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A review of Svenska kraftnät's EPAD Pilot 2023

2024

Svenska kraftnät

Svenska kraftnät is a state owned enterprise with the task of maintaining Sweden's electricity transmission grid, which consists of about 16,000 kilometres of 400 kV and 220 kV transmission lines with substations and interconnectors. Svenska kraftnät is also the system operator for electricity in Sweden.

Svenska kraftnät is developing the transmission grid and the electricity market to meet society's need for a secure, sustainable and cost-effective supply of electricity. In this, Svenska kraftnät plays an important role in implementing national climate policies.

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Executive Summary

In this report, Svenska kraftnät analyses how auctions of EPAD contracts worked during the initial pilot phase (2023). The focus of the report is to analyze price formation in the auctions. Prior to the release of this report a survey addressed to market participants was conducted. Svenska kraftnät asked for views on how the auctions were perceived, suggestions for improvements and feedback on the market participants' future plans.

In the report, Svenska kraftnät makes the following assessments:

- Overall, the auction model is considered to have worked well and the auctions contribute to increased transparency and to better price formation on the EPAD market. The auctions also fill an important need during a period of low market liquidity and are considered to support better opportunities for market participants to manage underlying structural market asymmetry between Swedish bidding zones. Participation in the auctions is assessed as satisfactory, but with some elements of market concentration. The market participants themselves are generally satisfied with the auctions, but see some potential for improvement.
- The price formation in the auctions is considered satisfactory, but the auctions of monthly contracts have not worked as well as, for example, the calendar year contracts.
- A positive trend that can be discerned is that the most liquid bidding zone, SE3, seems to have benefited most from the additional volume contributed by the auctions, while bidding zone SE4 continues to display a very low turnover in continuous trading. The EPADs traded in the auctions demonstrate significantly higher turnover compared to other EPADs, and this trend has also been accentuated during the first quarter of 2024.
- In terms of market participants' future plans, these appear to be characterized by a wait-and-see attitude towards zonal futures and a desire to keep EPADs as an auction instrument.
- Overall, there are some outstanding issues, which need to be addressed in the near future. Svenska kraftnät therefore intends to contact market participants before the summer in order to discuss possible adjustments to the auctions such as maturities, instruments and schedules.

Introduction

The purpose of this report is to analyze how Svenska kraftnät's auctions of EPAD contracts worked during the initial pilot phase (2023). The focus of the report is to analyze the price formation in the auctions. Prior to the report, Svenska kraftnät conducted a survey addressed to market participants, in which we requested: (i) views on how the auctions were perceived and (ii) suggestions for improvements and (iii) feedback on the participants' future plans. The survey was conducted during the period 7 - 26 February 2024. The survey responses show that a large majority of the respondents, 88.9%, have also participated in Svenska kraftnät's auctions of EPAD contracts. In total, 24 of the 27 participants in the auctions responded to the survey.

In June 2023, EEX and Nasdaq announced that an agreement had been reached for EEX to acquire Nasdaq's European power trading and clearing business. The transaction, which has not yet been completed, has created uncertainty related to the future Nordic market model. The market participants' views on the future, instrument preferences and time schedules therefore constitute key inputs into Svenska kraftnät's future arrangements and planning.

Svenska kraftnät has previously published four quarterly follow-ups, which have primarily been of a descriptive nature. This full-year report is intended to serve as an in-depth analysis and complements previous follow-ups.

Background

The FCA Guideline (EU) 2016/1719 establishing a guideline on forward capacity allocation, aims to improve and ensure sufficient hedging possibilities in the forward markets. The regulatory framework mainly concerns Transmission System Operators (TSOs), regulatory authorities, Member States and market participants. The long-term hedging (forward) market shall ensure that it is possible to mitigate risks related to the price volatility in the Day Ahead market in bidding zones across the EU. TSOs are identified as one party that may be legally obliged to support the functioning of the market. Until now, the most common way of providing support has been for the TSOs to offer Long Term Transmission Rights.

Svenska kraftnät's pilot project of auctioning financial contracts used for hedging specific bidding zone price risk in the Nordic electricity derivatives market, Electricity Price Area Differentials (EPADs), aims to empirically test an alternative way for a TSO to increase liquidity in the forward market through the use of exchange-traded contracts.

EPAD auctions provide a transparent allocation method that allows market participants to regularly buy and sell EPADs at market prices. This model can also serve as an example of a future alternative to the measures currently described in the FCA GL.

In the pilot auctions, Svenska kraftnät offers to both buy and sell EPADs in the following bidding zones; SE2 (Sundsvall), SE3 (Stockholm) and SE4 (Malmö). The auctions on each side of a bidding zone border (buy on one side and sell on the other) are matched with each other and transactions only go through if Svenska kraftnät's buy transaction is at the same or lower price than Svenska kraftnät's sell transaction in the adjacent bidding zone.

For the practical implementation of the auctions, Svenska kraftnät has procured the company Svensk Kraftmäkling AB (SKM) to arrange the auctions. All transactions are cleared at Nasdaq Clearing AB. During the pilot project, Svenska kraftnät has limited the volume of offered contracts to approximately 10% of the expected available physical capacity for the relevant bidding zone borders (section 2 [SE2/SE3] and section 4 [SE3/SE4]).



Figure 1: Swedish bidding zones and bidding zone borders.

Bidding zones and hedging

The spot price of electricity varies between bidding zones and any price difference depends, among other things, on the transmission capacity of the electricity networks. Price developments on the forward market provide an indication of how market participants view future price developments in different bidding zones.

At the same time, the forward market provides an indication of the market's expectations of price differences between bidding zones and the size of future congestion revenues, which accrue to the TSOs. Congestion revenues for Sweden's internal bidding zone borders accrue to Svenska kraftnät, and for external borders these revenues are shared between the bordering TSOs.

Trading in energy derivatives on the forward market is used throughout Europe for hedging and is a complement to trading on the spot market. It involves buyers and sellers entering into a financial agreement to trade electricity at a certain fixed price during a given contract period. The advantages of trading on the forward market are that the marketplace, such as Nasdaq or EEX, is transparent and that the parties trading and settling contracts there must be approved by the electricity exchanges, which guarantees that the parties are creditworthy.

As mentioned above, other hedging instruments are used in the Nordic region than in the rest of Europe. Here, market participants use system price contracts, which are supplemented by EPAD contracts to cover price differences between electricity areas. The system price is a reference price calculated as if electricity could be transported without transmission constraints in the Nordic/Baltic market area. EPAD contracts in turn show the difference between the price in an individual bidding zone and the system price. So-called system price contracts make it possible to hedge large parts of the fundamental price risk that exists on the electricity market as a result of varying access to, for example, hydro and nuclear power and variations in fuel prices.

The system price thus serves as a reference price for different types of contracts in the Nordic/Baltic market area. The remaining price risk, i.e. the difference between the price in a specific bidding zone and the system price, cannot be managed with system price contracts for obvious reasons. EPAD contracts enable hedging against the remaining price risk of the difference between a specific bidding zone price and the system price.

In the rest of Europe, market participants use transmission rights in combination with (zonal) futures for hedging instead of EPAD contracts and system price futures. One difference is that transmission rights are not an exchange-traded product and are instead issued by Transmission System Operators (TSOs) via a dedicated platform.

By design, the combination of system price contracts and EPAD contracts provides an effective hedge for the price risk in the system as a whole and for the specific bidding zone against which the EPAD contract is settled.

Although an EPAD contract, by design, hedges the risk of deviations between a bidding zone price and the system price, EPAD contracts can also be combined in pairs to hedge the price difference between two or more bidding zones.

A combination of buying an EPAD in one bidding zone and selling in an adjacent bidding zone is thus equivalent to a financial instrument for hedging the price difference between two bidding zones. This type of hedging has limited uses for most market participants. However, the construct can be used to manage the financial exposure of a TSO when engaging in the financial market as the contract combination acts as an effective hedge of the congestion income.

Turnover and liquidity

Svenska kraftnät's pilot project with EPAD auctions aims, as mentioned earlier, to test a new way for a TSO to support improved hedging opportunities and contribute to increasing liquidity in the forward market.

The forward market has been struggling with declining liquidity for many years. In 2022, the challenges increased further as a result of higher margin requirements that forced participants to allocate more capital to clearing, as well as increasing spot price differences and lower price correlation between bidding zones. The latter has in turn led to a lower relevance of the system price as a reference price for market participants' hedging.

The follow-up presented in this report covers the 376 individual auctions carried out on 22 occasions in 2023. The follow-up is consequently supplemented with an initial longer-term review of the development of the Nordic financial electricity market.

The figure below shows the total cleared volume for system price contracts and EPAD contracts on Nasdaq since 2013. As shown in the figure, system contracts represent the bulk of the turnover in the Nordic market and it is these that have lost the most volume (TWh) in both absolute and relative terms.

Since 2013, the turnover of system price contracts has fallen by more than 75%, while EPAD contracts have lost around 30%. The relative share of EPAD contracts in total turnover has thus increased from just under 10% to more than 20%. In 2023, total turnover on Nasdaq rose by more than 9% compared to the low point in 2022, relatively evenly distributed between contract types.

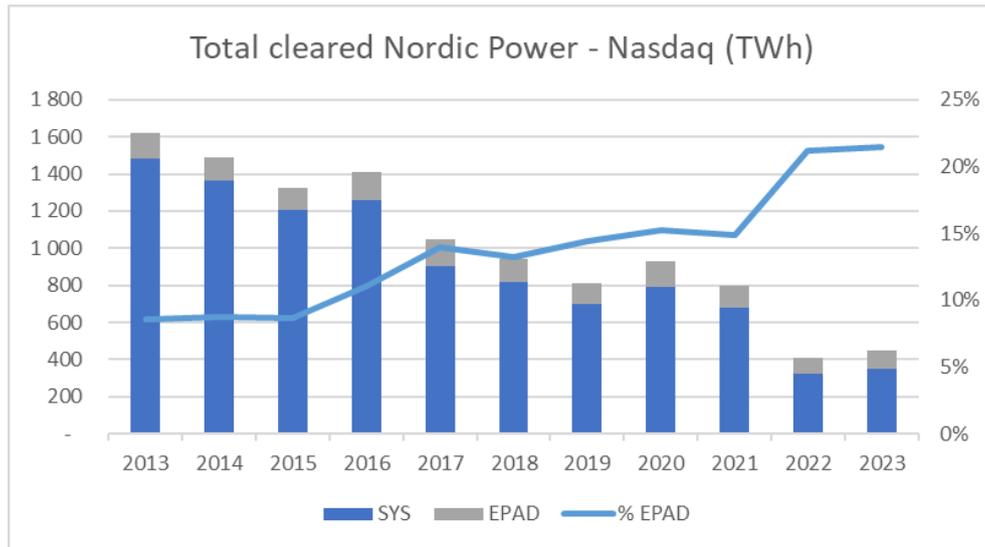


Figure 2: Total cleared volume for system price contracts and EPADs (Nasdaq) 2013 - 2023.

Market participants

The figure below summarizes the participation per auction date, with a total of 27 unique participants in the 2023 auctions. On average, 20 of the 27 participants attended the different auction occasions, with the last auction of the year attracting the highest number of participants (26).

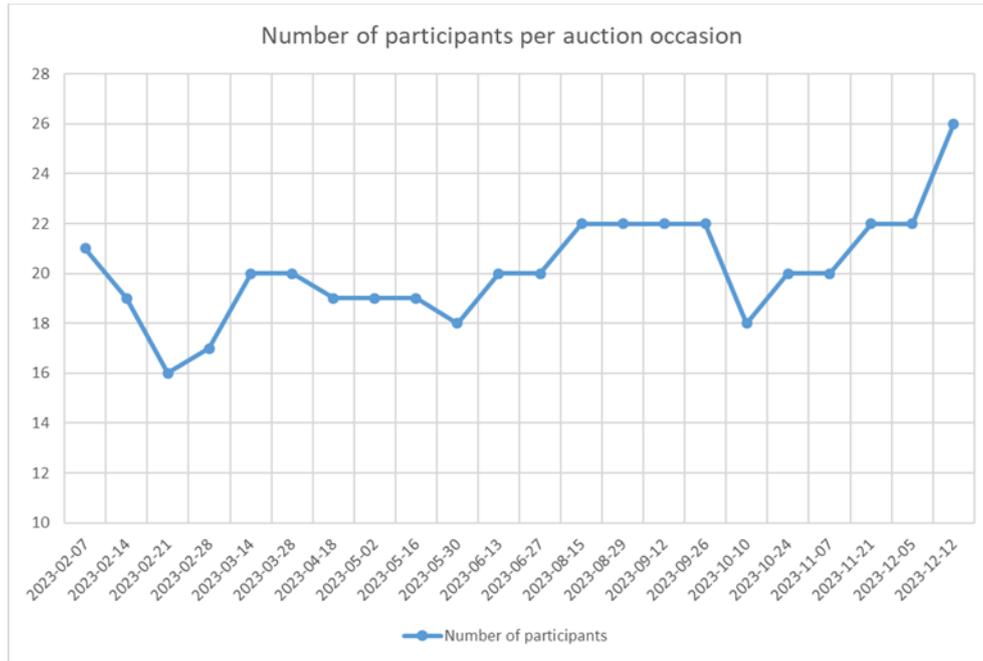


Figure 3: Total number of participants per auction occasion (2023).

Roles and hedging needs

The participants in the Nordic financial electricity market are electricity producers, electricity trading companies and major electricity users. The summary below shows that the lion's share of the participants have fundamental hedging needs and that the largest single group is electricity producers¹.

¹ The totals may exceed 100% as individual participants may have several different roles in the electricity market.

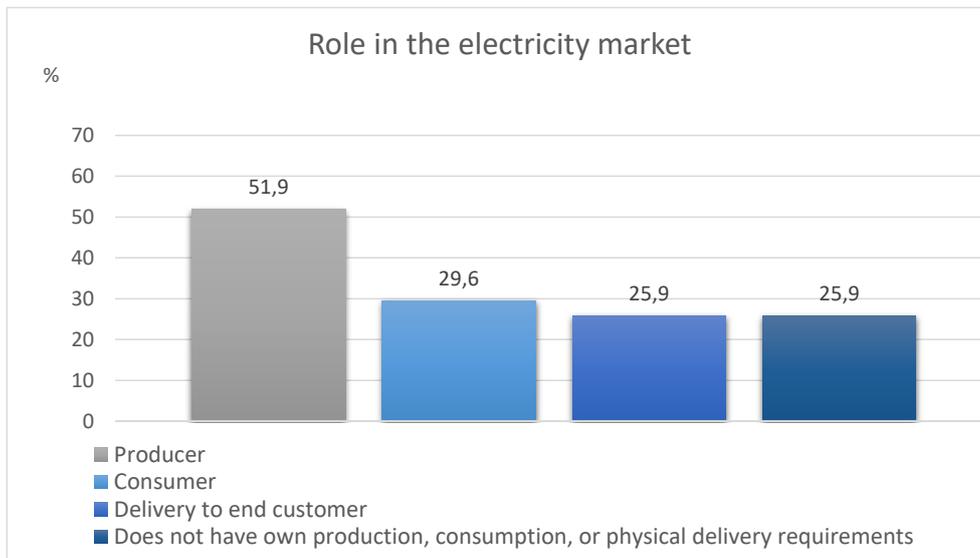


Figure 4: Role in the electricity market of survey respondents.

Based on the figure below, it can be noted that among the market participants who purchase physical electricity, the spread between the individual bidding zones is relatively evenly distributed between the three bidding zones included in the pilot.

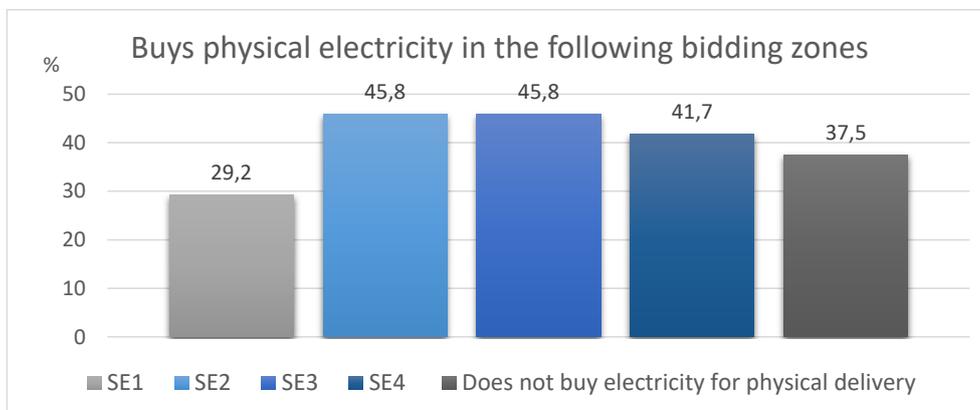


Figure 5: Distribution of buyers of physical electricity between different Swedish bidding zones (based on survey responses).

