

- There is a preference for basic products in energy markets suggesting that the main risk that is being hedged is underlying price movement rather than short-term volatility; this conclusion even extends to the relative lack of volume traded in peaking products and shorter timeframe products (quarterly and monthly). This seems to apply across all markets, where peakload product volumes are negligible. In most markets, annual products are preferred but, where offered, quarterly products can also be popular (for example: the Spanish and Portuguese markets – OMIP MIBEL – the Italian market – IDEX – and the UK market – ICE); reasons for this variation will partly depend on the sophistication of the market but could also represent the underlying basis risk where gas-fired generation sets the spot price.

- There is greater choice offered in financial products than physical ones. The reasons we were given for this are that this is more on the demand side than the supplier side because although larger traders have a preference for physical products – partly because of fears of breaching thresholds under new financial regulations – smaller traders find financial products easier to deal with because they do not commit them to move onto delivery.

- The exception to the previous point is in the trading of transmission rights, which are predominantly physical at present, although in many cases, rights holders are allowing UIOSI provisions to effectively turn these products into financial instruments – nevertheless, until the nomination deadline, these remain physical options.

3 Task B: Methods to evaluate efficiency

Section 3 reports on Task B, the objective of which is to examine the literature and different market examples agreed with ACER with the aim of **identifying specific methods to evaluate the 'efficiency' of forward markets**.

We believe that before reporting on the findings from the literature, it is helpful to initially **examine from first principles why forward markets might warrant particular regulatory attention and be subjected to market monitoring** and ascertain what 'efficiency' might imply in this regard. This serves to place the literature review into a broader and structured context, while the discussion and findings can complement those from the literature, highlight features of the market that can be subjected to monitoring and evaluation, and identify the metrics that could be applied to determine market performance. Accordingly, this Section begins with a discussion of the importance of forward markets and the identification of market features that would demonstrate that they function effectively together with associated monitoring indicators (Section 3.1), followed by an overview of the findings from the literature (Section 3.2). A final Section contains a summary of the key findings and conclusions.

3.1 Defining requirements of forward markets

In thinking about the role, function and assessment of forward markets, we need to address four key questions:

- **Why are forward markets important?** An understanding of the role of forward markets is necessary for identifying the *potential* scope and focus of regulatory monitoring.
- **What are some possible problems with the operation of forward markets?** Recognising the import of forward markets does not on its own make a case for regulatory intervention or assessment. The latter would also need to be driven by concerns about participants being able to exercise market power in forward markets or other related issues around contestability (in related markets), market and product access, effective competition and minimisation of costs.[5]
- **What features characterise a well-functioning forward market?** The objective here is to help identify a set of forward market features that correspond to a well-functioning market and support desirable market outcomes.
- **How can forward markets be monitored?** Having addressed the previous points, relevant metrics can be specified for the market characteristics of interest, which can be used for undertaking market monitoring (if justified).

Each of these issues is sequentially considered in further detail below.

[5] Moreover, these concerns ought to be material enough to outweigh the cost of regulation (even the light-handed monitoring kind) and the risk of 'regulatory failure' (in the event that more heavy-handed regulatory intervention is chosen).

3.1.1 Why are electricity forward markets important?

Forward markets in electricity (as for any commodity market) *primarily* exist for two reasons – hedging and price discovery.

Hedging is a mechanism that allows market participants to offset their exposure to the price volatility (or geographic price differences in the case of transmission congestion, including nodal pricing where locational marginal prices apply) they encounter in the real time or prompt markets. They are therefore important in reducing uncertainty and stabilising future revenue streams.[6] By insulating firms from volatile and extreme price movements and thereby lowering the *real* cost of financial distress, hedging can be value-enhancing; it is also especially important for smaller and independent suppliers[7] that could otherwise be wiped out by extreme price movements and/or which have no access to the natural hedge offered by also engaging in electricity generation.[8] Hedging is also used by generators seeking to lock in revenue streams that support investment. For the purposes of the present study, forward markets and hedging may relate to the energy commodity market and/or cross-border (or cross-zonal) transmission capacity markets, although forward markets can exist for reserves and greenhouse gas emissions.

Price discovery is the second important aspect of forward markets in that they provide an indication of where prices in the prompt markets are moving to; therefore forward prices can be used to forecast or predict future spot prices. Having reliable forward prices in turn is important for ensuring adequate long term investment, notably in generation and transmission capacity. However, this presupposes that there are high-volume trades all along the forward curve (i.e. a set of available forward prices as a function of their maturity) and that this extends sufficiently into the future.

Importantly, **the forward market is a derivatives market**, that is, it is dependent on the underlying real time wholesale electricity market. Hence, the value of the products traded in the forward market is derived from and determined by the value in the underlying assets in the physical market.

3.1.2 What are possible concerns with how forward markets function?

Market dominance in forward trading

A primary (but not the only) motivation for the economic regulation of the electricity sector is to address problems of monopoly power or pricing. However, is market dominance necessarily a concern in forward electricity markets?

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[6] Hedging is arguably even more important for electricity markets compared to other energy and commodity markets, as in electricity markets there are currently no economic storage options that can be used to manage price fluctuations.

[7] Independent suppliers in this context are those that do not have an affiliated power generation business.

[8] We note that vertically integrated generation and supply businesses would have a complete hedge only where their load obligation equates to their generation capacity. If they are net buyers or sellers of electricity, they will still have some exposure to the spot market (and presumably a motivation to hedge in forward markets). Nevertheless, vertical integration does have the effect of reducing the need for hedging contracts.

If arbitrage is not deliberately inhibited, **it is arguably impossible for market participants to exercise market power (defined as raising the price above competitive levels) in a forward market**. As stated above, forward markets are derivative markets and hence the price in forward markets is derived from the real time market. Suppose for the moment that a generator *could* raise the price in the forward market. Load would recognise the price difference between the forward and real time market and migrate to the latter. This would therefore address the problem of market power; before real time, the opposing side of the market always has the alternative of waiting. In practice, in low liquidity forward markets, market power may still be exercised because weaker parties may not be able to trade out of a position effectively and so remain exposed to market power in the prompt markets.

Nevertheless, this is not the end of the story; it is also relevant to ask:

1. Can market participants in the real time market *extend* their market power through forward markets, and

2. Can the forward market *mitigate* market power in the *prompt* electricity market?

Regarding the first question, forward markets would arguably suffer from market power exercised in the prompt markets, as any increase in the prompt market would translate into the forward markets. However, this is not a problem with the forward market; **the issue arises in the physical market**. Hence, while forward trading activity would be relevant in assessing market power and the profitability of monopolistic actions in the real time market, this alone does not necessarily justify regulatory intervention or systematic monitoring of the forward market. The latter becomes important if it is also considered that forward markets can limit market power in the prompt markets, which is the second question above.

Forward contracting and trading could conceivably have procompetitive effects on prices in the prompt markets. This is because if most output is already sold in the forward market, then a supplier might have little interest in raising the real time price (as the resulting increase in the spot market price might not be sufficient to outweigh the loss resulting from the withheld capacity). However, **this effect is ambiguous** particularly in a dynamic setting and where current prices help determine future prices. That is, if current prices are high and buyers anticipate that future prices will also be high they will be willing to pay more for a fixed price forward contract, and the seller would therefore take this into account (in its prompt market pricing/bidding). There is considerable theoretical academic literature that has developed in recent years that examines whether forward markets help mitigate market power in the real time markets. The broad consensus is that forward contracting and trading does help countervail dominance in the wholesale market, although the results are sometimes sensitive to the assumptions made and the opposite case (i.e. that forward markets can be used to further entrench market dominance) has also been made.[9]

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[9] See, for example, Allaz, B. and J.-L. Vila (1993) "Cournot competition, futures markets and efficiency" Journal of Economic Theory 59: 1–16,
Joskow, P. and J. Tirole (2007) "Reliability and Competitive Electricity Markets", The RAND Journal of Economics, 38(1), Spring, 60-84,
Breitmoser, Y. (2012) "Allaz-Vila competition with non-linear costs or demands', MPRA 41772, working paper,
Li, Y. (2014), "Vertical Structure and Forward Contract in Electricity Market", Working Papers 2014-117, Department of Research, Ipag Business School,

Facilitation of contestability

Notwithstanding the above, forward markets are universally seen as important in facilitating **new entry** in generation and supply by allowing new entrants to buy and sell electricity to match their output and customer base. Hence, the focus is not so much on incumbents exercising market power in the forward market, but the **promotion of contestability** in wholesale and retail electricity markets particularly by allowing non-vertically integrated entrants and smaller suppliers to compete on similar terms with vertically integrated incumbents. Viewed this way, indicators of market power and barriers to entry (in the forward market) would be important in assessing the degree to which potential competitors have **access to the market**, but equally important is whether forward markets are fulfilling their principle functions of **hedging** and **price discovery** – suppliers would be more able to compete in retail electricity markets and offer attractive stable prices if they can hedge in forward markets, while both robust prices and effective hedging strategies facilitate generation investment (and therefore new entry).

3.1.3 What features characterise a well-functioning forward market?

The main contention of the foregoing is that the significance of well-functioning forward electricity markets derives from the degree to which they **facilitate effective competition in the real-time markets of electricity generation and supply**. We have already identified hedging and price discovery as important parameters, but if forward markets are to facilitate competition in prompt markets, there are additional aspects that are also likely to be critical. Generally, we would expect that effective forward markets would:

- Provide effective hedging opportunities and be sufficiently liquid
- Facilitate price discovery
- Allow market access (at reasonable cost)
- Otherwise support contestability in the wholesale and retail electricity markets
- Be characterised by effective competition.

We briefly elaborate on each of these features in the sub-Sections below. While we treat these forward market dimensions separately there is much interdependence between them. For example, if a market is *liquid*, it provides robust prices and facilitates *price discovery* while an illiquid market may act as a barrier to entry and therefore impede *market access* by new entrants. Nevertheless, we believe categorising the issues around the above market features is helpful in drawing out the relevant performance parameters and thinking about monitoring indicators.

Hedging and the importance of liquidity

As already discussed, hedging is an important part of the efficient operation of electricity markets. A fundamental aspect of hedging is the level of **liquidity** offered by the relevant

Powell, A. (1993) "Trading Forward in an Imperfect Market: The Case of Electricity in Britain", The Economic Journal, 103 (417), March, 444-453.

forward market. Liquidity is the ability to quickly purchase or sell an asset without causing a significant change in its price and without incurring substantial transaction costs.

Liquidity is important in that it facilitates the buying and selling of energy (and capacity) whenever market participants require. In a liquid market, suppliers have greater certainty that they will be able to purchase electricity to supply their customers and generators have confidence that they can sell the output from their power stations. Liquidity is therefore conducive to the overriding objective of encouraging new entry (or the threat of new entry) and thereby creating competitive pressure in both wholesale and retail electricity markets. Put differently, a liquid market allows firms to match their contracted position to its physical shape and therefore manage their price risks. If the forward market itself generates risk (as it would if it were illiquid), then it largely defeats one of its underlying purposes i.e. that of offering a mechanism for hedging risks.

Price discovery

The degree to which forward markets *accurately* predict future spot prices and the extent to which there is a risk premium extracted (from more risk-averse consumers/load representatives) is the subject of considerable academic debate.[10] In any case, we believe the importance of price discovery is incontrovertible. Again, liquidity will be an important aspect of price discovery – as more market participants trade a particular product, information is revealed about its valuation and this can be incorporated in the market price. However, other factors *facilitating* price discovery are also important. These include:

- **Product availability** - longer dated products are particularly important in this respect given that retailers and generators (especially) need to make decisions and investments that span some time into the future.

- **Transparency** e.g. proportion of trade that is exchange-based rather than over-the-counter – OTC contracts are a direct (or brokered) agreement between two parties and while they allow a high level of flexibility in the terms of the arrangement, they can frustrate transparency and price discovery as volumes and prices under such contracts are generally private information (although such information is often shared with price reporters, with traders valuing the information thereby resulting – such trades will be reported under REMIT. In New Zealand, OTC trades are reported). As more forward market trading shifts to exchanges, prices can become more transparent and (provided the exchange markets are liquid) can be used by market participants as a reference for contracts and OTC trades. They also facilitate the entry of 'non-physical' market

[10] Some of the literature reviewed later in this Section addresses precisely this matter. Other reviews consider a premium between day-ahead and spot is a sign of efficiency – a principle that has not been explicitly explored with regard to premiums between prices further forward and day-ahead prices. See: Nogales, F.J. and Conejo, A.J., 2006, 'Electricity price forecasting through transfer function models', Journal of the Operational Research Society, 57, 350-356,
Cartea, A. and Villaplana, P., 2008, 'Spot price modelling and the valuation of electricity forward contracts: The role of demand and capacity', Journal of Banking & Finance, 32 (12), 2502-2519,
Arciniegas, I., Barret, C., and Marathe, A., 2003, 'Assessing the efficiency of US electricity markets', Utilities Policy, 11, 75-86,
Longstaff, F.A. and Wang, A.W., 2004, 'Electricity Forward Prices: A High-Frequency Empirical Analysis', Journal of Finance, 59 (4), August, 1877-1900.

participants, such as financial intermediaries and 'speculators'.[11] However, as in the New Zealand case, OTC contracting could be made just as transparent as exchange trading.

Importantly, the function of **regulatory monitoring itself can also be a mechanism for promoting transparency** and confidence and therefore facilitating price discovery (and liquidity). However, reporting obligations should be carefully considered so that costs are kept to a minimum and unnecessary duplication is avoided. For example, in the present context, it will be important to clarify reporting requirements for REMIT and forward market monitoring purposes, and to clearly distinguish the reporting requirements for national regulators and ACER and also those between financial authorities and energy regulators.[12]

Access to forward markets (or barriers to entry and exit)

As with any market, the absence of barriers to entering the forward market is important for facilitating competition. **If forward markets have large barriers to entry then independent parties could be denied an avenue for effectively participating in the real time markets**. Minimising transaction costs and the cost of entry requirements is particularly important for non-vertically integrated and smaller suppliers that generally do not have strong balance sheets. These businesses are 'asset light' and must hold significant levels of working capital, given the cash negative nature of the electricity retailing business - energy purchases are made well in advance of the payments received from customers. Having to provide substantial **collateral or credit cover** for participation in forward markets **and other such costs** (such as exchange membership fees and non-pecuniary requirements such as IT infrastructure) further adds to the cost and difficulty of such players entering the market.

The ability to exit or, more specifically, to be **able to trade out of positions when required at reasonable cost** is also an important aspect of market access.[13] Liquidity will once more be an important factor in this regard, but the degree to which other intermediaries or 'market makers' participate in forward markets is also likely to minimise the risk of parties being 'trapped' in unfavourable market positions. Because market makers essentially undertake to buy or sell at specified prices at all times, they help instil greater confidence in the forward markets and encourage other participants to actively trade in the market. This can create a virtuous cycle where the additional trades result in greater depth and liquidity which, in turn, attract even more market players and exchanges. Thus, **market makers can play an important role** in terms of building and maintaining highly liquid forward markets.

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[11] Trading through centralised exchanges might also lower transaction costs and credit requirements and therefore barriers to entry (which are discussed immediately below).

[12] Interestingly, the Council of European Energy Regulators (CEER) has only just recently (20 April 2015) advised the European Commission that financial market regulation (MiFID II) would duplicate REMIT and impose unnecessary regulatory burden on energy trading. See: http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/PRESS_RELEASES/2015/PR-15-05_MiFIDII%20Proposal_2015-04-20.pdf

[13] If market participants are not confident that they can exit the market or particular trading positions when needed, this would deter entry in the first place.

Other features supporting contestability

There are additional features beyond those discussed above that could be important both for reinforcing these same attributes (i.e. liquidity, price discovery, market access) and also encouraging entry and competition in electricity markets. These include:

- The **diversity** of financial derivatives, which would offer a broad product range and facilitate hedging by participants of different circumstances and organisation. A market which contains a wide range of products aids contestability because it makes it easier for market participants to hedge their customer demand and adjust their hedged position over time thereby reducing the overall cost of hedging. In the case of small or independent suppliers, the availability of suitable products with **small clip sizes** is likely to also be important as in the absence of these, they may be unable to enter the market and/or hedge their customer demand requirement.

- Participation of **diverse market players** including 'speculators' or financial intermediaries. A high number and diverse range of market participants trading in forward markets are an indication of low barriers to entry and can help contribute to the formation of robust forward prices.

Effective competition in the forward market

It was argued earlier that there is probably limited capacity to exercise market power in forward markets alone (i.e. without also being dominant in prompt markets). Hence, provided this tenet is accepted, the focus of these measures need not be so much on market behaviour (i.e. the degree to which market power is exercised), but on structural indicators of market access. Some of these have already been identified under other headings above (e.g. low barriers to entry and large number of market participants). Measures of **market concentration** (e.g. HHI) will reflect the extent to which there may be access to the forward markets for smaller players but although high levels of concentration are likely to result in limited liquidity which in turn limits the effectiveness of competition, they do not really inform on the reasons for the concentration.

3.1.4 Framework for assessing forward markets

Having identified a range of features that should ideally characterise forward markets if they are to promote competition in prompt markets, we can identify a series of metrics that could merit attention or form the subject of market monitoring. Accordingly, Table 6 below contains the **market features** discussed above together **with suggested corresponding metrics and monitoring methods** that could be used for monitoring and assessing electricity forward markets.

As already noted, there are important overlaps between the various features and metrics, but we believe it is still useful to group them as suggested to capture the different dimensions of performance (although other groupings are also possible). Moreover, having a broad set of indicators enables the evaluation of the contribution of the different features to market outcomes and the exercise of judgement in assessing market performance, which is inevitably required. However, this needs to be measured against the cost of having to obtain the requisite information and the complexity introduced when examining multiple measures.

Table 6 Possible measures for monitoring electricity forward markets

<table>
<tr><th>Features</th><th>Metrics</th><th>Monitoring method</th></tr>
<tr><td colspan="3">1. Effective hedging opportunities</td></tr>
<tr><td rowspan="4">Liquidity</td><td>Aggregate churn rate: volumes traded across all products ÷ physical consumption (capacity)</td><td rowspan="4">▪ Trend over time for given market
▪ Comparison to a range of other high liquidity markets</td></tr>
<tr><td>Bid-offer spreads for a range of standard products</td></tr>
<tr><td>Volumes traded: total quantity of a product bought and sold during a trading day</td></tr>
<tr><td>Multiplicity of forward products supported by market</td></tr>
<tr><td colspan="3">2. Facilitation of price discovery</td></tr>
<tr><td rowspan="2">Product availability - volume of trade along the forward curve</td><td>Volume of trades that are for more than 12 months ahead</td><td rowspan="2">▪ Trend over time for given market by trading period of delivery
▪ Comparison to a range of other high liquidity markets</td></tr>
<tr><td>Average trade size further along the forward curve</td></tr>
<tr><td rowspan="2">Price transparency – use of exchange platforms</td><td>Proportion (%) of trade that is exchange-based</td><td rowspan="2">▪ Trend over time for given market</td></tr>
<tr><td>Proportion (%) of consumption/ capacity that is exchange-based</td></tr>
<tr><td colspan="3">3. Ease of market access (low barriers to entry and exit)</td></tr>
<tr><td rowspan="4">Low transaction and entry costs</td><td>Credit cover / collateral requirements (for bilateral contracts)</td><td rowspan="4">▪ Mostly descriptive/qualitative information
▪ Evolution over time</td></tr>
<tr><td>Margin calls (on centralised trading platforms and exchanges)</td></tr>
<tr><td>Membership fees and structure (for exchanges)</td></tr>
<tr><td>Description of other participation or qualification requirements (governance arrangements, IT requirements, time for approvals, etc. that might constitute non-price barriers)</td></tr>
<tr><td>Presence of market makers</td><td>Number of market makers active in the forward market</td><td>▪ Growth in number over time</td></tr>
<tr><td colspan="3">4. Other measures supporting contestability in prompt markets</td></tr>
<tr><td rowspan="3">Diversity of products</td><td>Range of traded products (peak, baseload, monthly, annual, etc.)</td><td rowspan="3">▪ Trend over time for given market
▪ Comparison to a range of other high liquidity markets</td></tr>
<tr><td>Minimum contract/clip size for various products</td></tr>
<tr><td>Volume of trade at minimum contract/clip size</td></tr>
</table>

Features	Metrics	Monitoring method
Diversity of counterparties	Number of counterparties active in the forward market	▪ Growth in number over time
	Number of counterparties offering products to small and/or independent suppliers	
	Number of small / independent market participants who are trading directly on the various market platforms	
	Number of financial and other intermediaries participating on the various market platforms	
5. Effective competition in the forward market		
Low market concentration	Herfindahl-Hirschman Index (HHI): square of market shares	▪ Trend over time for given market ▪ Comparison to a range of other high liquidity markets
	Concentration ratio: the market share of the four largest firms	

3.2 Literature and selected country review

3.2.1 Literature list

Approach to review

At the kick-off meeting a list of literature to be reviewed was agreed with ACER. This consisted mostly of papers and articles published within the last five years (although some older articles were also included that were thought to be potentially relevant). The literature was originally grouped around the headings of "financial and physical transmission rights", "price formation in forward markets" and "forward and futures market efficiency" on the basis of the anticipated content and scope of the literature.

The main objective of reviewing this literature was to **try to extract lessons and suggestions for how forward markets and their products can be evaluated and monitored and to identify those market features and monitoring methods that are likely to be most relevant and capable of application to EU electricity markets**. With this in mind, we reviewed all papers and present information in three different ways:

- ❑ We summarise the findings of the papers based on their stated objective and scope and for ease of reference group them around a series of common themes (see 'Summary of results' below)
- ❑ In Annex A2 we provide a detailed bibliographical table of the literature reviewed – this contains the set of information required by our ToR and can act as a guide for readers who wish to further explore the content and findings of the various articles

- We extract the metrics (wherever available) employed in the reviewed literature articles and present them with the same categorisation of market features and monitoring metrics that we developed in Section 3.1.4 (see 'Evaluation of results' in Section 3.3.1 below).

Summary of results

In Table 7 we summarise the literature studied. After reviewing the papers, we have regrouped them around five general themes that emerged as follows:

- **Theme 1: Hedging and liquidity in forward markets** – these papers examine the degree of liquidity in the various markets, but in most cases with a view to determining desirable design features and policy interventions for promoting the establishment and/or increased liquidity of forward markets. The main exception is a report from New Zealand that presented various *metrics* that may be used to assess the competitiveness, efficiency and reliability of the market.

- **Theme 2: Financial and physical transmission rights** – a second (and smaller) set of papers deals with financial transmission rights, but again mostly from a policy perspective and with the aim of assessing the prerequisites for financial transmission rights to support the development of competition across regions or bidding zones. Most of this literature originates from the US.

- **Theme 3: Relationship between forward and prompt market prices** – these papers are mostly written by academics and apply modelling and statistical techniques to examine the relationship between spot and forward prices and, more specifically, to investigate whether there is a price premium extracted in forward markets. The literature tends to use the analysis to determine how well the market is functioning.

- **Theme 4: Assessment of prompt markets** – this is a key focus area in all market contexts. The papers generally investigate the level and effectiveness of competition in prompt wholesale and retail electricity markets and assess whether and how certain market design parameters and characteristics influence market outcomes. Liquidity is an important aspect of this assessment and although the focus is on prompt rather than forward markets, some of the discussion and metrics are transferable to the latter.

- **Theme 5: Market design** – the last set of papers examine specific structural and performance characteristics of electricity markets. A number of these that examine the effect of trading and the introduction of forward markets have some relevance to the present study, while others address issues such as optimal price setting, capacity markets, bidding zone configuration and nodal pricing that fall outside the study scope.

In Table 7 we summarise the main literature reviewed.

Table 7 Scope, issues and key findings from the literature review

Report title	Author and date	Country (ies)	Issues / findings	Comments
Theme 1: Hedging and liquidity in forward markets				
Evaluation of Hedge Market Liquidity	Energy Link, 2011	New Zealand	Reaching trading volume goals organically unrealistic. Market changes needed, such as setting a max bid-offer spread, ensuring markets can support increased trading, and market players being confident that futures prices are efficient.	Review of the Government's efforts to implement a liquid electricity hedge market
Long-term cross-border hedging between Norway and Netherlands	Redpoint, 2013	Norway, Nether-lands	Locational risks exist in Norway due to product unavailability or low liquidity for some areas Dutch liquidity has migrated to neighbouring German market. Hedges can be constructed with cross-border products, but this introduces locational risk Identify limited stakeholder demand for instruments to hedge against cross-border risk, but do find interest in accessing liquid foreign markets	Evaluation of needs and opportunities for long-term cross-border hedging between the Nordic and Dutch electricity markets
A financial electricity market in the Baltic States	Houmoller Consulting, 2013	Baltics	Liquidity too low in Baltic CfDs, FTRs preferable for providing market players with hedging opportunities MiFID II drafting provides uncertainty for TSO obligations in operating FTR auctions	Highlights liquidity's key role in linking physical and financial markets. Provides insights on setting up financial markets for a smaller EU market
Hedge Market Development: Metrics	Wholesale Advisory Group (WAG), May 2014	New Zealand	Presents various metrics to assess the competitiveness, efficiency and reliability of the hedge market; metrics grouped by volume, price, depth and liquidity, and non-price barriers	Report prepared as part of WAG's hedge market review
Hedge Market Development: A WAG Discussion Paper	Wholesale Advisory Group, November 2014	New Zealand	Suggests that hedge prices are efficient, hedge markets generally facilitate meaningful competition, but there are avoidable non-price barriers preventing participation for smaller-scale operators.	Paper is not the final report in the review process (due June 2015); presentation of key issues under review for development of the hedge market, requests for further feedback. Preliminary responses include problems from large clip size for trades

Report title	Author and date	Country (ies)	Issues / findings	Comments
Nordic Market Report 2014	NordREG, 2014	Nordic	The Nordic financial electricity market is highly transparent and liquid. However, during the past four years there has been a fall in the volume and value turnovers and the number of transactions.	Regular report published by NordREG describing on a yearly basis status and developments in the Nordic electricity market with focus on generation, consumption, transmission, wholesale power market and retail markets.
Efficiency of Contracts for Differences (CfDs) in the Nordic Electricity Market	Petr Spodniak, Nadezda Chernenko, and Mats Nilsson, 2014	Nordic	Suggest EPADs have a key hedging role. The need for a hedge varies by hydro capacity and the share of end user fixed price contracts	Use risk premia and a VAR (vector autoregression) model to assess the efficiency of EPAD products and the drivers of risk premia
Forward Contracts in Electricity Markets: the Australian Experience	Edward J. Anderson, Xinmin Hu, and Donald Winchester, 2007	Australia	Emphasises high proportion of trades conducted OTC Regulatory risk cited as reason to not engage in long-term contracts Traders wary of locational risk, hesitant to engage in inter-regional trade	Review actual contracting process in Australia's forward energy market via market participant interviews
Wholesale power market liquidity: statutory consultation on the 'Secure and Promote' licence condition	Ofgem, 2013	UK	Dominance by a few vertically integrated parties. Lack of availability of forward products and prices on the full forward curve for smaller players to access coverage. Need for acceptable terms of trade for small parties. Need for small clip sizes.	Ofgem's liquidity project sought to ensure that the wholesale electricity market supported effective competition, delivering benefits to consumers in terms of downward pressure on bills, greater choice and better service.
Theme 2: Financial and physical transmission rights				
Transmission Risk Hedging Products	ENTSO-E, 2012	CWE, Italy, USA (PJM), Nordic, Spain-Portugal	'Firmness' a key risk for transmission rights products. Not the case for CfDs. TSOs need to decide between PTRs, with use-it-or-sell-it obligations, or FTRs that are options, obligations, or both.	Educational paper on PTRs, FTRs, and CfDs. Reviews international cases.

Report title	Author and date	Country (ies)	Issues / findings	Comments
Review of Financial Transmission Rights and Comparison with the Proposed OFA Model	NERA, 2013	USA, New Zealand	PJM's FTR market has had to grow and enhance over time to promote transparency and market access Common denominator of markets with FTRs is a nodal pricing system Despite their contribution to hedging, FTRs alone cannot encourage investment	Review of existing FTR arrangements around the world
State of the Market Report for PJM	Monitoring Analytics, Annual and Quarterly reports (1999-2014)	USA (PJM)	Independent commentary on market design issues. Provides monitoring metrics for FTRs: volume, price, revenue adequacy, etc., which can be linked to market design issues.	Provides a comprehensive review of PJM's FTR market, including recommendations on market design issues. The reports highlight the complete lack of oversight of forward, financial, and OTC markets.
Theme 3: Relationship between forward and prompt market prices				
Electricity Forward Prices: A High-Frequency Empirical Analysis	Francis A. Longstaff and Ashley W. Wang, 2004	USA (PJM)	Significant forward premia exist on PJM. Volatility relates to unexpected changes in risk, suggesting rational price setting.	Regression analysis of the interaction between day-ahead and spot market prices
Spot price modelling and the valuation of electricity forward contracts: The role of demand and capacity	Alvaro Cartea and Pablo Villaplana, 2008	USA (PJM), UK (England, Wales), Nordic	Forward contracts trade at a premium during months of high demand volatility Premia can turn negative during low volatility periods as sellers will always seek to sell forwards to reduce revenue variability	Constructed a structural econometric model of electricity prices as a function of demand and generation state variables
Efficient hedging in an illiquid market	Erik Kalin, 2011	Nordic	The risk premia are positive (forward price is higher than expected spot price) for contracts signed close to delivery. The higher the time to delivery, the lower the risk premia.	The paper investigated the risk premia in the Nord Pool electricity market

Report title	Author and date	Country (ies)	Issues / findings	Comments
Futures Prices and their Relationship to Modelled Spot Prices	Energy Link, August 2014	New Zealand	Identifies a 10% premium for futures prices over modelled spot prices Methodology allows a lot of room for variance in observed results Difficult to determine whether the premium is from inefficiency or risk	Paper prepared as part of the WAG's hedge market review
Theme 4: Assessment of prompt markets				
Assessing the efficiency of US electricity markets	Ismael Arciniegas, Chris Barrett, and Achla Marathe, 2003	USA (CAISO, PJM, NYISO)	Efficiency of energy markets improves over time. Multi-settlement scheduling associated with higher efficiency.	Test for efficiency using stationary tests, cointegration of day-ahead and spot prices, and price convergence
Electricity price forecasting through transfer function models	F.J. Nogales and A.J. Conejo, 2006	USA (PJM)	Find instantaneous relationship between demand and price, indicating PJM has a well-functioning electricity market	Construct a dynamic, structural econometric model. Compare fit of a model with an instantaneous demand-price relationship to a model with a non-instantaneous relationship.
Industry and market monitoring: Reliability and efficiency	Electricity Authority (EA), April 2012	New Zealand	Present the EA's approach to regulation: the EA fulfils its role in a 'light-handed' manner, with the threat of regulation providing the incentive for the market (and therefore the largest operators) to exercise self-regulation. That is, rather than explicitly monitoring prices and price levels, it aims to ensure market conditions are such that "workable competition" can be achieved.	Presents the EA's approach to monitoring reliability and efficiency across all markets
Industry and market monitoring: Competition	Electricity Authority, August 2011	New Zealand		Presents the EA's approach to monitoring competition across all markets
Focus on Nordic electricity market	Fortum Energy Review, 2015	Nordic	The Nordic electricity market provides a success story for power market liberalisation and integration. Various generation types compete in the wholesale electricity market on a least marginal cost basis. The Nordic power market is also well connected internally and with its neighbours.	Presents an overview of the Nordic and Baltic electricity market, the power generation structure, and the operation of the wholesale and retail electricity markets.

Report title	Author and date	Country (ies)	Issues / findings	Comments
Theme 5: Market design				
Gains from Trade under Uncertainty: The Case of Electric Power Markets	Hendrik Bessembinder and Michael L. Lemmon, 2006	USA (CAISO, PJM, NYISO)	Simulated results suggest introducing forward and spot trading can reduce real-time prices by 0-20% Gains from trade largest when there are a large number of markets and low demand correlations across markets	Run simulations with Californian generating cost data, and capacity and power demand data.
Nordic Financial Electricity Market	NordREG, 2010	Nordic	The report concluded that the Nordic financial electricity market functions well and has good liquidity in the basic products. The report also concluded that there is significant trust in the market.	The aim of the report was to examine the efficiency of the Nordic financial electricity market and check whether further improvements can be made in order to secure optimal price setting in the wholesale and end-user markets.
Using forward markets to improve electricity market design	Lawrence M. Ausubel and Peter Cramton, 2010	Colombia	Forward markets could have prevented the California 2000-01 energy crisis, which occurred due to excessive spot market reliance. Regulated forward markets are needed due to demand side market failures.	Provides case studies on the benefits of Colombia's forward reliability market
Capacity Markets in PJM	Joseph Bowring, 2013	USA (PJM)	Using historical prices to define cost of new entry. Treating inferior demand resources as equal to supply resources in the capacity market	Reviews the development of PJM's improved Reliability Pricing Model Capacity Market, while identifying remaining capacity market design flaws
Does One Design Fit All? On the Transferability of the PJM Market Design to the German Electricity Market	Katrin Schmitz and Christoph Weber, 2013	USA (PJM), Germany	No major impediments to implementing nodal pricing in Germany. Germany has lower congestion than PJM, suggesting the relative benefits of nodal pricing will be lower for Germany. Germany could not enjoy all the benefits of nodal pricing by unilaterally implementing it.	Compare PJM and Germany across various indicators of transmission congestion, generation mix, loop flows, and interconnectedness.

Report title	Author and date	Country (ies)	Issues / findings	Comments
Report on the influence of existing bidding zones on electricity markets	ACER, 2014	EU (incl Nordic)	The Nordic market (NRD) exhibits high levels of churn rates despite the generally small size of the bidding zones and it is generally a well-functioning and competitive market.	The ACER report aims to evaluate the influence of the current bidding zone configuration on electricity market efficiency. It provides an extensive analysis of the different metrics of market liquidity and competition.

Source: ECA

3.2.2 Country case studies

Approach to review

We have sought to apply a standardised approach to the literature review pertaining to specific markets. This has not always been followed precisely but the information in the more detailed case studies in Annexes A4, A5 and A6 has been organised as follows:

- Description of market
  - What type of market is it?
    - Market structure, i.e. degree of competition in the market, number of players, contestability – this covers both the prompt and forward markets
    - How has competition evolved, and what has been the role of forward markets in this?
  - What are the objectives of the forward market?
    - What are the perceived problems with the market?
    - What instruments are used to address these?
    - How (and how well) do the instruments work?
  - What are the purposes of market monitoring (if there is any monitoring)?
    - How is information collected on each instrument?
    - How is the effectiveness of monitoring evaluated?
    - Are there gaps in market monitoring?

- What lessons are applicable to the European market generally?
  - Adequacy of products?
  - Adequacy of monitoring?

Here, we present a brief overview of the three case studies.

Summary of case study results

Nordic forward market

This is a summary of the case study presented in Annex A4

The Nord Pool area is a rare example of a regional, highly integrated and competitive energy market providing security of supply while ensuring low carbon emission levels.

In the Nordic forward market, comprising the Nasdaq OMX Commodities exchange and the OTC market, competition determines the price of electricity and the traded volumes.

Our review has found that the general assessment is that the Nordic forward electricity market functions efficiently, has sufficient liquidity in most of the hedging products and is highly transparent. There is also a general consensus that there is trust in the market. The high number of market players (around 450) has a positive influence on the liquidity and level of competition.

Monitoring of the Nordic forward electricity market and framework, governed by the Norwegian Exchange Act, is considered a fundamental element of a transparent, liquid and efficient market. In that respect, NordREG, which is an organisation comprising all the Nordic energy regulators, oversees the institutional and legal framework within the Nordic electricity market to ensure the market functions adequately.

The focus of NordREG is on promoting competitive market structures in the financial electricity market, ensuring the efficient operation of the power exchange and promoting adequate levels of transparency. Analysis of efficiency is periodic but detailed. Heavy reliance is made on measures such as HHI and turnover.

The Market Surveillance unit (MSU) within NASDAQ OMX, created by Ministerial order, is responsible for monitoring market conduct and detecting market abuse. Unlike NordREG that focuses on structural indicators of liquidity to monitor the efficiency of the market, MSU's primary function is to monitor trading activity and identify non-compliance cases that override the Market Conduct Rules.

Both NordREG and MSU have been successful in monitoring the efficiency of the market and the market conduct of trading participants, respectively, and in proving confidence in the pricing mechanisms, the transparency of price relevant information and the integrity of the market.

PJM market

This is a summary of the case study presented in Annex A5.

In our review of PJM, there was a notable lack of monitoring of forward markets beyond the day-ahead market. Independent monitoring reviews are regularly conducted by Monitoring Analytics (the independent market monitor of the PJM market) but their reviews are largely focused on the markets directly administered by PJM, including the spot, day-ahead, capacity, and FTR markets. Monitoring Analytics tracks numerous indicators in order to evaluate the efficiency and competitiveness of these markets and makes market design recommendations if it detects any issues. PJM forward products are available to market participants on exchanges, such as NYMEX and ICE, but PJM does not appear to consider monitoring the operations of these exchanges as part of its remit. PJM appears to take the view that if the real-time, capacity, and FTR markets are operating in a competitive and efficient manner, forward markets must be operating sufficiently. Issues regarding market conduct on exchanges outside of PJM would fall under the purview of the Federal Energy Regulatory Commission (FERC).

Hedging considerations for PJM are concentrated on its FTR market, which has been expanded and redesigned since first being introduced in 1999. Adjustments have included removing incumbency advantages and transitioning to an Auction Revenue Rights (ARRs) allocation process, with subsequent FTR auctions in 2003. Under this design, ARRs are allocated to network service and long-term, firm point-to-point transmission customers, but the value of ARRs is subsequently determined via market forces in FTR auctions. ARR holders can either receive the revenue they are entitled to, as determined in the FTR auctions, or 'self-schedule' their ARR as an FTR along the same path as their ARR.

PJM now operates long-term, annual, monthly, and secondary FTR markets, giving market participants plenty of opportunities to adjust their positions. Existing FTRs can be traded bilaterally outside of these markets, but PJM explicitly does not track such transactions. Monitoring Analytics' reports track numerous FTR market metrics, such as price, volume, pay-out ratio, etc. to evaluate how the market is operating. As a recent example, major shifts in these metrics served to signal the fallout from FTR underfunding, an issue arising due to various market design issues.

New Zealand hedge market

This is a summary of the case study presented in Annex A6.

Our review of the efficiency and effectiveness of New Zealand's hedge market analysed the views of both its participants and its regulator. Their opinions tend towards a view that the market is growing towards an efficient and effective state. Major market participants are actively engaged (as market makers) in growing the depth of the market under direction from the regulator, with the basic premise that more trading should lead to greater efficiency and effectiveness. At the same time, the focus of the regulator is on creating the conditions for an efficient market to operate, particularly through promoting transparency of all transactions in both the OTC and exchange-based markets, and the annual presentation of various market metrics, e.g. trading volumes, unmatched open interest, HHI.

Regular monitoring is 'light handed', focusing more on 'spotlight regulation', where they investigate a matter thoroughly and then shine a light for all to see on particular activity by participant(s) that may be considered out of the ordinary. The next phase of market development is addressing liquidity and barriers to entry, particularly for smaller market participants. Recommendations are taken on board by the major market players, with the regulator becoming actively involved only if necessary.

3.3 Summary of findings and conclusions

3.3.1 Evaluation of results

In this Section we **extract from the literature the monitoring metrics** that were employed to assess the effectiveness of forward markets (or which could be used for this purpose). We note that not all papers were pertinent in this regard and we have therefore only relied on those that were of direct relevance, notably the papers that explicitly addressed issues of hedging and liquidity and also (to a degree) those that assess prompt market performance. Also, in order to keep the presentation of results tractable, we have grouped the identified metrics according to our own analysis at the beginning of this Section and the categorisation of Section 3.1.4 and Table 6. The indicators identified together with information about the relevant study, geographical scope and some general explanatory comments (as presented in the papers themselves) are contained in Table 8 below.

Some key observations on the results of the review are:

- **Liquidity as expected is a major focus** of the assessments and the metrics used are consistent with those we propose earlier – churn rates, bid-ask spreads, volumes of transactions. The indicators also attempt to distinguish between types of product and their period of delivery.

