Threshold for Publishing Inside Information

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A quantitative and qualitative study to find an appropriate threshold for publishing inside information in the Nordic and Baltic wholesale electricity market

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Executive summary

Based on REMIT, market participants shall publish inside information they possess in respect of their business or facilities. Inside information is a specific type of information, which, if it were made public, would be likely to significantly affect the prices of wholesale energy products. Therefore, an assessment on whether a piece of information constitutes inside information shall take into account the market situation and the potential market impact of the specific information.

This report aims to support the establishing of a framework for assessing whether specific facts can be seen as inside information. The authors of the report have performed quantitative and qualitative analysis that covers all market timeframes, to conclude what information may significantly affect the prices of wholesale energy products. The outcome of the study is to provide an appropriately tested threshold for the Nordic and Baltic[1] market.

First, we describe the importance and need for a common threshold and the legal background for using a threshold for the publication of inside information.

We continue by describing and explaining the methodology. Our methodology covers the non-exhaustive list of factors proposed in ACER Guidance[2] for identification of inside information. We make considerations to ensure that the methodology covers all market timeframes and bidding areas in the Nordic and Baltic market. The methodology is designed to establish a threshold that can be used in the vast majority of market situations.

As proposed in ACER Guidance, we use qualitative and quantitative analysis to test a variety of market conditions and geographical areas:

- Qualitative analysis: Covers the current practice of disclosing inside information and existing regulatory guidance relevant when establishing a threshold. Another part of the qualitative analysis is a questionnaire to traders. We asked questions to identify what information is likely to affect their trading decisions.

- Quantitative analysis: Separate testing approaches are designed for the day-ahead and intraday markets. Day-ahead is tested using the Simulation Facility, a tool that allows the simulation of market coupling scenarios using Euphemia. For the intraday market, historic UMMs are combined with relevant trading records. The aim is to conclude whether there is a significant impact on prices when UMMs are published.

Finally, after discussions on the findings and results of the analysis, we conclude. Based on input from traders and current practice, it seems that the appropriate threshold for the publication of inside information is 100 MW. The quantitative results provide econometric support for this threshold. We argue that this threshold is the most practical level that would offer the highest benefit for the market. The threshold may need to be reassessed under extraordinary market situations – special announcements made by TSOs, extreme weather conditions, etc. However, the authors of this report believe the threshold is appropriate in all market timeframes, in the vast majority of market situations.

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[1] The Nordic and Baltic market is to be understood as bidding areas in the following countries: Norway, Sweden, Denmark, Finland, Estonia, Latvia and Lithuania

[2] ACER Guidance on the application of Regulation (EU) No 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency (6th Edition, published 22 July 2021)

1 Why a common threshold?

1.1 Background and scope

REMIT[3] Article 3 provides a prohibition of insider trading in wholesale energy markets, while REMIT Article 4 sets out the obligation to publish inside information in an effective and timely manner.

Inside information may, among other things, include unavailability of production and consumption units. Market participants should have internal procedures for identifying, handling and publishing inside information. The Agency for the Cooperation of Energy Regulators (ACER) has published its Guidance on REMIT that includes, among other matters, guidelines on how to comply with the requirement to publish inside information in an effective and timely manner. Also, the REMIT Best Practice Report[4], a sector review on how to comply with REMIT related to inside information and market abuse, provides a best practice approach for establishing a compliance regime for market participants. The REMIT Best Practice Report was developed by a number of market participants in cooperation with Nord Pool, with a first edition published in August 2017.

ACER Guidance on REMIT states that best practices for internal compliance rules may include a framework for the assessment of whether the facts at hand can be qualified as inside information – "*This may include, for example, measures on how to identify inside information, appropriately tested thresholds, etc*". Importantly, it is stated in a footnote that appropriately tested thresholds are "*For example, qualitative and quantitative (econometrical) analysis to test the likelihood of a significant price effect*".

In this report, we address the issue of appropriately tested thresholds and aim to find a common threshold in terms of MW for the Nordic and Baltic market that is supported by the authors of this report. This means that we are aiming at finding a threshold to be used by market participants for identifying information that should be treated as inside information. This is a way to simplify and operationalize the daily handling of inside information for market participants.

The threshold must include the vast majority of incidents that may be inside information. It must not be set too low, due to impracticalities and the insignificance of information concerning small outages. The authors of the report fully acknowledge that this will mean that a certain piece of information may exceed the threshold and thus be treated as inside information, even if it is in fact not inside information – while the opposite is also true. This is necessary for the threshold to be commonly applied in the majority of situations and to be relied upon as predictable.

A "threshold" in this document is to be understood as a quantitative threshold in terms of MW unavailable capacity of electricity generation units, production units and consumption units, with a duration of one market time unit. This may also apply for cases where the unavailability of transmission capacity directly affects the availability of production or consumption capacity. However, this report does not investigate an inside information threshold for transmission capacity.

As the operator and developer of the Nordic and Baltic power market over the last three decades, Nord Pool sits in the perfect position to coordinate such a task. Nord Pool has a unique set of data – no other party has access to all transactions, orders, market messages and the ability to rerun the market calculation. In addition, Nord Pool has decades of experience with running a system to disclose inside

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[3] REGULATION (EU) No 1227/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2011 on wholesale energy market integrity and transparency

[4] REMIT Best Practice Report 2nd Edition

information, with market surveillance being applied. In other words, Nord Pool has a long tradition of advising market participants and of assessing potential inside information. The rest of the group behind the report represents some of the largest and most experienced companies operating in the Nordic and Baltic market.

1.2 Benefits of one common threshold in the Nordic and Baltic market

Market participants must publicly disclose in an effective and timely manner inside information relating to their own business, according to REMIT Article 4. Such information can occur in different parts of the organization at any time. Establishing whether a certain piece of information constitutes inside information can be complex and requires significant market knowledge and it is therefore important to have simple and clear internal guidelines and routines to allow employees to easily identify and publish inside information. An established threshold is an important tool in this respect. Incorporating a threshold in routines could support operational personnel in focussing on technical tasks, while at the same time ensuring a timely and effective information disclosure to the market. An established threshold, along with the rationale for implementing it, is also important for market participants to document compliance with REMIT.

The bidding areas in the Nordic and Baltic market have different characteristics. For example, some areas mainly export energy, while others import it. However, the whole Nordic and Baltic market is becoming increasingly interlinked and is in a state of constant development. With different thresholds (or assessment criteria for that matter) one would often end up in a situation where an incident in one area is not considered inside information, while a similar incident in the neighbouring area – potentially even in the same price area – is. This situation is highly relevant both in the day-ahead and intraday timeframe, where the price area is changing from hour-to-hour. For this reason, the most realistic and practical threshold would be a common one across the bidding areas concerned in this report.

A clear and well-known threshold for what is considered inside information is also valuable for users of information, whether traders or analysts, as they will know what information they can and cannot expect to have available. Further, a threshold leads to an objective differentiation between what is information and what constitutes inside information, thus removing the potential error when market participants have to assess new information as close to real time as possible, but within one hour. For information regarding unavailabilities in the future, it is very hard to know whether the event will have a significant price impact when first receiving the information. Whether it will have a significant price impact can depend on unknown fundamental factors at the time of the event, such as grid capacity, weather conditions, etc. In such cases, a threshold is very beneficial. Additionally, a threshold supports the clarification of situations where several market participants assess the same information differently, e.g., co-owners of a power plant.

1.3 Relevant regulations and guidance

1.3.1 REMIT Regulation and ACER Guidance

Article 2 of REMIT defines inside information as follows:

"'inside information' means information of a precise nature which has not been made public, which relates, directly or indirectly, to one or more wholesale energy products and which, if it were made public, would be likely to significantly affect the prices of those wholesale energy products.

For the purposes of this definition, 'information' means:

(a) information which is required to be made public in accordance with Regulations (EC) No 714/2009 and (EC) No 715/2009, including guidelines and network codes adopted pursuant to those Regulations;

(b) information relating to the capacity and use of facilities for production, storage, consumption or transmission of electricity or natural gas or related to the capacity and use of LNG facilities, including planned or unplanned unavailability of these facilities;

(c) information which is required to be disclosed in accordance with legal or regulatory provisions at Union or national level, market rules, and contracts or customs on the relevant wholesale energy market, in so far as this information is likely to have a significant effect on the prices of wholesale energy products; and

(d) other information that a reasonable market participant would be likely to use as part of the basis of its decision to enter into a transaction relating to, or to issue an order to trade in, a wholesale energy product.

Information shall be deemed to be of a precise nature if it indicates a set of circumstances which exists or may reasonably be expected to come into existence, or an event which has occurred or may reasonably be expected to do so, and if it is specific enough to enable a conclusion to be drawn as to the possible effect of that set of circumstances or event on the prices of wholesale energy products;"

ACER Guidance on REMIT provides extensive guidance on how the definition of inside information is to be interpreted. In chapter 3.3. ACER writes that

"The best practices for internal compliance rules may include:

- *a framework for the assessment of whether the facts at hand can be qualified as inside information. This may include, for example, measures on how to identify inside information, appropriately tested thresholds*, etc.;"*

The asterisk elaborates this bullet point, saying that *"For example, qualitative and quantitative (econometrical) analysis to test the likelihood of a significant price effect."*

In chapter 3.3.4. ACER writes that "*It is important, however, to note that the mere 'likelihood' of a significant price effect is enough to meet this condition and that no actual price effect is required*". ACER also specifies the assessment of the likelihood of information having a significant impact on prices:

"The assessment of the likelihood of price effect has to be performed by a market participant on a case-by-case basis. The market participant should take into consideration the anticipated effect of the information in light of the nature of the information, as well as the specificities of the market and the market situation at the time of the assessment. A non-exhaustive list of factors that are typically relevant for this assessment are provided below:

- the characteristics of the market (size, timeframe, market design, liquidity, type of participants etc.);

- the size of the event;

- the already published information on supply or demand situation;

- availability and unavailability of transmission facilities, storage or network constraints;

- the time of day (e.g. weekday/weekend, office hours/out of office hours);

- the existence of announcements on non-regular events (for example, the commissioning of new power plant, the re-commissioning of mothballed power plant, etc.);

- TSO announcements related to the system (imbalances, security of supply, technical constrains etc.); and

- any other market variables likely to affect the price of the related wholesale energy product in the given circumstances (e.g. weather conditions, CO2, fuel prices, news on political and geopolitical developments etc.).

As referred to in Subchapter 3.3, in this context, market participants are advised to have a systematic framework for the assessment of whether particular information is likely to have a significant price effect, i.e. clear internal compliance rules that reflect this non-exhaustive list of factors and are adapted both to their activities and to the specificities of the information they handle."

ACER Guidance chapter 3.3.4. also provides a list of factors on how to evaluate whether a market participant's assessment on the likelihood of some information having a significant price effect, is consistent with what would be expected from a reasonable market participant. An NRA performing an ex-post check of the reasonability of a market participant's assessment could verify whether:

- *"the type of information is the same as information which has, in the past, had a significant effect on prices;*
- *pre-existing analysts research reports, price reporter publications and opinions indicate that the type of information in question has effects on prices;*
- *the market participant itself has already treated similar events as inside information;*
- *another reasonable market participant has already treated similar events as inside information; or*
- *a reasonable market participant would be likely to use it as a part of its trading decisions[5]."*

1.3.2 NEM-regulation

In Norway, REMIT is not implemented, but similar regulations regarding the definition of inside information, the obligation to publish it and the prohibition against insider trading, exist under the Energy Act (NEM-regulation)[6]. We have not addressed the Norwegian legislation specifically in this document. However, the legislation is implemented to align the Norwegian regulations with those of REMIT. This is stated by the Norwegian regulator on its website[7] and mentioned explicitly in the comments to § 8-2 and § 8-3 in the Norwegian legislation (energilovforskriften) preceding the NEM-regulation[8]. The authors of this

[5] *"This use of this concept in this context is consistent with its use in the financial legislation. See Article 7(4) of MAR."*

[6] Forskrift om nettregulering og energimarkedet (NEM) chapter 5

[7] RMEs website on REMIT in Norway

[8] Forskrift om endring i forskrift om produksjon, omforming, overføring, omsetning, fordeling og bruk av energi m.m. (energilovforskriften)

report therefore believe that the discussions and conclusions in this document are also relevant in Norway.

1.3.3 Transparency Regulation

The Transparency Regulation[9] provides requirements for publishing unavailability information. In particular - planned unavailability of 100 MW or more and changes in actual availability of 100 MW or more of a consumption unit (Article 7) and generation unit (Article 15) shall be published. Similarly, planned unavailability of 100 MW or more, and actual changes in availability of 100 MW or more for a production unit with an installed generation capacity of 200 MW or more shall also be published (Article 15).

The requirements of the Transparency Regulation mean that there is an established practice of publishing outages of 100 MW or more to the market. Commonly, such information is also treated as inside information by market participants.

[9] COMMISSION REGULATION (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council

2 Methodology

The aim of this report is to find an appropriate, common threshold for publication of inside information in the Nordic and Baltic market, by performing qualitative and quantitative (econometric) analysis to test the likelihood of a significant price effect. The threshold should be appropriately tested and applicable for use in any bidding area of the Nordic and Baltic market, as well as be applicable under the vast majority of market situations.

The authors of this report decided primarily to investigate three different thresholds that are considered realistic and practical for the publication of inside information. Those are: 50 MW, 100 MW and 200 MW. The results for these three levels would also indicate if a higher or lower threshold should be considered.

This report considers all the aspects mentioned in the ACER Guidance. ACER writes that appropriately tested thresholds may be a part of a framework for the assessment of whether the facts at hand can qualify as inside information. Such thresholds could include qualitative and quantitative analysis to test the likelihood of a significant price effect from different types of information, or facts, to clarify whether, in the past, such facts had a significant effect on prices. ACER also writes that it is relevant to investigate which events market participants currently treat as inside information. The report should therefore investigate current market practice when evaluating the likelihood of significant price effect.

What is *not* provided in REMIT or in ACER Guidance, is numerical indicators for how large a price impact needs to be, in EUR/MWh, to be considered significant. The same goes for what probability tolerance one has for such a price impact to occur before information is considered inside information. These restrictions (or lack thereof) affect how the methodology is designed to answer the question of what is an appropriate threshold. The methodology therefore must be quite open-ended in terms of describing how we bring the results from the qualitative and quantitative analysis into a conclusion. At the end of the methodology chapter, we discuss how the eight factors from ACER Guidance mentioned in chapter 1.3.1, are taken into account in the methodology.

2.1 Qualitative analysis – methodology

The qualitative analysis aims to investigate what type of information a reasonable market participant would be likely to use as part of its trading decision. This is done by investigating current market practices and by collecting the views of traders regarding the use of information for their trading decisions.

2.1.1 Current practice – methodology

To evaluate current practice for disclosure of inside information in the Nordic and Baltic market, two different analyses are performed.

Firstly, production and consumption UMMs published on Nord Pool's UMM system from 2018-2020 are investigated. In this period, Nord Pool's UMM system was the only place where market participants disclosed inside information – meaning that the data provides a complete picture of the Nordic and Baltic market. The analysis will show what type of information market participants historically treated as inside information over different geographical areas. As part of the analysis, relevant experience from the authors of this report is also included, making it possible to discuss how a threshold for the publication of inside information would fit into the current practice. As transmission is outside the scope of the report, such UMMs are not analysed.

Secondly, to collect pre-existing reports on the topic, we gather information on guidance from relevant regulatory authorities.

2.1.2 Input from traders – methodology

Where investigating the current practice of UMM-publication gives insight into the *publication* of inside information, input from traders aims to provide additional insight on how inside information is actually *used* by them. To evaluate the views of traders in the Nordic and Baltic market, a questionnaire is sent to traders among the participants contributing to the report. The questionnaire does not have alternative choices for its answers - all answers were provided using free text. This was done to ensure traders provided their input freely.

The questionnaire was distributed to professional traders[10] both responsible for short-term physical trading and longer-term derivatives trading. The questions focused on how traders use inside information published through UMMs and what information they consider to be inside information. It was separated between normal market situations and strained market situations, to investigate if traders had views on what may be inside information under different market situations.

2.2 Quantitative analysis – methodology

The quantitative analysis will use actual trading data from the day-ahead and intraday market. It will provide econometric analysis of both markets, to support a common threshold for the publication of inside information.

There are 15 bidding areas in the Nordic and Baltic market. Our view is that if we identify the most constrained areas, our findings would also be applicable for the remaining ones. It should therefore be sufficient to focus the analysis on these areas to draw conclusions valid for all 15 bidding areas. We will also investigate if it is possible to cluster together some bidding areas, so if there are insufficient data points to reach a conclusion, it would be possible to combine observations from several bidding areas. This can be particularly relevant for Baltic bidding areas.

To identify the most constrained bidding areas, we investigate the years 2018 to 2020 and include the following parameters.

- The supply-demand balance per bidding area. Areas with low supply relative to demand may be more prone to experiencing a strained market situation. This is investigated by looking at the overall sell and buy volumes per bidding area.
- The price correlation between bidding areas. Information regarding the correlation between prices identifies areas that will be tested together for the intraday market, to ensure enough data.

In the next steps, the areas identified as constrained will be further investigated. Separate testing procedures for the day-ahead and the intraday market are used to consider different liquidity levels and market design (auction vs. continuous).

2.2.1 Day-ahead – methodology

The Simulation Facility is a web-based application in which Euphemia, the day-ahead price coupling algorithm, is embedded. This allows the simulation of market coupling scenarios based on historical and/or user-defined data. The tool is available to Nord Pool, as a NEMO (Nominated Electricity Market Operator). The Simulation Facility can re-run Euphemia for a given period or date using the actual data

[10] The authors of this report are of the opinion that the Nordic Electricity market is a market for professional traders, and it is not relevant to consider market participants that are not professional.

from the Single Day-Ahead Coupling (SDAC). It is also possible to alter the original input data. This allows us to investigate how reduced supply will affect the market price. In our case, we chose to remove price-independent supply volume. By doing so, we can investigate the scenario where an asset that would otherwise be generating is out of the market.

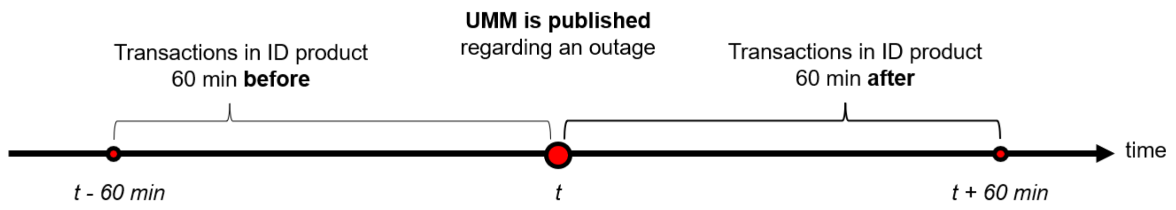
We choose to simulate one week in each of the eight quarters of 2018 and 2019. This will ensure that the price impact is evaluated in periods with different fundamental market conditions such as seasons, weekdays and weekends, holidays, different water reservoir levels and different consumption. The week in each quarter with the highest system price is simulated, in order to approximate a strained market situation. A threshold working under such strained market situations would be well suited for normal situations as well.

50 MW, 100 MW and 200 MW supply will be removed to identify the price impact of reduced supply. Simulation is limited to the supply curve as we expect similar results if we were to alter the demand curve.

2.2.2 Intraday – methodology

To investigate the price impact of outages in the intraday market, transaction data are combined with the publication of Urgent Market Messages (UMM) on Nord Pool's UMM System[11]. By doing this, it is possible to measure how the publication of UMMs with different MW outages has affected intraday market prices. The price impact is quantified for each UMM by calculating the difference between the volume weighted average price (vwap) in the 60 minutes before UMM publication and the vwap 60 minutes after UMM publication in the area concerned.

Figure 1: Illustration of how the price impact of a UMM, the vwap, is quantified.



We use the following UMMs:

- Published in 2018, 2019 and 2020 in the 15 Nordic and Baltic bidding areas
- Production unavailability messages – due to the limited amount of published consumption messages, these are not included
- Outage size of minimum 20 MW, as those are especially relevant for the analysis.
- UMMs published before the event and where there are affected intraday products open for trading
- The first message in each UMM-series – since that is a completely new event, we expect the largest price impact for these UMMs
- If a UMM contains multiple periods with different levels of unavailability, then the period with the largest unavailability is investigated. This is done in order to capture the affected product with the most significant price impact.

[11] https://umm.nordpoolgroup.com/

Based on the publication time of the UMM, the following transactions are considered:

- Transactions with delivery time during the event time of the UMM
- Transactions (buy and/or sell side) in the same area as the UMM12
- Transactions happening within 60 minutes post and prior to UMM publication. By doing this, we try to isolate the price effect of the UMM publication from other factors driving prices in the intraday market.

Using this data, we conduct a descriptive statistical analysis and a regression analysis.

2.2.3 Significant price effect – methodology

For a fact to be considered inside information, a trader using the information should be likely to be able to make a profit if he/she trades based on that information. To be considered significant, a price impact stemming from inside information should be relatively high compared to the general uncertainty in the market. A way to quantify the uncertainty in the market, is to investigate the performance of an existing market modelling tool when it tries to predict market prices for the day-ahead auction. In this report, we analyse Montel's area price predictions. Montel has a commercial area price prediction model that is generally recognized in the market. As Montel only delivers price predictions for the day-ahead market, we will compare the model with the price impact from removing supply, as described in chapter 2.2.1.

