BILATERAL HEDGING OF ELECTRICITY IN SWEDEN

Bilateral hedging of electricity in Sweden

Energimarknadsinspektionen

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1 SAMMANFATTNING

På uppdrag av Energimarknadsinspektionen (Ei) har Hagman Energy, Bodecker Partners och DNV undersökt möjligheterna till bilateral prissäkring av el i Sverige. Uppdraget omfattar fyra övergripande frågor.

- Varför och hur hedgar marknadsaktörer bilateralt?

- Hur stor är volymen och omfattningen av bilateral hedging i Sverige?

- Hur mycket kostar det för marknadsaktörerna att hedga sig?

- Vilka kan konsekvenserna bli av den framtida utvecklingen på hedgingmarknaderna?

Syftet med rapporten är att hjälpa Ei i sina bedömningar av om marknadsaktörerna har tillräckliga möjligheter till prissäkring i Sverige.

I denna studie definieras bilateral säkring som säkring av prisrisken med vilket säkringsinstrument som helst utan inblandning av ett clearinghus eller en börs.

Utöver vår egen tidigare kunskap och erfarenhet bygger våra analyser på insamlad information från marknadsaktörer. Vi har skickat ut en enkät till 170 marknadsaktörer och vi har haft djupintervjuer med 20 marknadsaktörer och intressenter.

1.1 Varför och hur marknadsaktörer säkrar bilateralt

Priserna på elmarknaden varierar kraftigt. Detta skapar finansiella risker. Marknadsaktörerna strävar efter att minska – inte eliminera – dessa risker genom prissäkringsavtal så att konsekvenserna av ett visst negativt utfall ändå blir hanterbara. Ett annat viktigt motiv för prissäkring är att möjliggöra lånefinansiering av investeringar i ny elproduktion eller ny elanvändning.

Marknadsaktörerna har olika preferenser och strategier när det gäller vilka risker de säkrar, tidshorisonten för säkringen, vilken typ av instrument de använder och hur de skapar och vidmakthåller sina säkringsportföljer. En portföljstrategi för säkring används ofta av producenter och konsumenter, vilket innebär att företaget gradvis utvecklar sin önskade säkringsnivå genom att använda kontrakt med olika löptider och volymer. Flera marknadsaktörer har strategier som tillåter viss flexibilitet när det gäller hur stor del av den underliggande risken som säkras vid varje given tidpunkt. Det är viktigt att uppmärksamma att prissäkringsavtal kan skapa nya risker. Följaktligen är en riskpolicy ofta ganska detaljerad.

Marknaden för prissäkring har likheter med andra marknader. Många marknadsaktörer är köpare av säkringsavtal medan andra har specialiserat sig på att erbjuda säkringsarrangemang. Marknadsaktörer som inte har avtal med ett clearinghus är aktiva på vad som väsentligen är en slutkundsmarknad för prissäkring. De söker normalt säkringsavtal från en eller ett fåtal föredragna prissäkringsleverantörer. De senare säkrar sig själva via kraftbörsen eller med andra stora prissäkringsleverantörer såsom stora kraftproducenter och tradingbolag, på vad vi kan kalla en grossistmarknad för prissäkring. Ofta används någon plattform för registrering av ingångna prissäkringsavtal. Den svenska plattformen NetMW har 1350 användare, främst i Sverige. De flesta av dessa är marknadsaktörer som köper säkringslösningar från en eller två föredragna säkringsleverantörer. Enbart denna plattform registrerade 85 TWh handel under de senaste 12 månaderna.

Ett vanligt tillvägagångssätt för prissäkringsköpare är att ha någon form av dynamisk upphandling, ofta baserad på baslastkontrakt med varierande volym per månad och ofta avräknade i SEK. Dessa kontrakt är i grunden ganska lika de kontrakt som handlas på elbörsen, men kan inte clearas på grund av bland annat profileringen och/eller valutan.

Ett annat marknadssegment är kraftköpsavtal (PPA), som förekommer i olika former. De vanligaste är baslastavtal och avtal där volymen varierar utifrån vad som producerats (pay-as-produced). Både fysisk och finansiell avräkning av PPA-avtal är vanligt förekommande. PPA-priserna är vanligtvis förankrade i avtalsparternas uppfattning om det långsiktiga

priset, justerat för att återspegla nuvarande och framtida prisutveckling, profilrisk, volymrisk, värdet av ursprungsgarantier (GoO), etc. För närvarande finns det ett prisgap i flera elområden på minst 10-15 EUR/MWh mellan det minimipris som krävs av utvecklare av nya vind- och solkraftsparker och det maximipris som fortfarande gör vätgas eller P2X i allmänhet lönsamt. Det finns inte många marknadsaktörer som är villiga att ta på sig risker utan att ta ut mycket höga premier för att täcka volym- och profilrisker. Marknadsaktörer med låg kapitalisering kämpar extra hårt för att slutföra affärer på grund av kreditrisker (motpartsrisker).

1.2 Volym och omfattning av säkringar

Vår enkät och våra intervjuer visar på förvånansvärt små förändringar i Sverige av den volymandel som prissäkrats under de senaste fem åren. Ökad volatilitet har skapat ett uppåtriktat tryck på kostnaderna för säkring, främst relaterade till säkerhetsställande och spreadkostnader. Samtidigt har den ökade volatiliteten också ökat behovet av prissäkring.

De ökade kostnaderna för säkerhetsställande har fått vissa deltagare att lämna clearade positioner och övergå till bilaterala arrangemang med aktörer som inte kräver säkerhetsställande. Flera av anstränger sig dock för att cleara så mycket som möjligt av sin handel för att bidra till pristransparens.

På aggregerad nivå följer tidsstrukturen för säkring det klassiska mönstret, med högre säkringsandelar närmare leveranstidpunkten. Det finns dock betydande individuella skillnader. Vissa vindparksutvecklare säkrar så mycket som möjligt under nästan så lång tid som möjligt, medan andra inte säkrar alls. Detta avspeglar helt olika finansieringsmodeller och även helt olika typer av ägare och investerare. Vi kan se en liknande variation på konsumtionssidan, där nya typer av elintensiv industri ofta organiseras i bolag med begränsat eget kapital. En hög grad av skuldfinansiering innebär typiskt sett höga säkringsandelar med lång löptid. Väletablerade industrier har ofta kortare säkringshorisonter och lägre säkringsandelar.

I de enkätsvar vi erhållit avseende slutet av 2023 varierar säkringsgraden för produktion mellan 0 och 100 procent, med ett genomsnitt på 45 procent för de närmaste 12 månaderna. Den genomsnittliga säkringsgraden sjunker sedan till en tredjedel för nästa år. För löptider på 10 år eller mer var den genomsnittliga säkringsandelen 23 procent. För konsumtion var den lägsta säkringsgraden för de närmaste 12 månaderna i de enkätsvar vi erhållit 23 procent, genomsnittet var 71 procent och den högsta var 100 procent. Den genomsnittliga säkringsandelen minskadeer till 33 procent för löptider upp till 10 år.

Vi finner få belägg för att det finns en betydande besvikelse över de nuvarande prissäkringsmöjligheterna. Några marknadsaktörer skulle prissäkrat mer om prissäkringskostnaderna varit lägre än vad kostnaderna varit under senare år. Emellertid verkar marknadsaktörerna förstå och acceptera att hög osäkerhet leder till höga prissäkringskostnader och att större ansträngningar därför måste göras för att säkerställa rimliga prissäkringsandelar. Ändå skulle allt offentligt stöd för att underlätta prissäkring naturligtvis uppskattas av marknadsaktörerna - i synnerhet om detta görs på ett sådant sätt att det också bidrar till pristransparens och prisbildning.

1.3 Prissäkringskostnader

Kostnaden för prissäkring via en elbörs och ett clearinghus följer offentligt tillgängliga avgifter och villkor. Medan volymavgifterna är mer eller mindre obetydliga, är det säkerheterna och den potentiella spreadkostnaden som skapar betydande kostnader. Spreadkostnaden kan beskrivas som skillnaden mellan det senast publicerade stängningspriset och det aktuella pris som erbjuds. Det bör observeras att spreadkostnaden är normalt mindre än skillnaden mellan bästa köp- och säljbud (bid-ask spread). Den faktiska prissäkringskostnaden är mycket känslig för antaganden om bid-ask spread och motsvarande spreadkostnader samt om säkerhetens storlek och kostnad för säkerhetsställande. Säkerhetens storlek är i huvudsak en funktion av marknadsvolatiliteten och korrelationen mellan priser, medan

kostnaden för kontanter för säkerhetsställande beror på skillnaden mellan WACC för marknadsaktören och den kortfristiga ränta som erhålls vid ställande av säkerheten.

Bilaterala säkringskostnader är olika. Det finns inga medlemsavgifter till börs eller clearinghus. Det kan finnas en mäklaravgift som kan vara jämförbar med volymbaserade börs- och clearingavgifter. Men spreadkostnaderna kan vara betydligt större, eller ibland lägre, än i det börsbaserade alternativet. De som erbjuder bilateral prissäkring tenderar att inkludera kostnader för säkerheter på sin sida som en extra del av spreadkostnaden. Dessutom är bud-ask-spreaden normalt större på den bilaterala marknaden än på den börsbaserade marknaden. Det är vanligt att säkerheter inte behöver ställas vid bilateral prissäkring när parterna har förtroende för varandras betalningsförmåga. Beroende på det aktuella fallet kan en bilateral transaktion således ha högre eller lägre kostnader jämfört med en liknande transaktion som görs via elbörsen.

