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## Quarterly summary: Svenska kraftnät's auctioning of EPAD contracts to improve hedging opportunities

**Q4 2023**

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# Svenska kraftnät

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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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Org. No 202 100-4284

Svenska kraftnät  
Box 1200  
172 24 Sundbyberg  
Sturegatan 1

Phone: +46 10-475 80 00

Fax: +46 10-475 89 50

[www.svk.se](http://www.svk.se)

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## 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 auctioning of the financial contracts used for hedging specific bidding zone price risk in the Nordic market, Electricity Price Area Differentials (EPADs), aims to empirically test an optional way for the TSO to increase liquidity in the forward market. If successful, this model could potentially serve as an alternative to the measures currently described in the FCA GL.

In the pilot's auctions, Svenska kraftnät offers to both buy and sell EPADs in bidding zones SE2, SE3 and SE4. 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 the transactions only proceed if Svenska kraftnät's buy transaction is made at the same or a lower price than Svenska kraftnät's sell transaction in the adjacent bidding zone.

For the implementation of the auctions, Svenska kraftnät has procured Svensk kraftmäklings AB (SKM), which arranges the auctions. All transactions are cleared through Nasdaq Clearing.



During the pilot project, Svenska kraftnät has limited the volume of offered contracts to approximately 10 percent of the expected available physical capacity on each bidding zone border.<sup>1</sup>

In order to simplify the follow-up and analysis of the pilot project, Svenska kraftnät compiles the results of the auctions and presents a number of metrics that also illustrate the development of the continuous market for EPADs in the affected bidding zones. These summaries are published quarterly in the form of short reports, of which this is the fourth one and refers to the fourth quarter of 2023.

Please note that Svenska kraftnät has decided not to include the appendix with the compilation of the auction results published by SKM in connection with each auction that has been conducted. For these, please refer to SKM's website.

## Introduction

### Bidding zones and hedging

The spot price of electricity varies between bidding zones and depends for example on the transmission capacity of the power grid. Price developments in the forward market provide an indication of how market participants view future price developments and future differences in electricity prices between bidding zones. At the same time, the forward market gives an indication of the market's expectation of the size of the future congestion income that arises from price differences between bidding zones and accrues to Svenska kraftnät.

So-called system price contracts enable hedging of large parts of the fundamental price risk that exists in the Nordic electricity market because of varying availability of, for example, hydro and nuclear power and variations in fuel prices. The system price serves as a broader reference price<sup>2</sup> 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, indeed cannot be managed with system price contracts. EPAD contracts allow hedging against the basis risk represented by the difference between a specific bidding zone's price and the system price.

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<sup>1</sup> For more detailed information on how the auctions are set up and concluded, please refer to [www.svk.se](http://www.svk.se) and [www.skm.se](http://www.skm.se).

<sup>2</sup> A virtual hub that pools all bids and offers on forward electricity contracts in the Nordics, boosting liquidity and creating a single reference price for several bidding zones.

By design, the combination of system price contracts and EPAD contracts provides effective hedging of the price risk that exists in the system as a whole and in 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's price and the system price, EPAD contracts can also be combined in pairs to hedge the price difference between two bidding zones or more. Thus, the combination of buying an EPAD in one bidding zone and selling in an adjacent bidding zone corresponds to a financial hedging instrument between two bidding zones. This is a type of hedging that for most market participants has limited use, but the design can be used to manage the financial exposure that a transmission system operator (TSO) obtains when engaging in the financial market. This is because the contract combination provides an effective hedge of congestion income.

## Turnover and liquidity

The aim of Svenska kraftnät's pilot project with EPAD auctions is to test a new way for a TSO to support improved hedging opportunities and to contribute to increasing liquidity in the financial electricity market.

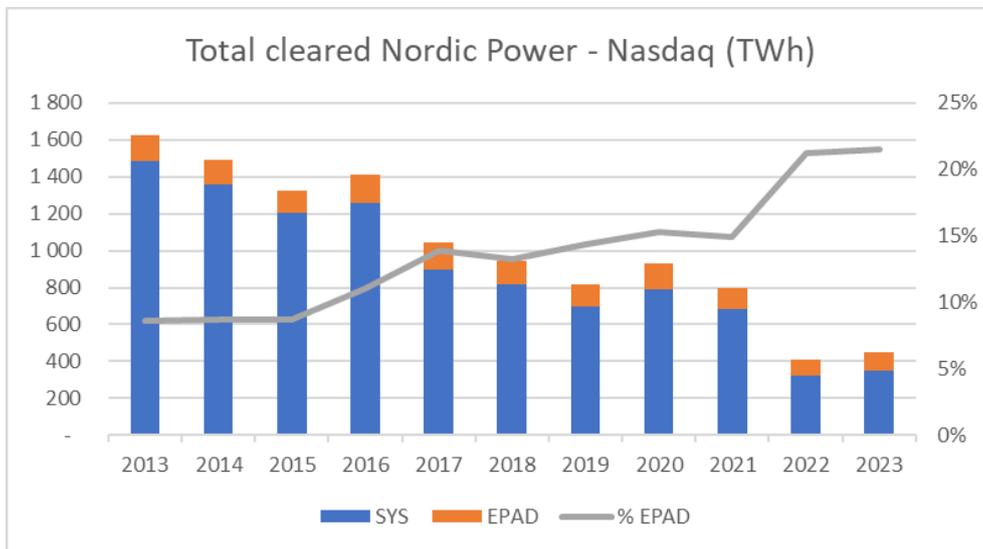
The Nordic financial market for electricity has struggled with declining liquidity for many years. In 2022, the challenges increased further as a result of higher margin requirements, which meant that participants had to allocate a lot of capital to clearing, as well as increasing spot price differences and lower price correlation between bidding zones. The latter, in turn, has led to reduced relevance of the system price as a reference price for market participants' hedging.

The follow-up presented in this report covers the 22 auctions conducted during 2023, with a focus on the fourth quarter. It was therefore considered reasonable to complement the monitoring of short-term developments with a longer-term perspective.

**Figure 1** below shows the total cleared volume of system and EPAD contracts at Nasdaq since 2013. As can be seen in the figure, system contracts account for the majority of the turnover in the Nordic market and it is these that have lost the most in volume (TWh), in both absolute and relative terms.

Since 2013, turnover in system price contracts has fallen by more than 75%, while EPAD contracts have lost about 30%. The relative share of EPAD contracts in total turnover has thus increased from just under 10% to just over 20%.

In 2023, total turnover on Nasdaq increased by just over 9% compared to the bottom year of 2022, relatively evenly distributed between the contract types.



**Figure 1.** Total cleared volumes at Nasdaq Clearing (2013-2023).

# Summary of auction results

Svenska kraftnät conducted six auctions during the fourth quarter of 2023, starting on 10 October, where monthly, quarterly and annual contracts were auctioned in separate auctions. The sixth and final auction day of the quarter was 12 December.

The total number of participants per auction averaged 21, a marginal decrease compared to the third quarter (22). The participation rate has been fairly stable during the auction period, with the last auction of the year standing out with a high of 26 participants.