- Although the price discovery function of forward markets is acknowledged and many papers examine the relationship between forward and spot prices, we were **unable to identify explicit measures of how effective price discovery is** in the various markets/countries (other than the liquidity of different and longer-dated products)

- Particular attention is given to the **various facets of contestability and competition**, so that indicators of entry/exit activity, the number and variety of market participants and market concentration measures feature prominently.

Table 8 Monitoring metrics identified in the literature

Features	Metric	Study	Geographical scope	Comments / Advantages and disadvantages / etc.
1. Effective hedging opportunities				
Liquidity	Volume/value turnover	NordREG 2010	Nordic market	Typical measure of level of trading activity
	Number of transactions	NordREG 2010	Nordic market	Ignores the value per transaction

Features	Metric	Study	Geographical scope	Comments / Advantages and disadvantages / etc.
	'Open interest' (number of open contracts which have not yet been liquidated)	Laboratory of Electricity Market and Power Systems 2014	Nordic market	Direct measure of liquidity
		NZ WAG	New Zealand	
	Churn rates	ACER 2014	EU	There is no conclusive evidence as to the level of churn rate that indicates a liquid market, but some stakeholders use a churn rate of 3 as the minimum threshold. The main disadvantage of this metric is that it is very challenging to calculate exact churn rates in a multi-market context. Also, there is no universal definition of churn ratios. The collection of data is another significant limitation, since volumes of electricity traded OTC are hard to obtain.
	Bid-ask spread	ACER 2014	EU	Bid-ask spread indicators are a more direct measure of liquidity than churn rates, since they estimate transaction costs that result from an instantaneous change in a market participant's contractual position.
		NZ WAG	New Zealand	Only analysed periodically, following market demand
	Volume of bid and sell offers (MW)	MA, PJM State of the Market reports	PJM	Differentiates volume by: obligations versus options, counter-flow versus prevailing flow, by auction type (long-term, annual, monthly), and secondary bilateral market. Does not account for OTC bilateral transactions. Indicator of the general desire to use FTRs as a hedge.

Features	Metric	Study	Geographical scope	Comments / Advantages and disadvantages / etc.
	OTC CfD, FPVV, ASX futures volumes, by timeframe	NZ WAG	New Zealand	Adopted as a metric to measure market development – greater volumes should imply greater liquidity, access and efficiency
2. Facilitation of price discovery				
Product availability	Share of long term hedging products in total open interest	NordREG 2010	Nordic market	A higher share of long term contracts might indicate higher liquidity in the forward market, but might also mean that international traders (in the Nordic context) are more focused on factors other than hydrological development and therefore prefer trading in-year contracts.
Price transparency	Demand and supply transparency (e.g. capacity and flow data)	EC 2008	EU	Weak transparency is a contributory factor to the lack of forward trading.
	Reporting of all trades	NZ WAG 2014	New Zealand	Premise that greater disclosure enhances market efficiency; potential for information overload, making identifying relevant and useful information challenging.
3. Ease of market access (low barriers to entry and exit)				
Low transaction and entry costs	Percentage of OTC contracts with force majeure and/or suspension clauses	NZ WAG	New Zealand	Such clauses are a potential barrier to entry for some buyers. The presence of such a clause is not necessarily burdensome as it depends on the exact terms of the clause.
	Bid- ask spread	ACER 2014	EU	Bid-ask spread indicators provide an indication of the transaction costs. A product that is bought at the ask price and is sold right away can only be sold at the bid price. The difference represents the cost of conducting a financial transaction.

Features	Metric	Study	Geographical scope	Comments / Advantages and disadvantages / etc.
	Entrance/trading fees (€/MWh)	Norwegian Water Resources and Energy Directorate 2011	Nord Pool	Trading platforms for energy products and brokers often charge entrance fees (platforms) and trading fees for the execution of orders and the registration of trades. The fees depend either on the executed volume in Megawatt hours (MWh) or on the number of contracts concluded. This metric shows the explicit costs of trading a particular forward product.
	Entry/exit activity as a % of the number of suppliers/market participants	ACER	EU	Can indicate the ease with which traders, suppliers, retailers, etc. can take part in forward energy markets in the face of any barriers to entry.
Presence of market makers	No specific measure	NZ WAG	New Zealand	Some large market participants have chosen to act as market makers, increasing their activity in the hedge market, in part at the request of the regulator
		Ofgem	UK	Ofgem has imposed licence conditions on dominant parties to require them to be market makers in forward markets
Level of granularity	Standard product clip size	NZ WAG	New Zealand	This is a new issue arising from the November 2014 responses to the WAG discussion document and it relates to ability of small players to cover their position in the forward market if a minimum of 1 MW per hour is the smallest unit to be covered
4. Other measures supporting contestability in prompt markets				
Diversity of products	No measures identified			
Diversity of counterparties	Number of market players/ new entrants per year	NordREG 2010	Nordic market	The higher the number of new markets entrants per year the lower the barriers to enter the market. However, this metric alone does not show the geographic spread of market participants.

Features	Metric	Study	Geographical scope	Comments / Advantages and disadvantages / etc.
	Number of active traders	EC 2008	EU	The number of traders is indication of how concentrated the market is. However, the metric alone, without information on market share is not a robust measure of the efficiency of the market.
		NZ WAG 2014	New Zealand	Does not capture all participants as some do not disclose; does not capture the number of unique traders, just the number active in any one month; counts a broker as a single trader, and hence does not account for the many parties they may be trading on behalf of
	Volume by trader type: retailer, financial, market maker	NZ WAG	New Zealand	Participation by financial institutions, such as banks, may bring increased liquidity and a wider range of available OTC products.
	Percentage of FTRs held by financial entities versus physical entities	MA, PJM State of the Market reports	PJM	Financial entities are defined as banks, hedge funds, or international participants. Physical entities are utilities or customers. Participation by financial institutions may bring increased liquidity. Financial entity participation may indicate extent of speculation (suspected to have increased amid PJM FTR underfunding)
5. Effective competition in the forward market				
Low market concentration	Minimum number of companies that are needed to reach 50 % of the market volume	NordREG 2010	Nordic market	A good indication of competition in the Nordic financial electricity market

Features	Metric	Study	Geographical scope	Comments / Advantages and disadvantages / etc.
	Herfindahl–Hirschman Index (HHI)	NZ WAG	New Zealand	Little discussion of strengths / weaknesses; primarily used for information purposes.
		MA, PJM State of the Market reports	PJM	FERC, taking its cue from the Department of Justice's guidelines for evaluating mergers, suggests a market is reasonably competitive if its HHI index is below 1800. A New Zealand consultation paper suggests using 2500 as a threshold.
	The combined share of the five leading producers of total buy volume and total sell volume	NordREG 2010	Nordic market	A lower share of the five leading producers *ceteris paribus* shows that the rest of volumes came from other smaller producers.
	Concentration ratios (CR3)	ACER 2014	EU	There is no data consistency among regulators. While some NRAs report values based on total installed capacity/ total generated volume, other NRAs take account of the size of generators.

3.3.2 Key lessons for monitoring metrics

This is written in terms of what needs to be monitored and potential results and with respect to available data now and when REMIT is fully functional. The information is mainly based on Table 8 above. We have divided the measures consistent with the evaluations set in Section 3.3.1 and have further divided the results according to whether the measure is recommended as "Essential" or just "Useful". It should be noted that essential measures were not identified in every category. In the lists below, the Essential measures are highlighted.

1. Effective hedging opportunities

As expected, the literature concentrated on measuring liquidity as a means for parties to both enter and exit positions. The monitoring instruments proposed are:

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
Turnover (*see Annex A3.1.1*)	Volume / value	Time trend comparison or benchmark comparison. Need to consider in context of size of overall market (including changes in	**Advantages:** Easily understood. **Disadvantages:** What is correct level for a

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
Essential		interconnection availability). A sustained upward trend in turnover indicates that traders have developed new business strategies that have resulted in increased hedging and trading, while a reduction in the turnover trend over time might indicate a potential reduction in the demand for electricity. Need to differentiate between changes in value of trading compared to value of underlying commodity (which changes over time). Scope of market needs to cover both exchange and OTC, physical and financial. Monitored in Nordic market.	liquid market? Data on all trades difficult to accumulate (will be easier once REMIT in place). Need to differentiate between different periods of the forward curve.
	Recommendation:	This is a measure of liquidity. We recommend that it be applied to a whole national forward energy market and should apply to energy volumes. Although it can apply to specific time segments (monthly, quarterly, annual products), it is best applied to all forward products amalgamated. It needs to be measured as a time trend. This proposal means that it is best as an annual analysis.	
Churn rates (*see Annex A3.1.2*) **Essential**	Ratio	Useful in both time trend and benchmarking. Industry consensus on what constitutes liquidity (at least 300% recommended, which broadly reflects current average churn across European wholesale and forward markets). Need to define scope carefully (churn of market or churn of specific instrument). Need to distinguish between spot and future markets. Usually, the spot market will have a lower churn rate than forward markets. A churn rate of 3 is considered as the minimum threshold. Already used in ACER reports.	**Advantages:** Applicable to all sizes of market. Measure of how easily a trader is likely to get into or out of a trading position **Disadvantages:** Often calculated using nominated volumes reported by TSOs rather than actual traded volumes. Periodic calculation rather than continuous monitoring. Data needed on whole market to be useful (but feasible from REMIT data). In smaller markets and in transit countries, the churn rate will not be comparable with more developed markets where futures trading takes place.
	Recommendation:	A measure of liquidity. It can be used for individual products or for whole markets; we recommend the latter and that it be mainly applied to all forward products as a proportion of physical throughput. Interpretation should best be as annual. This should be used for both time series analysis and benchmarking, with an initial target churn	

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
		rate of at least 300%. This may need to be increased if and when traded versus physical volumes increase, as higher churn ratios (in the order of 700%-800%) are typically considered necessary for characterising markets as being sufficiently liquid.[14]	
Bid-Ask spread (*see Annex A3.1.3*) **Essential**	Absolute €/MWh or % of price	Used to assess instantaneous change in the position of traders so is a measure of competitiveness Used by ACER and in New Zealand.	**Advantages:** Direct measure of transaction cost **Disadvantages:** Intensive to monitor Point of time measure really Specific to instruments rather than to markets Not good for covering non-screen trading
	Recommendation:	Although not a good market metric because it must apply to specific instruments, it is a well-recognised measure of market competitiveness and cost of getting into or out of a position. This should be calculated daily with potential to recommend that market policy should be to require all bids and offers to be reposted on a daily basis. As a benchmark, the bid-ask spread should be <5% of average price and should average <1% in the most popular instruments (see Annex A3.1.3 for calculation methodology[15]). We recommend ACER to encourage a market policy for each exchange to publish the Bid-Ask spreads on a consistent and daily basis and to report excursions from recommended bounds rather than ACER being responsible for the calculation because this is very much a metric that traders wish to see.	
Open interest (*see Annex A3.1.4*) *Useful*	Volume of unclosed positions	This is the volume of energy at a point in time that could go to real time physical and so is the true measure of energy looking for a buyer/seller. While volume turnover shows the amount of contracts that have been traded, measuring the pressure behind a price trend, and can only increase, open interest shows the number of contracts that are held, providing an indication of the money that is brought into the futures market, and can either increase or decrease. An increase in open interest accompanied with an increase in price shows an upward trend in the market. Similarly, an increase in open interest accompanied by a decrease indicates	**Advantages:** Well understood by traders. Not computationally demanding. **Disadvantages:** Very specific to market instruments so tells little about the overall market. Need for market provider to publish – data difficult to gather otherwise.

[14] Please refer to the 'Monitoring tools' sub-section of 3.3.3 for further discussion regarding the proposed thresholds and the supporting evidence for these.

[15] A benchmark for spreads varies by market. Market makers in New Zealand are required to give spreads of no more than 5%, spreads on Australian futures tend to hover around 2-3%, and E.ON in the UK is required to post spreads for both baseload and peakload products of 0.3-1%. See Annex A3.1.3 for details.

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
		that the market is weak. Monitored in Nordic market and New Zealand.	
	Recommendation:	This is measure of liquidity showing true energy on offer for purchase and sale. It is instrument-specific and required for a point of time. This is something that exchanges should be publishing on a daily basis and trends over time in total volumes can be monitored. There is no universally accepted threshold for unmatched open interest and in some cases this is quoted as a number of contracts, while in other cases in GWh of unmatched open interest. No threshold recommended.	
Volume of bids and offers (*see Annex A3.1.5*) *Useful*	MW	Measure of willingness to trade.	**Advantages:** Shows market depth. REMIT orders to trade can be used. **Disadvantages:** Getting at the data is limited to auction-type markets at present so not necessarily good for OTC.
	Recommendation:	This is another point-of-time measure and is only effectively measured for auctioned instruments. It could therefore be useful for monitoring PTR and FTR auctions more than monitoring forward energy trading. However, if all orders at a point in time can be aggregated then a measure of willingness to trade in forward instruments can be established. There is no recommendation as to an acceptable volume of orders but trends over time can be established.	

2. Facilitation of price discovery

The features in this section relate to product availability metrics and price transparency metrics. There are not really direct monitoring instruments in this category, which is far more about information transparency than about regulatory monitoring. The monitoring instruments proposed are:

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
Reporting of trades (*see Annex A3.2.1*) **Essential**	Price	Live reporting of actual trades in prompt and forward markets. Price reporters traditionally perform this role, which works better in forward markets than prompt ones. REMIT requires all trades to be reported to ACER. New Zealand has also disclosure requirements in place since 2009 Specific timeframe for providing such	**Advantages** Does not require regulatory oversight – self-governance. Creates market confidence, which promotes trading and contestability. **Disadvantages** Possibly difficult to interpret results.

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
		information. Monitored in NZ.	
	Recommendation:	This is not really a monitoring tool but rather a performance standard. Most exchanges will already provide this information to members; making it the norm that it be publicly available may be resisted as there will be a perceived market value to the information (and it is most of the business value of the price-reporting organisations for the OTC market). This cannot really be separated from a general movement towards greater transparency but exchnages and markets could be rated accortding to level of transparency with public availability on a live basis (or within 15 minutes of trades being struck) being a gold standard.	
Share of long-term hedging in total open interest **(*see Annex A3.2.2*)** *Useful*	%	A specialised measure of liquidity along the forward curve. This is therefore, more a measure of liquidity at different points in the curve. This is specific to open interest. Comparing the share of a product in total open interest with the share of the same product in total turnover, provides an indication of the entext of hedging in that product compared to short term trading in such contracts. Monitored in Nordic market.	**Advantages:** Looks along the whole forward curve. Trade turnover information may also be useful. **Disadvantages:** Difficult to interpret. What is an adequate share of long/short-term? Why might the share reduce (including cost of open interest positions perhaps)?
	Recommendation:	This needs to be monitored in some ways with regard to the implementation of the FCA NC because the critera for how transmission rights are allocated across time periods in PTR or FTR auctions will be open to interpretation by the TSOs. In terms of forward energy markets, the liquidity across the time curve seems to vary between markets and there is no clear reason why one market will be relatively more or less liquid in say monthly or annual products than another market. However we cannot offer any benchmarks for comapring markets. As this essentially relates to open interest in energy markets, it will require continuous monitoring on a daily basis.	
Demand/ supply publication **(*see Annex A3.2.3*)** *Useful*	MW	Transparency regarding demand and supply dampens high price volatility and encourages investment. This is a measure of spot volumes that will inform likelihood of future price volatility. Monitored in Europe.	**Advantages:** Transparency allows traders to assess risk and so contract forward to manage it. **Disadvantages:** Requires specialist knowledge to convert such information into price movements and knowledge of probabilities to assess actual price risk.
	Recommendation:	This is readily available in all markets on an ex post annual basis but could be usefully published on a daily basis in all markets. This is a TSO or MO responsibility more than ACER's and good practice on	

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
		transparency should be encouraged but this would really be the responsibility of NRAs.	

3. Ease of market access (low barriers to entry and exit)

There are various indirect measures that could be used. The measures do not inform on what are correct levels. The monitoring instruments proposed are:

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
OTC contracts with force majeure and suspension clauses (*see Annex A3.3.1*) *Useful*	%	Information on OTC contract terms needs to be gathered. A contract that may not deliver in real time greatly reduces the hedging value compared to the spot market risk. The extent to which force majeure and suspension clauses reduce the willingness of a buyer to trade is highly dependent on the exact terms of these clauses. It should be noted that PTRs will exhibit this form of risk transfer to the user; TSOs are keen to include such clauses in FTRs (making them mimic PTRs). Monitored in New Zealand.	**Advantages:** Easily understood even if possibly difficult to interpret. **Disadvantages:** Data gathering will be difficult unless standardised products are offered.
	Recommendation:	Although most OTC contracts will tend to follow EFET terms, a main reason for OTC trading is the ability to offer non-standard contracts. Therefore, it is not easy to be prescriptive on contract terms. However, it is difficult to see why a buyer would want to be exposed to force majeure risk on a contracts that are usually financial and so non-firm offers that are being accepted may be an indication of market power. We cannot make any clear recommendations on this other than that key contract terms should be reported.	
Market participant churn (*see Annex A3.3.2*) *Useful*	% of traders joining or leaving the market	Across all markets, the numbers of traders becoming active in a year or ceasing to be active as a proportion of all traders in the market. The definition of active is ambiguous as very low volume trading could be interpreted as inability to establish a position even if churn volumes are high. Monitored by ACER.	**Advantages:** Proxy for identifying barriers to entry. **Disadvantages:** Easy to misinterpret. No information on quality of new entrant and whether they can actually survive.
	Recommendation:	Although this is relatively easy to monitor, it is difficult to interpret the results. We cannot offer a benchmark that could be used and are not sure how time trends could be interpreted other than an expectation that markets with fewer traders should expand the average numbers over time: this suggests that a market with few traders will be exhibiting problems if the number of traders leaving exceeds the numbers joining, but this does not apply to a market with	

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
		a larger number of traders.	
Entrance trading fees (see Annex A3.3.3) *Useful*	Fixed fees in (€) and variable fees in (€/MWh)	The lower the entrance/trading fees the higher the chances that a small investor will enter the market and therefore the higher the level of competition in the market.	**Advantages:** Monitors the ability of smaller investors to participate in the market. **Disadvantages:** The metric overlooks the size of the market. A market that is bigger in size than another market is likely to have lower trading fees as the cost of operating the market is shared between a higher number of participants.
	Recommendations:	A more detailed comparison of entrance/trading fees between markets in comparison to their size is needed to understand what level of trading fees promote an efficient market operation Asociated with trading fees are margin requirements, which can either tie up cash or will deter parties without a substantial credit rating. We have not identified a metric that can compare requirements between exchanges and with OTC contracts.	
Presence of market makers (*see Annex A3.3.4*) *Useful*	Yes or no	Market makers prepared to absorb risks of other traders can greatly facilitate forward market entry. Difficult to conclude the impact on liquidity and competitiveness since there are a number of factors involved and the impact of market makers alone is hard to estimate. Used in New Zealand and Nordic market.	**Advantages:** Ensures access for small players **Disadvantages:** Requires financially strong parties, which may mean a degree of dominance (although pure financial players may perform the role). May require regulatory intervention to bring about (the case in GB market and also, to an extent, in New Zealand).
	Recommendation:	Market makers are a feature of a significant number of exchanges. Because it is a voluntary position, it is less clear whether parties are taking a market making role in the OTC market. As noted, in New Zealand and UK, the role is informally or formally mandatory on larger parties. No recommendations on this although, if it is to be mandatory then a review of the Ofgem Decision on this for GB to consider what detailed obligations should be placed.	
Granularity (*see Annex A3.3.5*) *Useful*	Clip size relative to sixth or smaller supplier	This is not a generally accepted measure as it has only recently come up. It relates to supplier size but should equally be applicable to small generators Granularity also shows the extent to which products are available for every requirement; you could have a separate	**Advantages:** Lack of access to energy products at the right level of granularity and clip size is a major barrier to entry. Monitoring of platform and contract rules – does not

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
		contract for every single eventuality, but that will lead to difficulties in trading as there will not be many products, nor other players keen to trade. Alternatively, you could have just a few products, meaning much more market depth, more people trading, but the products don't line up with what players want.	require data **Disadvantages:** New measure – no accepted standards or track record Says nothing about whether small players have specific issue with forward markets (need same measure in prompt markets) Actual design parameters for measure still need to be confirmed
	Recommendation:	This is a market led requirement. It was recently raised as an issue in New Zealand so there is a potential that smaller traders are being detered by lack of small parcels to trade. The minimum clip size is usually set by the exchanges. Recommendation is to consider consulting on an optimum clip size for trades. The real issue for exchanges will be IT and screen display because there is no real issue for a larger trader in dealling in multiples of small-clipsize trades.	

4. Other measures supporting contestability in prompt markets

Many of the measures we found in this category could equally apply to category 3 above. The measures that could be used include:

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
Volume by trader type **(*see Annex A3.4.1*)** *Useful*	%	The trader types are mainly divided into physical (generators/ retailers/consumers) and financial, and whether they are market makers. Monitored in New Zealand.	**Advantages:** Captures the extent to which the market is supported by diverse parties. **Disadvantages:** Definitional issues – parties could be in more than one category. Interpretation is difficult; dominance of financial parties may mean an absence of physical players due, for example, to vertical integration.
	Recommendation:	It is not clear whether a metric applicable across Europe would be useful. The presence of financial parties and market makers may be useful to know but there is no way of determining the correct numbers. In reality, the issue is about the presence of smaller parties in the physical market and whether they are accessing forward markets. No recommendastion on benchmarking.	
FTRs held by	%	The percentage of FTRs held by	**Advantages:**

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
financial entities **(*see Annex A3.4.2*)** *Useful*		financial entities as opposed to physical entities provides an indication of increased liquidity and extent of speculation. Parties without a physical presence in the prompt market could offer a market making or risk management service to physical players in the FTR market. FTRs are in finite quantity as issued by TSOs and so the percentage shows the proportion of non-physical players in this market quite accurately. Monitored in USA.	Easy to measure. **Disadvantages:** Difficult to interpret – in the PJM market, the interest in the market was driven by underfunding speculation rather than offering hedging services.
	Recommendation:	This is a very specialised measure and only applicable to very few markets. It is also not clear if there is a correct proportion of financial players in the FTR market. We have no recommendations for this metric.	

5. Effective competition in the forward market

All the measures in this category relate to market concentration. Measures include:

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
Minimum number of companies needed to reach 50% market share in production/ number of contracts traded **(*see Annex A3.5.1*)** **Essential**	Number	This needs to be interpreted for the defined market or sub-market (e.g. for all forward contracts or just for products over a defined date range). The metric can either be used to examine the minimum number of companies needed to reach 50% market share in production or 50% market share of contracts bought/sold over a period of time. The bigger the number of companies, the greater the competition. Monitored in Nordic market.	**Advantages:** Independent of market size. **Disadvantages:** No settled position on what is the correct number. Data gathering needs to cover different platforms (should be resolved by REMIT).
	Recommendation:	This measure is more normally used with respect to physical market shares. However, it can be adapted to forward markets as a whole or to individual time periods. It is straightforward to calculate. For interpretation, we recommend (i) annual time trends or (ii) comparison with the number of players in the physical genration and supply market. The logic for the second indicator is to assess the extent to which smaller parties in the physical market are actually using forward hedging.	

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
Herfindahl-Hirschman Index (HHI) ***(see Annex A3.5.2)*** **Essential**	Index	Recognised measure of concentration with a monopoly reaching an index of 10000 and perfect competition approaching zero. Generally a market with a HHI of less than 1,500 is considered very competitive, while a result of more than 2500 shows a highly concentrated market. Main use is for trends over time. Market scope required (products covered, etc.)	**Advantages:** Familiar measure. Reasonable data access. **Disadvantages:** Some dispute as to application in electricity (lack of storage means that competition may need to be ensured by a lower index than in other markets). The metric alone does not inform us about the reasons of market concentration.
	Recommendation:	As this is a well-recognised metric, it should be adapted for monitoring forward markets. Although it is more commonly used to measure concentration in generation or supply, it can be used to measure concentration over a year in trades in forward products. As this is a concentration measure, we recommend that it be used to cover all forward trading in the market regardless of time period. It can be used in comparison with the HHI applied to generation and supply in the physical market to determine whether there is more concentration in trading in the forwards market than should be indicated by concentration in the physical markets. We recommend the established benchmark of 2,500.[16]	
Share of biggest 5 ***(see Annex A3.5.3)*** *Useful*	%	Similar to HHI but not with the same statistical base. The market share of the biggest 5 market players in the total volume of contracts bought/sold, provides an indication of the degree of competition in the forward market. If the share of the biggest 5 market players in total buy to their share in total sell is very close it means that their turnover mostly originates from spot trading rather than hedging. Monitored in Nordic market.	**Advantages:** Simple to understand. Easy to calculate **Disadvantages:** No consensus on what share represents a competitive market.
	Recommendation:	This could be used as an alternative to HHI but our view is that there are diminishing returns in using too many measures of market concentration. We therefore do not recommend pusuing this, especially as there is no consensus on what constitutes sufficient competition on this measure.	

[16] In the U.S., the Federal Energy Regulatory Commission identifies HHIs above 2,500 as highly concentrated (NOI, FERC Stats. & Regs. ¶ 35,571 at P 12.). A New Zealand consultation paper similarly recommends a threshold of 2,500: Para 5.1.3, p38 of 'Hedge Market Development Project: Metrics' from 1 May 2014.

Instrument	Metric	Interpretation/ Limitations	Advantages /disadvantages
Concentration ratios **(*see Annex A3.5.4*)** *Useful*		Same definition as share of biggest 5 but different number of largest firms used. Used by ACER. The concentration ratio (CR) is the ratio of the sum of market shares of a certain number of the largest firms to the total size of the market, namely the total installed capacity or total generated volume. This can also be applied to the share of the largest traders in a market (exchange and/or OTC) out of all trades going through the market; this can be applied to individula products or else to all products traded over a required timeframe (probably a full year of forward trades).	**Advantages:** Simple to understand. Easy to calculate **Disadvantages:** Inconsistency in the definition of market size. Some regulators excludes intermittent or renewable generation and smaller generating units from the calculation of market size. No clarity on how to interpret.
	Recommendation:	This has been effectively discusseed above, we do not see any advantage in pursuing this measure as there is no consensus as to what concentration should be used as a benchmark.	

3.3.3 Concluding remarks

The available literature

The literature falls into two main categories:

- ❑ Evaluation of general market
- ❑ Queries on specific issues.

The literature tends not to provide solutions for overall market efficiency. This is not surprising given that different markets will have varying fundamentals so that a unique solution is hard to come by. However, there does seem to be a gap in the literature concerning overall market efficiency given that it seems to be a valid question to ask.

There is a general assumption that markets will be efficient provided that they are liquid enough and so the only role for monitoring seems to be for detection of market abuse; this is not a really satisfactory outcome.

However, the literature is ultimately weak on market structure issues. Dominance in the prompt physical market (share of generation or, more commonly, share of supply) is not really addressed in terms of contestability in the forward markets. The possible exception to this is the Ofgem liquidity study that culminated in licence changes forcing dominant parties to take an effective market maker role across the forward supply curve; even here, the impact of dominance is anecdotal rather than effectively analysed.

Monitoring tools

We divided the monitoring tools into five categories. Within these categories, we reviewed what was available and categorised them into six, which we regarded as "Essential" (i.e. that we recommend that ACER pursue them) and thirteen "Useful" (i.e. nice to have if the task of collecting the data is not too onerous). A description of each monitoring tool is tabulated in Section 3.3.2 above, with details of each measure discussed in Annex A3; in both cases, the monitoring tools are divided into the five categories.

The categories and the tools we saw as essential are as follows:

1. Effective hedging opportunities

The essential tools identified in this category are:

- **Turnover**. This is a measure of liquidity. We recommend that it be applied to a whole national forward energy market and should apply to energy volumes. Although it can apply to specific time segments (monthly, quarterly, annual products), it is best applied to all forward products amalgamated. It needs to be measured as a time trend. This proposal means that it is best as an annual analysis.

- **Churn rates**. A measure of liquidity. It can be used for individual products or for whole markets; we recommend the latter and that it be mainly applied to all forward products as a proportion of physical throughput. Interpretation should best be as annual. This should be used for both time series analysis and benchmarking, with an initial target churn rate of **at least** 300%. It is important to recognise that there is no objective or scientifically based threshold for deciding whether a market is sufficiently liquid or not and, as we state elsewhere, this is only a partial indicator that must be considered together with other metrics such as turnover, bid-ask spreads, market concentration and/or number of participants, etc. The proposed 300% threshold represents the current realities of electricity wholesale and forward markets in Europe where churn rates range from as low as 100% (or lower) to a maximum range of between 700%-800%, but with most markets characterised by churn rates below the recommended 300% threshold and the latter broadly representing the market average churn.[17] However, it should also be noted that some analysts and regulators consider that churn rates of at least 700% or more are necessary for characterising a market as liquid.[18] A higher threshold of this order could be adopted in future, if trading volumes increase compared to the physical volumes generated.

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[17] See, for example, figure 4 in http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Market%20Report%20on%20Bidding%20Zones%202014.pdf.

[18] For example, the UK regulator, Ofgem, considers 700% as the minimum threshold (http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/writev/consumer/ce33.htm), ACER has set a threshold of 800% for the Gas Target Model (see, for example, slide 4 in http://www.acer.europa.eu/Media/Events/3rd-Gas-Target-Model-Stakeholders-Workshop/Documents/03.%20Boltz%20objective%20and%20criteria.pdf), while the Oxford Institute

- **Bid-Ask Spreads**. Although not a good market metric because it must apply to specific instruments, it is a well-recognised measure of market competitiveness and cost of getting into or out of a position. This should be calculated daily with potential to recommend that market policy should be to require all bids and offers to be reposted on a daily basis. As a tentative threshold, the bid-ask spread should be <5% of average price and should average <1% in the most popular instruments (see Annex A3.1.3 for calculation methodology).[19] We recommend ACER to encourage a market policy for each exchange to publish the Bid-Ask spreads on a consistent and daily basis and to report excursions from recommended bounds rather than ACER being responsible for the calculation because this is very much a metric that traders wish to see.

2. Facilitation of price discovery

Only one metric (reporting of trades) was found essential in this category although price discovery can be facilitated by other metrics:

- This is not really a monitoring tool but rather a performance standard. Most exchanges will already provide this information to members; making it the norm that it be publicly available may be resisted as there will be a perceived market value to the information (and it is most of the business value of the price-reporting organisations for the OTC market). This cannot really be separated from a general movement towards greater transparency but exchanges and markets could be rated according to level of transparency with public availability on a live basis (or within 15 minutes of trades being struck) being a gold standard.

3. Ease of market access (low barriers to entry and exit)

We do not identify any essential metrics under this category.

Nevertheless, one way of assessing the ease of entry into a market is the magnitude of transaction costs. One useful metric of transaction costs is the ***bid- ask spread*** (already identified as an essential measure above); the difference compensates for the costs of doing business. Higher transaction costs arising from high bid- ask spreads deter market entry unless the costs can be passed on to final customers.

Entrance/trading fees, measured in €/MWh, also provide a good indication of the barriers to enter a forward electricity market. High entrance/trading fees will prevent smaller firms or low volume traders from participating in the market and will therefore lower the degree of competition. However, a more detailed comparison of entrance/trading fees between

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of Energy Studies (in the context of gas trading) considers a benchmark of 10 (or 1,000%) is more appropriate – see p.11 http://www.oxfordenergy.org/wpcms/wp-content/uploads/2011/03/NG49.pdf).

[19] As discussed in Annex A3.1.3, market makers in New Zealand were requested by the Electricity Authority to ensure a 5% maximum on bid-ask spreads, while bid-ask spreads in liquid markets tend to be under 1%. See Assessment of Deltas in Futures Prices', Energy Link, 2014, p12 and 'Submission to the Wholesale Advisory Group, on Hedge Market Development', Contact Energy, December 2014, p10.

markets in comparison to their size is also necessary to understand what level of trading fees promote an efficient market operation.

Low transaction costs and low taxes and licensing costs will make forward markets easier to enter. The existence of market makers can also be useful.

Although an important potential barrier to market entry, no measure reviewing the requirements for collaterals in order to trade is proposed. This is due to a lack of objective standards for setting such a measure including little in the literature on this subject. Collection of data from the OTC market on credit barriers is also a problem for measuring this.

4. Other measures supporting contestability in prompt markets

We did not identify any essential metrics that could be used in this category.

5. Effective competition in the forward market

We have listed two very similar measures in this category:

- **Minimum number of companies needed to reach 50% market share**. This measure is more normally used with respect to physical market shares. However, it can be adapted to forward markets as a whole or to individual time periods. It is straightforward to calculate. For interpretation, we recommend (i) annual time trends or (ii) comparison with the number of players in the physical generation and supply market. The logic for the second indicator is to assess the extent to which smaller parties in the physical market are actually using forward hedging.

- **Herfindahl-Hirschman Index (HHI)**. As this is a well-recognised metric, it should be adapted for monitoring forward markets. Although it is more commonly used to measure concentration in generation or supply, it can be used to measure concentration over a year in trades in forward products. As this is a concentration measure, we recommend that it be used to cover all forward trading in the market regardless of time period. It can be used in comparison with the HHI applied to generation and supply in the physical market to determine whether there is more concentration in trading in the forwards market than should be indicated by concentration in the physical markets. We recommend the established benchmark of 2,500.

Overall assessment of monitoring tools

Missing from most of the literature on the monitoring measures is a rigorous methodology for interpretation of the results. This reduces monitoring measures mainly to a time series and benchmarking role: is competition increasing (and so the market is presumably more efficient) and have particular markets achieved greater competition (and so may have features that other markets should emulate)?

What also seems to be lacking in monitoring tools is the underlying relationship between forward markets and the prompt markets. There are only a few specialist and essentially non-transferable studies looking at this.

In the next section of the report, as well as looking at the specifics of monitoring tools applicable to the requirements for monitoring the FCA NC, we will explore options for assessing systemic problems in the forward market that might make it inefficient in relation to the prompt market. This seems applicable because the FCA NC introduces processes that will impact the forward energy market as much as the forward capacity markets, given that the purpose of capacity is for the ultimate delivery of energy and the users will want forward capacity only for that purpose; therefore, there should be a relationship between the forward capacity markets and the forward and prompt energy markets.

4 Methodology for assessing impact of FCA NC

4.1 Approach

4.1.1 Analysis of the FCA NC

Scope and content

The Forward Capacity Allocation Network Code was delivered by ENTSO-E as a revised draft to ACER in April 2014; this analysis is based on that draft.

The FCA NC includes the following provisions:

- **Calculation of Forward Capacity volume**. The FCA NC seeks to harmonise and determine the methodologies for setting the net volume of capacity available for energy transfer at each border between bidding zones. It seeks to institute a common grid model and, where possible, ensure allocation at each border uses a flow based method – used in the Capacity Allocation and Congestion Management Network Code – rather than the more traditional Net Transfer Capacity (NTC) approach.

  The current common approach is NTC where each TSO calculates potential flows across borders based on worst case scenarios of system loading with the lower calculation of bordering TSOs determining the amount of net capacity available. This has led TSOs to set a conservative NTC which, in consequence, has pushed or maintained capacity prices at a certain level. There is therefore a prima facie case that the proposed integrated approach will increase overall forward transfer capacity.

  NTC is the maximum capacity that can be safely used for energy transfer between borders and is the basic delimiter of auction volumes for capacity allocation.

- **Splitting of cross zonal capacity between time frames**. The FCA NC requires that allocation of NTC between products of different time durations (annual, quarterly and monthly) should meet market needs and facilitate competition rather than optimising revenue recovery for the TSOs. However, there is no methodology specified for doing this.

- **Capacity auctions**. The objective is to develop a coordinated auction platform to make access easier for users. This will not entail a single set of capacity products being offered across the EU but will allow for the auction mechanics to be the same at each border.

- The **Clearing Price** at borders between bidding zones will be the marginal price for the product offered in each direction up to the calculated NTC. If FTR obligations are the chosen product on a border then netting will be feasible with flows in one direction serving to increase capacity available for flows in the opposite direction provide the NTC limit is not thereby breached.

- Two types of product will be allowed:
  - **Physical Transmission Rights (PTR)** – the dominant form at present – where users are allocated physical capacity, subject to Use-it-or-sell-it (UIOSI) provisions and then can nominate physical flows against them[20];
  - **Financial Transmission Rights (FTR)** – the allocation platform may auction either one-way options or two-way obligations (similar to CfDs) based on the difference between the DAM clearing prices in coupled markets; with a one-way option, if the price spread between the markets is positive in the direction of the option purchased then the allocation platform compensates the option holder for the difference while, in the obligation, if the spread is positive then the allocation platform compensates the option holder but if the spread is negative then the option holder compensates the allocation platform;

  The FCA NC also plans that where NRAs agree that the forward financial electricity market is liquid and competitive, all physical capacity can be allocated to the DAM and market players offer each other CfDs or any other forward products to cover exposure to cross-zonal price spreads.

  PTRs and FTRs cannot be offered at the same border between bidding zones. This does not preclude third parties from offering financial products regardless of the type of transmission right offered.

- **Firmness deadlines, emergency and force majeure** – the proposed rules allow for curtailment of rights up to the firmness deadline with compensation for the rights withdrawn capped by TSO revenue from congestion (sale of PTRs plus congestion revenues earned through market coupling, or FTRs) but afterwards, compensation payments are at TSO risk. Issues with this include lack of uniformity in the setting of the deadline for different markets (which may soon be sorted out in later drafts of the Code) as well as the methodology for calculating and applying the compensation cap. For emergencies and force majeure, compensation is straightforward.

- **Costs recovery** – this is allowed for the costs of a common allocation platform but the FCA NC is silent about costs such as transmission losses.

[20] The potential compensation for rights released under UIOSI provisions is equal to price spreads between coupled markets – As of today, this could possibly make UIOSI more valuable than nomination to the rights holder because compensation would be on each MW released whereas potential benefit under nomination is confined to the MW actually nominated against after technical nomination restrictions (e.g. on ramp rates) are taken into account. Although, as noted previously, there are also advantages linked to the nomination, such as the avoidance of setting positions on power exchanges.

FCA issues

Products offered

The FCA NC leaves the door open to other products than baseload (24/7) ones. In addition to splitting of NTC into time tranches (yearly, quarterly, monthly), it mentions the possibility of time of day products (e.g. peaking) but there is no assessment of likely demand for such products.

Capacity markets are likely to be different to energy markets in that there is no underlying cost to utilisation (no gas to be purchased or whatever); capacity – whether network or generation capacity – is ultimately an option for allowing energy flow. The value of capacity is therefore derived from the economic rent derived from energy market differentials. When there is no congestion between markets then the price differentials will disappear and the market value of the capacity will fall to zero.

Given that the auctioneers of transmission rights are essentially non-commercial organisations, more clarity on what products to offer and criteria for offering them would be useful. However, it must be recognised that while the predominant forward energy product in the market is baseload, the likely demand for time-of-day transmission rights products will be similarly small.

Splitting criteria

As with types of product offered, although there is some general guidance on criteria for determining how NTC will be split between time periods, there is no definitive distribution. How an auction platform will determine what the market requires in terms of products of different duration is not defined. It is possible that the regulatory authorities will need to offer more precise guidance as well as processes for making such determinations[21].

It should be noted that the criteria set out in the FCA NC for determining splitting may be contrary to the financial interests of the NTC providers because a lower cost capacity product will result in lower congestion revenues to the TSOs.

TSO revenue risks

TSOs either flow electricity as nominated or provide back the value of the capacity as they receive it from power exchanges. Where there are some issues (such as curtailment) for the nominated and/or resold capacity , transmission tariffs covers the missing money. Consequently, TSOs should be neutral between the allocation of PTRs or FTRs option.

Firmness

In normal circumstances, the calculation of transfer capacity will be sufficiently conservative to ensure continuity of supply without overloading of tie lines. This will apply for a range of

[21] The TSO on the Dutch borders currently undertakes a continuous market testing exercise to determine how much of each product should be offered; this is a potential template for market testing on all borders.

scenarios where generation and demand within a bidding zone are mis-matched. Therefore, curtailment of rights will always be relatively rare and mostly related to transmission failures. The FCA NC therefore seems relatively generous to the rights providers in allowing capping of the compensation to be paid when rights are curtailed to the amount received in congestion revenues (plus auction revenues). However, all curtailed transmission rights are treated as FTRs with full payout of the price spread between markets guaranteed up to the price spread cap.