1.4 Konsekvenser av framtida utveckling

EEX och Nasdaq meddelade i juni 2023 att de har nått ett avtal enligt vilket EEX kommer att förvärva Nasdaqs europeiska verksamhet i fråga om kraftkontrakt. Om detta genomförs kommer det sannolikt att medföra förändringar för nordiska marknadsaktörer i tillgången till clearing. EEX:s clearingmodell bygger på att finansiella institutioner är clearingmedlemmar. Andra marknadsaktörer kan registrera sig som icke-clearingmedlem på EEX-börsen om de har ett avtal med en finansiell institution som är clearingmedlem. Detta innebär att marknadsaktörer möter såväl förhandlade bankavgifter med en clearingmedlem som dennes börs- och clearingavgifter. Vi förväntar oss att ett betydande antal av de nuvarande deltagarna på Nasdaq inte kommer att ingå avtal med en clearingmedlem på EEX clearinghus. Om så är fallet kan detta ge en ytterligare ökning för den bilaterala handeln och en fortsatt övergång till en mindre transparent marknad.

En annan förändring som är EEX introduktion av zonkontrakt (separata områdespriskontrakt för varje budzon) för att ersätta EPAD-kontrakt i kombination med systempriskontrakt. De flesta aktörer är oroliga för att likviditeten i zonkontrakt inte kommer att vara bättre än likviditeten i EPAD-kontrakt och att zonkontrakt kommer att späda ut likviditeten i systempriskontrakt. De är också oroliga för att denna utspädning av systemprislikviditeten kommer att göra systemprishandel mindre attraktiv för spekulativa handlare och orsaka en ytterligare minskning av likviditeten. Vissa aktörer ser en risk för att bid-ask-spreaden i zonkontrakt kommer att bli ännu värre än bid-ask-spreaden i EPAD-kontrakt.

EU:s nyligen genomförda reform av elmarknaden innehåller flera inslag som rör finansiella elmarknader och möjligheter till prissäkring. Kommissionen ska bl. a. göra en konsekvensanalys av möjliga åtgärder för att förbättra marknadsaktörernas möjligheter till prissäkring på den inre elmarknaden. De kommande två åren kommer sannolikt att vara mycket viktiga för den framtida utvecklingen på marknaderna för prissäkring.

Kraftköpsavtal (PPA) ses i elmarknadsreformen som ett viktigt verktyg för att förbättra investeringsincitamenten för att uppnå unionens mål om minskade koldioxidutsläpp. Vi tolkar elmarknadsreformen som ett stöd till PPA-marknaden som sådan, samtidigt som man förstår att det finns en risk för att andra mål, såsom en välfungerande terminsmarknad, kan äventyras. Balansen mellan de motstridiga målen definieras inte i förordningen. Uppgiften att finna en balans överförs i stället till kommissionen och medlemsstaterna.

Vi uppfattar fokuseringen på kontrakt för skillnader (CfD) som ett försök att harmonisera det offentliga stödet till ny elproduktion. CfD-kontrakt med staten kan lösa den finansiella utmaningen och prissäkringsutmaningen för investerare i ny produktion. Ett garanterat pris för varje producerad MWh kommer dock att snedvrida den fysiska marknaden under timmar med negativa priser. CfD-kontrakt kommer också att minska deltagandet på den finansiella elmarknaden, eftersom en del av efterfrågan på prissäkring effektivt tas bort från marknaden. Det kan också skapa en särskild utmaning för elanvändare som behöver PPA innefattande ny förnybar kraft, t.ex. för certifiering av produktion av förnybara bränslen. Om det statliga stödet istället ges som ett investeringsbidrag eller som en kreditgaranti är

incitamenten för en anläggningsägare att prissäkra på terminsmarknaden eller att ingå en PPA ungefär desamma som idag.

1.5 Avslutande reflektioner

Sammanfattningsvis kan vi konstatera att den bilaterala marknadens hälsa är starkt beroende av en likvid och transparent marknad för handel i börsnoterade kontrakt. Svenska kraftnäts EPAD-auktioner har skapat förankringspunkter för bilaterala EPAD-förhandlingar. "Värdet" av auktionerna är inte så mycket de faktiska transaktionerna, utan pristransparensen och den garanterade möjligheten att genomföra en handel.

Det finns för närvarande en obalans mellan köpares och säljares önskemål på PPA-marknaden. Det är nu mycket svårt att utveckla tillräckliga prissäkringsmöjligheter med effektiva produkter för dessa olika företag. Det ska kanske inte vara statens uppgift att säkra en sådan prissäkring för verkligt långsiktiga risker. Marknaderna och marknadsaktörerna måste arbeta med affärsmodeller och affärsstrategier för att hitta en jämvikt. Flexibilitet, lagring, stödtjänster och andra ytterligare intäktsströmmar, riskdelningskontrakt och andra instrument och strukturer för att addera potentiella "win-win" delade intäktsströmmar kommer att vara avgörande. Emellertid kan statliga investeringsstöd och/eller kreditgarantier reducera kreditrisker och långsiktiga risker som hinder på PPA-marknaden.

2 EXECUTIVE SUMMARY

On assignment from Energimarknadsinspektionen (Ei), Hagman Energy and Bodecker Partners, and DNV have investigated bilateral hedging opportunities for electricity in Sweden. The assignment covers four overarching questions.

- Why and how do market participants hedge bilaterally?

- What is the volume and magnitude of bilateral hedging in Sweden?

- How much does it cost for market participants to hedge?

- What can be the consequences of future developments on the hedging markets?

The objective of the report is to aid Ei in its assessments of whether market participants have sufficient hedging opportunities in Sweden.

For the purposes of this study, bilateral hedging is defined as hedging of the price risk with any hedging instrument without the involvement of the clearing house or an exchange.

In addition to our own earlier knowledge and experience, our analyses rely on collected information from market participants. We sent a questionnaire to 170 market participants, and we have had in-depth interviews with 20 market participants and stakeholders.

2.1 Why and how market participants hedge bilaterally

The day-ahead prices of electricity are volatile. Future price volatility implies financial risks. Market participants aim to reduce – not to eliminate – these risks by entering into hedging agreements, such that they are confident that the consequences of defined negative outcomes still will be manageable. Another important motivation is to make asset investments in new production or consumption bankable.

Market participants have different risk preferences, in terms of which risks they hedge, the time horizon for the hedge, the type of instruments they use, and how they create and maintain their hedge portfolios. A portfolio strategy for hedging is often used by producers and consumers meaning that the company gradually develops its wanted level of hedging by using contracts with different maturities and volumes. Several market participants have strategies that allow for some flexibility with respect to how much of the underlying risk is hedged at any given point in time. Hedging can create new risks. Consequently, a risk policy is often quite detailed.

Most market participants in Sweden have chosen not to become an exchange member or a clearing client and are thus without access to the clearing house. There are varying reasons for this choice. Fixed membership fees can be significant for participants with smaller hedging volumes. Collateral costs are avoided in bilateral trades if the counterparty does not demand collateral. Daily settlement with the clearing house is administrative demanding. Back-office routines are simplified if a hedge provider produces needed reports. Many small and medium actors find that it is not convenient or efficient to follow the market on a continuous basis.

The market for hedging has similarities with other markets. Many participants are buyers of hedge agreements while others have specialised in offering hedge arrangements. Market participants without access to the clearing house are active in what is essentially a retail market for hedging arrangements. They typically seek hedging agreements from one or a few preferred hedge providers. The hedge providers hedge themselves via the power exchange or with other hedge providers and with large power producers, in what we can call a wholesale market for hedging solutions. Hedge providers often use a trade registration platform. The Swedish platform NetMW has 1350 users. Most of these are end users buying hedge solutions from one or two preferred hedge providers. This platform alone registered 85 TWh trade over the last 12 months.

A common approach by hedge buyers is to have some sort of dynamic procurement, often based on baseload contracts with varying volume per month and often settled in SEK. These contracts are essentially quite similar to the contracts traded at the power exchange but cannot be cleared due to i.a. the profiling and/or the currency.

Another market segment is power purchase agreements (PPAs), which comes in various forms. The most common are baseload and pay-as-produced. Both physical and financial settlement are common. PPA prices are typically anchored in the contracting parties' perception of long-term price, capture rates and profile risk, volume risk, value of Guarantees of Origin (GoOs), etc. Currently, there is a price gap in several bidding zones of at least 10 to 15 EUR/MWh between minimum price required by developers of new wind and solar parks and maximum price that still make hydrogen or P2X in general profitable. There are not many market participants willing to take on risks without charging very high premiums to cover volume and profile risks. Market participants with thin capitalisation struggle extra hard to close deals because of credit (counterparty) risks.

2.2 Volume and magnitude of hedging

Our survey and interviews show surprisingly small changes in hedging ratios in Sweden over the past five years. Increased volatility has created an upward pressure on cost of hedging, primarily related to collateral and spread costs. At the same time, increased volatility has also increased the need of hedging.

The increased cost of collateral has triggered some participants to leave cleared positions and instead use bilateral arrangements. Nevertheless, several make an effort to clear much of their trading at the clearing house in order to contribute to price transparency.

On an aggregate level, the time structure of hedging is following the classical pattern, with higher hedge ratios closer to delivery time. However, there are significant individual differences. Some wind farm developers hedge as much as possible for almost as long as possible, while others do not hedge at all. This reflects quite different financing models and also quite different types of owners and investors. We can see a similar variation on the consumption side, where in particular new types of industrial electricity demand often is organised in companies with limited equity. A high degree of debt financing will typically mean high hedge ratios with a long tenure. Well established industries often have shorter hedge horizons and lower hedge ratios.

In the replies to our survey, the hedge ratios for production varied at year-end 2023 between 0 and 100 percent, with an average of 45 percent for the nearest 12 months. The average hedge ratio dropped to a third for the next year. For tenures of 10 years or more, the average hedge ratio was 23 percent. For consumption, the minimum hedge ratio for the nearest 12 months was 23 percent, the average was 71 percent, and the maximum was 100 percent. The average ratio declined to 33 percent for tenures up to 10 years.