Furthermore, the figure below illustrates that the same pattern essentially also applies to the distribution of sellers of physical electricity, but that electricity areas SE2 and SE3 are clearly in a shared first place.

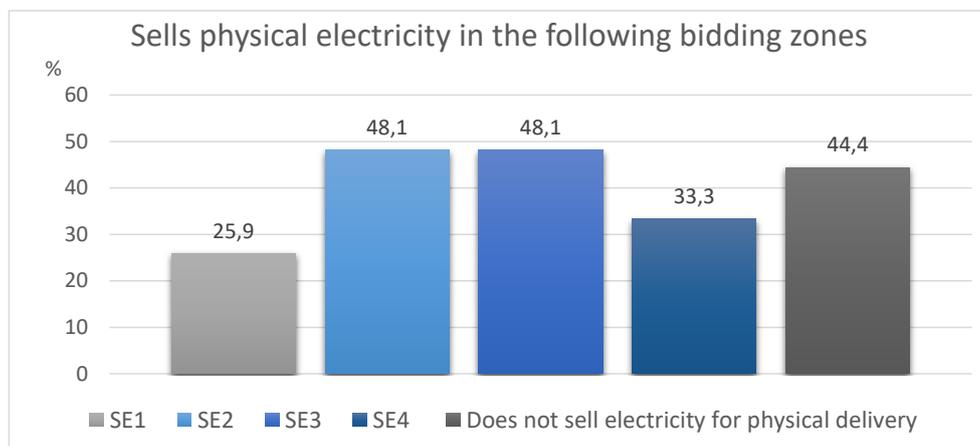


Figure 6: Distribution of sellers of physical electricity between different Swedish bidding zones (according to survey responses).

With regard to the concrete need for hedging, the figure below shows that the distribution is fairly even between the different bidding zones, with SE3 at the top. A full 81.8% of the participants stated that they had a need for hedging in this area. However, a not insignificant proportion (36.4%) responded that there was a need for hedging in SE1, i.e. a bidding zone that is not currently covered by Svenska kraftnät's auctions.

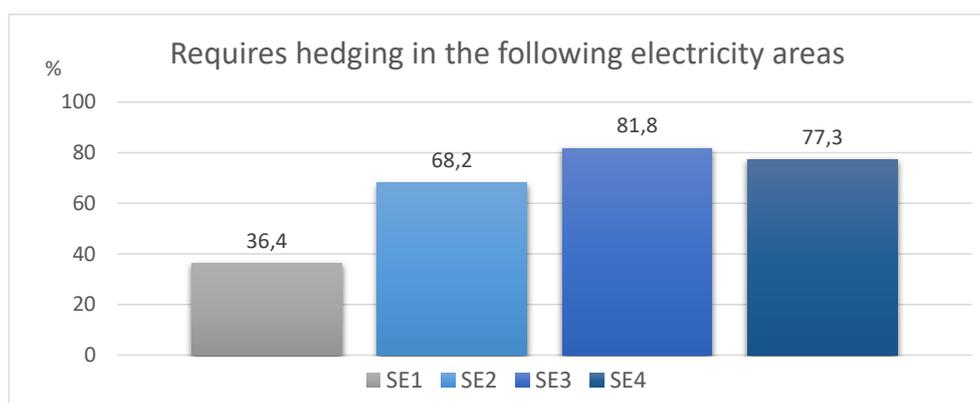


Figure 7: Distribution of hedging needs between different Swedish bidding zones (according to survey responses).

With regard to the motive for participation in the auctions and the participants' trading on the financial electricity market, we note in the figure below that speculation ranked high. Furthermore, hedging in order to obtain a stable income from production is relatively well met by the need to hedge consumption.

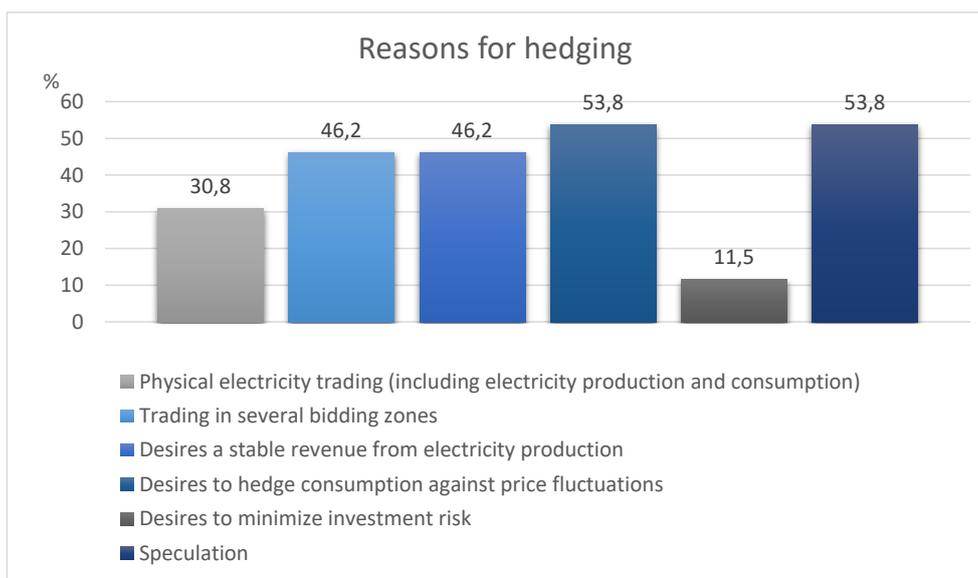


Figure 8: Breakdown of reasons for hedging, according to survey respondents.

A preliminary assessment is that the auction participants, as a collective, appear to be a relatively diverse group reflecting different needs.

Market concentration

In addition to established quantitative measures characterizing various aspects of liquidity (e.g. bid-ask spreads), an assessment of liquidity can also be indirectly derived from various market characteristics that usually go hand in hand with the liquidity measures. Academic literature and industry reports often cite certain characteristics that are generally considered to be drivers of liquidity in the electricity market: the size of the bidding zone, changes in cross-border network capacity, the share of variable generation assets, the existence of hedging opportunities and market concentration.

Market concentration is usually defined as 'the extent to which production in an industry is dominated by a few large firms' or 'the extent to which market shares are concentrated to a small number of firms'. Two standard measures of market concentration are the concentration ratio (CR) and the Herfindahl-Hirschman index (HHI). Both measures have been used to identify concentration in renewable energy auctions.

Market concentration has traditionally been summarized by CR, which simply adds up the market shares of the four, eight or twenty largest firms in an industry.

Suppose that an industry contains ten firms, each accounting for 25, 15, 12, 10, 10, 8, 7, 5, 5 and 3 percent. The CR of the four largest entities in this industry (CR4) - the most commonly used number - would then be $25 + 15 + 12 + 10 = 62$, meaning that the four largest entities account for 62%. The HHI, on the other hand, is calculated by summing the squared market shares of all entities in the industry: $25^2 + 15^2 + 12^2 + 10^2 + 10^2 + 8^2 + 7^2 + 5^2 + 5^2 + 3^2 = 1\,366$.

HHI is considered to have two distinct advantages over CR. One of the main advantages of HHI over CR is that the measure gives more weight to the larger participants in the market and less weight to the smaller ones. This means that the HHI captures the differences in market power and influence between participants more accurately than the CR, which treats all firms equally. Another advantage of the HHI over the CR is that the HHI takes into account the total number of participants in the market, not just the largest ones.

This means that the HHI reflects changes in market structure and competition better than the CR, which ignores the smaller participants. Moreover, a high market concentration with a small number and low diversity of participants and a dominance of only a few large participants may affect the price formation of the auctions, i.e. result in a reduction of efficiency.

An HHI index below 1 000 generally indicates a highly competitive market; an HHI between 1 000 and 1 500 indicates a not unconcentrated market; a value between 1 500 and 2 500 indicates moderate concentration; and a value above 2 500 indicates a highly concentrated market.

A graphical representation of market concentration in the auctions is presented below, see Figure 9. The picture shows that 2 of the 27 auction participants clearly appear to be dominant, but at the same time there is a significant 'middle group' of participants who appear to be relatively equal in size and thus contribute to competition in the auctions.

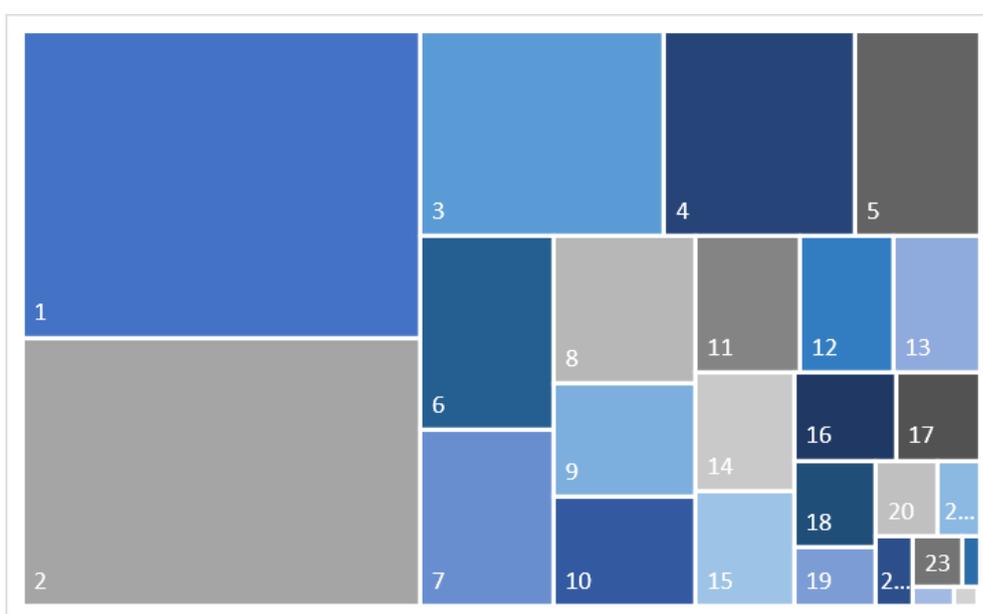


Figure 9: Relative market shares in the auctions illustrated in the form of a tree diagram.

If instead CR4 and HHI are used as measures and they are broken down by maturity and bidding zones, it appears that the four largest participants in total received 58% of the auction volumes and that the HHI in total (376 individual auctions) amounted to 1,126, i.e. a clear indication and confirmation of a relatively well-functioning and competitive market, compared to the lower range in the interval 1,000 - 1,500.

Furthermore, in a relative comparison between different durations, we observe that the auctions of calendar year contracts showed the highest market concentration (HHI = 1,464). However, when comparing different bidding zones, it is clear that SE2, with a CR4 of 84% and an HHI of 2,846, showed clear signs of a highly concentrated (non-competitive) market. See Table 1.

Table 1: Market concentration according to the CR4 and HHI indices for the different types of contracts auctioned.

Market Concentration	CR4 (%)	HHI
Total	58	1 126
Monthly Contracts	58	1 049
Quarterly Contracts	53	1 015
Calendar Year Contracts	64	1 464
SE2 (Sundsvall)	84	2 846
SE3 (Stockholm)	59	1 100
SE4 (Malmö)	55	1 121

We can thus conclude that the surplus area SE2 seems to be dominated by a few prominent sellers (electricity producers), while the deficit area SE4 is instead characterized by a larger number of more equal buyers.

More generally, an increase in market concentration would probably lead to poorer price formation, even if there is no collusion between participants. Market concentration among auction participants is expected to have negative effects on competition as sufficient number of participants is a prerequisite for competition, good price formation and, as a result, the best possible auction prices.

The market dominance that characterizes SE2 thus constitutes an important input for the evaluation of the pilot auctions and for future bilateral arrangements of TSOs, especially if these would potentially include bidding zones with a limited number of active market participants.

How to interpret the auction results

When allocating the coupled EPADs the symmetrical volume offered by Svenska kraftnät for purchase and sale is distributed to market participants based on the marginal price of their bids and offers for each individual EPAD contract, i.e. market participants submit orders for a discrete product on each side of the bidding zone border.

- Where Svenska kraftnät offer to purchase EPADs, the offers from sellers will be accepted beginning with the lowest price and increasing to the price level of the offer that fulfils Svenska kraftnät's buy volume (marginal price).
- Where Svenska kraftnät offer to sell EPADs, the bids from buyers will be accepted beginning with the highest price and decreasing to the price level of the bid that fulfils Svenska kraftnät's sell volume (marginal price).

The results of each auction opportunity are published just after 13:00 CET on the day of the auction.² The auction results are presented in the form of bid curves.

Figure 10 (below) shows the first auction conducted on February 7, this is one example of price formation illustrated with the bid curves.

- The green bid curve illustrates the prices at which market participants are prepared to buy the March contract in the SE4 bidding zone, these are ordered from highest to lowest bid.
- The red curve illustrates the prices at which market participants are prepared to sell corresponding contracts in the SE3 bidding zone.
- The points on each bid curve represent the marginal price at which the transactions are concluded. On the x-axis, these are placed at the offered volume (50 MW) and the marginal prices (16.03 EUR/MWh and -2.5 EUR/MWh, respectively) can be read off the y-axis.

² Auction results are published on SKM's website, [Link to Auction Results](#)

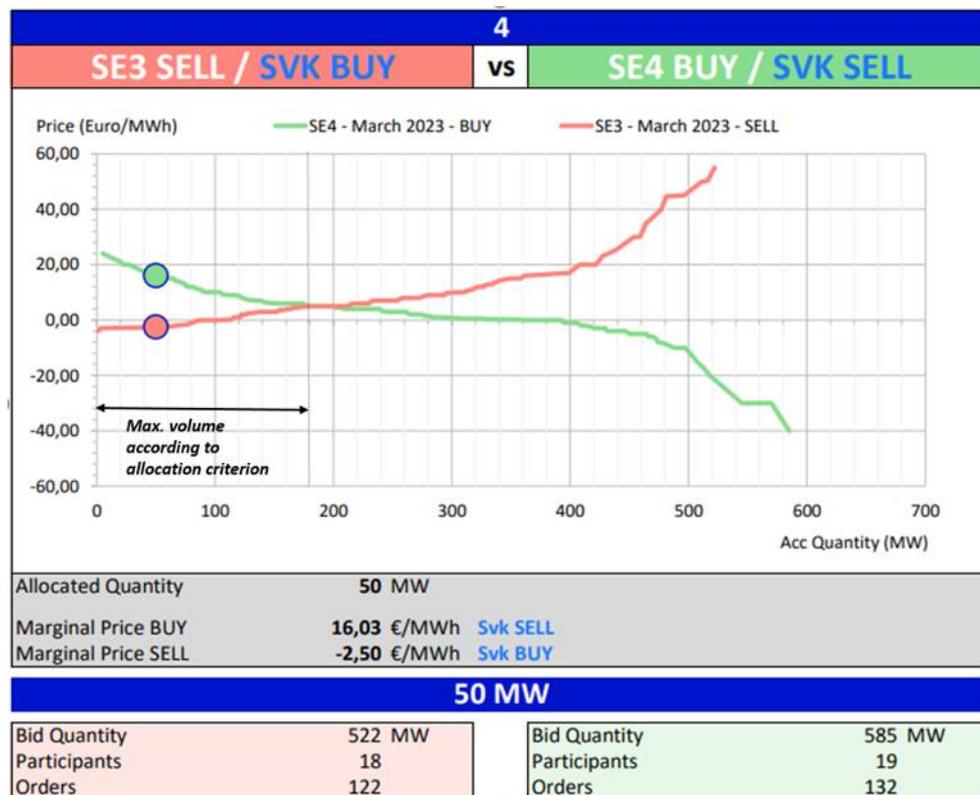


Figure 10: Example of results from an auction. The results show bidding curves, marginal price for the different contracts, allocated volume, number of participants and total order volume. The matching of the buy and sell auction is indicated in the Figure by a green and a red circle for the buy and sell auction respectively.