The number of individual transactions varied between 110 and 178 per auction and amounted to 141 on average. The total volume, here expressed in energy terms (GWh), has been evenly distributed between the auctions.

**Table 1** summarizes the auctions in terms of participation, number of trades and volumes.

**Table 1** Auction date, number of participants, number of trades and total volume (GWh).

Auction date	Number of participants	Number of trades	Total volume (GWh)
2023-10-10	18	131	1,195
2023-10-24	20	124	1,199
2023-11-07	20	110	1,199
2023-11-21	22	157	1,199
2023-12-05	22	147	1,183
2023-12-12	26	178	1,190

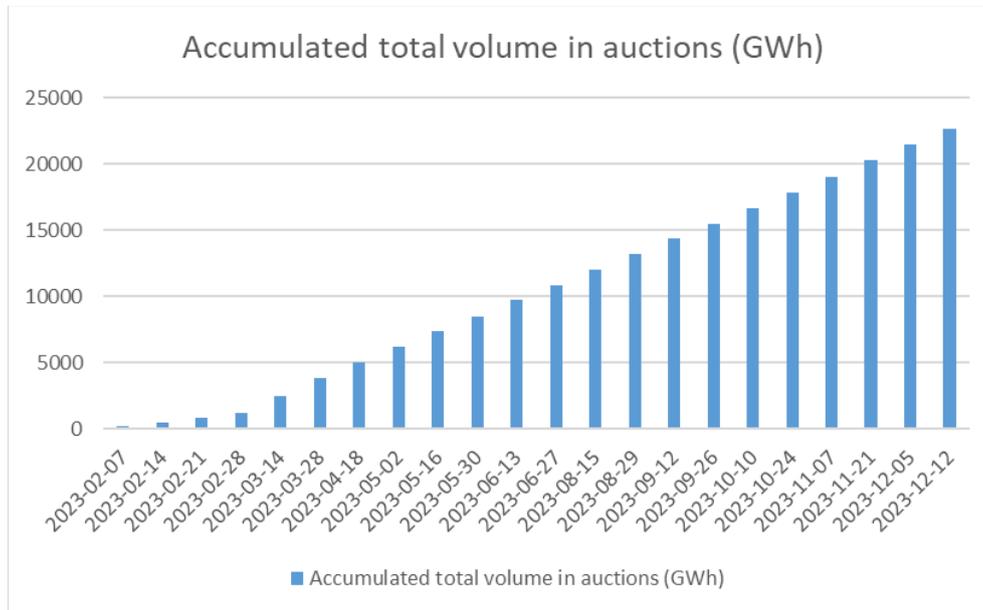
## Total allocated volumes in the auctions

**Table 2** below shows a summary of volumes for each contract in the auctions conducted during the period covered by this report.

**Table 2** Allocated volumes in the auctions held between October 10 and December 12 2023.

Bidding Zone	Contract	Volume (MW)	Svk BUY	Svk SELL
SE2	23-nov	50	BUY	
SE2	23-dec	100	BUY	
SE2	24-jan	100	BUY	
SE2	24-feb	50	BUY	
SE2	Q1-24	120	BUY	
SE2	Q2-24	120	BUY	
SE2	YR-24	60	BUY	
SE2	YR-25	60	BUY	
SE3	23-nov	50 + 50	BUY	SELL
SE3	23-dec	100 + 100	BUY	SELL
SE3	24-jan	89 + 100	BUY	SELL
SE3	24-feb	50 +50	BUY	SELL
SE3	Q1-24	120 + 120	BUY	SELL
SE3	Q2-24	120 + 120	BUY	SELL
SE3	YR-24	60 + 60	BUY	SELL
SE3	YR-25	60 + 60	BUY	SELL
SE4	23-nov	50		SELL
SE4	23-dec	100		SELL
SE4	24-jan	89		SELL
SE4	24-feb	50		SELL
SE4	Q1-24	120		SELL
SE4	Q2-24	120		SELL
SE4	YR-24	60		SELL
SE4	YR-25	60		SELL

**Figure 2** (below) illustrates the total accumulated volumes offered to the market through the auctions since the auctions started in February 2023. In 2023, the total aggregated volume amounted to 22,651 GWh.



**Figure 2.** Total accumulated volume in auctions during 2023 (GWh).

## How to interpret 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 for their bids and offers for the individual EPAD contract, i.e. market participants submit orders for discrete products for 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 volume to purchase (marginal price).

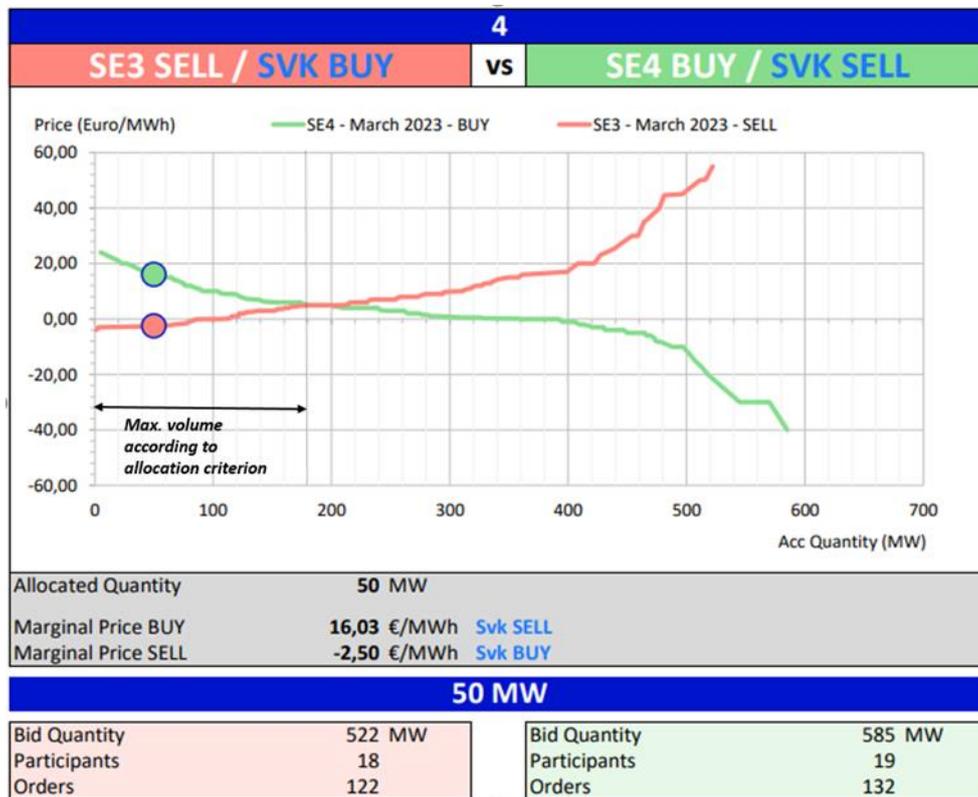
Where Svenska kraftnät offer to sell EPADs, the bids from buyers will be accepted beginning with the highest price and decreasing to the price level of the bid that fulfils Svenska kraftnät's volume to sell (marginal price).