2.3 Discussion of methodology

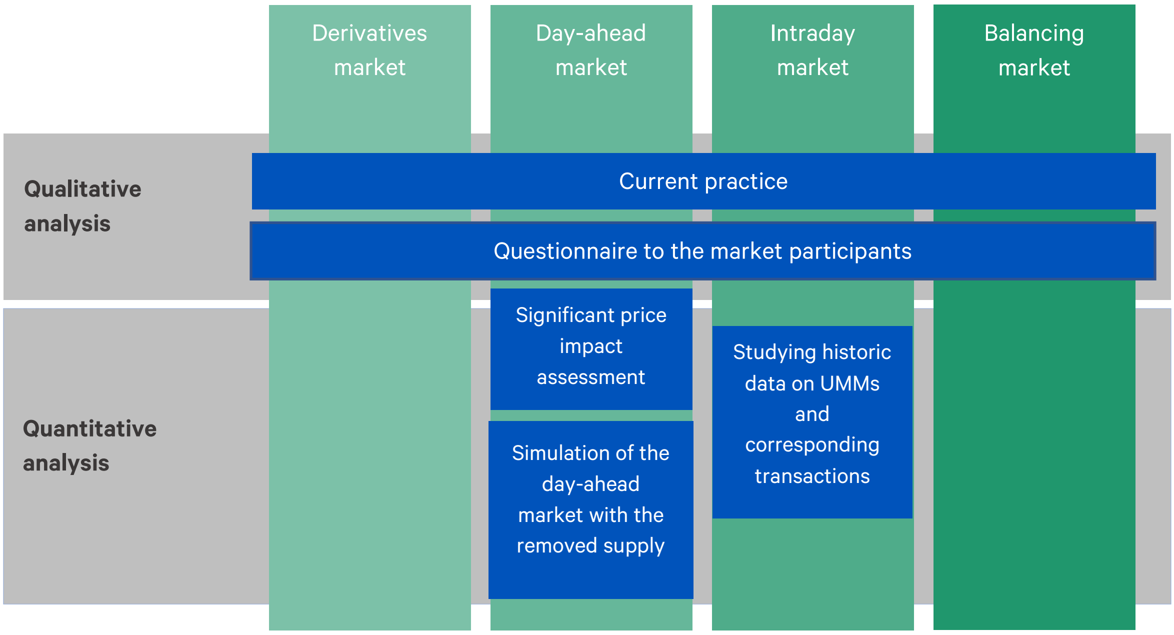
A challenge with the day-ahead methodology is that it measures the price elasticity of the market, rather than the impact of the potential information. To our knowledge, there is no suitable methodology to test how the market would change its bidding behaviour in the day-ahead market when inside *information* is published. In this sense, the price elasticity of the market works as a proxy for the actual effect the disclosure of information would have on prices. The results we get may show a larger price impact than the disclosure of the inside information would actually have had on the day-ahead price.

However, the intraday methodology should, to a great extent, capture the price effect of the publication of inside information. A drawback with the intraday methodology is that it may be other facts or information that drive the price change (upwards or downwards) rather than the specific UMM being investigated. By analysing enough data over a longer period, we hope to minimize this random effect. Another aspect is that only UMMs with observations both before and after the publication will take part in the analysis. Null-observations, where the publication led to no transactions or transactions only before or after, will not be taken into account. Therefore, the results might overestimate the price impact of UMM publication.

The questionnaire will give insight into what type of information market participants consider when placing orders in the market – but the questionnaire, sent out to a limited number of traders, may not be representative of the whole market. Similarly, current practice will show what facts market participants treat as inside information, but it might be that market participants also publish facts that do not have a significant price effect. By being aware of the advantages and disadvantages of the different procedures, the report should be able to see the overall picture and draw conclusions based on that. An illustration of the methodology is found in Figure 2 below.

[12] We acknowledge that in case there is transmission capacity available to other bidding zones, trading in those bidding zones might also be considered. We choose to focus only on the bidding zone, where the UMM is published, as it is more likely to reflect the price impact of the UMM, and as it is not trivial to add hub-to-hub capacities between bidding zones to the analysis.

Figure 2: The structure of the methodology, covering four different market timeframes.



2.3.1 Evaluation of methodology under ACER Guidance

We consider that the methodology covers the ex-post check of reasonability from ACER Guidance mentioned at the end of chapter 1.3.1. By doing intraday and day-ahead quantitative analysis we check if the same information, in the past, had a significant effect on prices. The review of guidance from regulatory authorities will show what information is considered to have an effect on prices. By examining historical UMMs we investigate what kind of information market participants have previously treated as inside information. The questionnaire sent to traders will show what kind of information market participants are likely to use as a part of their trading decisions.

The methodology of this report considers the factors for assessment of inside information proposed in ACER Guidance, presented in chapter 1.3.1. How the methodology of this report captures each of these factors is addressed below.

- *Market specificities and characteristics of the market (size, timeframe, market design, liquidity, type of participants, etc.).*

The methodology is designed to analyse different market specificities and characteristics by investigating the day-ahead and intraday markets, while the effects of inside information on the financial and balancing markets is discussed in 2.3.2 and 2.3.3. A choice has been made to identify the most constrained bidding areas and situations for the day-ahead market and only to analyse products in the intraday market where it is possible to quantify a price impact. We believe these design choices makes it possible for the report to make universal considerations without going into the details of each situation specifically and that these considerations will also be valid going forward.

- *The size of the event.*

The methodology explicitly investigates different event sizes in terms of MW unavailable production. This is done via quantitative analysis both for the day-ahead and intraday market, as well as in the questionnaire to traders. A wide range of event sizes is therefore analysed in the report, to see how the event size affects the price impact of the information.

- *The already published information on supply or demand situation, and*
- *Availability and unavailability of transmission facilities, storage or network constraints.*

The day-ahead methodology captures strained market situations, due to analysing only those weeks in each quarter of 2018 and 2019 with the highest system price. Although the methodology does not include a specific assessment of, for example, transmission facilities or already published UMMs, it is believed that the generally strained market situation can be used as a reliable proxy for such events.

The threshold in this report considers the vast majority of situations. This means that there may be extraordinary market situations, for instance due to special circumstances regarding the abovementioned indicators, where a separate assessment will be necessary. In such situations an assessment of individual announcements may be relevant.

- *The time of the day (e.g. weekday/weekend, office hours/out of office hours).*

The methodology does not differentiate by hour of the day, or by days of the week. As argued above, the selection of the week in each quarter with the highest system price in 2018 and 2019 seeks to capture a generally strained situation. We believe that this will, to a reasonable degree, expose the price impact in, for example, peak hours on days with high demand – thus not making a specific time-of-day- or weekday/weekend-assessment necessary.

- *The existence of announcements on non-regular events (for example, the commissioning of new power plant, the re-commissioning of mothballed power plant, etc.)*, and
- *TSO announcements related to the system (imbalances, security of supply, technical constrains etc.)*, and
- *Any other market variables likely to affect the price of the related wholesale energy product in the given circumstances (e.g. weather conditions, CO2, fuel prices, news on political and geopolitical developments etc.).*

Market announcements and market variables can change rapidly. Our aim is to find a threshold that can be used in the vast majority of market situations. Therefore, the testing procedure for the day-ahead market specifically targets a generally strained market situation. Considering generally strained situations limits the necessity of evaluating individual announcements and making separate assessments.

2.3.2 Balancing market

Market participants have an obligation to balance their position before the balancing market. This obligation comes from balancing agreements with the respective TSO and is, in some countries, also written into law[13].

Consequently, the price impact of new information, e.g. about an unplanned production unavailability, is already included in transactions on the intraday market. It may be possible that the new information concerns products already closed for trading in the intraday market and therefore may affect the balancing market. We consider that if the information is likely to have a significant price impact on the balancing market, then it is also likely to impact sequential intraday products still open for trade. As a result, we believe our testing procedure for the intraday market also covers situations which may impact the balancing market. Thus, the conclusions drawn from the intraday market can be extended to the balancing market.

2.3.3 Financial market

Generally, the financial market uses the physical market as underlying. Primarily, derivatives are based on day-ahead prices coming from SDAC. This means that the value of derivatives products is fully dependent on actual price development in the physically settled market. It is therefore our view that information regarding unavailable capacity that is not considered inside information in the underlying market should also not be considered inside information in the derivatives market.

Similarly, as financial trading has a longer time horizon and is often based on the average of several wholesale energy products, what is considered inside information in the underlying market, should be considered as a lower boundary for inside information in the financial market. The further in the future financial trading is considered, the lower the impact of the information that is published.

Based on these considerations, the threshold should therefore also apply to the financial market.

[13] I.e. § 8 of the Norwegian Forskrift om systemansvaret I kraftsystemet

3 Qualitative analysis

3.1 Current practice

3.1.1 UMMs published in the Nordic and Baltic region

Investigating the current practice of UMM publication is important for assessing a threshold for inside information, as it shows what outages market participants have previously considered as inside information under REMIT[14].

A range of different outages is published through Nord Pool's UMM system. In the below figure you can find a frequency distribution, based on maximum unavailable capacity in MW, of the first version of production UMMs published in the Nordic and Baltic region 2018 to 2020[15], in total 7 498 UMMs.

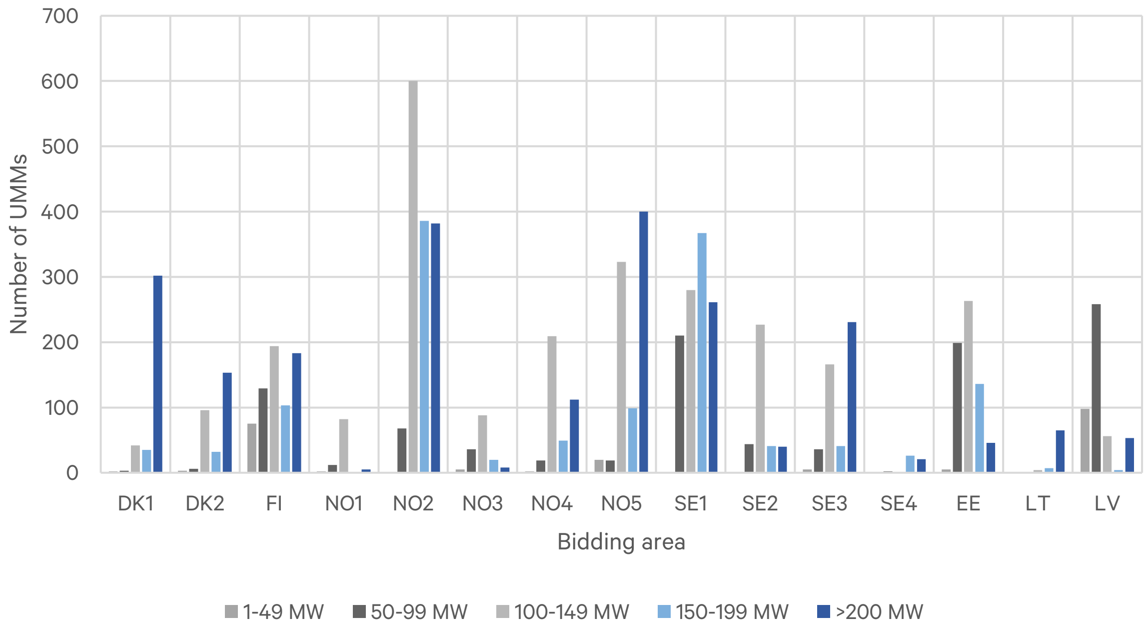


Figure 3: Frequency distribution of production UMMs published in 2018-2020.

[14] We believe the UMMs are representative for what outages market participants consider inside information, as the distribution of UMMs is not proportionate to the size of power plants in the Nordic power system. To exemplify, 89.6 % of power plants in Norway have an installed capacity of below 50 MW by the end of 2020, while UMMs below 50 MW only accounted for 6.2 % of UMMs in Norway in the period investigated.

[15] Only the first message in each UMM-series was counted, messages with an unavailability of 0 MW were disregarded and if a message covered multiple time periods with different unavailabilities, only the unavailability of the first time period was considered.

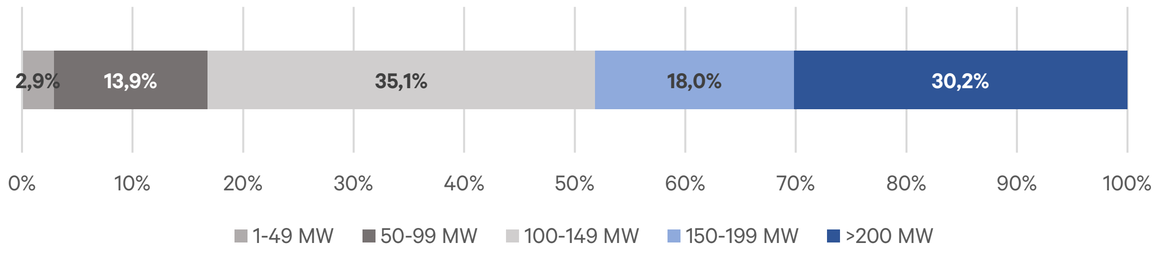


Figure 4: Percentage of different MW intervals of production UMMs, published in 2018-2020.

Figure 3 and Figure 4 show that 2.9% of UMMs published concern outages below 50 MW and that the majority of these UMMs are published in Finland and Latvia. Production UMMs concerning outages below 100 MW make up 16.8%. These percentages give an indication of how many currently published UMMs would potentially not be published, if a strict threshold was implemented.

However, in the experience of the authors, UMMs concerning low MW outages often contain additional information, making these UMMs inside information. Examples are change of fuel[16] which will mainly affect marginal cost, but marginally affect the available capacity. It may also be an on-going/scheduled unavailability at the same plant[17] or uncertainty about the exact unavailability[18]. Another cause is if it is likely that the accumulated unavailable capacity will later exceed the threshold from Transparency Regulation[19]. The publication of UMMs regarding small unavailable capacity may also mean that some market participants prefer to publish too much information, rather than risk publishing too little.

Figure 5 shows that relatively few consumption UMMs are published, compared to the amount of production UMMs. Like production UMMs, most consumption UMMs are in the range between 100 and 199 MW.

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[16] UMM exemplifying change of fuel
[17] UMM exemplifying ongoing/scheduled unavailability at the same plant
[18] UMM exemplifying uncertainty about the exact unavailability
[19] According to the Transparency regulation outages of more than 200 MW in one production unit have to be published. For power plants with several generation units below 100 MW it may be preferable to publish outages on generation unit level in order ensure compliance with the 200 MW threshold whenever several generation units are unavailable at the same time.

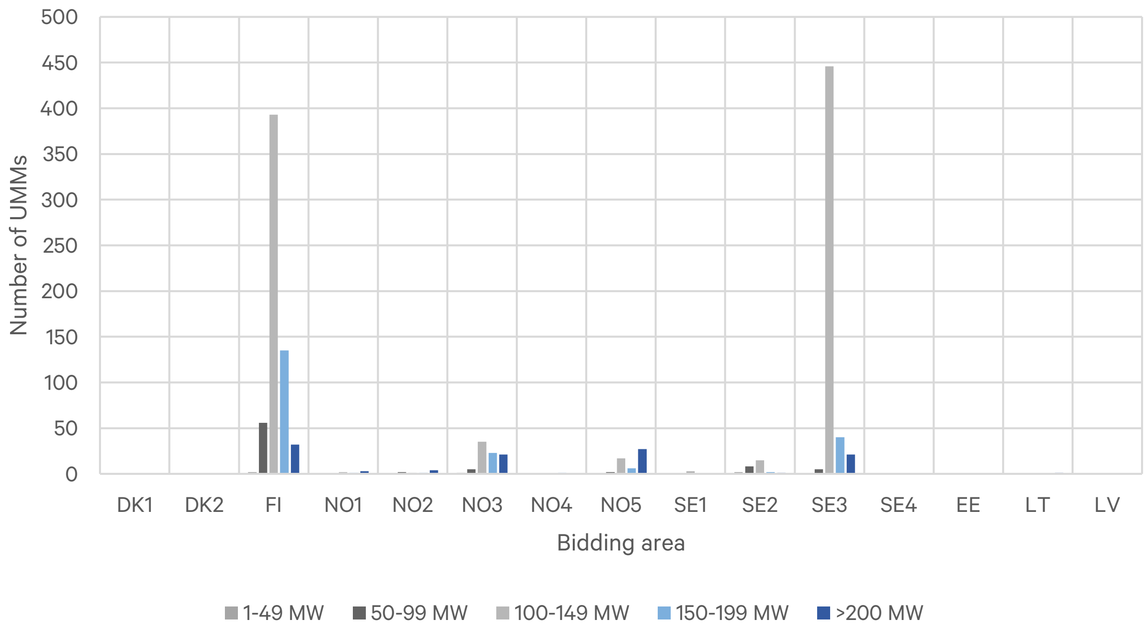

Figure 5: Frequency distribution of consumption UMMs published in 2018-2020.

3.1.2 Guidance from regulators

In this report we also consider existing regulatory guidance and decisions that can be useful for identifying an appropriate threshold.

3.1.2.1 Consultation answers to the Transparency Regulation

The Transparency Regulation has a similar purpose as REMIT as it aims to create transparency regarding relevant market information. Part of the process leading up to the implementation of the Transparency Regulation was a public consultation by the European Regulators' Group for Electricity and Gas (ERGEG) in 2010[20]. ERGEG's initial impact assessment, which supplemented the consultation document, outlines that a 100 MW threshold had been in force since 2006[21] and that "*on the basis of the gained experience it seems reasonable to preserve the current threshold for publication*"[22]. ERGEG's summary of the consultation answers[23] shows support for a 100 MW threshold and that no stakeholder argued for a lower threshold than 100 MW for the publication of planned and unplanned outages.

3.1.2.2 ACM's REMIT consultation

ACM (Authority for Consumers and Markets, the Dutch NRA) consulted stakeholders in August 2013 on topics related to the publication of inside information[24]. In this consultation, ACM also invited market participants to provide their thoughts on the need to establish a threshold for the publication of inside information relevant to the gas market.

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[20] Public consultation for ERGEG Draft Comitology Guidelines on Fundamental Electricity Data Transparency
[21] COMMISSION DECISION of 9 November 2006 amending the Annex to Regulation (EC) No 1228/2003 on conditions for access to the network for cross-border exchanges in electricity
[22] ERGEG Draft Comitology Guidelines on Fundamental Electricity Data Transparency page 22 and 23
[23] Evaluation of responses for ERGEG Public Consultation on Fundamental Electricity Data Transparency
[24] Evaluation of responses for ACM Consultation on Publication of Inside Information

Respondents considered that turnover, liquidity and size of national consumption are important factors in determining the threshold. It was also important to align the threshold with neighbouring countries. Some respondents proposed to perform a quantitative analysis to find out at what MW-level information has a market influencing effect – everything that has a market influencing effect shall be published. Also, there were several concrete proposals for the exact threshold. However, while ACM concluded that there seemed to be a genuine need for a clear threshold, they stated that "[e]stablishing the threshold is too difficult, since it depends on the market and market circumstances whether information on outages has a price influence."

3.1.2.3 CRE report on the effect of unavailability on the short-term risk premium

In September 2021 the French NRA CRE (Commission de régulation de l'énergie) published a study of the price sensitivity of wholesale electricity to unavailability of generation capacity in France[25]. The study uses regression models to investigate if changes in aggregated unavailable capacity[26] can be used to explain the price change between the corresponding day-ahead and intraday products. As control variables in the regression, the consumption forecast error, solar and wind generation forecast error and imports/exports on cross-border connections, were used. Different measurements of the intraday price were used (price index, volume weighted average price, last, min and max price). The period from 2015 to 2020 was studied.

The study concludes that the publication of 100 MW outage did not, on average, have a significant influence on the French intraday market. The overall findings of the report lead CRE to consider that the unavailability of electricity production resources of a magnitude less than specified in Transparency Regulation are not, as a general rule, likely to have a significant effect on the prices of wholesale energy products and therefore, are not qualified as inside information under REMIT.

3.1.2.4 E-Control Q&A regarding the price impact of information

E-Control (the Austrian NRA) publishes Questions and Answers on interpretation of REMIT on its webpage[27]. One question refers to significant price effect: "When are prices likely to be significantly affected?". Among other factors, E-Control states that "For the electricity market, it was assumed before the AT-DE price zone separation that a limit value of 100 MW [outage] would influence prices. Due to the changed market situation, however, this threshold value has to be seen critically. For both natural gas and electricity, this limit must be set lower in narrow market situations." Based on this, it appears that E-Control identifies the size of the bidding zone as one factor affecting the significance of price impact of outages. In E-Control's view, the price impact following an outage is different in normal and strained market situations.

3.1.2.5 Baltic stakeholder meeting

We have been informed that several years ago there was a meeting between market participants and NRAs in the Baltic region where a threshold for publication of inside information was discussed. In this meeting it was considered that the 100 MW threshold from Transparency Regulation was too high for the publication of inside information under REMIT and that 50 MW would be an appropriate threshold.

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[25] Étude sur la sensibilité du prix de gros de l'électricité aux publications d'informations relatives aux indisponibilités des moyens de production en France

[26] This is done by measuring the change in available capacity between 11:30 CET, half an hour before gate closure of SDAC, and the intraday gate closure.