Figure 10 also illustrates the distance that corresponds to the volume that could have been allocated given Svenska kraftnät's allocation criteria. (The price at which Svenska kraftnät purchase must always be lower than or equal to the price at which Svenska kraftnät sell in each coupled transaction.) In the figure just above, this corresponds to a volume of 188 MW, i.e. where the two curves intersect. The total bid volume, number of participants and total number of orders can be found in the information boxes at the bottom.

Price formation

Liquidity is usually described as the possibility to easily and quickly sell a financial instrument at a price close to the market price just before the trade. If liquidity is good, the holder can turn it into cash quickly, in large quantities, at little transaction cost and with an insignificant price impact, even under stressed market conditions. If liquidity deteriorates, it becomes more difficult for the holder to convert large volumes of the financial instrument quickly and efficiently without the transaction adversely affecting the market price.

Liquidity is also important for price discovery and price formation, i.e. the process by which prices for the instrument are set. In a market with poor liquidity, the number of transactions tends to be lower and fewer participants are prepared to quote prices in the instrument. This leads to less effective price formation, for example resulting in a greater difference between bid and ask prices. Due to the Nordic EPAD market conditions quantitative methods for estimating continuous market liquidity are not easily applied.

In the absence of qualitative market data, in this section we present a compilation of a few different measures which together may substitute e.g. bid-ask spreads, in order to better understand the price formation in the auctions. Svenska kraftnät considers the auctions as a subset and a sub-market integrated within the continuous market.

Bid-to-cover ratio

The bid-to-cover ratio is calculated as the bid volume (buy or sell) for an EPAD contract divided by the volume allocated and accepted by Svenska kraftnät. A high bid-to-cover ratio thus indicates a high demand for the contracts. As previously mentioned, the price at which Svenska kraftnät buys must always be lower than or equal to the price at which Svenska kraftnät sells in each coupled transaction. The bid-to-cover ratio presented below is adjusted to reflect this condition, i.e. calculated as the volume accepted by Svenska kraftnät divided by the total order volume where the respective buy and sell price would meet the above criterion³.

The Table below shows that the bid-to-cover ratio has been consistently higher in the auctions for the individual bidding zones that relate to the southern border (SE3/SE4) compared to the northern border (SE2/SE3). Furthermore, the same was highest for calendar year contracts and lowest for monthly contracts. This manifests itself clearly if we compare the bid-to-cover ratio for monthly contracts in the auctions of the northern border (3.6) with the calendar year contracts of the southern border (6.7), as shown in the Table below.

³ Note that the bid-to-cover ratio is thus not calculated and based on the total (gross) order volume.

Table 2: The bid-to-cover ratio by maturity of the products being auctioned. The table shows the bid-to-cover ratio in relation to the different contract types to which the allocation conditions apply.

No of Auctions	Contracts	SE2/SE3	SE3/SE4	Total
376	Total	4.6	5.4	5.0
124	Monthly Contracts	3.6	4.3	3.9
152	Quarterly Contracts	4.5	5.4	5.0
100	Calendar Year Contracts	5.8	6.7	6.2

If we combine all 376 auctions and choose to take the individual auction occasions (22) as a starting point to look at how the average bid-to-cover ratio developed during 2023, we can observe a slightly negative trend towards the end of the period. The figure below also clearly illustrates that the southern border has generally shown more interest, but at the same time we can note a certain convergence towards the end of the period.

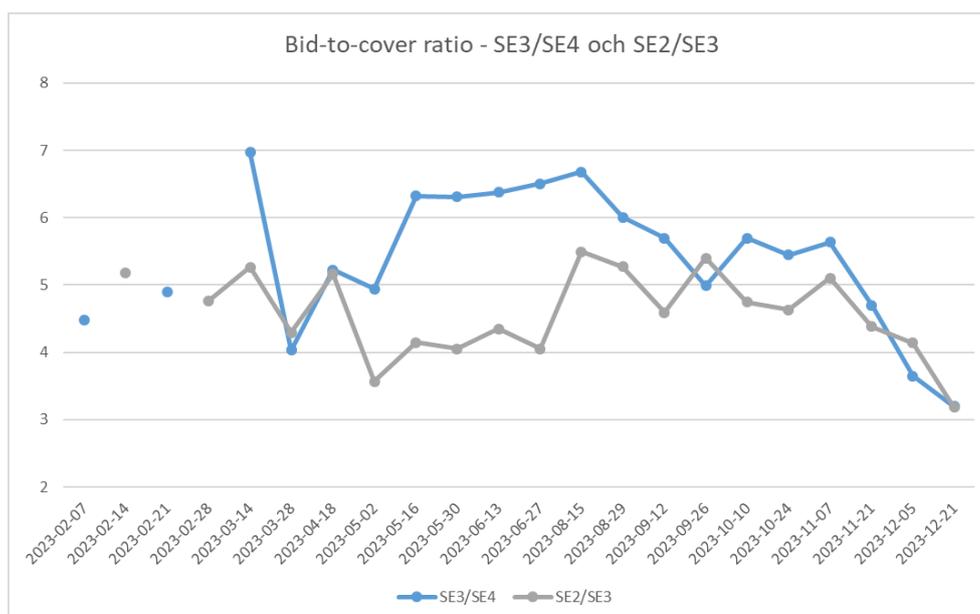


Figure 11: The bid-to-cover ratio in relation to the individual auctions for which the allocation conditions apply, which are the same as the bidding zone borders SE2/SE3 and SE3/SE4 for each auction occasion (the dots on the lines) in 2023.

The (implicit) price tails

How do we assess the overall success of an auction?

Typically, interest is measured by the number of participants, number of bids and bidding volumes. The ratio of the offered volume to the total bid volume, the bid-to-cover ratio (as described above), is a simple and popular way to measure the strength of the auction as it illustrates the 'balance' between supply and demand for different contracts.

Consequently, the bid-to-cover ratio focuses on the appearance of bidding curves to the right of marginal prices. However, the ratio may not always be informative as participants may bid very high or low prices in the sell and buy auctions, which are unlikely to lead to an allotment, thus artificially inflating the ratio. So the bid-to-cover ratio is probably not always the best and most reliable indicator of auction interest.

How can we measure the success of an auction in alternative ways? Did all buyers in an auction pay a similar price, or were some participants able to buy cheaply and some able to sell expensively? If so the efficiency and price formation in the auction market should be considered less satisfactory.

The difference between the average price paid in an auction and the cut-off price (the lowest price at which a product was bought in the auction) is usually referred to as the price tail. A large price tail is usually considered negative because the marginal buyer was only willing to pay a much lower price than the average buyer.

In 'pay-as-clear' auctions, there are no explicit tails because all participants who have obtained an allotment are allowed to transact at the same marginal price. This does not prevent us from calculating 'implicit tails' by comparing the marginal price with the (i) best bid and (ii) the volume-weighted average bid.

In the figure below, we therefore instead zoom in on the part of the bidding curves to the left of the marginal price. The greater the difference between the highest bid in SE4 and the marginal price, the greater the discount that bid has received, or we can compare the average bid for all participants who received an allotment at the marginal price. In 'pay-as-clear' auctions, there is no penalty for bidding well above (in a buy auction) the current indicative market price.

This means that the average price is likely to be more distorted than in a buy auction where everyone pays their own bid price. Sometimes referred to as tactical bids, this means that a participant with a strong buying interest may submit a high bid in order to increase the probability of obtaining a certain volume, knowing that the marginal price is in fact likely to be lower than the bid price.



Figure 12: Graphical illustration of long and short tails in relation to the marginal price.

In the above auction, the same example as before, the marginal price in SE4 was 16.03 EUR/MWh. The highest buy bid amounted to 24.03 EUR/MWh, the difference (the long tail) amounted to as much as 8.00 EUR. The volume-weighted average price for the allocated volume (50 MW) ended up at 19.89 EUR/MWh, i.e. 3.86 EUR above the marginal price.

In the same auction, a marginal price was established in SE3 of -2.50 EUR/MWh. The lowest selling bid amounted to -4.00 EUR/MWh, the difference (the long tail) thus amounted to 1.50 EUR. The volume-weighted average price for the allocated volume (50 MW) ended up at -2.67 EUR/MWh, i.e. only 0.17 EUR below the marginal price.

The table below shows the implicit tails, broken down by maturity (M, Q and YR) and bidding zones (SE2, SE3 and SE4) and combinations of maturities and bidding zones:

Table 3: Short and long tails from the auctions broken down by product and aggregated by maturity, year, quarter and month.

No of Auctions	Breakdown		Short Tail	Long Tail
376	Total		1.12	3.29
124	Monthly Contracts		1.54	4.59
152	Quarterly Contracts		1.15	3.36
100	Calendar Year Contracts		0.57	1.59
94	SE2 SELL		1.22	3.35
94	SE4 BUY		1.49	3.96
94	SE3 BUY		1.05	3.09
94	SE3 SELL		0.74	2.78
31	SE2 SELL	M	1.58	5.23
38	SE2 SELL	Q	1.22	3.11
25	SE2 SELL	YR	0.77	1.37
31	SE4 BUY	M	1.93	4.98
38	SE4 BUY	Q	1.59	4.35
25	SE4 BUY	YR	0.79	2.09
31	SE3 SELL	M	1.08	3.99
38	SE3 SELL	Q	0.69	2.69
25	SE3 SELL	YR	0.39	1.42
31	SE3 BUY	M	1.56	4.17
38	SE3 BUY	Q	1.10	3.28
25	SE3 BUY	YR	0.35	1.47

If we were to rank the auctions on the basis of the short tail, we can see that the calendar year contracts exhibit very good price formation especially in SE3. At the same time, we see in the table above that the tails of the monthly contracts have been almost three times larger than those of the calendar year contracts. As for the tails in the different bidding zones, the auctions in SE3 have worked best and those in SE4 worst.

If we were to group the auctions according to the long tail, the relationships are similar. We can see that the yearly contracts in SE2 exhibit the smallest average long tail (1.37 EUR/MWh). The monthly contracts in SE2 are at the bottom of the list, with the equivalent tail averaging 5.23 EUR/MWh.

If we put this result in relation to the market concentration in each bidding zone, an attempt at interpretation could be that SE2 is dominated by a few large market participants who have real fundamental needs for hedging at longer maturities. If this interpretation is correct, it could explain why the calendar year contracts in SE2, despite the market concentration, show comparatively short tails.

The fact that the monthly contracts exhibit the poorest price formation (the longest tails) could be due to the auction volume (number of contracts) being normally greater than, for example, the calendar year contracts at each auction, but we assume that this may be linked to the fact that the actual need for hedging is generally smaller and that the speculative element is greater.

If we combine all 376 auctions and choose to take the individual auction occasions (22) as a starting point to look at how the tails developed during the auction periods, we see a slightly positive trend in 2023. Both tails showed a marginal downwards trend, which was broken at the end of the period.

The weaker auctions at the end of the year were, in our assessment, a result of the market expecting future smaller differences between SE2 and SE3 and between SE3 and SE4, which resulted in low buying interest in SE4 and low selling interest in SE2.

The price difference between, for example, SE4 and the system price for the yearly contract (2024) was 66.5 EUR at the beginning of 2023 and gradually decreased to 3.0 EUR at the end of 2023. The interest in hedging is therefore deemed to have been lower.

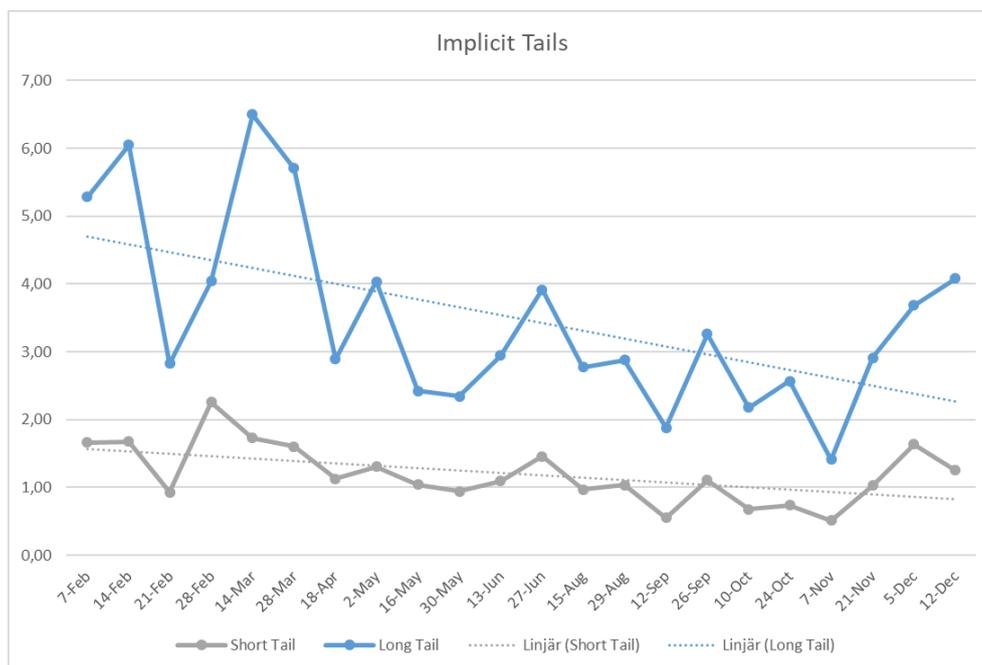


Figure 13: Average implied short and long tails per auction occasion, from February 7 to December 12 2023. The linear trend lines for short and long tails (dotted lines) in the Figure show the overall change in tails during 2023.

Auction marginal prices and closing prices

Low liquidity in EPAD contracts means not only that turnover is low, but also that closing prices are likely to be subject to some uncertainty as a reference price for the auctions. In a perfectly functioning market with no transaction costs, the auctions would be conducted at a price between the best bid and ask price, i.e. in the middle of the spread.

One way of analyzing (i) the information value of the official closing prices and (ii) the extent to which the auctions fulfil a price-forming function (“price discovery”) in the market is to compare the margin locked in by Svenska kraftnät in the auctions with the margin that would have been locked in if the transactions had instead been carried out at closing prices.

In a liquid market, we could have compared the auction prices with the realtime ‘Mid-Price’ quoted on Nasdaq on auction day, but we have instead referred to the previous trading day's or auction day's closing prices.

The figure below illustrates the price development in 2023 for the calendar year contract in SE4 (calendar year 2025). The graph clearly shows that the price tends to make discrete jumps (often in the context of the auctions) and then establish a new equilibrium level.

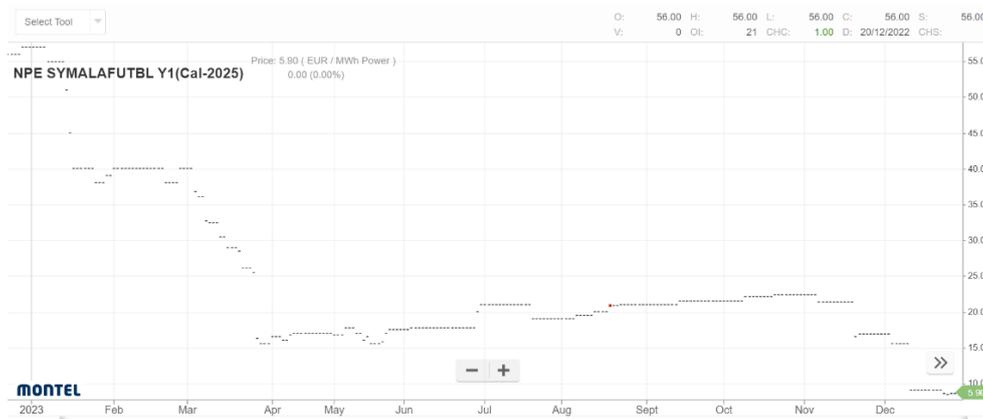


Figure 14: Price development of the calendar year contract in SE4 (YR-25) in 2023 (Source: Montel).