The results of each auction opportunity are published just after 13:00 CET on the day of the auction.<sup>3</sup> The auction results are presented in the form of bid curves.

<sup>3</sup> Auction results are published on SKM's website, [Link to Auction Results](#)

**Figure 3** (below) shows the first auction conducted on February 7, this is one example of how to illustrate price formation 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 ranked 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.



**Figure 3.** Example of auction result showing order curves, price for each contract, allocated volume, number of participants, number of orders and the total order quantity.

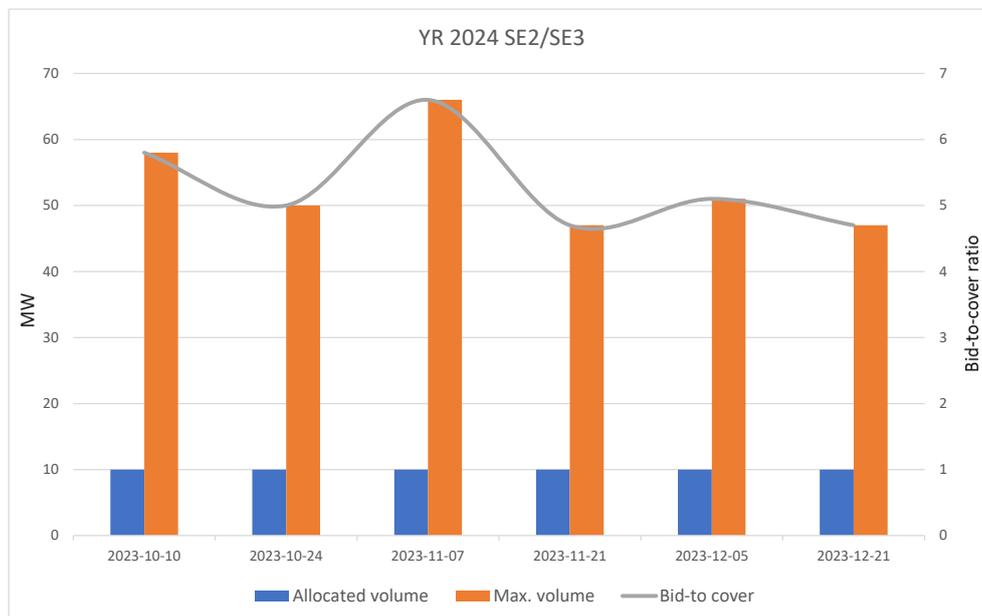
Figure 3 also illustrates the distance that corresponds to the volume that could have been allocated given Svenska kraftnät's allocation criteria. (The price at which Svenska kraftnät purchase must always be lower than or equal to the price at which Svenska kraftnät sell in each coupled transaction.) 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.

## Bid-to-cover ratio

The bid-to-cover ratio is the quantity of orders (buy or sell) for an EPAD-contract divided by the quantity accepted by Svenska kraftnät. A high bid-to-cover ratio indicates a strong demand for the contracts.

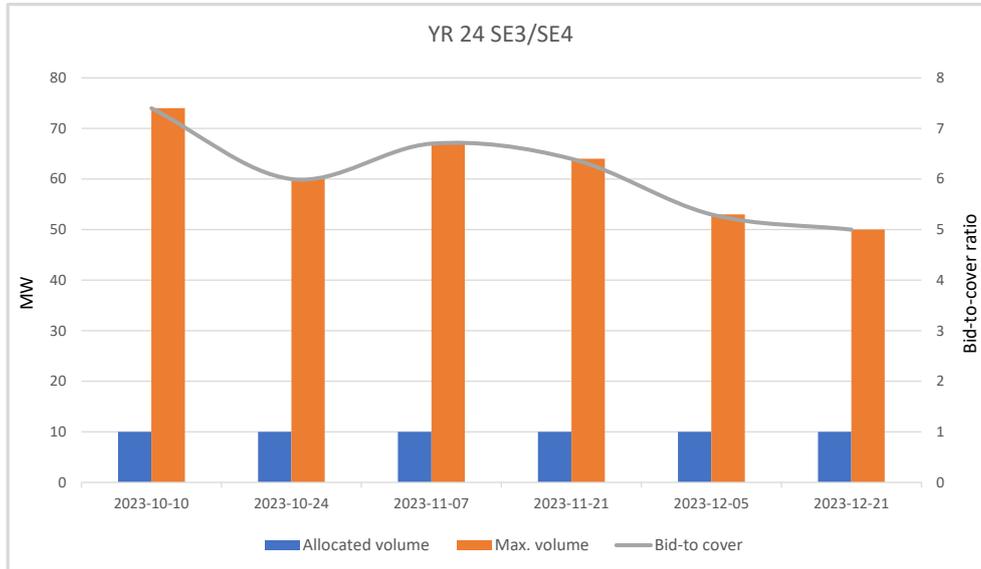
As mentioned earlier, the price at which Svenska kraftnät purchase must always be lower than or equal to the price at which Svenska kraftnät sell in each coupled transaction. The bid-to-cover ratio presented below is adjusted to reflect this condition, i.e. calculated as the volume accepted by Svenska kraftnät divided by the total volume of orders where the respective purchase and sales price would meet the above criterion. This means that the bid-to-cover ratio is not calculated and based on the total (gross) volume of orders.

During the fourth quarter, the bid-to-cover ratio was highest for the yearly contracts and amounted close to six times the volume offered. **Figure 4** illustrates the bid-to-cover ratio for the offered yearly contracts that link to the northern bidding zone border SE2-SE3. On average, the order volumes continued to be more than five times greater than the volume offered by Svenska kraftnät.



**Figure 4.** Volumes for SE2/SE3 yearly contracts, shown per auction date.

**Figure 5** (below) shows the same relationship for the contracts in auctions for the southern bidding zone border between SE3 and SE4. On average, the total volume that met the criterion has been more than six times greater than the volume offered, even though the ratio decreases over the auction period.

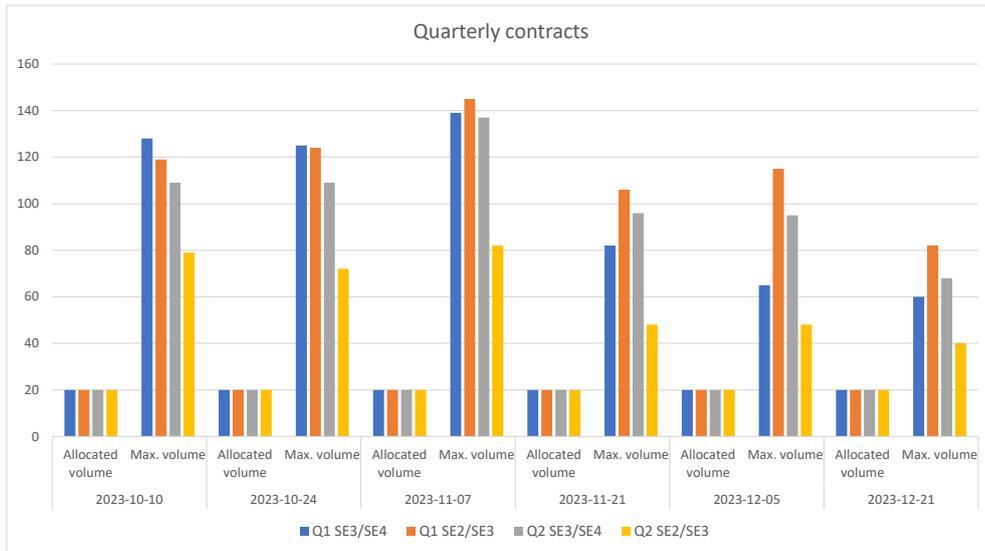


**Figure 5.** Volumes for SE3/SE4 yearly contracts, shown per auction date.

Quarterly contracts had a slightly lower bid-to-cover ratio than the yearly contracts, which follows the same pattern as the auctions in the third quarter.