[27] The full list of questions is available on E-Control's website

3.2 Input from traders

A questionnaire was distributed to traders within market participants contributing to the report. This resulted in 19 responses, representing both traders from the physical and derivatives markets. Some companies provided answers representing the company as a whole, meaning there were several traders represented in one questionnaire. Others provided one response from each trader. Consequently, the answers represent the views of more than 19 individuals, but this is not weighted into the summary below. Not all 19 provided a response to all questions. The full questionnaire and the traders' responses can be found in Appendix 4 – Questions to market participants. The main findings from the questionnaire are categorized and presented below.

Do you actively use UMMs as input to your trading strategy in the Nordic market?

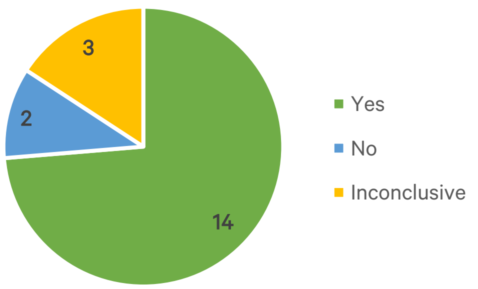


Figure 6: Summary of question to traders.

16 out of 19 respondents provided a conclusive answer to the question. Of these, 14 confirmed that they actively use UMMs as input to their trading strategy. Two traders responded that they did not use UMMs for this, as they place orders based on production costs.

Respondents were also asked what outage size, in UMMs for the Nordic market, would be likely to affect the price and/or volume of orders they place in the market – under normal and strained market situations.

When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in normal *situations?*

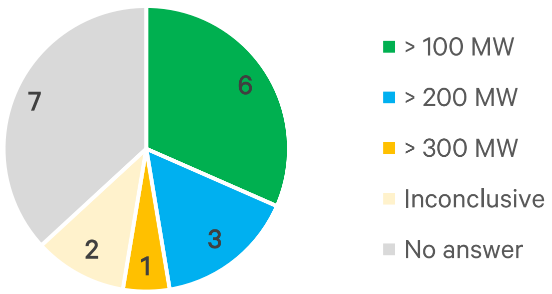


Figure 7: Summary of question to traders.

When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in strained situations *(e.g. situations with very cold weather, low water reservoir levels, or similar)?*

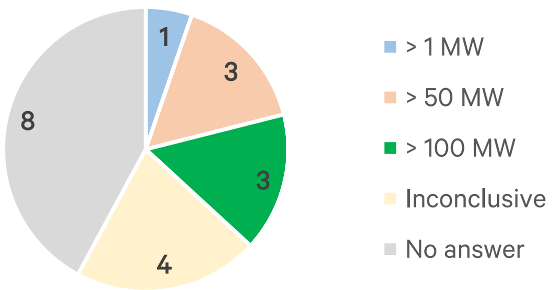


Figure 8: Summary of question to traders.

12 out of 19 respondents answered the question regarding reading UMMs in *normal* market situations. Of these 12, all ten answers which could be categorized, stated 100 MW or more. In the *strained* market situation UMMs concerning lower outages are considered by some traders, as 4 of 11 answered that UMMs above 1 MW or above 50 MW could affect their orders.

Traders were also asked directly if they considered a threshold of 100 MW appropriate.

Today, many market participants are applying a threshold of 100 MW for publishing an outage as inside information. Do you consider this as an appropriate threshold?

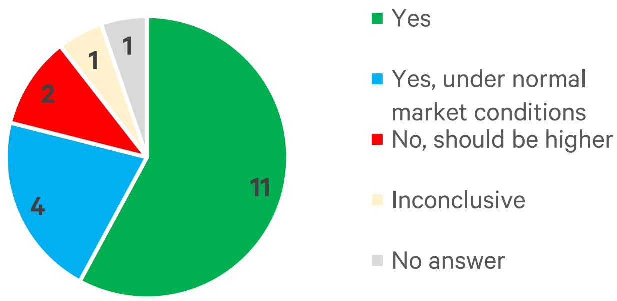


Figure 9: Summary of question to traders.

Of the 19 respondents, 18 provided an answer to this question. Categorization of answers is provided above. In addition, some respondents specified that the appropriate threshold would be different in *normal* and *strained* situations. 17 of 19 respondents believed 100 MW is a sufficiently low threshold for publishing inside information under *normal* circumstances. Four of the 19 respondents believed a 100 MW threshold was sufficient under normal circumstances, but a lower threshold could be suitable under strained circumstances. Respondents who suggested a number, suggested that between 50 and 100 MW in strained situations could become inside information.

In addition to those discussed above, traders were asked several questions regarding their view on a threshold for publication of inside information. Some highlights were the following.

- Some respondents state DK2 and FI as areas where UMMs typically have a high impact on prices. SE4 is also mentioned as a sensitive area.
- One respondent specifically pointed at the level of uncertainty when arguing for a sensible threshold for publishing inside information:

  > *"What unavailabilities that should be published needs to be put in relation to all other uncertainties where, with the big wind build, the uncertainty in wind forecasts probably is the largest one. Given this the current practice of 100 MW seems appropriate, or the other way around a lower value seems in-appropriate."*

- One respondent also highlighted that UMMs are often published for events far into the future, making it difficult to assess the market situation at that future point. It is therefore desirable that the threshold chosen is the same in all market situations.

4 Quantitative analysis

In this chapter we firstly identify the most constrained bidding areas. Afterwards, analysis of the day-ahead and intraday market is carried out on the most constrained areas, before showing the performance of Montel's price predictions.

4.1 Identifying the most constrained bidding areas

4.1.1 Supply and demand balance

Table 1 below shows the hourly mean buy and sell volumes on Nord Pool for 2018, 2019 and 2020 in MW. Based on that data, sell volume divided by buy volume as a percentage is provided.

Table 1: Mean sell and buy volumes in 2018, 2019 and 2020 and sell divided by buy as a percentage

	SE1	SE2	SE3	SE4	FI	DK1	DK2
Sell volumes (MWh)	2 510	5 231	9 539	873	7 367	2 277	902
Buy volumes (MWh)	1 142	1 843	9 785	2 724	9 412	2 351	1 496
Sell divided by buy	220%	284%	97%	32%	78%	97%	60%

	NO1	NO2	NO3	NO4	NO5	EE	LV	LT
Sell volumes (MWh)	2 057	5 617	2 459	2 854	3 453	794	685	452
Buy volumes (MWh)	4 082	4 126	3 020	2 192	1 854	936	822	1 375
Sell divided by buy	50%	136%	81%	130%	186%	85%	83%	33%

The colour coding in the table above shows areas having the weakest supply-demand balance. The following areas stick out: SE4, LT, NO1, DK2 and FI. Note also that Baltic areas have relatively low mean production and consumption – indicating that a change in supply or demand may have a greater price effect than in larger bidding areas. SE4 and DK2 have low production.

4.1.2 Price correlation between bidding areas

A correlation analysis is used to assess whether some bidding areas can be considered as a single price area, since their prices tend to change in the same direction over time. This is relevant for the intraday market when there are too few data points in a single bidding area to perform a meaningful analysis.

When looking at hourly day-ahead prices in the Nordic and Baltic region, certain bidding areas have a strong correlation over time. In many periods, these bidding areas also display the same day-ahead price. Figure 10 shows the correlation of hourly day-ahead prices for 2020. The lighter the colour, the stronger the correlation.

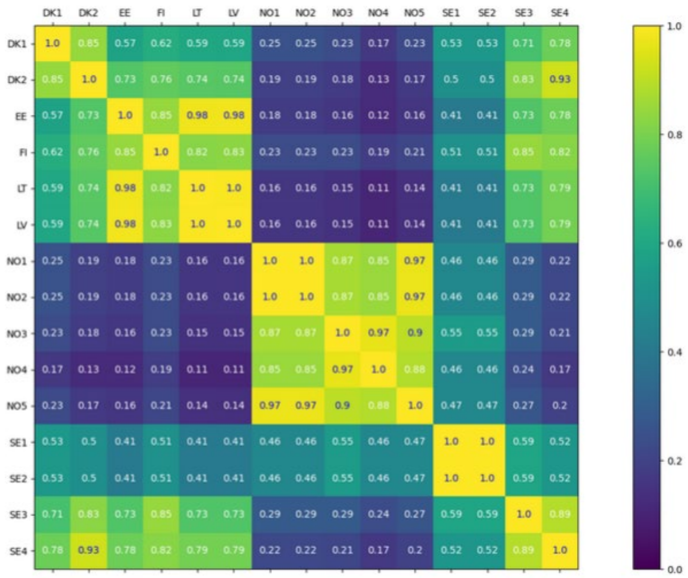


Figure 10: Correlation of day-ahead prices (2020). The numbers are rounded to the second decimal place.

Certain bidding areas have a high correlation with one another, indicating a strong interdependency:

- Northern Sweden (SE1 and SE2) correlation 1
- Baltic countries (EE, LT, LV) correlation at least 0.98
- Northern Norway (NO3 and NO4) correlation 0.97
- Southern Norway (NO1, NO2, NO5) correlation at least 0.97
- Southern Sweden and East Denmark (SE4, DK2) correlation 0.93

To make sure these observations hold historically, we also perform analysis for 2018 and 2019. The same distinct groups are clearly visible. This can be seen in Appendix 1 – Correlation analysis in years 2018 and 2019.

4.1.3 Areas chosen for quantitative analysis

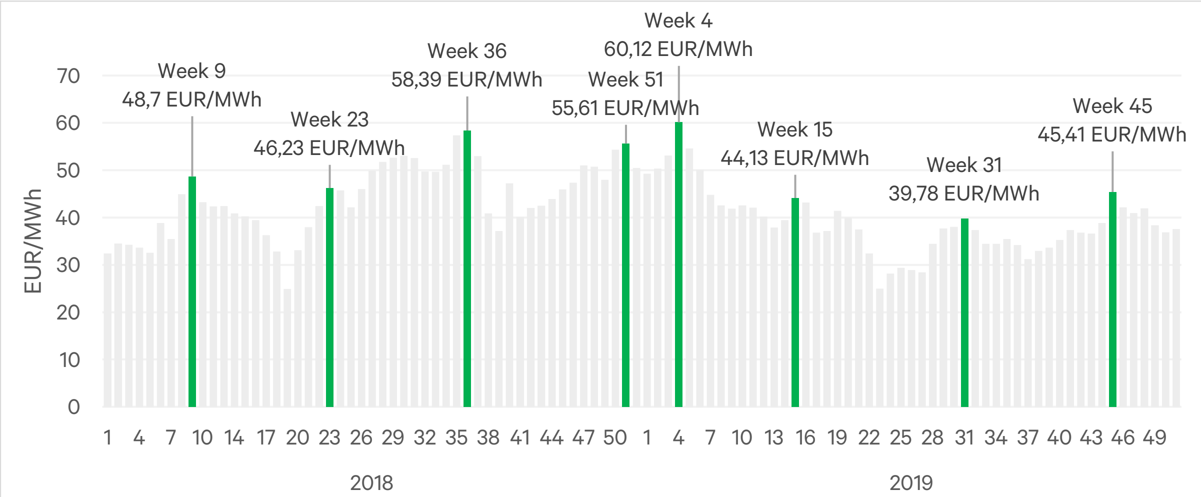
Our assessment is that the bidding areas most likely to be sensitive to outages are SE4, LT, NO1, DK2 and FI. These areas will therefore be the focus for quantitative analysis. The Baltic areas have a high correlation with one another. As LT has the weakest supply-demand balance of these, LT is the preferred area for further analysis. By choosing these five bidding areas, all Nordic countries - Norway, Sweden, Denmark – and Finland are represented, while LT represents the Baltics.

The correlation analysis identified 5 distinct groups of bidding zones, where prices in day-ahead are highly correlated (over 0.93 or above). This indicates that these areas are more likely to be in the same price area and also remain coupled in other market timeframes. The following areas will therefore be clustered together for the intraday analysis: (EE, LT, LV), (NO1, NO2, NO5), (SE4, DK2). The area-clusters (SE1 and SE2) and (NO3 and NO4) will not be prone to intraday analysis as they have a good supply-demand balance and high correlation.

4.2 Day-ahead market

The bidding areas identified in the previous chapter as most sensitive to changes in supply (NO1, DK2, SE4, FI and LT) are simulated and analysed according to the methodology in chapter 2.2.1. Weeks with the highest system price in each quarter in 2018 and 2019 will be simulated. These weeks are shown in Figure 11.

Figure 11: The weeks in each quarter of 2018 and 2019 with the highest system price.



First, a benchmark is made by re-running Euphemia for the given period without any changes to input data[28]. Then we run simulations where 50, 100 and 200 MW price-independent supply is removed. This means shifting bid curves horizontally. Finally, the price difference between the benchmark run and the rest of the simulations is analysed.

4.2.1 Simulation results

Simulation results are illustrated by the boxplot in Figure 12. This shows different statistical properties of the data:

- The vertical line in the box represents the median of the data
- The ends of the box show the lower (Q1) and upper (Q3) quartiles (for example, if the Q3 is 1 EUR/MWh, it means that 75% of observations are lower than 1 EUR/MWh)
- The horizontal line[29] reflects the range containing most of the observations, or the highest and lowest value excluding outliers

There is an evident increase in the median price impact when more supply is removed, as can be seen by the vertical line inside the box moving to the right. Also, the uncertainty of price outcome is increased when more supply is removed, illustrated by the broadening of the box.

[28] The official market prices cannot be used as a benchmark due to the continuous evolution of the underlying Euphemia algorithm, i.e. we want to compare prices which are based on the same Euphemia version. Additionally, benchmark and simulation runs that cover the same period are run on the same Simulation Facility machine, i.e. the same hardware to ensure comparability.

[29] The difference between Quartiles 1 and 3 is called the interquartile range (IQR). The line represents shows Q3+1.5xIQR to Q1-1.5xIQR.

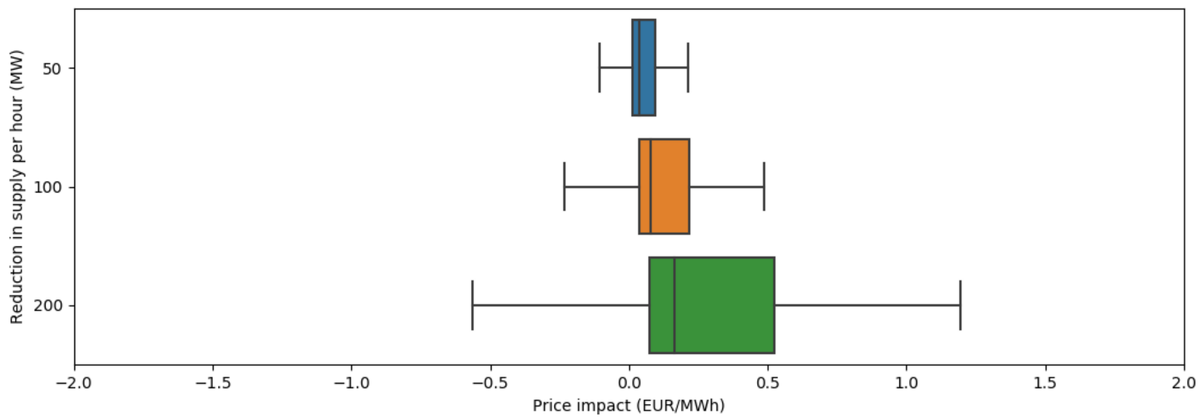


Figure 12: Box and whisker plot showing distribution of all observed price impacts in DK2, FI, LT, NO1, SE4. The vertical line in the box represents the median of the data. The ends of the box show the lower (Q1) and upper (Q3) quartiles. The horizontal line reflects the range containing most of the observations, or the highest and lowest value excluding outliers.

The figures below visualise the same data as in the plot above, but do so per bidding area. It is clear that when less supply is available, this leads to a higher median price impact and higher uncertainty for all areas. FI and LT are the areas most sensitive to removal of supply.

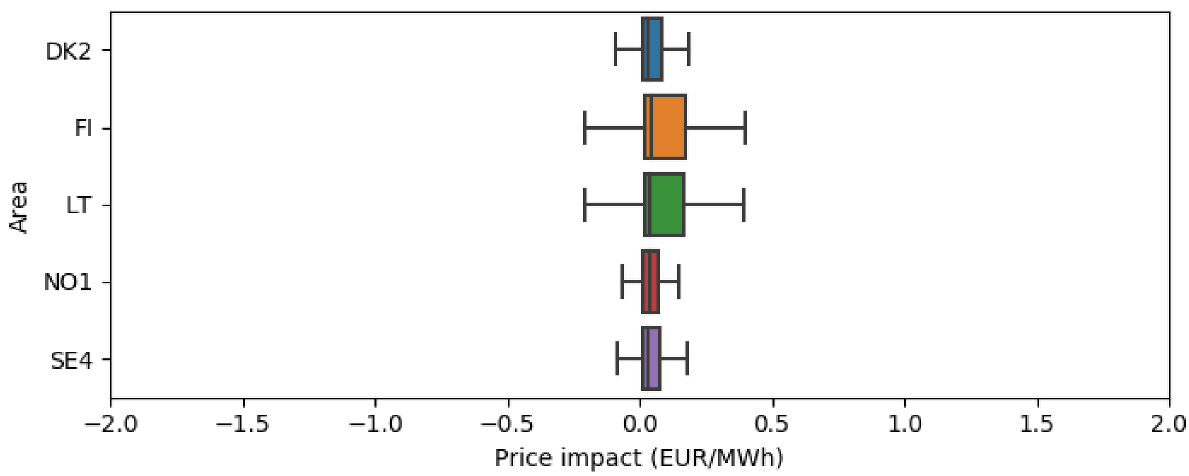


Figure 13: Box and whisker plot representing price impact after a removal of 50 MW supply. The vertical line in the box represents the median of the data. The ends of the box show the lower (Q1) and upper (Q3) quartiles. The horizontal line reflects the range containing most of the observations, or the highest and lowest value excluding outliers.

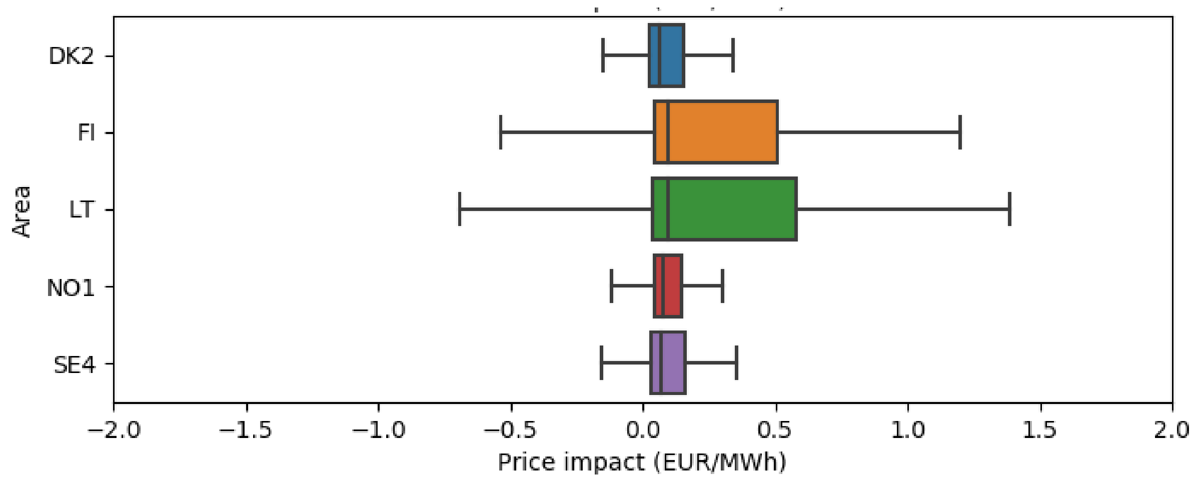


Figure 14: Box and whisker plot representing price impact after a removal of 100 MW supply. The vertical line in the box represents the median of the data. The ends of the box show the lower (Q1) and upper (Q3) quartiles. The horizontal line reflects the range containing most of the observations, or the highest and lowest value excluding outliers.

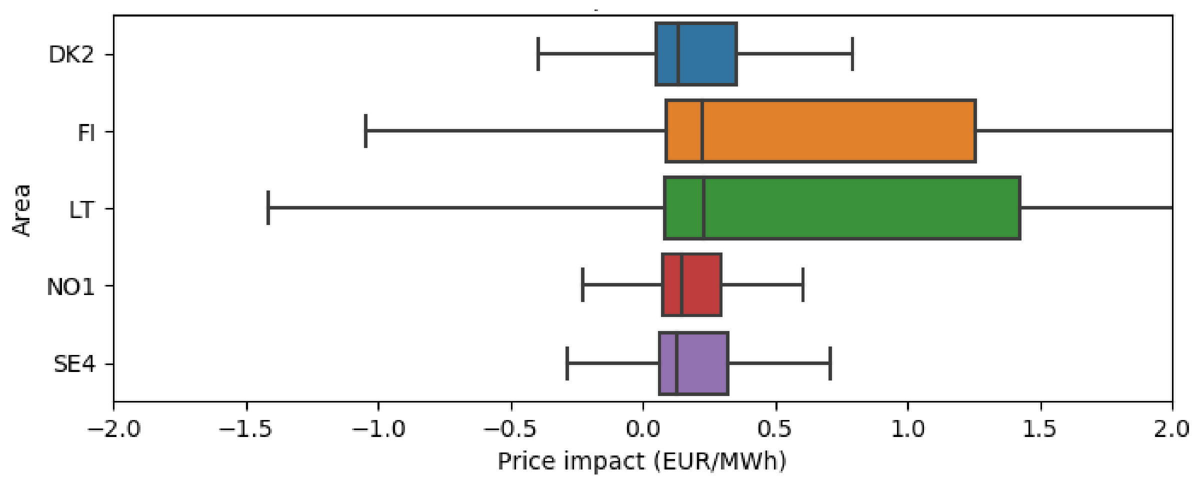


Figure 15: Box and whisker plot representing price impact after a removal of 200 MW supply. The vertical line in the box represents the median of the data. The ends of the box show the lower (Q1) and upper (Q3) quartiles. The horizontal line reflects the range containing most of the observations, or the highest and lowest value excluding outliers.