We find little evidence for significant disappointment with current hedging opportunities. Some participants would have hedged more, if hedging costs (broadly speaking, including spreads, liquidity, and availability) were lower than what we have seen during the latest years. However, market participants seem to understand and accept that high uncertainty trigger high hedging costs and thus that larger efforts must be made to ensure reasonable hedge ratios. Still, any public supporting in easing hedge arrangements would of course be appreciated by market participants – in particular if this is done such that it also helps price transparency and price discovery.

2.3 Cost of hedging

The cost of hedging via a power exchange and clearing house follows publicly available prices and conditions. Fixed costs can be significant for participants with low hedging volumes. While the volumetric fees are of less importance, it is the collateral and the potential spread cost that create significant costs. The spread cost can be described as the

difference between the most recently published closing market prices and the actual price offered to the market participant. The spread cost is normally lower than the bid-ask spread, which can be defined as the difference between the best buy and the best sell prices in the market. The actual hedge cost is thus highly sensitive to assumptions about bid-ask spread and about size and cost of the collateral. The size of collateral is essentially a function of the market volatility and correlation between prices, while the cost of cash to fulfil the collateral depends on the spread between the WACC for the market participant and the short-term interest rate received for pledged collateral.

Bilateral hedging costs are somewhat different. There are no explicit exchange or clearing fees. There might be a brokerage fee that could be comparable to the volumetric exchange and clearing fees. But the spread costs can be significantly larger, or sometimes lower, than in the exchange-based alternative. Hedge providers tend to include induced costs of collateral on their side as an extra element of the spread cost towards the hedge buyer. In addition, the bid-ask spread is normally larger in the bilateral market than in the exchange-based market. It is usual that no collateral have to be pledged when the hedge buyer and hedge provider have mutual trust in the ability to pay the other. Depending on the actual case, a bilateral transaction could thus have higher or lower total costs, as compared to a similar transaction made via the power exchange.

2.4 Consequences of future developments

EEX and Nasdaq announced in June 2023 that they have reached an agreement under which EEX will acquire Nasdaq's power business in Europe. If completed, this is likely to bring changes in access to the clearing house in the Nordic market. EEX's clearing model relies on financial institutions as clearing members. Other market participants can register as a Non-Clearing Member if they have an agreement with a financial institution with membership. This implies that market participants essentially face negotiated bank fees to the clearing member in addition to the member's exchange and clearing fees. We expect that a significant number of the current Nasdaq participants will not enter into an agreement with a clearing member at EEX clearing house. If so, this can further increase bilateral trade and a further shift to less transparent hedging practices.

Another change is EEX introduction of zonal futures in order to replace EPADs in combination with system price contracts. Most participants are worried that the liquidity in zonal contracts will not be better than the liquidity in EPAD contracts and that zonal contracts will dilute the liquidity in system price contracts. They are also worried that this dilution of system price liquidity will make system price trading less attractive for speculative traders and cause a further reduction of liquidity. Some participants see a risk that the bid-ask spread in zonal contracts will be even worse than the bid-ask spread in EPADs.

The recent EU reform of the electricity market include several elements related to forward markets and hedging opportunities. The Commission is required to prepare an impact assessment of possible measures to improve the ability of market participants to hedge price risks in the internal electricity market. The coming two years will likely be very important for future developments on the hedging markets.

PPAs are recognised in the reform as an important tool to improve investment incentives to achieve the Union's decarbonisation objectives. We interpret the Electricity regulation as support to the PPA market as such, while at the same time understanding that there is a risk that other objectives such as a well-functioning forward market may be jeopardized. The balance between the conflicting objectives is not defined in the regulation. The task to find a balance is instead transferred to the Commission and the Member States.

We understand the focus on contracts for differences (CfDs) as an effort to harmonise public support to new electricity generation. CfDs with a state might solve the financial and hedging challenge for investors in new production. However, a guaranteed price for every MWh produced will distort the physical market in hours with negative prices. CfDs will also reduce participation in the hedging market, as some hedge demand is effectively taken out of the market. It might also create a particular challenge for end users needing PPAs with new renewable power, e.g., for the purpose of

certification of production of renewable fuels. If state support is instead provided as an investment grant or as a credit guarantee, the incentives for a plant owner to hedge in the forward market, or to contract a PPA, are approximately the same as today.

2.5 Final reflections

To summarize, we find that the health of the bilateral market strongly depends on a liquid and transparent market in exchange-listed contracts. Svenska kraftnät's EPAD auctions have created anchoring points for bilateral EPAD negotiations. The 'value' of the auctions is not so much the actual transactions, but the price transparency and the guaranteed possibility to make a trade.

There is currently a mismatch between bids and asks in the PPA market. It is now very hard to develop sufficient hedging opportunities with efficient products for these types of companies. Maybe it should not be the State's duty to ensure such a development regarding hedging opportunities for truly long-term risks. Markets and market participants need to work on business models and business strategies to find an equilibrium. Flexibility, storage, ancillary services and other additional revenue streams, risk sharing contracts, and other instruments and structures to add potential "win-win" shared revenue streams will be key. However, public investment grants and/or credit guarantees, or similar instruments can reduce credit risks and long-term risks as barriers in the PPA market.

3 OBJECTIVE AND APPROACH FOR THIS PROJECT

National regulatory authorities are according to Article 30 in the Guideline on Forward Capacity Allocation (FCA GL)[1] obliged to – at least every four years – assess the forward market and decide on whether it provides sufficient hedging opportunities for the market participants.

Energimarknadsinspektionen (Ei) has access to information regarding financial instruments cleared by the clearing house of an exchange. This information covers both all instruments traded directly on the exchange and instruments traded bilaterally but reported for clearing at the clearing house.

To be able to assess the full range of hedging opportunities, Ei needs information also about bilateral hedging of electricity in Sweden. Bilateral hedging is here defined as hedging of the price risk with any hedging instrument without the involvement of the clearing house or an exchange.

Ei has assigned DNV to prepare a report which investigates and describes how and to what extent Swedish market participants hedge bilaterally. The assignment covers four overarching questions.

- Why and how do market participants hedge bilaterally?

- What is the volume and magnitude of bilateral hedging in Sweden?

- How much does it cost for market participants to hedge?

- What can be the consequences of future developments on the hedging markets?

The objective of the report is to aid Ei in its assessments of whether market participants have sufficient hedging opportunities in Sweden.

DNV has joined forces with Hagman Energy and Bodecker Partners to perform the project. The project team has been Jørgen Bjørndalen (project leader), Björn Hagman, Mia Bodin, Fredrik Bodecker and Ine Solsvik Vågane.

We have structured our project work – and our report – according to the four overarching questions. We will for each overarching question examine the sub questions specified by Ei. In the final section we discuss possible measures to improve hedging opportunities.

In addition to our own earlier knowledge and experience, our analyses have to a large extent relied on collected information from market participants. We sent a questionnaire to 170 market participants in order to get information regarding the second overarching question. We have performed in-depth interviews with 20 market participants and stakeholders in order to get information regarding the three other overarching questions.

We have collected information from end-users, retailers, and generators. We have also collected information from portfolio managers and trading companies offering hedging solutions. In addition, we have made in-depth interviews with a bank, a broker and a platform provider.

Besides ‘traditional’ end-users, we have collected information from ‘new’ end-users such as battery, hydrogen, and PtX companies with factories under construction or in advanced planning stage.

For sales to end users, we have reached out to both retailers integrated in traditional utilities as well as independent retailers and suppliers, as these are likely to pursue quite different hedging strategies.

Within power production we have addressed wind and solar power parks, both in operation and under planning or construction, generators with CHP plants and traditional producers with hydropower and/or nuclear plants.

[1] Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation.

Companies within the well-established sectors have often already been in active operation for years, if not for decades. Within the new segments, the key information sources are typically project developers, investors, and owners, yet to establish the planned operation and hence the planned energy consumption (or production).

We have aimed for a fair distribution of respondents across the four Swedish bidding zones.

4 WHY AND HOW MARKET PARTICIPANTS HEDGE BILATERALLY

4.1 Drivers to hedge

The day-ahead prices of electricity are volatile. Future price volatility implies a financial risk for the market participants. The risk for a consumer is future higher prices and the risk for a producer is future lower prices. An agreement to reduce the financial risk by a fixed price for a certain volume during a certain time is a hedge agreement. An important driver to hedge is to get the level of certainty for future energy costs or revenue that a market participant desire. The risk appetite (the willingness to be exposed to volatile short-term prices vs. hedging future costs or revenues) is often influenced by, for example, ownership structure, financing structure (equity/debt financing), lengths of final offtake contracts, etc. For example, a wind-or solar park, or a new industrial company in need of debt financing, are often required to hedge power price exposure in order to secure sufficient financing.

A portfolio strategy for hedging is often used by producers and consumers meaning that the company gradually develops its wanted level of hedging by using contracts with different maturities and volumes. A portfolio hedging strategy prescribes intervals for percentage of the volume to be hedged at different times before the delivery period. Such a strategy can be mechanical (the timing of the hedging transactions is not dependent on price expectations) or dynamic (the timing of the hedging transactions is to some extent dependent on price expectations). A dynamic hedging strategy can also allow selling of acquired contracts as long as the remaining hedge is not lower than the minimum allowed hedge. Dynamic hedging can thus include some speculative trading elements. dependent on price expectations.

A possible dynamic portfolio strategy for hedging is illustrated in Figure 4-1 below. Whether the hedging starts years or months before delivery depends on risk analyses and relevant transaction and hedging costs.