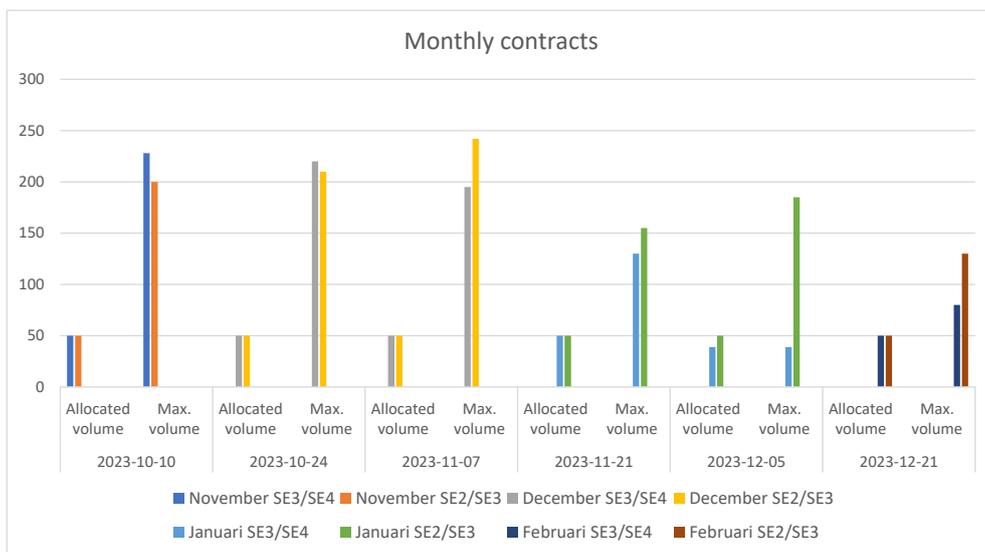
**Figure 6** below shows that the southern border (SE3-SE4) continued to attract greater interest than the northern border (SE2-SE3), even though the differences were significantly smaller than during the third quarter.

Q1 2024 contracts exhibits an average bid-to-cover ratio close to 5 for the southern border and 5.7 for the northern border. For the Q2 2024 contracts the relationship was similar, with a bid-to-cover ratio close to 5 for the southern border and slightly more than 3 for the northern border.



**Figure 6.** Volumes for quarterly contracts, shown per auction date.

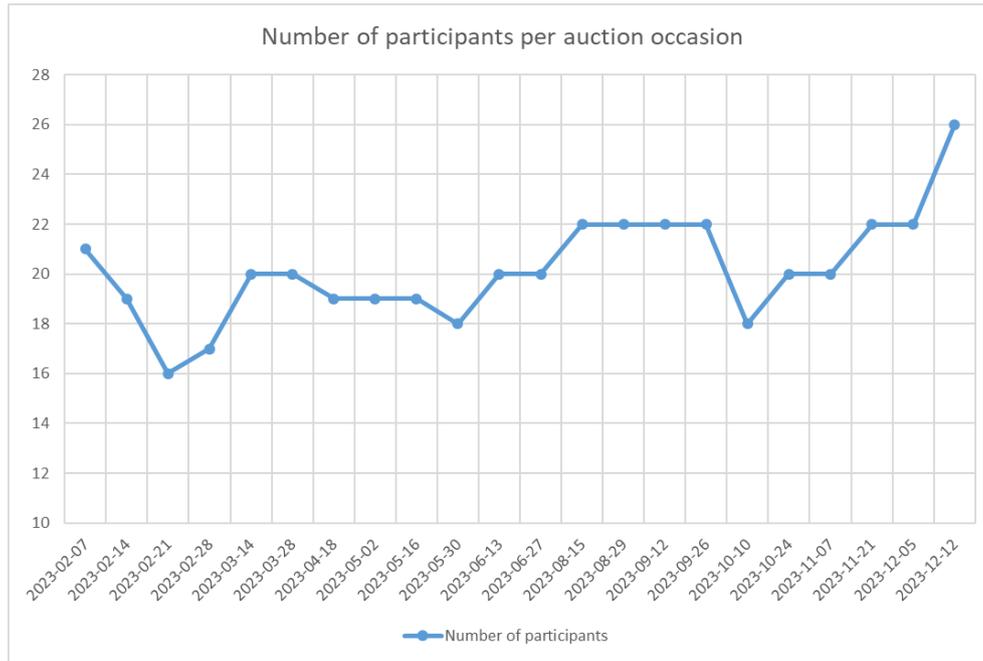
**Figure 7** illustrates that the bid-to-cover ratio for monthly contracts is lower than for other maturities in the auctions. The southern border presents a bid-to-cover ratio of 2.8 while the northern border had a bid-to-cover ratio of 3.4.



**Figure 7.** Volumes for monthly contracts, shown per auction date.

## Participation in auctions

**Figure 8** below summarises the total number of participants in the 22 auctions carried out since the start of the pilot. In a quarterly comparison, it can be noted that the auctions attracted an average of 21 market participants in the fourth quarter, which was marginally higher than the annual average of 20. Furthermore, a slightly positive trend can be seen in the figure.