Table 2 contains the mean, median, standard deviation (SD) and 95% and 99% quantiles of the data illustrated in the above figures. More details from simulations in specific weeks, areas and some additional statistical parameters can be found in Appendix 2 - Results of the simulations in the day-ahead market.

Table 2: Price impact in EUR/MWh of 50/100/200 MW removed supply in the day-ahead market per bidding area. The number of observations is n=1344 for each bidding area, for each volume of supply removed (each row of the table).

50 MW					
	Mean	Median	SD	95 %	99 %

DK2	0.16	0.03	1.01	0.52	4.71
FI	0.62	0.04	3.76	1.85	7.96
LT	0.58	0.04	2.85	2.23	14.32
NO1	-0.32	0.04	2.31	0.35	1.77
SE4	0.12	0.03	0.55	0.45	1.89

100 MW					
	Mean	Median	SD	95 %	99 %
DK2	0.38	0.07	1.82	1.32	7.64
FI	1.18	0.10	5.68	3.69	27.77
LT	0.97	0.09	4.86	4.61	19.53
NO1	0.24	0.08	0.98	0.68	4.04
SE4	0.28	0.07	1.06	1.21	5.44

200 MW					
	Mean	Median	SD	95 %	99 %
DK2	0.82	0.14	3.14	3.92	16.25
FI	2.48	0.22	11.15	6.75	57.88
LT	1.95	0.23	6.22	7.79	29,41
NO1	0.47	0.15	1.93	1.44	6.32
SE4	0.54	0.13	1.84	1.75	9.17

The median price impact is close to zero for all sizes of removed supply and in all bidding areas. For 200 MW in Finland and Lithuania the median is 0.22 and 0.23 EUR/MWh – the highest of the areas. This shows that in most hours the removed supply resulted in a limited price increase across all areas. The mean is consistently higher than the median, indicating that there are outliers driving up the mean. The only exception is in NO1 when 50 MW is removed, where the average price was reduced. This is likely due to a different activation of blocks than in the benchmark simulation. The largest impact of removed supply seems to be in FI and LT, where removal of 100 MW supply on average leads to a 1.18 and 0.97 EUR/MWh price increase, respectively. For 200 MW, the mean is 2.48 and 1.95 EUR/MWh.

Considering the 95% quantile (the more extreme market outcomes) DK2, NO1 and SE4 all show a minor effect (up to 1.32 EUR/MWh) of removing up to 100 MW. For LT and FI 95% of simulated hours saw a price impact of less than 3.69 and 4.61 EUR/MWh, respectively, for missing volume of 100 MW. LT had the highest 95% quantile for removal of 50 MW – 2.23 EUR/MWh, while it stays below 2 EUR/MWh in FI. Removing 200 MW had a larger price impact – 95% quantile reached 7.79 EUR/MWh in LT.

4.3 Intraday market

Using the criteria described in the methodology chapter, 3 920 UMMs were identified and trading data from the corresponding 34 898 products was investigated. Less than 10% of the products (3 434 products) had trading in the 60 minutes after the UMM was published. Only 1 946 products had trading both in the 60 minutes before and after the publication of the UMM and, therefore, could be used in the analysis.

The fact that most UMMs had no trading either before or after the UMM, shows that most UMMs did not have a measurable price impact. It should be kept in mind that excluding all of these from the analysis may lead to an over-estimation of the expected price impact from a UMM.

To analyse the data we first analyse the price impact by performing a descriptive statistical analysis in different bidding areas. Second, to investigate the relationship between the size of the outage and the price impact, we perform a linear regression analysis for the different bidding areas.

4.3.1 Price impact after publication of the UMM

The difference between the vwap 60 minutes before and after publication of a UMM is defined as the price impact of the UMM. We fit a probability density function to the data to get a descriptive overview of the price impacts. The data is not normally distributed, so we fit an alternative distribution[30] instead of the normal distribution. By doing so, we find the single *most likely* outcome, further referred to as the loc-parameter. This fitted distribution for all price impacts is illustrated in Figure 16. For a complete overview, Appendix 3 - Results of the simulations in the intraday market, provides additional details on the data presented in this chapter.

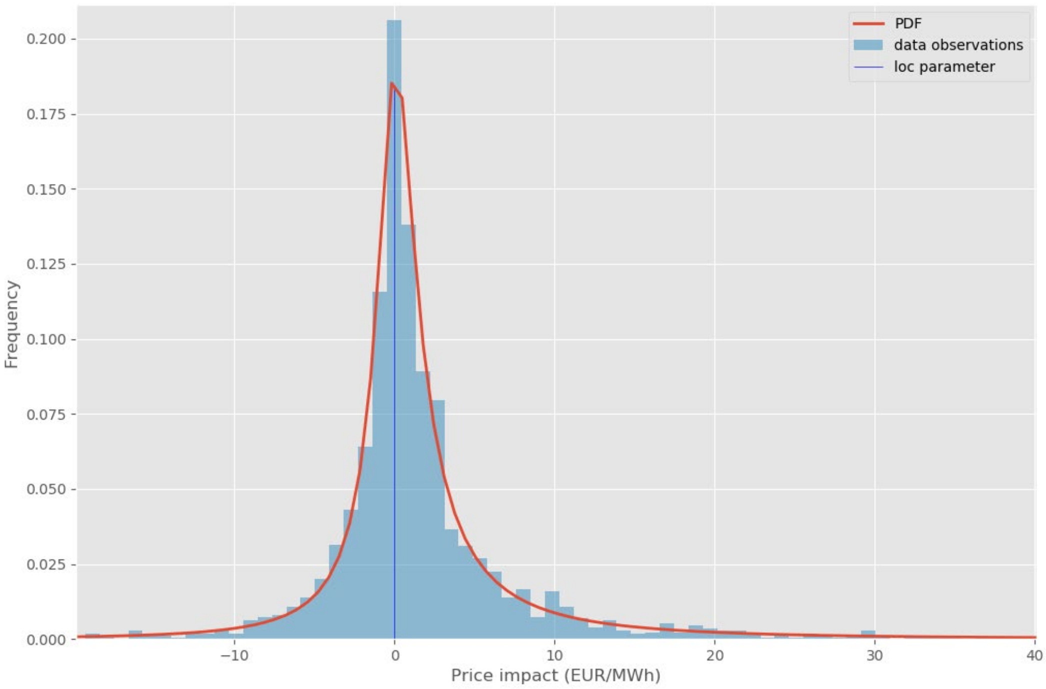


Figure 16: All price impacts with the best fit probability density function – johnsonsu(a=-0.27, b=0.60, loc=-0.05, scale=1.22).

[30] We performed normality tests to study if the dataset follows the normal distribution, which were negative. The distribution used is therefore a Johnson SU-transformation of a normal distribution. See appendix 2.

Figure 17 shows the 1 946 products grouped together using the outage size, less than 100 MW, from 100 to 199 MW and from 200 MW upwards.

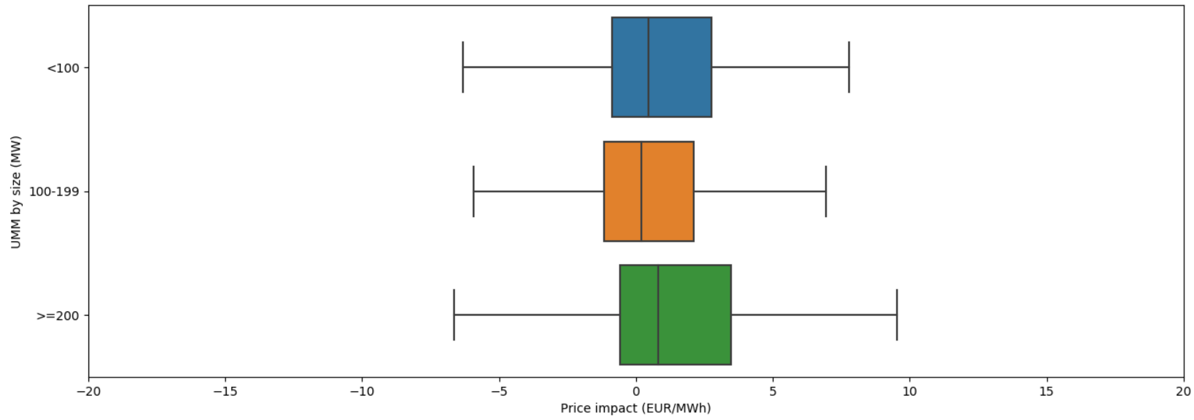


Figure 17: Box and whisker plot illustrating price impact in the intraday market after publication of UMMs. The vertical line in the box represents the median of the data. The ends of the box show the lower (Q1) and upper (Q3) quartiles. The horizontal line reflects the range containing most of the observations, or the highest and lowest value excluding outliers.

A more detailed description of the data in Figure 17 is presented in Table 3. Table 3 shows that the mean and median price impacts are the largest for the largest unavailability messages (UMM > 200 MW), indicating that the larger the UMMs, the larger the price impact on average. However, the *loc* parameter is very close to zero in all categories. This means that the single most likely price impact of the UMM publication is close to zero for all categories. In other words, when a UMM is published, the single most likely outcome is - no price impact.

Table 3: Statistical characteristics of price impacts in EUR/MWh, represented with mean, median and single most probable outcome (loc). All data points are divided into three categories, depending on the size of the UMM. See the extended version of the table in Appendix 2.

UMM size	Mean	Median	SD	95%	99%	Loc
<100 MW (n=398)	1.46	0.44	8.85	12.08	36.79	0.04
100-199 MW (n=778)	1.28	0.18	9.94	12.76	29.54	-0.08
>200 MW (n=770)	3.77	0.82	19.03	17.06	62.37	-0.04

Similarly, we present statistical characteristics for the bidding areas identified as most strained in Figure 18 and Table 4. As there are a limited number of observations in some of the investigated bidding areas, we combine the results from several bidding areas.

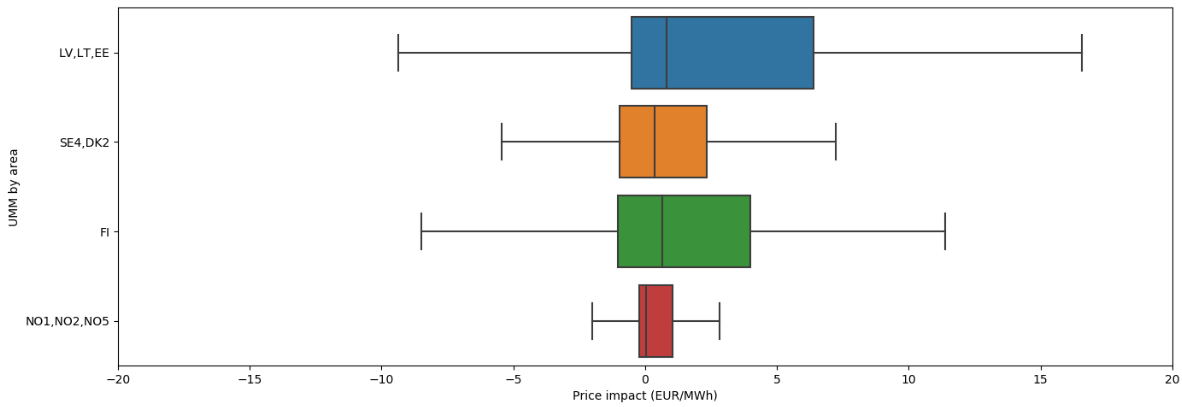


Figure 18: Box and whisker plot illustrating price impact in the intraday market after publication of UMMs. The vertical line in the box represents the median of the data. The ends of the box show the lower (Q1) and upper (Q3) quartiles. The horizontal line reflects the range containing most of the observations, or the highest and lowest value excluding outliers.

Table 4: Statistical characteristics of UMM data points and price impacts in EUR/MWh, represented with mean, median and single most probable (loc) in different bidding areas. See the extended version of the table in Appendix 2.

Bidding area	Mean UMM size	Mean	Median	SD	95%	99%	Loc
LV, LT, EE (n=126)	157.44	2.97	0.82	10.20	20.38	29.16	0.26
SE4, DK2 (n=108)	267.47	1.47	0.36	7.84	9.11	28.56	0.14
FI (n=830)	153.56	3.60	0.66	20.32	19.77	67.93	-0.09
NO1, NO2, NO5 (n=108)	177.57	0.42	0.03	2.31	3.80	7.19	0.06

Table 4 shows that mean UMM size varies between the areas. FI and the Baltics have the lowest average outage size, just above 150 MW, but the highest mean price impact (3.60 and 2.97 EUR/MWh, respectively). The median is below 0.82 EUR/MWh for all areas and the loc-parameter, the *single most likely* price impact of UMM publication, is close to zero. As the mean is higher than the median, the mean is affected by outliers.

4.3.2 Regression analysis

To analyse the relationship between the size of an outage and observed price impact, we perform a linear regression analysis. The definition for the price impact is the same as in the previous subchapter. The regression model is:

$$Price\ impact = \alpha + \beta * MW_{UMM} + \varepsilon$$

Based on the observed price impact and the corresponding outage size, a value for α (intercept) and β (slope) is estimated by the regression model. Keep in mind that when doing a regression analysis with only one explanatory variable, one assumes that other variables other than the outage size of UMMs which affect the price impact are zero on average. The regression model fitted to the whole dataset is presented in Figure 19 below. Each dot represents an observation of price impact and outage size.

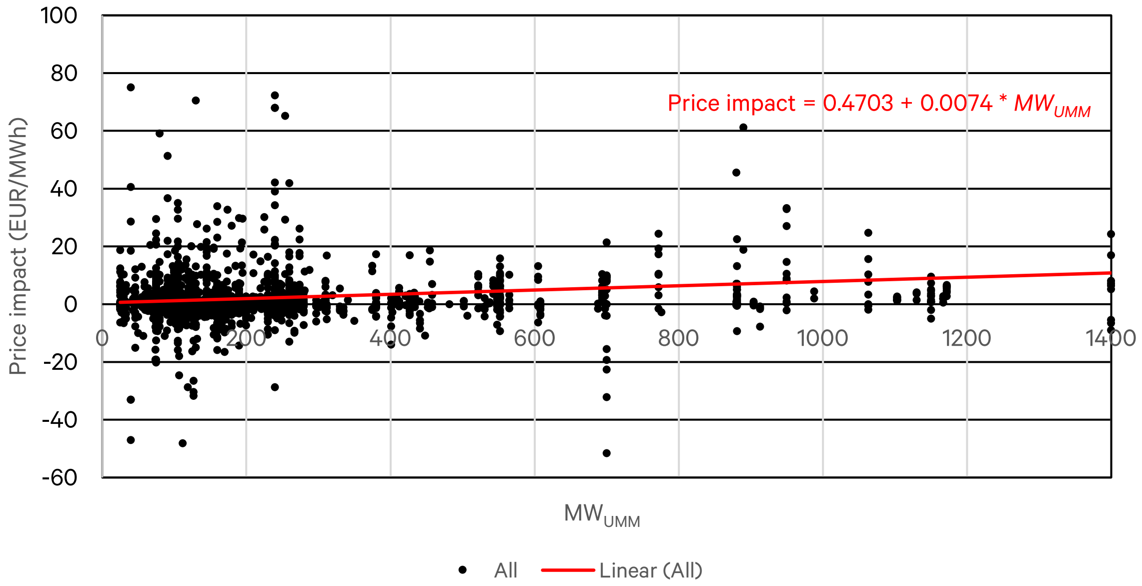


Figure 19: Regression plot for all bidding areas

The equation of the fitted trendline is 0.4703 + 0.0074 * MW_{UMM}. The trendline has a positive slope of 0.0074 – meaning that for each MW increase in outage size, the price impact is predicted to increase with 0.0074 EUR/MWh. The intercept of 0.4703 together with a positive slope tells us that the regression model in general predicts a positive price impact. Entering a 100 MW UMM into this equation predicts a price impact of 0.4703 + 0.0074 * 100 = 1.2103 EUR/MWh.

We perform the same study separately for different bidding areas, using the same bidding area aggregation as in the previous chapter. Additionally, we use the resulting linear regression equation to calculate the expected price impact of different sizes of outages – 50 MW, 100 MW and 200 MW. The results are presented in Table 5 below.

*Table 5: Summarised results of fitting a linear regression model to the datapoints in different bidding areas. The columns to the right are calculated based on the linear regression model and hypothetical outage sizes. Estimated slopes are statistically significant at levels * 5%, ** 1% and *** 0,1%. No star indicates no statistical significance.*

Investigated bidding area	Intercept (EUR/MWh)	Slope (EUR/MWh)	Expected price impact based on the linear regression model		
			50 MW	100 MW	200 MW
LV, LT, EE (n=126)	-2.4463	0.0344 ***	-0.73	0.99	4.43
SE4, DK2 (n=108)	0.7575	0.0027	0.89	1.03	1.30
FI (n=830)	-3.7284	0.0477 ***	-1.34	1.04	5.81
NO1, NO2, NO5(n=108)	0.3959	0.0001	0.40	0.41	0.42

For all the bidding areas above, the slope of the linear regression line is positive, which means there is a positive correlation between the size of outage and the observed price impact. The effect is most significant in Finland (slope of 0.048 EUR/MWh) and the Baltics (slope of 0.034 EUR/MWh).

Regression model plots for Finland and the Baltic bidding areas are shown below. As can be seen, there are many points that lie far from the trendline, both above and below. This indicates that variables other than UMMs are affecting the price – for instance changes in wind output or increased demand.

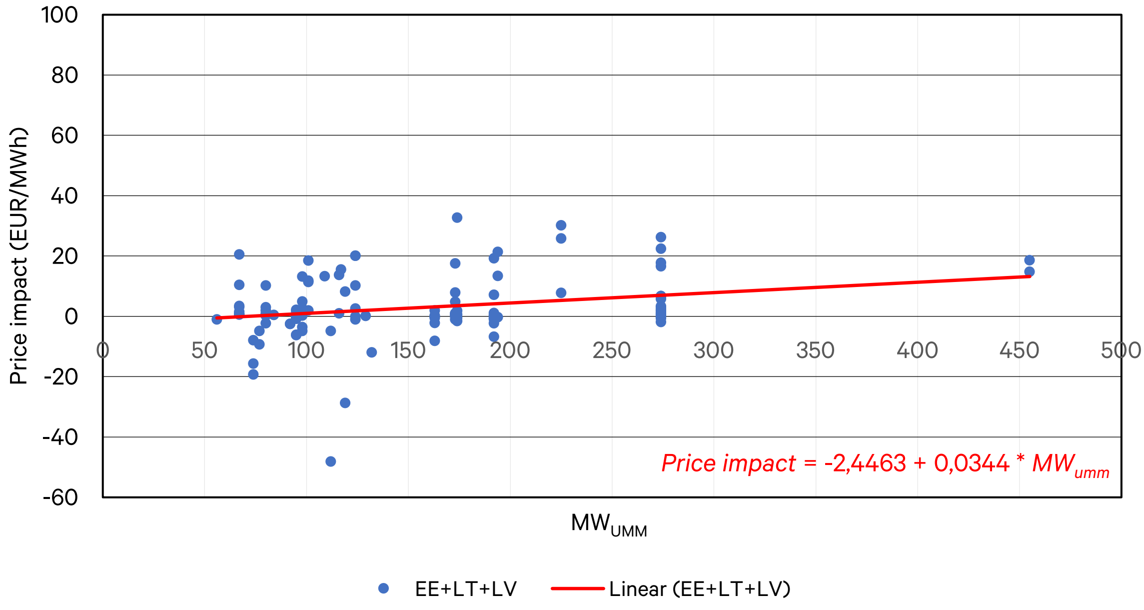


Figure 20: Regression plot for the Baltic countries.