After the firmness deadline, the TSO is exposed to the full imbalance cost (although this may be mitigated in intraday markets) because contractual throughput is guaranteed.

4.1.2 Impact of implementing the FCA NC

In the sub-section above, the key points of the FCA NC have been highlighted. In large part, the FCA NC ratifies existing practices in forward capacity allocation: the Nordic market may continue unchanged and the main allocation platforms are substantially compliant with the key provisions of auctioning. Of course, not all the good practice observed is universally applied with forward capacity allocation in markets in South-eastern Europe often deficient[22]. Therefore, one obvious impact will be to bring all markets up to a better level of efficiency and transparency. For other markets, many of the impacts will be limited.

Addressing the majority of Europe, where a reasonable level of allocation efficiency and competition is already in place, the main provisions that may have an impact are as follows:

- **Increase in capacity due to the flow based method**. This is likely to reveal more capacity for allocation than is currently allowed for. This could reduce forward congestion revenues of TSOs because, although they will auction more transmission rights, the perception will be that future congestions will be less and so auction clearing prices will be lower. On the day, the amount of NTC actually available will not be altered. In practice, if the auctions are efficient, this should make no difference to TSO revenue because the underlying basis for the auction price (the congestion rents anticipated between coupled markets) will not have changed.

- **Improved access through a co-ordinated platform**. This will be a qualitative improvement making trading and access to auctions easier. Improvements will be most apparent in the more inefficient markets. Some increase in number of traders can be expected and this will improve liquidity in both primary and secondary markets for forward products.

- **Improved criteria for splitting of NTC across the forward curve**. Although the rules are not prescriptive, the objective imposed on the NTC providers to be market responsive in the splitting decision should be positive.

Where the FCA NC offers less help is in the translation of price signals into development of transfer capacity. The price signals are and will remain reasonably apparent to TSOs. Cross-border capacity is in a slightly ambiguous position relative to internal transfer capacity; with the latter, there is a clear incentive in regulated price control formulae for network to be developed and added to the regulatory asset base, which NRAs can act upon, but with

[22] This particularly applies where interconnections are with non-EU countries.

cross-border assets, there is not such a clear requirement to develop new assets – especially with merchant interconnections.

4.1.3 Criteria for assessing monitoring methodologies

In Section 3 above, we looked at the literature regarding monitoring of markets and found very little that relates well to the requirements of forward capacity allocation. However, the criteria to be looked at in selecting monitoring methods need to look at some or all of the attributes discussed in this sub-section 4.1.3.

1. Market accessibility and contestability

The FCA NC seeks to improve access to forward transfer capacity. However, this is always a means to an end, with the actual requirement being to be able to access energy markets and to use forward capacity to hedge cross-border energy positions. Therefore, we need to monitor the extent to which the FCA NC facilitates trade in forward hedging in the energy market.

FTRs explicitly turn forward capacity into an energy hedge between markets but they do not cover underlying changes in price levels over time that energy hedging products need to cover. PTRs are similarly limited to an option against market price differentials and cannot cover a movement in price levels. Therefore, there is a need to look at the impact of improved access to transfer capacity on explicit trading of hedging products in the energy market.

2. Liquidity

Again, the main element of liquidity relates to the extent to which the FCA NC will promote liquidity in the forward energy markets; liquidity in transmission rights products is a secondary but still relevant issue because trade in transmission rights will still depend on the ability of the trader to trade out of any position held. Therefore, it is relevant to look at measures of liquidity in transmission rights products across the forward curve but this must also be looked at in parallel with liquidity in energy products traded over the same time frames.

3. Impact on energy prompt markets

As noted, the purpose of the FCA NC is ultimately to provide efficient access to prompt energy markets for traders using energy products sourced from or destined for markets outside the local bidding zone. This is facilitated when the hedging products used in the local energy market are complemented by hedging products for energy markets located outside the local bidding zone. In effect, this impact is therefore a subset of the accessibility and liquidity criteria already discussed.

In terms of access, the Nordic market provides no explicit forward capacity products: all NTC is allocated to the day ahead market. Parties then cover their forward positions by trading with other parties and market makers; the FCA NC does not change this provided that the Nordic market can continue to demonstrate liquidity.

4. **Revenue adequacy**

The business case for the development of interconnections will not necessarily have required revenue adequacy as a primary consideration. In developing an interconnection, considerations of security of supply and market competition will have informed decisions to construct.

4.2 Auction revenue reduction

The proposed monitoring measure would look at the impact of introducing the flow based method of capacity calculation, and would calculate the impact in terms of changes in average unit prices of transfer capacity at auction in the wider are affected by the introduction of the flow based method. The measure can also be used more generally to examine trends in unit auction prices within wider areas than just at single borders.

One aspect of the FCA NC is that TSOs will be encouraged to use the flow based method of calculation of transfer capacity in the forward markets. The CACM Regulation introduces the flow based method for calculating availability of transfer capacity in prompt markets and this calculation determines how much transfer capacity will be used in the algorithms that determine price spreads between markets; the FCA NC suggests that TSOs should consider applying the same methodology for determining transfer capacity available for auction in forward markets. It is assumed that this method will optimise availability by assessing flows in the wide area; the current methodology for calculating ATC involves individual TSOs each making their own assessments with respect to their own borders, which limits the extent to which they can consider how wider area flows can avoid, to an extent, specific congestion points.

This is therefore a periodic test to assess the effectiveness of implementing the flow based method in parts of the wider transmission network. Additionally, over time, efficient network investment should lead to lower costs of access and so the measure could be used to assess trends over time in selected areas covering bidding zones where looped flows are significant (i.e. a strong possibility that investments in one bidding zone will impact on congestion in neighbouring bidding zones).

4.2.1 Evaluation against criteria

Calculation methodologies promoted under the FCA NC are likely to result in an increase in overall transfer capacity revealed in the forward timeframe compared to what is currently allowed for. Fair, non-discriminatory and transparent methods of calculation will affect the expectations regarding future congestion and should result in lower average forward auction revenues for TSOs. Out of the four criteria mentioned in the previous section, monitoring of auction revenue values can provide evidence indirectly against three of the criteria:

- market accessibility and contestability – bidders at auction will have a clearer view of expectation of congestion on different pathways in the wider area and so will be able to bid more realistically (the ability of larger participants to model the network will cease to give them as big an advantage over smaller parties and new entrants)

- liquidity – by signalling more availability, more transfer rights are likely to be auctioned, allowing more parties to be successful at auction
- impact on access development – by signalling more accurately where congestion can be expected, TSOs will, where incentivised, develop additional network capacity more efficiently.

4.2.2 Calculation methodology

In a European context, the auction revenue monitoring metric is calculated directly as the price of rights sold at auction multiplied by the volume of rights sold. This is calculated over the year, with rights sold potentially at multiple auctions covering different timeframes within the year. Therefore, the methodology would be applied to the data for the year prior to a move to the flow based method and then to the year following its implementation. For the control areas affected by the change, auction revenue for each year would be calculated and divided by the sum of the volume of rights sold over the year using the formula:

$$P_y = \frac{\sum_{c=1}^{cc}\sum_{a=1}^{n}\left(R_{cay} * P_{cay}\right)}{\sum_{c=1}^{cc}\sum_{a=1}^{n} R_{cay}}$$

where:

y = either the year preceding the implementation of the flow based method or the year following

c = a border between control areas within the set of all borders cc between control areas affected by the implementation of the flow based method

a = an auction for transfer rights in either direction for rights sold on a border during the year, where n is the set of all such auctions for that border for that year

R = transfer rights sold in MW

P = the auction price of transfer rights for a particular auction.

The flow based method can be considered to be successfully implemented if $P_y < P_{y-1}$ and will be considered to signal potential problems and the need for further investigation if $P_y > P_{y-1}$.

4.2.3 Interpretation of results

This methodology is not directly applied elsewhere because other jurisdictions do not have the precise requirement that FCA NC suggests. However, it is based on analysis by Shmuel

Oren[23] looking at the implementation of wide area transfer rights in the US context. The Oren paper looks at the valuation of transfer rights when sold as FTRs and when sold as flowgate rights. Although FTRs and PTRs with UIOSI dominate in Europe, the product is slightly different to the US product because, in the US, FTRs are sold between two bidding zones that are not necessarily adjacent whereas flowgate rights are acquired within the wider area using a calculation of loadflow with the bidder acquiring a portfolio of rights matching the expected pathway of his energy flows. Therefore, transfer rights in the EU context have similarities to flowgate rights because the bidder must similarly bid for the pathway of his energy flows by acquiring rights at each border. Oren calculated that there would be a potential TSO surplus from selling FTRs because rights would be sold also on non-congested pathways whereas, with flowgate rights, no TSO surplus would occur. Given the European implementation of transfer rights has flowgate-like properties, TSO surpluses should be minimised. Therefore, the expectation from implementation of the flow based method should lead to all efficiencies accruing to bidders rather than to TSOs, that is prices should fall.

An increase in the auction revenue would indicate that the congestion management is not very efficient and that the FCA NC has not been very successful in increasing the available capacity. However, this simple basic interpretation needs to be heavily caveated. There are many reasons why congestion revenue will change and so a case by case assessment of each change in congestion revenue would need to be made:

- ❑ There can reasonably be expected to be a lag between an increase in forward prices for transfer capacity and development of network reinforcements; if parts of the network had previously been overbuilt then an increase in congestion may not signal sufficient additional revenue to justify investment in network development.
- ❑ A change in relative fuel prices could affect dispatch between areas leading to changes in congestion; this would be additional to changes in year-on-year energy flows attendant on changes in hydrology in areas with a strong contribution from hydroelectric generation.
- ❑ Construction of significant new generation or demand could have a similar impact on congestion through flow changes although such changes in production/consumption capacity should be well anticipated; potentially more difficult to anticipate may be closure or mothballing of existing generating capacity (which may also be the result of changes in relative fuel prices).
- ❑ Changes in demand could lead to a systemic under-utilisation of network during an economic recession (leading to less congestion at borders), whereas economic recovery could increase anticipated congestion.
- ❑ Improvements in market information and modelling could lead to better forecasting of future congestion costs, which could lead to an assessment that the value of transfer capacity is higher (noting that current pricing of transfer capacity often undervalues expectation of price spreads).

[23] Oren, S., 2013, 'Point to Point and Flow-Based Financial Transmission Rights: Revenue Adequacy and Performance Incentives', Chapter 3 in Financial Transmission Rights: Analysis, Experiences, and Prospects, T. Kristiansen and J. Rosellon (eds.), Springer.

This offers no more than a prima facie indication of the success or otherwise of implementation of the flow based method. Similarly, where applied as a time trend over a wider area even where there is no underlying change in the methodology for calculation of transfer capacity availability, the caveats listed above will also apply.

Table 9 Auction revenue method for assessing impact of FCA NC

Calculation methodology	Data required for the calculations	Interpretation of results	Advantages and disadvantages
The sum of volume of transmission rights sold at each border between bidding areas times the average price of those rights, summed for all borders in the wider area where flow based method has been implemented, is divided by the volume of rights sold; this is compared to .the value calculated in the previous year.	All data derived from the auction platform used for sale of transmission rights	An increase in auction revenues over time indicates inefficiencies in the calculation of available transfer capacity and therefore the ineffectiveness of the FCA NC to reveal available capacities. This is primarily a test for the success of the flow based method but could be applied more broadly to look at the trend in efficient development of transfer capacity across Europe.	Applicability in Europe Easy to calculate and recognise changes; less easy to unambiguously interpret results Doesn't identify the source of inefficiency.

4.3 Churn rates and Net Transfer Capacity

The proposed monitoring measure would look at churn rates in energy market forward products of different durations and identify where there is a difference in relative churn rates between products in the same market compared to an EU benchmark; this may indicate a misallocation of splitting of NTC but cannot be looked at in isolation from other factors affecting churn rates in different forward energy products.

Cross-border transfer capacity can serve to cover price risks associated with cross-border generation assets. If a market participant sells electricity forward across a border, but then cannot secure cross-border capacity at the time of delivery, they must cover the contract by purchasing electricity in that country’s domestic market. This brings exposure to cross-border price differential risk.

Therefore, in order to cover a position in a forward energy market where there is a price risk arising from cross-border price differentials, there is a need for forward capacity to match cross-border forward energy contracts. The prevalence of trade in forward energy markets is thus partially dependent on the availability of cross-border transmission rights, which allows liquidity to spill into adjacent markets.

The relationship between forward energy trade and cross-border capacity suggests churn rates in forward energy markets can be used to indicate whether there is sufficient transfer capacity between adjacent markets. Furthermore, the pattern of churn rates across timeframes can suggest whether there has been a misallocation of NTC splitting. Over time, this approach can also indicate whether TSOs are efficiently investing in net transfer capacity.

Churn rates for annual, quarterly, and monthly energy products should follow a relatively uniform pattern across the EU. Market participants across the EU should on average exhibit similar demand preferences for products across timeframes, with annual products having the highest volumes and shorter timeframe products having less demand. Therefore, where cross-border traders are acting in a market, disproportionately high churn rates in annual or monthly products could indicate unmet demand for unavailable seasonal or quarterly transmission rights products.

Since liquidity tends to spill across markets, adjacent markets may display a similar break. However, any effect on adjacent markets would depend on the relative size of the markets (both in delivered volume terms and in size of forward market), i.e. a misallocation of NTC splitting between the Czech Republic and Germany may have a discernible effect on Czech churn rates, but not on the churn rates of the much larger German market.

4.3.1 Evaluation against criteria

In investigating the relationship between churn rates and net transfer capacity, this method focuses on the impact on **liquidity** in forward energy markets. Net transfer capacity facilitates forward energy trade across borders. The availability of transmission rights across different timeframes will contribute to liquidity within those timeframes as market participants are enabled to cover cross-border price risks.

A second order effect is that transmission rights-driven liquidity increases will help facilitate **market accessibility and contestability**. Higher liquidity allows market players to trade in and out of positions more easily, making trade more accessible to all types of market participants. By encouraging both market entry and further trade, liquidity thus inherently enhances energy market competition.

By allowing markets to approach their ideal churn rates as market participants optimise their energy portfolios, cross-border transmission rights can contribute to energy market development. This monitoring metric thus aims to signal whether transmission rights have been sufficiently and efficiently allocated in order to allow such development to occur.

4.3.2 Calculation methodology

The key comparison is whether a market's curve of churn rates across the forward market timeframe deviates from an EU benchmark. The curve in question is each product's percentage share of total forward trade.

Forward product t's share of total forward product volume in country i is given as:

$$Forward\ share_{t,i} = \frac{Product\ volume_t}{Total\ forward\ volume_i}$$

If the curve of churn rates across energy product timeframes exhibits a significant break from the EU benchmark, this could indicate a misallocation of NTC splitting. The extent to which this break can be attributed to insufficient transfer capacity depends on how much churn can be attributed to cross-border trade. This requires adjusting for the amount of churn that can be potentially attributable to imports.

This can be inferred by scaling down forward volumes for a specific timeframe by the ratio of import capacity offered at that timeframe to aggregate physical consumption. This takes the form:

$$Domestic\ forward\ share_{t,i} = Forward\ share_{t,i} \times (1 - \frac{Offered\ import\ capacity_i}{Physical\ delivery_i})$$

The remaining forward product churn can then be considered of domestic origin.

If the domestic churn rate is still out of line, this can either indicate a systemic issue for that market or an energy market with inherently different characteristics to the rest of the EU. If the churn rate curve across timeframes does not match that of the rest of the EU, this may indicate a misallocation of NTC splitting.

A consistent definition of churn rates in forward energy markets is needed in order to make cross-border comparisons. The defined churn rate must also account for the entire market, including both exchange and OTC forward volumes.

It is important to focus on the pattern of churn rates rather than gross levels. More developed energy markets will inherently have higher churn rates. The metric of interest is thus a forward timeframe product's percentage share of total forward volumes and whether the pattern of these percentages match the EU benchmark.

We have defined the churn rate of a forward product as the annual volume of contracts (both exchange and OTC-based) for a specific timeframe divided by annual physical delivery in a market.

4.3.3 Interpretation of results

If a market's churn rates across timeframes curve is out of line with the rest of the EU, it can serve as a signal that there has been a misallocation of cross-border transfer capacity. An insufficient volume of available transfer capacity products in one timeframe may force market players to purchase longer or shorter timeframe products than they prefer, or drop out of the market altogether. Such a misalignment can thus impede energy market development.

The credibility of this analysis depends on the appropriateness of comparing one market's churn rates curve to another's. Two energy markets with similar depth, market player tastes, and power generation profiles should roughly exhibit similar churn rates. The advancement of the internal energy market in the EU should contribute to such homogeneity.

However, no two markets will be exactly the same and some significant differences are bound to remain across EU countries. Some markets will inherently have different time preferences for forward products. Adjusting for import capacity takes a step in this direction by indicating the level of domestic churn rates, which may reveal market-specific preferences that differ from the EU benchmark.

This method begins by broadly comparing a market's churn rates to the rest of the EU. This step provides a first indication of whether a forward market is malfunctioning due to a transfer capacity misallocation. However, firm conclusions should not be drawn until a market's broader context is taken into account.

Illustrative example: Hungarian forward market

Hungary is used as an illustrative example, using HUPX exchange data, OTC volumes,[24] and capacity products available on CAO.

In terms of the split of forward products, 24,179 GWh (18.8%) are monthly products, 31,139 GWh (24.2%) are quarterly products, and 73,542 GWh (57.1%) are yearly products.

Using EU benchmarks of 15%, 30%, and 55%, respectively'[25] this would suggest churn rates for Hungarian monthly and annual products are disproportionately high.

To discern how much of this distortion could potentially be attributed to imports, we reduce the monthly and annual volumes by the percentage of import capacity products relative to total physical electricity consumption. For CAO in 2014, there were 6,132 GWh of monthly import products (17% of Hungarian electricity consumption) and 11,388 GWh of annual import products (32%). We adjust for imports by using the formula for the implied domestic share of forward churn:

$$Domestic\ forward\ share_{t,i} = Forward\ share_{t,i} \times (1 - \frac{Offered\ import\ capacity_i}{Physical\ delivery_i})$$

This adjustment suggests domestically originated forward churn percentages of 19.8% for monthly products, 30.7% quarterly, and 49.6% yearly.

In this case, the inferred domestic churn rate for quarterly products is almost exactly equal to the EU benchmark, but the aggregate figure is lower. Strong conclusions cannot be drawn given there are many different reasons churn rates will differ across countries. For this illustration, it suggests either Hungary would benefit from the availability of quarterly transmission rights products that would encourage higher quarterly churn rates, as their inferred domestic churn rate suggests is preferred, or that market participants in Hungary simply prefer shorter dated monthly products to quarterly products.

Figure 6 illustrates the points above. As shown in the graph, the inferred Hungarian domestic churn rate largely matches the EU benchmark, but the aggregate quarterly product share of churn is below the EU benchmark.

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[24] We use Hungary as an example as the TFS OTC volume data is divided by time period (monthly, quarterly, and yearly).

[25] These illustrative benchmarks are constructed by taking the percentage splits between monthly, quarterly, and annual products for Belgium, Czech Republic, Hungary, Italy, Poland, Portugal, and Spain, using volumes reported on ICE, GME, HUPX, ICE, IDEX, MIBEL, and POLPX and weighting by each country's annual electricity consumption.

Figure 6 Illustration of Hungarian churn vs EU benchmark

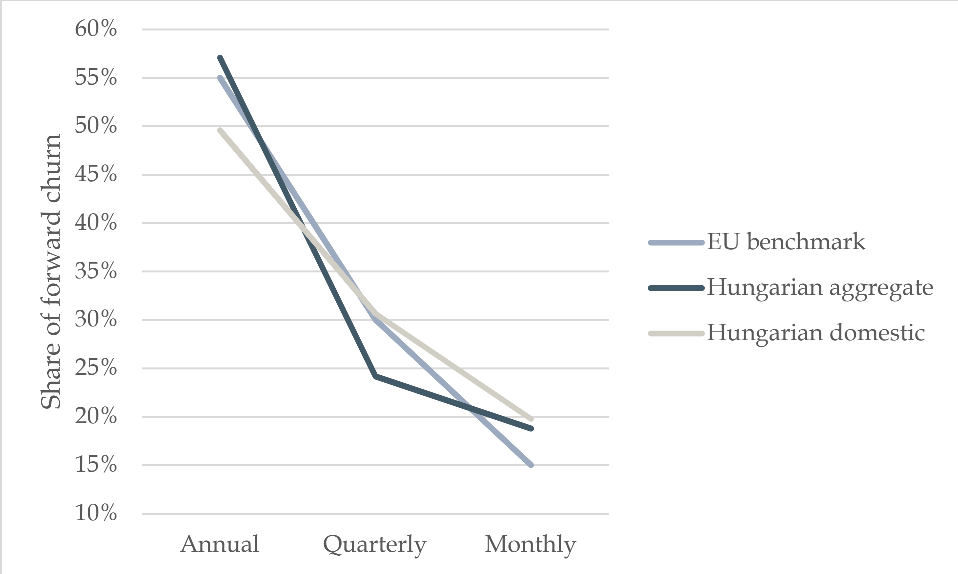

Table 10 Churn rates for assessing impact of FCA NC

Calculation methodology	Data required for the calculations	Interpretation of results	Advantages and disadvantages
Calculate the proportional split of forward market churn rates across timeframes. Compare to EU benchmark. Subtract allocated import capacity to infer domestically originated churn rates.	Volume of forward products across timeframes for the entire EU. Annual electricity consumptions to provide denominator for churn rate and weight benchmarks. Allocated import transfer capacity for each timeframe.	Divergence from EU benchmark may indicate a misallocation of transmission rights products across timeframes. Inferring domestically originating churn rates can indicate the extent misallocations can be attributed to cross-border capacity.	Straightforward calculation. Tool for evaluating the splitting of transfer capacity. Interpretation difficult as many different factors play a role in churn rates. Local market preferences may differ from EU benchmark.

4.4 Efficient pricing of long-term capacity[26]

The proposed monitoring measure would look at whether auctions are efficiently pricing congestion rents over time or are exposing TSOs to increasing or decreasing revenue risk.

[26] This is a simplification on a methodology considered in Bautista Alderete, G., 2013, 'FTRs and Revenue Adequacy', Chapter 10 in Financial Transmission Rights: Analysis, Experiences, and Prospects, T. Kristiansen and J. Rosellon (eds.), Springer, a brief summary of which can be found in Annex A2 – the paper looks at overall revenue adequacy in a nodal system and so the formulae used here are a simplification for consideration of individual borders.

In an efficient market, the revenue from transmission rights auctions should be equal to the congestion rents defined as the price spreads between markets. In making this calculation, the products on offer will need to be taken into account as follows:

- PTRs with UIOSI will be assumed to be non-nominated such that the border will be treated as if all such PTRs were sold as FTR options. This is increasingly the outcome on many borders. This means that the costs of nomination risk will not feature in the calculated price.
- FTR prices (and PTRs) will be adjusted to the extent that interconnector transmission losses are defined as an adjustment in the product definition.
- FTR obligations will be priced on the basis of net price spreads.

It should be noted that this cannot cover markets where no transmission rights are sold to market parties (i.e. the Nordic area).

The calculated congestion rents will be compared to actual auction revenues. It should be noted that, under the FCA NC, the compensation for curtailment will change on some borders from a simple reimbursement of auction revenue per MW to compensation based on price spreads between markets (subject to a revenue cap). This means that current discounts in the auction price due to the potential for curtailment should no longer apply; it should be assumed that the risk of hitting the compensation cap will be sufficiently small to be ignored[27].

This would be an annual calculation covering the aggregate of all products sold up to the firmness deadline and would apply individually to each border. Trends on each border could be monitored although absolute discrepancies should be investigated regardless of the time trend.

It must be remembered that auction revenues should be based on *expected* congestion rents (price spreads between markets); in this methodology, an ex post evaluation against *actual* outcomes (actual price spreads) will be made. This therefore gives only a prima facie suggestion of market inefficiency because unforeseen events will lead to differences between expected and outcome congestion rents.

4.4.1 Evaluation against criteria

This should address criterion 4 (revenue adequacy). Efficient markets should fully capture anticipated congestion rents within auction revenues.

The proposed measure looks at **market efficiency** defined as the extent to which auction revenues equate to expected rents. This only indirectly indicates that the market is **accessible and contestable**. This does not assess prices in secondary markets and so does not cover liquidity. Energy prompt markets are used to measure the efficiency of the auction markets and so this measure does not consider the impact on those markets.

[27] This will not necessarily be the case on DC interconnectors where the compensation cap is based on TSO monthly congestion income rather than on annual.

It should be noted that this is a measure designed to test an economic principle about efficient markets. Given the core requirements of the FCA NC, it seems a worthwhile objective to test whether the ATC auctions are providing the required signals to both the market and to the transmission rights providers.

4.4.2 Calculation methodology

This is an annual calculation. For the specified year, all transmission rights sold in the primary auctions for each border for application in that year will be evaluated to arrive at a total TSO revenue combined for the border. These rights will have different durations (annual, quarterly, monthly – shorter-term rights sold after the day ahead markets clear will be excluded). The year must be chosen such that annual rights sold are fully used up; this will not be a problem as the transmission rights year is or shortly will be synchronised across the EU. The formula used will be:

$$AAR = \sum_{i=1}^{2}\sum_{j=1}^{n} TRP_{ji} * MW_{ji} * D_j$$

where:

i = a direction of flow (from bidding zone A to B or B to A)

j = a discreet auction for transmission rights of a specified life (month, quarter, year, etc.) in a particular direction

n = the total of transmission rights auctions conducted for the specified year for direction i

TRP_{ji} = the clearing price for auction j in direction i

MW_{ji} = the MW of transmission rights sold for auction j in direction i

D_j = the number of days for which product j is valid (depending on whether it is annual, quarterly or monthly)

AAR = Annual Auction Revenue of the TSOs on the border for which the transmission rights auctions were held.

On the other side, there will be a corresponding ex post calculation of the congestion rents that should have been the basis for setting auction revenues. The formula used will be:

If PTRs with UIOSI or FTR options are auctioned then the formula will be:

$$ACR = \sum_{d=1}^{365}\sum_{h=1}^{24} \left(\left(Maximum\left(P_{Ah} - P_{Bh}\right), 0\right) * MW_{ad} + \left(Maximum\left(P_{Bh} - P_{Ah}\right), 0\right) * MW_{bd}\right)$$

IF FTR obligations are auctioned then the formula will be:

$$ACR = \sum_{d=1}^{365}\sum_{h=1}^{24}\left(\left(P_{Ah} - P_{Bh}\right) * MW_{ad} + \left(P_{Bh} - P_{Ah}\right) * MW_{bd}\right)$$

where:

d	=	a day of the year
h	=	an hour of day d
P_{Ah}	=	the clearing price in day ahead market A in hour h
P_{Bh}	=	the clearing price in day ahead market B in hour h
MW_{ad}	=	the total MW of transmission rights sold for delivery from bidding zone B to bidding zone A on day d
MW_{bd}	=	the total MW s of transmission rights old for delivery from bidding zone A to bidding zone B on day d

Market efficiency is measured as:

$$\frac{ACR - AAR}{AAR}$$

4.4.3 Interpretation of results

With perfect foresight, the market efficiency measure should equal zero; a positive result suggests that auctions have under-priced the value of congestion rents while a negative result suggests that the auctions have over-priced congestion rents. A result very close to zero is the target, suggesting that the auctions are efficient.

It should be noted that AAR may equal zero if no congestion on a border is anticipated. In this case, ACR should also be expected to be zero. However, other factors could affect market valuation of future congestion costs including the risk appetite of suppliers who may over-forecast these costs in order to avoid exposure to price shocks (which will depend on the extent to which such hedging costs can be passed through to customers), whereas asset-less traders would seek to under-price transfer capacity rights in order make a profit from the transaction.

It should also be noted that in the case of FTR obligations, AAR should normally be slightly below ACR. With FTR obligations, the holder of a right in the direction B to A is paid if the price in market A is above that in market B, but must pay to the TSO in hours when the price in market A is below that in market B: a mis-forecast of future price spreads can therefore cost the holder money. Therefore, while the revenue for the holder from FTR options could drop as low as zero if he has mis-forecast, holding FTR obligations could end up costing money. This is because there are two main drivers to the bid pricing in FTR obligation auctions: anticipated congestion rents and a risk of mis-forecast in which there is an uncapped possibility of having forecast wrong with price spreads in the market moving against the bidder; this mis-forecast risk must reduce bid prices at auction. There are additional issues to consider with FTR obligations including the collateral requirements due to holders needing to pay money to the TSO in the settlement periods where the price spread covered by the FTR obligation goes against the holder; this can be mitigated to the extent that the FTRs are traded across exchanges allowing netting of the users total traded position.

The following reasons why the market efficiency measure might not be close to zero would need to be explored:

- **Market abuse**; a party (or parties) are cornering transmission rights to deter other parties from cross-border trades. This would see auctions over-recovering.
- **Market mechanics inefficiency**; the costs of participating in the auction are too high or the rules are too onerous. This might include credit arrangements (a big issue with FTR obligations).
- **Market rules inefficiency**; this might include poor firmness regime or setting reserve prices too high on an essentially uncongested border. It should be noted that an auction for FTR obligations could potentially have a negative clearing price (the payment is two-way with the bidder expecting to pay out more than he receives).
- **Mis-forecasting**; unforeseen changes in fundamentals between the two markets could lead to a different outcome to that used when auction prices were determined. Unforeseen changes in the wider European market will make this quite a likely reason given the multiple meshing of the continental network with multiple borders and coupled markets. This is the most likely cause of the efficiency measure deviating from zero.
- **Illiquidity**. If too few parties bid in the auctions then results are likely to be skewed.

A combination of reasons could apply. The weakness of this measure is that it compares an ex ante prediction of congestion rents with an ex post measure. This is only therefore an indicator of any problem rather than a proof of that problem.

With regard to individual markets, a trend over time could be applied looking at whether the measure is getting closer to zero. Because the issue of mis-forecasting could well be general across the EU, a degree of benchmarking of trends could be applied against the EU average but this would only be very approximate (because market fundamentals mean that adjacent markets could respond very differently to shocks such as a drastic change in gas price affecting generation costs in some, but not all markets).

Table 11 Revenue adequacy and market efficiency for assessing impact of FCA NC

Calculation methodology	Data required for the calculations	Interpretation of results	Advantages and disadvantages
Calculate annual revenues from auction of transmission rights on a border (AAR). Compare to annual congestion rents (ACR – sum of hourly price spreads between coupled markets over the year). Divide (ACR-AAR) by AAR. Result should be close to zero.	Volume of transmission rights sold * auction clearing prices for those rights. Sum of: price spreads between coupled markets either side of the border subject to the auction * MW of rights sold.	For an efficient market, the result should be close to zero. No target range of values but an initial arbitrary range of ±10% could be tried. Trend over time could be monitored but there is no definite benchmark for monitoring this.	Straightforward calculation. Data fully available. No benchmark range (target is zero but no measure of significance for deviation). No history of this measure (based on pure economic theory). Indicator of issue but not proof.

4.5 Market efficiency of EPADs

The proposed monitoring measure would look at whether EPAD auctions are efficiently pricing congestion rents over time or are delivering excess revenues or insufficient revenues to market makers.

EPADs (Electricity Price Area Differentials) are a spatial CfD-type product sold as contracts in the Nordic market. Both importers to and exporters from an area purchase EPADs to cover forward spatial price risk but with financial intermediaries (including market makers) also taking positions in the market and offering risk management.

The resulting product will have similarities to an FTR Obligation with each product settled as the difference between the Area price and the System Price (a weighted average day ahead price based on market clearing without any transmission constraints). It seems likely that the System Price will, on average, be lower than a throughput weighted average of the clearing prices of each area because it will, by definition, not include any element of congestion rent. Nevertheless, negative prices in congested export zones can be expected and are observed. However, the average clearing price of an EPAD should be positive.

There are differences between EPADs and FTR Obligations, which mean that they cannot be directly used to indicate outcomes for any implementation for FTR Obligations elsewhere in Europe. The most significant difference arises from the fact that EPADs are not issued by TSOs. The consequences of this include:

- No limit to number of EPADs that can be issued – driven by market supply and demand and not transfer capacity availability
- EPADs are bidirectional – purely driven by differences between area price and system price regardless of whether the buyer/seller is seeking to import into or export from the area.

Additionally, the reference price is an overall system price and not price differences between markets on specific borders – this makes them closer, in some ways, to spatial CfDs observed in US markets, which are settled based on multiple node-to-node pathways.

In a paper by Spodniak, Chernenko and Nilsson[28], a long series of CfDs in the Nordic market is examined looking for, among other things, risk premia. These are defined as the difference between EPAD gross values and net price spreads.

4.5.1 Evaluation against criteria

Although this measure relates to a specific type of forward transmission right that is not generally applicable across the EU, the Nordic market remains a significant area and so deserves to be analysed. This is particularly the case given the requirement in FCA NC for regulatory assessment of whether the market satisfies the requirement for forward hedging instruments.

This indirectly addresses criterion 4 (revenue adequacy). Efficient markets should fully capture anticipated congestion rents within auction pricing, regardless of whether the revenue accrues to TSOs or to market parties.

The proposed measure looks at **market efficiency** defined as the extent to which auction revenues equate to expected rents. This is open to interpretation in that EPADs are measured against a system price rather than against prices in adjacent markets and so congestion rents may be obscured.

This measure does not look at whether the market is **accessible and contestable**.

4.5.2 Calculation methodology

The calculation methodology is based on Spodniak/Chernenko/Nilsson paper (the "paper") but has slightly different objectives and is simplified. While the paper sought to consider global efficiency and risk premia, it is unsatisfactory in identifying specific issues. This is because the region has areas dominated by hydro generation and other areas dominated by wind such that there is a seasonal and year-on-year variation in demand for transfer capacity that needs to be factored into any analysis. Therefore, we believe that a better metric would look at each area separately to assess the extent to which the value of the EPADs sold in that area properly reflect the price spreads between the area and the system price.

Another factor we believe to be relevant is the inherent physical seasonality of pricing in any year that ought to affect flows and price spreads. Therefore we believe information should be standardised on years.

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[28] See Spodniak, P., Chernenko, N., and Nilsson, M., 2014, 'Efficiency of Contracts for Differences (CfDs) in the Nordic Electricity Market', Ninth Conference on Energy at a Crossroads: Preparing the Low Carbon Future, 1-39 (http://tiger-forum.com/Media/speakers/abstract/261405pm/petr_spodniak.pdf) , which is also summarised in Annex A2). It should be noted that EPAD is a relatively recent name for products formerly known as CfDs.

The resulting formulae are as follows:

$$P_{ACT} = P_C - \sum_{j=TC1}^{TC2} \left(P_{Aj} - P_{Sj} \right)$$

$$P_{Ay} = \frac{\sum_{C=1}^{n} \left(P_{ACT} * V_C \right)}{\sum_{C=1}^{n} V_C}$$

where:

y	=	the year being analysed
A	=	the area for which the EPAD is offered
C	=	an EPAD contract (monthly/quarterly/annual) for delivery in year y
T	=	the duration in electricity settlement periods (i.e. hours or half-hours) of contract C
$TC1$	=	the first settlement period of time T
$TC2$	=	the last settlement period of time T
P_{ACT}	=	the average net value of contract C over time T in area A
P_C	=	the average traded price of contract C (as specified by NASDAQ OMX) in €/MWh
P_{Aj}	=	the day ahead area price in settlement period j (from Elspot market)
P_{Sj}	=	the day ahead system price in settlement period j (from Elspot market)
P_{Ay}	=	the average net value EPADs for area A in year y in €/MWh
V_C	=	the traded volume of contract C (as specified by NASDAQ OMX) in MWh

It is not clear whether NASDAQ OMX publish aggregate trades of contracts and volumes of EPADs and so it may be necessary to calculate P_C and V_C from published daily volumes, in which case P_C should be a volume weighted average price.

A benchmark value of the regional EPAD can be additionally calculated using the formula:

$$P_y = \frac{\sum_{A=1}^{AA} \left(P_{Ay} * \sum_{C=1}^{An} V_{AC} \right)}{\sum_{A=1}^{AA} \sum_{C=1}^{An} V_{AC}}$$

where:

AA = all areas (A) in the Nordic region

AC = each contract traded with respect to area A in year y

An = all contracts traded with respect to area A in year y

P_y = the benchmark net value of an EPAD in year y

4.5.3 Interpretation of results

According to the paper, the net price calculated here is a risk premium. This is possibly open to interpretation because, as noted, the system price calculated by Elspot is an uncongested price, which must, inevitably be lower than the average of the set of congested prices because at least some cheap generation must have failed to be dispatched due to congestion. Also, if parties are seeking a hedge against congestion affecting prices within a zone then the price of the EPAD should reflect anticipated congestion rent.

However, regardless of the interpretation of the nature of the net price of EPAD contracts, the usefulness of this monitoring measure should be in the degree of consistency of results for any zone. Even this will not always be easy because factors such as hydrology will affect prices from year to year. Nevertheless, a year-on-year change in average EPAD price will be indicative of the extent to which an area is facing more or less congestion and so trends can be developed.

Interpretation of the results is difficult because there is no underlying metric such as cost of provision of transfer capacity by which the results can be judged. However, a result close to zero indicates that there is no persistent shortfall in transfer capacity affecting an area.

The benchmark EPAD price calculated is also difficult to interpret. It is best used to check for consistency of an area EPAD price over time in that the difference between the area EPAD price and the benchmark EPAD price might be considered to be reasonably consistent although, for many areas, this may not be the case, especially where there are changes in hydrology affecting individual areas from year to year.

Therefore, interpreting the result can be no more than a prima facie indication of changes in trading of EPADs that *may* have a systemic or market abuse cause.

Table 12 Revenue adequacy and market efficiency for assessing impact of FCA NC

Calculation methodology	Data required for the calculations	Interpretation of results	Advantages and disadvantages
Calculate the value of the EPAD as the difference between the traded price and the average price spread in the market over a year A Nordic benchmark can be derived from the same data; this should be used to adjust the EPAD value for each area to remove any year-on-year variation affecting the whole market	Price spread data from the Elspot published area prices and system prices for each settlement period Prices and volumes of traded EPADs in each area published by NASDAQ OMX	A net EPAD value per MWh should be close to zero once adjusted by subtracting the regional benchmark value from the area value. Trends over time in area EPAD values can then be assessed with changes investigated. Issues such as hydrology can affect the year-on-year values and so results are only a prima facie assessment.	All data readily available Can be used for comparison with revenue adequacy measures elsewhere in EU (see Section 4.4) although results are open to interpretation. It is unclear whether the result is a risk premium or a congestion rent.

4.6 Comparison of methodologies

In examining monitoring methods, there is a poverty of literature around monitoring of transfer capacity, particularly with regard to the elements that will change under the FCA NC. To be clear, the FCA NC will make incremental improvements in efficiencies at the overall level of EU cross-border trading with its main benefit possibly forcing best practice across the EU. However, it will not, of itself, fundamentally change the dynamics of cross-border access because it will need to cater for existing practices in many areas such as product design fundamentals (i.e. choice of PTRs, FTR options, FTR obligations or whether TSOs should offer any hedging products at all).

In reviewing the impact of the FCA NC we have sought to consider the reason for cross border access, which is for the transfer of energy into another market. Therefore, the FCA NC should not be divorced from forward trading in energy markets.

Another area where we have made assumptions is in the products offered for forward transmission rights. Currently, the only forward access products offered are annual and monthly products. Time-of-day products (peak, off-peak, etc.) are considered as something that could be offered in future but there is no explicit requirement for them. This compares with forward energy products where time-of-day products are offered but are usually not particularly popular. This could change but it should also be recognised that forward energy products provide temporal hedging whereas interconnector hedging is essentially spatial (i.e. parties looking for forward temporal hedging would buy a temporal hedge product in one of the markets and then buy a spatial hedge to cover risks in the other market – it is not clear that spatial hedges need to cover time-of-day issues while temporal hedges do not, or vice versa[29]).