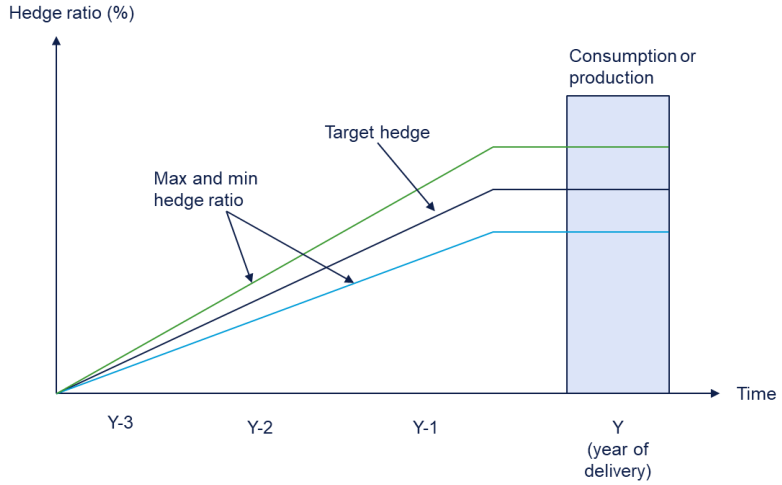

Figure 4-1 Illustration of a dynamic portfolio strategy for hedging

The main instrument for hedging on the Nordic forward market is system price contracts. The Nordic system price is a virtual reference price for the day-ahead market, calculated by using all the buy and sell orders to the Singel Day-Ahead market Coupling (SDAC) to all NEMOs for Norway, Sweden, Denmark and Finland under the assumption that there are no bottlenecks between the Nordic bidding zones. The **system price risk** can be hedged by system price contracts. Exchange-based system price contracts are baseload contracts, i.e. the same volume during each hour of the contract period. Hedging by means of system price contract has for a long time been seen as sufficient by many market participants. However, more and more participants now consider such hedging as insufficient because of increased differences between bidding zone prices and the system price.

Area price risks can be hedged by Electricity Price Area Differentials (EPADs). An EPAD contract is settled against the difference between the system price and a specific bidding zone price. A combination of system price contracts and EPAD contracts can hedge both system price risks and area price risks. An alternative for the Nordic bidding zones is now zonal contracts launched by EEX in March 2024. We will in section 6.1.2 compare zonal contracts with system price contracts combined with EPADs.

There are also **profile risks** related to a different realized consumption or production profile than the baseload profile in exchange-based contracts. Profile risks can be hedged if bilateral pay-as-consumed or pay-as-produced contracts are possible, and someone is willing to overtake this risk.

The difference between forecasted (and potentially hedged) volumes and actual production or consumption over a period (e.g., a month or a year) creates **volume risks.** Observed volume variations of 30 percent from year to year is not uncommon for a wind park. There are innovative bilateral PPA-structures with fixed or smoothened payout independent of productions volumes. However, at some point in time, the difference between actually produced volume and paid-for volume always needs to be settled though. The cost for these has so far been high.

Profile and volume risks can also be (partially) hedged by means of weather-related hedge products. These are often structured contracts that are settled based on actual measured weather conditions such as wind or temperature (at pre-agreed measuring stations) combined with settled power spot prices during that same period. Such contracts can be structured in different ways but are nowadays not common.

It is important for a market participant to be aware that the use of hedging instruments can also generate new risks.

Exchange-based system price contracts and EPAD contracts are in euro. A market participant can hedge the c**urrency risk** by a separate currency hedge or by bilateral contracts in SEK instead of exchange-based contracts in euro.

It is crucial that the other party in a hedge transaction will fulfil its part of the deal. **Counterparty risk** refers to the risk that the other party will default on its contractual obligations in the transaction. When a contract is cleared, the clearing house will be the counterparty to both the buyer and the seller. For non-cleared contracts, the counterparty risk remains with the other party in the transaction.

Collaterals are demanded by clearing houses and can also be demanded in bilateral contracts. Price changes can give rise to position losses. In addition, there are margin requirements to cover possible price changes. The high price volatility since 2021 has in periods increased the margin requirements drastically. Many market participants have experienced a very substantial **liquidity risk** that their liquidity (of cash or similar) will not be sufficient to timely cover the daily changes in collateral demand and that their hedging position as a result will be closed.

There are also legal risks and administrative risks that must be observed. **Legal risks** refer to the risk that the contract has not exactly the same contractual rights and obligations as was believed by the actor(s) when the contract was agreed upon. Legal risks are generally lower with standardised contracts, but are not fully eliminated by clearing.. **Administrative risks** refer to the risk that the market participant will miss e.g. some of the administrative requirements of a contract or some of the reporting activities that are required by authorities.

It is also important to be aware that a hedge contract is only for a certain period. If all the hedge expires at one point of time, the market participant will be fully unhedged when the hedge expires.

Finally, it shall be observed that perfect hedges that transfer all risks are often not sought. The ‘insurance premium’ will often be too high if all risks are to be transferred. The challenge for a market participant is therefore to find an acceptable level of risk at acceptable costs. An effective risk management requires that the hedging strategy is based on risk analyses, analyses of possible hedging instruments and correlation analyses.

4.2 Market participants without access to the clearing house

Contracts traded at an exchange must be cleared at the clearing house. Most market participants have no access to the clearing house. They have not a membership agreement or a clearing agreement with a Direct Clearing Agent or a General Clearing Member.

A market participant without access to the clearing house can neither trade at the exchange nor enter into a contract that is reported for clearing at the clearing house. Its hedging arrangements have therefore to be performed bilaterally – without clearing.

The possible ways to hedge thus differ between different categories of market participants. In this subchapter, we explain the variety of contractual arrangements for participants without access to a clearing house.

Fixed-price contracts with a retailer regarding all the volume consumed or produced is an easy way to hedge for households and enterprises. It gives a perfect hedge for all the consumed or produced volume during the contract period. However, the household or enterprise is completely unhedged after the expiry date of the agreement. Another drawback is that the hedge is performed at one point in time instead of a gradual build-up.

Fixed-price contracts based on a price formula are possible to negotiate with many larger retailers – at least for more significant consumption or production. The price formula can e.g. reflect the average forward price for the delivery year during one or two years before. Such a contract means a gradual build-up during one or two years before the delivery year and results in a long-term relation with the retailer.

The main advantage for the enterprise with such a price formula is that it gets a hedge that corresponds to what is possible with a gradual build-up of a position without needing to be active in the market. Another advantage is that the hedge is applied for all its consumption or production – not only a fixed baseload volume. The advantage for the retailer is that it gets a negotiated surcharge and a long-term relation with the enterprise.

An enterprise wanting to be more active or flexible in its hedging decisions and accepting profile risks can make a deal with its retailer that the retailer shall enter into **financial baseload contracts** upon request from the enterprise.

In one variant, the contract with the retailer is not formally a financial contract. Instead, the contract is **settled in the physical delivery** during the contract period. This has the advantage for the enterprise that there is no settlement (i.e., no payments) before the physical delivery.

Another variant is that the **financial contracts** are **settled separately from the physical delivery**. This enables the enterprise to deal with also other market participants than its selected retailer.[2] The enterprise has in this variant more flexibility in its selection of financial counterparties and also reduced complexity if the enterprise wants to change retailer.

These financial contracts with financial settlement cannot be cleared with the clearing house since the enterprise has no access to the clearing house. However, these contracts are often very **similar to contracts traded at the exchange**. One difference is frequently that there is monthly settlement instead of daily settlement. Many contracts are without margin requirements if the contract parties trust each other. Contracts can be in SEK instead of EUR. Contracts can also be in tenths of a MW while the granularity in exchange traded contracts is a whole MW.

A bilateral year contract or a quarter contract can have a monthly profile to reflect monthly variations in the consumption or production profile. Other **tailor-made financial contracts** to reduce profile risks exist but are not commonly used. Contracts to reduce profile risks are more often parts of physical delivery contracts.

Our interviews indicate that one group of market participants have a **framework agreement** with only one counterparty regarding financial contracts. Their counterparty is often their retailer. The advantage is administrative simplicity with all

[2] The key point here is that the retailer normally is also the balance responsible party (BRP) for the consumption (and/or production) of its customers. Physical deliveries from other than the selected retailer would unnecessarily complicate the settlement of the BRPs in the wholesale market.

needed reporting provided by the counterparty. This choice typically reflects that searching for the very best deal at any moment in time is time-consuming and not a natural activity for an enterprise for which energy after all is a limited cost-factor. These arrangements will typically continue as long as the customers estimate that their surcharges are reasonable in relation to market prices.

Another group of market participants have framework agreements with about three counterparties. They appreciate the possibility to compare offers and choose the most advantageous.

A third group have framework agreements with several counterparties. These companies have often larger hedging volumes and values the increased competition between their counterparties.

Retailers have no need to hedge variable price contracts with their customers, as these contracts don't create any (significant) price risks for the retailers. They need only to hedge their fixed-price contracts. In April 2024, only a fourth of the total number of retail customers have fixed-price contracts.[3] This share is much lower than the share one or two decades ago. The share of fixed-price contracts is lowest in SE4. Some retailers do not offer fixed prices at all.

Most retailers have no access to the clearing house and have therefore to use the bilateral market for their hedging. Retailers try to hedge back-to-back the system price risk when they enter into new fixed-price contracts. EPAD hedging is often done later since EPADs compared to system price contracts are less volatile measured in absolute terms (EUR/MWh). However, some retailers make sure to also hedge the area prices risk immediately as new larger sales are done. Entering into a large fixed-price contract can require that the needed hedge is done simultaneously. An alternative for smaller retailers is to make a reseller agreement with a larger retailer or to make fixed-price agreements with a producer or larger retailer regarding all the fixed price volume. Such agreements manage system price risks, area price risks and profile risks.

One of the key principles in the **International Financial Reporting Standards (IFRS)** is that derivatives such as power derivatives should be booked at **mark-to-market value**. Changes of the mark-to-market value between periods shall according to IFRS have immediate effect on the profit and loss account. A listed company has in such a case to succeed in explaining to the stock market that a big reported loss due to changes in the mark-to-market valuation is in fact mirroring a profitable hedging portfolio. To avoid such a situation, some companies perform instead physical bilateral hedging or hedging in other kinds of contracts that do not necessitate mark-to-market valuation.