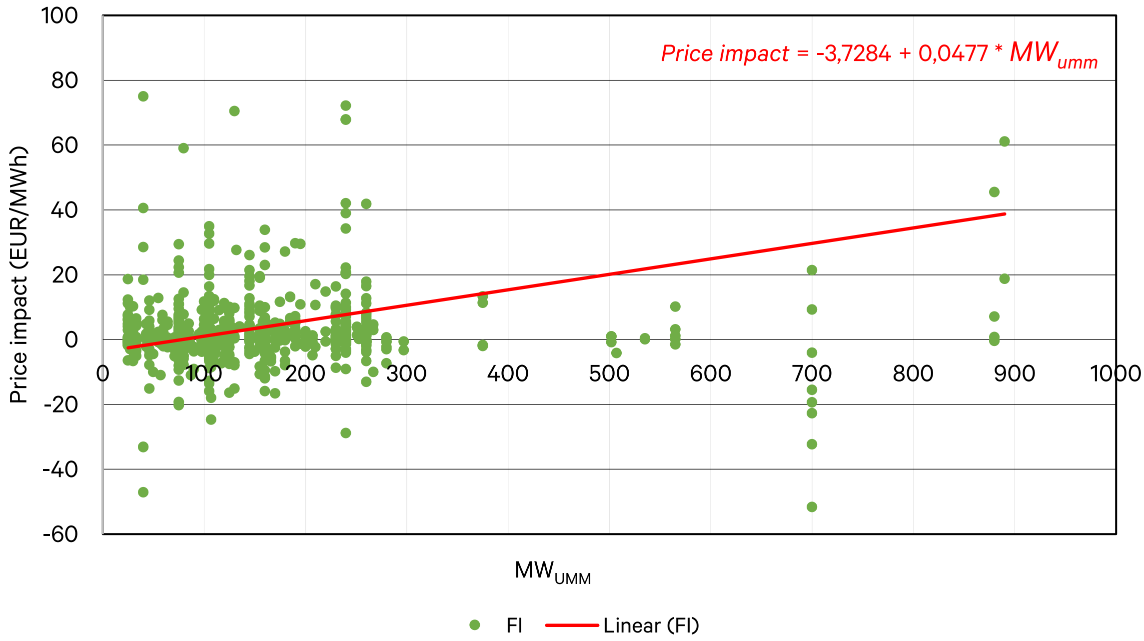


Figure 21: Regression plot for Finland.

As we observe a significant number of points that lie far from the trendline, both in the positive and negative direction, it appears only a small part of the price impact can be explained by outages. The above figures also show a positive linear relationship between the size of the outage and the observed price difference – indicating that information about larger outages is more likely to have a significant price impact. When bidding areas are studied in separate clusters, the results indicate that outage size affects price the most in FI and the Baltics. The model predicts that a 100 MW UMM gives a price increase of up to about 1 EUR/MWh. A 200 MW UMM is estimated to give a price increase of up to 4.43 EUR/MWh and 5.81 EUR/MWh, respectively, in the two areas.

4.4 Significant price effect

To put the results from the day-ahead analysis in perspective, we have analysed Montel's hourly price predictions for the Nordic and Baltic market in the five bidding areas identified as most sensitive to outages. The deviation between Montel's price prediction and actual market outcomes between 01.08.2020 and 31.07.2021 is summarized in Table 6 below. Positive values indicate an overestimation from Montel - negative values an underestimation. On average, Montel's price prediction underestimates the actual market price in the range -0.64 to -2.80 EUR/MWh depending on the bidding area. The standard deviation (SD) is a measure of variation in the projections. It is between 8 and 13 EUR/MWh, meaning that the price forecast tends to be spread over a wider range rather than staying close to the mean. The forecast is therefore more accurate in NO1 than in for example LT, as both the mean and SD is lower in NO1.

Table 6: Montel's forecasted price minus the actual price in the period 01.08.2020 to 31.07.2021

Deviation in Montel forecast			
	Mean	Median	SD
DK2	-1.94	-0.83	12.46
FI	-2.25	-0.42	13.48
LT	-2.80	-1.72	13.57
NO1	-0.64	-0.04	8.01
SE4	-0.88	0.15	12.33

Analysis of Montel's data reveals the difficulty in predicting the general price level, especially during price peaks. Table 7 below shows the deviations in Montel's forecast for hours with an actual bidding area price above 60 EUR/MWh. 60 EUR/MWh is picked as an arbitrary, rather high price level based on the price level in Figure 11. Negative mean and median values indicate an underestimation of the bidding area price by the model.

Table 7: Montel's forecasted price minus the actual price in the period 01.08.2020 to 31.07.2021 for hours priced over 60€/MWh

Deviation in Montel forecast in hours priced over 60€/MWh			
	Mean	Median	SD
DK2	-7.05	-3.45	16.85
FI	-10.88	-8.08	20.38
LT	-10.30	-7.95	16.52
NO1	-13.59	-7.94	22.49
SE4	-7.15	-5.76	17.21

As can be seen from Table 7, the prediction consistently underestimated the bidding area price in the hours when the actual bidding area price was 60 EUR/MWh or higher. Both the mean, median and SD shows larger deviations than when looking at the whole dataset. This can indicate that the forecast on average is less accurate when the actual market price is above 60 EUR/MWh.

5 Discussion of results

If market participants use a threshold that is either too high or too low, it can have consequences for transparency, integrity and functioning of the market, as well as the usability of inside information for trading decisions. In essence, setting a threshold is a trade-off, where:

- A too high threshold increases the risk of false negatives – events affecting prices significantly, but is under the set threshold and thus risks not getting published, and
- A too low threshold decreases the value of information on Inside Information Platforms. There are several aspects to this:
  - Higher costs of handling inside information for market participants, including establishing 24/7 facilities for UMM publication
  - More information to process for traders, analysts and other users. Even though much information can be processed automatically, this is not the case for all information
  - Creating inefficiencies, frequent trade stop and increasing costs where 'Chinese walls' are not established within a company handling inside information.

On one hand, non-compliance with the requirement to publish inside information, which may result from setting the threshold too high, is a serious risk to market participants and may also lead to insider trading. If such non-compliance is concluded by an NRA as having occurred, the consequences may include fines, imprisonment, reputational and financial losses. The authors of this report take this risk very seriously.

On the other hand, we should avoid a situation where most information published on an Inside Information Platform is not actually inside information. While it may be argued that, for instance, a threshold of 0 MW may comply with REMIT in the sense that all unavailabilities that in theory can lead to significant price impacts are published, such a threshold will most likely contradict the purpose of REMIT. It would make Inside Information Platforms less useful for trading decisions, when compared to, for example, the ENTSO-E Transparency Platform.

5.1 Qualitative analysis

5.1.1 Current practice – UMM publication

Figure 4 in chapter 3.1.1 showed that about 70% of generation UMMs published on Nord Pool's UMM system are below 200 MW, indicating that the market considers this information to be inside information. Introducing a threshold of 200 MW would therefore diverge from current practice. Looking at the lower end, about 17% of UMMs are below 100 MW. This indicates that some information concerning outages below 100 MW may have been considered inside information by the publishing market participants. However, as stated in chapter 3.1.1, the experience of the authors suggests that a significant amount of these outages are considered inside information for reasons other than the outage itself – for instance because of a change of fuel, uncertainty of the exact unavailability, or accumulated unavailable capacity. Therefore, the writers of this report cannot see that current practice points to recommending a threshold below 100 MW. In conclusion, 100 MW is considered a suitable threshold when considering current practice.

5.1.2 NRAs' guidance

ACM, CRE and E-Control have all published different types of reports or guidance to market participants concerning an inside information threshold (3.1.2), all pointing in slightly different directions. The most extensive study is conducted by CRE, which, with a different method than that used in this report, concludes the unavailability of electricity production resources of a magnitude less than specified in

Transparency Regulation (100 MW), is not, as a general rule, likely to have a significant price effect in France and is therefore not inside information under REMIT. Even though the French bidding area is considerably larger than the Nordic and Baltic bidding areas and the CRE's approach is different, the conclusion does not contradict the analysis in this report. It is also in line with the consultation responses to the Transparency Regulation. The Baltic stakeholder meeting recommended a threshold of 50 MW, but to our knowledge no qualitative and quantitative (econometric) analysis to test the likelihood of a significant price effect was not provided to document or substantiate the recommendation.

Based on communication from NRAs, it might be challenging to find a threshold that can be used in all market situation. Both ACM and E-Control state that what is considered inside information depends on market circumstances. REMIT itself also points in the same direction, as it does not define a set threshold. To accommodate these concerns, certain market situations may be predefined, under which the threshold needs to be reassessed.

5.1.3 Input from traders

From the questionnaire sent to traders, it is apparent that UMMs are an important input in their trading. Most traders responded that they use UMMs in their trading decisions, but the level of outages relevant for their consideration varied. In normal market situations most traders reported using UMMs starting at between 100 to 300 MW in trading decisions. Four respondents answered that in strained situations, information below 100 MW may be used. The term *strained market situations* was only loosely defined in the questionnaire, so the respondents' views on what constitutes 'strained' likely varied.

The results of the questionnaire should be interpreted with the following considerations in mind. Firstly, even if some traders state they would use UMMs below 100 MW in their trading decisions, for example through aggregation of several smaller UMMs, this does not necessarily mean the individual UMMs constitute inside information. Secondly, the majority still explicitly agreed that 100 MW or higher would be an appropriate threshold for publication of inside information.

One respondent highlighted that a single threshold should consider the level of general variability in the market, especially pointing towards variability in wind power. This answer is in line with the methodology of comparing price impacts with the predictability of Montel's market model (see chapter 4.4 and 4.2.1). Another respondent emphasized the importance of having one single threshold across market situations, as UMMs are often published for events far into the future.

In conclusion, the answers from respondents clearly point towards not setting a threshold above 100 MW. A threshold of 100 MW is considered appropriate under normal situations, while the answers to the questionnaire reflect the traders' opinion that a lower threshold could be relevant for *strained market situations,* as defined in the questionnaire.

5.2 Quantitative analysis

5.2.1 Day-ahead

The quantitative method used for the day-ahead market aims at investigating the price impact of different levels of removed supply, in the bidding areas and periods where an unavailability is assumed to have the largest impact.

The results in Table 2 clearly indicate there were positive outliers driving up the mean price impact. For example, when removing 200 MW of supply the mean price impact is between 0.47-2.48 EUR/MWh, while the median only varied between 0.13-0.23 EUR/MWh. Investigating the outliers therefore seems appropriate. Table 2 also shows the 95th percentile. For LT and FI these values were 4.61 and 3.61

EUR/MWh, respectively, when removing 100 MW, while it stays below 1.32 EUR/MWh in the other areas. This may indicate that for 100 MW outages in the most constrained bidding areas, there is a certain probability of having a significant price impact.

However, our method does not measure the impact of the *publication* of the information. It instead measures the effect of removing supply volumes with a volume identical to the outage that is informed about. It is expected that the simulations overestimate the price impact the information would have had on the market. This must be kept in mind when interpreting the somewhat high 95th percentile impacts in LT and FI.

Furthermore, Table 8 below compares the simulation results with Montel's market model, combining the data from Table 6 and Table 2. To be considered significant, a price impact stemming from inside information should be relatively high compared to the general uncertainty in the market. The standard deviation in the Montel forecast clearly indicates a large uncertainty in their predictions, expressed as standard deviation. The Montel forecast has a much larger uncertainty than the price impact that can on average be expected from the actual removal of supply. This means that the price impact stemming from the removal of supply is difficult to distinguish from general variation in the power market, especially with an increase in renewable production.

This is important, as it is the *information* about an outage and not the actual removal of supply, that should be likely to significantly affect prices on related products to qualify as inside information.

Table 8: Comparison between deviations in Montel's price forecast (final run) and the simulated price impact of removing supply in the market. Montel's deviations are based on predictions and actual prices from 01.08.2020 to 31.07.2021.

Deviation in Montel forecast			
	Mean	Median	SD
DK2	-1.94	-0.83	12.46
FI	-2.25	-0.42	13.48
LT	-2.80	-1.72	13.57
NO1	-0.64	-0.04	8.01
SE4	-0.88	0.15	12.33

Simulated price impact of removed supply		
Mean 50 MW	Mean 100 MW	Mean 200 MW
0.16	0.38	0.82
0.62	1.18	2.48
0.58	0.97	1.95
-0.32	0.24	0.47
0.12	0.28	0.54

Table 7 shows Montel's deviation when the actual price turned out above 60 EUR/MWh. These predictions are even less accurate, with both the average price deviation being larger, and the standard deviation being roughly doubled. This suggests that it is very difficult to predict the price for the highest priced hours in the Nordic and Baltic region. Multiple factors likely contribute to prices turning out to be very high. Market participants may also be less likely to change their bidding behaviour due to new information. Yet, 4 out of 19 respondents to the questionnaire believed a lower threshold could be suitable under strained situations.

The simulation results, as well as comparison with the market model, indicate that most information about the removal of supply between 50 and 100 MW will not have a significant effect on prices. Simulation results for 200 MW do however yield price impacts that can be considered significant in certain areas.

5.2.2 Intraday

The quantitative testing in the intraday market analyses the price impact from UMM publications on contracts that are open for trading at the time of publication. Table 3 shows that for the three bins investigated (smaller than 100 MW, 100-199 MW, from 200 MW) there is positive mean price impact. When comparing the largest bin, from 200 MW upwards, with the other two bins in Table 3, the mean, median, 95%-quantile and standard deviation are all larger. This indicates that a threshold for the publication of inside information should probably be set lower than 200 MW.

The results from the two smaller bins are very similar. The mean and median are actually higher for the smallest bin, but this may simply be due to random variation. Again, as for the day-ahead, we see that the mean is higher than the median – indicating that there are outliers driving up the mean. The 95th quantile is above 12 EUR/MWh, much higher than for day-ahead. This can be explained by dropping the null-observations from the data, as discussed in 2.3. As the two smallest bins are very similar, the data in Table 3 does not reveal whether the threshold should be 100 MW or lower. The loc-parameter (the single most likely price impact from a UMM publication) is close to zero for all three bins.

Figure 18 and Table 4 group together data from different bidding areas. As for day-ahead it seems Finland and the Baltic areas are most sensitive to outages. It is challenging to draw conclusions based on this data without going into details on the outage sizes. This is addressed by the regression analysis.

Results from the regression model should be interpreted with care, as not all results are statistically significant at five percent significance levels. Few observations in combination with large outliers can greatly affect the slope of the regression line.

However, there are some valuable insights from the regression model. We believe it clearly indicates that UMMs of 50 MW do not, on average, have significant price impacts. UMMs of 100 MW are estimated to have an impact of around 1 EUR/MWh in three out of four clustered bidding areas, and UMMs of 200 MW can, on average, have significant price impacts, at least in Finland and the Baltics. Considering this, we believe the regression model points towards 50 MW being too low a threshold, 200 MW too high and 100 MW to be an appropriate threshold. In addition, keep in mind that due to dropping the null-observations in the selection of which UMMs to analyse, the model likely overestimates price impacts.

5.2.3 Common conclusion

A common conclusion from the quantitative testing, both for day-ahead and intraday, is that no results clearly indicate a threshold needs to be set below 100 MW. Similarly, the analysis shows that 200 MW on average and in many areas, may lead to significant price impacts. The quantitative analysis will be viewed along with the qualitative analysis to identify an appropriate threshold.

5.3 Summary of discussion and conclusion

The next three subchapters summarize the main findings in the report and provide a discussion of the 50 MW, 100 MW and 200 MW threshold.

The first table in each subchapter shows a selection of quantitative results. Since Finland and Lithuania were the bidding areas with the most prominent results, we have only summarized those, although all areas are part of the overall discussion and conclusion. As results from the intraday market are aggregated, the areas concerned are specified in the table text.

The second table in the following subchapters show arguments for and against the different thresholds using the whole methodology.

5.3.1 50 MW threshold

*Table 9: Summary of key quantitative results on price impact for the day-ahead and intraday markets for 50 MW outages. Only the most constrained areas are presented. *LT, LV, EE. ** All areas.*

Day-ahead 50 MW (EUR/MWh)						Intraday (EUR/MWh)				
						50 MW	UMMs < 100 MW**			
	Mean	*Median*	*95th pct*	*SD*	*SD (Montel)*	*Lin. Reg*	*Mean*	*Median*	*Loc*	*SD*
FI	0.62	0.04	1.85	3.76	13.5	-1.34	1.46	0.44	0.04	8.85
LT	0.58	0.04	2.23	2.85	13.6	-0.73*				

Type of analysis	Arguments for (the threshold is appropriate)	Arguments against (the threshold is too high or too low)
Current practice	Some UMMs have historically been published on this level.	Only 2.9% of historic UMMs concern an outage of less or equal to 50 MW – lack of current practice supporting this threshold.
Guidance from regulators	E-Control states the threshold must be set lower than 100 MW in narrow market situations. Baltic stakeholder meeting suggests a threshold of 50 MW.	100 MW is the threshold on the generation unit level in Transparency Regulation for generation units. No one suggested a lower threshold in the consultation. CRE report points towards 100 MW for France.
Input from traders	Four out of 19 respondents believe the threshold should be lower than 100 MW in strained market situations.	Majority of traders believe 50 MW is too low, even in strained market situations.
Quantitative analysis: Day-ahead market	The median impact is close to zero, and the mean is well below 1 EUR/MWh. All inside information is likely to be published with a 50 MW threshold.	The median impact is close to zero, and the mean is well below 1 EUR/MWh. This can also be interpreted as meaning a 50 MW threshold may be too low.
Quantitative analysis: Intraday market	The single most likely (loc) and median impacts are both close to zero. Based on linear regression, the price impact is below 1 EUR/MWh. This indicates that all inside information is likely to be published with a 50 MW threshold.	-

Analysing historic UMMs, very few concern outages of 50 MW or less. Many of these are considered inside information due to reasons other than the size of the outage itself, as explained in 3.1.1. Regarding input from traders, a majority considered 100 MW to be an appropriate threshold. Some stated they use information between 1 and 50 MW in strained situations and some explicitly expressed that an appropriate threshold in strained situations should be below 100 MW. However as discussed in 5.1.3, the term *strained market situation* was only loosely defined, so traders' interpretation of the term likely varied. Also, even if some traders state they would use UMMs below 100 MW in their trading decisions, for example through aggregation of several smaller UMMs, this does not necessarily mean the individual UMMs constitute inside information.

The quantitative analysis implies much information published in the range between 50 and 100 MW may not be inside information, as in most cases it does not lead to a significant price impact. This is especially true when considering the uncertainty in predicting day-ahead prices in the power market, as described in 4.4. A threshold of 50 MW would impose the disadvantages of a too low threshold as discussed in the first part of chapter 5, mainly reducing the value of published information, creating inefficiencies and increasing administrative costs.

The authors of the report hence conclude that a threshold of 50 MW is too low in the vast majority of market situations.

5.3.2 100 MW threshold

*Table 10: Summary of key quantitative results on price impact for the day-ahead and intraday markets for 100 MW outages. Only the most constrained areas are presented. *LT, LV, EE. ** All areas.*

	Day-ahead 100 MW (EUR/MWh)					Intraday (EUR/MWh)				
						100 MW	UMMs 100-199 MW**			
	Mean	*Median*	*95th pct*	*SD*	*SD (Montel)*	*Lin. Reg*	*Mean*	*Median*	*Loc*	*SD*
FI	1.18	0.1	3.69	5.68	13.5	1.04	1.28	0.18	-0.08	9.94
LT	0.97	0.09	4.61	4.86	13.6	0.99*				

Type of analysis	Arguments for (the threshold is appropriate)	Arguments against (the threshold is too high or too low)
Current practice	The majority (83.2%) of UMMs concern outages above 100 MW. Other factors may explain why lower outages are published.	16.8 % of UMMs concern outages below 100 MW.
Guidance from regulators	100 MW is the threshold on the generation unit level in Transparency Regulation for generation units. No one suggested a lower threshold in the consultation. Support from the CRE report.	E-Control states the limit must be set lower than 100 MW in narrow market situations. Baltic stakeholder meeting suggests a threshold of 50 MW.
Input from traders	17 out of 19 respondents stated that 100 MW is a sufficiently low threshold for publication of inside information under normal conditions. 10 out of 19 respondents (whereas 12 answered the question) stated that UMMs at or above 100 MW are relevant for their trading decisions.	Four out of 19 respondents (whereas 11 answered the question) stated that UMMs about outages below 100 MW are likely to affect their orders in strained market situations.
Quantitative analysis: Day-ahead market	The median impact is close to zero. The mean impact is up to 1.18 EUR/MWh, but a large SD and Montel data indicates that this is unpredictable.	The 95th percentile is 4.61 EUR/MWh in Baltics and 3.69 EUR/MWh in FI. This means that there are some observations with significant price effect.

Quantitative analysis: Intraday market	The single most likely (loc) and median impacts are both close to zero. Large SD in the data. Based on linear regression the expected price impact is around 1 EUR/MWh.	The mean price impact of UMMs between 0-100 MW is 1.39 EUR/MWh.

Analysing historic UMMs shows that a significant portion concern outages below 100 MW. As explained in 3.1.1 however, there are often other reasons than the outage itself that make market participants disclose this information. Some traders state they use UMMs below 100 MW in their trading decisions in strained situations – but as discussed in 5.1.3, this term was loosely defined. For market participants there is an operational advantage in having a threshold for publishing inside information similar to the 100 MW threshold of the Transparency Regulation. The CRE report also supports this. A threshold of 100 MW thus seems to be well in line with current market practice and overall, is supported by the qualitative analysis.

The quantitative analysis shows that outliers in the data can yield significant price impacts. These occurrences are, however, relatively rare. Additionally, the impacts are likely to have been somewhat overestimated, both for the day-ahead and intraday analysis, as discussed in 5.2.1 and 5.2.2.

To be considered significant, a price impact stemming from inside information should be relatively high compared to the general uncertainty in the market. Analysis of Montel's price forecast in 4.4, shows the high uncertainty in predicting market prices. As discussed in 5.2.1 it is therefore hard to reliably profit from information of single outages, reducing its significance for trading decisions. With these considerations of the quantitative analysis in mind, the authors of the report believe the quantitative analysis supports a 100 MW threshold for the publication of inside information.