The above picture can be interpreted as an indication that the closing prices of the EPAD contracts did not act as a reliable source of information in 2023. Furthermore, it can be interpreted that Svenska kraftnät at auctions sold the SE4 contracts at marginal prices substantially below the previous trading day's closing prices (e.g. the November/December period) and as a result locked in a lower margin, given that the price in SE3 was stable, than indicated.

In addition, the above hypothesis also imply that the marginal prices in auctions should help to establish a new equilibrium, i.e. where the difference between the marginal price and the closing price on the day of the auction should be very small, or at least smaller than the difference between the marginal price and previous day's closing price.

The Table below is a summary of the price differences between auction marginal prices and closing prices, split by maturity and bidding zone borders.

Table 4: Average price differences between auction marginal prices and closing prices for EPADs (2023).

Price Differences (EUR)	Border	Previous Day	Auction Day
Total	SE2/SE3	-1.8	-0.6
Monthly Contracts	SE2/SE3	-3.2	-1.3
Quarterly Contracts	SE2/SE3	-2.0	-0.5
Calendar Year Contracts	SE2/SE3	-0.1	-0.2
Total	SE3/SE4	-2.0	-0.5
Monthly Contracts	SE3/SE4	-2.3	-0.9
Quarterly Contracts	SE3/SE4	-2.6	-0.5
Calendar Year Contracts	SE3/SE4	-1.2	-0.2

From the table above it can clearly be seen that marginal prices, from Svenska kraftnät's perspective, in most cases have meant that the locked-in margins have been lower than if we had transacted at closing prices. In addition, the table shows large differences between the closing prices of the previous trading day and the closing prices of the auction day. For example, for the SE3/SE4 border, we can see that the relationship between the marginal price and the closing prices on the day of the auction amounts to only about 25% of the difference between the marginal price and the closing prices the previous trading day. In addition, it is worth noting that the differences are consistently lowest for the calendar year contracts. Svenska kraftnät can thus conclude that the auctions contribute to increased transparency and better price formation in the EPAD market.

If, instead, the individual auction occasions are taken as a starting point to look at how these differences developed over time in 2023, two things are noted in the figure below, firstly (i) that marginal prices consistently over the entire period tend to be very close to the closing prices of the auction day, and secondly (ii) that the deviations of marginal prices from the previous day's closing prices can be clearly linked to the larger market movements that characterized both the spring and the end of the year.

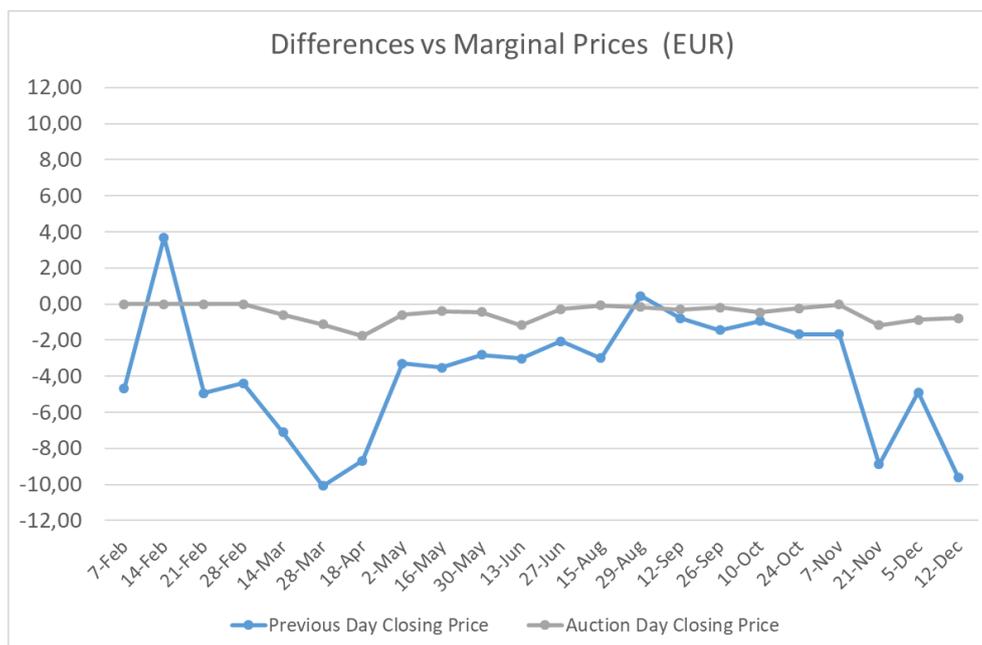


Figure 15: Price differences between marginal prices and closing prices (2023).

Indicative bid-ask spreads

Since trading in EPAD contracts at Nasdaq is very limited, this also means that, for example, quoted bids and offers do not give the market much information about the real liquidity.

A large part of the trading instead takes place at SKM, which is one of the largest brokers in the Nordic electricity market when it comes to cleared financial electricity contracts. SKM provides for a fee, indicative bid and offer prices on its website. SKM has indicated that the informative value of quotas represents real buying and selling prices relatively well.

If we briefly analyze these spread indications, see the next page, we can conclude that SE3 (Stockholm) shows the tightest spreads. Furthermore, these look rather good for both months, quarters and calendar years.

In the case of SE2 (Sundsvall), the price picture shows quite large differences between the bid and ask price. This is in line with the imbalance and market concentration that characterizes this bidding zone and this is particularly notable for the monthly contracts. It should be noted that the print was retrieved on 19 March 2024, a few hours after Svenska kraftnät's EPAD auction, for which the results were published at 13.00. This means that most of the trades that can be read in the images are the marginal prices of the auctions.



SKM EPAD prices (EUR)

EPAD MARKET GREEN MARKET MID PRICE GRAPHS TIME: 15:43:44

SUNDSVALL

Product	Bid	Ask	Time	Last	Last date
SYSUNAPR-24	-12.00	-2.00	13:12	-7.50 ↑+1.00	19 Mar 13:12
SYSUNMAY-24	-10.00	-6.00	14:10	-7.52	19 Mar 13:11
SYSUNQ2-24	-11.00	-7.00	13:12	-10.00	7 Mar 13:37
SYSUNQ3-24	-8.00	-5.00	14:10	-6.31 ↑+0.74	19 Mar 13:12
SYSUNQ4-24	-15.00	-12.00	14:09	-13.49 ↑+2.01	19 Mar 13:12
SYSUNYR-25	-13.00	-12.25	13:13	-12.40 ↑+0.20	19 Mar 13:13
SYSUNYR-26	-14.00	-12.50	13:13	-12.85 ↑+0.41	19 Mar 13:13
SYSUNYR-27	-9.75	-9.40	13:13	-9.60 ↑+0.10	15 Mar 14:45
SYSUNYR-28	-9.50	-8.75	13:13	-9.35 ↑+0.25	28 Feb 15:40

STOCKHOLM

Product	Bid	Ask	Time	Last	Last date
SYSTOAPR-24	-3.75	-3.00	14:50	-3.25	19 Mar 14:50
SYSTOMAY-24	-6.00	-3.50	13:16		
SYSTOQ2-24	-5.75	-4.50	13:16	-5.50 ↓-1.00	8 Mar 14:46
SYSTOQ3-24	-5.25	-4.25	13:16	-4.65 ↑+0.10	11 Mar 13:11
SYSTOQ4-24	-5.50	-5.05	13:16	-5.20	15 Mar 14:43
SYSTOYR-25	-5.40	-5.10	15:09	-5.25 ↓-0.30	19 Mar 15:08
SYSTOYR-26	-3.25	-2.75	14:06	-2.85 ↓-0.20	15 Mar 13:00
SYSTOYR-27	-1.45	-1.15	15:09	-1.15 ↑+0.10	19 Mar 15:09
SYSTOYR-28	-0.95	-0.50	13:14	-0.95 ↓-0.45	12 Mar 13:46

MALMÖ

Product	Bid	Ask	Time	Last	Last date
SYMALAPR-24	3.25	4.50	15:30	3.75 ↑+0.50	19 Mar 15:30
SYMALMAY-24	6.00	9.00	14:09	7.12	19 Mar 13:09
SYMALQ2-24	6.75	8.00	14:00	7.25	19 Mar 14:00
SYMALQ3-24	3.00	6.00	14:08	4.14 ↓-0.41	19 Mar 13:10
SYMALQ4-24	4.00	6.50	14:08	5.51 ↑+0.05	19 Mar 13:10
SYMALYR-25	5.00	6.00	14:00	6.00 ↓-0.13	19 Mar 13:37
SYMALYR-26	6.00	7.50	14:08	6.51 ↓-0.74	19 Mar 13:11
SYMALYR-27	7.00	8.00	13:11	7.25 ↑+0.25	14 Mar 12:39
SYMALYR-28	7.00	8.50	13:11		

Figure 16: Indicative EPAD prices at SKM for bidding zones Sundsvall (SE2), Stockholm (SE3) and Malmö (SE4) for which EPADs are auctioned. The images were taken a few hours after the auction on March 19th, 2024.

Friction costs

As mentioned earlier, Svenska kraftnät offers to buy and sell EPADs in the SE2, SE3 and SE4 bidding zones. The auctions on either side of a bidding zone border (buy on one side and sell on the other) are matched with each other and transactions are only successful if Svenska kraftnät's purchase is made at the same or lower price than Svenska kraftnät's sell transaction in the adjacent bidding zone. It is therefore worth recalling that, from the market participants' perspective, the individual auctions are not linked to any bidding zone borders. On the other hand, bidding zone borders (and price differences) are important elements of the auction model.

A logic element of the model's current design is that Svenska kraftnät buys and sells matching volumes related to the two bidding zone borders. Normally, Svenska kraftnät buys EPADs in the SE2 surplus area and sells corresponding contracts in the adjacent SE3 bidding zone. By analogy, Svenska kraftnät sells EPADs in the deficit area SE4, and locks in future congestion income by buying the corresponding contracts in SE3. In such a model, hedging opportunities and liquidity are thus provided to all bidding zones.

One consequence that arises is that the transactions carried out in SE3 contracts will be netted out if the auctions are fully subscribed. However, as a result of the auction results, Svenska kraftnät may obtain different positions across each border, but will always have a matching position between two adjacent bidding zones. Normally, however, the model entails that Svenska kraftnät's position in SE3 is neutral and that we buy and sell the same volume in the auctions. Svenska kraftnät thus buys SE3 relative to selling SE4 and sells SE3 against the purchases in SE2.

One effect of the auction model is that Svenska kraftnät, in its role as price taker, will buy and sell SE3 contracts in two separate auctions. We buy at the marginal price in a sell auction and sell at the marginal price in a buy auction. This means that two different prices are potentially established for each SE3 contract at each individual auction. This price difference can, from Svenska kraftnät's perspective, be regarded as a friction effect.

This friction is in itself a measure of liquidity. In a perfect (auction) market, the participants' buying and selling interests would meet at a unique price, resulting in zero friction. Conversely, the greater the friction, the less liquidity in the (auction) market in question.

The Table below shows the average friction expressed as the price difference between Svenska kraftnät's buy and sell transactions in SE3.

Table 5: Average friction broken down by maturities.

Friction – SE3	EUR
Total	-0.91
Monthly Contracts	-1.53
Quarterly Contracts	-0.85
Calendar Year Contracts	-0.25

From the table above we can see that the average difference for all products in the auctions was -0.91 EUR. We can also see that the difference was greatest for the monthly contracts (-1.53 EUR) and smallest for the calendar year contracts (-0.25 EUR). Thus, based on friction we conclude that price formation works best in auctions of calendar year contracts and that the friction of monthly contracts has been on average as much as 6 times greater.

Normally, friction entails a theoretical cost for Svenska kraftnät, but when it comes to the calendar year contracts, we conclude that 4 out of a total of 28 auctions instead resulted in a theoretical profit and that the marginal prices in one auction ended up at exactly the same level.

If we instead choose the individual auction occasions as a basis for analyzing how the friction has developed over time, a slightly positive trend can be identified for the main part of 2023, not unlike the development shown for the short tails, but like here, the year also ended with a weakened trend.

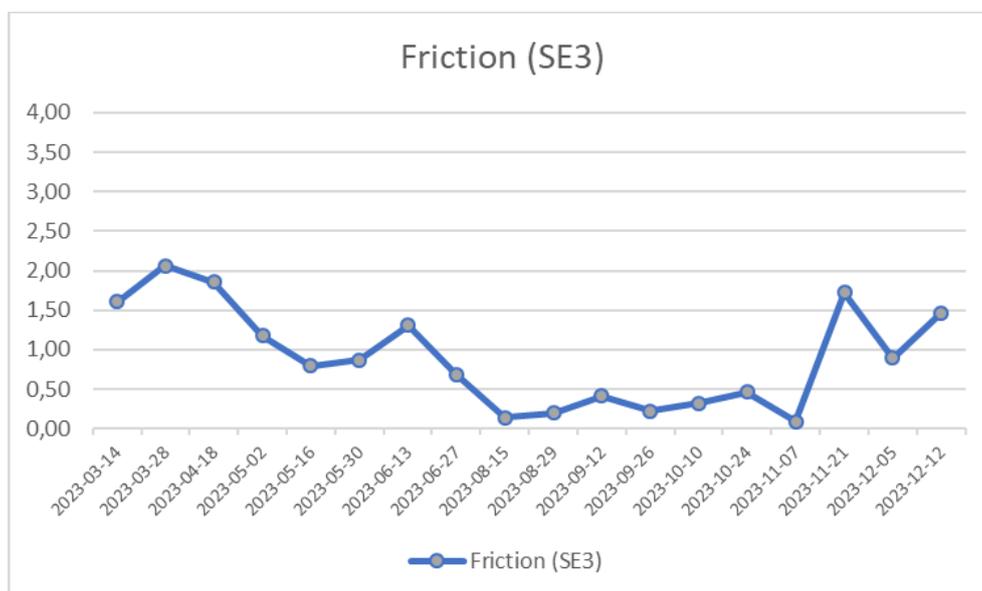


Figure 17: Average friction for the products auctioned in bidding zone SE3 between March 14 and December 12, 2023.

Auction efficiency

When it comes to price formation in the auctions, the bid-to-cover ratio, the implicit tails, the relationship between marginal prices and closing prices and friction show a clear consensus. In summary, we thus conclude that the auctions of calendar year contracts have worked quite well. At the same time, monthly contracts show a significantly weaker price formation. Furthermore, it can also be established that the various indicators showed a similar progression during the period, where the development over time is assessed as slightly positive, but with a negative finish.

Furthermore, we assume that the interest in bidding in auctions to buy or sell monthly contracts differs from the calendar year contracts in that the demand does not reflect a structural need for hedging in the same way. Instead, interest is seemingly characterized by more short-term price movements, which means that price formation periodically gets poorer, which is also reflected in the average figures.

Market participants' views on auctions

As mentioned earlier, the survey was conducted between the 7th and 26th of February 2024, i.e. before EEX published its indicative margin requirements and before the introduction of zonal futures (25 March 2024).

The overall impression of the auctions remains unequivocally positive (88.5%) and we note that the respondents who answered either 'Negative' or 'Neutral' did not actually participate in the auctions.

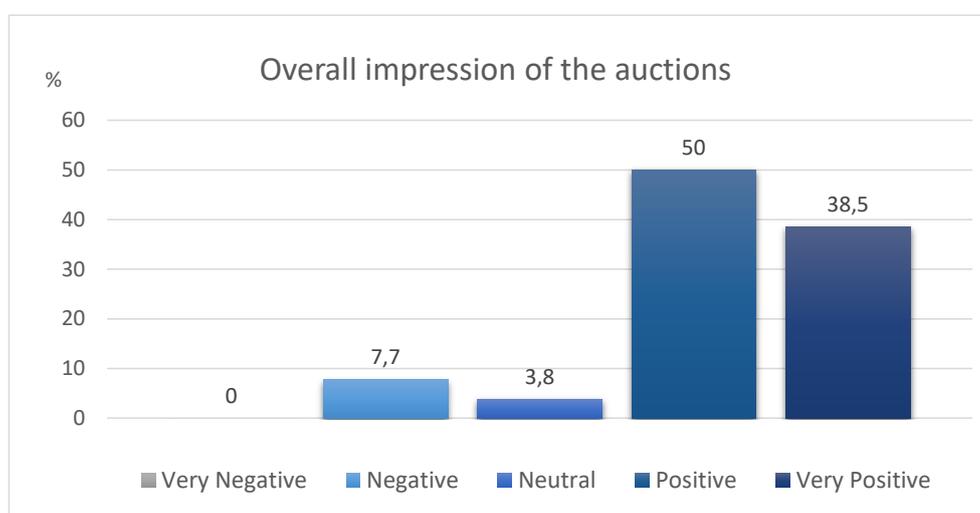


Figure 18: The distribution of the respondents' overall impression of Svenska kraftnät's auctions.