4.3 Market participants with access to the clearing house

The Nasdaq Commodities member list included 184 market participants in April 2024. The list includes clearing clients with a clearing agreement with a Direct Clearing Agent or a General Clearing Member. Of the total number, 41 were from Norway, 26 from Finland, 25 from Sweden, 17 from Denmark while 65 were from countries outside the Nordic countries. In addition to the members registered in Sweden, many members in countries outside Sweden have significant business in Sweden.

The 25 members registered in Sweden include end-users, retailers and producers as well as one bank, one broker and other intermediaries in the Swedish electricity market.

This means that most market participants in Sweden have chosen to not become a member or a clearing client and are thus without access to the clearing house. There are varying reasons for this choice. Fixed membership costs can be significant for participants with smaller hedging volumes. Collateral costs are avoided in bilateral trades if the counterparty does not demand collateral. Daily settlement with the clearing house is administrative demanding. Back-office routines are simplified if a hedge provider produces needed reports. Many small and medium actors find that it is not convenient or efficient to follow the market on a continuous basis.

3 https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__EN__EN0301__EN0301A/SSDManadElAvtalstyp/

4.3.1 Bilateral contracts with market participants without access to the clearing house

When market participants without access to the clearing house performs a bilateral hedge, the counterparty is often a market participant with access to the clearing house. In the event that the counterparty is also a market participant without access to the clearing house, that market participant will most often hedge its position with a market participant with access to the clearing house. Market participants with access to the clearing house are thus crucial for enabling bilateral hedging by market participants without access to the clearing house.

A participant acquires a new position when it is the counterparty to another participant performing a hedge. The acquired position can sometimes be regarded as a natural hedge, e.g., when a producer is the seller of a contract to a retailer or a consumer. However, the acquired positions result often in trading positions that normally are offset by exchange trades or bilateral trades reported for clearing. Some acquired positions are kept as trading positions for a shorter time or until delivery.

Retailers are very important in offering fixed-price contracts. Retailers with access to the clearing house also often offer financial contracts to their customers. Such contracts means that the customer has hedged only a part of its volume, and the contracts can often be settled in the physical delivery instead of a separate financial settlement. Settlement in the physical delivery can be wanted for administrative reasons or by companies wanting to avoid mark-to-market valuation.

Larger producers are active in offering bilateral contracts. They get normally a natural hedge when an end-customer or a retailer performs a hedge transaction with them.

Some **traders** play an important role and have originators selling and developing bilateral contracts to market participants without access to the clearing house.

Some market participants without access to the clearing house have outsourced their hedging operations to a **portfolio administrator**. The portfolio administrator performs in such cases the hedging on behalf of the market participant according to an agreed hedging strategy (mandate). Companies offering portfolio administration include large retailers and producers but also trading companies.

Also, **banks** are an important distribution channel of hedging instruments. Some banks offer direct bilateral trading with the bank as the counterparty. An advantage for the bank is that it has already an established contact with many market participants and can determine credit lines based on this knowledge.

4.3.2 Bilateral contracts with other participants with access to the clearing house

There is no transparency regarding bilateral contracts that are not reported for clearing. Interviews with market participants indicate that for a long time, nearly all trades in contracts that could be cleared were indeed reported for clearing.

The situation is now different. Our interviews indicate that there is now an extensive trade in contracts that can be cleared but are not cleared. Some active participants explained that on different occasions, they had agreed with counterparts to take (significant) volumes out of clearing and converted to bilateral arrangements. Three occurrences are stated in the interviews as contributing to this change.

The European Market Infrastructure Regulation (EMIR) came into force in 2012. EMIR ended the possibility for clearing houses to accept **bank guarantees as collateral**. However, EMIR included an exemption that allowed non-financial counterparties to use bank guarantees as collateral. That **exemption expired in March 2016.**

A report[4] in 2015 found that 76 % of the respondents among Nasdaq members were using bank guarantees as their main collateral. The comments regarding chosen collateral pointed out that bank guarantees were seen as cost-effective, flexible, secure and simpler to administer. Nasdaq had at that time 306 members in the Nordic electricity market.

The stop for bank guarantees in 2016 meant a substantial change for the Nordic market. Some participants chose to only trade bilaterally while others chose to partly replace exchange trade with bilateral trade in order to reduce the cost for collaterals with the clearing house.

In September 2022, as part of EU's emergency measures to tackle the high energy prices, the Commission requested ESMA to temporary enable bank guarantees as eligible collateral. Bank guarantees could be allowed again by Nasdaq in June 2023. This possibility is extended to 7 September 2024.

The Commission presented in December 2022 a proposal for a revised EMIR, EMIR 3. The European Parliament and the Council reached a provisional agreement in February 2024. EMIR 3 includes the possibility for bank guarantees to be considered eligible collateral. ESMA is given the task to specify the conditions under which bank guarantees may be accepted as collateral by clearing houses.

Nasdaq Clearing declared in September 2018 a member in **default**. The defaulted portfolio contained a large spread position between Nordic and German Power that was negatively impacted by extraordinary fluctuations in the spread. The close out resulted in a loss for Nasdaq Clearing that exceeded the defaulting member's collateral and the Junior Capital Fund provided by Nasdaq. A big share of the **Member Default Fund** had also to be used. The default fund was 168 million EUR before the default and the contributions to the fund were proportional to the exposures of each clearing participant. The default fund was recapitalized within one week after the default with mandatory contributions from the clearing participants.

The loss because of the default meant for most participants that they for the first time realized that they have also a counterparty risk versus the clearing house. The risk analysis and the risk management by Nasdaq was questioned in the market and some participants changed partly to bilateral non-cleared trade with participants they had approved. The default meant also that the market had lost a very active trader resulting in worsened liquidity and spreads.

The electricity prices started to increase very much in autumn 2021 and continued to increase in summer 2022. This led to increased volatility. The correlation parameters for time spread contracts and area spread contracts were also worsened. The combined result was **extreme high margin requirements** by Nasdaq on cleared contracts. The Nasdaq margin requirements increased from 70 billion SEK in June 2022 to 180 billion SEK in August 2022.

Finally, the Swedish Parliament decided on very short notice in the beginning of September to authorize Riksgälden to issue credit guaranties during 2022 and 2023 for new loans up to totally 250 billion SEK to Swedish market participants. The purpose was that liquidity shortage should not result in defaults for solvent companies and create a situation that would threaten the financial stability in Sweden. The decision by the Parliament and corresponding decisions in some other countries calmed the financial electricity market and no Swedish company applied for a credit guarantee.

However, the stress during summer 2022 because of the increased extreme margin requirements led some companies to reduce their cleared positions by entering into new bilateral contracts. The risk for new extreme margin requirements is still a factor that is included in many risk assessments and is often for these participants a driver for a significant share of non-cleared bilateral contracts.

[4] Online survey on bank guarantees as collateral - a report to the Nordic Association of Electricity Traders (NAET), Hagman Energy and Sweco Energuide, 2015-06-30.

4.4 Finding counterparts for bilateral hedging

The variety of contractual hedging arrangements for market participants without access to the clearing house was described in section 4.1. Obviously, fixed-price contracts with a retailer can only be done with the existing retailer or done with a change to a new retailer.

We have found during our project that there is well above 1000 active hedge buyers in Sweden. They are typically small and medium sized enterprises who have an active engagement towards the electricity market and buys financial contracts but typically find that it is not convenient or efficient to follow the market on a continuous basis. These enterprises can be regarded as hedging buyers and their counterparties as sellers or providers of hedging solutions. The latter category was described in section 4.3.1. The relation between hedge buyers and hedge providers can be described as a 'retail' market for hedging solutions.

Hedge providers find hedge buyers via i.a. sales activities and promotion activities. Some hedge buyers perform tender processes. The relation between hedge buyers and hedge providers is normally a long-term relation. Most hedge buyers have one hedge provider, but many have two, three or more hedge providers.

The Swedish platform NetMW is a system for portfolio administration and trade registration.[5] It enables also order requests and risk analysis. A hedge provider can buy licences for its hedge buyers, and they can communicate via the platform. Currently, 1 350 companies are using NetMW and 85 TWh trades were registered during the latest 12 months. Some active hedge providers are offering more or less similar tools and communication channels to their customers.

There is also a 'wholesale' market for hedging solutions, as outlined in Figure 4-2 below. The hedge providers in the 'retail' market have limited risk appetite and capacity and will thus typically seek to hedge most of the risks that arises from providing hedges. They will typically do this with a combination of exchange trades and bilateral trades with other hedging providers or trading companies.

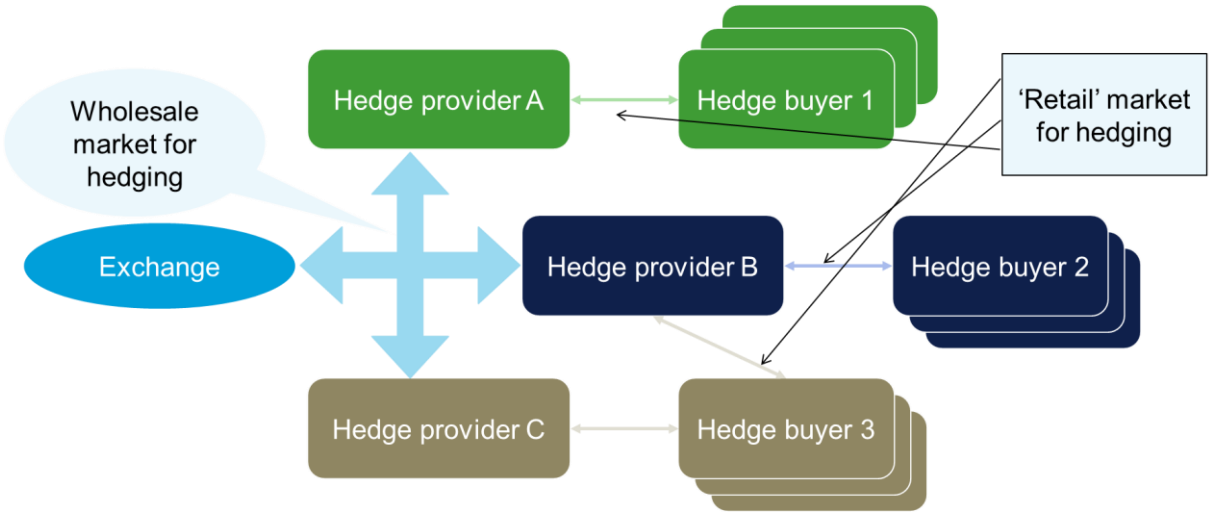

Figure 4-2 Sketch of markets for hedging solutions

Counterparties for bilateral trades in the wholesale market can be found through assistance by a broker or direct contacts with other market participants.