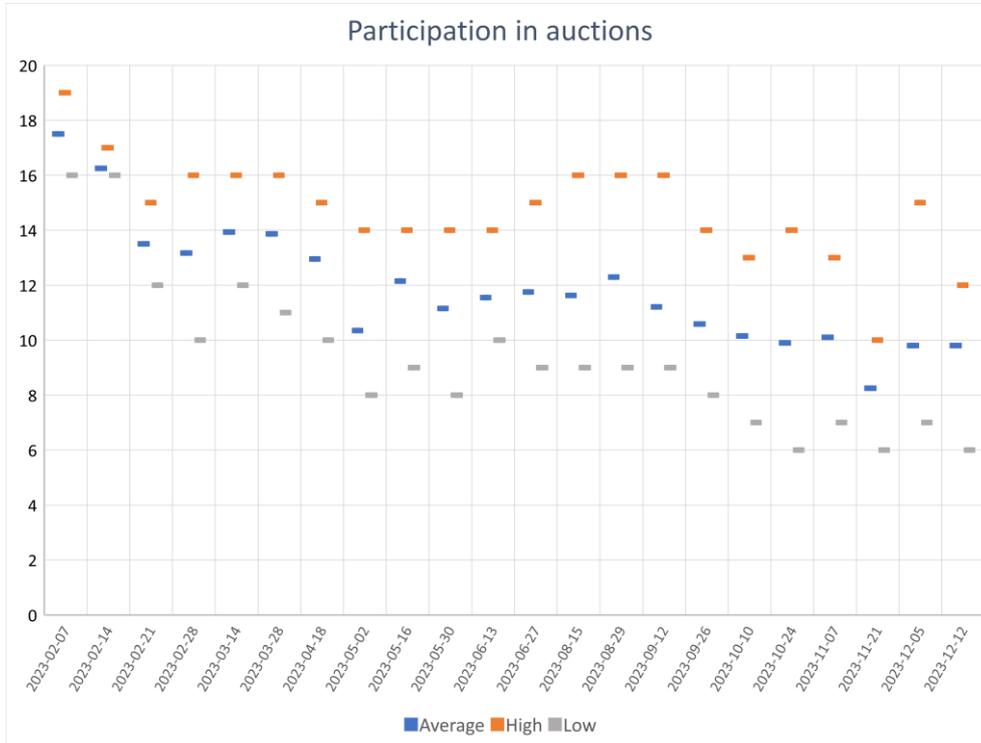


**Figure 8.** Number of participants per auction date (February – December 2023).

The illustration in **Figure 9** below summarizes the maximum, minimum and average number of participants at the different individual auctions since the start of the pilot (presented per auction date).

As seen in the figure the participant rate is decreasing over the year. But at the same time, the total number of participants per auction has increased during the same period.

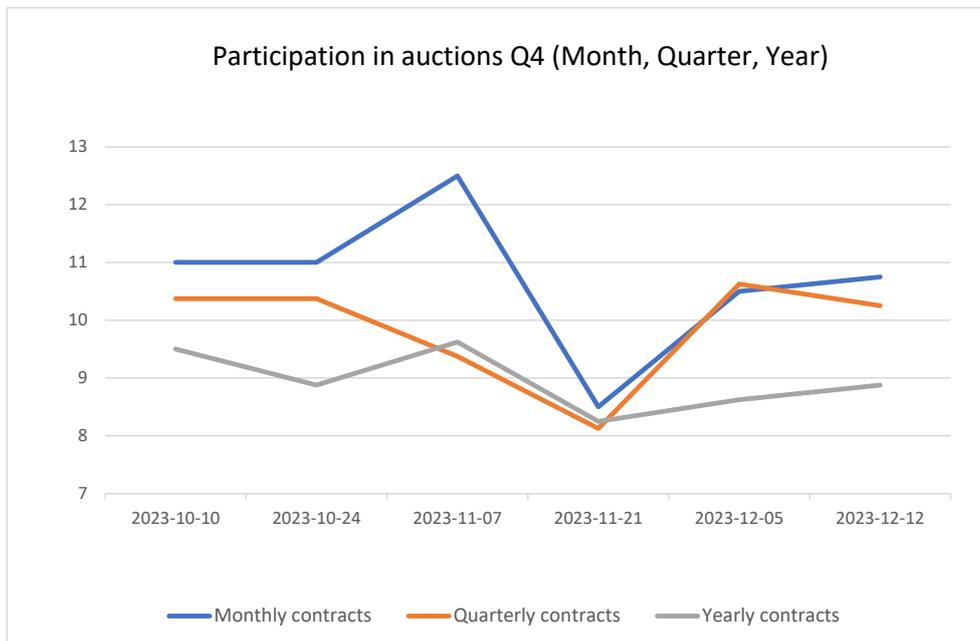
The highest number of participants in a single auction was 15, while the lowest number of participants was 6. The average amount of participants per auction during Q4 was 10.



**Figure 9.** Average, high and low participation in auctions (per auction date).

**Figure 10** (below), shows the auction participation in the fourth quarter broken down into monthly, quarterly and yearly contracts. As stated above, the yearly contracts have consistently shown a high bid-to-cover ratio, but at the same time attracted the lowest average number of participants.

Furthermore, the monthly contracts have shown the greatest participation interest on average in contrast to the previous quarter where quarterly contracts generated the most interest.



**Figure 10.** Average number of participants during quarter 4 per auction date split by maturity.

## Price development in the continuous market

In general, auction marginal prices have ended up relatively close to the previous trading day's closing prices and usually within the (unofficial) indicative price difference between the best buyer and the best seller (the so-called bid-ask spread).

Low liquidity in EPAD contracts means not only that turnover is low, but also that the closing prices are also likely to be subject to some uncertainty as a reference price for the auctions. As can be seen in some of the figures below, with special regard to SE4, market prices have generally remained close to the price levels set in the auctions during the trading days following the auctions. This indicates that the auctions have a price-forming function in the market (price discovery).

During the fourth quarter, Svenska kraftnät conducted six auctions in bidding zone SE3 for front year contracts. In **Figure 11** the auction dates have been plotted in relation to the historical price development of the front-year contract during 2023. It can be noted that SE3 has been trading below the system price since mid-March.

The average marginal price in the auctions amounted to around -4 EUR/MWh, a decrease of about 1.5 EUR/MWh compared to the third quarter (about -2.5 EUR/MWh).

Svenska kraftnät both buys and sells SE3 contracts in the linked auctions vis-à-vis SE4 and SE2 respectively and therefore normally does not have any net positions in SE3.



**Figure 11.** Daily closing prices (2023) in the continuous market plotted together with the auction dates (October - December) for SE3 YR-24 contracts.

The corresponding contract for bidding zone SE4 showed a marked decline during the first quarter and the expected price difference relative to the system price fell sharply. The following quarters were instead characterized by a sideways movement with a slight upturn in the third quarter.

During the fourth quarter, the contract approached the system price and closed at 3 EUR/MWh. We have to go back to 2020 to find such a "tight" spread relative to the system contract.

Svenska kraftnät conducted six auctions during the fourth quarter and the average marginal price in the auctions ended up at approximately 13 EUR/MWh, a significant decrease compared to the third quarter (approximately 21 EUR/MWh).

See **Figure 12** below for closing prices in the continuous market plotted along with auction dates.



**Figure 12.** Daily closing prices (2023) in the continuous market plotted together with the auction dates (October - December) for SE4 YR-24 contracts.

The price of the corresponding SE2 contracts showed a slightly increasing trend, but was primarily characterised by a sideways movement in the range of -35 EUR/MWh to -15 EUR/MWh. The marginal price in the auctions ended up at -21 EUR/MWh, slightly higher than in the previous quarter (about -23 EUR/MWh). Closing prices and auctions are shown in **Figure 13**.



**Figure 13.** Daily closing prices for (2023) in the continuous market plotted together with the auction dates (October - December) for SE3 YR-24 contracts.