4.6.1 Methodologies compared

The monitoring methods chosen look at different aspects of the impact of FCA NC:

- **Auction revenue reduction** looks at the potential change in efficiency of forward capacity allocation; by making more transfer capacity available in forward markets through efficiency in calculation, the FCA NC will lower the forward cost of rents.

- **Churn rates and net transfer capacity** looks at an explicit obligation placed on TSOs to manage the splitting of capacity into time periods and products in response to market requirements. This metric seeks to discover the efficiency with which this is done.

- **Efficient pricing of long-term capacity** is a metric based on economic theory of efficient pricing. It postulates that markets will value transmission rights based on expected economic rents (price spreads between markets) that transmission rights either provide access to (in the case of FTRs and the UIOSI element of PTR products) or allows avoidance from (nominated PTRs). Efficiency suggests that forward prices of transmission rights should equal these economic rents.

- **Market efficiency of EPADs** is a metric approximately equivalent to TSO revenue adequacy in that EPADs – traded contracts by market parties rather than being issued by TSOs should still represent the value of congestion rent within their traded price. The value of EPADs is based on price spreads between the calculated uncongested system price and the congested area price. And so the price of the EPAD minus the average price spread should be zero for an area in an efficient market (once adjusted for variations between average price for all areas and the lower uncongested price).

[29] Analysis of some of the properties of FTR obligations suggests that time-of-day products may be very necessary hedging tools.

Table 13 Comparison of methodologies for assessing efficiency of FCA NC forward markets

	Auction revenue reduction over time	Churn rates and NTC	Efficient pricing	Market efficiency of EPADs
Description	Potential change in efficiency of forward capacity allocation by making more transfer capacity available in forward markets through efficiency in calculation; lower forward cost of rents should result. This should be used primarily to assess the effectiveness of implementing the flow based method.	Obligation placed on TSOs to manage the splitting of capacity into time periods and products in response to market requirements; this metric seeks to discover the efficiency with which this is done by looking at discrepancies in the shape of the price curves over time.	Markets will value transmission rights based on expected economic rents (price spreads between markets). Efficiency suggests that forward prices of transmission rights should equal these economic rents. Therefore rents can be compared to auction revenues.	EPADs are spatial CfD-type products traded on the NASDAQ OMX market in the Nordic area. They cover the difference between the day ahead System Price (computed uncongested regional price) and the day ahead Area Price.
Countries in which the methodology is found (entirely or in part)	PJM, Nordic	Partly looked at in new Zealand but not directly using this methodology.	n.a	Nordic
Data required to use the methodology	Transmission capacities in all interconnection lines, prices in each bidding area.	Volume of forward products across timeframes for the entire EU. Annual electricity consumptions to provide denominator for churn rate and weight benchmarks. Allocated import transfer capacity for each timeframe.	Volume of transmission rights sold * auction clearing prices for those rights. Sum of: price spreads between coupled markets either side of the border subject to the auction * MW of rights sold.	Published Elspot System and Area Prices for each settlement period. Average prices and volumes of EPADs traded for each area

	Auction revenue reduction over time	Churn rates and NTC	Efficient pricing	Market efficiency of EPADs
How results intended to be interpreted and inefficiencies quantified	An increase in auction revenue indicates inefficiencies in availability calculation and therefore the ineffectiveness of the FCA NC to increase available capacities. This is an indicator for further investigation, noting that reasons for increases in auction revenues can have many causes not related to inefficiencies in capacity provision.	Divergence from EU benchmark may indicate a misallocation of transmission rights products across timeframes. Inferring domestically originating churn rates can indicate the extent misallocations can be attributed to cross-border capacity.	For an efficient market, the result should be close to zero. No target range of values but an initial arbitrary range of ±10% could be tried. Trend over time could be monitored but there is no definite benchmark for monitoring this.	A benchmark EPAD value/MWh is subtracted from the calculated area EPAD value for each year with the residual value representing residual congestion rent or risk premium. A value close to zero indicates efficient market. No target range and difficult to be certain how to quantify inefficiencies; possibly best as a time series analysis for each area.
Prima facie case for market abuse in forward capacity allocation	Abuse would be by TSOs restricting availability of NTC (low probability).	Possible TSO mis-application of product splitting (this is not abuse but is non-compliance with FCA NC requirements). Party cornering a particular forward energy product.	Under-recovery of auction revenues is indicative of market inefficiency; over-recovery suggests potential attempts by some parties to freeze other parties out of forward hedging markets (making them more vulnerable in day ahead markets).	Price moving away from zero indicative of inefficiency but unlikely to be market abuse. Year-on-year results are affected by factors such as changes in hydrology

4.6.2 Main lessons

The key lessons from this are:

- Very few attempts have been made to monitor the efficiency or efficacy of cross-border hedging tools.
- The FCA NC does not intrinsically change the landscape for cross-border transmission access but seeks to introduce efficiencies into the process, largely by

instilling best practice across the board – bigger improvements can be expected in markets that are currently less efficient.

- Transmission access is a means of transferring energy from one market to another and so efficiencies should be felt most in forward energy markets.
- Monitoring methods need to be adapted to European and FCA NC requirements.
- The methods we are proposing look at the relative efficiencies of markets over time and between markets, with a European benchmark feasible in one or two cases.
- Because of the differences in market fundamentals, most markets need to be compared against their own history, but absolute results can be found when looking at measures of economic efficiency.

5 Conclusions

In this report we have been looking at the role of forward markets in delivering competitive electricity markets. Much of the focus of concern has naturally been on the ability of forward hedging instruments that provide price assurance to competitors in the prompt energy markets. This must be seen in the context of providing new entrants with physical or financial hedging tools that can compete more effectively with the natural hedging instruments enjoyed by vertically integrated incumbents in many markets.

Another element in enhancing competition is improving the ability for competitors from other countries to contest local energy markets and this requires them to have effective access to transfer capacity. This is what the Forward Capacity Allocation Network Code (FCA NC) seeks to enhance because, unless confidence in competitive cross-border physical access is strong in forward timeframes, actual cross-border trade will not be competitive.

Task A: Survey of forward markets and hedging products

Our first approach to the analysis was to establish the base line for degree of contestability in forward markets. This was done mainly by analysis of published sources of data on forward markets and products although we also spoke with market services providers and forward market users.

The key results from our analysis of forward markets and hedging products are:

- Liquidity on exchanges is relatively low in many markets. In south-east Europe, we were told that a likely additional factor was regulatory burdens and costs associated with trading.

- Volumes are concentrated in basic products, which suggests that market participants are primarily concerned with hedging against underlying price movements rather than short-term volatility. This conclusion extends to the relative lack of volume traded in peaking products and products of shorter timeframes (daily, monthly, quarterly, etc.).

- There is more choice in financial products than physical products. Smaller traders prefer products that they can trade easily in order to exit positions. However, larger traders, who provide most of the hedging products in the broker markets, have a preference for physical products – mainly due to fears of breaching thresholds under new financial regulations.

- The trading of transmission rights is predominantly physical although PTRs resolve into financial products if not nominated against and many holders seem to use them as such. Larger traders with significant physical assets may prefer PTRs as holding a physical option enables them to avoid exposure to spot prices in two markets by allowing them to choose a physical option in one of the markets.

- Northern and Western European markets are generally considered well run and transparent with procedures in place to prevent abusive behaviour, all of which support liquidity. In contrast, there are concerns on all of these points in some South-eastern European markets.

Task B: Methods to evaluate efficiency

We extracted an array of monitoring metrics from the literature that address the issues of hedging and liquidity. We also considered some methods that assess the performance of prompt markets, noting that much of the literature concentrates on analysing these markets, partly due to easier data accessibility and the relatively new establishment of financial futures markets.

Some key observations on the results of the review are:

- **Liquidity as expected is a major focus** of the assessments and the metrics used are consistent with those we propose: churn rates, bid-ask spreads, volumes of transactions. The indicators also attempt to distinguish between types of product and their period of delivery.
- Although the price discovery function of forward markets is acknowledged and many papers examine the relationship between forward and spot prices, we were **unable to identify explicit measures of how effective price discovery in forward markets is** in the various markets/countries (other than the liquidity of different and longer-dated products).
- Particular attention is given to the **various facets of contestability and competition**, so that indicators of entry/exit activity, the number and variety of market participants, and market concentration measures feature prominently.

The identified monitoring tools largely consist of evaluating market concentration and market liquidity and can be divided into five categories:

- **Effective hedging opportunities:** the literature concentrates on liquidity measures as a means for market participants to enter and exit positions. Measures such as volumes, churn rates, bid-ask spread, etc. are easily understood but they may not provide a nuanced view of the market as a whole and relevant benchmarks are not always clear.
- **Facilitation of price discovery:** identified measures, such as the share of long-term hedging in open interest or live trade reporting, focus more on information transparency rather than direct regulatory monitoring. The measures may assist in providing useful information to traders but they are difficult to interpret from a regulatory perspective.
- **Ease of market access:** largely indirect measures that do not have clear benchmarks and may be misinterpreted. Although imperfect, measures such as the percentage of contracts with force majeure clauses or the churn rate of market participants can highlight the key matter of easy market participation.
- **Composition of market participants:** market efficiency can be enhanced by the participation of diverse parties. This can be derived from volume by trade type or the extent of financial speculation, but interpretation is not straightforward.

- **Market concentration:** measures of concentration are often easy to understand, such as the minimum number of market participants to reach a certain threshold of market share, but benchmarks that suggest an efficient, competitive energy market have not been settled.

A general impression from the literature is that there is no unique solution for determining overall market efficiency. This is not surprising given that different markets will have varying fundamentals. However, given overall market efficiency is a critical question regarding the operation of energy markets, there does seem to be a gap in the literature in attempts to tackle this issue. Instead, there tends to be a general assumption that markets will be efficient as long as they are liquid enough (with wavering assessments on what constitutes 'enough' liquidity). This line of thinking would lead one to conclude that the only role for monitoring is for detecting market abuse, which is not a satisfactory conclusion.

The literature is ultimately weak in addressing market structure issues. The detrimental effect of dominant prompt markets on forward market contestability is rarely addressed. A notable exception is the Ofgem liquidity study, which ultimately led to a licensing change that forced dominant parties to take on the role of market maker across the forward supply curve. However, even in this case the impact of prompt market dominance is anecdotal rather than effectively analysed.

Although a wide array of potential monitoring measures have been identified, what is largely lacking is a rigorous methodology for interpreting the results of these measures. This reduces monitoring measures to mainly a time series and benchmarking role: whether some measure of competition has significantly increased over time or if a measure has reached a (perceived) important threshold.

Task C: Methodology for assessing impact of FCA NC

The FCA NC seeks to rationalise and introduce best practice into forward capacity allocation of cross-border access rights. As such, it does not necessarily introduce any revolutionary new concepts and also does not seek to impose a one-size-fits-all approach to the area; it simply seeks improvements in a few important areas and a framework for implementing those improvements. We started our evaluation by identifying several key issues within the FCA NC:

- **Products offered** – There is a lack of clarity around what products are to be offered and the criteria for offering them. Also there is no assessment of likely demand for the various time tranches including time of day products.

- **Splitting criteria –** There is only general guidance on the criteria for splitting NTC into time tranches. How an auction platform determines what products the market requires is not clear. Regulators may need to offer specific guidance and processes for making such determinations.

- **Efficient pricing of long-term capacity –** With both physical and financial transmission rights, the provider is exposed to the markets' assessments of congestion rent between adjacent markets and may face over- or under-recovery in auction revenues.

- **Firmness –** When rights are curtailed the FCA NC is relatively generous in that it allows compensation to be capped at the value of congestion revenues.

We then formulated the following criteria for evaluating the methods to be used in monitoring the impact of FCA NC:

- Market accessibility and contestability
- Liquidity
- Impact on energy prompt markets
- Impact on revenue adequacy arising from forward capacity auctions.

The above criteria were then used to assess the following monitoring methods:

- **Auction revenue reduction**

  The current approach of setting NTC tends to reveal less capacity to the forward market than will subsequently be available. This has the effect of increasing expectation of congestion and so increasing auction prices. It is expected that implementation of the flow based method will lead to more capacity being revealed in the forward timeframe and so to a fall in the unit price of capacity in the wider area where the flow based method has been implemented.

  Monitoring of auction revenues can provide evidence against market accessibility and contestability, liquidity and impact on access development.

  Regulatory incentives should ensure the system operators make network investments that will improve access, irrespective of congestion management. If congestion rents are increasing over time, then the incentives provided to system operators to make network investments are not effective.

- **Churn rates and Net Transfer Capacity**

  The relationship between churn rates and NTC can have an impact on liquidity in forward energy markets. The availability of transmission rights across different timeframes will contribute to liquidity as market participants are enabled to cover cross-border price risks. High liquidity allows trades in and out of positions easily, also making trade more accessible to all types of participants.

  It is evident that no two markets will be exactly the same and differences are bound to remain. Adjusting for import capacity somewhat reduces this issue by indicating the level of domestic churn rates, which may reveal market-specific preferences. Nevertheless, our proposed methodology should suggest where forward access product availability does not adequately match the requirements of energy markets for hedging products that widen the available market.

- **TSO Revenue adequacy**

  This measure looked at market efficiency defined as how well auction revenues equate to expected rents. It was designed to test an economic principle about efficient markets. It is based on a theory of efficient markets that suggests that the anticipated economic congestion rents should be fully captured in auction bids. The measure is easy to implement but the interpretation lacks benchmarks because nobody would seem to have attempted to make this measurement.

There is a general perception that, currently, auctions are under-recovering revenue compared to congestion rent outcomes (i.e. price spreads between markets); the efficacy of the FCA NC could perhaps be measured in terms of closing this revenue adequacy gap but investigation of why there is a revenue shortfall should be undertaken in any case as it may point at fundamental weaknesses in the current dominant PTR product on the market (although there is also a possibility that price spreads are being under-forecast in current CfD markets in the Nordic area where no explicit hedging products are offered by TSOs).

- ❑ Market efficiency of EPADs.

  This is analogous to the revenue adequacy measure but cannot measure TSO incomes because they do not sell transmission rights in the forward market in the Nordic area. An EPAD is a spatial CfD that pays or is paid the price difference between the area price and the system price (the uncongested price calculated for the Elspot market). In an efficient market, the value of the EPAD should be close to zero (once adjusted for the difference between average EPAD price and the uncongested system price, which will tend to be lower than the average congested price).

  Monitoring trends in EPAD values will look at whether the market is efficient and increasingly efficient over time. However, the monitoring measure is hard to interpret because there is no consensus as to what variation from zero is reasonable and especially as hydrology can affect the congestion of certain areas.

The overwhelming conclusion from our assessment is that there is a clear lack of consideration in the literature for monitoring the efficiency of forward capacity allocation. This is partly a product of the fact that it is hard to formulate a 'one size fits all' methodology but this is not really an adequate basis for doing nothing in the monitoring sphere once the FCA NC is implemented and it is hoped that the suggested monitoring tools will help fill the gap.

ANNEXES

A1 Key data

Table 14 Summary information on European forward exchange platforms

Exchange	**Countries covered**	**Product types**	**Product coverage**	**Product time-frames**	**Annual volumes GWh**	**% of country demand[1]**	**Key terms**
EEX Source: Markets and Products 2015 (http://www.eex.com/blob/83274/321821b768f2ba9c8f923baca2b83d5c/e-eex-markets-and-products-2015-data.pdf) and August 2014, March 2015 market volume press releases	Phelix (Germany, Austria, Luxembourg)	Financial futures	Baseload, Peakload, Off-peak	D, WE, W, M, Q, Y	1,341,668	228.5%[2]	Annual fee: €15,000 Standard fee: €0.0025-0.015/MWh Delivery rate: 1 MW Tick size: €0.001-€0.01/MWh Liable equity of at least €50,000
		Financial options	Baseload	M, Q, Y	32,607	5.6%[2]	
	Belgium	Physical futures	Baseload	M, Q, Y	44[3]	0.0%	
	Netherlands	Physical futures	Baseload, Peakload	M, Q, Y	918	0.1%	
	France	Financial futures	Baseload, Peakload	W, M, Q, Y	82,701	18.8%	
	Greece	Financial futures	Baseload	M, Q, Y	432[4]	0.9%	
	Italy	Financial futures	Baseload, Peakload	W, M, Q, Y	115,633	40.2%	
	Nordic	Financial futures	Baseload	M, Q, Y	-	-	
	Romania	Financial futures	Baseload	M, Q, Y	58	0.0%	
	Spain	Financial futures	Baseload	W, M, Q, Y	4,729[3]	2.0%	
	Switzerland	Financial futures	Baseload	M, Q, Y	1,229[3]	2.1%	
GME Source: Historical data 2014 (http://www.mercatoelettrico.org/En/download/DatiStorici.aspx	Italy	Physical futures	Baseload	Monthly	426	0.2%	Access fee: €7,500 Annual fee: €10,000 Standard fee: €0.01-0.045/MWh
				Quarterly	493	0.2%	
				Yearly	29,241	10.2%	
			Peakload	Monthly	72	0.0%	
				Quarterly	66	0.0%	
				Yearly	44	0.0%	
			Total		30,341	10.6%	
HUPX Source: 2014 Monthly Reports (https://www.hupx.hu/en/Market%20data/Public%20reports/Pages/Fizikai-	Hungary	Physical futures	Baseload	Weekly	2.5	0.0%	Participation fee: €15,000 Monthly fee: €1,000 Standard fee: €0.05/MWh
				Monthly	909	2.6%	
				Quarterly	619	1.8%	
				Yearly	2612	7.5%	
			Peakload	Weekly	20	0.1%	
				Monthly	0	0.0%	
				Quarterly	0	0.0%	

Exchange	Countries covered	Product types	Product coverage	Product time-frames	Annual volumes GWh	% of country demand[1]	Key terms
futures%20%28 PhF%29-piac.aspx				Yearly	0	0.0%	
			Total		4,162	12.0%	
ICE Source: https://www.theice.com/endex	UK	Financial futures	Baseload	Monthly	2,256	0.7%	Annual fee: €0 Monthly fee: €75 Standard fee: €0.005-0.025/MWh
				Quarterly	44	0.0%	
				Seasons	307	0.1%	
			Peakload	Monthly	313	0.1%	
				Quarterly	0	0.0%	
				Seasons	0	0.0%	
		Financial futures Gregorian	Baseload	Monthly	387	0.1%	
				Quarterly	1,161	0.4%	
				Seasons	548	0.2%	
			Peakload	Monthly	16	0.0%	
				Quarterly	0	0.0%	
				Seasons	0	0.0%	
		Total			5,030	1.6%	
	Belgium	Financial futures	Baseload	Monthly	558	0.7%	
				Quarterly	5,793	7.1%	
				Seasons	0	0.0%	
				Yearly	7,052	8.6%	
			Total		13,403	16.4%	
	Netherlands	Financial futures	Baseload	Monthly	7,561	7.1%	
				Quarterly	28,755	27.1%	
				Seasons	0	0.0%	
				Yearly	67,005	63.1%	
			Peakload	Monthly	1,200	1.1%	
				Quarterly	4,752	4.5%	
				Seasons	0	0.0%	
				Yearly	7,937	7.5%	
			Total		117,209	110.4%	
IDEX Source: Monthly Turnover (http://www.borsaitaliana.it/borsaitaliana/statistiche/mercati	Italy	Financial futures	Baseload	Monthly	1,936	0.7%	IDEX Annual membership fee: €2,500 IDEX subscription fee: €8,000-26,000 Standard fee:
				Quarterly	4,345	1.5%	
				Yearly	7,825	2.7%	
			Peakload	Monthly	365	0.1%	
				Quarterly	372	0.1%	
				Yearly	204	0.1%	

Exchange	Countries covered	Product types	Product coverage	Product time-frames	Annual volumes GWh	% of country demand[1]	Key terms
/commodities/commodities.en.htm			Total		15,046	5.2%	€0.006-0.03/MWh Spread: €2-3/MWh Delivery rate: 1 MW
NASDAQ OMX Commodities Source: Monthly Volumes (http://www.nasdaqomx.com/commodities/markets/reports)	Germany (Austria, Luxembourg)	Financial futures, options, EPAD	Baseload, Peakload	D, W, M, Q, Y	58,100	9.9%[2]	Annual fee: €13,500, €1,500 per contract type Standard fee: €0.0039-0.0094/MWh Minimum contract: 1 MW Tick size: €0.01/MWh
	Netherlands	Financial futures	-	-	0	0.0%	
	Norway	Financial futures, options, EPAD	Baseload, Peakload	D, W, M, Q, Y	866,900	235.8%	
	United Kingdom	Financial futures	Baseload, Peakload	W, M, Q, S	0	0.0%	
OMIP (MIBEL) Source: MIBEL Contracts (>1 June 2010) (http://www.omip.pt/Downloads/DerivadosdeElectricidade/tabid/104/language/en-US/Default.aspx)	Spain	Financial and physical futures	Baseload	D, WE, M, Q, Y	26,076	10.7%	Participation fee: €10,000 Monthly fee: €125-€833 Standard fee: €0.0025-€0.0075/MWh
			Peakload	Daily	0	0.0%	
				Weekly	0	0.0%	
				Monthly	0	0.0%	
				Quarterly	8	0.0%	
				Yearly	0	0.0%	
		Forwards OTC	Baseload	W, M, Q, Y	216	0.1%	
		Swaps OTC	Baseload	D, WE, W, M, Q, Y	40,765	16.7%	
		Call options	Baseload	M, Q, Y	166	0.1%	
		Put options	Baseload	M, Q, Y	111	0.1%	
		Total			67,341	27.6%	
	Portugal	Financial and physical futures	Baseload	Daily	0	0.0%	
				Weekend	0	0.0%	
				Weekly	0	0.0%	
				Monthly	0	0.0%	
				Quarterly	3,603	8.0%	

Exchange	Countries covered	Product types	Product coverage	Product time-frames	Annual volumes GWh	% of country demand[1]	Key terms
				Yearly	2,234	4.9%	
			Total		5,837	12.9%	
POLPX Source: Monthly Reports (http://www.tge.pl/en/458/polpx-monthly-market-reports-for-2014)	Poland	Physical futures	Baseload	Weekly	884	0.7%	Application fee: €488 Annual fee: €4,879/year Standard fee: €0.01/MWh
				Monthly	11,509	9.3%	
				Quarterly	25,062	20.2%	
				Yearly	111,427	89.8%	
			Peakload	Weekly	61	0.1%	
				Monthly	766	0.6%	
				Quarterly	1,486	1.2%	
				Yearly	11,725	9.5%	
			Offpeak	Weekly	0	0.0%	
				Monthly	0	0.0%	
				Quarterly	17	0.0%	
				Yearly	0	0.0%	
			Total		162,937	131.3%	
PXE https://www.pxe.cz/	Czech Republic	Financial futures	Baseload	Monthly	2,041	3.6%	Participation fee: €15,000 Monthly fee: €1,225 Standard fee: €0.015/MWh Market maker fee: €0.005/MWh Margin using SPAN ® Minimum contract: 1 MW/hr
				Quarterly	3,219	5.7%	
				Yearly	12,078	21.3%	
			Peakload	Monthly	112	0.2%	
				Quarterly	149	0.3%	
				Yearly	125	0.2%	
			Total		17,723	31.3%	
	Slovakia	Financial futures	Baseload	M, Q, Y	341	1.4%	
			Peakload	M, Q, Y	3.4	0.0%	
		Physical futures	Baseload	M, Q, Y	583	2.3%	
			Peakload	M, Q, Y	46	0.2%	
		Total			974	3.9%	
	Hungary	Financial futures	Baseload	M, Q, Y	2,433	7.0%	
			Peakload	M, Q, Y	362	1.0%	
		Physical futures	Baseload	M, Q, Y	154	0.4%	
			Peakload	M, Q, Y	0	0.0%	
		Total			2,949	8.5%	
	Poland	Financial futures	Baseload, Peakload	M, Q, Y	7.2	0.0%	

Exchange	Countries covered	Product types	Product coverage	Product time-frames	Annual volumes GWh	% of country demand[1]	Key terms
Over-the-counter (OTC)[5]	Austria				246,126	391.1%	
	Belgium				5,518	6.7%	
	Czech Republic				123,362	217.6%	
	Denmark				53,651	171.8%	
	Estonia				16,180	237.2%	
	Finland				79,586	99.7%	
	France				785,601	178.9%	
	Germany				2,025,976	391.1%	
	Hungary				143,563[6]	412.1%	
	Italy	Financial futures			13,683	4.8%	
		Physical futures			191,579	66.7%	
	Latvia				11,485	174.7%	
	Lithuania				14,805	165.3%	
	Luxembourg				19,711	317.2%	
	Netherlands				204,935	193.0%	
	Norway				228,808	209.4%	
	Poland				77,850	62.8%	
	Romania				13,315	33.0%	
	Slovakia				0	0.0%	
	Spain				40,210	17.4%	
	Sweden				225,386	180.3%	
	Switzerland				155,013	262.9%	
	United Kingdom				300,679	94.7%	

D=Daily, WE=Weekend, W=Weekly, M=Monthly, Q=Quarterly, S=Seasonal, Y=Yearly. [1]Consumption drawn from Eurostat, [2]Calculated from summing Austria, Germany, and Luxembourg electricity consumption, [3]April 2014-April 2015 volume, [4]December 2014 (first month offered)-April 2015 volume, extrapolated to a year, [5]Extrapolated from ICIS and Argus daily reported data, [6] includes TFS recorded volumes and extrapolation of ICIS data.

Table 15 Summary information on European forward exchange volumes by country

Country	Exchange	Product type	Time-of-use	Timeframe	Annual volumes GWh	% of country demand[1]
Austria	EEX, ICE	Financial futures	Baseload, Peakload, Offpeak	D, WE, W, M, Q, Y	143,798[3]	228.5%
		Options, Spreads[2]	Baseload	W, M, Q, Y	3,495[3]	5.6%
	NASDAQ	Financial futures, options	Baseload, Peakload	D, W, M, Q, Y	6,227[4]	9.9%
	OTC[5]				246,126[6]	391.1%
				Total	399,645	635.0%
Belgium	ICE, EEX	Financial futures	Baseload	M, Q, Y	13,447[7]	16.4%
	ICE			Seasonal	0	0.0%
	OTC				5,518	6.7%
				Total	18,965	23.2%
Bulgaria						No coverage identified
Croatia						Only bilateral contracts
Cyprus						No coverage identified
Czech Republic	PXE	Financial futures	Baseload	Monthly	2,041	3.6%
				Quarterly	3,219	5.7%
				Yearly	12,078	21.3%
			Peakload	Monthly	112	0.2%
				Quarterly	149	0.3%
				Yearly	125	0.2%
				Total	17,723	31.3%
	OTC				123,362	217.6%
				Total	141,085	248.9%
Denmark	NASDAQ	Financial futures, options, EPAD	Baseload, Peakload	D, W, M, Q, Y	73,837[8]	236.4%
		OTC			53,651[8]	171.8%
				Total	127,488	408.2%
Estonia	NASDAQ	Financial futures, options, EPAD	Baseload, Peakload	D, W, M, Q, Y	22,267[9]	326.5%
		OTC			16,180[9]	237.2%
					38,447	563.7%
Finland	NASDAQ,	Financial futures, options, EPAD	Baseload, Peakload	D, W, M, Q, Y	109,530[10]	137.2%
		OTC			79,586[10]	99.7%
					189,116	236.9%
France	EEX	Financial futures, Spreads	Baseload, Peakload	W, M, Q, Y	82,701	18.8%

Country	Exchange	Product type	Time-of-use	Timeframe	Annual volumes GWh	% of country demand[1]
	OTC				785,601	178.9%
					868,301	197.7%
Germany	EEX, ICE	Financial futures	Baseload, Peakload, Offpeak	D, WE, W, M, Q, Y	1,183,670[11]	228.5%
		Options, Spreads	Baseload	M, Q, Y	28,767[11]	5.6%
	NASDAQ	Financial futures, options	Baseload, Peakload	D, W, M, Q, Y	51,258[12]	9.9%
	OTC				2,025,976[13]	391.1%
				Total	3,289,671	635.0%
Greece	EEX	Financial futures	Baseload	M, Q, Y	315[14]	0.1%
Hungary	PXE	Financial futures	Baseload	M, Q, Y	2,433	7.0%
			Peakload	M, Q, Y	362	1.0%
		Physical futures	Baseload	M, Q, Y	154	0.4%
			Peakload	M, Q, Y	0	0.0%
	HUPX	Physical futures	Baseload	Weekly	2.5	0.0%
				Monthly	909	2.6%
				Quarterly	619	1.8%
				Yearly	2,612	7.5%
			Peakload	Weekly	20	0.1%
				Monthly	0	0.0%
				Quarterly	0	0.0%
				Yearly	0	0.0%
	OTC[25]				143,563	412.1%
				Total	150,673	432.5%
Ireland	SEM	CfD	Baseload	-	Anecdotal evidence suggests low volumes	
			Mid-Merit	-		
			Peakload	-		
		CfD Public Service Obligation	-	-		
		Non-direct contracts (Ireland Power Auction Platform)	-	-		
		Non-direct contracts (OTC)	-	-		
Italy	EEX, ICE[15], IDEX	Financial futures, Spreads	Baseload, Peakload	W, M, Q, Y	130,679	45.5%
	GME	Physical futures	Baseload	Monthly	426	0.2%
				Quarterly	493	0.2%
				Yearly	29,241	10.2%

Country	Exchange	Product type	Time-of-use	Timeframe	Annual volumes GWh	% of country demand[1]
			Peakload	Monthly	72	0.0%
				Quarterly	66	0.0%
				Yearly	44	0.0%
	OTC	Financial futures			13,683	4.8%
		Physical futures			191,579	66.7%
				Total	366,283	127.5%
Latvia	NASDAQ	Financial futures, options, EPAD	Baseload, Peakload	D, W, M, Q, Y	15,806[16]	240.4%
		OTC			11,485[16]	174.7%
					27,291	415.0%
Lithuania	NASDAQ	Financial futures, options, CfD	Baseload, Peakload	D, W, M, Q, Y	20,375[17]	227.5%
		OTC			14,805[17]	165.3%
					35,180	392.9%
Luxem-bourg	EEX, ICE	Financial futures	Baseload, Peakload, Offpeak	D, WE, W, M, Q, Y	14,199[18]	228.5%
		Options	Baseload	M, Q, Y	345[18]	5.6%
	NASDAQ	Financial futures, options	Baseload, Peakload	D, W, M, Q, Y	615[19]	9.9%
	OTC				24,304[20]	391.1%
				Total	39,463	635.0%
Malta					No coverage identified	
Nether-lands	ICE, NASDAQ	Financial futures	Baseload, Peakload	D, W, M, Q, Y	117,209	110.4%
	EEX	Physical futures	Baseload, Peakload	M, Q, Y	918	0.9%
	OTC				204,935	193.0%
				Total	323,061	304.3%
Norway*	NASDAQ	Financial futures, options, EPAD	Baseload, Peakload	D, W, M, Q, Y	314,897[21]	288.2%
		OTC			228,808[21]	209.4%
					543,704	497.6%
Poland	PXE, POLPX[22]	Financial futures	Baseload, Peakload	M, Q, Y	7	0.0%
	POLPX	Physical futures	Baseload, Peakload, Offpeak	W, M, Q, Y	162,937	131.3%
	OTC				77,850	62.8%
				Total	240,795	194.1%
Portugal	OMIP (MIBEL)	Financial and physical futures	Baseload	Daily	0	0.0%
				Weekend	0	0.0%
				Weekly	0	0.0%

Country	Exchange	Product type	Time-of-use	Timeframe	Annual volumes GWh	% of country demand[1]
				Monthly	0	0.0%
				Quarterly	3,603	8.0%
				Yearly	2,234	4.9%
				Total	5,837	12.9%
Romania	EEX	Financial futures	Baseload	M, Q, Y	58	0.2%
	OTC				13,315	33.0%
				Total	13,374	33.2%
Slovakia	PXE	Financial futures	Baseload	M, Q, Y	341	1.4%
			Peakload	M, Q, Y	3	0.0%
		Physical futures	Baseload	M, Q, Y	583	2.3%
			Peakload	M, Q, Y	46	0.2%
				Total	974	3.9%
	OTC				0	0.0%
Slovenia					No coverage identified	
Spain	EEX, OMIP (MIBEL)	Financial and physical futures, Spreads	Baseload	D, WE, M, Q, Y	30,804[23]	12.6%
	OMIP (MIBEL)	Financial and physical futures	Peakload	Daily	0	0.0%
				Weekly	0	0.0%
				Monthly	0	0.0%
				Quarterly	8	0.0%
				Yearly	0	0.0%
		Forwards OTC	Baseload	W, M, Q, Y	216	0.1%
		Swaps OTC	Baseload	D, WE, W, M, Q, Y	40,765	0.0%
		Call options	Baseload	M, Q, Y	166	0.1%
		Put options	Baseload	M, Q, Y	111	0.1%
	OTC				184,106	75.5%
				Total	256,175	105.0%
Sweden	NASDAQ	Financial futures, options, EPAD, CfD	Baseload, Peakload	D, W, M, Q, Y	310,187[24]	248.1%
		OTC			225,386[24]	180.3%
					535,573	428.4%
Switzerland*	EEX	Financial futures, Spreads	Baseload	M, Q, Y	1,229[7]	2.1%
	OTC				155,013	262.9%
				Total	156,242	265.0%
United Kingdom	ICE, NASDAQ	Financial futures, options	Baseload, Peakload	D, W, M, Q, Y	2,920	0.9%

Country	Exchange	Product type	Time-of-use	Timeframe	Annual volumes GWh	% of country demand[1]
	ICE	Financial futures Gregorian	Baseload	Monthly	387	0.1%
				Quarterly	1,161	0.4%
				Seasons	548	0.2%
			Peakload	Monthly	16	0.0%
				Quarterly	0	0.0%
				Seasons	0	0.0%
	OTC				300,679	94.7%
				Total	305,709	96.3%

*D=Daily (volumes excluded), WE=Weekend, W=Weekly, M=Monthly, Q=Quarterly, S=Seasonal, Y=Yearly. *Non-EU. [1]Consumption drawn from Eurostat, [2]'Spreads', equivalent to EPADs, have recently been introduced on EEX for some markets, but no data is yet available, [3]Phelix (Germany and Austria) futures/options volume, scaled by Austria's share of the sum of Germany, Austria, and Luxembourg electricity consumption, [4]NASDAQ volume weighted by Austria's share of German (Austria, Luxembourg), Dutch, Nordic, and UK consumption, [5]Extrapolated from ICIS and Argus daily reported data, [6]Weighted by Austria's share of the sum of Germany, Austria, and Luxembourg electricity consumption, [7]April 2014-April 2015 EEX volume, [8]Denmark's share of Nordic NASDAQ volume inferred by Denmark's share of 7 May Elspot Day-Ahead volume and the Nordic's share of German, Dutch, Nordic, and UK electricity consumption. EEX Nordic volume unavailable, [9]Estonia's share of Nordic NASDAQ volume inferred by Estonia's share of 7 May Elspot Day-Ahead volume and the Nordic's share of German, Dutch, Nordic, and UK electricity consumption. EEX Nordic volume unavailable, [10]Finland's share of NASDAQ volume inferred by Finland's share of 7 May Elspot Day-Ahead volume and the Nordic's share of German, Dutch, Nordic, and UK electricity consumption. EEX Nordic volume unavailable, [11]Phelix (Germany and Austria) futures/options volume, weighted by Germany's share of the sum of Germany, Austria, and Luxembourg electricity consumption, [12]NASDAQ volume weighted by Germany's share of German (Austria, Luxembourg), Dutch, Nordic, and UK consumption, [13]Weighted by Germany's share of the sum of Germany, Austria, and Luxembourg electricity consumption, [14]December 2014 (first month offered)-April 2015 volume, extrapolated to a full year, [15]Base and Peakload Italian futures introduced on ICE in March 2015. No data yet available. [16]Latvia's share of NASDAQ volume inferred by Latvia's share of 7 May Elspot Day-Ahead volume and the Nordic's share of German, Dutch, Nordic, and UK electricity consumption. EEX Nordic volume unavailable, [17]Lithuania's share of NASDAQ volume inferred by Lithuania's share of 7 May Elspot Day-Ahead volume and the Nordic's share of German, Dutch, Nordic, and UK electricity consumption. EEX Nordic volume unavailable, [18]Phelix (Germany and Austria) futures/options volume, scaled by Luxembourg's share of the sum of Germany, Austria, and Luxembourg electricity consumption, [19]NASDAQ volume weighted by Luxembourg's share of German (Austria, Luxembourg), Dutch, Nordic, and UK consumption, [20]Weighted by Luxembourg's share of Germany, Austria, and Luxembourg electricity consumption, [21]Norway's share of NASDAQ volume inferred by Norway's share of 7 May Elspot Day-Ahead volume and the Nordic's share of German, Dutch, Nordic, and UK electricity consumption. EEX Nordic volume unavailable, [22]Financial instruments market to be introduced in the latter half of 2015, [23]Sum of OMIP and EEX volumes. April 2014-April 205 EEX volume, [24]Sweden's share of NASDAQ volume inferred by Sweden's share of 7 May Elspot Day-Ahead volume and the Nordic's share of German, Dutch, Nordic, and UK electricity consumption. EEX Nordic volume unavailable, [25]Hungarian OTC data includes TFS recorded trades and extrapolation from ICIS data.*

Table 16 Summary information on European capacity allocation platforms

Auction office	Interconnector	Period	Offered capacity (MW)	Requested capacity (MW)	% of offered capacity allocated	Price (€/MWh)	Auction participants
Central Allocation Office (CAO) Source: http://www.central-ao.com/capacity-auctions/	Austria-Czech Republic (APG-CEPS)	Daily[1]	797	1,392	100	0.10	9
		Monthly[2]	200	835	100	0.09	12
		Yearly[3]	300	1840	100	0.12	22
	Austria-Hungary (APG-MAVIR)	Daily	299	1,377	100	7.88	17
		Monthly	0	0	0	0	0
		Yearly	300	1,944	100	7.56	31
	Austria-Slovenia (APG-ELES)	Daily	283	1,311	100	7.52	16
		Monthly	100	677	100	7.95	21
		Yearly	450	1,642	100	7.56	31
	Czech Republic-Germany (CEPS-50HzT)	Daily	853	1,588	100	0.14	11
		Monthly	330	1,860	100	0.17	17
		Yearly	379	1,680	100	8.01	23
	Czech Republic-Austria (CEPS-APG)	Daily	406	1,058	100	0.18	9
		Monthly	200	1,080	100	0.14	14
		Yearly	300	1,881	100	0.41	24
	Czech Republic-Germany (CEPS-TENNET)	Daily	896	1,772	100	0.16	14
		Monthly	400	1,850	100	0.15	18
		Yearly	450	1,970	100	0.44	26
	Slovenia-Austria (ELES-APG)	Daily	1,346	2,160	100	0.05	14
		Monthly	200	1,124	100	0.03	15
		Yearly	450	2,046	100	0.05	21
	Hungary-Austria (MAVIR-APG)	Daily	814	1,514	100	0.13	14
		Monthly	200	865	100	0.07	14
		Yearly	300	1,996	100	0.12	27
	Poland-Germany (PSE-50HzT)	Daily	121	566	100	0.48	5
		Monthly	70	445	100	0.29	7
		Yearly	71	933	100	0.82	9
	Poland-Czech Republic (PSE-CEPS)	Daily	363	698	100	0.33	5
		Monthly	50	445	100	0.29	4
		Yearly	51	716	100	0.41	8
	Poland-Slovakia (PSE-SEPS)	Daily	215	373	100	0.36	3
		Monthly	180	445	100	0.12	6
		Yearly	278	1,045	100	0.41	8
	Slovakia-	Monthly	300	1,001	100	4.70	23

Auction office	Interconnector	Period	Offered capacity (MW)	Requested capacity (MW)	% of offered capacity allocated	Price (€/MWh)	Auction participants
	Hungary (SEPS-MAVIR)	Yearly	400	2,001	100	6.52	25
	Germany-Czech Republic (TENNET-CEPS)	Daily	1,123	2,024	100	0.14	16
		Monthly	200	1,075	100	0.11	16
		Yearly	100	1,179	100	0.16	24
	Slovenia-Croatia (ELES-HOPS)	Daily	1,019	1,677	100	0.52	13
		Monthly	400	1,091	100	0.09	17
		Yearly	800	2,029	100	0.29	21
	Croatia-Slovenia (HOPS-ELES)	Daily	1,411	1,538	100	0.03	14
		Monthly	400	1,405	100	0.07	18
		Yearly	800	1,519	100	0.05	19
	Croatia-Hungary (HOPS-MAVIR)	Daily	1,252	1,673	100	0.10	14
		Monthly	400	1,224	100	0.06	18
		Yearly	600	1,464	100	0.12	20
	Hungary-Croatia (MAVIR-HOPS)	Daily	889	1,397	100	0.16	15
		Monthly	500	1,291	100	0.16	16
		Yearly	700	2,126	100	0.41	22
Capacity Allocating Service Company (CASC) Source: http://www.casc.eu/en/Market-data/	Austria-Italy	Daily[4]	69	296	33.6	20.69	7
		Monthly[5]	145	1,372	99.3	15.11	23
		Yearly[6]	110	1,138	100	16.29	26
	Italy-Austria	Daily	354	214	60.5	0	3
		Monthly	10	58	70	0.01	6
		Yearly	70	759	100	0.08	18
	Austria-Switzerland	Daily	1,147	5,267	99.9	1.64	19
		Monthly	215	1,584	100	3.28	17
		Yearly	160	1,110	100	5.77	23
	Switzerland-Austria	Daily	1,254	5,363	99.9	0.01	12
		Monthly	642	5,753	99.8	0.05	14
		Yearly	450	2,585	98.9	0.11	18
	Belgium-France	Monthly	215	2,160	98.1	0.02	15
		Yearly	400	2,932	99.8	0.39	22
	France-Belgium	Monthly	339	2,257	100	16.46	15
		Yearly	1,450	2,441	100	2.86	19
	Belgium-Netherlands	Monthly	351	3,008	99.1	0.02	16
		Yearly	468	5,241	100	1.25	24
	Netherlands-	Monthly	349	2,124	100	6.88	17

Auction office	Interconnector	Period	Offered capacity (MW)	Requested capacity (MW)	% of offered capacity allocated	Price (€/MWh)	Auction participants
	Belgium	Yearly	468	4,301	99.8	5.44	21
	Denmark1-Denmark2	Monthly	150	975	100	1.16	11
	Denmark2-Denmark1	Monthly	150	745	100	0.11	11
	Denmark2-Germany	Monthly	120	1,006	100	1.89	12
		Yearly	120	761	100	2.40	10
	Germany-Denmark2	Monthly	120	1,025	100	2.58	12
		Yearly	120	707	100	2.65	10
	Germany-Denmark1	Monthly	250	1,250	100	0.75	12
		Yearly	150	1,430	100	3.12	12
	France-Italy	Daily	1,442	3,781	99.9	4.01	30
		Monthly (base)	1,400	12,681	131.7	5.74	34
		Monthly (peak)	150	1,968	100	7.16	50
		Yearly	990	10,048	99.9	9.74	53
	Italy-France	Daily	2,706	1,935	44.3	0	9
		Monthly	170	1,674	98.8	0.06	16
		Yearly	700	6,815	99.9	0.17	33
	France-Spain	Monthly	350	2,245	100	16.75	18
		Yearly	300	2,353	100	8.09	20
	Spain-France	Monthly	370	3,314	100	0.41	21
		Yearly	300	3,101	100	3.82	23
	France-Switzerland	Daily	1,561	5,269	99.7	0.04	17
	Switzerland-France	Daily	1,419	7,398	99.9	4.69	18
	Germany-Netherlands	Monthly	613	3,612	99.8	10.66	22
		Yearly	832	4,987	99.9	8.79	26
	Netherlands-Germany	Monthly	584	5,526	99.0	0.01	16
		Yearly	832	8,508	99.6	0.09	25
	Germany-Switzerland	Daily	1,334	4,495	99.9	2.30	27
		Monthly	310	2,915	100	3.31	30
		Yearly	300	2,159	100	5.82	31
	Switzerland-Germany	Daily	4,394	11,287	99.8	0.02	23
		Monthly	1,695	13,985	99.7	0.02	19
		Yearly	1,200	7,948	99.8	0.17	29

Auction office	Interconnector	Period	Offered capacity (MW)	Requested capacity (MW)	% of offered capacity allocated	Price (€/MWh)	Auction participants
	Greece-Italy	Daily	530	1,209	99.9	0.89	14
		Monthly	300	1,024	100	0.41	14
		Yearly	200	1,186	100	0.79	22
	Italy-Greece	Daily	470	1,005	99.9	0.42	14
		Monthly	300	992	100	3.30	18
		Yearly	200	1,256	100	4.61	23
	Italy-Slovenia	Monthly	115	343	99.1	0	7
		Yearly	150	824	100	0.10	17
	Slovenia-Italy	Monthly (base)	120	1,024	100	8.68	22
		Monthly (peak)	40	359	100	4.85	14
		Yearly	284	1,626	100	7.66	20
	Italy-Switzerland	Daily	2,873	3,718	69.9	0	4
		Monthly	340	2,074	98.8	0.01	11
		Yearly	650	6,443	99.4	0.12	30
	Switzerland-Italy	Daily	1,276	6,372	100	27.79	36
		Monthly (base)	1,000	6,018	100	5.08	41
		Monthly (peak)	1,000	5,232	99.9	3.24	36
		Yearly	800	5,370	99.9	8.36	43

[1]Average of 2014 daily CAO auction results, [2]May 2015 CAO auction results, [3]Year 2015 CAO auction results, [4]Averaged across hourly results for early May CASC daily auction, averaged, [5]May 2015 CASC auction results, [6]Year 2015 CASC auction results.