The exchange bid-ask spread on the screen is often high for less liquid contracts. OTC spreads are often lower, and brokers are most often used to assist in closing the bid-ask spread. Brokers have therefore normally a high market

5 netmw.com

share in less liquid contracts. Closing a bid-ask spread can take some time and brokers are not starting their work until they have a request. Brokered contracts are normally reported for clearing at the clearing house.

Direct contacts can be taken with other participants. Another possibility is to use a chat function. Some news agencies covering i.a. commodity markets, have chat functions, in which parties quickly can ask each other if a certain deal could be considered. If parties agree to trade, they will also jointly decide whether it should be a cleared trade or simply a bilateral agreement between the two parties.

4.5 Counterparty risks

Contrary to many continental bilateral markets, counterparty risk in the Swedish bilateral market is usually not managed by collaterals and margin requirements. This means less administrative costs, but it also means that the counterparty risk is usually accepted and can result in losses.

The focus is instead on trading only with trusted counterparties. There are processes for approval of new counterparties. Perhaps it is easier in a small country as Sweden to have knowledge regarding accepted counterparties.

Sometimes, the approval of a counterparty is subject to a credit limit. An overrun of the credit limit requires in such cases that collaterals or guarantees are provided.

If the credit review process results in a concern against establishing a credit line to the counterpart, some sort of collateral would be required. Unlike regulated clearing houses, market participants can for themselves decide that a bank guarantee, or even simpler, a guarantee from a trusted party (e.g., an owner), will be sufficient. The larger guarantee a party can offer, the larger exposure towards the other can be accepted, all else equal.

Under this approach, the actors can also agree on how to calculate the required guarantee, e.g. on how to account for opposite positions (netting).

Another possibility is to apply margin requirements more or less similar to those for cleared contracts. This could be relevant e.g., if a customer without sufficient credit score contracts with a counterpart with access to clearing, and an important element of the arrangement is that the latter will establish a ‘corresponding’ position in cleared contracts. The latter would then face margin requirements from the clearing house, which then might be reflected in similar or comparable requirements to the customer. However, the most common approach in such cases seems to be either that the contract price differs sufficiently from the hedge provider’s ‘corresponding’ price at the exchange to cover the provider’s incurred costs for collateral, or that the hedge provider simply sends separate invoices regularly to cover the cost of providing collateral to the clearing house.

4.6 Power Purchase Agreements (PPAs)

A Power Purchase Agreement (PPA) can be any type of bilateral agreement related to sales and purchase of power. However, it is mainly used for bilateral hedging structures over a longer period of time (tenor). A PPA directly between a power producer and a power consumer (often an industrial end-user with a significant annual consumption) is often referred to as a **Corporate PPA**. PPAs with an intermediate, such as, for example, a Balancing Responsible Party (BRP) or an energy trading company is often referred to as a **Utility PPA**.

A major benefit of PPAs over exchange-based contracts are the longer tenors and the embedded delivery of Guarantees of Origin (GoOs). For corporates, the use of PPAs is also driven by sustainability requirements where a PPA, for example, can link consumed electricity to produced renewable electricity at a specific wind- or solar park. PPAs

will even become an EU requirement on top of GoOs in order to fulfil renewable criteria for renewable transport fuel and hydrogen in bidding zones with a lower than 90% renewable share in the electricity grid.[6]

Some interviewees mention that while trading through the exchange now has higher margining costs and risks than before, there are also mixed experiences with long bilateral contracts due to both credit risks and difficulties of either reversing the positions or renegotiate the contracts. Some of the participants that needed long PPAs some years ago now find themselves in contracts that are not equally attractive as they used to be. Some of the current bilateral activity is driven by a motivation to partly compensate for this, e.g., buying additional volumes at fixed prices for periods where it turns out that actual production tends to be lower than committed PPA volumes.

PPAs may be physical or financial. In a physical PPA there is an agreement on actual delivery of electricity and a BRP is involved as a so-called “sleeving partner”. A financial (or “virtual”) PPA, is a purely financial contract which does not involve any actual electricity, but only a financial settlement of the difference between a market price and an agreed price during an agreed period of time.

Regarding the risk sharing and basic structure of PPAs, there are two most common “plain vanilla” PPA structures, but there many different versions of these. There is in general an agreement of a fixed price for at least a certain volume or percentage of a volume involved, but there are also examples of completely floating/market-price structures, or with a cap and floor price agreement.

PPAs are always signed with prices for a specific bidding zone. This is normally the bidding zone of the power plant, but it could also be the area of the offtaker in which case the power producer has an area price risk (price differential between the two bidding zones). Combinations of long and short positions in EPADs might reduce the area price risk if PPA parties are not located in the same bidding zone. However, EPADs are only listed for the nearest three years, while the tenure of PPAs is typically much more – in particular if the PPA is used for financing an asset.

4.6.1 Baseload versus Pay-as-Produced

A baseload PPA is based on a fixed annual volume per year (equal production per hour every day of the year) and an agreed contract price for the delivery period. The starting point for the price discussion is typically currently quoted future contract prices. However, as the tenure of a PPA is often longer than quoted prices, the negotiated price typically also reflects other factors, such as other contracts known to the parties, their expectations beyond the horizon on the exchange, and how important the contract is for each party.

A baseload PPA implies that the seller takes all the profile and volume risk. During periods of lower production than the volume agreed upon in the baseload PPA, the seller must buy additional power in the market. Often, the price to purchase this additional power is higher than the average market price since it would occur at times when there is less power production also from other assets. The result is reduced net revenue and **capture price** for the seller. Profile costs and risks are thus often referred to as “cannibalization” costs or risks.

A Pay-as-Produced PPA refers to a sales contract for all (or percentage) of all produced power. The buyer pays the same price for all hours, but the volume is based on actual production. With this type of PPA, the buyer takes over the volume- and profile risks from the power producer. Therefore, the price for a Pay-as-Produced contract should consider:

- Market prices (Nasdaq, and potentially other prices known to the parties and/or the advisors)
- Power price forecasts
- Capture rate (profile cost)
- Capture rate forecasts
- Volume risk
- Price indexation (covering increased cost for operations and maintenance)

6 The PPA requirement follows from the revised Renewable Energy Directive and delegated acts according to this.

- Balancing responsibility or services (often included in physical PPAs)
- GoO value

An example might be useful to illustrate the relation between a 'general' baseload financial contract versus a pay-as-produced PPA price.

Element	Parameter	Unit
Market price for baseload contract	50,9	EUR/MWh
Capture rate (due to profile risk; calculated as the value of expected production relative to a constant (baseload) production)	86	percent
Volume risk reduction	2,5	EUR/MWh
GoO price	4,7	EUR/MWh
Resulting price for a pay-as-produced PPA	45,97	EUR/MWh
Formula	50,9 * 86% - 2,5 + 4,7 = 45,97	

Table 4-1 Example - relation between baseload financial contract and pay-as-produced PPA

4.6.2 Current challenges in the Swedish PPA market

Currently, we observe a significant bid-ask spread in the PPA market. In several bidding zones, there is a price gap of at least 10 to 15 EUR/MWh between minimum price required by developers of new wind and solar parks and maximum price that still make hydrogen or P2X in general profitable.

Previous experience with volume and profile risks because of baseload PPAs has caused power producers in need for PPAs to require pay-as-produced structures. Industrial developers are, on the other hand, dependent on baseload structures, as much of the 'new' electricity demand is planned for 24/7 production of hydrogen, ammonia, steel, data services, or similar. No-one seems eager to cover the resulting volume and profile risks without charging very high risk premiums.

Adding to this is the fact that many developers of wind and solar parks are special purpose vehicles with small balance sheets and thin capitalisation. Due to lack of previous history, they can often not achieve any 'official' credit rating. Hence, their counterparts often require rather high cash collaterals or expensive bank guarantees.

There is an increasing trend, both regulatory and among buyers of goods and services, to require that suppliers use renewable energy, preferably from new power plants (and also otherwise ensure a minimum carbon footprint). In recent delegated acts, EU has introduced requirements on PPAs. One example is the requirements for certification of renewable fuels. If produced in bidding zones with less than 90% renewable share (SE 3 and SE4), there must be a temporal correlation between the consumption of electricity and production of the fuel. Initially it will be sufficient to have monthly correspondence, but from 2030 there must be an hourly match between production and consumption. It is not clear how this can be solved in practice, as not all consumption processes (e.g., for manufacturing hydrogen by electrolysis), can ramp down or up, at least not without significant costs.

5 VOLUME AND MAGNITUDE OF BILATERAL HEDGING IN SWEDEN

To help understand the market for bilateral hedging arrangements in Sweden, we have made a survey among market participants. An Excel spreadsheet was designed and shared per email with 170 contact persons among electricity producers, retailers, (large) end-users, portfolio managers and trading companies offering hedging solutions. Besides 'traditional' end-users, we have collected information from 'new' end-users such as battery, hydrogen, and PtX companies with factories under construction or in advanced planning stage.

The survey focuses on production and consumption volumes, hedge volumes and choice of hedging instruments. Costs of hedging as well as the more qualitative aspects of hedging have been discussed in the interviews, see the other chapters of this report. A copy of the questionnaire is included in Appendix A.