Considering the overall picture of the report, we are confident that a threshold of 100 MW is appropriate in the vast majority of market situations. To address concerns from some traders, E-Control and the Baltic stakeholder meeting, market participants can in *extraordinary market situations* reassess the threshold. It is outside the scope of this report to define what might be considered an extraordinary market situation, but a non-exhaustive list of suggestions can be found in Appendix 5 – Extraordinary market situations.

5.3.3 200 MW threshold

*Table 11: Summary of key quantitative results for the day-ahead and intraday market for 200 MW outages. Only the most constrained areas are presented. *LT, LV, EE. **All areas.*

	Day-ahead 200 MW (EUR/MWh)					Intraday (EUR/MWh)				
						200 MW	UMMs < 200 MW**			
	Mean	*Median*	*95th pct*	*SD*	*SD (Montel)*	*Lin. Reg*	*Mean*	*Median*	*Loc*	*SD*
FI	2.48	0.22	6.75	11.2	13.5	5.81	3.77	0.82	-0.04	19.03
LT	1.95	0.23	7.79	6.22	13.6	4.43*				

Type of analysis	Arguments for (the threshold is appropriate)	Arguments against (the threshold is too high or too low)
Current practice	-	69.8 % of UMMs published are below 200 MW.

Guidance from regulators	200 MW is the threshold on the production unit level in Transparency Regulation.	Higher than the generation unit threshold in Transparency Regulation. CRE report, E-Control and Baltic stakeholder meeting suggest a lower threshold.
Input from traders	Four out of 19 respondents (whereas 12 answered the question) stated that under normal conditions they do not look at messages below 200 MW.	Six out of 19 respondents (whereas 12 answered the question) stated that information regarding outages below 200 MW is likely to affect their orders. Under strained market conditions the number was seven out of 19 respondents.
Quantitative analysis: Day-ahead market	The median impact of the removal of 200 MW of supply is close to zero.	The 95th percentile of price impact is 7.79 EUR/MWh, meaning that there is a significant price impact in some hours. The mean price impact is 2.48 EUR/MWh, indicating that there might be a price increase in many hours.
Quantitative analysis: Intraday market	The single most likely (loc) price impact is close to zero.	The median price impact for UMMs above 200 MW is close to 1 EUR/MWh. Based on linear regression, the expected price impact is 5.81 EUR/MWh.

Analysis of current practice clearly shows it is common to treat outages less than 200 MW as inside information, as argued in chapter 5. Similarly, traders and regulators alike argue that 200 MW is too high a threshold. Even if the median and loc-parameter suggest that in many situations there is no price impact, there seems to be a significant probability of larger price impacts. This can be seen from both the mean, 95th percentile and linear regression. Overall, we conclude that 200 MW is not an appropriate threshold for publication of inside information in the Nordic and Baltic region.

6 Recommendation

The aim of this report is to find an appropriate, common threshold for publication of inside information in the Nordic and Baltic market, by performing qualitative and quantitative (econometric) analysis. We primarily discuss three different thresholds – 50, 100 and 200 MW. The authors are mindful of the trade-off between setting the threshold too high or too low. This is discussed in detail in the beginning of chapter 5, with results of the qualitative and quantitative analysis in chapters 5.3.1-5.3.3. When weighing-up results from different types of analysis against each other, we put a particular focus on concluding on a threshold that would ensure compliance with REMIT, while at the same time being practical for market participants.

Based on the analysis and arguments in chapter 5.3.3, a threshold of 200 MW is considered too high. At the same time, there are several considerations in chapter 5.3.1 that make us consider a 50 MW threshold as being too low.

Based on the discussion in chapter 5 and specifically the arguments in chapter 5.3.2, the authors of this report conclude that the combination of qualitative and quantitative analysis strongly supports a threshold of **100 MW** per market time unit being used for the publication of inside information in the Nordic and Baltic power market.

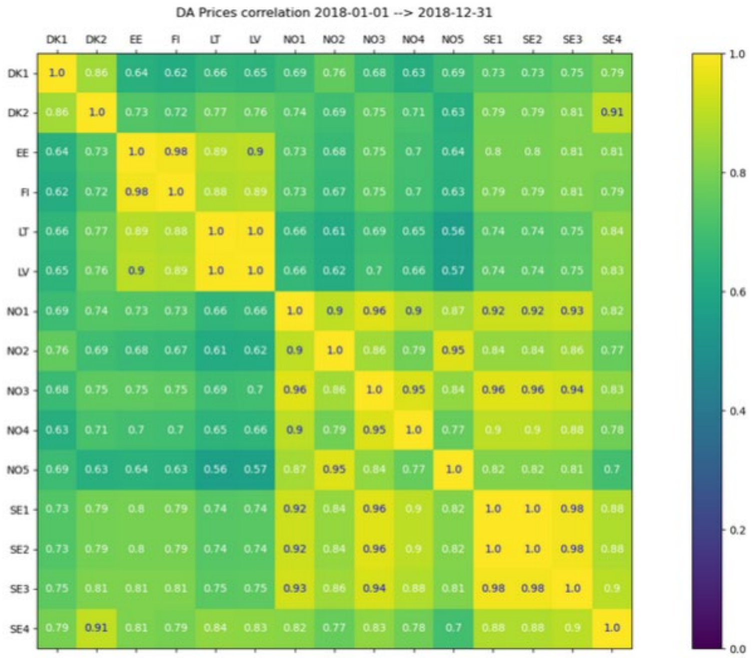
It is the view of the authors that this threshold can be used in the vast majority of market situations. The main reasons are as follows:

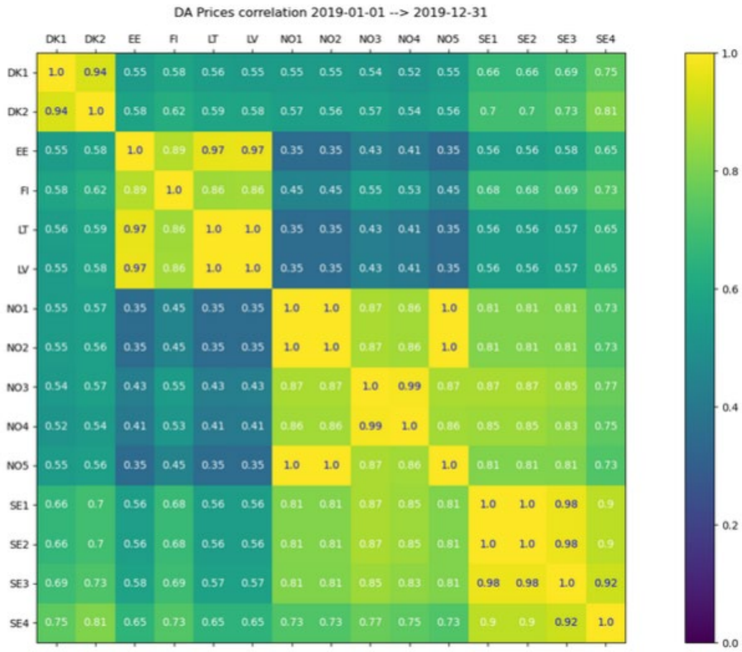
- The threshold of 100 MW is consistent with current market practice.
- On average, outages below 100 MW seem unlikely to result in a significant price impact. We acknowledge that outliers in the data can sometimes be considered significant. However, those represent unusual events and are likely overestimated, due to the methodology chosen.
- The mean price impact from 100 MW outages is small compared to the high uncertainty in the market price forecast.
- The majority of traders interviewed stated that 100 MW is an appropriate threshold. This is consistent with regulatory practice.

Market participants can reassess the threshold during *extraordinary market situations*. A non-exhaustive list of such situations, that may require a reassessment of the threshold, is provided in Appendix 5 – Extraordinary market situations.

Appendix 1 – Correlation analysis in 2018 and 2019

The figures below present the correlation of day-ahead prices in 2018 and 2019 (the period over which the correlation is calculated is presented in the title of the plot). The correlation coefficient is rounded to the second decimal.





Appendix 2 - Results of simulations in the day-ahead market

Reproducibility issue

It should be noted that the removal of a certain volume from the supply curve in some cases may not result in a positive price difference, i.e. a higher simulation price than benchmark price, in all hours. This is primarily due to the following:

- Euphemia replaces the removed volume from single-hourly sell orders with volume from block sell orders. That may reduce the market price in some hours but increase it in others.
- Reproducibility: Euphemia is running multiple optimisation threads in parallel and, when two threads are ending at almost the same time, it is possible that in two consecutive runs, i.e. the Benchmark run and the Simulation run, one or the other thread will end first. As Euphemia may consider the outcome of these threads to update the optimization tree, it may lead to a different exploration of the search space (i.e. different solutions in the end). Over time, this issue should result both in higher prices and in lower prices. Consequently, it does not affect our conclusions unilaterally in one direction, but may help to explain some of the deviations that we observe in individual hours.

The impact of the reproducibility issue is limited by the fact that the benchmark and simulation runs, which cover the same period, are performed on the same hardware (i.e. SF-machine) and with the same Euphemia version. This is confirmed when comparing the results of performing the benchmark runs for 2018 twice. We focused on the prices in DK1, DK2, NO1, NO2, NO3, NO4, NO5, SE1, SE2, SE3, SE4, FI, EE, LT and LV and got the following results:

- Week 9 2018: prices deviated between -1.52 and 1.99 EUR/MWh (average of the absolute price difference: 0.032 EUR/MWh)
- Week 23 2018: prices deviated between -1.10 and 1.15 EUR/MWh (average of the absolute price difference: 0.025 EUR/MWh)
- Week 36 2018: prices deviated between -0.93 and 0.40 EUR/MWh (average of the absolute price difference: 0.011 EUR/MWh)
- Week 51 2018: prices deviated between -1.47 and 6.87 EUR/MWh (average of the absolute price difference: 0.056 EUR/MWh)
    - 20.12.2018 hour 14: price difference of 4.65 EUR/MWh
    - 20.12.2018 hour 20: price difference of 6.87 EUR/MWh
    - The next biggest price differences: 2.17 EUR/MWh, 1.24 EUR/MWh, 1.09 EUR/MWh

Except for three hours in week 51, we did not observe any price differences above 2 EUR/MWh. The average price difference is very close to 0 EUR/MWh in all four weeks. Consequently, we are confident in saying that the issue of reproducibility does not significantly impact our average results.

Extended simulation results

Table 14 presents the summarized results across all weeks of testing.

Table 12: The summary of simulating price impact of 50/100/200 MW removed supply in the day-ahead market. The number of observations is n=1344 for each bidding area, for each volume of supply removed (each row of the table).

50 MW							
	Mean	Median	SD	Min	Max	95 %	99 %
DK2	0.16	0.03	1.01	-2.43	27.50	0.52	4.71
FI	0.62	0.04	3.76	-1.42	69.13	1.85	7.96
LT	0.58	0.04	2.85	-6.47	48.93	2.23	14.32
NO1	-0.32	0.04	2.31	-19.76	5.36	0.35	1.77
SE4	0.12	0.03	0.55	-1.80	10.55	0.45	1.89
100 MW							
	Mean	Median	SD	Min	Max	95 %	99 %
DK2	0.38	0.07	1.82	-3.11	36.88	1.32	7.64
FI	1.18	0.10	5.68	-2.59	109.83	3.69	27.77
LT	0.97	0.09	4.86	-105.26	50.04	4.61	19.53
NO1	0.24	0.08	0.98	-0.53	23.87	0.68	4.04
SE4	0.28	0.07	1.06	-1.70	23.87	1.21	5.44
200 MW							
	Mean	Median	SD	Min	Max	95 %	99 %
DK2	0.82	0.14	3.14	-1.63	40.01	3.92	16.25
FI	2.48	0.22	11.15	-2.45	170.23	6.75	57.88
LT	1.95	0.23	6.22	-12.10	80.96	7.79	29.41
NO1	0.47	0.15	1.93	-0.76	34.11	1.44	6.32
SE4	0.54	0.13	1.84	-0.95	34.11	1.75	9.17

The following tables present the results per week of testing.

Week 9 2018: reduction of 50 MW					
	Mean	Min	Max	95 %	99 %
FI	2.69	-0.36	69.13	11.28	49.27
DK2	0.33	-2.04	9.21	1.71	5.31
LT	1.35	-3.36	48.93	4.41	33.60
SE4	0.26	-1.80	6.71	1.38	3.83
NO1	0.27	-2.94	5.36	1.46	2.82
Week 9 2018: reduction of 100 MW					
	Mean	Min	Max	95 %	99 %
FI	4.70	-0.06	109.83	42.26	59.93
DK2	0.91	-3.11	23.87	4.54	10.56

LT	1.12	-105.26[31]	50.04	8.12	37.13
SE4	0.75	-1.70	23.87	3.98	6.30
NO1	0.83	-0.07	23.87	4.81	9.97
Week 9 2018: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	9.97	0.01	170.23	65.63	136.79
DK2	1.99	-0.94	34.11	9.35	21.24
LT	4.49	-0.05	80.96	26.74	70.14
SE4	1.73	-0.95	34.11	8.34	21.24
NO1	1.88	-0.76	34.11	8.97	26.58

Week 23 2018: reduction of 50 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.53	-1.42	6.54	2.21	3.96
DK2	0.15	-0.75	7.19	0.50	2.68
LT	0.42	-2.14	6.54	2.54	4.70
SE4	0.15	-1.12	7.19	0.42	2.94
NO1	0.03	-0.39	0.65	0.21	0.47
Week 23 2018: reduction of 100 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.98	-2.59	18.42	4.41	7.24
DK2	0.37	-0.68	7.88	1.07	7.01
LT	1.19	-0.69	18.42	4.85	11.52
SE4	0.40	-0.66	7.86	1.36	7.01
NO1	0.09	-0.53	0.80	0.31	0.62
Week 23 2018: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	2.05	-2.45	68.37	8.05	18.78
DK2	0.71	-0.33	13.53	4.73	8.80
LT	1.64	-5.53	68.37	5.10	18.78
SE4	0.67	-0.28	13.53	1.72	9.51
NO1	0.15	-0.20	1.74	0.44	1.17
Week 36 2018: reduction of 50 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.08	-0.45	1.32	0.27	0.80
DK2	0.11	-0.35	6.47	0.28	0.71
LT	0.80	-6.47	20.34	4.26	15.99
SE4	0.09	-0.81	1.98	0.30	1.06
NO1	0.06	-0.06	0.35	0.18	0.26
Week 36 2018: reduction of 100 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.18	-0.84	2.49	0.54	0.98

[31] Reducing the supply with 100 MW in LT results in one hour with considerably lower price in LT. The benchmark run had a price of 200.26 EUR/MWh, while the simulation run had a price of 95 EUR/MWh. In the simulation run, some volume from single-hourly sell orders was replaced with volume from block sell orders.

DK2	0.26	-0.92	8.65	0.65	7.84
LT	1.88	-6.12	22.39	15.14	18.14
SE4	0.19	-0.95	3.17	0.50	2.59
NO1	0.14	-0.09	0.60	0.40	0.55
Week 36 2018: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.34	-0.31	3.20	1.06	1.76
DK2	0.90	-0.77	19.20	6.84	16.30
LT	2.10	-12.10	22.95	15.63	20.26
SE4	0.34	-0.53	7.88	0.91	3.48
NO1	0.31	-0.02	1.37	0.94	1.25

Week 51 2018: reduction of 50 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.20	-0.41	3.62	1.20	2.47
DK2	0.13	-2.43	6.98	0.55	5.09
LT	0.38	-2.07	27.22	1.44	5.15
SE4	0.02	-1.04	0.68	0.31	0.64
NO1	-3.29	-19.76	2.38	0.30	0.61
Week 51 2018: reduction of 100 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.44	-0.33	5.07	2.09	4.81
DK2	0.35	-1.91	36.88	0.57	5.13
LT	0.83	-0.54	28.34	3.49	12.59
SE4	0.09	-0.97	1.85	0.54	1.29
NO1	0.11	-0.32	2.40	0.47	0.90
Week 51 2018: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.89	-0.19	6.88	4.75	6.16
DK2	0.68	-1.63	40.01	0.93	15.72
LT	1.45	-0.35	27.20	5.99	18.10
SE4	0.22	-0.19	2.56	0.77	2.09
NO1	0.22	-0.43	2.39	0.70	2.26

Week 4 2019: reduction of 50 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.27	-0.16	4.79	1.28	3.65
DK2	0.38	-0.89	27.50	0.72	5.98
LT	0.26	-0.19	7.24	0.92	5.35
SE4	0.13	-0.59	5.30	0.34	3.10
NO1	0.18	-0.79	4.79	0.73	2.48
Week 4 2019: reduction of 100 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.53	-0.17	9.30	2.10	4.70
DK2	0.76	-0.29	27.53	4.80	12.30
LT	0.49	-0.17	7.28	2.65	5.50
SE4	0.30	-0.17	5.57	1.08	4.97

NO1	0.40	-0.17	9.30	2.11	4.39
Week 4 2019: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.96	-0.11	10.44	4.15	6.18
DK2	1.44	-0.68	33.90	5.53	29.62
LT	0.86	-0.53	9.34	5.18	7.47
SE4	0.50	-0.68	9.34	2.02	6.33
NO1	0.59	-0.68	10.44	2.34	5.84

Week 15 2019: reduction of 50 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.12	-0.11	7.05	0.40	1.25
DK2	0.05	-0.42	2.11	0.17	0.50
LT	0.12	-0.11	7.05	0.38	1.48
SE4	0.04	-0.11	0.68	0.14	0.37
NO1	0.05	-0.06	1.93	0.13	0.34
Week 15 2019: reduction of 100 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.24	-0.54	12.57	0.69	3.41
DK2	0.12	-0.48	5.86	0.34	0.81
LT	0.30	-0.20	12.57	1.19	4.18
SE4	0.08	-0.24	1.14	0.24	0.61
NO1	0.08	-0.16	1.93	0.22	0.34
Week 15 2019: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.45	-0.24	17.11	1.85	4.30
DK2	0.42	-0.48	6.84	1.46	6.27
LT	0.64	-0.24	17.11	2.58	7.33
SE4	0.18	-0.09	1.70	0.55	1.38
NO1	0.18	-0.01	1.93	0.53	1.25

Week 31 2019: reduction of 50 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.45	-0.44	4.70	1.74	3.71
DK2	0.08	-0.47	1.49	0.45	1.06
LT	1.04	-3.98	26.43	4.18	18.51
SE4	0.18	-0.25	10.55	0.85	1.56
NO1	0.04	-0.45	0.65	0.10	0.16
Week 31 2019: reduction of 100 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.93	-0.08	7.00	3.52	5.58
DK2	0.13	-0.92	1.63	0.72	1.20
LT	1.49	-2.00	26.48	7.77	26.47
SE4	0.31	-0.24	10.62	1.48	4.88
NO1	0.08	-0.02	0.24	0.19	0.23

Week 31 2019: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	1.79	-0.07	11.03	5.84	8.13
DK2	0.16	-0.92	1.75	0.78	1.33
LT	3.42	-0.07	33.43	17.41	31.22
SE4	0.41	-0.36	10.65	1.52	6.50
NO1	0.14	-0.05	0.46	0.33	0.42

Week 45 2019: reduction of 50 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	0.64	-0.05	25.07	2.29	9.95
DK2	0.07	-0.28	1.38	0.23	1.14
LT	0.30	-0.23	9.06	1.46	3.44
SE4	0.08	-0.24	1.38	0.23	1.14
NO1	0.09	-0.16	1.38	0.30	1.14
Week 45 2019: reduction of 100 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	1.41	-0.21	53.96	6.07	16.74
DK2	0.14	-0.31	2.26	0.69	1.63
LT	0.49	-0.38	6.61	2.85	4.63
SE4	0.16	-0.21	2.26	1.04	1.63
NO1	0.18	-0.17	2.26	0.70	1.63
Week 45 2019: reduction of 200 MW					
	Mean	**Min**	**Max**	**95 %**	**99 %**
FI	3.41	-0.10	74.96	16.54	46.14
DK2	0.25	-0.31	3.99	1.33	2.16
LT	0.99	-0.12	20.06	4.47	9.72
SE4	0.29	-0.13	3.99	1.46	2.16
NO1	0.30	-0.35	3.99	1.35	2.16

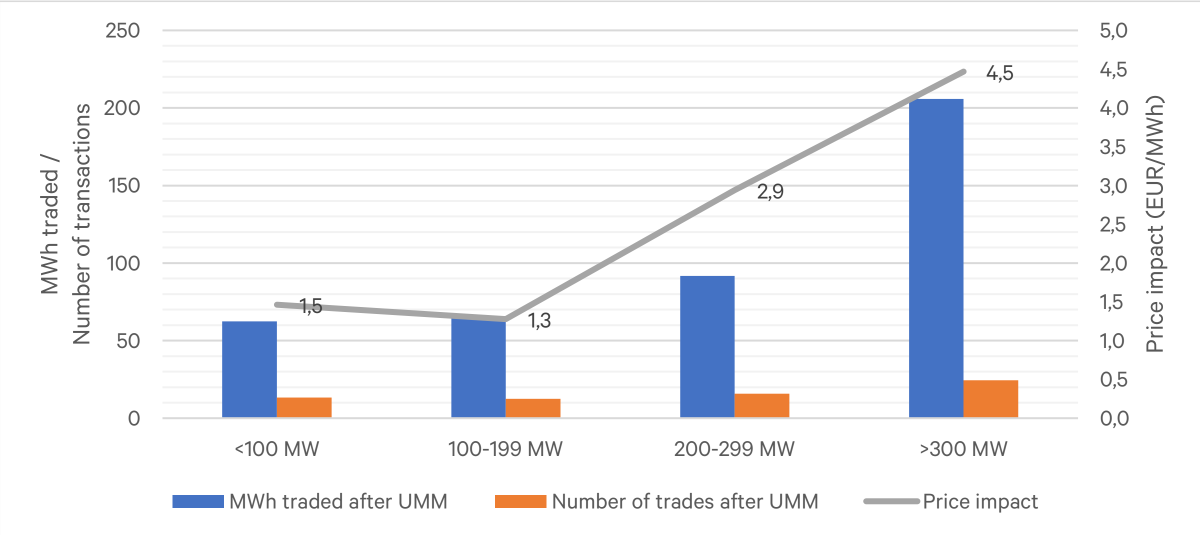
Appendix 3 - Results of simulations in the intraday market

This appendix presents additional data for explaining results in the quantitative testing.