Table 17 Summary information on FTRs in Spain-Portugal and Italy

Interconnector	Period	Volume (MWh for Spain-Portugal, MW for Italy)	Price (€/MWh)	Interconnector capacity (MW)[1]	Awarded companies
Spain-Portugal (FTR options)	Monthly[2]	0	0	-	-
	Quarterly[2]	3,069,700	0.21		
	Yearly[2]	1,752,000	0.11		
Portugal-Spain (FTR options)	Monthly[2]	0	0	-	-
	Quarterly[2]	3,069,700	0.15		
	Yearly[2]	1,752,000	0.11		
Italy CSUD interconnector (base) (FTR obligations)	Monthly[3]	15	1.90	9,970	1
	Yearly[4]	281	2.30		2
Italy CSUD interconnector (peak) (FTR obligations)	Monthly[3]	15	2.30		1
	Yearly[4]	0	0		0
Italy Nord interconnector (base) (FTR obligations)	Monthly[3]	1,440	0.30	7,100	18
	Yearly[4]	2,023	0.10		37
Italy Nord interconnector (peak) (FTR obligations)	Monthly[3]	372	0.30		12
	Yearly[4]	110	-1.00		8
Italy ROSS interconnector (base) (FTR obligations)	Monthly[3]	872	1.70	-	5
	Yearly[4]	1,625	2.70		2
Italy ROSS interconnector (peak) (FTR obligations)	Monthly[3]	0	0		0
	Yearly[4]	66	0.10		1
Italy SARD interconnector (base) (FTR obligations)	Monthly[3]	5	1.50	1,920	1
	Yearly[4]	0	0		0
Italy SARD interconnector (peak) (FTR obligations)	Monthly[3]	0	0		0
	Yearly[4]	0	0		0

Interconnector	Period	Volume (MWh for Spain-Portugal, MW for Italy)	Price (€/MWh)	Interconnector capacity (MW)[1]	Awarded companies
Italy SICI interconnector (base) (FTR obligations)	Monthly[3]	170	-11.00	350	6
	Yearly[4]	127	11.60		2
Italy SICI interconnector (peak) (FTR obligations)	Monthly[3]	25	10.60		2
	Yearly[4]	81	-17.50		4
Italy Sud interconnecter (base) (FTR obligations)	Monthly[3]	511	1.50	4,600	12
	Yearly[4]	1,177	2.40		10
Italy Sud interconnector (peak) (FTR obligations)	Monthly[3]	108	2.20		3
	Yearly[4]	0	0		0

[1]Italian interconnector capacity (for 2012) drawn from PLEXOS Study of the Italian Power System and Market in the Medium-term: Realities and Expectations of Renewables Integration (http://www.docstoc.com/docs/170888184/WIW13_paper), [2]2014 MIBEL contracts, [3]March 2015 auction results, [4]2015 annual auction results.

A2 Literature review for hedging products

Table 18 Literature review

ACER, 2014, 'Report on the influence of existing bidding zones on electricity markets', Market Report, 7 March

http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Market%20Report%20on%20Bidding%20Zones%202014.pdf

Type of study:	Regulatory review
Credentials of author:	Regulator
Countries covered:	EU (including Nordic)
Hedging products covered:	n/a
Main issues:	The Nordic market (NRD) exhibits high levels of churn rates despite the generally small size of the bidding zones and it is generally a well-functioning and competitive market.

Scope: The ACER report aims to evaluate the influence of the current bidding zone configuration on electricity market efficiency in the EU, as well in Nordic countries. It provides an extensive analysis of the different metrics of market liquidity and competition.

Ofgem, 2013, 'Wholesale power market liquidity: statutory consultation on the 'Secure and Promote' licence condition'

https://www.ofgem.gov.uk/ofgem-publications/84508/wholesalepowermarketliquiditystatutoryconsultationonthesecureandpromotelicencecondition-pdf

Ofgem, 2013, 'Wholesale power market liquidity: final proposals for a 'Secure and Promote' licence condition'

https://www.ofgem.gov.uk/ofgem-publications/39302/liquidity-final-proposals-120613.pdf

Type of study:	Regulatory review
Credentials of author:	Regulator
Countries covered:	UK
Hedging products covered:	Physical futures
Main issues:	Dominance by a few vertically integrated parties. Lack of availability of forward products and prices on the full forward curve for smaller players to access coverage. Need for acceptable terms of trade for small parties. Need for small clip sizes.

Scope: Ofgem's liquidity project sought to ensure that the wholesale electricity market supported effective competition, delivering benefits to consumers in terms of downward pressure on bills, greater choice and better service. Ofgem was concerned that poor liquidity in the wholesale electricity market is posing a barrier to effective competition, thereby preventing consumers from fully realising the benefits of competition. The statutory consultation is the culmination of a detailed consultation process leading to the changes in licence condition changes for specific dominant licensees. The previous consultation document is also referenced but many other documents can be cross-referenced from these sources.

NordREG, 2010, 'Nordic Financial Electricity Market', Report 8/2010.

http://www.nordicenergyregulators.org/wp-content/uploads/2013/02/Nordic_financial_market_NordREG_Report_8_2010.pdf

Type of study:	Regulatory review
Credentials of author:	Regulator
Countries covered:	Nordic
Hedging products covered:	Futures, CfD, Options
Main issues:	The report concluded that the Nordic financial electricity market functions well and has good liquidity in the basic products. The report also concluded that there is significant trust in the market.

Scope: NordREG decided during 2009 to undertake a study on the Nordic financial electricity market. The aim of the report is to consider whether any improvements can be made to further increase the efficiency of the Nordic financial electricity market in order to secure an optimal price setting in the wholesale and the end-user markets. The report concluded that the Nordic financial electricity market functions well and has a good liquidity in the basic products. The report also concluded that there is significant trust in the market.

Fortum, 2015, 'Focus on Nordic electricity market', Fortum Energy Review March 2015.

http://apps.fortum.fi/gallery/Fortum_Energy_review_EN_FINAL.pdf

Type of study:	Market participant insights
Credentials of author:	Energy company
Countries covered:	Nordic
Hedging products covered:	n/a
Main issues:	The Nordic electricity market provides a success story for power market liberalisation and integration. Various generation types compete in the wholesale electricity market on a least marginal cost basis. The Nordic power market is also well connected internally and with its neighbours.

Scope: Presents an overview of the Nordic and Baltic electricity market, the power generation structure, and the operation of the wholesale and retail electricity markets.

Kalin, E., 2011, 'Efficient hedging in an illiquid market', Master's thesis, SLU, Swedish University of Agricultural Sciences, Faculty of Natural Resources and Agricultural Sciences, Department of Energy and Technology, Master Programme in Energy Systems Engineering.

http://stud.epsilon.slu.se/2483/1/kalin_e_110413.pdf

Type of study:	Master's thesis

Credentials of author: Master's student

Countries covered: Nordic

Hedging products covered: CfD

Main issues: Find the risk premia are positive (forward price is higher than expected spot price) for contracts signed close to delivery. The higher the time to delivery, the lower the risk premia.

Scope: Investigates risk premia in the Nord Pool electricity market.

NordREG, 2014, 'Nordic Market Report 2014: Development in the Nordic Electricity Market', Report 4/2014.

http://www.nordicenergyregulators.org/wp-content/uploads/2014/06/Nordic-Market-Report-2014.pdf

Type of study: Regulatory review

Credentials of author: Regulator

Countries covered: Nordic

Hedging products covered: n/a

Main issues: The Nordic financial electricity market is highly transparent and liquid. However, during the past four years there has been a fall in the volume and value turnovers and the number of transactions.

Scope: Regular report published by NordREG describing on a yearly basis status and developments in the Nordic electricity market with focus on generation, consumption, transmission, wholesale power market and retail markets. Find the Nordic financial electricity market is highly transparent and liquid. However, during the past four years there has been a fall in the volume and value turnovers and the number of transactions.

Spodniak, P., Chernenko, N., and Nilsson, M., 2014, 'Efficiency of Contracts for Differences (CfDs) in the Nordic Electricity Market', Ninth Conference on Energy at a Crossroads: Preparing the Low Carbon Future, 1-39.

http://tiger-forum.com/Media/speakers/abstract/261405pm/petr_spodniak.pdf

Type of study: Conference paper

Credentials of author(s): PhD students

Countries covered: Nordic

Hedging products covered: EPAD

Main issues: Suggest EPADs have a key hedging role. The need for a hedge varies by hydro capacity and the share of end user fixed price contracts

Scope: This paper presents new and updated evidence on the efficiency of the EPAD contracts in the Nordic financial electricity market, based on a long sample of 14 years, from 2000 to 2013 inclusive. The Electricity Price Area Differentials (EPADs) are used to hedge against price differences between a bidding area and the Nordic system price. The aim of this paper is twofold. First, we estimate the magnitude and significance of ex-post risk premia in EPAD products (season, month, quarter, year) with delivery in 2000-2013. Further, we estimate the relationship between spot and futures prices by vector autoregression (VAR) model. By observing Granger causalities, adjustments to price shocks, and decomposing variance, we aim to shed light on the EPADs' efficiency. Second, we elaborate on some determinants of risk premia and test the roles of time-to-maturity and open interest on risk premia. We additionally consider, for the Nordic system an essential energy source, the role of water availability in the hydro reservoirs on explaining local area price spreads. We support and reject some of the earlier findings about the limited efficiency of the EPADs and bring new empirical evidence on the drivers behind the regional price dynamics.

Redpoint, 2013, '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), March.

https://www.acm.nl/nl/download/publicatie/?id=11395

Type of study:	Consultant report
Credentials of author(s):	Consulting firm
Countries covered:	Norway, Netherlands
Hedging products covered:	FTR, CfD, Forwards
Main issues:	Locational risks exist in Norway due to product unavailability or low liquidity for some areas. Dutch liquidity has migrated to neighbouring German market. Hedges can be constructed with cross-border products, but this introduces locational risk. Identify limited stakeholder demand for instruments to hedge against cross-border risk, but do find interest in accessing liquid foreign markets.

***Scope**: Netherlands Competition Authority Office of Energy Regulation (NMa) and the Norwegian Water Resources and Energy Directorate (NVE) have engaged Redpoint to explore the options for long-term cross-border hedging on NorNed, a 580-kilometre (360 mi) long HVDC submarine power cable between Feda in Norway and 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.*

Houmoller Consulting, 2013, 'A financial electricity market in the Baltic States', report for Elering, March.

http://elering.ee/public/Infokeskus/Uuringud/A_financial_electricity_market_in_the_Baltic_States.pdf

Type of study:	Consultant report
Credentials of author(s):	Consulting firm
Countries covered:	Baltics
Hedging products covered:	FTR, CfD
Main issues:	Liquidity too low in Baltic CfDs, FTRs preferable for providing market players with hedging opportunities. MiFID II drafting provides uncertainty for TSO obligations in operating FTR auctions.

Scope: Elering charged Houmoller Consulting with the task of carrying out a feasibility study analysing the potential for financial instruments in the Baltic electricity markets. The feasibility study investigates whether financial instruments are needed, and if so, which instruments are viable for the Baltic market.

Monitoring Analytics, 1999-2014 'State of the Market Report for PJM', Independent Market Monitor for PJM.

http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2014.shtml

Type of study:	Monitoring reports
Credentials of author(s):	Independent market monitor
Countries covered:	USA (PJM)
Hedging products covered:	FTR/ARR
Main issues:	Independent commentary on market design issues. Provides monitoring metrics for FTRs: volume, price, revenue adequacy, etc., which can be linked to market design issues.

Scope: Annual and quarterly monitoring reports conducted by PJM's independent market monitor, Monitoring Analytics. Reports multiple metrics for the markets PJM administers (spot, capacity, ancillary services), but does not cover forward markets, whether OTC or through exchanges. Provides a comprehensive review of PJM's FTR market, including making market design recommendations and making note of significant metric changes, but has no oversight of bilateral OTC FTR transactions.

Bowring, J., 2013, 'Capacity Markets in PJM', Economics of Energy & Environmental Policy, 2 (2), 47-64.

Type of study:	Academic paper
Credentials of author(s):	Head of Monitoring Analytics, PJM's independent market monitor
Countries covered:	USA (PJM)
Hedging products covered:	Capacity markets
Main issues:	Using historical prices to define cost of new entry. Treating inferior demand resources as equal to supply resources in the capacity market.

Scope: Reviews the development of PJM's improved Reliability Pricing Model Capacity Market, while identifying remaining market design flaws. Criticisms of the current capacity market setup include the use of historical prices to define the cost of new entry, which is susceptible to outlier years, and treating inherently inferior demand resources equal to supply resources in the capacity market.

'Hedge Market Development: A WAG Discussion Paper', Wholesale Advisory Group, November 2014, New Zealand

https://www.ea.govt.nz/dmsdocument/18695

Type of study:	Consultant report
Credentials of author(s):	Consulting firm
Countries covered:	New Zealand
Hedging products covered:	CfD, Futures, FPVV

Main issues:	Suggests that hedge prices are efficient, hedge markets generally facilitate meaningful competition, but there are avoidable non-price barriers preventing participation for smaller-scale operators.

Scope: The Electricity Authority's Wholesale Advisory Group is currently undertaking a review of the Hedge Market in New Zealand (OTC and ASX, but excluding FTRs). This Paper was released following consultation with many of the smaller market participants, but prior to consultation with the largest participants (including the major gentailers and consumers). The final consultation report is due in June 2015. The paper presents the key issues under review for development of the hedge market, specifically whether: hedge prices are efficient (see Energy Link report below), markets facilitate meaningful competition, and whether there are avoidable non-price barriers preventing participation. It provides analysis on each of these elements.

'Futures Prices and their Relationship to Modelled Spot Prices', Energy Link, August 2014, New Zealand

https://www.ea.govt.nz/dmsdocument/19004

Type of study:	Consultant report
Credentials of author(s):	Consulting firm
Countries covered:	New Zealand
Hedging products covered:	Futures
Main issues:	The paper identifies a 10% premium for futures prices over modelled spot prices. The methodology for modelling spot prices allows a lot of room for variance in observed results. The analysis points out that it is difficult to determine whether the premium is from inefficiency or risk.

Scope: This paper was prepared as part of the WAG's hedge market review, and released alongside the November 2014 paper as an appendix. It reports analysis of futures prices against modelled future spot prices to determine the efficiency of prices.

'Evaluation of Hedge Market Liquidity', Energy Link, June 2011, New Zealand

https://www.ea.govt.nz/dmsdocument/10822

Type of study:	Consultant report
Credentials of author(s):	Consulting firm
Countries covered:	New Zealand
Hedging products covered:	Futures, CfD
Main issues:	Reaching trading volume goals organically unrealistic. Market changes needed, such as setting a max bid-offer spread, ensuring markets can support increased trading, and market players being confident that futures prices are efficient.

Scope: Energy Link was engaged in May 2011 to undertake a review, and to prepare a report that evaluates the progress the major generators have made toward achieving the Government's expectations concerning a liquid electricity hedge market, and to recommend actions to address shortcomings identified in the evaluation.

'Hedge Market Development: Metrics', Wholesale Advisory Group, May 2014, New Zealand

www.ea.govt.nz/dmsdocument/18124

Type of study:	Consultant report

Credentials of author(s): Consulting firm

Countries covered: New Zealand

Hedging products covered: CfD, Futures, FPVV

Main issues: This report presents various metrics that may be used to assess the competitiveness, efficiency and reliability of the market. The metrics are not currently part of a formal monitoring methodology for the EA. The metrics are grouped by volume, price, depth and liquidity, and non-price barriers.

Scope: Also prepared as part of the WAG's hedge market review.

'Industry and market monitoring: Reliability and efficiency', Electricity Authority, April 2012, New Zealand

https://www.ea.govt.nz/dmsdocument/13302

Type of study: Regulatory report

Credentials of author(s): Regulator

Countries covered: New Zealand

Hedging products covered: n/a

Main issues: Present the EA's approach to regulation: the EA fulfils its role in a 'light-handed' manner, with the threat of regulation providing the incentive for the market (and therefore the largest operators) to exercise self-regulation. That is, rather than explicitly monitoring prices and price levels, it aims to ensure market conditions are such that "workable competition" can be achieved.

Scope: This paper presents the EA's approach to monitoring reliability and efficiency across all electricity markets.

'Industry and market monitoring: Competition', Electricity Authority, August 2011, New Zealand

https://www.ea.govt.nz/dmsdocument/11525

Type of study: Regulatory report

Credentials of author(s): Regulator

Countries covered: New Zealand

Hedging products covered: n/a

Main issues: Present the EA's approach to regulation: the EA fulfils its role in a 'light-handed' manner, with the threat of regulation providing the incentive for the market (and therefore the largest operators) to exercise self-regulation. That is, rather than explicitly monitoring prices and price levels, it aims to ensure market conditions are such that "workable competition" can be achieved.

Scope: This paper presents the EA's approach to monitoring competition across all markets. The overall approach is summarised above for the April 2012 reliability and efficiency paper.

Anderson, E.J., Hu, X., and Winchester, D., 2007, 'Forward Contracts in Electricity Markets: the Australian Experience', Energy Policy, 35 (5), 3089-3103.

http://www.ceem.unsw.edu.au/sites/default/files/uploads/publications/contractsurvey_short_May2006.pdf

Type of study:	Academic paper
Credentials of author(s):	Professors of Economics, Research Student
Countries covered:	Australia
Hedging products covered:	Forwards
Main issues:	Emphasises high proportion of trades conducted OTC. Regulatory risk cited as reason to not engage in long-term contracts. Traders wary of locational risk, hesitant to engage in inter-regional trade

Scope: Forward contracts play a vital role in all electricity markets, and yet the details of the market for forward contracts are often opaque. In this paper we review the existing literature on forward contracts and explore the contracting process as it operates in Australia. The paper is based on interviews with participants in Australia's National Electricity Market. The interviews were designed to understand the contracting process and the practice of risk management in the Australian energy-only pool market. This survey reveals some significant gaps between the assumptions made in the academic literature and actual practice in the Australian market place.

Ausubel, L.M. and Cramton, P., 2010, 'Using forward markets to improve electricity market design', Utilities Policy 18, 195-200.

Type of study:	Academic paper
Credentials of author(s):	Professors of Economics
Countries covered:	Colombia
Hedging products covered:	Forwards
Main issues:	Forward markets could have prevented the California 2000-01 energy crisis, which occurred due to excessive spot market reliance. Regulated forward markets are needed due to demand side market failures.

Scope: Forward markets, both medium term and long term, complement the spot market for wholesale electricity. They reduce risk, mitigate market power, and coordinate new investment. In the medium term, a forward energy market lets suppliers and demanders lock in energy prices and quantities for one to three years. In the long term, a forward reliability market assures adequate resources are available when they are needed most. The forward markets reduce risk for both sides of the market, since they reduce the quantity of energy that trades at the more volatile spot price. Spot market power is mitigated by putting suppliers and demanders in a more balanced position at the time of the spot market. The markets also reduce transaction costs and improve liquidity and transparency. Recent innovations to the Colombia market illustrate the basic elements of the forward markets and their beneficial role.

ENTSO-E, 2012, 'Transmission Risk Hedging Products – An ENTSO-E Educational Paper', June.

https://www.entsoe.eu/fileadmin/user_upload/_library/consultations/Network_Code_CACM/20120619_Educational_Paper_on_Risk_Hedging_Instruments_review5.pdf

Type of study:	Regulatory education paper
Credentials of author:	Regulator
Countries covered:	CWE, Italy, USE (PJM), Nordic, Spain-Portugal

Hedging products covered:	PTR, FTR, CfD
Main issues:	'Firmness' a key risk for transmission rights products. Not the case for CfDs. TSOs need to decide between PTRs, with use-it-or-sell-it obligations, or FTRs that are options, obligations, or both.

Scope: In order to contribute to ongoing discussions regarding forward capacity allocation this educational paper describes different forward hedging products that can be offered to hedge the risk associated with trading between different hubs separated by congestion. This paper focuses on Physical Transmission Rights (PTRs), Financial Transmission Rights (FTRs), and Contracts for Differences (CfDs) and discusses relevant international case studies.

NERA, 2013, 'Review of Financial Transmission Rights and Comparison with the Proposed OFA Model', A Report for the Australian Energy Market Commission, March.

http://www.aemc.gov.au/getattachment/ba583ab5-fea3-468b-bc0e-8ebfdec2c668/NERA-Review-of-Financial-Transmission-Rights-and-C.aspx

Type of study:	Consultant report
Credentials of author:	Consulting firm
Countries covered:	USA, New Zealand
Hedging products covered:	FTR
Main issues:	PJM's FTR market has had to grow and enhance over time to promote transparency and market access. Common denominator of markets with FTRs is a nodal pricing system. Despite their contribution to hedging, FTRs alone cannot encourage investment

Scope: This report has been prepared by NERA Economic Consulting (NERA) at the request of the Australian Energy Market Commission (AEMC). The AEMC has requested a review of existing Financial Transmission Rights (FTR) arrangements around the world and a comparison of their main design elements with the AEMC's proposed Open Firm Access (OFA) model. The AEMC has also requested a discussion of alternative mechanisms adopted in other jurisdictions to provide financially firm transmission access for generators.

Longstaff, F.A. and Wang, A.W., 2004, 'Electricity Forward Prices: A High-Frequency Empirical Analysis', Journal of Finance, 59 (4), August, 1877-1900.

Type of study:	Academic paper
Credentials of author(s):	Professors of Finance
Countries covered:	USA (PJM)
Hedging products covered:	day-ahead vs. spot
Main issues:	Significant forward premia exist on PJM. Volatility relates to unexpected changes in risk, suggesting rational price setting.

Scope: We conduct an empirical analysis of forward prices in the PJM electricity market using a high-frequency data set of hourly spot and day-ahead forward prices. We find that there are significant risk premia in electricity forward prices. These premia vary systematically throughout the day and are directly related to economic risk factors, such as the volatility of unexpected changes in demand, spot prices, and total revenues. These results support the hypothesis that electricity forward prices in the PJM market are determined rationally by risk-averse economic agents.

Arciniegas, I., Barret, C., and Marathe, A., 2003, 'Assessing the efficiency of US electricity markets', Utilities Policy, 11, 75-86.

Type of study:	Academic paper
Credentials of author(s):	n/a
Countries covered:	USA (CAISO, PJM, NYISO)
Hedging products covered:	day-ahead vs. spot
Main issues:	Efficiency of energy markets improves over time. Multi-settlement scheduling associated with higher efficiency.

Scope: The recent California's energy crisis has raised doubts about the benefits of energy deregulation. While it is true that the California electricity market is in turmoil, other electricity markets like the Pennsylvania–New Jersey–Maryland (PJM) are doing fine. This paper assesses the mark of efficiency reached by the electricity markets in California, New York, and PJM. It also compares the degree of efficiency across markets (forward vs. real time) and across time. No significant differences between the California and PJM electricity markets were discovered in the year of California's energy crisis (2000) using the cointegration tests. This research suggests that differences in price behaviour between these two markets during 2000 did not arise from differences in efficiency. According to our analysis and measures of efficiency, PJM and California electricity markets are more efficient than the New York market. Also, as these markets become more mature over time, their efficiency level goes up. We also found evidence that a multi-settlement scheduling system leads to higher efficiency.

Cartea, A. and Villaplana, P., 2008, 'Spot price modelling and the valuation of electricity forward contracts: The role of demand and capacity', Journal of Banking & Finance, 32 (12), 2502-2519.

Type of study:	Academic paper
Credentials of author(s):	Finance Professor, Regulator/Visiting Professor
Countries covered:	USA (PJM), England and Wales, Norway
Hedging products covered:	day-ahead vs. spot
Main issues:	Forward contracts trade at a premium during months of high demand volatility. Premia can turn negative during low volatility periods as sellers will always seek to sell forwards to reduce revenue variability.

Scope: We propose a model where wholesale electricity prices are explained by two state variables: demand and capacity. We derive analytical expressions to price forward contracts and to calculate the forward premium. We apply our model to the PJM, England and Wales, and Nord Pool markets. Our empirical findings indicate that volatility of demand is seasonal and that the market price of demand risk is also seasonal and positive, both of which exert an upward (seasonal) pressure on the price of forward contracts. In all markets we find that the forward premium exhibits a seasonal pattern. During the months of high volatility of demand, forward contracts trade at a premium. During months of low volatility of demand, forwards can either trade at a relatively small premium or, even in some cases, at a discount, i.e. they exhibit a negative forward premium.

Nogales, F.J. and Conejo, A.J., 2006, 'Electricity price forecasting through transfer function models', Journal of the Operational Research Society, 57, 350-356.

Type of study:	Academic paper
Credentials of author(s):	Engineering Professors

Countries covered:	USA (PJM)
Hedging products covered:	day-ahead vs. spot
Main issues:	Find instantaneous relationship between demand and price, indicating PJM has a well-functioning electricity market.

Scope: Forecasting electricity prices in present day competitive electricity markets is a must for both producers and consumers because both need price estimates to develop their respective market bidding strategies. This paper proposes a transfer function model to predict electricity prices based on both past electricity prices and demands, and discuss the rationale to build it. The importance of electricity demand information is assessed. Appropriate metrics to appraise prediction quality are identified and used. Realistic and extensive simulations based on data from the PJM Interconnection for year 2003 are conducted. The proposed model is compared with naive and other techniques.

Bessembinder, H. and Lemmon, M.L., 2006, 'Gains from Trade under Uncertainty: The Case of Electric Power Markets', The Journal of Business, 79 (4), July, 1755-1782.

Type of study:	Academic paper
Credentials of author(s):	Economics Professors
Countries covered:	USA (CAISO, PJM, NYISO)
Hedging products covered:	n/a
Main issues:	Simulated results suggest introducing forward and spot trading can reduce real-time prices by 0-20%. Gains from trade largest when there are a large number of markets and low demand correlations across markets.

Scope: This article refocuses attention on the potential efficiency gains from competitive wholesale power trading, which allows the diversification of demand risk. The greatest efficiency gains obtain when power demand is least correlated across markets and when there is substantial cross-sectional variation in expected demand. Real-time power trading can reduce retail prices by conservative estimates of 3%–4% on average in the United States, and forward and real-time trading can reduce prices by a combined 6%–10% or more. Economic efficiency would be best served by policy ensuring that deregulated power markets are indeed competitive, rather than by renewed regulation.

Schmitz, K. and Weber, C., 2013, 'Does One Design Fit All? On the Transferability of the PJM Market Design to the German Electricity Market', EWL Working Paper No. [02/2013].

http://www.ewl.wiwi.uni-due.de/fileadmin/fileupload/BWL-ENERGIE/Arbeitspapiere/RePEc/pdf/wp1302_DoesOneDesignFitAll-OnTheTransferabilityOfThePjmMarketDesignToTheGermanElectricityMarket.pdf

Type of study:	Working paper
Credentials of author(s):	Economics Professors
Countries covered:	Germany, USA (PJM)
Hedging products covered:	n/a
Main issues:	No major impediments to implementing nodal pricing in Germany. Germany has lower congestion than PJM, suggesting the relative benefits of nodal pricing will be lower for Germany. Germany could not enjoy all the benefits of nodal pricing by unilaterally implementing it.

Scope: Germany's nuclear phase out and an increasing share of fluctuating RES production amplifies the North-South congestion problem in the German electricity grid. But congestion management becomes a serious issue not only in the German but in the whole European electricity system as German wind production does not only affect the German grid. In theory it is well established that nodal pricing is the most efficient congestion management method. In literature the PJM well-established nodal market design often serves as a reference and is viewed as benchmark. To benefit from experiences made in the U.S. the transfer of the PJM market design to Germany could be advantageous. This article compares key elements of the generation mix, the network structure, the cross-border interconnection as well as the congestion situation of both electricity markets to assess potentials and impediments for an implementation of the PJM nodal market design in Germany. We show that both markets are less different in structure than expected but that large differences in performance respectively in congestion frequency lead probably to much lower welfare gains. Transfer of the PJM market design to Germany is possible in principle, but adjustments to RES would be advantageous.

Allaz, B. and J.-L. Vila (1993) "Cournot competition, futures markets and efficiency" Journal of Economic Theory, 59, 1–16.

Type of study:	Academic paper
Credentials of author(s):	Economics Professors
Countries covered:	n/a
Hedging products covered:	Forward markets
Main issues:	Forward markets can enhance competitive pressures, increasing output and lowering prices. However, market power can become further entrenched if access to the forward market is not equal among market participants.

Scope: Builds a Cournot duopoly market, where forward trade can occur for *N* periods before delivery at Time *0*. Shows that in equilibrium, each duopolist will trade forward which makes them worse off and makes consumers better off. The outcome tends to the competitive solution as the number of trading periods, *N*, approaches infinity. This result is dependent on each duopolist having equal access to the forward market.

Breitmoser, Y. (2012) "Allaz-Vila competition with non-linear costs or demands', MPRA 41772, working paper.

Type of study:	Working paper
Credentials of author(s):	Economics Professor
Countries covered:	n/a
Hedging products covered:	Forward markets
Main issues:	Extends the Allaz-Vila model to the non-linear case. Forward markets still improve social efficiency, but not to the fully competitive case.

Scope: Imposes non-linear costs and demands to the Allaz-Vila Cournot model. Demonstrates that in equilibrium, social efficiency is improved by forward markets, but the equilibrium does not approach the fully competitive outcome as in the linear case.

Joskow, P. and J. Tirole (2007) "Reliability and Competitive Electricity Markets", The RAND Journal of Economics, 38(1), Spring, 60-84.

Type of study:	Academic paper
Credentials of author(s):	Economics Professors
Countries covered:	n/a
Hedging products covered:	Forward markets, capacity obligations

Main issues:	Identifies a case where if a capacity obligation sets the price for capacity *ex ante*, but the price of energy to be supplied *ex post* is not set in the forward contract, then forward markets supporting capacity obligations are unlikely to mitigate market power unless the forward market is more competitive than the spot market. If both the capacity price and energy supply price are set *ex ante*, then forward markets can mitigate market power regardless of the competitiveness of the forward market.

Scope: We derive the optimal prices and investment program for an electric power system when there are price-insensitive retail consumers served by load serving entities that can choose any level of rationing contingent on real-time prices. We then examine the assumptions required for competitive electricity markets to achieve this optimal price and investment program and the implications of relaxing several of these assumptions. We analyse the interrelationships between regulator imposed wholesale market price caps and generating capacity obligations. The implications of potential network collapses for operating reserve requirements and whether market prices yield generation investments consistent with these reserve requirements are examined.

Li, Y. (2014), "Vertical Structure and Forward Contract in Electricity Market", Working Papers 2014-117, Department of Research, Ipag Business School.

Type of study:	Working paper
Credentials of author(s):	Economics researcher
Countries covered:	n/a
Hedging products covered:	Forward markets
Main issues:	Explores implications of vertical integration between generators and retailers and forward markets. Vertical integration reduces the need for hedging, mitigating the pro-competitive effects of forward markets.

Scope: The pro-competitive effects of forward contracts in electricity market cannot be regarded alone without examining the market structure. In this paper, we show that under retail competition, spot market demand uncertainty and risk aversion, partially or fully integrated electricity generators and retailers have less incentives to be involved in trading electricity under forward contracts. Therefore, the effect of market power mitigation of forward contracts is countered by this vertical relationship between retailers and generators since it provides a natural hedging device as a substitute of forward contracts to the retailers.

Powell, A. (1993) "Trading Forward in an Imperfect Market: The Case of Electricity in Britain", The Economic Journal, 103 (417), March, 444-453.

Type of study:	Academic paper
Credentials of author(s):	Economics Professor
Countries covered:	UK
Hedging products covered:	Forward markets
Main issues:	Takes into account the imperfect nature of electricity markets, focusing on the case of the liberalised UK market. Taking into account contracted CfDs, demonstrates that in equilibrium the positive effects of forward markets depend on whether the two dominant generators in the UK market choose to cooperate in the spot and forward markets.

Scope: applies forward markets to the case of imperfect power markets in the UK: two dominant generators, electricity is non-storable, contracts are not standardised, and the industry was privatised with a portfolio of CfDs. Whether forward markets contribute to moving toward a fully competitive market depends on whether the generators cooperate in the forward and/or spot markets.

Norwegian Water Resources and Energy Directorate, 2011, 'Effects of Intraday Trade on NORNED'

Type of study:	Consultant report
Credentials of author(s):	Poyry
Countries covered:	Nordpool
Hedging products covered:	Forward and day-ahead markets
Main issues:	Examines the impact of introducing intraday trade on the NorNed cable between Norway and the Netherlands, increasing the area covered by the existing intraday markets, by analysing the potential effects on the incentives of existing and potential new market participants. The paper also compares the trading fees (both fixed and variable) for each membership type in the Elspot and Elbas markets, pointing out that differences in trading costs affect the market participation rate.

Scope: After analysing the Dutch and the Norwegian power markets, the report provides an analysis of the impact of introducing intraday on NorNed, and especially on competition and price behaviour in all relevant markets.

Oren, S., 2013, 'Point to Point and Flow-Based Financial Transmission Rights: Revenue Adequacy and Performance Incentives', Chapter 3 in *Financial Transmission Rights: Analysis, Experiences, and Prospects*, T. Kristiansen and J. Rosellon (eds.), Springer.

Type of study:	Academic paper
Credentials of author(s):	Engineering professor
Countries covered:	USA
Hedging products covered:	FTR
Main issues:	The use of FTRs may result in an inherent rent surplus, which results from the fact that in an FTR auction only the share of the flowgate capacity that has been sold is allocated. The remaining flowgate capacity which remains unsold is retained by the ISO. This capacity may become valuable and the congestion revenue corresponding to that unsold capacity is turned into a revenue surplus for the ISO. On the other hand, the FGR allocation is made on the basis of full flowgate capacity Therefore, the entire wire capacity can be subscribed through FGRs, which makes the congestion revenues equal to the FGR settlements (i.e revenue adequacy is guaranteed), unless flowgate capacities are reduced.

Scope: An introduction to financial transmission rights in electricity markets with locational marginal pricing (LMP) explaining the mechanics and fundamental relationships between point to point Financial Transmission Rights (FTRs) and Flowgate Rights (FGRs). Examines the issue of revenue adequacy in FTR/FGR markets and address two questions: a) How should revenue shortfalls in FTR markets be assigned to market participants? and b) How can active participation by transmission owners in FTR markets incentivize transmission performance through incremental and long term investment? Focuses on the possibility of short positions by transmission owners on financial Flowgate Rights (FGRs). Such positions would allow their holders to capture some of the FTR auction revenues in exchange for assuming liability for the corresponding FTR market revenue shortfall, which can be avoided through improvements in line ratings.