## Activity and trading in the continuous EPAD market

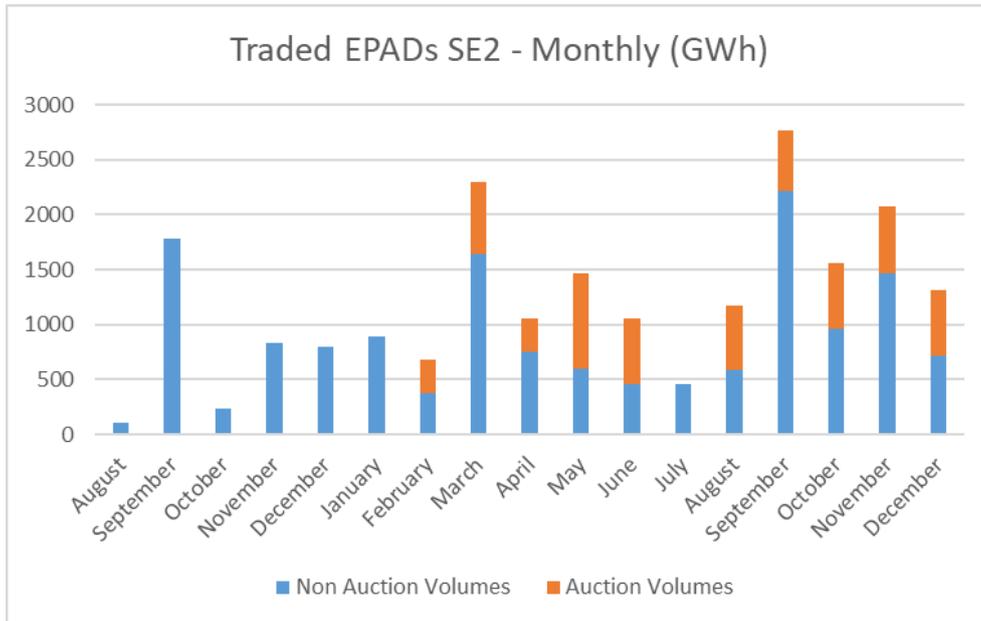
The model used by Svenska kraftnät in the pilot is primarily designed to add liquidity to the existing market, not to establish a parallel market or trading venue to the existing. Therefore, one of the most important long-term effects of the pilot to study and evaluate will be its' impact on the continuous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

**Figure 14** (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.

As mentioned earlier, trading in EPADs has been fairly limited for many years. This market situation was reinforced in 2022 (and also applied to 2023) when sharply increased margin requirements made it more capital-intensive to trade EPAD contracts than before. Nasdaq Clearing's total collateral requirement increased tenfold from the beginning of 2021 to the end of August 2022 when the price of electricity was at its highest.

Furthermore, the margin requirements for positions in SE2 contracts were significantly higher during the period than for corresponding contracts in SE4.

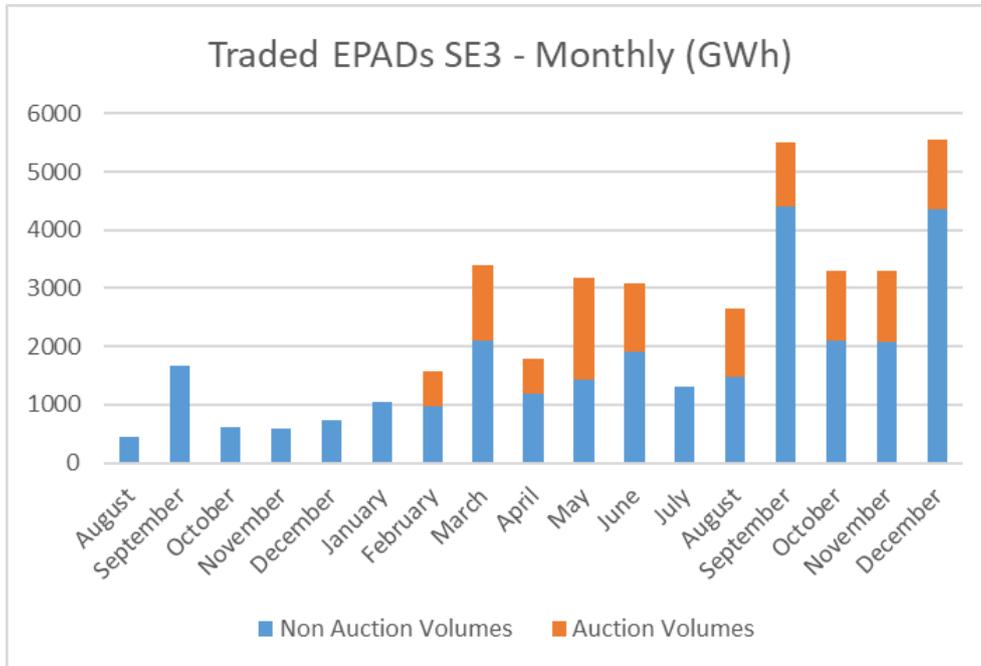
From the picture below, it can be seen that the total turnover in SE2 has increased since the auctions started in February. However, turnover does not show a clear trend if auction volumes are excluded, possibly, a slight upturn can shine through. Auction volumes accounted for approximately 38% of total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



**Figure 14.** Turnover (GWh) of EPADs for SE2 per month, August 2022 - December 2023.

In the case of SE3 as illustrated in **Figure 15**, which is the bidding zone that during the period showed 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. Auction volumes accounted for approximately 31% of total turnover in the fourth quarter.

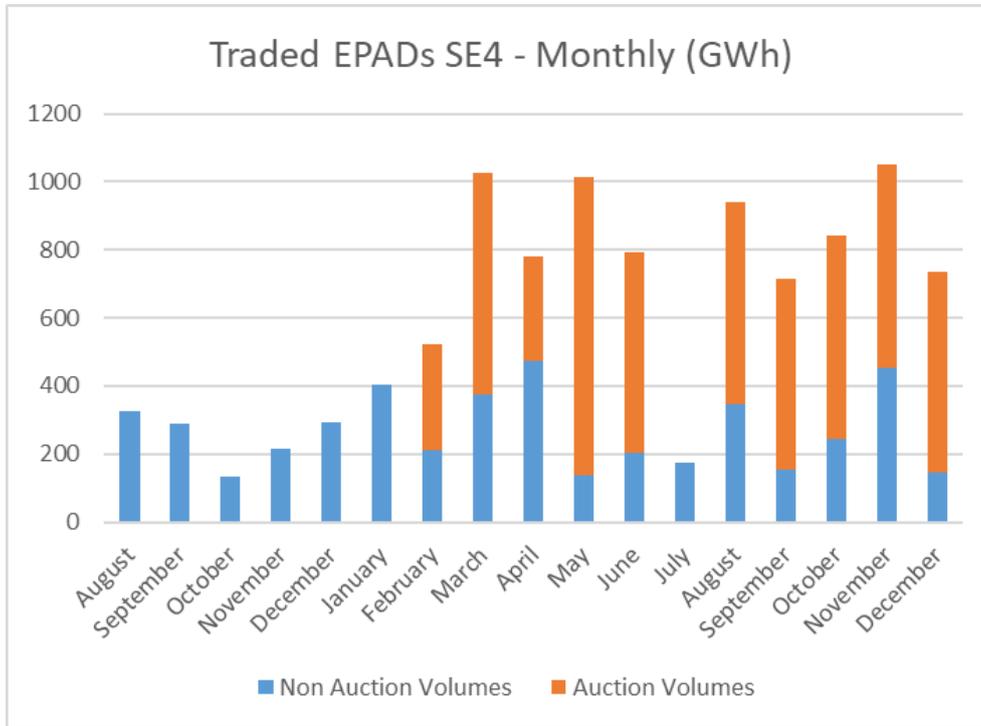
Note that the scale on the y-axis in the figures varies for the different bidding zones and that the turnover in SE3 was significantly higher than for SE2 and SE4.