A question that has been up for discussion during the previous year is whether the time between the bid window (08.00-10.00 CET) and the publication of the results (13.00 CET) is considered satisfactory.

A clear majority of the participants (88%) believe that 3 hours is an acceptable processing time, see the image below, but one respondent instead stated 1 hour as a more reasonable level of ambition. The auctioneer (SKM) has prepared measures that streamline the auction process, but has, given the uncertainty regarding future marketplaces and instruments etc., chosen to wait until further notice with the concrete implementation.⁴

⁴ SKM could relatively easily reduce the processing time to at least 2 hours.

One respondent also pointed out that the day-ahead market results are published at 12:45 p.m., and that the publications thus clash with each other⁵.

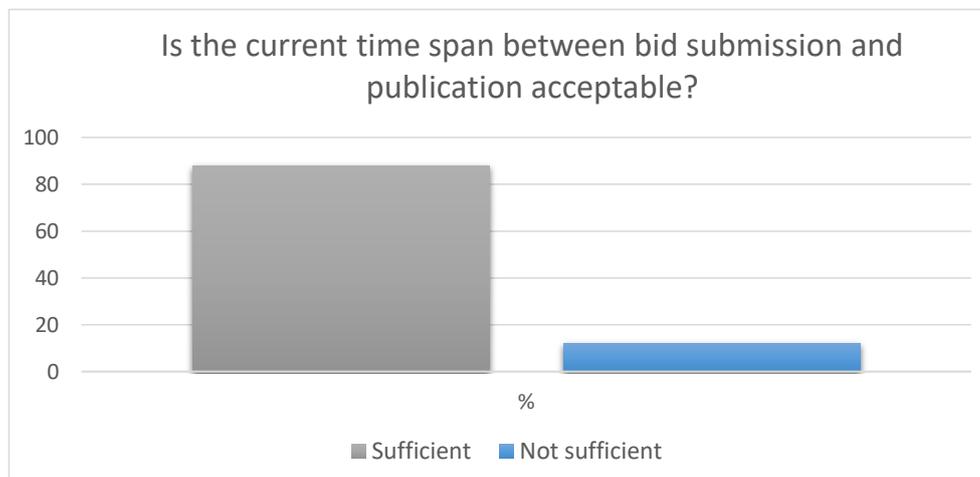


Figure 19: The respondents' attitude to the current time span between bid submission and publication of the results.

When it comes to the structure of bidding in the auctions, the vast majority are satisfied, or very satisfied (84.6%).

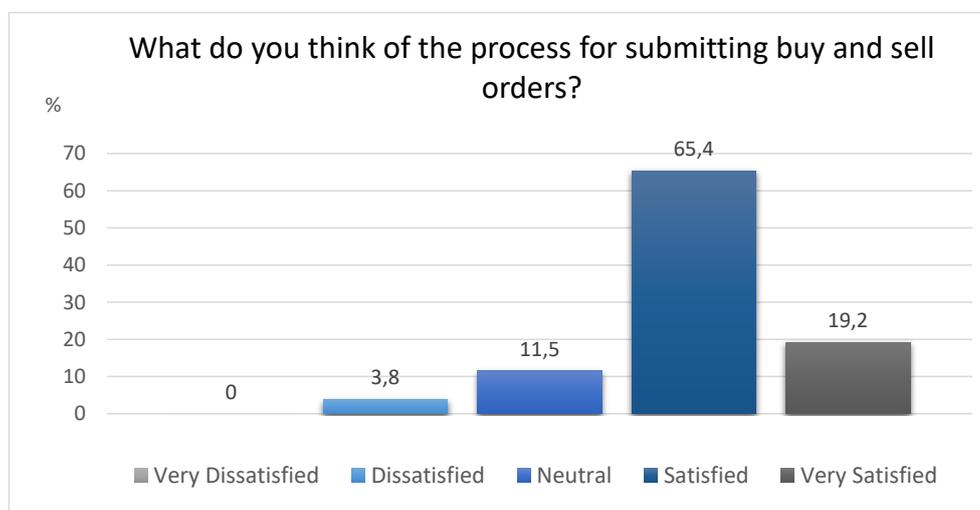


Figure 20: Respondents' perception of the process for submitting buy and sell orders at the auctions.

⁵ If the SDAC Auction is delayed or cannot be performed, Nord Pool shall inform all Participants by publishing an operational message at regular intervals starting no later than 12:45 CET, until such time as the relevant SDAC Auction is successfully completed or there is a decision regarding Market Decoupling.

In addition, a number of comments were received that requested a simpler process with a higher degree of automation, e.g. a web interface. One respondent pointed to JAO as a good example. An argument that was put forward as a reason for implementing a shorter time span was that the system price has the potential to move quite a lot during the 3 hours.

Furthermore, we asked whether the auctions' marginal prices reflected the market value of the contracts. The participants responded in unison (95.7%) that they considered this to be the case.

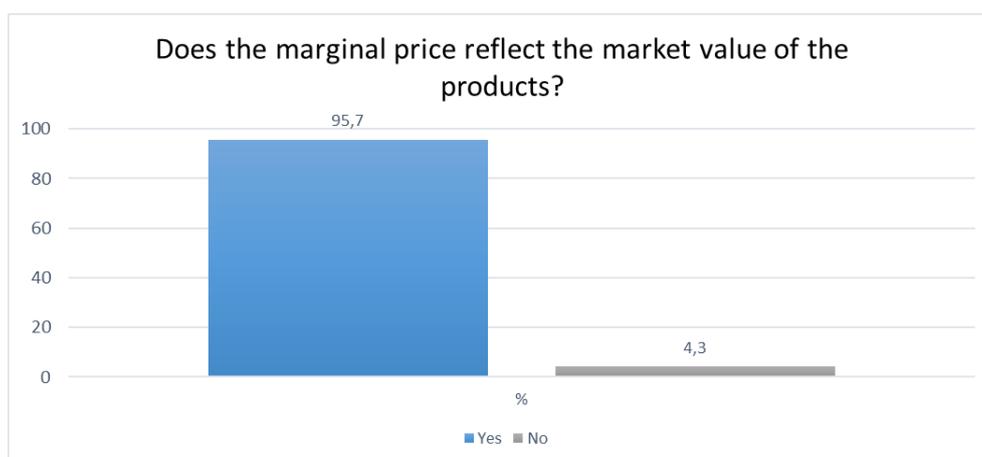


Figure 21: Respondents' perception of whether the marginal prices in the auctions reflect the market value of the products.

The picture below shows that the auction rules are also perceived as clear and easy to understand. In this context, it may be worth highlighting that the choice of auctioneer, i.e. using an established brokerage firm, is considered to have contributed to lowering the barrier to entry for the auction participants (primarily through SKM's established customer relationships and the possibility of regular direct communication).

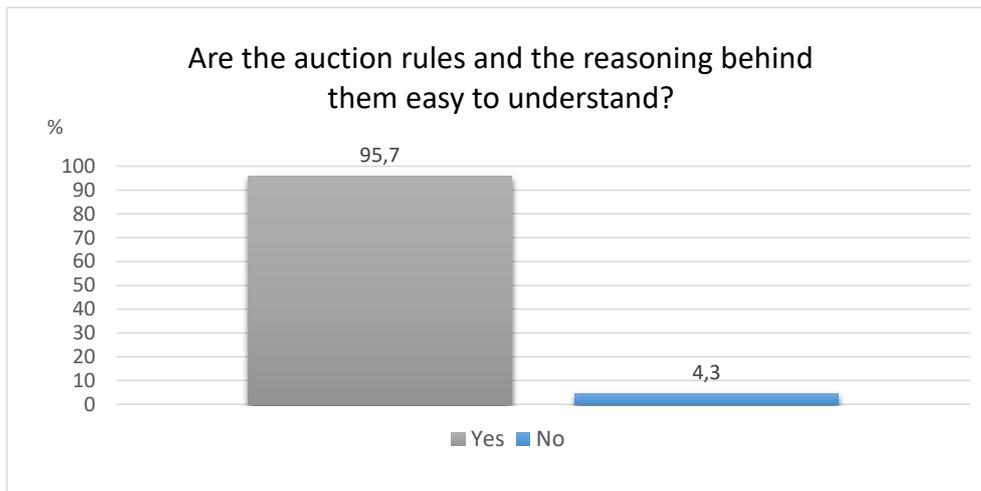


Figure 22: Respondents' perception of auction rules and underlying reasoning.

The participants were also asked how they perceived the publication of the auction results and the vast majority (87%) considered this to be satisfactory. However, one respondent wished to obtain 'all results in one file and, if possible, with pure data'.

Trading venues and clearing

We asked for market participants' general perception and view of Nasdaq as a trading venue. Nasdaq received a slightly positive rating, with the alternatives 'Neutral' and 'Positive' receiving an equal number of votes.

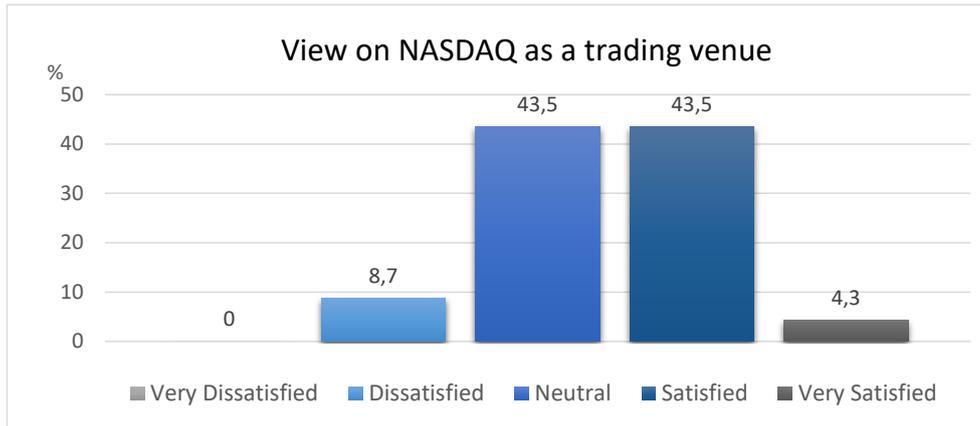


Figure 23: The respondents' general perception of Nasdaq as a trading venue.

When it came to Nasdaq Clearing, the spread around 'Neutral' was slightly larger and 21.7% had a negative impression, while a total of 26.1% reported a positive view.

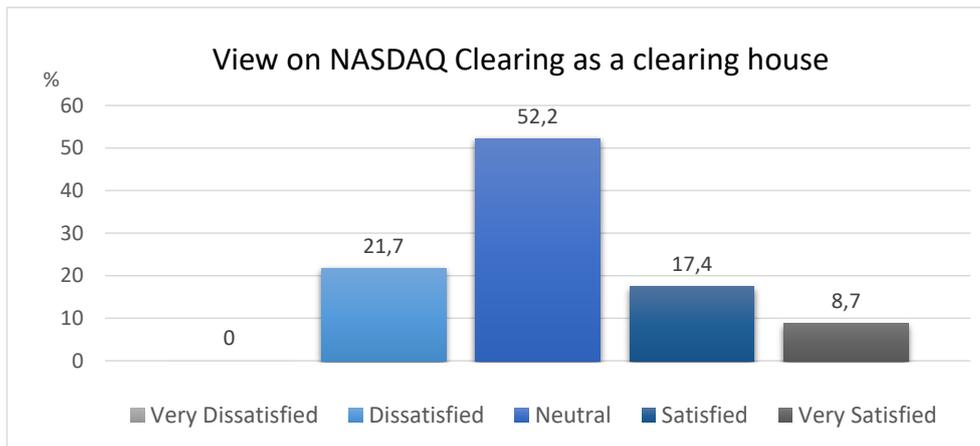


Figure 24: Respondents' general perception of Nasdaq Clearing as a clearing house.

Respondents' view on the trading venue EEX, was characterized by a wait-and-see attitude and 57.1% responded that the general view of EEX was neutral, here too there was a marginally positive tendency, although not as pronounced as for Nasdaq.

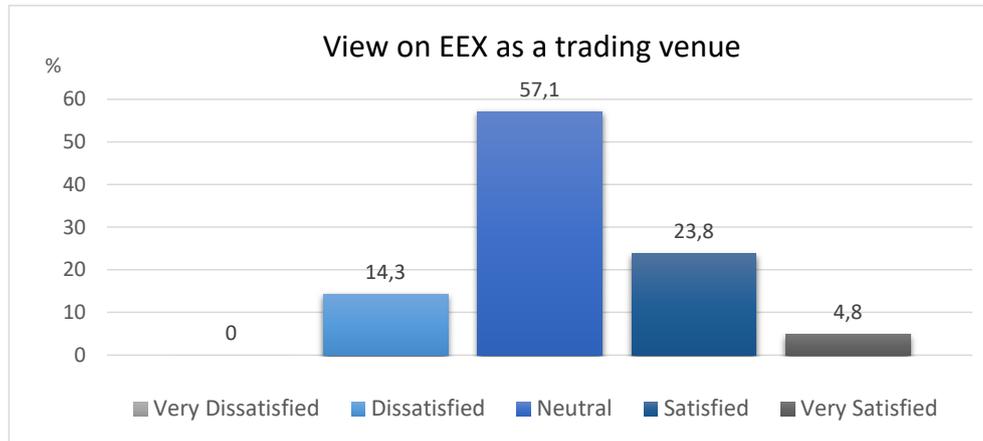


Figure 25: Respondents' general perception of EEX as a trading venue.

The perception of ECC as a clearinghouse showed an overall response that is reminiscent of the view of EEX as a trading venue.

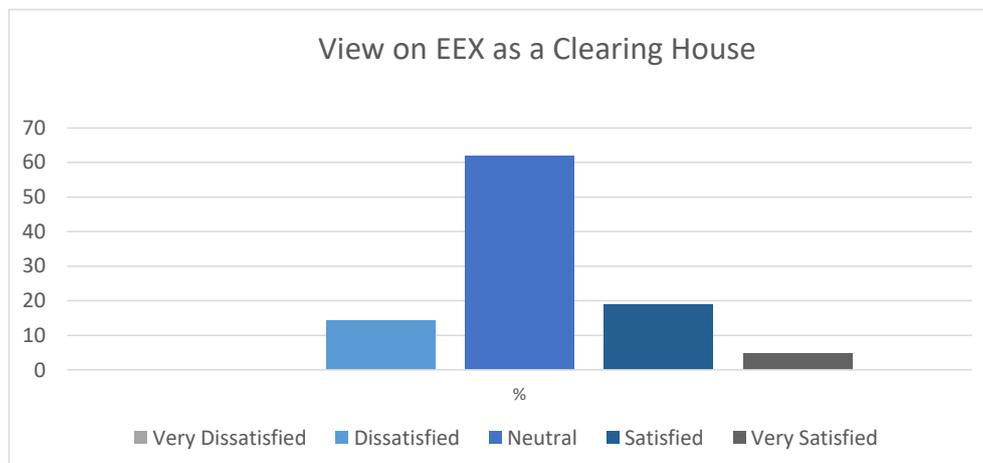


Figure 26: Respondents' general perception of ECC as a clearinghouse.

Overall, the answer option 'Neutral' dominated for both EEX and ECC. We assume that this is due to the fact that the majority of the respondents do not currently use EEX/ECC.

The Future

Svenska kraftnät's survey was, as mentioned earlier, conducted during the period 7 - 26 February 2024. In June 2023, EEX and Nasdaq announced that they had agreed for EEX to buy Nasdaq's European power trading and clearing business. The transaction means, if the deal goes through, that EPADs will be removed from the product portfolio according to EEX.