5.1 Level of underlying activity

Question 2 of the survey focused on the underlying volume for hedging activity. It is included for two reasons. First, it helps understand the outreach and the representativity of the survey. Second, seen together with information about hedging volumes, it helps us understand the actual hedge ratio (defined as hedging volumes relative to underlying activity) of the market and calculate volume-weighted average hedge ratios of different market actors.

For the survey, we received replies from 28 companies. In addition, we have been in contact with 4 companies which for various reasons have not disclosed numbers. Of the 28 responses, 4 companies did not have any numbers to report for 2018 and 2023, while 7 companies did not report any numbers for 2030. One reason for not reporting numbers for 2030 is probably that the company discusses changes in production or consumption but has yet not made any decisions. We have in Table 5-1 below summarised the received replies. For 2030 we have two columns. The first summarizes the received replies for 2030. We have in the rightmost column '2030 est' – in absence of other information – added the numbers for 2023 for those who did not provide numbers for 2030.

Question 2 – What is the underlying volume of your activity?				
GWh/year	**2018**	**2023**	**2030**	**2030 est.**
Production	85 659	80 858	19 395	85 260
SE1	18 783	19 631	4 940	21 337
SE2	16 841	17 177	3 924	16 936
SE3	46 682	38 502	5 951	39 815
SE4	3 352	5 549	4 580	7 172
Consumption	47 049	43 684	45 444	72 180
SE1	7 189	7 038	32 019	34 846
SE2	3 028	2 852	8 447	9 674
SE3	31 405	28 614	4 081	23 523
SE4	5 427	5 180	897	4 137

Table 5-1 Reported production and consumption

While the approach opens for some double counting if a producer or consumer hedge via a portfolio manager or other form of service provider and both report numbers, there is little evidence of this being a significant phenomenon in the resulting data set.

Portfolio managers have confirmed in interviews that they have only included consumption for customers for which they offer some form of hedging.

The most significant change until 2030 in the table above is the planned huge increase in consumption in SE1 and SE2. Huge production surplus in the north of Sweden have so far resulted in huge power flows from north to south and often congestions and area price differences between SE2 and SE3. If the planned investments resulting in increased consumption in SE1 and SE2 are realized, the congestions and area price differences between SE2 and SE3 will probably diminish.

5.2 Volume and magnitude of hedge over the past five years

When analysing hedging activity, it is common to focus on the traded volumes and the open positions kept until delivery of a contract. Like in Table 5-1, this will be metrics in e.g., GWh/year. However, if the objective is to understand if or to what extent market participants are satisfied with their hedge portfolio, it is more relevant to consider the actual hedge ratio (hedged volume relative to underlying or fundamental volume) and study the development of this over time and relative to (stated) preferences by market participants.

Table 5-2 below provides the aggregated volume-weighted hedge ratios **for the respondents** who submitted sufficient datapoints (hedge volumes and underlying volumes, question 2 and 3 from the survey). To produce the table, we ignored responses from those who indicated that they did not hedge at all and from those who did not provide sufficient quantitative information. For some respondents, we have approximated the hedge ratio going into the calculation of the aggregated ratios. Hence, the table is an approximation based on our sample, not necessarily representative for the whole market.

Question 3 – Approximate size of hedge portfolio at end of year					
	Exchange based products, traded via exchange	Exchange based products, via broker or bilaterally	Structured products, via broker or bilaterally	Hedging via retail contract or portfolio management	Sum across all types
Hedging of production 2018	34 %	15 %	3 %	0 %	52 %
Hedging of production 2023	31 %	13 %	3 %	1 %	48 %
Hedging of consumption 2018	45 %	28 %	10 %	2 %	85 %
Hedging of consumption 2023	50 %	23 %	8 %	2 %	84 %

Table 5-2 Volume weighted average hedge ratios

One interesting observation is the relatively small changes in hedge ratios from 2018 to 2023. This comes at a time of increased price volatility, which suggests that risks are increased and that the desire for hedging is, if different, more important in 2023 than in 2018. Some have explained in comments and interviews that the rather weak indications of reduced hedging ratios rather reflect inability to find acceptable hedges than preferred hedge ratios. One producer, not reporting any volume of hedge for production, stated that their preferred hedge ratio is some 60 to 80 percent, but that it currently is lower. One could argue that due to increased volatility, the need of hedging have also increased. However, the reduction suggests that the cost increase associated with increased volatility is more important than the increased need of hedging.

An important change from 2018 to 2023 is the reduced correlation between SYS and capture prices for producers. As a result, SYS only hedges are less efficient and EPAD supplement is more important than before. The limited liquidity in

EPADs thus effectively limits the ability to achieve a satisfactory hedge ratio. This is especially true for liquidity further out on the curve, which for some companies is equally important as front year liquidity for effective risk management.

As indicated in section 5.1, portfolio managers have reported in comments that the numbers they have submitted for consumption refers to what they have sold on fixed price contracts and hedged back-to-back. These companies thus have a hedge ratio of 100 % for consumption – almost by definition. If they cannot find reasonable hedges, they will not offer fixed-price contracts to their customers. This largely explains the high hedge ratios for consumption.

An interesting difference in hedge ratios between production and consumption is that the bilateral involvement seems larger on the consumption side. For a large number of small and medium sized companies – the participants that have no exchange and clearing house access – bilateral hedging accounts for 100 percent of the hedging.

It follows from Table 5-2 what was also confirmed in interviews that the split between cleared and non-cleared products varies and depends on commercial considerations (hedging costs, liquidity, etc.). Some market participants emphasised their preference for cleared products because of contribution to transparency and price discovery. Their argument for still considering bilateral trade is the costs associated with margin requirements.

5.3 Time structure of hedge portfolios

Two thirds of the respondents have indicated how their hedge portfolio is split across time going forward. Some of these have provided numbers for the first two periods only: next 12 months and 2-3 years forward. Hence, the number of replies declines as we read from left to right in Table 5-3.

Question 5 – Consider your hedge portfolio at the end of 2023. How is the achieved hedge ratio split across years? Please indicate either the volume (GWh) of the hedge portfolio per 31/12-23 or alternatively the hedge ratio for each timeframe (hedge ratio here refers to the hedge volume relative to the (expected) underlying production or consumption)

Replies converted to hedge ratio (%)	Next 12 months	2-3 years forward	4-9 years forward	Ten or more years forward
Hedging of production, number of replies	19	13	8	3
Average hedge ratio	45%	32%	27%	23%
Minimum hedge ratio	0%	0%	0%	0%
Maximum hedge ratio	100%	100%	90%	50%
Hedging of consumption, number of replies	12	12	9	3
Average hedge ratio	71%	50%	33%	47%
Minimum hedge ratio	23%	10%	2%	50
Maximum hedge ratio	100%	100%	100%	90%

Table 5-3 Time structure of hedge portfolio for those who have provided information

It is worth noting that some actors hedge close to 100 percent for the first 12 months, whereas others are around 20-30 percent or even below. From the interviews, it seems quite clear that the actual hedge ratio for several participants is the result of an (informal) optimisation process, where cost of hedging is compared with 'value' or benefit of hedging, and the optimum is found by varying the hedge ratio.

New power production and electricity demand for 'new' purposes (like power to x) is often arranged by new companies, often organised as joint ventures. One motivation for this organisational setup is to limit the risks for the investors behind

the new capacity or demand. A consequence of this is that other financiers get to influence strongly the hedging philosophy, including hedge ratio and which risks to prioritise, tenure, etc.

Some relatively new investors in renewable energy production have either very low hedge ratios or are not hedging production at all. A common feature for these actors is that the equity of these companies comes from investors with a long history from other very capital-intensive sectors in which hedging is not very common. Also, these companies have long experience in arranging debt financing at competitive costs, e.g., by using well established consortia of lenders, with whom they have had business relationships for decades, and by having a relatively high equity-share of the projects.

In contrast, it is well known that pension funds and other 'managed' capital bases (like hedge funds, etc.) on the one hand are eager to invest in infrastructure and assets with long economic lifetime, while on the other hand are trying to hedge as much of the key risks (price, profile, volume, counterpart) as they can. A relevant question is if the latter is a bit counter-intuitive to traditional financial theory, suggesting that capital owners are generally better off by diversifying their portfolios themselves (by spreading investments across sectors) than hedging the individual investments. While this might be the case to some extent, there are regulatory limitations for pension funds investing in infrastructure, such that fully unhedged assets could be challenging.

5.4 Satisfaction with hedging opportunities

Two thirds of the companies have not indicated any preference for other hedge ratios than those that are behind the numbers in Table 5-3. This suggests that that these are generally satisfied, or not overly dissatisfied with the current state of play, at least not on an aggregated level. This is also supported by comparison with Table 5-2. Some also stated clearly in comments or in interviews that they are quite satisfied and are indeed able to make the hedging arrangements they desire.

About one third of the survey respondents replied to question 6, about preferred hedge ratio going forward, see Table 5-4. The preferred hedge ratios are generally within the range of the actual hedge ratios in Table 5-3. However, the respondents are not always the same, such that some replied to question 5 only, others to question 6 only, and some to both questions. Both the survey and the subsequent interviews confirm that some participants would have hedged more, if hedging costs were lower than what we have seen during the last years. However, some others found that a low hedge ratio turned out to be beneficial for them. Today, they consider the hedges they would have accepted a few years back (but could not find at reasonable costs), would not have been attractive today.

Question 6 – Looking at the previous question, do you consider the (implicit) hedge ratio as satisfactory? If not, please complete the same table as in previous question, but now with your desired volumes or ratio. Please add unit.