**Figure 15.** Turnover (GWh) of EPADs for SE3 per month, August 2022 - December 2023.

Regarding SE4, from **Figure 16**, 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.

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%.

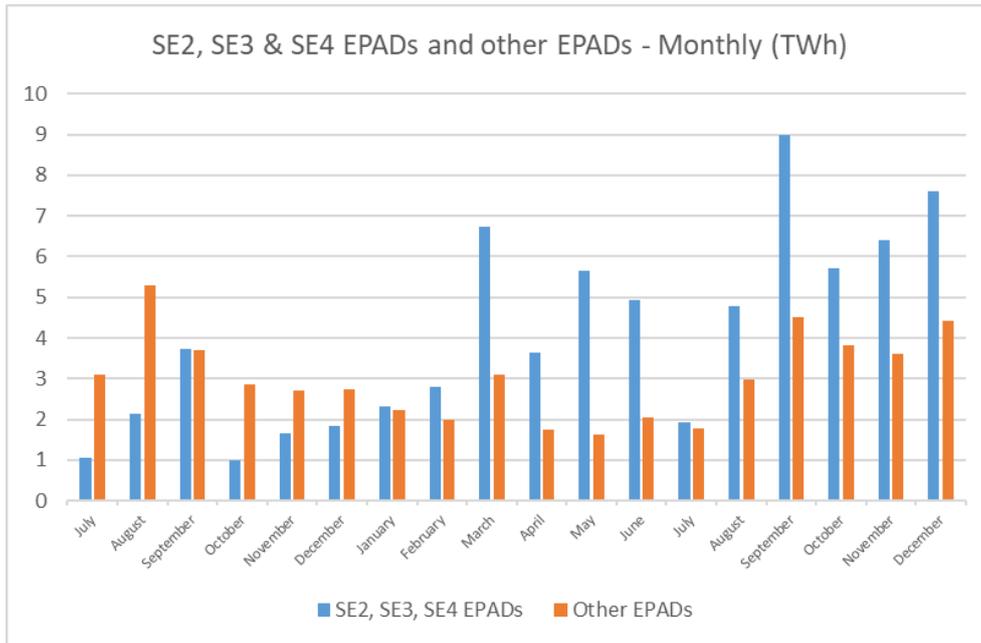


**Figure 16.** Turnover (GWh) of EPADs for SE4 per month, August 2022 - December 2023.

**Figure 17** (below) shows how the total turnover (TWh) in the contracts included in Svenska kraftnät's pilot (SE2, SE3 and SE4) has developed over the past 18 months in relation to other EPAD contracts.

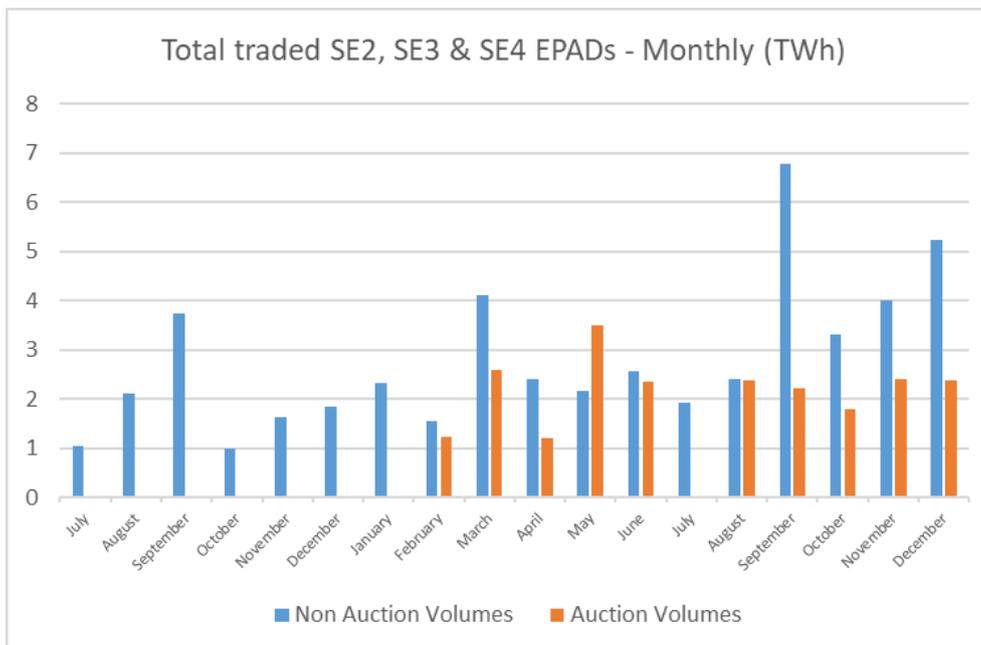
This comparison presents a significant increase in turnover, both in absolute and relative terms, for the bidding zones where EPADs have been auctioned, clearly illustrated via the blue bars.

Since Svenska kraftnät started auctioning EPADs, the contracts included in Svenska kraftnät's pilot have accounted for an average of 65% of total turnover. During the period July 2022 to January 2023, i.e. before the introduction of EPAD auctions, this ratio amounted to 37%.



**Figure 17.** Total trading for SE2, SE3 and SE4 EPADs compared to other EPAD contracts (July 2022 - December 2023).

If the total turnover (TWh) for the contracts included in the pilot is split into continuous trading volumes and auction volumes, **Figure 18** below shows that auction volumes accounted for an average of around 37% of total turnover in the fourth quarter, its share varied between 31% and 42%.