Summary of data

In total, we identified 34 898 products that were affected during the event time of a newly published UMM. Out of these, 4537 had transactions within 60 minutes before **or** after the UMM publication time. Further, only 1 946 data points had trading both before **and** after the UMM was published. We describe these 1 946 data points in this chapter.

The figure below shows the 1 946 products grouped together by outage size. About 10-20 trades on average are done after publication. The traded volume increases by outage size. For UMMs below 300 MW, the price impact is between 1.3 and 2.9 EUR/MWh for different sizes of outages.



The table below describes the intraday testing results per bidding area:

Bidding area	Statistics on the difference between vwap 60 min before and after the publication of a UMM					Average UMM size
	Count of observations	Mean (EUR/MWh)	SD (EUR/MW h)	Min (EUR/MWh)	Max (EUR/MWh)	
DK1	181	-0.5	5.0	-31.8	17.3	282.9
DK2	100	2.0	7.9	-7.2	65.2	264.2
EE	111	2.1	9.9	-48.2	32.7	158.5
FI	830	3.6	20.3	-51.6	307.3	153.6
LT	5	19.4	8.9	7.7	30.2	317.0
LV	10	4.1	6.6	-1.1	20.5	65.9
NO1	26	0.0	1.2	-2.9	1.8	114.2
NO2	68	0.6	2.7	-7.0	14.2	191.1
NO3	5	0.8	0.8	0.0	2.2	109.0
NO4	6	-0.7	2.6	-5.8	1.3	191.3
NO5	14	0.4	1.9	-1.9	5.6	229.4
SE1	38	0.1	2.1	-6.7	4.4	168.8

SE2	79	-0.5	2.4	-7.1	7.2	137.0
SE3	465	2.2	6.1	-14.3	51.3	464.8
SE4	8	-4.6	3.5	-10.9	-1.2	308.4
Grand Total	**1946**	**2.3**	**14.1**	**-51.6**	**307.3**	**247.5**

The overview of the data for different outage intervals is presented in the table below.

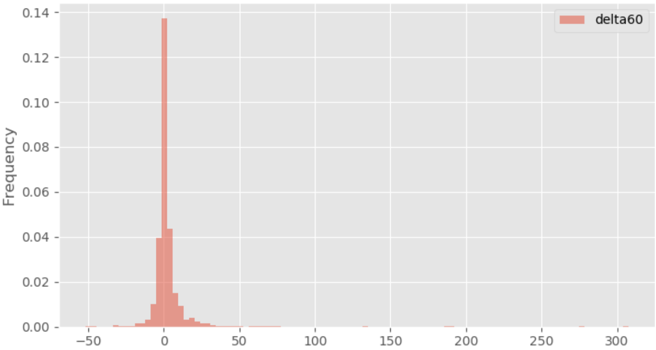
UMM size	Mean	Median	SD	Min	Max	95%	99%	Loc
<100 MW (n=398)	1.46	0.44	8.85	-47.07	75.07	12.08	36.79	0.04
100-199 MW (n=778)	1.28	0.18	9.94	-48.16	191.26	12.76	29.54	-0.08
>200 MW (n=770)	3.77	0.82	19.03	-51.62	307.29	17.06	62.37	-0.04

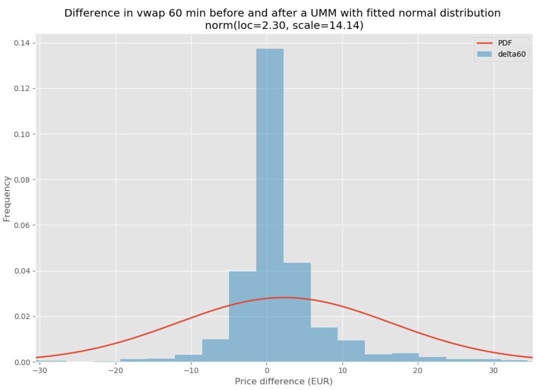
Group together according to the findings in chapter 4.1.3, is found in the below table.

Bidding area	Mean UMM size	Mean	Median	SD	Min	Max	95%	99%	Loc
LV, LT, EE (n=126)	157.44	2.97	0.82	10.20	-48.16	32.70	20.38	29.16	0.26
SE4, DK2 (n=108)	267.47	1.47	0.36	7.84	-10.94	65.15	9.11	28.56	0.14
FI (n=830)	153.56	3.60	0.66	20.32	-51.62	307.29	19.77	67.93	- 0.09
NO1, NO2, NO5 (n=108)	177.57	0.42	0.03	2.31	-6.96	14.17	3.80	7.19	0.06

Fitting a probability distribution

The plot below shows the histogram of all delta observations. X-axis shows delta, the observed difference between vwap before and after the UMM in EUR/MWh. Y-axis shows the frequency of data observations in that range. Figure on the right shows the normal probability density function with the same statistical parameters as the dataset.





As can be clearly seen from the figure on the right above, the distribution of the data does not follow normal distribution. To confirm what could be seen here, we performed statistical normality tests. These were a Shapiro-Wilk test (scipy.stats.shapiro in python) and D'Agostino's K^2 test (scipy.stats.normaltest in python). Both tests showed with 100% confidence that the data set cannot be treated as having a normal distribution.

Statistical analysis shows that the observed data shows kurtosis (presence of extreme values in tails of the distribution) and skewness (asymmetry of the outcome's distribution). These results concluded that in order to extract properties of the probability distribution, we had to fit an alternative distribution to the data, not a normal distribution. A common method is a Johnson SU-transformation of the normal distribution. How this is done is described in the python scipy documentation.

The following chapter contains the parameters of the Johnson SU-transformation of the normal probability density function, along with a visualization.

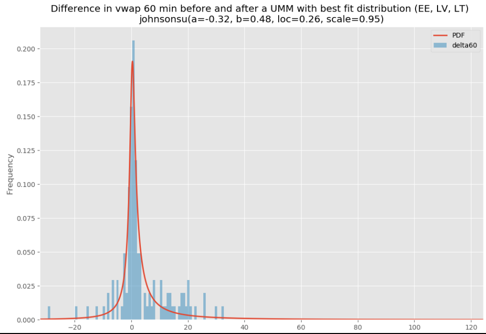
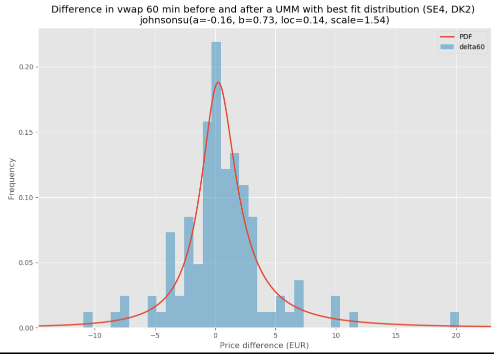
Characteristics of fitted probability distributions

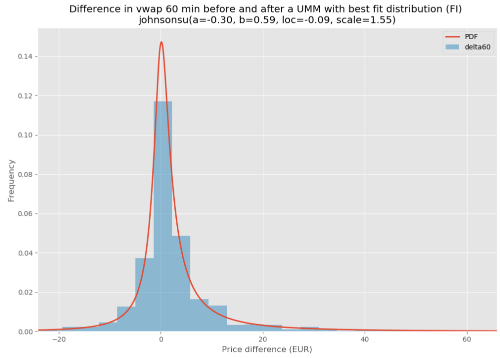
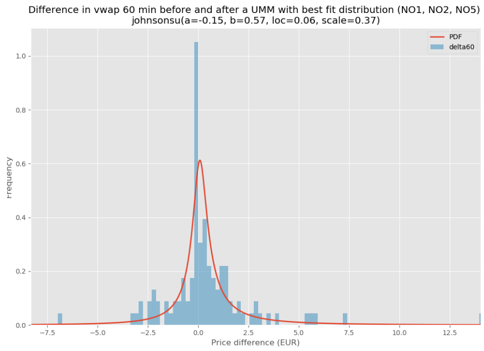
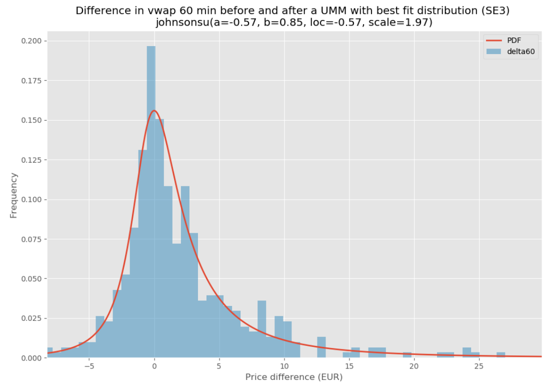
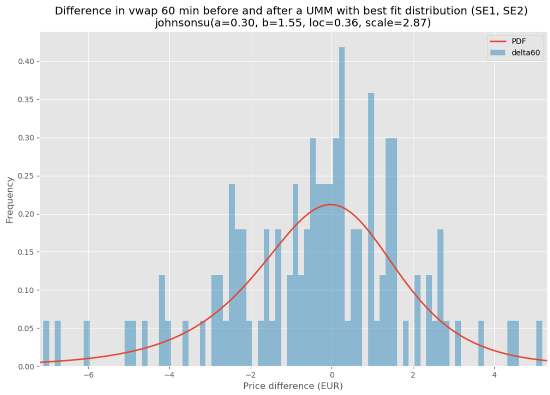
The table below presents the statistical characteristics of the delta data points (the difference in vwap before and after publication of the UMM) and the best fit probability density function. First, a distribution is fitted to all data points. Then all data points are divided in three categories, depending on the size of the UMM; below 100 MW, between 100 and 200 MW and above 200 MW. Parameters *a* and *b* define the shape of the probability density function, parameter *loc* shows the shift on x-axis and parameter *scale* the width of the distribution. The *loc* parameter will represent the peak of the probability density function.

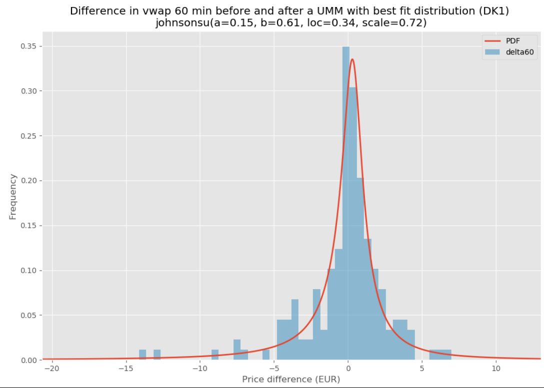
UMM size (MW)	Price change after publication of the UMM (EUR/MWh)	Statistical characteristics of the probability density functions
All	count 1946.00 mean 2.30 std 14.14 min -51.62 50% 0.45 95% 14.16 99% 35.92 max 307.29	loc = -0.05 scale =1.22
UMM <100	count 398.00 mean 1.46 std 8.85 min -47.07 50% 0.44 95% 12.08 99% 36.79 max 75.07	loc = 0.04 scale = 1.29
100 <= UMM < 200	count 778.00 mean 1.28 std 9.94 min -48.16 50% 0.18 95% 12.76 99% 29.54 max 191.26	loc = -0.08 scale = 1.12

UMM >= 200	count 770.00 mean 3.77 std 19.03 min -51.62 50% 0.82 95% 17.06 99% 62.37 max 307.29	loc = -0.04 scale = 1.29

The table below shows the same results per bidding area. To ensure a sufficient number of observations, we consider some bidding areas together – the aggregation is based on the assessment made in the first part of chapter 5. The characteristics of UMMs observed in the bidding areas are also provided in the table. This table is an extended version of Table 4.

Investigated bidding area	The size of UMMs observed in the bidding area (MW)	Price change after the publication of the UMM (EUR/MWh)	Statistical characteristics of the probability density functions and visualisation
LV, LT, EE	count 126 mean 157.44 SD 80.33 min 56.00 25% 95.00 50% 124.00 75% 192.00 max 455.00	count 126 mean 2.97 SD 10.20 min -48.16 25% -0.51 50% 0.82 75% 6.39 max 32.70	loc = 0.26 scale = 0.95 
SE4, DK2	count 108 mean 267.47 SD 130.01 min 100.00 25% 157.00 50% 250.00 75% 254.00 max 548.00	count 108 mean 1.47 SD 7.84 min -10.94 25% -0.97 50% 0.36 75% 2.35 max 65.15	loc = 0.14 scale = 1.54 
FI	count 830 mean 153.56 SD 130.36 min 25.00	count 830 mean 3.60 SD 20.32 min -51.62	loc = -0.09

	25% 75.00 50% 120.00 75% 190.00 max 890.00	25% -1.03 50% 0.66 75% 3.99 max 307.29	scale = 1.55 
NO1, NO2, NO5	count 108 mean 177.57 SD 83.56 min 30.00 25% 110.00 50% 160.00 75% 250.00 max 310.00	count 108 mean 0.42 SD 2.30 min -6.96 25% -0.22 50% 0.03 75% 1.03 max 14.17	loc = 0.06 scale = 0.37 
SE3	count 465.00 mean 464.81 SD 370.56 min 75.00 25% 130.00 50% 312.00 75% 700.00 max 1400.00	count 465.00 mean 2.22 SD 6.10 min -14.35 25% -0.72 50% 0.73 75% 3.56 max 51.28	loc = -0.57 scale = 1.97 
SE1, SE2	count 117.00 mean 147.30 SD 65.36 min 65.00 25% 105.00 50% 130.00 75% 175.00 max 440.00	count 117.00 mean -0.31 SD 2.32 min -7.11 25% -1.66 50% -0.13 75% 1.00 max 7.18	loc = 0.36 scale = 2.87 
NO3, NO4	count 11.00	count 11.00	Not a representative number of observations

	mean 153.90 SD 75.23 min 109.00 25% 109.00 50% 120.00 75% 167.50 max 350.00	mean -0.03 SD 2.08 min -5.82 25% -0.08 50% 0.35 75% 0.88 max 2.19	
DK1	count 181.00 mean 282.93 SD 118.14 min 72.00 25% 190.00 50% 267.00 75% 409.00 max 427.00	count 181.00 mean -0.47 SD 5.02 min -31.79 25% -0.91 50% 0.10 75% 1.14 max 17.27	loc = 0.34 scale = 0.72 

Statistical significance of a price change after publication of the UMM

Here is the output from the regression analysis. The results are per cluster of bidding areas analysed.

<table>
<tr><td>Investigated bidding area</td><td></td></tr>
<tr><td>LV, LT, EE</td><td><pre>
                            OLS Regression Results
==
Dep. Variable: y   R-squared: 0.073
Model: OLS   Adj. R-squared: 0.066
Method: Least Squares   F-statistic: 9.833
Date: Wed, 04 Aug 2021   Prob (F-statistic):   0.00214
Time: 16:27:46   Log-Likelihood: -466.04
No. Observations: 126   AIC: 936.1
Df Residuals: 124   BIC: 941.8
Df Model: 1
Covariance Type: nonrobust
==
                 coef   std err   t   P>|t| [0.025   0.975]
----
const   -2.4463   1.938   -1.263   0.209   -6.281   1.389
x1   0.0344   0.011   3.136   0.002   0.013   0.056
==
Omnibus: 28.440   Durbin-Watson: 1.686
Prob(Omnibus):   0.000   Jarque-Bera (JB):   153.299
Skew: -0.526   Prob(JB):   5.15e-34
Kurtosis: 8.300   Cond. No.   390.
==
</pre></td></tr>
<tr><td>SE4, DK2</td><td><pre>
                            OLS Regression Results
==
Dep. Variable: y   R-squared: 0.002
Model: OLS   Adj. R-squared: -0.007
Method: Least Squares   F-statistic: 0.2054
Date: Wed, 04 Aug 2021   Prob (F-statistic):   0.651
Time: 16:41:23   Log-Likelihood: -375.05
No. Observations: 108   AIC: 754.1
Df Residuals: 106   BIC: 759.5
Df Model: 1
Covariance Type: nonrobust
</pre></td></tr>
</table>

```
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.7575      1.739      0.436      0.664      -2.690       4.205
x1             0.0027      0.006      0.453      0.651      -0.009       0.014
==============================================================================
Omnibus:                      161.010   Durbin-Watson:                   1.300
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             7862.620
Skew:                           5.527   Prob(JB):                         0.00
Kurtosis:                      43.312   Cond. No.                         682.
==============================================================================
```

FI

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.094
Model:                            OLS   Adj. R-squared:                  0.093
Method:                 Least Squares   F-statistic:                     85.64
Date:                Wed, 04 Aug 2021   Prob (F-statistic):           1.80e-19
Time:                        16:41:53   Log-Likelihood:                -3636.0
No. Observations:                 830   AIC:                             7276.
Df Residuals:                     828   BIC:                             7285.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         -3.7284      1.038     -3.590      0.000      -5.767      -1.690
x1             0.0477      0.005      9.254      0.000       0.038       0.058
==============================================================================
Omnibus:                     1170.189   Durbin-Watson:                   1.540
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           304078.326
Skew:                           7.658   Prob(JB):                         0.00
Kurtosis:                      95.510   Cond. No.                         311.
==============================================================================
```

NO1, NO2, NO5

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.009
Method:                 Least Squares   F-statistic:                  0.001898
Date:                Wed, 04 Aug 2021   Prob (F-statistic):              0.965
Time:                        16:42:34   Log-Likelihood:                -242.98
No. Observations:                 108   AIC:                             490.0
Df Residuals:                     106   BIC:                             495.3
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.3959      0.526      0.753      0.453      -0.646       1.438
x1             0.0001      0.003      0.044      0.965      -0.005       0.005
==============================================================================
Omnibus:                       76.500   Durbin-Watson:                   1.408
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              719.986
Skew:                           2.135   Prob(JB):                    4.54e-157
Kurtosis:                      14.907   Cond. No.                         462.
==============================================================================
```

SE3

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.048
Model:                            OLS   Adj. R-squared:                  0.046
Method:                 Least Squares   F-statistic:                     23.23
Date:                Wed, 04 Aug 2021   Prob (F-statistic):           1.95e-06
Time:                        16:43:57   Log-Likelihood:                -1488.5
No. Observations:                 465   AIC:                             2981.
Df Residuals:                     463   BIC:                             2989.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5506      0.443      1.242      0.215      -0.321       1.422
x1             0.0036      0.001      4.819      0.000       0.002       0.005
==============================================================================
Omnibus:                      334.102   Durbin-Watson:                   0.943
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5999.519
Skew:                           2.888   Prob(JB):                         0.00
```

```
Kurtosis:                      19.622   Cond. No.                         954.
==============================================================================
```

SE1, SE2

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.008
Model:                            OLS   Adj. R-squared:                 -0.000
Method:                 Least Squares   F-statistic:                    0.9842
Date:                Wed, 04 Aug 2021   Prob (F-statistic):              0.323
Time:                        16:43:34   Log-Likelihood:                -263.72
No. Observations:                 117   AIC:                             531.4
Df Residuals:                     115   BIC:                             537.0
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.1726      0.532      0.324      0.746      -0.881       1.226
x1            -0.0033      0.003     -0.992      0.323      -0.010       0.003
==============================================================================
Omnibus:                        4.469   Durbin-Watson:                   1.277
Prob(Omnibus):                  0.107   Jarque-Bera (JB):                5.271
Skew:                          -0.161   Prob(JB):                       0.0717
Kurtosis:                       3.989   Cond. No.                         398.
==============================================================================
```

NO3, NO4

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.680
Model:                            OLS   Adj. R-squared:                  0.644
Method:                 Least Squares   F-statistic:                     19.10
Date:                Wed, 04 Aug 2021   Prob (F-statistic):            0.00180
Time:                        16:43:05   Log-Likelihood:                -16.904
No. Observations:                  11   AIC:                             37.81
Df Residuals:                       9   BIC:                             38.60
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          3.4915      0.888      3.933      0.003       1.483       5.500
x1            -0.0228      0.005     -4.370      0.002      -0.035      -0.011
==============================================================================
Omnibus:                        1.246   Durbin-Watson:                   1.630
Prob(Omnibus):                  0.536   Jarque-Bera (JB):                0.595
Skew:                           0.552   Prob(JB):                        0.743
Kurtosis:                       2.717   Cond. No.                         402.
==============================================================================
```

DK1

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.037
Model:                            OLS   Adj. R-squared:                  0.032
Method:                 Least Squares   F-statistic:                     6.879
Date:                Wed, 04 Aug 2021   Prob (F-statistic):            0.00947
Time:                        16:44:17   Log-Likelihood:                -544.88
No. Observations:                 181   AIC:                             1094.
Df Residuals:                     179   BIC:                             1100.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         -2.7798      0.955     -2.911      0.004      -4.664      -0.896
x1             0.0082      0.003      2.623      0.009       0.002       0.014
==============================================================================
Omnibus:                      146.435   Durbin-Watson:                   1.061
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2442.333
Skew:                          -2.844   Prob(JB):                         0.00
Kurtosis:                      20.073   Cond. No.                         797.
==============================================================================
```

Appendix 4 – Questions to market participants

The following questions were asked of traders:

1. Do you actively use UMMs as input to your trading strategy in the Nordic market?

    - If yes to the above:
      When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in normal situations?