On 25 March, EEX launched trading in Nordic zonal futures. In order to obtain a better and somewhat clearer picture of how market participants viewed the future and how they viewed different alternatives, we asked a number of questions related to preferences and time schedules. We started by asking the participants where they intend to trade financial instruments for the remainder of the current year.

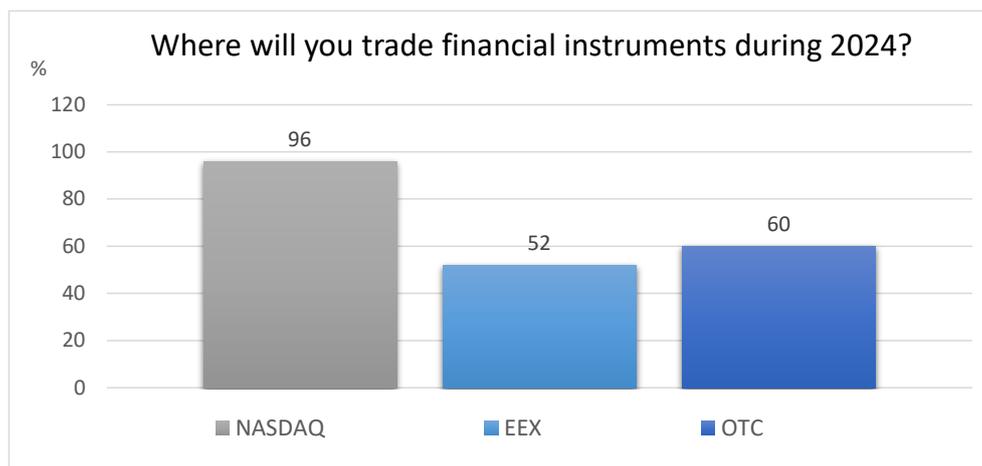


Figure 27: Respondents' plans for which trading venues to use in 2024.

From the answers above, we conclude that 96% plan to continue trading on Nasdaq in 2024. Just over half of the respondents will also trade at EEX. When it comes to OTC, we conclude that the proportion is relatively high and that the same varies greatly between the 13 respondents who chose to answer the question of what proportion of their trade in 2024 would consist of OTC.

Timetable for a possible transition to EEX

Of particular interest to Svenska kraftnät, with regard to our internal planning, is the question of the participants' timetables for a possible transition from Nasdaq to EEX.

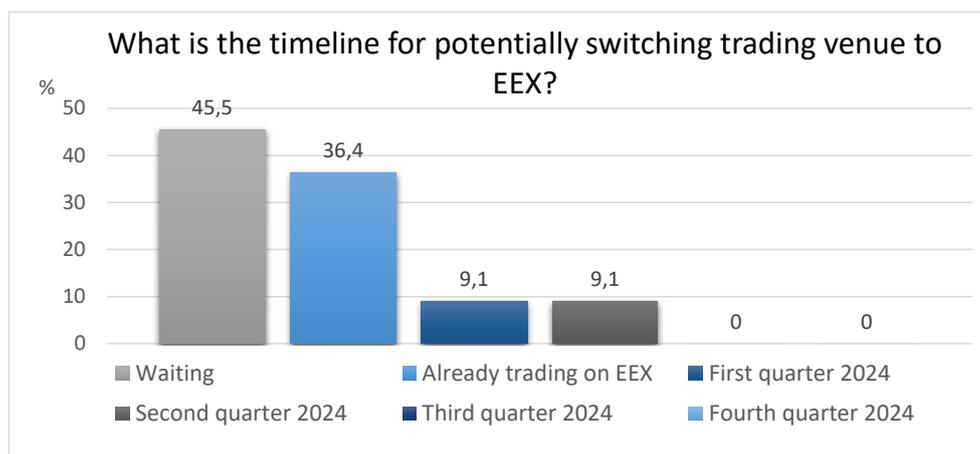


Figure 28: The respondents' timetable for a possible transition of the trading venue from Nasdaq to EEX.

In the above summary, we noted a clear wait-and-see attitude among those who do not already trade at EEX. Almost half of the respondents answered that they take this cautious approach. A smaller proportion stated that they planned an 'onboarding' in the first half of 2024.

Margin requirements

As a result of the increase in spot price volatility, i.e. the increasing price volatility in the day-ahead market, some of the advantages of the forward market mentioned above have turned into disadvantages, at least in the short term, due to higher margin requirements, leading participants to abandon or reduce their exposure to regulated markets. This, in turn, has meant that the forward market has become less liquid and prices more volatile, which has further reduced the attractiveness and price transparency of the financial electricity market.

In the longer term, the lack of market liquidity and price transparency will hit hardest at the smaller market participants, who lack the resources and creditworthiness to enter into and manage a large number of bilateral agreements. In this way, the 'electricity crisis' has had a negative impact. Less reliable prices and a lower correlation between the system price and bidding zone prices have, in addition, also made bilateral hedging more difficult.

A particular challenge with hedging via the regulated market is that in particular producers, who typically act as sellers on the forward market, have to provide additional collateral if the contract value increases and/or becomes more volatile. These increased margin requirements therefore place high liquidity requirements even on healthy companies with plannable power generation. In the long term, however, a well-functioning forward market is of great importance for all categories of market participants. Svenska kraftnät's initiative to auction EPAD contracts was thus launched in this context. In light of the EEX introduction of zonal futures, we therefore wanted to ask market participants about their views on margin requirements when changing clearing house, from Nasdaq Clearing to ECC.

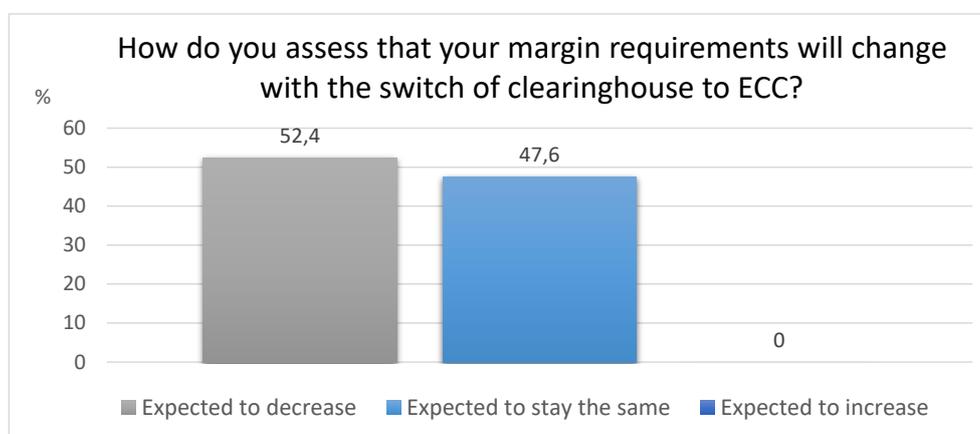


Figure 29: The respondents' assessment of the margin requirements of Nasdaq Clearing and ECC, respectively.

The above picture shows that a slight majority of the respondents estimated that the margin requirements would decrease and the remainder that they would remain at the same level.

If we instead start from Svenska kraftnät's perspective and try to analyze how our own margin requirements would be affected by a transition from EPADs to zonal futures with clearing at ECC, we can conclude that these would be lower.

Our positions are, as mentioned earlier, characterized by the fact that we always have a matching position across a bidding zone border, i.e. that a long position in e.g. SE2 is combined with a short position in SE3. This means that Svenska kraftnät needs to provide (initial) margins for both contracts, but for separate contracts with correlated underlying instruments (e.g. the zonal futures in SE2 and the zonal futures in SE3), the price variations are co-variable. Therefore, opposing positions in two different combined contracts may lead to a reduction in the overall risk of the (net) position.

For such 'spreads', the risk models of clearing houses potentially generate relief in the form of a so-called 'Intercommodity Spread Credit'.

At present, no such relief is available at Nasdaq Clearing, while the risk model at ECC offers such relief. The figure below illustrates how different combinations of long and short positions are affected by margin requirements (Initial Margin)⁶.

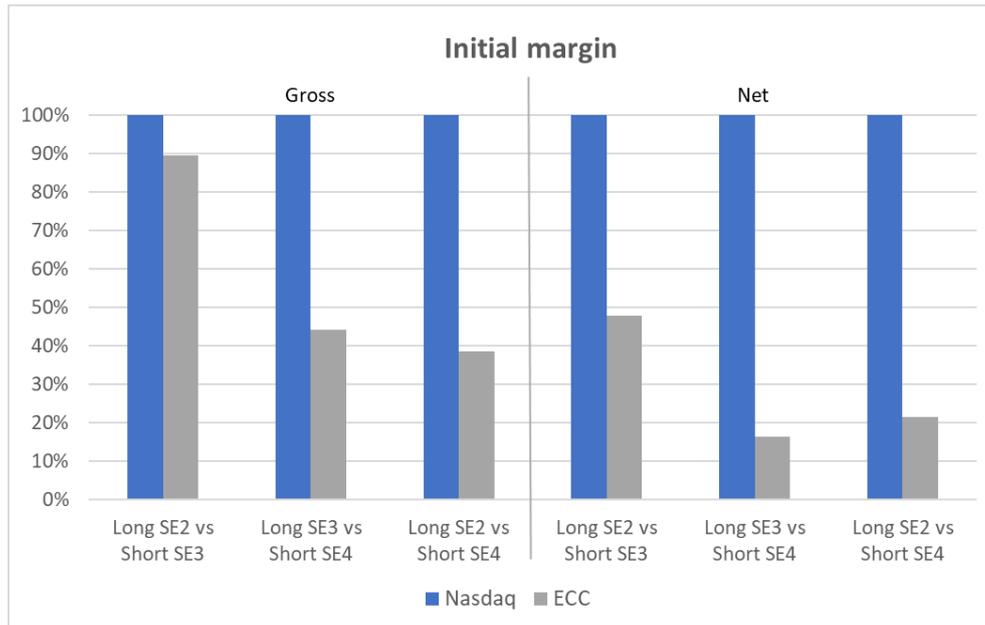


Figure 30: Comparison between Gross and Net Initial margin requirements (for an EPAD combination at Nasdaq and a zonal futures combination at ECC) for calendar year contracts 2025 (YR-25).

In summary, the above figure shows that the margin requirements for the gross positions ('Gross') are lower at ECC compared to Nasdaq Clearing. Furthermore, we can see that this difference increases further ('Net') by ECC taking greater account of the price correlation between the individual bidding zones.

⁶Please note that these margin requirements are indicative estimates.

Future auction volumes

The volumes auctioned in Svenska kraftnät's pilot are, as mentioned earlier, based on the predicted transmission capacity on the borders currently covered; SE2/SE3 and SE3/SE4. In determining the volumes to be auctioned, two objectives in particular had an initial impact; that the volume auctioned should be so large that it had the potential to improve the possibilities for hedging in the bidding zones in question, while at the same time the auction volumes were not so large that they risked flooding the market or otherwise affecting the market to more than only a marginal extent.

When it comes to the ambition to improve the possibilities for hedging, Svenska kraftnät's contribution is primarily about trying to remedy the asymmetry that arises in the forward market. On the spot market, this is done automatically by the market coupling enabling surplus areas to export electricity to deficit areas (supply meets demand) based on the transmission capacity that exists between bidding zones.

In the financial electricity market, this link is lacking, sellers in SE2 and buyers in SE4 thus lack a natural counterparty. The imbalance, or asymmetry, can therefore be reduced if a TSO steps in as a counterparty, since the congestion income in a sense represents a mirror image of the participants' financial risk exposure.

In order to fully balance the forward market, the 'Forward Equilibrium' theory postulates that 100% of the expected net flow across a bidding zone border should be provided by a TSO in the form of hedging opportunities⁷.

Here it should be noted that the expected net flow over the two current borders, in a European comparison, is both large and over time very stable. This means that the expected net flow is normally the same as the gross flow, or the available capacity. Which in turn means that, to date, there has been no need for any active portfolio management with, for example, buybacks of EPADs in the event of potential flow reversals.

⁷ <https://neon.energy/Neon-Forward-Markets.pdf>

Svenska kraftnät believes that the model/theory of 'balanced futures markets' is both intuitive and appealing. However, there are additional aspects that need to be addressed, such as whether the current asymmetry really needs to be fully remedied and whether the real hedging needs always correspond to this imbalance. We therefore asked market participants the following question about their views on appropriate volumes:

'During the pilot, Svenska kraftnät has offered the market a volume corresponding to approximately 10% of the expected available transmission capacity. Within academia, there are different theories and approaches regarding how large a volume a TSO should provide to the financial market. One approach is based on a theoretical equilibrium and implies that the TSO should offer the future expected net flow across a bidding zone border. However, this approach does not take into account market participants' risk appetite, real hedging needs or other types of hedging (e.g. PPAs/CfDs). What percentage do you think would be most beneficial if the purpose of the auctions is to remedy the current asymmetry and to support liquidity in the continuous market, but at the same time not to flood the market, with an undesirable price impact as a result?'

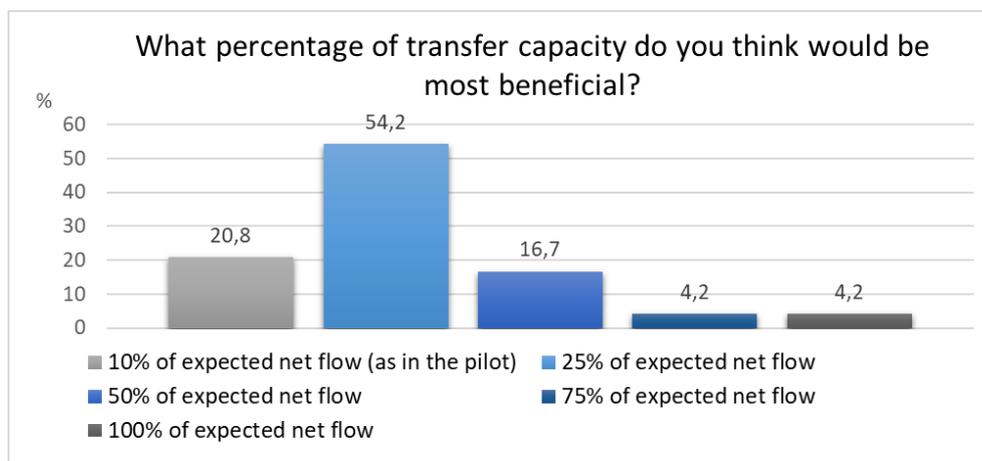


Figure 31: Respondents' views on the proportion of expected transmission capacity that should be auctioned.

A majority of respondents (54.2%) said that 25% of the expected net flow would be the most favorable level for the market. Furthermore, we can state that as many as 75% of the respondents landed in the range of 10% - 25%. We can therefore conclude, somewhat surprisingly, that there is currently no expressed desire on the part of the market participants for major increases in volume.

EPADs or Zonal Futures?

In the Nordic countries, as mentioned earlier, different hedging instruments are used than in the rest of Europe. EPAD contracts show the difference between the price in a bidding zone and the system price⁸. A change in the Nordic market model means that the auctions of EPADs would have to be replaced by auctions of zonal futures. Svenska kraftnät assesses that such an adjustment can be implemented relatively quickly. Instead, a governing input value consists of the preferences of market participants.

When asked what type of financial instrument was preferred, a majority said they wanted to continue trading EPADs, see Figure 32 below.

An important question for the auction model is whether the auctions (at EEX/ECC) in the future and potentially, would be conducted in the form of naked zonal futures or more similar to existing EPADs, i.e. in the form of a basis risk hedge, i.e. as a quoted location spread.

Svenska kraftnät took its starting point in a generic and simplified Nordic risk management model where market participants initially 'proxy hedge' their delta exposure with system price contracts and then manage the basis risk with EPADs. A zonal future can be regarded as a combination of a system price contract and an EPAD contract. Against this background, it was considered relevant to ask whether market participants saw any challenges in bidding (and then waiting for a period of time for auction results and notification of possible allotment) in an instrument that normally exhibits a significantly higher volatility and thus a higher risk. EEX has announced that the trading venue intends to list both zonal futures (for each bidding zone) and the opportunity to trade so-called location spreads - i.e., the difference between the system price and the price for individual zonal future. (EPADs are CfDs and are primarily used to hedge a basis risk and thus in a way constitute a different instrument type than the zonal futures EEX introduced on March 25th.)