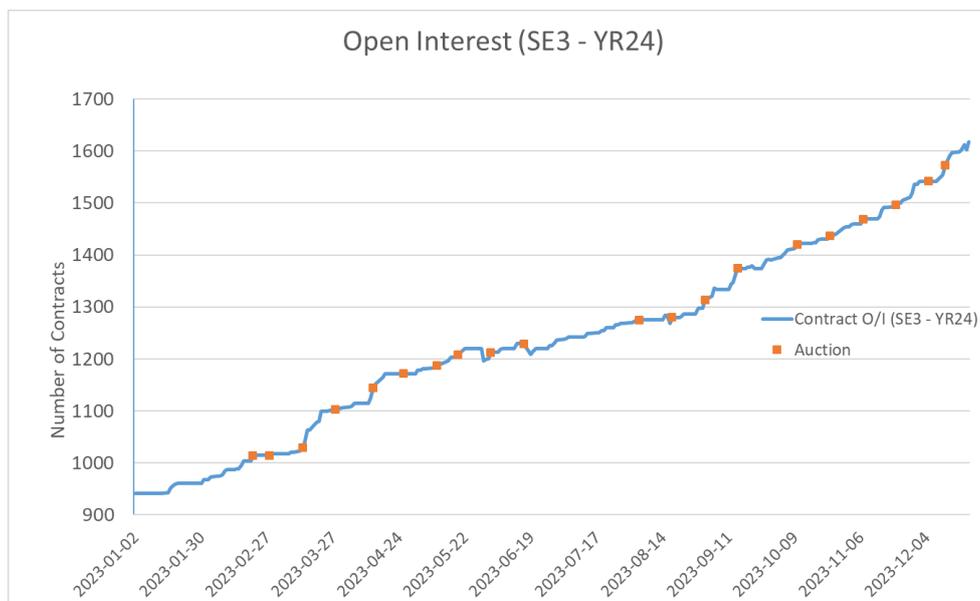


**Figure 18.** Total trading for SE2, SE3 and SE4 split into non auction volumes and auction volumes (July 2022 - December 2023).

## Open Interest

Open interest is often used as an indicator of liquidity and market activity in continuous trading. Open interest is the total number of derivative contracts (e.g. EPAD-futures) held by market participants at the end of the trading day. Open interest is calculated by adding all the contracts from opened trades and subtracting the contracts when a trade is closed by a market participant. Open interest is thus not the same as traded volume, as traded volume increases by both entries and exits while open interest increases by entries and decreases by exits.

**Figure 19** (below) shows the development in the continuous market of the SE3 yearly front contract. The figure illustrates that open positions have increased almost linearly throughout the period. The line in the graph shows the open interest, and the auction dates are plotted with orange marks in the graph.



**Figure 19.** Open interest in SE3 YR-24 EPAD contract (2023).

Open interest is commonly used as an indicator of liquidity and market activity in continuous trading. An assessment of causality between the EPAD auctions and open position will have to wait until future reports. The strength of this metric is that it enables a follow-up of the development in the volumes that are actually hedged.

As mentioned above, Svenska kraftnät does not normally have any open positions in SE3. In addition, Svenska kraftnät only auctioned a limited volume in yearly (YR-24) contracts from February to December in SE3.

# In-depth section

## Svenska kraftnät's own role and exposure

From the figure below, which covers the entire pilot period, it can be seen that the first quarter was characterized by a belief in reduced future bidding zone differences, primarily manifested by gradually decreasing prices for the SE4 contract. Instead, the second and third quarters were characterised by market expectations of relatively stable future differences. During the last quarter, the differences continued to narrow, again predominantly driven by lower prices in the SE4 contract.



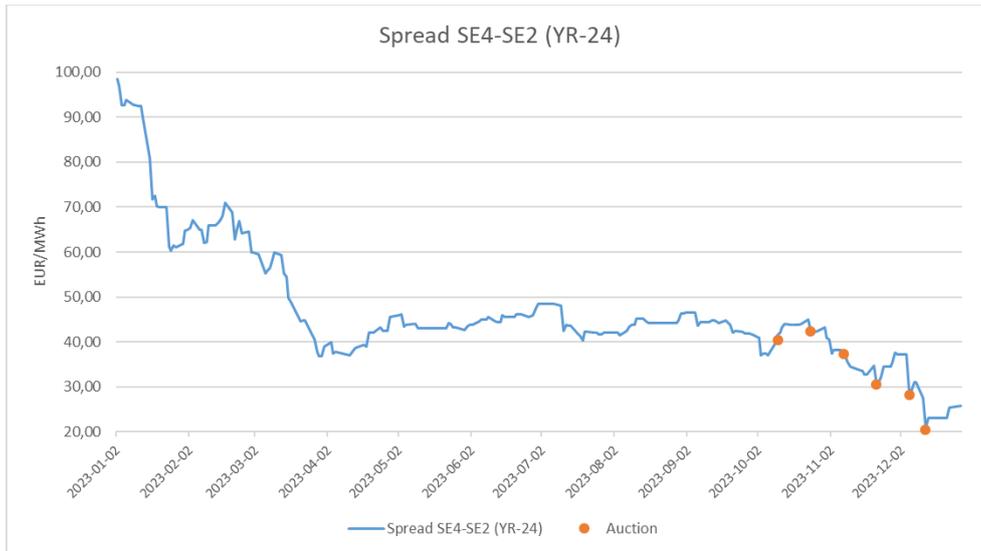
**Figure 20.** Closing prices YR-24 contracts (January–September, 2023).

Svenska kraftnät has the opportunity to offer market participants these trading opportunities via auctions, since congestion income attributable to each bidding zone border constitutes an inherent financial exposure.

Conceptually, the auctions can therefore also be described as Svenska kraftnät partially hedging expected future congestion income generated through price differences between different bidding zones in the day-ahead market.

Normally, Svenska kraftnät buys EPADs in the surplus area SE2 and sells EPADs in the deficit area SE4. The net position after auctions thus means that Svenska kraftnät obtains a long SE2 position (a neutral SE3 position) and a short SE4 position.

**Figure 21** below shows the price difference between SE2 and SE4, this spread gives an indication of the level of hedged congestion income. The locked-in margin for annual contracts decreased during the fourth quarter and averaged around 33 EUR/MWh. In the previous quarter, a higher margin was locked in, where it amounted to about 44 EUR/MWh.



**Figure 21.** Price difference between SE2 and SE4 for YR-24 contracts (2023).

# Conclusions

The purpose of the EPAD pilot is to support market participants by providing transmission capacity in the forward market. By adding trading volumes, the long-term goal is to contribute to increased hedging opportunities and higher liquidity in continuous trading.

This report primarily aims to continue to identify various initial indications, which in the future can be analyzed more thoroughly.

Overall, Svenska kraftnät notes that the auctions have continued to function well and that the high bid-to-cover ratio shows great interest from market participants. The participants in the auctions believe that the auction process, both when auctions results in allocations and when bids do not result in allotment, has worked well.

This report covers less than a year of auctions. Although positive developments can be observed, we still consider it too early to draw any firm conclusions about the effects of the auctions on the overall EPAD-market.

However, one trend that can be discerned is that, in relative terms, the already most liquid bidding zone SE3 seems to have benefited from the auction volumes contribution, while bidding zone SE4 continues to show a very low turnover in continuous trading.

Finally, the auctions are deemed to support increased transparency and better price formation in the EPAD market. In addition, Svenska kraftnät can conclude that the auctions fulfill an important need during a period of continued low market liquidity. Further, Svenska kraftnät's role as a "natural" buyer and seller in the surplus respective deficit areas SE2 and SE4 is also considered to contribute to better opportunities for market participants to manage the underlying structural market asymmetry in Swedish bidding zones.

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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.

Svenska kraftnät  
Box 1200  
172 24 Sundbyberg  
Sturegatan 1

Phone: 010-475 80 00  
Fax: 010-475 89 50  
[www.svk.se](http://www.svk.se)