    - When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in strained market conditions (e.g. situations with very cold weather, low water reservoir levels, or similar)?

    - Is this different in different bidding zones where you trade?

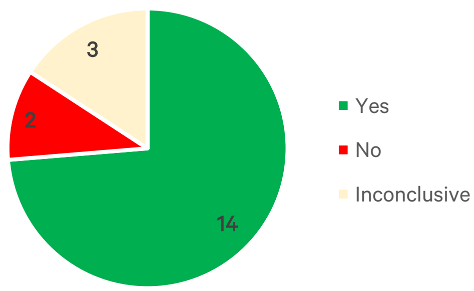
    - If no, why are you not using UMMs as input?

2. Today, many market participants are applying a threshold of 100 MW for publishing an outage as inside information. Do you consider this as an appropriate threshold?

Below we provide the answers from traders and a summary of responses:

1. Do you actively use UMMs as input to your trading strategy in the Nordic market?

Do you actively use UMMs as input to your trading strategy in the Nordic market?



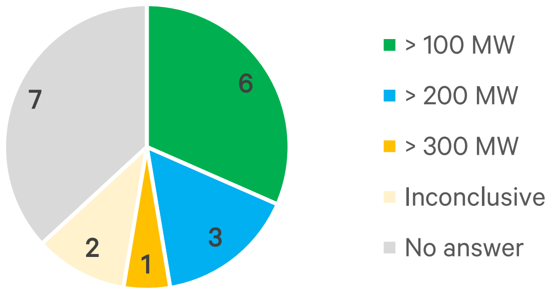
	Answer	Nord Pool's summary
1	No	No
2	Ja. Däremot gör jag ingen egen bedömning av hur mycket en viss storlek på otillgänglighet påverkar priset, utan lämnar denna bedömning till prisprognostisören. Jag försöker mest se om det finns UMM överhuvudtaget, så att en otillgänglighet kan komma att påverka	Yes

	priset. Mitt fokus ligger på UMM som vi själva har publicerat (för vattenkraft och kärnkraft), samt på UMM som gäller större nätbegränsningar i SE1, SE2 och SE3 som SvK har publicerat. Jag tittar både på ”Unavailability” och ”Market Information”.	
3	Yes	Yes
4	Yes	Yes
5	Only when it is unavailability of Nuclear power (much bigger volumes than 100 MW) because then we often have to do a lot of replanning of other power sources like hydropower	Yes
6	From a DA planner perspective UMM:s are used for getting as correct input as possible for long, medium and short term price forecasting. Long/medium forecasts are used for setting long/medium water values and short term forecasts are used for short term water values both highly relevant when bidding to SPOT and ancillary service markets.	Yes
7	No, not actively	No
8	Yes, in order to support a well-functioning market we monitor UMMs and REMIT notifications – both from a market support perspective and from a trading perspective.	Yes
9	Yes	Yes
10	Yes	Yes
11	It's the sum for the price area pr. Week/month that matters. 100 MW is ok, but there are times when less MW also matters because of how the producers can produce in the rest of the river. The grid capacity is also very important special now between NO2 - NO1 and cable to Germany and Holland. It only reflect my opinion about the price directions (up or down). Only trading sys price	Inconclusive
12	When it comes to the information about unavailable production units, we mainly use aggregated information from e.g. Wattsight etc. We do not manually read all the UMMs related to production or consumption, as it is the aggregated number that is most relevant for us. When it comes to transmission capacity, we read the UMMs from the TSOs manually to a larger degree, in order to get information about available capacity. However, this information often consists of large intervals, which makes the information less interesting to use for analytic purposes.	Inconclusive
13	Yes, but only as one of many information sources and level of importance varies highly from day to day where I typically: i. Monitor the UMM-page briefly a few times per day, ii. Immediately check the UMM-page if something unexpected happens (e.g. if the frequency drops rapidly) iii. Use notification-alarms for UMMs for some specific important assets	Yes
14	We actively use UMMs as input in our long term price forecast and short term (day-ahead) price forecast. We have an automatic set-up that read all UMMs and this is taken into account in our price prognosis. In the day-ahead market we always offer all available production at our marginal cost/water values. Since our price prognosis is an important factor for the water values our trading strategy in the day-ahead market is to some degree dependent of published UMMs, but not directly. - When trading in the intraday market we monitor if there are any new UMMs or changes in UMMs since day-ahead nomination, but it is seldom that this alone influence our trading strategy.	Yes

	- Also in forward trading, we actively monitor the UMMs and they influence our trading strategy.	
15	Yes	Yes
16	Yes	Yes
17	We have the operations team checking outages in all markets every 15 minutes, and traders always have the UMM pages open. The size that is impactful depends very much on the market and the fundamentals that day. For example, in Finland and DK2 where supply and demand are in very close margins, smaller outages will mean more because it further limits the flexibility in the already tight market. However, if these markets are coupled with the others where this is more flexibility then the same small outages won't have as large an effect. Another factor is of course the wind levels and temperatures like you mention to evaluate how tight the market is and understand what kind of flexibility there may or may not be from other suppliers.	Yes
18	The relevant size of an outage depends mainly on the coupling situation: a 100MW outage in a widely coupled scenario is rather irrelevant while a 100MW outage in say FI being decoupled up can be the cause of market pressure and regulation changes. - The general rule is: the smaller the market / price area the lower the threshold. - There is not much differentiation on the different areas in respect to 'relevant size'. The coupling is more important. - Often, it is even with a big outage not observable how much a plant was actually running so the impact is often guess work. We try to track live data from Energinet and SVK then to detect changes in production at the time of the outage. - What I think is quite relevant is the timing of the publication. I have noticed in the past that some outages are published quite late, even after the what I think is obligatory 1h-rule where outages must be published within 1h of happening.	Inconclusive
19	Depending on the wind production on that day as well and coupling situation, in general if it is an isolated market let´s say FI only, 100MW can impact the system already. If all Nordics are coupled, maybe around 400MW. Use 100mw as a general rule.	Yes

If yes to the above: When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in *normal situations*?

When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in normal *situations?*

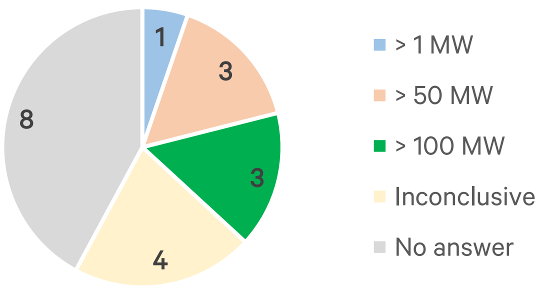


	Answer	Nord Pool's summary
1	-	No answer
2	-	No answer
3	It depends on which area it concerns however most 200mw or less UMMs I don't actively use in my estimations on the market. Anything above that is interesting and might affect my trading strategy.	>200 MW
4	Very hard to say. In high price areas smaller unavailabilities can have bigger effect on the balance, and it is depending on different circumstaince s (which is why this is a difficult topic).	Inconclusive/
5	It depend on time! When the outage happen! 200 MW can have an impact at a time when demand is high (Peak load) in market (for example wintertime!), but mostly not 100 MW. It should be 200MW limit or more in my point of view.	>200 MW
6	What unavailabilities that should be published needs to be put in relation to all other uncertainties where, with the big wind build, the uncertainty in wind forecasts probably is the largest one. Given this the current practice of 100 MW seems appropriate, or the other way around a lower value seems in-appropriate.	>100 MW
7	-	No answer
8	It depends on the market "conditions" if the market is under a lot of pressure even a small amount of MW can have an effect on the price. In these situations we know that prices can be very volatile and will take our precautions after best endeavor. It is our belief that 100MW is a fair and manageable size for UMM and REMIT reporting – you could ague that in some circumstances should the level be lower or even higher, but that will also cause additional administration and involve some guidance and reporting which we feel will create a lot of unnecessary effort both for regulators and market participants.	>100 MW
9	It depends on the area, but when the sum of the outage adds up to 100 MW or more it becomes important to know. Meaning that if an outage increases over time it must be made public when the sum of the outages becomes 100 MW or more.	>100 MW
10	All outages above 200 MW	>200 MW
11	-	No answer
12	-	No answer
13	When monitoring UMMs for ID-trading it's obviously larger unavailabilities (X*100 MW) which are interesting, either from single huge asset (> 300-400 MW) or from combinations of several medium-	>300 MW

	sized assets (>100 MW). It's always difficult to foresee if, when and to what extent an unavailability will impact the market – so when using the UMM-info for ID-trading my intention is not to do any detailed analysis or price forecast, but rather to understand what's happened in the power system (i.e. frequency drop, mFRR activations) to get a hint on market risk for the next few hours/days.	
14	With regard to the short-term market, in normal situations the size of outage communicated in a UMM should be large, around 500MW, before it directly affect the price we are willing to trade at in the intraday market. - As mentioned above our trading strategy in the day-ahead market is determined by our water values that only indirect are influenced by UMMs through our price prognosis. In normal situations UMMs concerning volumes from approximately 500MW will significantly affect our price prognosis. For the price prognosis the energy (volume and length of UMM) not available for production is also relevant. 'With regard to forward trading, in normal situations we consider an outage of 200 MW and more to influence our trading operation on the system price. An 100 MW outage might influence on our trading operation of EPADS.	>100 MW
15	300 MW+	>300 MW
16	100 MW	>100 MW
17	We use 100 MW as a general threshold to simplify, however often this is not a one sized fits all OK volume due to the reasons mentioned above. For markets that have more flexibility like DK1 or SE1 100 MW could have little impact to us, whereas 50 MW outage in DK2 could be very impactful on pressured days. From a trading perspective therefore, it is important we stay on top of all outages of all sizes – better to have too much information than not enough 😊	>100 MW
18	-	No answer
19	-	No answer

When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in *strained market conditions* (e.g. situations with very cold weather, low water reservoir levels, or similar)?

When reading UMMs published for the Nordic market, what size of outage in MW would be likely to affect the price and/or volume of the orders that you place in the market in strained situations (e.g. situations *with very cold weather, low water reservoir levels, or similar)?*



	Answer	Nord Pool's summary
1	-	No answer

2	-	No answer
3	I do not have that much to refer to here but I believe in strained conditions I would look into UMMs of any size. Strained situations changes the frequency of which I refresh the UMM status.	>1 MW
4	Extremely difficult to say	Inconclusive
5	I am not reading UMM that way! I just use the UMM application to inform market of my outages. I almost never change prices of bids because of a new 100 MW UMM, for me the regulation price is more important but may be a result of an outage!!!	Inconclusive
6	Naturally in strained situations when we are in the steep part of the bidding curve smaller outages may have a significant impact on the price. To lower the threshold value would in most cases not serve its purpose but rather spam the market with irrelevant information and also put a larger administrative burden on all market participants writing and/or reading UMMs. It should be up to each market participant to judge weather an outage < 100 MW may have a significant impact on the price in that specific price area and if so, publish an UMM	Inconclusive
7	-	No answer
8	Again it depends on the market conditions as you mentions – we could be in a situation where 1MW push the market from belong to short or 1MW causes a jump in imbalance prices – in other situations it could be several hundreds of MW. Every time a new asset is brought in or out of action you will see a regulation in prices – but with a well-functioning interconnector solution we would say that under normal circumstances a fair level will be around 100MW but it depends a lot on the given situation.	Inconclusive
9	It depends on the area, but when the sum of the outage adds up to 100 MW or more it becomes important to know. Meaning that if an outage increases over time it must be made public when the sum of the outages becomes 100 MW or more.	>100 MW
10	100 MW	>100 MW
11	-	No answer
12	-	No answer
13	-	No answer
14	In strained market conditions the level is of course lower, but for one single UMM do affect our strategy in the intraday market, it still has to be of a considerable size; 200-300MW. As mentioned we monitor the aggregated level of UMMs/unavailability. The forward market is here more sensitive to UMMs and here – in very strained market conditions – also an outage of 50 MW might sometimes influence our trading operations.	>50 MW
15	100 MW +	>100 MW
16	50 MW	>50 MW
17	(see the previous answer)	>50 MW
18	-	No answer
19	-	No answer

Is this different in different bidding zones where you trade?

	Answer	Nord Pool's summary

1	-	No answer
2	-	No answer
3	Yes, I check UMMs for the areas which I trade in and sometimes connected areas.	Yes
4	Yes, it is usually a lot more sensitive in Finland, SE4, DK1 and DK2.	Yes (in Nordics FI, SE4, DK1, DK2 are sensitive)
5	Yes it is!	Yes
6	-	No answer
7	-	No answer
8	Yes, DK1 have a stronger connection to 2 well-equipped markets Norway and Germany, while DK2 can struggle in some situations where the Swedish border is. Constrained. Germany is not having the same issues given their size and interconnectors to several countries, however there can be bottleneck issues between the local DSO areas which make it difficult to move power around. In these situation one area can be long while others can be short and move prices up – the TSOs in Germany are working on a grid buildout which should remove bottlenecks. NL have 2 major players and are often under some pressure which gives huge spreads in the market. UK have a strong setup but lately starting to suffer from intermittent effects from the buildout of renewables	Yes (in Nordics DK2 is sensitive)
9	Yes, the smaller the productions is in an area, the bigger effect of an outage (potentially).	Yes
10	Not relevant: We operate in one single bidding zone.	No
11	-	No answer
12	-	No answer
13	Yes of course (depending on size of loca area balance), but in most cases we're still talking about fairly large volumes (far > 100 MW) also for the smallest bid areas.	Yes
14	Yes, to some degree. Some bidding zones will more often be in a situation that resemble a strained situation.	Yes
15	Yes. UMMs in areas with high flexibility (Norway + SE1 & SE2) have much lower impact.	Yes
16	Yes	Yes
17	-	No answer
18	-	No answer
19	-	No answer

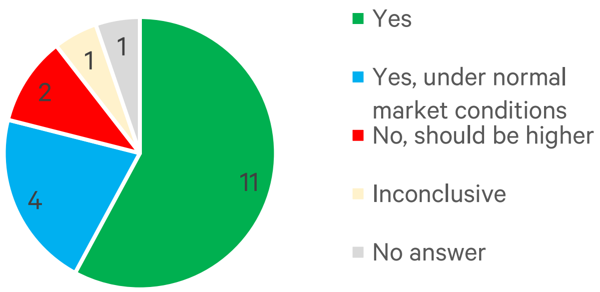
If no, why are you not using UMMs as input?

	Answer	Nord Pool's summary
1	We are pricing our assets all based on their generation costs/ opportunity costs. UMMs except for large volume/ long timespan ones are not affecting the cost basis underlying our pricing	Only really large UMMs are relevant
2	-	No answer
3	-	No answer
4	-	No answer

5	The UMM application is to bad and does not support the user in finding specific UMM, I can´t spend all time for searching UMM. Improvements needed!! The UMM application must get better search function.	Hard to find relevant UMMs
6	-	No answer
7	In my position , we are trading asset-backed meaning that there are more relevant signals for whether or not to make a trade, such as the published regulating prices as well as the activated intra-hour bids for mFRR. We have the possibility to decide whether we want to regulate our own assets or trade on the intraday market for handling imbalances. If an UMM has a real price effect, we can choose to trade if we see that the prices are beneficial for us, but we usually don't trade just based on information published in an UMM.	Other information is more relevant
8	-	No answer
9	-	No answer
10	-	No answer
11	-	No answer
12	-	No answer
13	-	No answer
14	-	No answer
15	-	No answer
16	-	No answer
17	-	No answer
18	-	No answer
19	-	No answer

2. Today, many market participants are applying a threshold of 100 MW for publishing an outage as inside information. Do you consider this as an appropriate threshold?

Today, many market participants are applying a threshold of 100 MW for publishing an outage as inside information. Do you consider this as an appropriate threshold?



	Answer	Nord Pool's summary
1	In general, yes. Depending on the coupling pattern, size of areas and market situation the volume threshold can also be significantly larger than 100MW.	Yes
2	Tycker 100 MW är en rimlig gräns. Jag ser det dock mest utifrån perspektivet att skicka UMM, och mindre utifrån perspektivet hur stor prispåverkan just 100 MW har. Oavsett gränsens storlek, och om den ska skilja sig åt mellan olika prisområden, tycker jag det är viktigt att ha en gräns, så att det inte blir en bedömning från fall till fall.	Yes

3	I don't have much input here however I believe the 100MW rule of thumb is a reasonable volume to work with. Decreasing it would probably be a lot of micromanagement work in comparison to what it would support the market. Increasing it above 100MW could let important changes go unnoticed and create instability.	Yes
4	Yes and no. Yes, because it is very clear and easy to keep track of. No, because I would probably want more information in high price areas.	Inconclusive
5	No! it should be at least 200 MW.	No, should be higher
6	What unavailabilities that should be published needs to be put in relation to all other uncertainties where, with the big wind build, the uncertainty in wind forecasts probably is the largest one. Given this the current practice of 100 MW seems appropriate, or the other way around a lower value seems in-appropriate. Even if the questions are related to production the same principals should apply to consumption.	Yes
7	I think that the threshold of 100 MW is fairly low, but I also want to emphasize that it's important that the rules for whether or not to publish an UMM should be simple and clear, meaning that I think it's better to have a pronounced limit rather than every market participant making their own interpretation of whether or not an outage affects the market prices.	No, should be higher
8	Yes, We believe that this is a fair level, easy to manage and easy follow up upon – one of the important tasks is to ensure the level will be the same in all the European markets and in all situations so we don't end up with 20 different levels and should make assumptions from market participants side whether its 75MW today, or 87MW or 225MW on a sunny and windy day. A shared platform for reporting is also on the list of development wishes as now it's a little blurring in some areas – in DKs there is a good and strong reporting method with current setup for UMMs	Yes
9	Yes, when the sum of the outage adds up to 100 MW or more it becomes important to know. Meaning that if an outage increases over time it must be made public when the sum of the outages becomes 100 MW or more.	Yes
10	The threshold is appropriate in normal situations, but in a strained market condition, an outage of 80 MW could affect the price.	Yes, under normal market conditions
11	100 MW is ok	Yes
12	-	No answer
13	Yes	Yes
14	Yes, as this is a well-established and known practice. The market expects that outages at 100MW or above is published.	Yes
15	Yes	Yes
16	Yes, under normal market conditions	Yes, under normal market conditions
17	We use 100 MW as a general threshold to simplify, however often this is not a one sized fits all OK volume due to the reasons mentioned above. For markets that have more flexibility like DK1 or SE1 100 MW could	Yes, under normal

	have little impact to us, whereas 50 MW outage in DK2 could be very impactful on pressured days. From a trading perspective therefore, it is important we stay on top of all outages of all sizes – better to have too much information than not enough 😊	market conditions
18	I think 100MW is a good size which though should not mean that any outages smaller should not be published anymore. - So in terms of 'relevant size' 100MW is an ok level. If though like FI is decoupled up and pressured already, even a smaller outage could mean 'jumping over the edge' then. Here, the factor 'market relevant driver' would be given why even a say 60MW outage needs to then be considered inside information	Yes, under normal market conditions
19	Yes, appropriate	Yes

Appendix 5 – Extraordinary market situations

When considering results from the qualitative testing, it became clear that market participants and regulators alike considered that under certain market situations, the threshold needs to be reconsidered (see 3.1.2 and 3.2). At the same time, quantitative analysis shows that in the vast majority of market situations, a threshold of 100 MW seems to be appropriate for the publication of inside information in the Nordic and Baltic market. Therefore, to weigh these two aspects, the authors of the report consider that during extraordinary market situations, the threshold should be reassessed.

It is up to each market participant to identify under which circumstances a reassessment of the threshold should be initiated. As a 100 MW threshold is considered appropriate over the three years investigated in this report, it is our view that only under extraordinary circumstances might the threshold need to be lowered.

As an example, the (now outdated) NordBER report "Energy Shortage - Coordinated handling of a potential disturbance in the Nordic power system"[32] states that all the Nordic countries have extraordinary measures ready to reduce the probability for load-shedding. The common feature of these measures is that their activation must be approved by either the Regulator or Government. When such measures are initiated in any of the Nordic and Baltic countries, we recommend that market participants reassess the 100 MW threshold. Other extraordinary events may include the risk of blackouts or rationing announced by TSOs, or under other extreme market conditions or constraints.

[32] https://www.energimyndigheten.se/globalassets/trygg-energiforsorjning/el/energy-shortage---coordinated-handling-of-a-potential-disturbance-in-the-nordic-power-system.pdf