A fundamental question is therefore whether the (naked) delta position obtained via bidding zone futures auction allocation would affect the interest in participating in the auctions. We therefore asked the question: 'What type of financial contract would you prefer to use in Svk's auctions?'

⁸ The Commission's proposal to introduce virtual hubs is inspired by the Nordic system with a reference price (which in the Nordic countries are system price contracts) and a product linked to the reference price to cover price differences between bidding zones

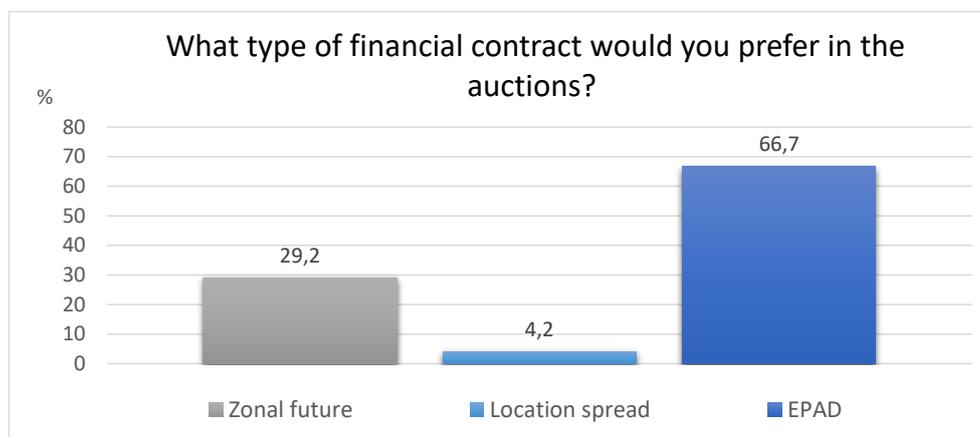


Figure 32: The respondents' preferred hedging instruments in Svenska kraftnät's auctions.

We interpret the above answer as somewhat ambiguous, the participants prefer EPADs as instrument type, but at the same time (under a different market model) outright zonal futures would be preferred over a location spread.

Svenska kraftnät therefore intends to contact the respondents in order to further clarify this issue.

Furthermore, and in preparation for a hypothetical interim period where both EPADs and zonal futures would potentially be traded in parallel, we also asked if there was interest in an arrangement where Svenska kraftnät conducted product-neutral auctions (EPADs and zonal futures) where the participants themselves could choose clearing house (Nasdaq Clearing or ECC).

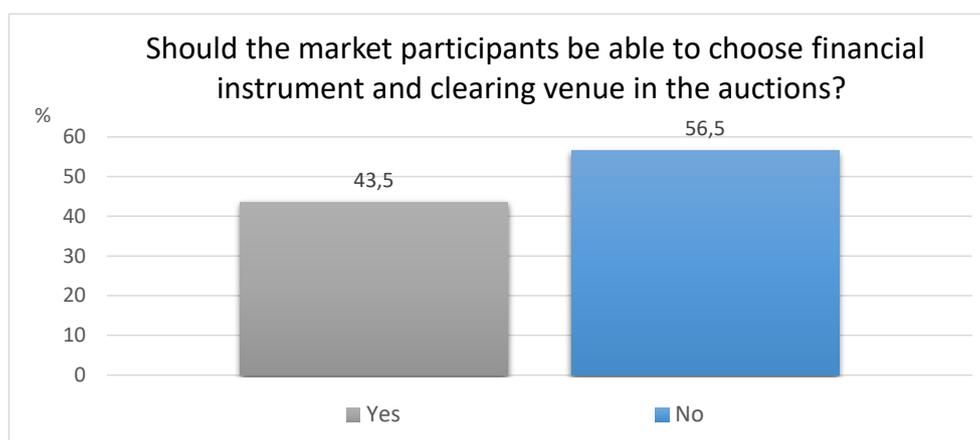


Figure 33: Interest in arrangements where Svenska kraftnät conducts product-neutral auctions.

A narrow majority answered no. The responses are interpreted to mean that this flexibility is not very high on the list of wishes at present.

Bidding Zones

The pilot project is carried out as part of Svenska kraftnät's work linked to the responsibility for TSOs to participate in the financial electricity market, which is regulated by the FCA Regulation. The coupled EPAD auctions are currently organised on a voluntary basis in the Swedish bidding zones; SE2, SE3 and SE4. However, Svenska kraftnät is open to expanding a permanent auction solution to include adjacent bidding zones to those within Svenska kraftnät's area of control, if the TSO for the adjacent bidding zone is interested and the available hedging product would support market participants' needs. However, current plans for expansion are subject to regulatory processes related to Article 30.5(b) of the FCA Regulation.

Regarding a possible expansion in connection with a permanent auction solution, i.e. a desire for an increase in the number of bidding zones, we found that the Swedish-Finnish bidding zone borders (SE3-FI and SE1-FI) ended up at the top of the respondents' 'wish list', especially SE3-FI, which was requested by 16 respondents, or 80%.

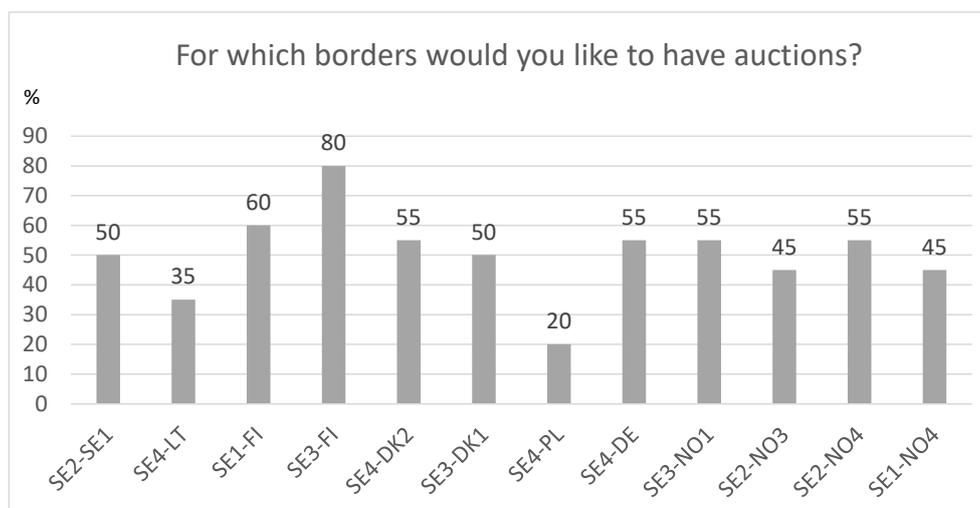


Figure 34: The respondents' preferences regarding the bidding zone borders for which future auctions could be conducted.

Furthermore, it can be noted that the interest in hedging flows between southern Sweden and Lithuania (SE4-LT) and southern Sweden and Poland (SE4-PL) was significantly weaker.

Impact on the continuous EPAD market

The model used by Svenska kraftnät in the pilot is primarily designed to add liquidity to the existing market, not to establish a parallel market or trading venue to the existing. Therefore, one of the most important long-term effects of the pilot to study and evaluate will be its' impact on the continuous market⁹.

SE2 (Sundsvall)

The picture below presents a summary of the total turnover of EPAD contracts for SE2 broken down by auction volumes and continuous trading. Turnover is presented as the total amount of energy (GWh) and thus take into account both power and time. The look back period extends from August 2022 to December 2023.

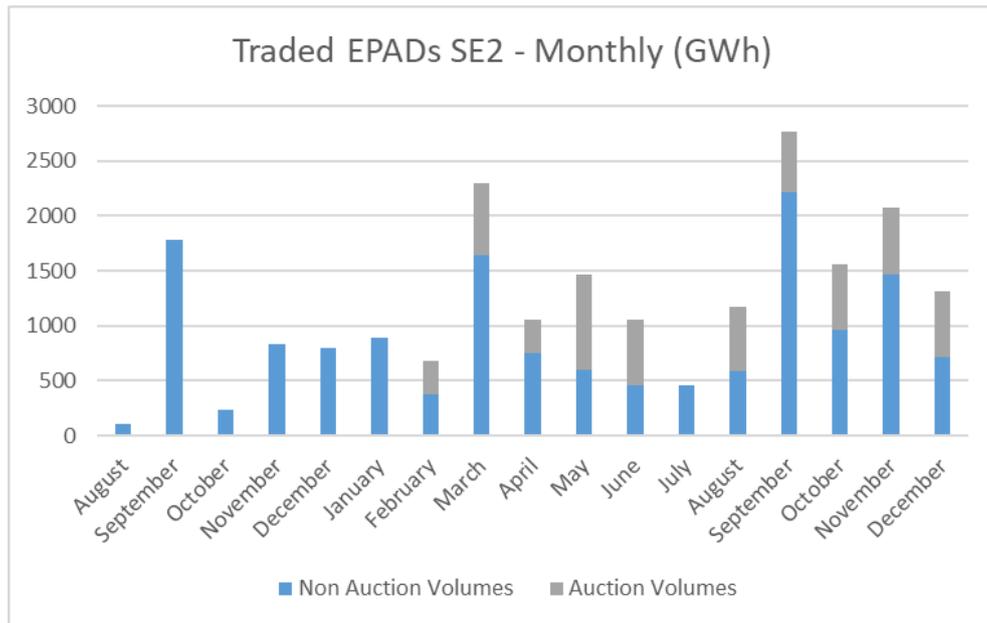


Figure 35: Turnover (GWh) of EPADs for SE2 per month, between August 2022-December 2023, split between continuous trading and auctions.

⁹ The content of this section was reported in the quarterly follow-up for the last quarter (Q4), but is deemed to have earned its place in this full-year report as well.

From the picture above, it can be seen that the total turnover in SE2 has increased since the auctions started in February. However, turnover does not show a clear trend if auction volumes are excluded, possibly, a slight upturn shines through. Auction volumes accounted for approximately 38% of total turnover in the fourth quarter.

SE3 (Stockholm)

In the case of SE3 as illustrated in Figure 36, which is the bidding zone that during the period displayed the highest liquidity and the highest turnover in continuous trading, a slightly positive trend can be seen, even though auction volumes also accounted for a large proportion of the increase.

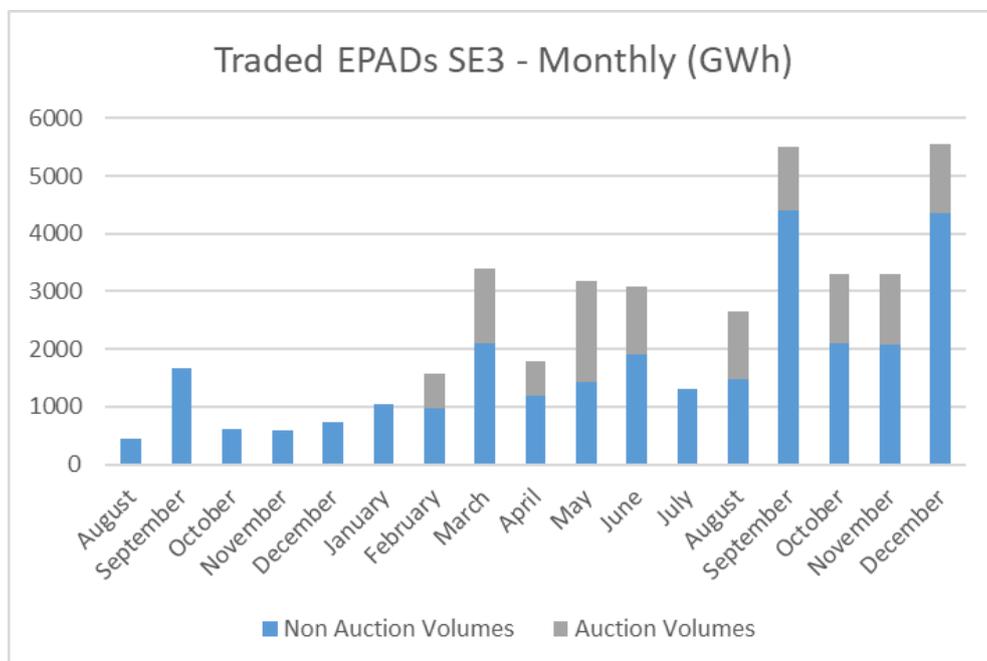


Figure 36: Turnover (GWh) of EPADs for SE3 per month, between August 2022 - December 2023, split between continuous trading and auctions.

Auction volumes accounted for approximately 31% of total turnover in the fourth quarter.

Note that the scale on the y-axis in the figures varies for the different bidding zones and that the turnover in SE3 was significantly higher than in SE2 and SE4.

SE4 (Malmö)

Regarding SE4, from Figure 37, it can be noted that auction volumes account for the lion's share of the total increased trading volumes and that turnover in continuous trading has varied, but remained at a low level, both in relative and absolute terms.

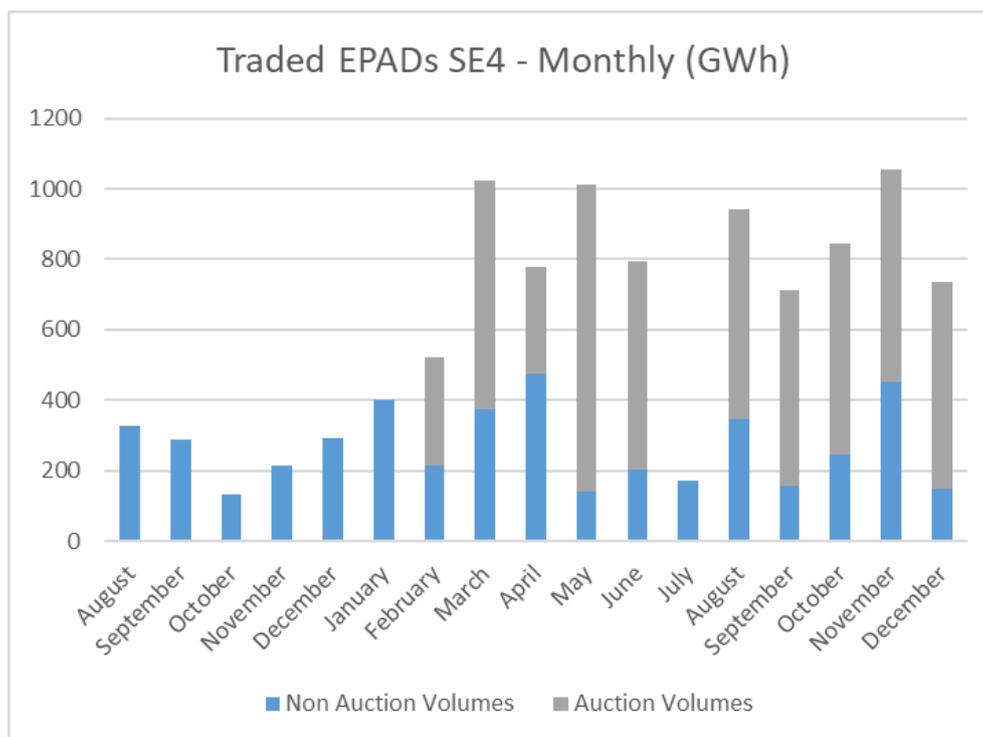


Figure 37: Turnover (GWh) of EPADs for SE4 per month, between August 2022 - December 2023, split between continuous trading and auctions.

Auction volumes accounted for as much as 69% of total turnover in the fourth quarter. However, if we compare the turnover in the continuous market during the fourth quarter of 2023 with the same quarter of the preceding year, it has increased by just over 30%, if we add the auction volumes, the increase is instead just over 400%.

Total turnover

Figure 38 (below) shows how the total turnover¹⁰ (TWh) in the contracts included in Svenska kraftnät's pilot (SE2, SE3 and SE4) has developed over the past 24 months in relation to other EPAD contracts¹¹. This comparison presents a significant increase in turnover, both in absolute and relative terms, for the bidding zones where EPADs have been auctioned, clearly illustrated via the blue bars.