Benjamin, R., 2013, 'FTR Properties: Advantages and Disadvantages', Chapter 9 in *Financial Transmission Rights: Analysis, Experiences, and Prospects*, T. Kristiansen and J. Rosellon (eds.), Springer.

Type of study:	Academic paper
Credentials of author(s):	FERC Economist
Countries covered:	N/A
Hedging products covered:	FTR, Flowgate Rights
Main issues:	FTRs no longer a perfect hedge once load aggregation taken into account. FTRs only hedge holders if long-term bilateral contracts are not in place, with distributional consequences. FTR values are an imprecise signal of the need for new investment. Ambitions for FTR programs should be dampened.

Scope: Discussion of whether FTR theory applies in practice, including an investigation of the cost of FTRs to US RTOs and the inferred impact on retail rates. Rules for FTR distribution, FTR market settlement, and the treatment of FTRs in rate cases have subtle impacts on retail rates. Impact depends on which party FTRs are allocated to, the prevalence of long-term contracts, the amount of electricity imported into load pockets, and the price difference between load-pocket and unconstrained generation.

Bautista Alderete, G., 2013, 'FTRs and Revenue Adequacy', Chapter 10 in *Financial Transmission Rights: Analysis, Experiences, and Prospects*, T. Kristiansen and J. Rosellon (eds.), Springer.

Type of study:	Academic paper
Credentials of author(s):	CAISO Engineer
Countries covered:	USA
Hedging products covered:	FTR
Main issues:	Revenue adequacy is the primary indicator of the overall condition of the transmission rights process

Scope: Discussion of the system-wide implications of revenue surpluses and shortfalls in FTR markets. Demonstration of the derivation required for identifying the revenue adequacy of specific transmission constraints within the CAISO market model.

de Maere d'Aertrycke, G. and Y. Smeers, 2013, 'FTRs and Revenue Adequacy', Chapter 14 in *Financial Transmission Rights: Analysis, Experiences, and Prospects*, T. Kristiansen and J. Rosellon (eds.), Springer.

Type of study:	Academic paper
Credentials of author(s):	Energy engineering researchers
Countries covered:	Europe
Hedging products covered:	FTR
Main issues:	Difficulties in guaranteeing transmission rights firmness across models. Practical obstacles facing transmission rights across Europe.

Scope: Technical review of the issues facing transmission rights implementation and hedging with multi-zonal models, transfer capacity models, flow-based models, and market coupling. Critical review of the current Framework Guidelines for implementing transmission rights in the EU.

A3 Evaluation of monitoring metrics

This Annex gives more details of the monitoring metrics listed in Section 3.3.2(see page 55). The annex is structured in the same way as the tables in the same section.

A3.1 Effective hedging opportunities

A3.1.1 Turnover

Turnover is a straightforward measure of the size of the market. Volume turnover can be estimated by adding up the volume of all hedging products that have been traded in a market over a period of time. Value turnover is the sum of the product of the unit of electricity traded times the price of each unit. The scope of market should cover both exchange and OTC, physical and financial.

The time trend of the volume/value turnover is a useful metric of liquidity as it provides an indication of the dynamics prevalent in the electricity market.

When estimating the volume/value turnover, particular attention should be paid to differentiate between changes in value of trading compared to value of underlying commodity (which changes over time).

Input data required

The estimation of turnover requires the aggregate volume of all products traded in the market and in the case of value turnover, the price of products as well. Although it is difficult to accumulate this information, once REMIT is established the computation of turnover will be straightforward; until then, market platforms and brokers will need to be canvassed to provide the data.

Thresholds

Turnover is monitored as a trend over time, and therefore there is no specific threshold that shows liquidity as this is unique for every market.

Interpretation

A sustained upward trend in turnover indicates that producers, customers, retailers and traders have developed new business strategies that have resulted in increased hedging and trading in the electricity market, ceteris paribus. On the other hand, a reduction in the turnover trend over time might indicate a potential reduction in the demand for electricity.

In order to be a useful metric of liquidity in the energy market, turnover has to be estimated for the market as a whole, including changes in interconnection availability, and not for particular products within the market.

A3.1.2 Churn rates

Churn rates, considered by many traders as the most appropriate metric of market liquidity, represent the ratio between the volume of all trades across all products in all timeframes executed in a given market and its total physical consumption (capacity).

The churn rate can be useful in both time trend and benchmarking.

However, the main drawback of this metric is that it is calculated periodically rather than continuously.

Input data required

In numerous studies, traded volumes reported by transmission system operators (TSOs) are used to estimate churn ratios, which however are not actually *traded* volumes, but *nominated* volumes declared on the delivery day for scheduling purposes, which might also integrate transactions between entities of the same group for accounting purposes. Therefore, for churn rates to be a good measure of liquidity actual traded volumes should be quoted and not those reported by TSOs. The collection of data for electricity traded OTC must also be accumulated.

Moreover churn rates need to be calculated for the whole market and not for a specific product, which in a multi-market context makes their calculation even more challenging.

Threshold

There is no conclusive evidence as to the level of churn rate that indicates a liquid market, but some stakeholders use a churn rate of 3 as the minimum threshold.

Interpretation

Churn rates show how many times a megawatt hour is traded before it is delivered to the final consumer and it can therefore be perceived as a measure of how easily a trader is likely to get into or out of a trading position.

The churn rate alone does not show whether or not a market is liquid or not, but rather it provides an indication of the market's turnover. In smaller markets and in transition economies, the churn rate will not be comparable with more developed markets where futures trading takes place.

Even if a harmonised method for calculating churn rates is used across Europe, an adjustment for regional circumstances should be made.

Moreover, the use of churn rate as a measure of liquidity in the market, should distinguish between spot and future markets. Usually, the spot market will have a lower churn rate than forward markets.

A3.1.3 Bid-Ask spread

The bid-ask spread (also referred to as the 'bid-offer spread') measures the difference between the most recent bid from a buyer of a product and the most recent ask (of offer) from a seller. In order for a trade to occur, these two limits must overlap between a buyer and seller. Therefore, the closer they are to each other, the more likely it is that a trade will take place.

Input data required

Calculation of the bid-ask spread requires transparent information on both bids and offers, showing price, volume and time. Either the most recent traded price, or the bid level, is required in order to calculate the spread relative to the price.

If there is light trading of a security, the bid, ask or most recent traded price can become quite dated. It is possible too that the most recent traded price is not within the bounds of the spread. In order to calculate a spread relative to the price at this point, the extreme end of the bid-ask spread that is closest to the last traded price is usually used, or simply the bid price.

An exchange may require compulsory re-loading of bids and offers on a regular basis (e.g. every 60 seconds) to ensure they remain valid for other traders. This should ensure that the absolute spread remains easily observable.

The basic spread calculation does not take into account the volume of a security either bid or offered; it is possible that a trader may have to move to more expensive offers (if bidding) in order to fulfil their desired quota of securities (and vice versa).

Threshold

Thresholds may be set to enhance the volume of trades in a market. They may be set in absolute terms (e.g. €/MWh), or relative to the reference price (e.g. % of bids, or % of last trade). The calculation of the threshold may be set in reference solely to the market in which it is traded, or in comparison with spreads observed over time, or in other markets.

Although there are no hard and fast rules, bid-ask spreads in liquid markets tend to be under 1%[30].

- In New Zealand, there is a requirement for market makers to give spreads of no more than 5% (set in October 2011). This followed from observed spreads over 10% prior to this requirement; observed spreads today are around 4%.
- Spreads on equivalent Australian futures ranged from 0.7%-3.0%, but tend to sit around 2%-3%.
- In the UK, E.ON (the 5th largest participant in the United Kingdom) is required to market make on one or more trading platforms (both base load and peak

[30] 'Assessment of Deltas in Futures Prices', Energy Link, 2014, p12

contracts up to four years ahead, with a trade size of at least 5MW, and spread of no more than 0.3 to 1 percent[31].

Interpretation

The bid ask-spread is interpreted in two ways:

- ❑ As a measure of liquidity. Small bid-ask spreads suggest that it is easier for traders to enter or exit the market as they will be able to find counterparties with whom to trade.
- ❑ As a measure of the costs of trading, or the 'cost of liquidity'. The larger the spread, the more a trader will have to adjust their price expectations in order to make a trade, effectively adding costs to the trade. This may be referred to as the premium paid in return for the ability to trade readily.

A3.1.4 Open interest

Open interest is the total number of security contracts in a futures market that are still open and held by traders and investors. These contracts have not been closed out, expired or exercised.

Open interest, therefore, shows the number of open contracts which have not yet been liquidated and is therefore a direct measure of liquidity in the market. This is essentially the volume of energy at a point in time that could go to real time physical and so is the true measure of energy looking for a buyer/seller.

Each transaction that is completed has an impact on the open interest for that day. If a new buyer and a new seller initiate a contract, open interest will rise by one contract. If traders close an existing position, open interest will decline by one. An option's open interest falls when holders and writers of the option close out their positons. In order to close out their position, they have to offset their position or exercise their option. A rise in the option's open interest occurs when investors open new long option positons and writers take on short positions. The development of new contracts causes an increase in open interest.

For instance, assuming the open interest of call option is initially 0 and on the next day a trader buys 5 option contracts and another investor sells 5 option contracts. The open interest of this call option is 5.

While volume turnover shows the amount of contracts that have been traded and can only increase, an option's open interest shows the number of contracts that are held and can either increase or decrease.

The main advantage of the measure is that it is well understood by traders and it is not computationally demanding. On the other hand, the metric is very specific to market

[31] 'Submission to the Wholesale Advisory Group, on Hedge Market Development', Contact Energy, December 2014, p10.

instruments so tells us little about the overall market. Also, for the open interest to be calculated, market participants are required to publish data regarding their open positions, which requires time and effort.

Input data required

For each seller of a contract there should only be one buyer of that contract. Therefore, to determine the total open interest for any given market we need only to know the totals from either buyers or sellers, not necessarily the sum of both.

Participants of a futures market are required to accurately report their open interest on a daily basis. For NASDAQ Futures, for instance, participants report their open interest to the Options Clearing Corporation ("OCC") in the form required by OCC and pursuant to OCC Rules.

Total open interest can then be estimated by calculating the volume of unclosed positions at any point in time.

Thresholds

There is no universally accepted threshold for unmatched open interest and in some cases this is quoted as a number of contracts, while in other cases in GWh of unmatched open interest.

In the Turkish Vorsa İstanbul Derivatives Market (VIOP) the number of FX Futures Open Interest threshold is 300,000 contracts.

Interpretation

The result of open interest figures, at the end of each trading day, provides some useful conclusions about the day's activity. An increase in the open interest means that new money is flowing into the market, which indicates that the current price trend (upward or downward) in the market is likely to remain the same. If, on the other hand, there is a fall in the open interest, that shows that the market is liquidating and thus the prevailing price trend is likely to end.

An increase in open interest accompanied with an increase in price shows an upward trend in the market. Similarly, an increase in open interest accompanied by a decrease indicates that the market is weak. Table 19 shows how changes in the open interest can be interpreted based on the corresponding changes in prices.

Table 19 Summary of proposed market changes through open interest

Price	Volume	Open Interest	Interpretation
Increase	Increase	Increase	Market is Strong
Increase	Decrease	Decrease	Market is Weakening
Decrease	Increase	Increase	Market is Weak
Decrease	Decrease	Decrease	Market is Strengthening

Unlike volume turnover which measures the pressure behind a price trend, open interest provides an indication of the money that is brought into the futures market.

A3.1.5 Volume of bids and offers

The volume of bids is a direct indicator of the general desire to use instruments as a hedge and therefore provides an indication of the willingness to trade and market depth.

The volume of bids and offers can be differentiated by obligations versus options, counter-flow versus prevailing flow, by auction type (long-term, annual, monthly), and secondary bilateral market. The type of input data depends on the type of bids for which the trend in volume is examined.

Getting at the data is limited to auction-type markets at present so not necessarily good for OTC transactions.

Threshold

There is no specific threshold for volume of bids and offers.

Interpretation

Generally, the higher the volume of bids and offers, the higher the desire of traders to trade hedging products. This is therefore a time series analysis.

A3.2 Facilitation of price discovery

A3.2.1 Reporting of trades

Reporting of trades helps sellers, buyers, industry and other market participants to have confidence that the wholesale energy market is transparent and competitive. Currently, some markets make data readily available on their websites while others only disclose the information to members. OTC reporting is provided via specialist price reporters who sell the information.

In Europe, the Regulation on Energy Market Integrity and Transparency (REMIT) was established in order to provide transparency in the wholesale energy market and identify market abuse. Once fully implemented, in October 2015, energy trading will be screened at EU level. REMIT requires market participants to report wholesale energy market trades, records of transactions, including orders to trade, within the EU to a Registered Reporting Mechanism (RRM). The Agency for the Cooperation of Energy Regulators (ACER)'s role is to monitor the reporting mechanism and to ensure greater transparency in wholesale energy markets, therefore ensuring the efficient functioning of the energy market.

Once REMIT comes into force, all wholesale energy market participants will be obliged to:

- Register with a National Regulatory Authority (NRA) in the EU,
- Submit information and data regarding trading in wholesale energy markets, and
- Disclose inside information in a timely manner.

In cases where market monitoring shows signs of potential market abuse, the incidents are investigated and action is taken. NRAs are responsible for the enforcement of REMIT.

New Zealand also has disclosure requirements in place that were in response in 2009 to concerns within the industry about the lack of hedge contract information available. The trade disclosure requirements were a measure recommended by the Hedge Market Development Steering Group to improve confidence in the competitiveness of the energy hedging market.

The purpose of the disclosure requirement for trades of long term hedging energy products is:

- To facilitate the comparison of electricity prices and other key terms of risk hedging contracts;
- Allow market participants to formulate their own historic contract curves for electricity; and
- Allow the assessment of competitiveness of the market for risk hedging contracts in respect of electricity.

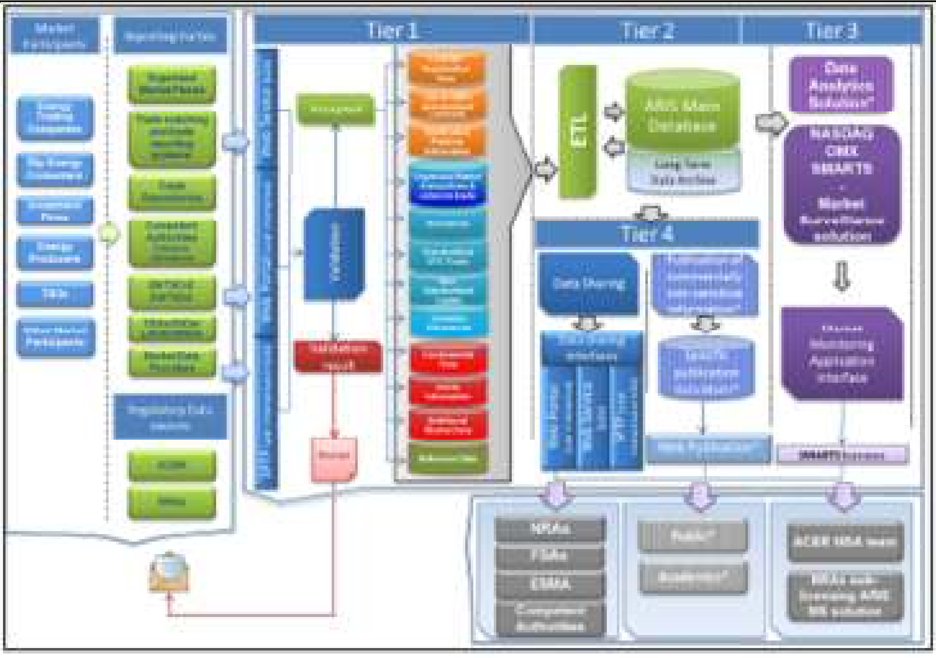
Input data required

In EU, the exact details that market participants will need to provide regarding their risk management contracts is yet to be decided, however it will include:

- **Trade Data** records of transaction data including orders to trade, lifecycle information on the pre and post trade stage of a transaction, details on physical settlement and whether a transaction was cleared or uncleared.
- **Fundamental Data** regarding the use of facilities for production, storage, consumption or transmission of electricity.

The data reporting under REMIT will be done through the Agency's REMIT Information System (ARIS). An illustration of the high level design of ARIS is provided in Figure 7.

Figure 7 Design of ARIS



Source: ACER 2015, REMIT: Manual of Procedures on transaction and fundamental data reporting

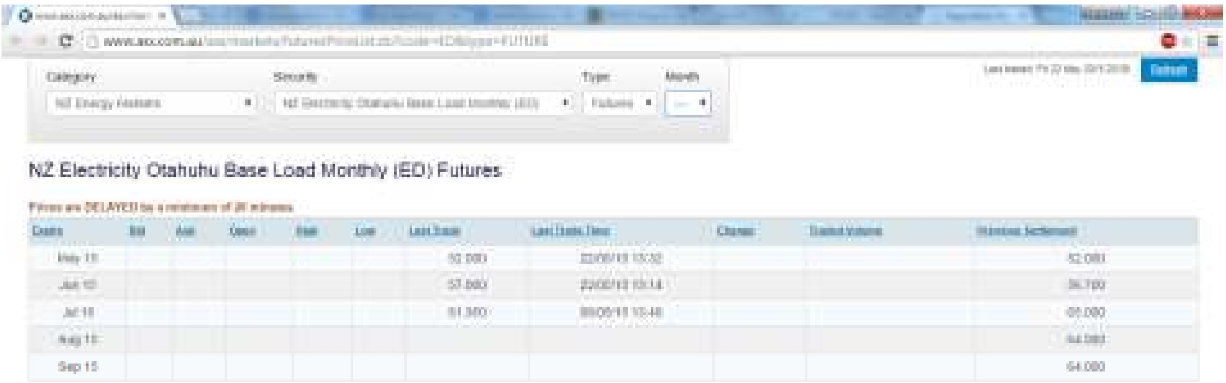
In New Zealand, market participants are required to disclose information regarding their risk management contracts in a specific format contained on www.electricitycontract.co.nz (Electricity Contract website). The information regarding prices of previous trades and volume of trades per product is publicly available and allows traders to formulate their risk management strategies more efficiently. An example of the information that is publicly available is provided in Figure 8.

The reporting of trades rule requires participants to disclose key details of their risk management contracts via the Information System in a form specified by the Board no later than:

- 5 business days after the trade date for a contract for differences or an option contract; and
- 10 business days after the trade date for other risk management contracts.

To avoid double entry of information, if both the buyer and seller are participants, only one of them is required to disclose the details of the contract.

Figure 8 Disclosure of ASX NZ electricity futures (Otahuhu)



Source: http://www.asx.com.au/asx/markets/futuresPriceList.do?code=ED&type=FUTURE

Threshold

Each regulatory framework defines separately the level of information that will be required from market participants regarding trading of risk hedging electricity products, as well as the timeline for providing such information.

For trade reporting in EU under REMIT, Articles 8(2) and (5) of the Implementing Acts define the format, channels and times for data collection and report.

In New Zealand, the Regulations defining the details that market participants need to disclose their risk hedging contract and the timeframe for submitting the information to the Information System are defined in part A of the Electricity Governance Regulations 2003.

Interpretation

Information on transactions in the wholesale energy market provides information about the market's competitiveness, liquidity and sustainability and help market participants to reduce their risk hedging costs.

A highly transparent market provides confidence among investors and regulators, which promotes liquidity. This is more of a policy area than in indicator, with availability of information being as important as its technical collection.

A3.2.2 Share of long-term hedging products in total open interest

The share of long term hedging products (i.e. CfDs) in total open interest is a specialised measure of liquidity along the forward curve that shows the composition of the open interest.

Input data required

In order to calculate the share of long term hedging products in total open interest we need to know the number of options that have not been exercised/ expired for each hedging product, as well as the open interest for the whole market (see Annex A3.1.4).

The advantage of this metric is that it provides useful information about the relative liquidity and availability of each product.

Threshold

There is no specific threshold set in any market about the share of hedging products in total open interest.

Interpretation

Generally, if a hedging product has a high share of total open interest it indicates that this product is liquid.

When comparing the share of a product in total open interest with the share of the same product in total turnover, some useful conclusions can be made. If at the end of the year, the share of a long term hedging product in total open interest is higher than the share in total turnover, this indicates extensive hedging in that product but small short term trading in such contracts.

A3.2.3 Demand/ supply publication

For a competitive market to be efficient and stable it has to provide the right price signals, which in turn means that market participants should have access to information regarding the demand and supply of hedging products.

Transparency regarding demand and supply dampens high price volatility and encourages investment by developing a more predictable market environment. Lack of transparency is a disincentive for players that might actually be interested in participating in the market and is a contributory factor to the lack of forward trading.

Apart from the availability of accurate data on markets, a key determinant of price volatility and an important factor for planning and investment is the time of supplying the demand and supply information.

Realising the importance of transparency, several markets have /are currently implementing legally binding guidelines for transparency of trading data, which however does not extend to OTC trade.

Input data required

For demand and supply publications, relevant data include the volume of capacity, flow data and volume of products purchased. Important information also includes the timeframe of data reporting.

Interpretation

The availability of spot volumes, provided in a systematic way provides an indication of the future price volatility and allows traders to assess risk.

However, demand and supply data alone are not very useful unless a trader has specialist knowledge on how to convert such information into price movements, as well as knowledge of probabilities to assess actual price risk.

A3.3 Ease of market access (low barriers to entry and exit)

A3.3.1 OTC contracts with force majeure and suspension clauses

A contract that may not deliver in real time greatly reduces the hedging value compared to the spot market risk. Therefore, the practice among OTC sellers of requiring force majeure or suspension clauses may be a potential barrier to entry for some buyers.

However, the extent to which force majeure and suspension clauses reduce the willingness of buyer to trade is highly dependent on the exact terms of these clauses.

It should be noted that PTRs will exhibit this form of risk transfer to the user; TSOs are keen to include such clauses in FTRs (making them mimic PTRs).

Input data required

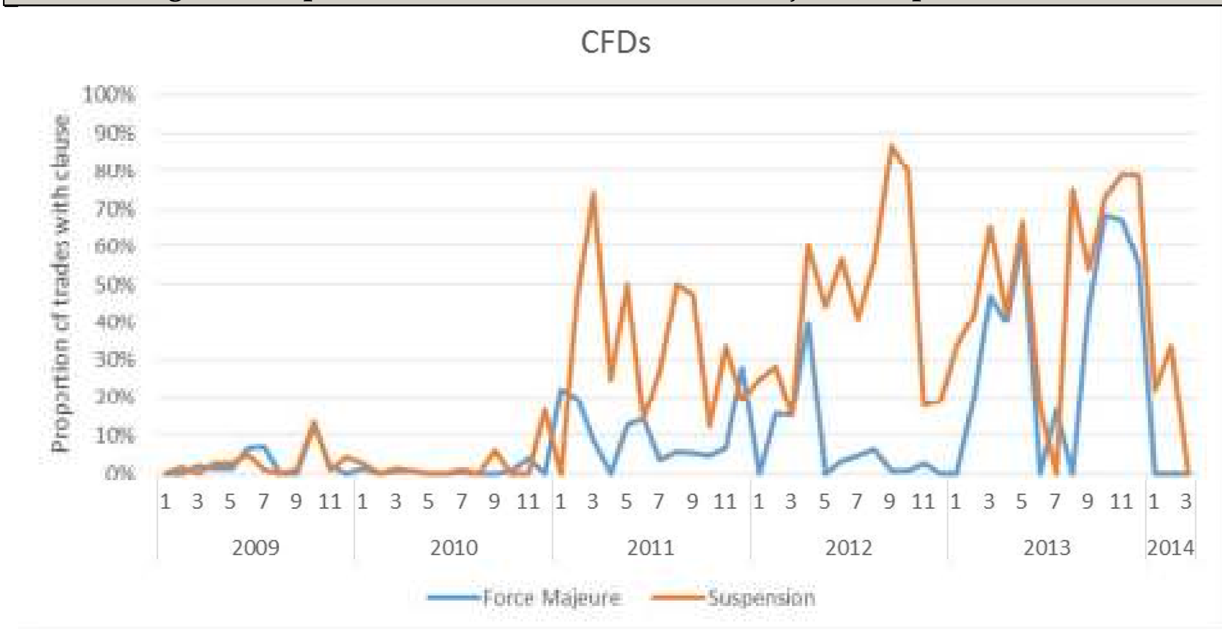
In order to derive the percentage of OTC contracts with force majeure and/or suspension clauses, information on OTC contract terms needs to be gathered. Gathering such data will be difficult unless standardised products are offered.

Threshold

There is no specific threshold in any of the countries that monitor the share of OTC contracts that include force majeure or suspension clauses.

In New Zealand, a country where this metric is monitored the proportion of such OTC contracts has increased over time, based on hedge disclosure data (see Figure 9). The average proportion of such contracts has been around 25% from 2009 until 2014.

Figure 9 Proportion of OTC trades with force majeure/suspicion clauses



Source: Wholesale Advisory Group (WAG) 2014, Hedge Market Development Project metrics

Interpretation

The interpretation of the percentage of OTC contracts with force majeure and/or suspension clauses in the total number of OTC contracts is not straightforward. The reason for that is that the exact terms within the clause are important to define whether inclusion of force majeure clauses is burdensome or not.

A3.3.2 Market participant churn

The market participant churn shows the percentage of traders joining or leaving the market.

It is estimated as the numbers of traders becoming active in a year or ceasing to be active as a proportion of all traders in the market.

The definition of active is ambiguous as very low volume trading could be interpreted as inability to establish a position even if churn volumes are high.

The market participant churn can serve as a proxy for identifying barriers to entry.

Input data required

The market participant churn rate can be estimated quite easily.

In order to calculate the market participant churn rate one needs to collect data regarding the number of traders that become active in one year, the number of those that have not been active for a year and the number of total traders in the market.

Threshold

There is currently no specific threshold for the share of active power exchange members in total number of traders.

Interpretation

The interpretation of the market participant churn rate is not very straightforward. Even though it provides information about the number of traders that become active in a year it doesn't provide information on the quality of new entrants and whether they can actually survive.

A3.3.3 Entrance/trading fees

Entrance/trading fees, measured in €/MWh, provide a good indication of the barriers to enter a forward electricity market. The presence of high entrance and trading fees would deter smaller firms or low volume traders from entering the market and would therefore lower competition and subsequently the efficiency of the market.

Input data required

In order to estimate entrance and trading fees, one needs to collect data regarding the fees that each auction market is charging its participants. Both fixed and variable fees need to be analysed as these have different implications on the barriers to entry and market competition.

It is also particularly important to distinguish between different customer categories and collect information regarding the arrangements in place for each category. For instance, in the Nord Pool area, Elspot and Elbas markets are charging a reduced participation fee for trading in Estonia only, in order to incentivise trading in that area.

However, it is difficult to provide a single comparator measure of potential barriers to entry because of the variations in type of fee; a composite measure of cost per MWh traded would fail to capture the impact on new entrants because the pattern of trading would be partly determined by the fees themselves and so no objective impact can be determined.

Threshold

There is no specific threshold for this metric, but lower values generally indicate higher market openness.

Interpretation

Generally, the lower the trading fees that market participants have to pay the lower are the barriers to enter the market and the more efficient the market is operating.

As mentioned above, it is important to distinguish between fixed and variable fees. This is because fixed fees have an impact on the investor's decision to enter the market, while variable fees affect the volume of bids that an investor makes. Each market participant compares both the fixed fees and variable fees for trading in a market before entering that market. For instance, the fixed fees for trading in Elspot and Elbas are higher than trading in Elbas only. However, investors pay a higher variable trading fee in the Elbas market. Small direct participants in the Elspot market are allowed to choose between an annual fixed fee of €15,000 a year plus a variable trading fee of €0.03/MWh, or pay no annual fixed fees and instead pay higher variable trading fees (€0.13/MWh), which are then capped at €3,000 per year. This choice is important for small investors that are not willing and/or capable of paying large annual fees and therefore lowers the barriers to entry for small investors.

In the Elspot market, direct participants may choose to undertake gross bidding, i.e. give separate bids for selling and buying electricity, instead of submitting a net bid per investor. The fee structure is such that it incentivises gross bidding, especially for large investors.

Whether participation fees apply only to a specific area within the market also affects the investors decisions. For instance, in the Elspot market, Norway is considered one bidding area and if an investor wants to buy or sell electricity in another bidding area within the Elspot market, he will incur extra fees. Such a fee structure provides a disincentive for participating in more bidding areas and therefore reduced market competition.

A3.3.4 Presence of market makers

The presence of market makers prepared to absorb risks of other traders can greatly facilitate forward market entry.

In New Zealand, some large market participants have chosen to act as market makers, increasing their activity in the hedge market, in part at the request of the regulator.

In UK, Ofgem has imposed licence conditions on dominant parties to require them to be market makers in forward markets.

The presence of market makers requires financially strong parties, which may mean a degree of dominance (although pure financial players may perform the role). Moreover, such an arrangement may require regulatory intervention to bring about as in the case of UK and, to an extent, in New Zealand.

Interpretation

It is difficult to conclude whether the presence of market makers increases liquidity and competitiveness in the market since there are a number of factors involved and the impact of market makers alone is hard to estimate.

In New Zealand, there is evidence to suggest that, since market-maker arrangement were put in place, the level of participation in the ASX market and OTC CfD markets has increased over the last few years, and the depth and liquidity of the ASX market has improved.

A3.3.5 Granularity

Granularity measures the size of the average contract or minimum size. Smaller contracts mean smaller players can participate and it is therefore a measure of market access. It is a relatively new measure, which was applied in the Wholesale Advisory Group (WAG) discussions in New Zealand in 2014 and it is therefore not a universally accepted method.

It relates to the ability of small players to cover their position in the forward market if a minimum of 1 MW per hour is the smallest unit to be covered. This measure relates to supplier size but should equally be applicable to small generators.

Granularity also shows the extent to which products are available for every requirement; you could have a separate contract for every single eventuality, but that will lead to difficulties trading as there will not be a lot of products, nor other players keen to trade. Alternatively, you could have just a few products, meaning a lot more market depth, more people trading, but the products don't line up with what players want. For instance, a player needs to cover 6.7 MW of exposure, but can only trade in 5 MW contracts, leaving 1.7 MW exposed. But lots of people will trade 5 MW contracts. Alternatively, they write a 6.7 MW contract that covers their exposure, but there will be very few traders interested in trading 6.7 MW contracts.

Input data required

The main advantage of this method is that it does not require any data and monitoring of the exchange platform alone and the contract rules can provide an indication about the granularity.

Threshold

The market maker should aim to provide products at the right level of granularity and clip size that will allow new entrants to hedge retail customer demand over a 2 to 3 year forward horizon.

Interpretation

Lack of access to energy products at the right level of granularity and clip size is a major barrier to entry, which therefore lowers competition.

A high availability of longer dated products (2 to 3 years) at the right level of granularity that will allow new entrants to hedge the price risk between retail prices and wholesale markets indicates low barriers to entry and therefore high competition in the market.

A3.4 Other measures supporting contestability in prompt markets

A3.4.1 Volume by trader type

The trader types are mainly divided into physical (generators/ retailers/consumers) and financial, and whether they are market makers.

The volume of trade conducted by each trader type provides useful information about the level of participation by each trader type and captures the extent to which the market is supported by diverse parties.

Input data required

The volume of trade for each trader type has to be collected.

Interpretation

The relative volumes of trade provide an indication about the composition of market participants.

However, definitional issues arise in the interpretation of this metric in that one party might be in more than one category.

Also, high participation by financial institutions, such as banks, might indicate increased liquidity and a wider range of available OTC products, but it may also mean an absence of physical players due, for example, to vertical integration.

A3.4.2 FTRs held by financial entities

Parties without a physical presence in the prompt market could offer a market making or risk management service to physical players in the FTR market.

FTRs are in finite quantity as issued by TSOs and so the percentage shows the proportion of non-physical players in this market quite accurately.

Input data required

The number of FTRs held by financial entities is a straightforward figure that is reported by the financial entities themselves.

Interpretation

This metric is difficult to interpret; in the PJM market, the interest in the market was driven by underfunding speculation rather than offering hedging services.

Generally, the percentage of FTRs held by financial entities as opposed to physical entities provides an indication of increased liquidity and extent of speculation.

A3.5 Effective competition in the forward market

A3.5.1 Minimum number of companies needed to reach 50% market share

The minimum number of companies needed to reach 50% market share provides a good indication of competition in the electricity market.

Input data required

The market share of the larger companies in each market is required in order to estimate the number of companies that together serve 50% of the market.

For this measure to be monitored in all the European markets, the data gathering needs to cover different platforms. However, this would be resolved once REMIT is implemented.

Threshold

There is currently no settled position on what number signifies sufficient competition in the market.

In the Nordic market, which monitors the measure of competition, the lowest number was needed in 2006 (11) and the highest number was needed in 2008 (17).

Interpretation

This metric needs to be interpreted for the defined market or sub-market (e.g. for all forward contracts or just for products over a defined date range).

Generally, the bigger the number of companies that is needed to reach the 50% market share, the greater the competition.

This measure of market competition can be used in any market type as it is independent of market size.

A3.5.2 Herfindahl-Hirschman Index (HHI)

The Herfindahl- Hirschman Index (HHI) is a commonly used measure of market concentration, reflecting the extent to which there may be access to the forward markets for smaller players.

It is calculated by squaring the market share of each firm competing in a market, and then summing the resulting numbers. The HHI number can range from close to zero for perfect competition to 10,000 for monopoly.

The main use of this metric is to estimate trends over time in a particular market.

Input data required

For the calculation of the HHI one needs to estimate the market share of each market player.

Threshold

There is no universally accepted threshold for HHI, but generally a market with a HHI of less than 1,500 is considered very competitive, while a result of more than 2,500 shows a highly concentrated market.

FERC, the Federal Energy Regulatory Commission in the US suggests a market is reasonably competitive if its HHI index is below 2,500.[32] In New Zealand, a consultation paper suggests using 2,500 as a threshold for a competitive market.[33]

Interpretation

The HHI shows the degree of concentration (and degree of competition) in the market and reflects the extent to which there may be access to the forward markets for smaller players.

High levels of concentration are likely to result in lower liquidity which limits the effectiveness of market competition, but that metric alone does not inform us on the reasons for the concentration.

Moreover, some argue that its application in the electricity market is inappropriate, since the lack of storage means that competition may need to be ensured by a lower index than in other markets.

A3.5.3 Share of biggest 5

The combined share of the five leading producers of total buy volume and total sell volume is a similar measure to that of HHI, but with a different statistical base.

The main advantage of this metric is that it is simple to understand and calculate.

[32] NOI, FERC Stats. & Regs. ¶ 35,571 at P 12.

[33] Para 5.1.3, p38 of 'Hedge Market Development Project: Metrics' from 1 May 2014.

Input data required

For this measure of competition, buying and selling data from the 5 biggest producers are needed. The total volume of buy and sell of the 5 biggest producers is divided by the total buy and sell volume in the market.

Threshold

There is no consensus on what share represents a competitive market.

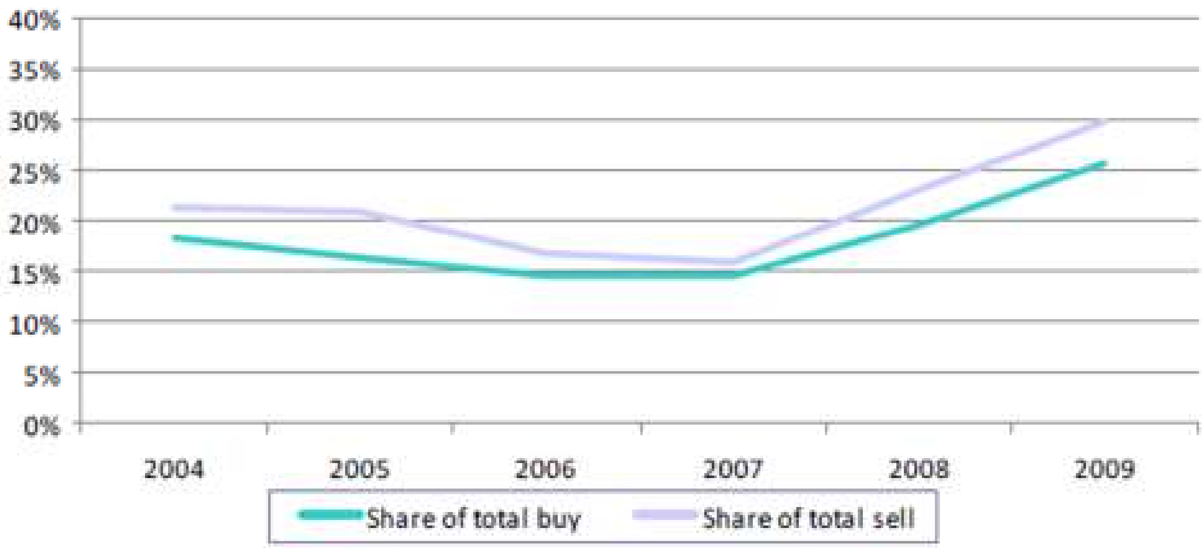
Interpretation

Generally a lower market share of the biggest 5 producers, *ceteris paribus*, indicates that the remaining volumes came from smaller producers and therefore there are low barriers to entry in the market.

Examining this metric over time provides information about the change of competition in the market.

Also, if the combined share in total buy is near their combined share in total sell, as in the case of Nordic market (Figure 10) shows that most of their turnover originates from trading instead of hedging.

Figure 10 The 5 leading producers' combined share 2004-2009 of total buy volume and total sell volume in the Nordic market



Source: NordREG 2010

A3.5.4 Concentration ratios

The concentration ratio (CR) is the ratio of the sum of market shares of a given number[34] of the largest firms to the total size of the market.

[34] Each NRA is using a different number of largest firms to calculate concentration ratios

There are two variations in CR indicators reflecting two possible definitions of relevant market size, namely the total installed capacity and total generated volume. Although focussed on generation in much of the literature, it should be applicable to share of open interest or share of holding of PTRs or FTRs or other metrics relevant to forward markets; defining what is to be considered makes this a rather vague metric in terms of forward market studies.

Input data required

The data required to estimate concentration ratios include the combined market share of the largest firms in the relevant market segment, depending on the type of CR that is calculated.

Threshold

There is no specific threshold for this metric.

Interpretation

Generally, a lower concentration ratio indicates lower market power and therefore higher competition in the market and vice versa.

The interpretational value of this measured is limited by the inconsistency of data supplied by the regulators and the assumptions that each regulator makes regarding market size. For instance, some regulators take account of the size and/or intermittency of generators. In these cases, the reference market typically excludes intermittent or renewable generation and smaller generating units. Therefore, CR values that have been calculated with this method are somehow overstated, compared to other methods that include intermittent and renewable generation in the market size.

A4 Nordic case study

A4.1 Nordic region wholesale market overview

A4.1.1 Description

Type of market

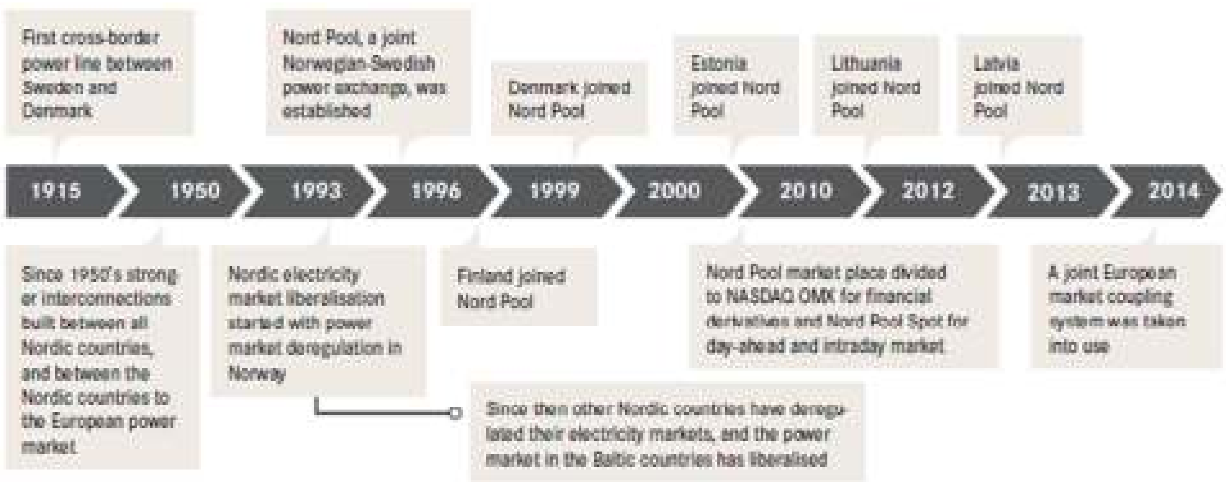
The Nord Pool electricity market was established in 1993, two years after the deregulation of the power markets in Norway as a Norwegian electricity exchange and extended its trade to Sweden in 1996.It is currently the largest and most liquid marketplace for financial power contracts in Europe. The Nordic electricity market includes Norway, Sweden, Finland (joined in 1998) and Denmark (joined in 1999- 2000), and it now also includes the Baltic countries of Estonia, Latvia and Lithuania. Strong interconnections between all Nordic national power systems form the basis of the regional power system.

About 90% of Nordic power generation is traded through the Nord Pool power exchanges Nord Pool Spot and Nasdaq Commodities[35]. The rest is covered by bilateral contracts or by industrial and municipal own production.

The financial power derivatives market was initially operated by Nord Pool and was sold to NASDAQ OMX in 2010 to operate under Nasdaq Commodities. Nord Pool Spot operates the day-ahead Elspot and intraday Elbas markets.

The diagram below illustrates some important events that led to the formation of the Nordic power market in its present form.

Figure 11 Developments in the Nordic power market



Source: Fortum Energy Review 2015

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[35] http://apps.fortum.fi/gallery/Fortum_Energy_review_EN_FINAL.pdf

Market structure

Physical power trading is conducted in the power exchange, Nord Pool Spot, while financial hedging trades are made in the derivatives exchange Nasdaq OMX Commodities and in the OTC market.

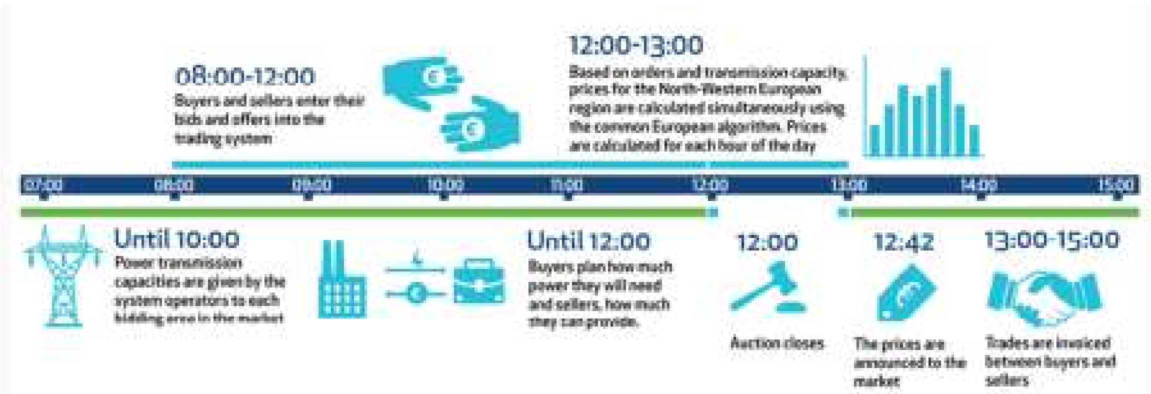
Nord Pool Spot was founded in 2002 and is the first multinational exchange for trading electric power in the world. It is owned by the national grid companies Fingrid (Finland), Energinet.dk (Denmark), Statnett (Norway), Svenska Kraftnät (Sweden), Elering (Estonia), Litgrid (Lithuania) and AST (Latvia) and has 380 members in roughly 20 countries.

Nord Pool Spot operates the Nordic and Baltic day-ahead Elspot marketplace and the continuous intraday Elbas marketplace. Members of the Elspot can place their orders up to 12 days ahead. When all members have concluded their orders, system and area prices for each bidding area are calculated:

- *Nordic System price;* Calculated by matching sale and purchase order, without any grid restrictions.
- *Area price*; Takes into account the transmission capacity in the bidding areas and establishes different area prices.

Figure 12 illustrates the structure of the Elspot day-ahead market.

Figure 12 The structure of the Elspot day-ahead market

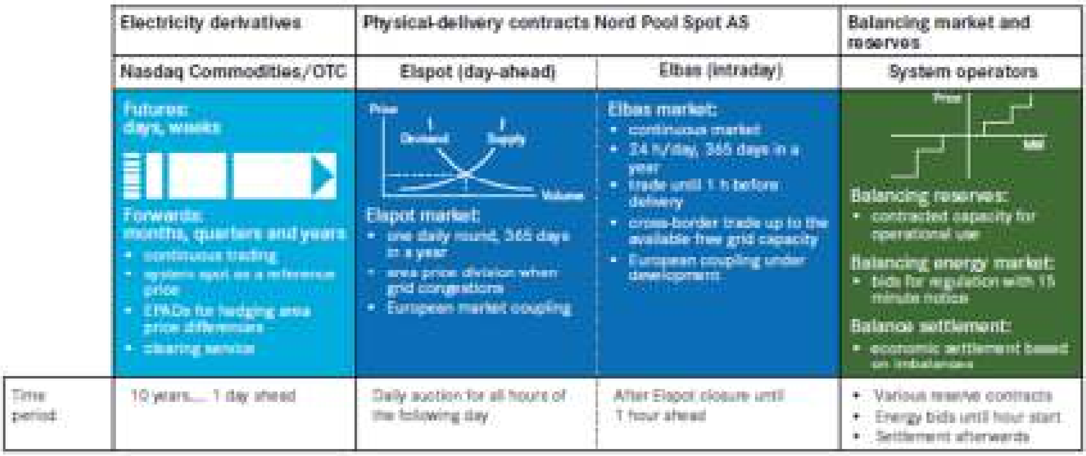


Source: NASDAQ OMX

The Elbas market provides continuous power trading 24 hours a day, up to one hour prior to delivery. It is based on hourly contracts, and it supplements the Elspot power market.

Figure 13 illustrates the power market structure in the Nordic power market.

Figure 13 Nordic power market structure



Source: Fortum Energy Review 2015[36]

In the wholesale market, the market share of the four largest producers was around 50% in 2013. Vattenfall, which operates in Denmark and Sweden, is the largest electricity generator in the Nordic region with 18.8 percent of the total generation followed by Statkraft (13.6 %), operating in Norway, Fortum (12.1 %) operating in Finland and Sweden and E.ON (7.0 %) in Sweden.

Table 20 shows the generation capacity of the main power producers in each of the Nordic countries. Vattenfall's share in total capacity is 15.4%, followed by Statkraft (13.4%).

Table 20 Generation capacity by producers, 2013

		Capacity (MW)	Share of total capacity (%)
Denmark	Dong Energy	5,445	5.4%
	Vattenfall	1,578	1.6%
Finland	Fortum	4,528	4.5%
	PVO	3,197	3.2%
	Helsingin Energy	2,567	1.6%
Norway	Statkraft	13,399	13.4%
	E-CO Energi	2,800	2.8%
	Hydro	2,000	2.0%
Sweden	Vattenfall	13,879	13.8%
	E.ON Sweden	6.736	6.7%
	Fortum	5,825	5.8%
Other generators		38,306	38.2%

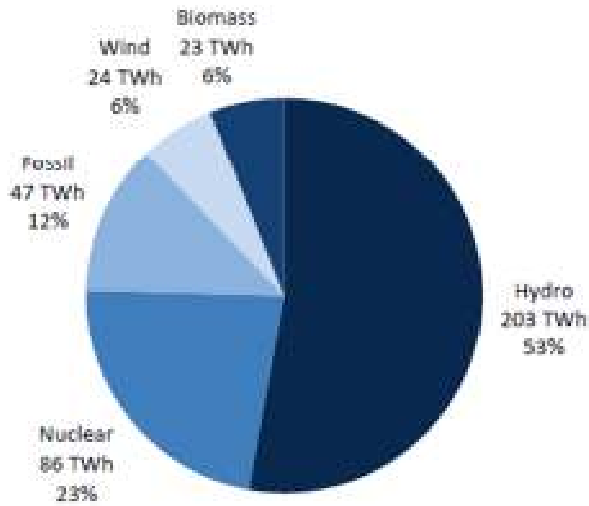
[36] http://apps.fortum.fi/gallery/Fortum_Energy_review_EN_FINAL.pdf

	Capacity (MW)	Share of total capacity (%)
Total generating capacity	100,313	100%

Source: Swedenergy, NVE, DERA

Power generation in the Nordic region is dominated by hydro power (53%), followed by Nuclear (23%) and fossil fuels (12%) (Figure 23).

Figure 14 Power generation by power source in the Nordic region (TWh, 2013)



Source: ENTSO-E

Approach to regulation

All Nordic countries have liberalised their electricity markets, opening both electricity trading and electricity production to competition.

There is currently no regulation covering universal service in the Nordic power market. The power balance settlement is being carried on a national level, by the responsible TSO in each Nordic country. There has recently been an attempt to harmonise the rules for balance settlement by introducing a model for common *Nordic balance and reconciliation settlement (NBS).* This is expected to facilitate market participation.

National system operators are responsible for physical cross border exchange. Nord Pool's Elspot market determines the planned power flow, and system operators exchange balance power up to the running hour.

A4.1.2 Competition

Degree of competition

Competition in the wholesale market is relatively strong. Figure 15, below, shows a concentration index, developed by NordREG, which is based on the HHI, for the Nordic wholesale markets from 2010 to 2013. Competition is very high in Norway, followed by Finland. In Sweden and Denmark competition is less intense.

Figure 15 Concentration index for the Nordic wholesale markets, 2010 – 2013[37]

	2010	2011	2012	2013
Norway	3	3	5	5
Sweden	3	2	2	2
Finland	3	3	3	3
Denmark	1	1	2	2

Source: NordREG 2014

A4.2 Nordic forward market

A4.2.1 Description

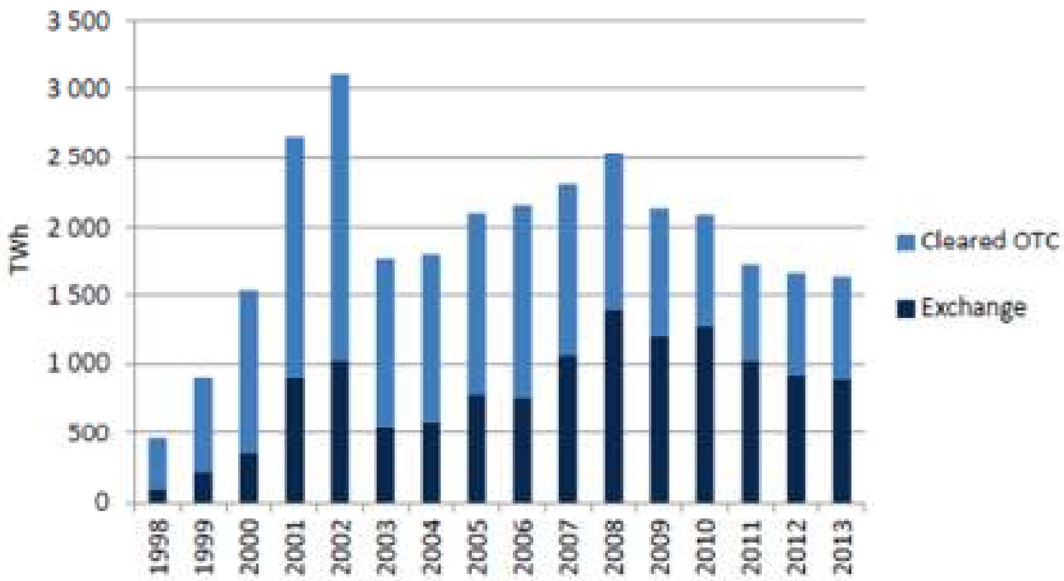
Type of market

Financial hedging products are traded both in the derivatives exchange, Nasdaq Commodities, and in the OTC market but cleared at the exchange. Supply and demand forces determine the price of electricity and the production volumes on both markets.

Traditionally, the majority of financial products were traded in the OTC market, but during the past decade the share of hedging products traded through the exchange has increased significantly.

[37] The concentration index is presented according to the following scale: < 1000=5; >1000, <1100=4; >1100, <1500=3; >1500, <2200=2; >2200= 1

Figure 16 Volume turnover in the Nordic electricity derivatives market (TWh, 1998 – 2013)



Source: NASDAQ OMX

The hedging power products offered by Nasdaq Commodities comprise Nordic, German, Dutch and UK power derivatives. The derivatives are base and peak load futures, Deferred Settlement Futures (DS Futures), options, and Electricity Price Area Differentials (EPAD)[38].

These products are used for trading and risk management purposes, and can be traded for up to ten years ahead. Base load contracts are delivered 24/7 during the length of the contract, while peak load contracts are delivered Mon-Fri, 08.00 – 20.00 during the length of the contract.

Market structure

In the NASDAQ OMX Commodities market only financial products are traded and there is no physical delivery. Financial contracts are traded without reference to technical characteristics, such as grid congestion, access to capacity, and other technical restrictions.

The clearinghouse, governed by the Swedish Financial Supervisory Authority is the contractual counterparty in all contracts traded at NASDAQ OMX Commodities Europe's financial market. The clearinghouse guarantees the financial settlement. The cash settlement is automatic, and is done through a variety of multinational settlement banks.

A4.2.2 Competition

Degree of competition

The market makers in the NASDAQ OMX power market are shown in Table 21.

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[38] http://www.nasdaqomx.com/commodities/markets

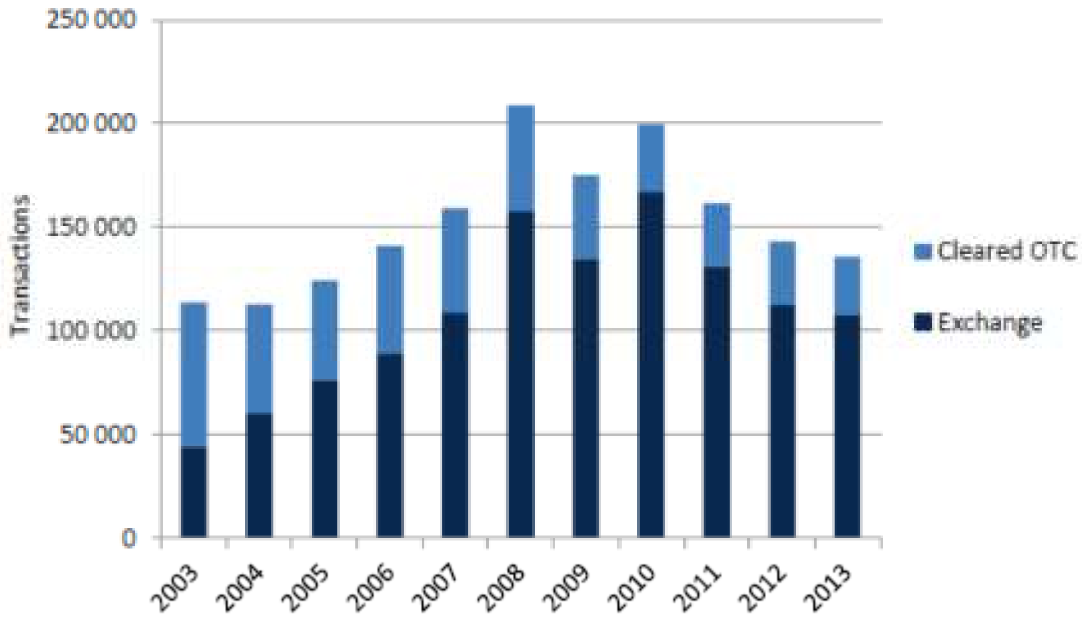
Table 21 Market makers in the NASDAQ OMX

Products	Market Makers
Nordic Power	Vattenfall
	RWE Supply & Trading GmbH
Nordic EPADs	DONG
	Energi Danmark A/S
	Vattenfall
German power	Three Market Makers
	(Anonymous)

Source: NASDAQ OMX

Liquidity is relatively high in the Nordic forward electricity market, but there has been a steady decrease in the volume of trade since 2010, i.e. the onset of the financial crisis. The number of transactions was 143,375 in 2013, 11% less than in 2011.

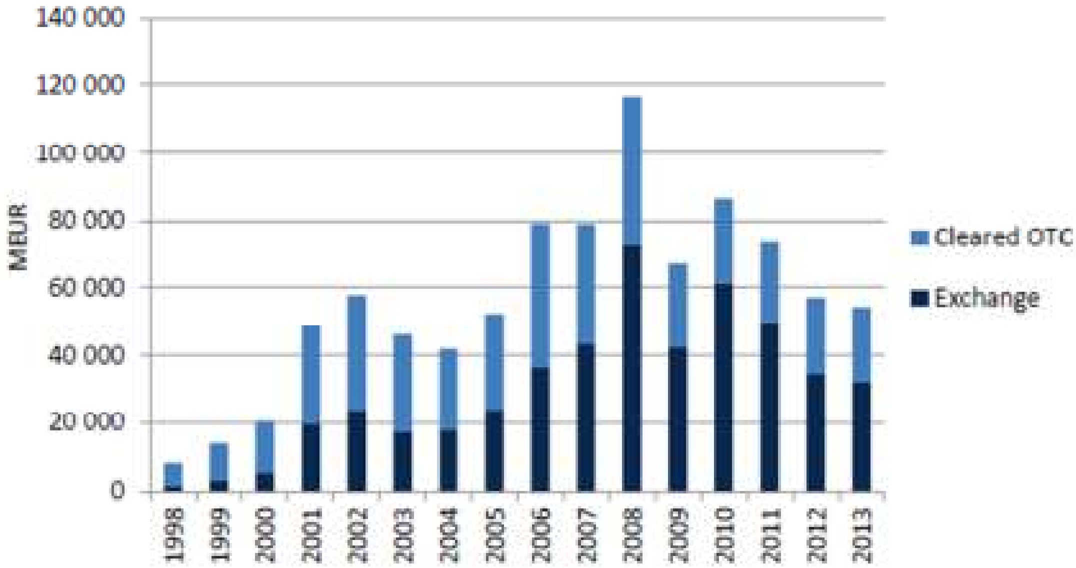
Figure 17 Number of transactions in the Nordic electricity derivatives market (TWh, 1998 – 2013)



Source: NASDAQ OMX

Similarly, the traded value of both OTC and exchange has fallen, as shown in Figure 18. The value turnover has also decreased by 4.8 percent to 54,266 million EUR (57,030 million EUR in 2012).

Figure 18 Value turnover in the Nordic financial electricity market 1998 – 2013



Source: NASDAQ OMX

A4.2.3 Market monitoring

Under the Nordic market and regulatory framework, market monitoring is considered essential for building market confidence, transparency, liquidity, integrity and, therefore ensuring the efficient functioning of the market. The requirements of market monitoring and surveillance are governed by the Norwegian Exchange Act.

NordREG

NordREG is an organisation comprising all the Nordic energy regulators, which oversees the institutional and legal framework within the Nordic electricity market.

Among NordREG's strategic priorities is the well-functioning of the wholesale market which includes:

- Promoting competitive market structures in the financial electricity market
- Ensuring efficiency in the operating of the power exchange
- Ensuring adequate level of transparency in the market

In 2010 NordREG published a report on the 'Nordic financial electricity market'. The aim of the report, the updated version of which will be published during 2015, was to assess the degree of efficiency in the Nordic financial electricity market and to consider measures for improving the functioning of the market. The report considered issues of liquidity, competition and transparency.

The analysis of the report indicated a solid development of the Nordic financial electricity market and a good liquidity in the basic products, with the exception of certain years when several indicators of liquidity showed a negative tendency[39]. There is also a general consensus that there is trust in the market.

NASDAQ OMX Market Surveillance

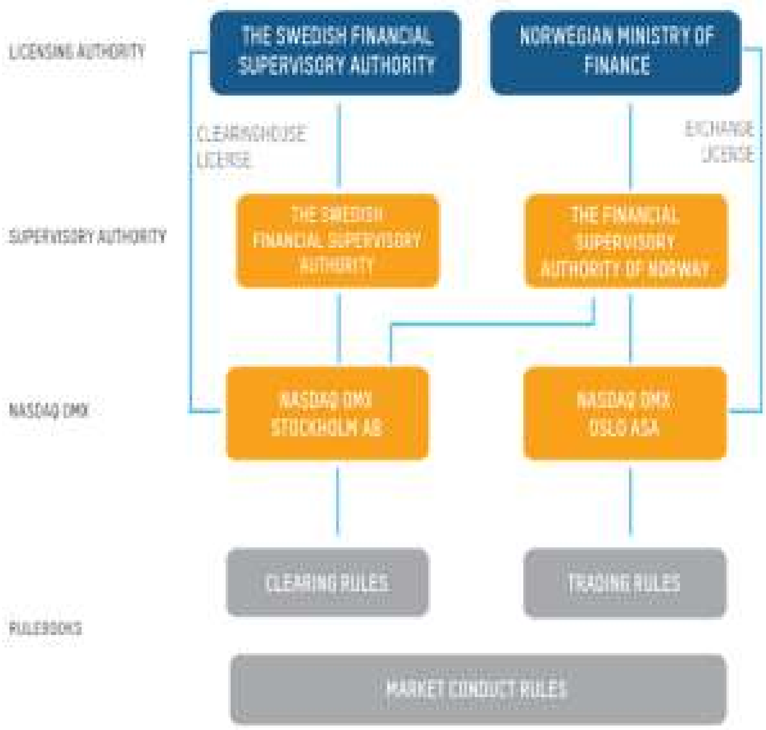
NASDAQ OMX Oslo ASA holds a licence as a forward products exchange platform under the Exchange Act (2007). The licence, granted by Ministerial order, obliges Nasdaq OMX to establish and maintain a market monitoring segment (Act § 27) and puts NASDAQ OMX Oslo ASA under the supervision of the Financial Supervisory Authority of Norway, Finanstilsynet. The clearinghouse, NASDAQ OMX Stockholm AB, was granted a licence by the Swedish Financial Supervisory Authority, Finansinspektionen.

The primary function of the market surveillance unit is to monitor the trading activity and identify non-compliance cases that override the Market Conduct Rules. The Rules apply to both exchange and non- exchange trading.

All market participants have to comply with the trading and clearing rules, as these are defined by the Norwegian Ministry of Finance and the Swedish Financial Supervisory Authority, respectively.

Figure 19 shows the regulatory regime that defines the market conduct rules in the exchange of hedging products.

Figure 19 NASDAQ OMX market monitoring regulatory regime



[39] The first drop in 2003 is related to the Enron and TXU collapses while the other drop in 2009 can be attributed to the financial crisis

Source: NASDAQ OMX

Responsibilities

The efficient functioning of the Nordic power exchange market is largely attributed to the continuous market surveillance, which plays an important role in establishing and maintaining the confidence of market participants.

NASDAQ OMX Oslo ASA (former Nord Pool ASA) monitors the trading activities in the commodity derivative markets and conducts investigations of possible breaches of laws and regulations.

Market Surveillance's main task is to monitor the bids placed by market participants and the trading activity and report non-exchange trades in the financial market. If there is suspicion that a market participant has breached any of the trading rules, Market Surveillance gathers information, and investigates the case further.

The responsibilities of the Market Surveillance unit of NASDAQ OMX include:

- monitoring the market conduct of trading participants,
- investigating possible breaches of the trading rules or applicable laws
- potential business in the markets that is likely to have an impact on the hedge product prices.

The focus of the Market Surveillance unit is more on market conduct rather than on structural indicators of liquidity, market concentration and other measures of the efficient functioning of the market.

All information collected during investigations is handled by Market Surveillance with strict confidentiality. Figure 20 illustrates the responsibilities of the Market Surveillance unit.

Figure 20 Market Surveillance responsibilities

Source: NASDAQ OMX

Tasks

The Exchange Regulation ('Børsforskriften') dictates the tasks that the NASDAQ OMX Oslo ASA Market Surveillance unit shall undertake.

The main focus areas of NASDAQ OMX Oslo's Market Surveillance can be divided into four main points:

- ***Reporting of non-exchange trades***; Market participants have to report the exact OTC transactions to the clearing house, NASDAQ OMX Stockholm, within 15 minutes of concluding the transaction (Market Conduct Rules § 2).
- ***Disclosure of inside information***; Market participants have the obligation to disclose to NASDAQ OMX Oslo all information they have, which is likely to affect prices in the OTC and exchange markets (enclosure 1 to the Market Conduct Rules).
- ***Insider trading***; Market participants have to refrain from trading while in possession of insider trading information and can resume trading once the information has been made public.
- ***Market manipulation***; Market participants are not allowed to manipulate the market (Norwegian Securities Trading Act and Market Conduct Rules).

Case proceedings

If the Market Surveillance (MS) finds that a certain activity constitutes a breach of the conduct rules, a further investigation is performed.

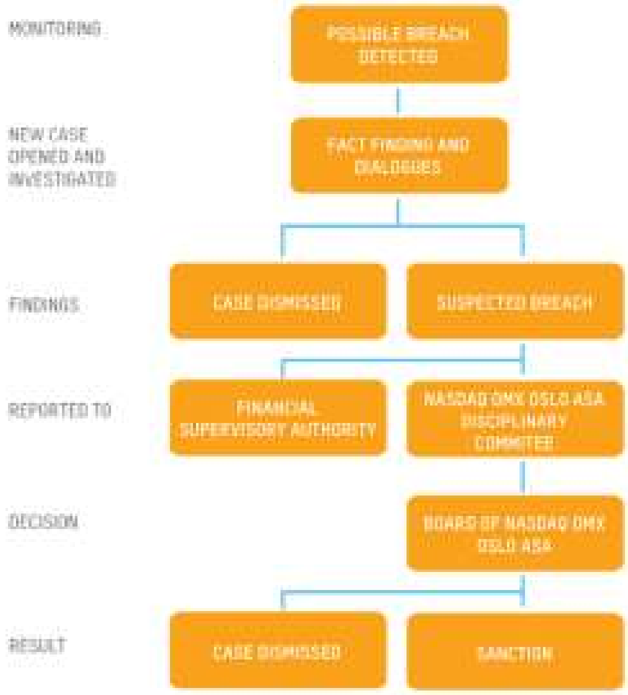
If after initial clarification this is not resolved, a case will be opened. Data and relevant information will be requested by all involved parties and if the suspicion cannot be dismissed a report will be sent to Finanstilsynet, the supervisory authority.

If the supervisory authority concludes that there has been a breach of market conduct rules at the financial market, the case will be brought forward to the Disciplinary committee and recommendations will be submitted to the NASDAQ OMX Oslo ASA Board of Directors. If any sanctions are applied these will be published.

The relevant parties can appeal the sanction to the Exchange Appeal Board, which is an independent appeal body for exchanges' administrative decisions[40].

[40] NASDAQ OMX

Figure 21 Case proceedings process



Source: NASDAQ OMX

Evaluation of monitoring effectiveness

It can be concluded that the monitoring approach is proving confidence in the pricing mechanisms, the transparency of price relevant information and in the integrity of the market.

A5 PJM Case Study

A5.1 Market overview

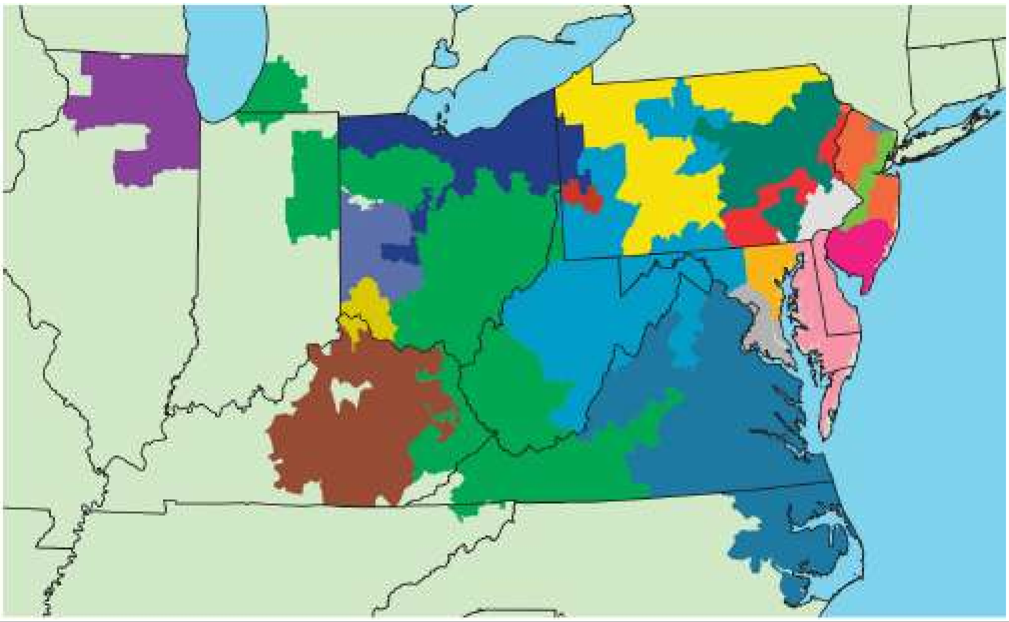
A5.1.1 Introduction

The PJM Interconnection (PJM) is a Regional Transmission Organisation (RTO) in the United States covering all or parts of 13 states and the District of Columbia. As of September 2014, PJM has 915 members, including market buyers, sellers, and traders of electricity, a generating capacity of 184,400 MW, and annual energy production of 793,679 GWh, making it the world's largest wholesale electricity market.

A5.1.2 Market structure

PJM operates a centrally dispatched, locational gross pool market consisting of Day-Ahead and Real-Time markets. Locational marginal pricing reflects the value of energy at a specific time and location. Variations in locational marginal prices arise due to transmission constraints. PJM introduced market-clearing nodal prices with market-based offers in 1999. PJM is split up into 20 control zones (Figure 22) for which unique marginal prices are determined.

Figure 22 PJM's 20 control zones



Source: Monitoring Analytics, State of the Market report

PJM also operates a market for Financial Transmission Rights in order to assist market participants with hedging price risks. PJM's FTR market has been expanded and redesigned since its first introduction in 1999, including transitioning to an Auction Revenue Rights (ARRs) allocation process, with subsequent FTR auctions, in 2003.

Various financial and forward products for PJM are available to market participants on exchanges outside of PJM's administered markets, including ICE and NYMEX. Both exchanges offer peak, off-peak, real-time, and day-ahead futures and options for different timeframes specific to PJM's control zones. Monitoring of these exchanges does not fall under the purview of PJM's independent market monitor, Monitoring Analytics, which provides regular monitoring reports on PJM's day-ahead, real-time, capacity, and FTR markets. Any issues regarding market conduct on exchanges outside of PJM would fall under the purview of the Federal Energy Regulatory Commission (FERC). PJM focuses on the operation of its FTR markets in regard to enabling hedging opportunities for market participants.

A capacity market is in place to ensure the future availability of generating capacity. PJM replaced its Capacity Credit Market in 2007 with a Reliability Pricing Model in reaction to low capacity prices discouraging investment.

A5.2 Financial Transmission Rights (FTRs)

A5.2.1 Auction Revenue Rights (ARRs)

In 2003, the direct allocation of FTRs was replaced by an annual allocation of ARRs, coupled with long-term, annual, and monthly FTR auctions. The allocation of ARRs is identical to the previous allocation of FTRs, being allocated to network service and long-term, firm point-to-point transmission customers, but the value of ARRs is determined by the subsequent FTR auctions.

An ARR holder is given a claim on the revenue from the FTR auctions, which is based on the locational price differences between the ARR's sink and sources. ARR holders can also 'self-schedule' their ARR as an FTR on the same path. The value of ARRs is thus a market-based function of the implicit nodal price differences, as determined by the FTR auctions.

The FTR allocation process was changed in June 2001 so that incumbents no longer had preferred access to their historical FTRs, but there was still a link between generation resources and an ability to nominate FTRs. Therefore, in June 2003, the FTR allocation was discontinued in favour of an allocation of ARRs, with subsequent FTR auctions. PJM argued the ARR allocation-FTR auction design protects load just as well, if not better, than the FTR allocation mechanism, while also providing greater price certainty, price transparency, and more flexible management of congestion costs. Excess transmission capacity is made available in FTR auctions, allowing for speculation and hedging.

Monthly FTR auctions, which auction residual FTR capacity and allow for the trade of existing FTRs, were later introduced to increase FTR liquidity. A secondary bilateral market is also administered to trade existing FTRs. PJM has no knowledge of bilateral transactions that take place outside of the administered secondary market.

A5.2.2 FTR underfunding

William W. Hogan states that FTRs are a "necessary"[41] part of the market design, instead of "unworkable" PTRs, but the design must include full funding of FTRs. FTRs support long-term contracts but their benefits as a hedge cannot accrue with underfunding.

FTRs are revenue adequate if, for a given grid configuration, all allocated FTRs are simultaneously feasible. Then no matter what the actual pattern of loads and generation, economic dispatch with locational prices will be revenue adequate.

FTR underfunding, a recent issue for PJM, can occur if simultaneous feasibility no longer holds. The issue for PJM stems from the original definition of pay-out obligations to FTR holders, which are fixed by day-ahead congestion, versus the definition of revenues to be collected to pay off FTR obligations, which come from both day-ahead and real-time balancing congestion, with the latter increasingly turning out negative.

Underfunding has thus been attributed to a combination of border congestion, unplanned transmission outages, reduced capacity ratings, intermittent resources, and market-to-market flowgates. Under the current market design, new flowgates can be elected in between FTR auctions, making previously feasible FTRs unfeasible.

PJM did not adhere to accounting discipline of economic dispatches, mixing and matching payments in real-time and day-ahead. Excluding real-time balancing congestion from the FTR funding formula has been proposed to make FTR revenue adequacy only dependent on day-ahead congestion, as is the case for CAISO, MISO, and NYISO. However, what to do with the remaining negative real-time balancing congestion cost is still debated. The costs could be applied to transmission users given it is impossible to identify the responsible market participants, but this would force balancing congestion costs on end users.

Loop flows complicate revenue adequacy as an RTO only covers part of an interconnected grid. Loop flows occur when energy from generation outside the region destined to serve demand outside the region flows through an RTO. Charging flows at different locational prices is controversial so revenue inadequacy can result to the extent that loop flows are unaccounted for.

PJM has chosen to protect the full funding of ARRs, protecting transmission owners from the responsibility of revenue adequacy and instead allocating the revenue deficit to FTR holders, diminishing FTR efficacy. Alternatively, NYISO allocates revenue deficiencies to transmission owners. The initial ARR allocation best approximates physical rights, while subsequent FTR auctions operate under the best approximation of anticipated grid conditions, making the allocation of FTRs simultaneously feasible and fully funded. Transmission owners become responsible for revenue deficiencies, incentivising them to maintain and improve grid capacity and to not sell transmission capacity in excess of actual grid capacity.

Given FTRs are essentially financial instruments, it has been argued holders should bear the risks like any speculative bet. Monitoring Analytics, in its role as independent market monitor, has argued in favour of ARRs being fully funded, as ARRs are allocated to loads in

[41] Hogan, W. W., 2013, 'Financial Transmission Rights, Revenue Adequacy and Multi-Settlement Electricity Markets', Working Paper and FERC Submission, March.

recognition that they pay for the transmission system. The acquisition of FTRs, in contrast, is voluntary and primarily for speculation. However, the value of ARRs is determined by FTRs. Underfunded FTRs result in FTR prices being bid down, lowering auction revenues for ARR holders.

There is evidence that the market has responded to FTR underfunding, bidding down prices and volumes. The clearing price of FTR obligations dropped from $0.71/MW for 2010-11 to $0.30/MW for 2013-14. Less ARRs have been self-scheduled as FTRs, dropping from 63% in 2010 to 31% in 2013. Some market participants have looked into buying swaps on exchanges or simply accepting more risk.

A5.2.3 FTR monitoring

Monitoring Analytics (MA) serves as PJM's independent market monitor, publishing regular reports on a variety of quantitative and qualitative indicators. MA evaluates the competitiveness and design of the markets operated by PJM and makes recommendations.

MA's monitoring reports do not cover derivative exchanges, such as ICE or NYMEX, or OTC trades. Monitoring is instead focused on the functioning of the day-ahead, real-time, capacity, and FTR markets.

PJM thus conducts little to no oversight of the functioning of derivative exchanges or OTC trades, instead operating under the assumption that they function in a manner that promotes liquidity and efficiency in the final delivery of energy and that the wide variety of products available to market participants on exchanges or OTC are sufficiently liquid to meet hedging needs.

PJM does administer an extensive FTR market and thus tracks multiple FTR market indicators. These include (and are not limited to):

- Volume of bid and sell offers in MW
  - Differentiated by: obligations versus options, counter flow versus prevailing flow, by auction, and the secondary bilateral market
- Percentage of FTRs held by financial entities (banks, hedge funds, international participants) versus physical entities (utilities, customers)
  - Can serve as an indicator of the extent of speculation in the FTR market. Speculation can enhance the price discovery process, but in the recent case of FTR underfunding, some market participants suggested speculation had overtaken hedging as the primary purpose of the FTR market as it ceased to properly function
- Weighted-average price of FTRs per MW, by auction
  - Over time, this can serve as an indicator of the value market participants place on holding FTRs
- Percentage of total congestion costs offset by ARR and FTR revenues

- An indicator of how effectively the ARR allocation-FTR auction process provides a hedge for congestion costs

- FTR pay-out ratio: the percentage of the ARR target allocation covered by FTR credits (actual congestion revenue)

  - This indicator made the FTR underfunding issue immediately apparent

- Value of FTR forfeitures for physical and financial entities: companies who submit bids near the source of sink of an FTR they hold that result in a higher LMP spread in the day-ahead market than the real-time market forfeit any revenue associated with that FTR

- Percentage of ARRs that are self-scheduled as FTRs

  - A further indicator of whether market participants value holding FTRs as a hedging tool

Such indicators can serve as a signal as to whether PJM's FTR market is functioning properly. The recent inability to fully fund FTRs was immediately apparent from the decline in the FTR pay-out ratio. Knock on effects from FTR underfunding could be inferred as market participants began to price in the underfunding risk. The clearing price of FTRs declined and the percentage of ARRs 'self-scheduled' as FTRs also declined. Prices and volumes have since rebounded as the underfunding issue has subsided amid market design changes.

MA does not track OTC trades of existing FTRs. PJM has no knowledge of such bilateral transactions if they take place outside of PJM's auctions or administered secondary market.

A5.3 Capacity market

The Reliability Pricing Model (RPM) replaced the Capacity Credit Market (CCM) in 2007. Capacity prices were too low pre-2007, causing the pace of generation development to slow and some generation to retire prematurely.

Under the CCM, LSEs acquired capacity resources through the PJM Capacity Market, constructing generation, or bilateral agreements. The CCM consisted of a daily, single-price, voluntary balancing market, which accounted for less than 10% of PJM capacity. On reflection by MA, the CCM had weak performance incentives, no market power mitigation rules, and did not permit demand-side resource participation.

Having a single capacity market price did not reflect local supply and demand conditions due to transmission constraints. Offers at short-run marginal cost did not cover replacement costs unless demand was high, which discouraged peaking capacity investment, motivating the switch to RPM.

Under RPM, LSEs pay a locational capacity price for their zone. LSEs can own capacity or purchase it bilaterally and can offer capacity into RPM auctions. RPM is an annual, forward-looking (up to three years) auction which provides more competition in a long-lived asset market, reducing volatility in forward prices. A must-offer component is also imposed on capacity resources and participation is mandatory for some players. Market power mitigation rules, in the form of offer caps if the market is too concentrated and a structural definition of market power, and stronger performance incentives are in place, and demand-side resource participation is allowed.

RPM also implements an administratively determined, downward-sloping demand curve in order to determine scarcity prices rather than solely relying on participant bids. This demand curve combines with capacity offers to give a market scarcity price.