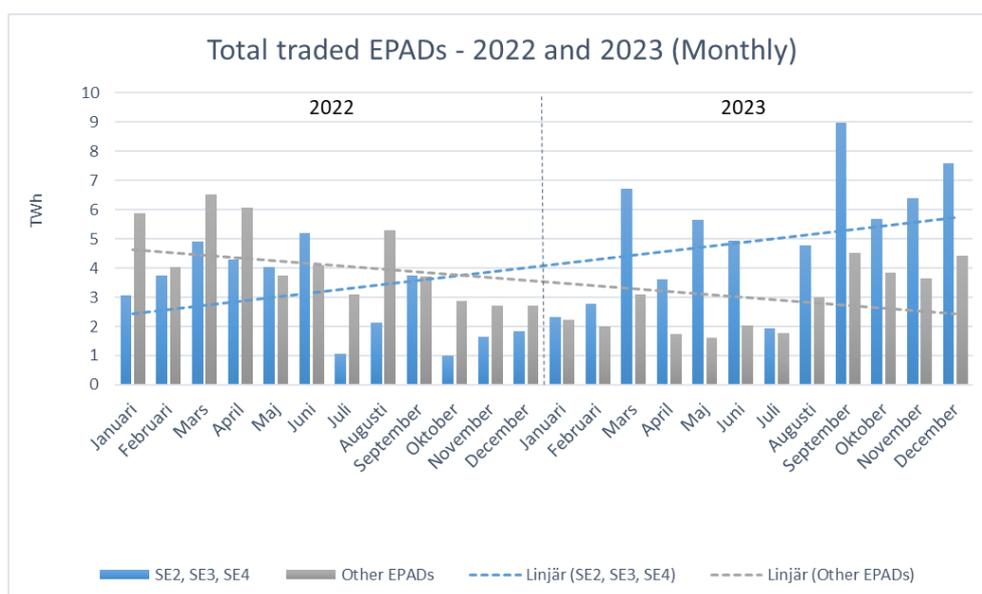


Figure 38: Monthly turnover, in TWh, of EPAD contracts for SE2, SE3 and SE4 compared to other EPAD contracts for 2022 and 2023 respectively. The trend lines reflect the development over time of EPAD's turnover in the bidding areas with auctions and other bidding areas in the Nordic region.

Since Svenska kraftnät started auctions in EPADs, the contracts included in Svenska kraftnät's pilot have accounted for an average of 65% of the total turnover of EPAD contracts. During the period February 2022 to January 2023, i.e. 12 months before the introduction of EPAD auctions, this ratio amounted to 42%. Trading in the contracts included in the auctions increased by 68% from 2022 to 2023, while in the other areas it decreased by 33% for the same period.

¹⁰ Total turnover includes both auction volumes and continuous trading.

¹¹ This includes, among others, EPADs for Danish, Norwegian and Finnish bidding zones.

If the total turnover (TWh) for only the contracts included in the pilot is divided into continuous trading volumes and auction volumes, the figure below illustrates, for example, that the auction volumes' share of total turnover on average during the last quarter of 2023 amounted to about 37%.



Figure 39: Monthly turnover (TWh) for EPADs, SE2, SE3 och SE4, in continuous trading and auction volumes in 2022 and 2023.

In-depth section

In this section, we present some of the financial aspects related to the auctions (congestion income and hedge effectiveness) and the auction schedule and portfolio profile.

Financial follow-up

From the picture below, it can be seen (i) that the margins Svenska kraftnät locked in (buy in SE2 and sell in SE4) in 2023 for the calendar year contracts (YR-24) on average amounted to approximately 43 EUR/MWh, further (ii) that the price relation closed at approximately 26 EUR/MWh.

This means, for example, that the calendar year contract for SE4 closed with large surplus values. These surplus values are not found in any realized profit, instead these will manifest themselves during the current year (2024) through the quarterly contracts' input values (via so called 'cascading') inheriting the same and are therefore only visible in connection with settlements of the respective monthly contracts on an ongoing basis during the current year.

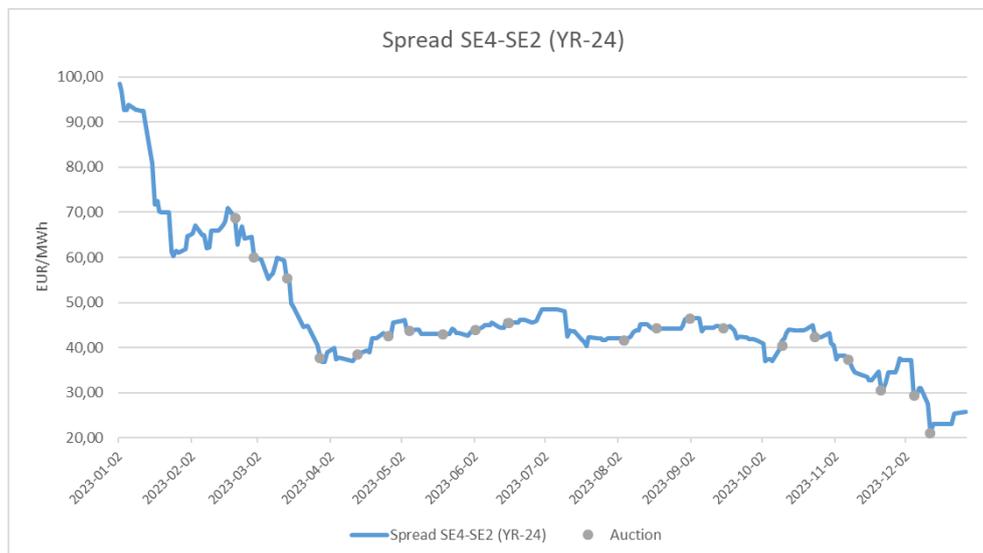


Figure 40: The total locked-in margin per auction for the northern border (SE2/SE3) and the southern border (SE3/SE4) is given as grey dots and the price difference for the calendar year contract for 2024 in SE2 and SE4 with a blue line, respectively.

As the spread (margin or price relation between SE2 and SE4) gradually decreased, Svenska kraftnät's hedging activities also contributed positively to total congestion income.

Of the total congestion income (calculated for the hedged volume), the congestion income arising from price differences in the day-ahead market accounted for about 74%, the remaining 26% emanating from EPAD auctions.

Congestion income and hedge effectiveness

A fundamental question is whether the coupled EPAD contracts actually act as an effective way of hedging congestion income. The figure below illustrates the result (EUR/MW). The light blue line shows the congestion income received and the grey line the hedging. The dark blue line represents the net position. The auctions started in February and March thus constitutes the first month of settlements.

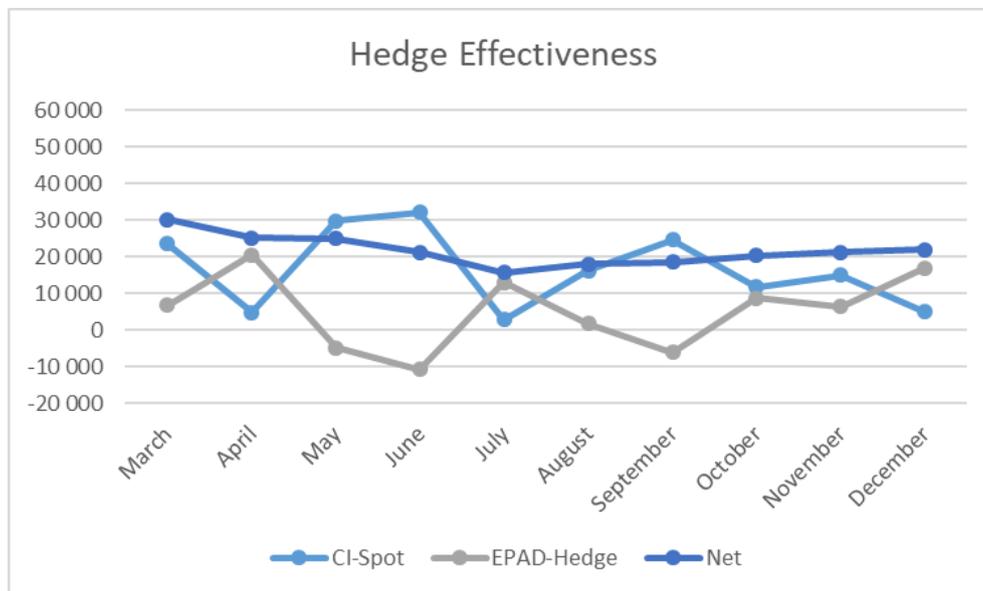


Figure 41: Congestion income and results from settled EPAD contracts, hedging of congestion income, and the net effect of these per month in 2023. As the first auctions were held in February, the first month in which settlements took place was March.

The figure above shows, as mentioned earlier, that EPADs made a positive contribution to total congestion income and that the light blue and grey line exhibit a strong negative correlation. Furthermore, the volatility of the total congestion income received decreases (cf. the dark blue line).

Portfolio profile and splitting

An issue that is currently frequently discussed among TSOs is how future auction volumes, under a potential future legal framework, should be allocated based on maturity ('splitting').

In the context of the EPAD pilot, we have tried to stick to a few simple principles. The purpose of the market-supporting auctions is primarily to contribute to improved hedging opportunities through transparent and predictable action.

It follows that auctions should be conducted on the basis of pre-published quarterly auction schedules in which total volumes and maturity distribution are to be kept substantially constant over time and between quarters. Svenska kraftnät allocates smaller volumes (10 MW) in each calendar year contract (2025 and 2026) at each auction. We have also chosen to prioritize quarterly volumes over monthly volumes for the current calendar year.

The auction schedule below summarizes how the volumes were distributed for Q2, 2024.

Table 6: Auction schedule for Q2 2024 with volumes for each product and total auction volume, in MW, at each auction date.

Contract and Date	2024-04-09	2024-04-23	2024-05-07	2024-05-21	2024-06-04	2024-06-18
MAY 2024	50					
JUN 2024		50	50			
JUL 2024				50	50	
AUG 2024					50	50
Q3 2024	20	20	20	20		
Q4 2024	20	20	20	20	20	20
Q1 2025					20	20
YR 2025	10	10	10	10	10	10
YR 2026	10	10	10	10	10	10
Total	110	110	110	110	160	110

The image below should be read as a complement to the auction schedule, it shows what the EPAD portfolio looked like on 20th of February 2024.

The figure describes the portfolio in the form of outstanding monthly equivalents on the border between SE3 and SE4. The grey bars correspond to the portfolio as of 20th of February, while the yellow bars illustrate the auction volumes remaining in Q1. The blue bars summarize the auction schedule for Q2. The thin dotted line is the benchmark for the portfolio. Note that this relates to the volumes that are to be settled only.

The thick dotted line shows how well the existing portfolio in combination with auction plans matches the mentioned benchmark. Svenska kraftnät thus has an internal objective of hedging congestion income corresponding to approximately 10% of the forecasted transmission capacity.

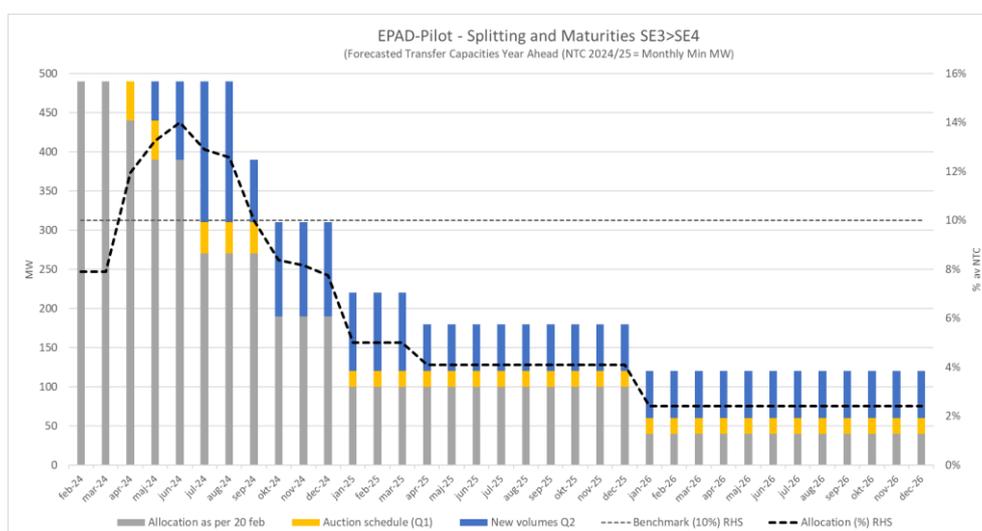


Figure 42: Distribution of the outstanding volume of EPADs. The figure shows how much of the predicted transmission capacity that is hedged and the guideline value for hedging. The grey portion of the bars illustrates the volume allocated. The volume in planned auctions is marked as yellow for Q1 and blue for Q2.

In reality, transmission capacity varies over time and from month to month. Externally, Svenska kraftnät has communicated a volume to market participants of approx. 400 - 500 MW. The figure shows that 490 MW will go to settlement during the period February – August. The careful reader can then deduce that the forecasted transmission capacity for the southern border is below 5000 MW as the thick dotted line, until September, sits above the benchmark value of 10%.

When it comes to monthly contracts, the front month has been prioritized and we are planning the volumes taking into account the interim goal of 'filling up' each settlement month to approx. 500 MW, as a fine-tuning of the portfolio. This means that the portfolio profile takes the form of a right-angled triangle where the catheters are represented by volumes on the y-axis, maturities on the x-axis and where the hypotenuse describes the maturity structure, which thus naturally becomes 'front-heavy'. It should be noted that the benchmark, as mentioned above, only relates to the volume under settlement. The financial exposure is proportional to the number of hours in the different contracts and the risk is measured with regard to historical volatility. (The maturity-weighted average maturity of the portfolio is approximately 1 year.)

Furthermore, it may be interesting to compare the auction schedule with the contracts that were listed in mid-March 2024. The auction schedule for the second quarter includes the current front month, all quarterly contracts and two calendar years (2025 and 2026). Thus, we can conclude that the auctions essentially contribute volumes in all relevant listed contracts up to and including YR-26.

If we look back at 2023 and instead look at the historical distribution, we can see that this was 'front-heavy' and relatively evenly distributed between quarterly and calendar year contracts, and that the monthly contracts received 19% of the total amount of energy auctioned.

Table 7: The number of auctions and the distribution of auction volumes between monthly, quarterly and calendar year contracts, as well as total volumes both in GWh and as a percentage.

No of Auctions	Breakdown	GWh	%
376	Total	22 658	100
124	Monthly Contracts	4 210	19
152	Quarterly Contracts	9 670	43
100	Calendar Year Contracts	8 778	39

Conclusions

Svenska kraftnät assesses that the auction model has worked well and that the auctions contribute to increased transparency, price discovery and to better price formation on the EPAD market.

Furthermore, Svenska kraftnät can state that the auctions meet an important need during a period of low market liquidity. Svenska kraftnät's role as a 'natural' buyer and seller in the surplus and deficit areas SE2 and SE4 is considered to support better opportunities for market participants to manage underlying structural market asymmetries between Swedish bidding zones.

Participation in the auctions is considered satisfactory, but we note some elements of market concentration. The market participants themselves are generally satisfied with the auctions, but see some potential for improvement.

When it comes to price formation in the auctions, we classify this as satisfactory overall, but note that the auctions of monthly contracts have not worked as well as, e.g. the calendar year contracts.

A positive trend that can be discerned is that, in relative terms, the already most liquid bidding zone SE3 seems to have benefited the most from the volumes contributed by the auctions, while bidding zone SE4 continues to show a very low turnover in continuous trading. Furthermore, the turnover in the EPADs included in the auctions show significant improvement when compared to other EPADs. This trend has also been accentuated during the first quarter of 2024.

When it comes to market participants' future plans, these seem to be characterized by a wait-and-see attitude and a desire to keep EPADs as auction instrument. The current uncertainty regarding instruments and trading venues indicates that the EPAD auctions will reasonably be completed throughout 2024 as planned, unless the conditions change radically in the relatively near future. However, the presumptively lower margin requirements speak in favor of EEX/ECC, but we see an obvious risk in the fact that the major market participants almost seem to be split into two camps when it comes to preferences regarding the future trading venue, which risks negatively affecting liquidity in the short term. We also assume that the EEX introduction of zonal futures will not be adequately evaluated by the market before the summer.

Overall, there are also some outstanding issues, which need to be addressed in the near future. Svenska kraftnät therefore intends to revert to the market participants in order to discuss possible adjustments to the auctions, such as maturities, instruments and schedules.