While an improvement over CCM, RPM is not without flaws.[42] These include estimating net revenues of new entrants via historical data, which can be distorted by rare scarcity pricing events. The introduction of demand-side resources in capacity markets may be a positive in allowing more flexibility in meeting security of supply needs, but demand-side resources are inherently inferior to supply products. They are given equal footing to supply products in the capacity market, which serves to suppress prices and capacity revenue.

A6 New Zealand Hedge Market

A6.1 New Zealand wholesale market overview

A6.1.1 Description

Type of market

Wholesale electricity is traded through a spot market, operated by Transpower, a State-Owned Enterprise[43]. Generators supply offers for a half-hourly period at 59 grid injection points (power stations), with retail companies and major users bidding at 226 grid exit points (many of which also include some capacity of embedded generation). The highest-priced bid offered by a generator required to meet demand for a given half-hour sets the spot price for that trading period at a specific location. Depending on grid constraints, there may be different marginal generators (and hence different spot prices) at different locations on the grid at the same time.

The market pricing principle is known as "Locational Marginal Pricing" (LMP). All electricity generated is required to be traded through the central pool, with the exception of small generating stations of less than 10MW (although these generators may be paid the spot price for their output). Bilateral and other hedge arrangements are possible, but generally function as separate financial contracts based on spot market outcomes.

Market structure

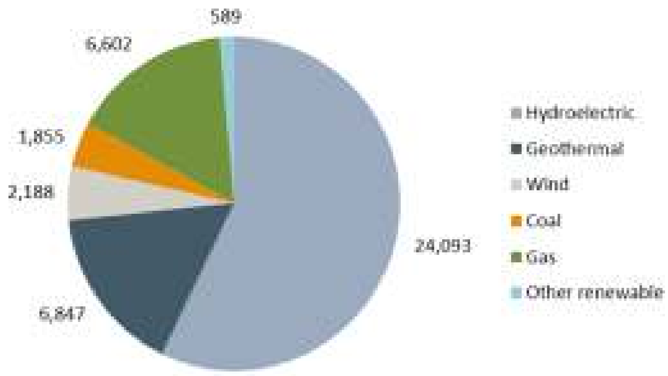
Five major generators produce around 95% of all New Zealand's electricity. Three (Meridian Energy, Mighty River Power and Genesis Energy) are under a mixed-ownership model, with the Crown holding 50% of the shares, and the remaining 50% publicly-traded. Contact

[42] Bowring, J., 2013, 'Capacity Markets in PJM', *Economics of Energy & Environmental Policy*, 2 (2), 47-64.
[43] As well as being the System Operator, Transpower is also New Zealand's Grid Owner.

Energy was previously a State-Owned Enterprise until its privatisation in 1999. The fifth company is publicly-traded Trustpower, which evolved from a local electricity supply business to a nationwide generator-retailer after divesting its network assets in 1999. There are a number of smaller generation companies.

New Zealand's generating capacity is dominated by renewable energy, with hydroelectric, geothermal and wind power providing more than 75% of the total GWh generated, as shown in Figure 23.

Figure 23 New Zealand electricity generation mix (GWh, 2014)



Source: Ministry of Economic Development

All five major generators also own retail businesses, and are therefore collectively known as 'gentailers' (generator-retailers). This provides them with a partial hedge against volatility in spot market prices.

A summary of the structure and products available in the NZ wholesale market (including the hedge market) is presented in Figure 24.

Approach to regulation

The electricity market is regulated by the Electricity Authority (EA). The EA was established in November 2010 under the Electricity Industry Act 2010, after a ministerial review in 2009 identified (among other conclusions) the need to manage hydro storage during extended periods of dry weather and to improve competition in the electricity markets, especially the retail market. Unlike its predecessor, the Electricity Commission (which existed from 2003-2010), the EA is an "independent Crown entity". This status gives an increased level of independence from government, compared with the Electricity Commission.

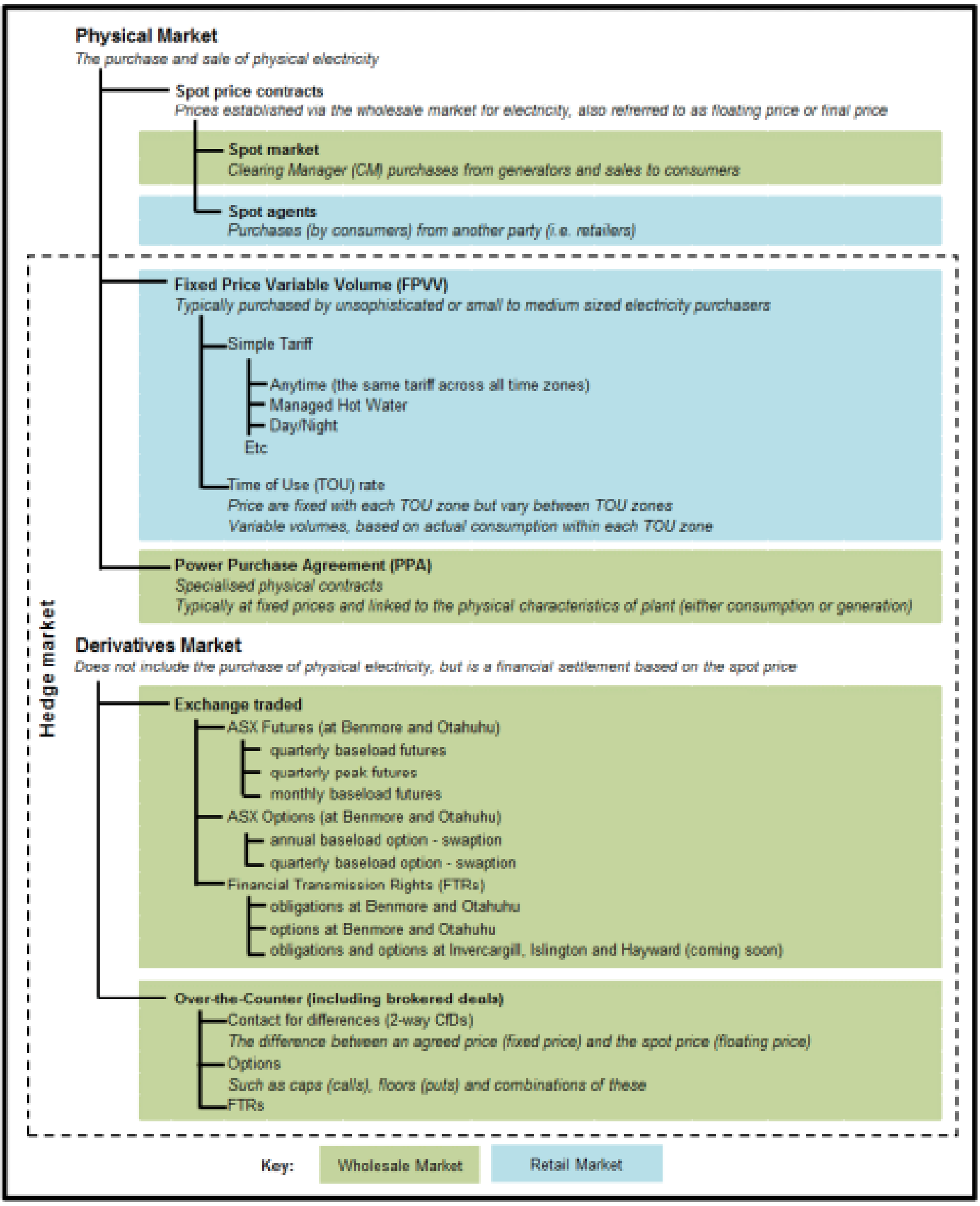
The EA provides regulatory oversight of the electricity sector. Its vision is to be a "world-class electricity regulator, delivering long-term benefits for consumers and contributing to the New Zealand economy". The scope of its operations is defined by its statutory objective to:

- promote ***competition*** in,
- ***reliable*** supply by, and

- the ***efficient*** operation of,
- the electricity industry for the ***long-term benefit of consumers***.

In general, the EA fulfils its role in a 'light-handed' manner, with the threat of regulation providing the incentive for the market (and therefore the largest operators) to exercise self-regulation. That is, rather than explicitly monitoring prices and price levels, it aims to ensure market conditions are such that "workable competition" can be achieved. The Electricity Industry Participation Code (the 'Code') sets out the duties and responsibilities that apply to the EA and all other industry participants.

Figure 24 New Zealand wholesale market structure and products



Source: Electricity Authority

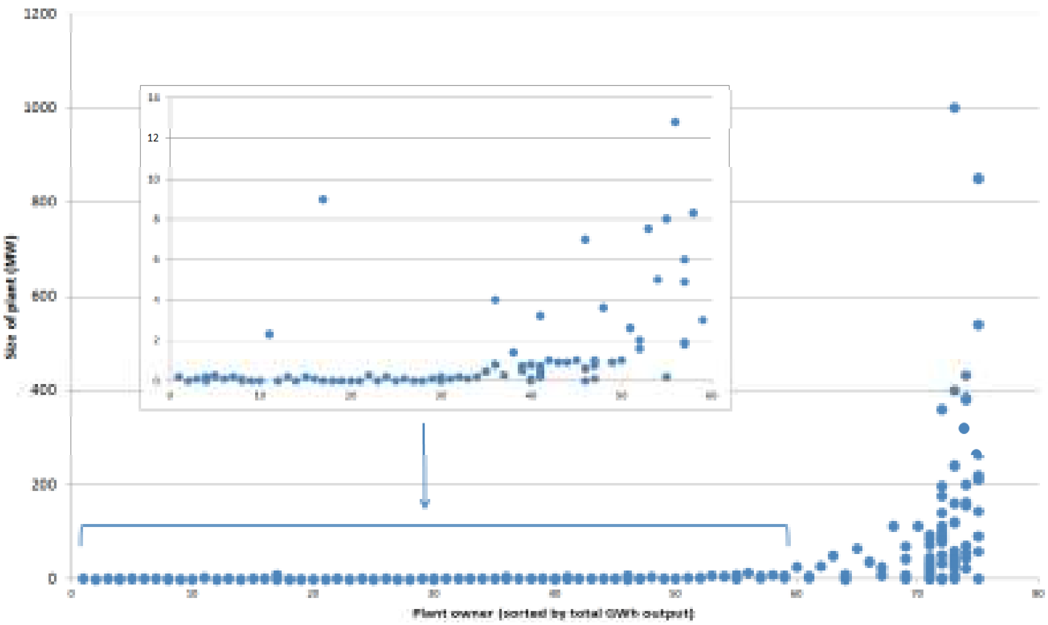
The Wholesale Advisory Group (WAG) is one of two standing advisory groups to the EA (the other being the Retail Advisory Group). The WAG provides independent advice to the Board of EA on projects concerning the design of the wholesale electricity market, including wholesale electricity, ancillary services and risk management contracts. Members of the WAG are drawn from across the industry, and include generation companies, distribution companies, large customers and independent consultants.

A6.1.2 Competition

Degree of competition

While 95% of generation is from five major companies, there are approximately 70 more generation owners. 13 of the generation companies have at least some of their capacity connected to the grid. The EA's strong focus on competition in the wholesale (and retail) market has led to positive responses from market surveys on the degree of competition. Market participants presume that there is sufficient competitive pressure on the major generation companies to lead to efficient market operation, with the lack of diversity (by volume) in the concentration of supply not leading to inefficiencies in supply. The spread of generation across the companies is shown in Figure 25, with each dot representing a specific generation plant.

Figure 25 Spread of generation across New Zealand generation entities

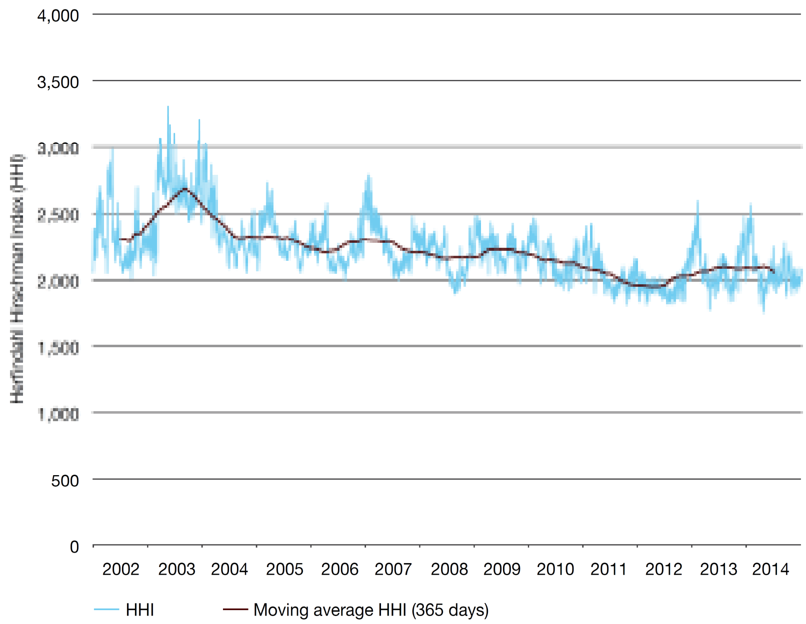


Source: Electricity Authority

Evolution of competition

New Zealand's wholesale electricity market began operating in October 1996. Trustpower was the first major private generation company, with Contact Energy's privatisation in 1999 adding a second major private generation company. Over time, there has been a steady increase in the number of generators, to the stage indicated above. The EA presented a time series of the HHI for wholesale generation in its 2014 Year in Review, presented here as Figure 26.

Figure 26 New Zealand wholesale market HHI over time



Source: Electricity Authority

Monitoring competition

The EA's interpretation of competition puts a premium on ***workable competition*** and ensuring that underlying or structural market conditions are conducive to competitive outcomes over the longer term. In a workably competitive market, suppliers are unable to influence prices over a sustained period without being undercut by other incumbent generators or new entrants. This introduces a focus on conditions for competition rather than achieving competition itself, e.g. reducing barriers to entry and exit from the various markets, and lowering transaction costs.

The EA works alongside the Commerce Commission (CC), with a shared interest in monitoring and promoting competition in the industry, with a Memorandum of Understanding to coordinate their respective roles. The CC's role is to promote competition in markets for the long term benefit of consumers within New Zealand by ensuring compliance with the Commerce Act. This includes investigating conduct that may breach the restrictive trade practices and business acquisitions provisions within the Commerce Act and enforcing compliance with them.

On rare occasions an issue highlighted by the Authority's market monitoring function may be referred to the Commerce Commission e.g. if a situation is encountered in which a market participant is suspected of taking advantage of a substantial degree of market power to prevent competitive conduct or market entry by another party.

A6.2 New Zealand hedge market

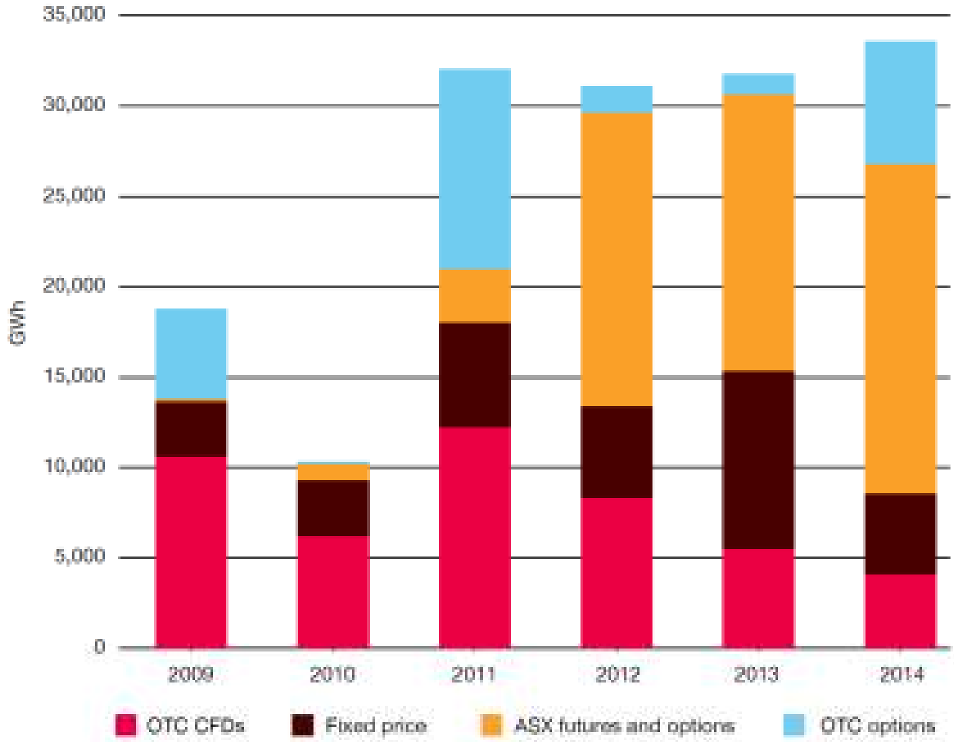
A6.2.1 Description

Type of market

There are two primary markets for energy hedges in New Zealand: the over-the-counter (OTC) and exchange-traded markets (using the Australian Stock Exchange, ASX).

Hedge products traded through the OTC market include CfDs, FPFV (Fixed price, fixed volume), FPVV (fixed price, variable volume), futures and options. The volumes (in GWh) of hedge products traded by type of contract are presented in Figure 27.

Figure 27 Volume of hedge market trades by type of contract



Source: Electricity Authority

Traditionally, a significant majority of energy hedges traded in New Zealand has been through the OTC market.

However, the ASX now represents the majority of total hedge market volumes. In 2014, around 19,000 GWh of contracted volumes were transacted through the ASX. This was equivalent to around 45 percent of the physical market, and comprised about 55 percent of all hedged volumes. This contrasts with the EnergyHedge platform, developed in 2004, but disbanded in 2010 following the establishment of ASX. Trading volumes on EnergyHedge peaked at around 2,000 GWh per year in 2008, representing around 5 percent of the physical market. Unmatched open interest sat at around 500 GWh.

There is also a separate specialised financial transmission rights (FTR) market to help parties manage the risk they face from large, unpredictable differences in wholesale electricity prices between different locations on the grid. Both obligations (two-way price differences) and options (one-way) are offered. Auctions are held twice monthly, under a single-stage, sealed bid uniform price process, however the results of the auctions (successful parties and volumes) are visible to all participants, to increase transparency. There are provisions for bilateral secondary trading to take place as long as the parties to an assignment (trade) are registered FTR market participants and meet the prudential requirements at the time. In addition, a reconfiguration auction offers a further option for secondary trading, in which not only can parties bid for FTRs, but FTR holders can offer their FTRs for sale.

Market structure

While energy hedge trading has occurred in the OTC market for many years[44], the ASX market was established in 2010, following a Ministerial review of the performance of the electricity market in 2009. This resulted in the Government placing obligations on the major generators concerning hedge market arrangements. All major generators (with over 500 MW of capacity) were requested to put in place by 1 June 2010 an electricity hedge market with the following characteristics:

- standardised, tradable contracts;
- a clearing house to act as a counter-party for all trades;
- low barriers to participation and low transaction costs;
- market makers to provide liquidity.

Section 42 of the Electricity Industry Act 2010 (the 'Act') requires the Authority to facilitate or provide for an active market for trading financial hedge contracts for electricity. Section 7 of the Act defines those parties legally permitted to trade in the OTC or ASX markets. This definition effectively includes any entity that engages actively in the electricity industry, including all generators, distributors, retailers, traders, consumers directly connected to the national grid, and aggregators.

The ASX futures market trades futures and options at two nodes – Otahuhu in the North Island and Benmore in the South Island. Electricity futures market hedges are always settled directly with the ASX. The ASX also has separate prudential requirements for traders in this market.

New Zealand's FTR market started operating in June 2013 with the two FTR points: Otahuhu and Benmore. In November 2014, the FTR market expanded to include new FTR points at Haywards, Invercargill and Islington. Energy Market Services (EMS), a division of Transpower (New Zealand's transmission grid owner and operator), is contracted as the

[44] OTC is not a market as such. Participants essentially contact other parties directly, to arrange contracts for buying or selling power, at a specific location and under certain conditions. These often take the form of sealed-bid tenders. Traditionally most generators have had a preference to sell at or near where they are located, although this has improved through the liquidity in the futures (ASX) and FTR markets.

FTR manager. The FTR Manager is also the FTR market champion in the sense that they will proactively lead development of products and promote the use of the market. NZX, the manager of New Zealand's stock exchange, acts as clearing manager. To date, there has been little analysis of the operations of the FTR market, with the EA undertaking regulation under an approach that is similarly light-handed to that of other markets.

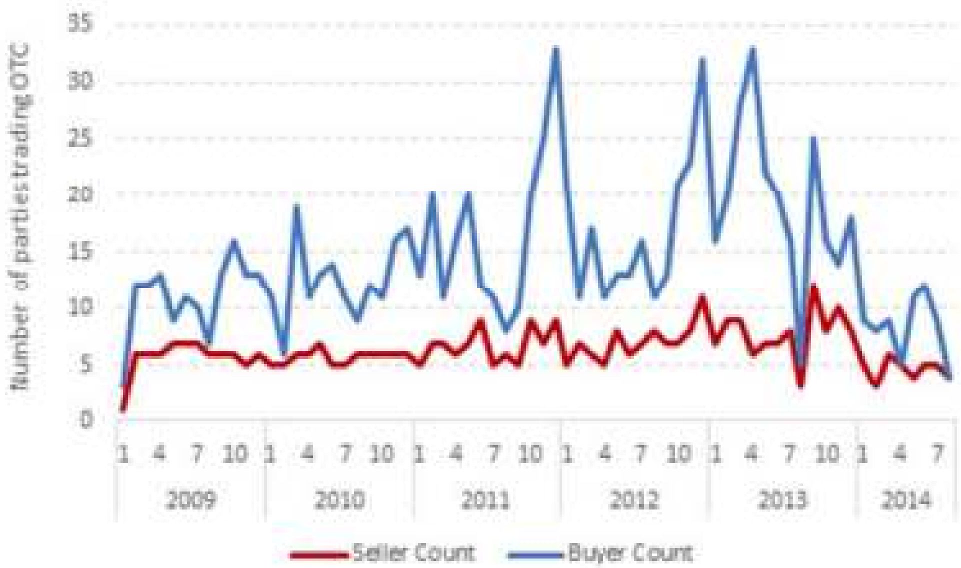
One of the EA's primary approaches to meeting its objective is through the transparent disclosure of information. To this end, Part 13 of the Code requires from all market participants the disclosure of risk management contract information, via a hedge contracts website[45].

A6.2.2 Competition

Degree of competition

In the OTC market, the number of participant trading in CfDs has grown, as shown in Figure 28.

Figure 28 Number of participants in the NZ OTC CfD market

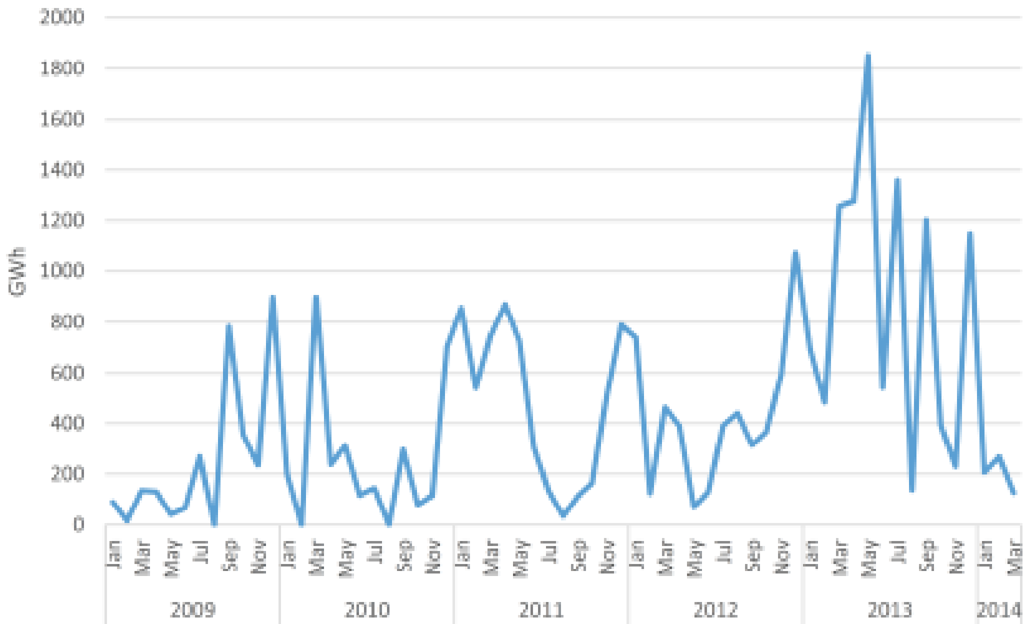


Source: Electricity Authority

While this shows that there are more participants on the buyer side of the OTC CfD market than the seller side, there is a higher number of sellers on average than there was before 2011. Similarly, the traded volumes of OTC FPVVs, according to the hedge disclosure data, have increased, as shown in Figure 29.

[45] www.electricitycontract.co.nz

Figure 29 OTC FPVV traded volumes



Source: Electricity Authority

In the ASX market, there are four market makers (Meridian, Mighty River Power, Genesis and Contact), who took on this role voluntarily. In addition, there are a number of other parties active, including brokers (e.g. OMF[46]) through whom others can trade. Trustpower is also understood to have been involved in casual trading from early on. The market makers make around 80 percent of purchases and sales. The participation on ASX can be compared with that on its predecessor EnergyHedge, on which participation was limited to the five gentailers, and ANZ (a bank) for a short period.

One recent analysis of the competitiveness of pricing in the hedging markets has shown that hedge instruments trade at approximately a 10% premium to forecast spot prices[47]. It is unclear whether this can be attributed to pricing inefficiencies or a risk premium.

Evolution of competition

The trend in the number of participants in the OTC market is presented in Figure 28 above.

There are now around nine traders active in the ASX during any one month, as shown in Figure 30.

[46] See www.omf.co.nz for more information.

[47] Energy Link

Figure 30 Number of participants in the ASX market

Source: Electricity Authority

It should be noted that this data, which is taken from the hedge disclosure website:

- does not capture all participants, because some parties do not disclose their trades
- does not capture the number of unique traders, just the number active in any one month
- counts a broker as a single trader, and hence does not account for the many parties on whose behalf they may be trading.

Figure 31 shows concentration in the ASX market using the Herfindahl–Hirschman Index (HHI) metric. With an HHI of 10,000 representing a perfect monopoly, some consider that an HHI of 2,500 or lower represents a competitive market.

Figure 31 HHI measure of concentration of the ASX market

Source: Electricity Authority

The EA has acted to reduce the amount of market power generators have in the spot market to reduce fears of hedge market participants that any single generator can have undue influence on wholesale outcomes. Relatedly, the WAG has also attempted to ensure all participants have visibility of information which may have a material impact on price outcomes in the various parts of the wholesale market through the introduction of the Wholesale Market Information Disclosure Obligations. An example of such information is the South Island snowpack, which impacts the quantity of inflows expected into hydro reservoirs over spring, summer and autumn.

A6.2.3 Objectives and problems

Objectives

The EA's core objective behind the function of the hedge market states that:

> an active hedge or futures market with transparent and robust forward prices and easy accessibility for new entrant generators, retailers and consumers is critical to promote competition, reliability and efficiency in the wholesale and retail markets.

This supports the notion that the goals of the hedge market are ultimately subservient to those of the wider electricity market (noting that the EA considers the hedge market to be just one component of the wholesale market). Therefore, if actions to improve the efficiency of the hedge market are detrimental to the wider wholesale market, they should not be pursued.

The disclosure of hedge contract information allows interested parties to view and compare hedge contract details and produce historical contract curves to better assess the competitiveness of the hedge contract market. Parties in the process of entering into a hedge contract can view details of historical contracts that may assist them when negotiating their own contracts. Contract information is presented without identifying the parties involved.

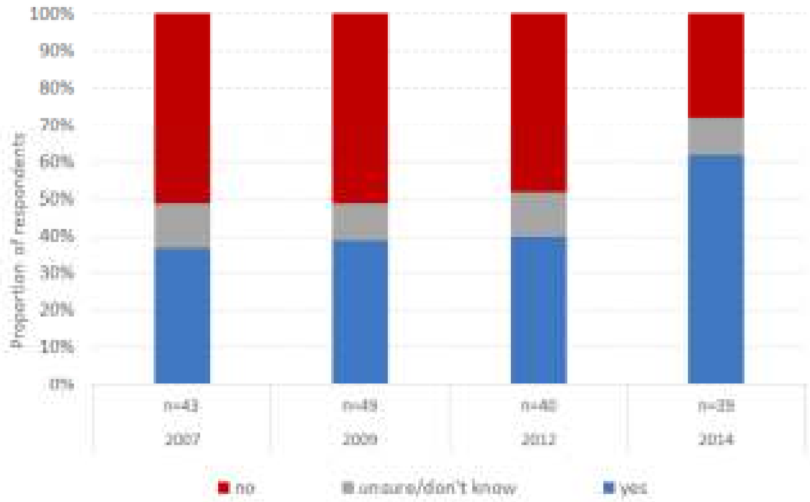
In the context of liquidity, the EA has specific targets in total unmatched open interest[48] and in unmatched open interest as a proportion of total generation. Through the actions of the market makers on the ASX in particular, the overall hedge market is growing in both its total and relative volumes.

Perceived problems

The EA conducts market research and stakeholder surveys annually on participants' perceptions of market competitiveness (including indirect participants, e.g. household consumers). The results of these show that the majority of respondents think the wholesale hedge market is generally competitive, retail less so; fewer than 30% of market participants believe the market is not competitive. This percentage has reduced over time, as shown by Figure 32.

[48] Contracts without matching offsetting contracts

Figure 32 Market views on whether a competitive hedge market currently exists in New Zealand



Source: Electricity Authority

A review of the hedge market by the WAG in 2014 identified that there are barriers to participation in the market that limit access to products, particularly for smaller-scale actors (generators, retailers and consumers).

Participants have also identified challenges in liquidity. This has multiple effects on the market:

- Trades of significant volume can lead to large movements in price, removing clear price transparency
- Bid-ask spreads can be larger, effectively increasing the costs of trading
- Challenges in exiting a position at a reasonable rate can act as a barrier to entry.

As noted in the previous section, the EA has set targets for absolute and relative volumes of unmatched open interest on the futures market, following the premise that greater volumes will improve liquidity and greater exposure to futures market prices will increase the credibility and validity of the forward curve.

Research[49] presented by the WAG has indicated that the delta (difference between future prices on the ASX and modelled forecast spot prices) in the hedge market is around 10%, but that there is variation between nodes, seasons and markets (ASX or OTC). Similarly, the finding is sensitive to changes in the reasonable assumptions necessary to forecast the modelled spot prices. Analysis of OTC prices is challenging because of less data availability and variability in the data. It is unclear if the reason for the premium in futures prices observed in the ASX is due to a risk premium, simple disagreement over prices in the future, the dynamics of the ASX market, or a pricing inefficiency.

[49] 'Futures Prices and their Relationship to Modelled Spot Prices', Energy Link, August 2014.

Instruments to address problems

The WAG's preliminary view of ways to address the challenges of liquidity in accessing the ASX, based on feedback from market participants, include[50]:

- Strengthen market making arrangements, similar to that which is currently being discussed in the UK
- Decreasing standard contract size below 1 MW – the current minimum size precludes many of the smaller players from engaging in the market
- Reduce transaction costs: require smaller bid-ask spreads from market makers, reduce transaction costs (or have more competitive brokerage fees), support initial and variation margin requirements
- Educate financial players to participate in the market
- Reduce the registration requirements for new participants; of around 2,000 customers that consume more than 10 GWh per year, only five have registered to participate.

A6.2.4 Market monitoring

As market regulator, the EA's mandate to promote competition, reliability and efficiency in the wholesale and retail markets is approached through a 'Structure-Conduct-Performance' (SCP) framework. The simple premise is that the structure of the market determines the conduct of its participants, and that this conduct drives outcomes. The more competitive the structure, the more competitive the conduct of participants and the more efficient their performance.

The EA has three distinct lines of work with regards to monitoring and regulating various hedge markets it oversees (including the hedge market):

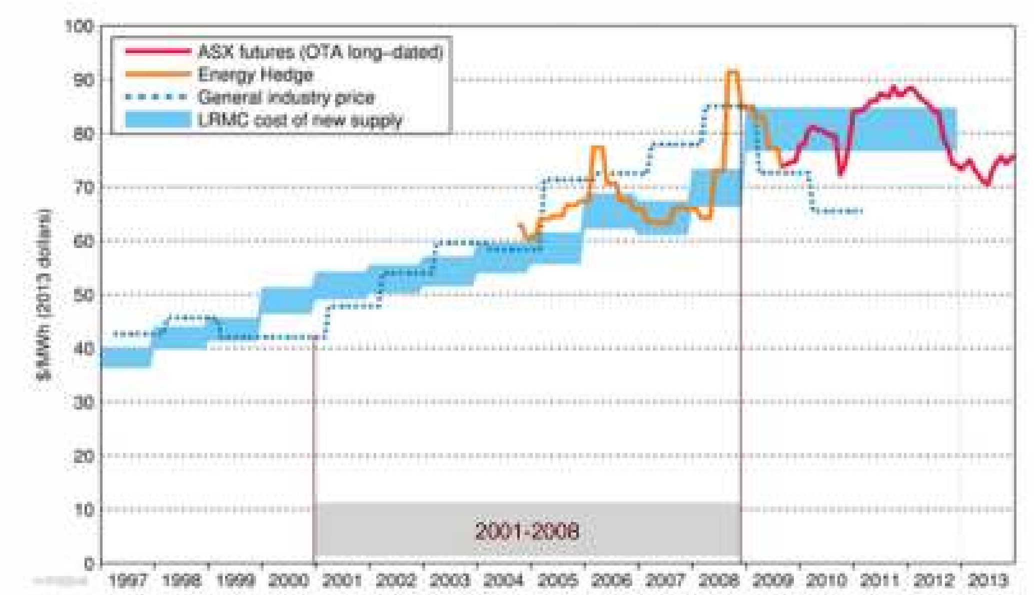
- routine monitoring to test, screen, measure, and report industry performance against specified benchmarks and thresholds;
- in-depth reviews and studies of particular topics that arise from time to time and/or are requested by the Minister of Energy and Resources; and
- market facilitation measures including educational initiatives, building market monitoring infrastructure and disseminating tools to improve market participants' own monitoring capacity and understanding of the work of the Authority.

To date, with regard to the wholesale market overall, the EA has focused more on the second and third lines of work, preferring to allow the market to 'self-regulate' against the first issues. However, it does report on some issues on a periodic basis, including market concentration (HHI), trading volumes, uncovered open interest, and net pivotal ability.

[50] 'Hedge Market Development: A WAG Discussion Paper', Wholesale Advisory Group, November 2014.

An example of the outputs of this routine monitoring is shown below in Figure 33, which plots prices from the hedge market alongside a theoretical new generation entry price (LRMC) to test the efficiency of hedge prices:

Figure 33 Hedge price v theoretical new generation entry price (LRMC)



Source: Electricity Authority

Over the past two years, the WAG has been undertaking an in-depth review of the progress of the hedge market (excluding the FTR market), with results to be published in June 2015.

Information collection

As noted, the EA conducts market surveys annually, covering some basic questions on competitiveness. In addition, it conducts more detailed surveys on particular issues as part of its enquiries, as and when they arise.

The EA routinely collects and reports on hedge market trading activity, including basic descriptive statistics. It has the mandate to provide market performance metrics as well but, to date, it has not produced any of these itself. In early 2014, the WAG produced its own analysis[51] of metrics that could be used to monitor the performance of the hedge market. These included:

- Volume
- Price, as compared with spot prices, between OTC and ASX markets, and between nodes
- Depth and liquidity
- Non-price barriers.

[51] 'Hedge Market Development Project: Metrics', May 2014, Wholesale Advisory Group.

In addition to the information that the EA provides, the forward price curve is readily available from the ASX website. It is also periodically published by independent analysts and brokers, as well as the EA. Improved price transparency in the ASX was cited as evidence for improved hedge market competition in the 2014 Hedge Market Survey. Relative to all previous surveys, respondents, particularly purchasers, were more likely to consider that there is sufficient information available to develop a view of the market price.

Detection of abuse

The EA will often investigate a particular issue if it has identified the issue internally through its own market monitoring, or an issue is brought to its attention by market participants or other stakeholders. The EA's general approach is towards "spotlight regulation", where they investigate a matter thoroughly and then shine a light for all to see on particular activity by participant(s) that may be considered out of the ordinary.

The EA's frameworks for the detection of abuse focus on two areas:

- **Compliance** with all Regulations and the Electricity Industry Participation Code (the Code)
- In the electricity market, an **Undesirable Trading Situation** (UTS) is an extraordinary event that:
  - a) "threatens, or may threaten, confidence in, or the integrity of, the wholesale market; and
  - b) in the reasonable opinion of the Authority, cannot satisfactorily be resolved by any other mechanism available under the Code."
  - A UTS claim can be lodged by any party. A notable investigation took place following an event in March 2011 that saw prices on the wholesale electricity spot market go as high as approximately $20,000/MWh over several hours for Hamilton, and regions north of Hamilton. This happened when the national grid operator, Transpower, closed part of the grid to upgrade its lines into Auckland.

A **Rulings Panel** assists in the enforcement of the Code by dealing with complaints about breaches of the Code, appeals against certain decisions made under the Code and resolving certain disputes relating to the Code. Members of the Rulings Panel are appointed by the Governor-General in accordance with a recommendation from the Minister of Energy and Resources after consultation with the Minister of Justice and the Electricity Authority. In the past two years, the Rulings Panel has only made three decisions, none of which related to the hedge market.

Remedies for abuse

The standard remedy for abuse is a fine.

By way of example, following a thorough investigation of the UTS in March 2011 (including detailed exposure and analysis of market participants' actions), the ruling from the March

2011 UTS inquiry, capped the spiked price at $3,000/MWh. The ruling judgment stated that allowing the interim (spiked) prices to become final prices would have increased uncertainty in the wholesale market for electricity, as it would have signalled that generators in a net pivotal position had total discretion in setting prices, regardless of whether a market squeeze occurred or not. The end result would have been that allowing market squeezes to occur in the wholesale market for electricity is likely to stifle competition in the hedge market.

Evaluation of monitoring effectiveness

Based on the prevailing, and improving, views of the competitiveness of the hedge market, it can be concluded that the monitoring approach is proving effective. Areas that have been highlighted for improvement focus less on monitoring and more on improved access for participants.

A6.2.5 Lessons for European markets

Adequacy of products

The WAG suggests that the majority of price risk may be able to be managed with existing tools, or will be manageable with the new FTR products. Given this, there will be diminishing returns from new products of any kind, as the residual risk will become increasingly small. However, the analysis also suggests that some elements of profile risk cannot be managed with existing tools (except through FPVV contracts).

However, in light of this view, and the fact that market participants are generally satisfied with the functioning of the hedging markets, some have raised suggestions of changes and improvements to the products available.

- As already noted, the clip size of products on the ASX is too high for many participants, at 1 MW. This is under review at the moment.
- Surveys have suggested that participants are more satisfied with the availability of products at various locations, but would still prefer a greater range of products. The addition of new nodes for trading FTRs has aided this.
- The WAG has raised the possibility of introducing further products on the ASX, such as caps, collars and floors. Caps, in particular, may be valuable in providing protection against high prices for proportions of load that are unhedged owing to mismatches in other hedging products, and for intermittent generators
- A day-ahead market is being considered as part of a wider programme of work examining the overall wholesale market

At the time of writing, the EA is about to publish a consultation paper that considers the value of introducing new products (such as half hourly caps) and pricing arrangements to support them.

Adequacy of monitoring

The monitoring approach adopted by the EA in New Zealand provides a few lessons for the monitoring of European markets:

- The 'light-handed' approach can work well, but relies on a well-functioning wholesale spot market;
- Spotlight regulation provides a strong incentive on participants to ensure their actions are well considered, and the constant and implicit threat of regulation places an emphasis on the market to resolve issues itself
- It may not be necessary to benchmark prices if there is a focus on ensuring that all the right conditions for a competitive market are in place, and focusing on achieve "workable" rather than "perfect" competition. Notwithstanding this, it is very challenging to come up with a good benchmark, especially given the need to account for various parties' portfolio positions and risk appetites.