	Next 12 months	2-3 years forward	4-9 years forward	Ten or more years forward
Hedging of production, number of replies	10	8	8	7
Minimum hedge ratio	0%	0%	0%	0%
Maximum hedge ratio	80%	75%	70%	60%
Hedging of consumption, number of replies	6	6	6	3
Minimum hedge ratio	40%	25%	2%	0%
Maximum hedge ratio	75%	75%	70%	80%

Table 5-4 Preferred hedge ratios

Looking at the numbers behind Table 5-4, only four (of ten responses) had a desire to hedge production beyond the nearest 3 years. The only one looking for a 10-year contract (or longer), wanted to hedge 60 percent of expected production. On the consumption side, two of six respondents would consider a similar tenure (10 years or more).

The table also suggests that variation in hedging preferences across time is larger for the longer tenures.

One category of respondents is underrepresented in Table 5-4; hedge providers hedging 100 percent of their customers demand for fixed price contracts. This is typically hedged back-to-back, such that unless the provider finds a reasonable hedge price, there is no sale of such contracts to end-users. Some of these hedge providers have risk policies that mandates some open positions in these sales portfolios but explained that this opportunity is currently not (fully) utilised.

Two interesting replies are together telling an interesting story. On the one hand, a large consumer in the northern part of Sweden indicates that reducing hedge ratios turned out to be beneficial. Historically, the most significant potential change or deviation from 'normal' price has been a drop in prices. This is of course not a problem for a large consumer; hence, not hedging can be quite profitable. In the same bidding zone, a producer explains that they struggle to find counterparts willing to pay what they consider a reasonable contract price. As both now are expecting a tighter energy balance in SE1 and SE2, it seems as if both are about to shift policy or hedging demand – the end user will be more interested in hedging, but the producer might see less of a problem not being hedged.

An important aspect of hedging is how much time it takes to create a hedge position. In times of high volatility and low liquidity, it is common to spread out the individual hedge transactions over time. Participants with relatively small hedging needs (in GWh) can generally manage to maintain hedge ratios within preferences, but some have stated clearly that they would have preferred being able to make larger trades in shorter periods of time than they manage today.

6 COST OF HEDGING

While the price of a good or service is usually clearly defined, the costs of hedging are diffuse and not precisely defined. Below, we explain the costs and the cost differences between the three different 'distribution channels' for hedging arrangements – hedging via exchanges, hedging with hedge providers and hedging via PPAs.

6.1 Hedging via power exchanges

An obstacle for hedging long-term via exchanges that has been mentioned in survey and interviews is high costs. The most significant part of the cost is the need for collateral, which comes on top of standardised market (trading and clearing) fees. Formally, the collateral is related to clearing of contracts traded at an exchange, and not the actual trade itself. But because all contracts traded at an exchange must be cleared, this difference has no practical impact.

When hedging on an exchange there are fees from the exchange (currently Nasdaq). There is a fixed annual member fee of currently 13 500 EUR per year, plus a clearing member fee of 12 500 EUR per year. A small clearing customer pays 2 500 EUR per year. There is also a variable transaction fee of 0,0075 EUR/MWh for trading and 0,0056-0,0114 EUR/MWh for clearing. The volumetric clearing fee is differentiated according to the volume of cleared transactions in most recent quarter [7]. Small clearing customers have a variable clearing fee of 0.0202 EUR/MWh.

Furthermore, due to low liquidity, there is also a significant spread cost to consider. This spread cost can be described as the difference between the most recently published closing market prices and the actual price offered to the market participant.[8] The less liquid contracts generally have higher spread costs. In general, spread costs are at least about 0.5-2.0 EUR/MWh, but often even higher further out on the curve, for example, if hedging more than 3-5 years. This is especially significant in the EPAD market for the more illiquid areas.

The spread cost also varies with price volatility. Higher volatility will, all else equal, by definition mean that the probability for a price deviation from the expected value is higher than if volatility is low. Higher volatility implies that a trading company is facing higher potential profit, but it also means larger risks that will result in higher 'risk surcharges' in its bids to the market.

The spread cost also varies with the price level – simply because price volatility tends to be higher for higher price levels. Part of the reason for this is that prices do not follow a normal distribution. While there are both technical and economic limits for how low prices can come, there are in principle no limits upwards. Also, the technical limits in SDAC are non-symmetrical, from minus 500 EUR/MWh to 4000 EUR/MWh.

On top of these pure market fees and costs, there are also significant requirements for collateral. Previously, bank guarantees were approved, but that exemption in EMIR expired March 2016. When bank guarantees are not allowed, market participants need to have cash available on separate accounts. The required cash amount to cover margin requirements differs daily depending on market prices and volatility. This is costly and requires much administration.

The cost of providing a bank deposit of a certain amount depends on the cost of capital for the market participant (e.g., the weighted average cost of capital; WACC) and the interest potentially earned on the collateral account. While the latter is likely to be rather low – banks do not generally offer very high interest rates for deposits that can be released on short notice – the former is generally high and reflecting the opportunity cost of capital for the company. Hence, this could easily be in the magnitude of 10% or more.

With the large volatility in prices observed the last couple of years, we have also seen large variations in margin requirements. Changes in volatility results sooner or later in changed parameters for the calculation of margin requirements. Changes in collateral requirements from one day to another can therefore be significant when compared

7 Source: https://www.nasdaq.com/solutions/commodities-fees

8 Note that this is not exactly the same as the bid-ask spread, which can be defined as the difference between the best buy and the best sell prices in the market. Unless the price level is going up or down, the closing price would most likely be somewhere between the best buy and the best sell prices.

with the capital available to the participant. The notion that the cost of a collateral is the difference between WACC and short-term interest rates is thus valid only up to a certain point. If collateral requirements increase beyond available credit lines, the portfolio must immediately be closed or reduced to fit with the margin requirement the participant can accommodate.

A cash deposit also has some administrative costs, as it adds to the burden of cash management for the participants. Furthermore, having significant cash deposits in banks implies less funding available for the core business, which is also one of the reasons the opportunity cost of capital is higher than the interest rate.

Interesting to note, is that interviewees gave contradictory comments on cost of collaterals, in particular when comparing current costs at Nasdaq with expected costs at EEX. Some told us that opposite positions at Nasdaq does not come with a considerable netting discount with regards to the collateral requirement. A short position in one period and long in another period, or short in one area and long in another area, was said to have a margin requirement at almost twice as only one of the positions if cleared via Nasdaq, and much less if cleared via EEX. Other market participants disputed that there would be such a difference in practise, i.a., because there is more in the cost calculation than just the netting factor (how to calculate value at risk, etc.).

6.2 Bilateral hedging with a hedge provider

When hedging bilaterally with a hedge provider, market participants still have to pay for the Nasdaq fees, but in an and less transparent way. The exchange fees are normally included in the fees and marginal that the hedge provider adds on top of the Nasdaq ask price. In addition, if the customer's contract is not directly clearable (e.g., because it is in SEK instead of EUR), the hedge provider would incur costs to hedge the currency risk, that will come on top of the fees to Nasdaq. It is our understanding that these fees are about 2-5 EUR/MWh.

Also, in these contracts, some form of counterpart guarantee or collateral can be needed, although the interviews indicate that most bilateral hedges are without collateral demands. There are, however, in general, more alternatives than cash collateral, and the level depends significantly on creditworthiness. A common approach is that the hedge provider offers a price slightly off the corresponding exchange price, reflecting the hedge provider's incurred cost for collaterals. As an alternative, the costs related to collaterals could be invoiced separately. If a bank guarantee is required, the fee from the bank to the hedge buyer is typically in the magnitude of 0,5 to 2 percent of the required margin.

This indicates a higher cost of hedging through an intermediate instead of directly at Nasdaq which is reasonable since the intermediate needs to cover their costs as well as charge risk premiums. On the other hand, the hedging party does not need to handle the administrative burden and risk of managing daily collaterals.

When hedge providers hedge themselves bilaterally, there is normally no collaterals; they typically do business together based on credit checks, trust, and risk limits per counterpart. This means that it is often a cost advantage for the hedge provider to hedge itself bilaterally.

Important to note is that if the hedge should be profiled in some way, or the hedge tenor is longer than about three years, there will be additional costs for risk premiums. At least 10% price deduction/addition should be estimated for a baseload PPA contract, and 25% for a pay-as-produced PPA.

6.3 Bilateral hedging directly between a producer and a consumer ("corporate PPA")

Bilateral hedging contracts directly between a power producer and an industrial power consumer are generally referred to as corporate PPAs. Corporate PPAs may be "physical" or "financial". Financial PPAs are also often called "virtual" PPAs. Physical PPAs can also be called "sleeved PPAs", referring to the need for an intermediate such as a balancing responsible party.

In corporate PPAs, Nasdaq fees and collateral requirements are avoided. However, there are, in general, still credit guarantees or security costs involved. If both counterparties are deemed highly credit-worthy or can arrange a guarantee from a highly credit-worthy parent company, the guarantee costs may be small. However, this is often not the case. Especially new industry segments, such as battery manufacturing, hydrogen or other PtX concepts, are typically dominated by joint ventures – new companies that by themselves lack company history and solid balance sheets. Quite often, they are capital constrained – it is their lack of cash that limits their development and growth. Hence, these companies have in general difficulties posting enough collateral. Available cash must be used to construct the assets. The same goes for wind- and solar parks that are formed in separate legal entity structures. The lack of creditworthiness is a major, if not the single most significant, obstacle to close corporate PPAs.

If creditworthiness is there, or some form of guarantees can be granted from a credit-worthy party, bilateral corporate PPAs is a hedging structure involving lower yearly costs compared to hedging on an exchange or through an intermediary.

However, corporate PPAs often imply large initial costs for setting up the contract, plus a sourcing fee per unit of energy delivered. The initial costs are largely due to the lack of standardization. Advisors and intermediaries are often required to find suitable counterparties, structure the terms, and finalize a contract. Setting up a corporate PPA often requires 80 hours or more of advisory from commercial advisors, at least the same amount from legal advisors, and potentially technical advisors as well. Interviewees indicated that the legal fees alone could account for 50 to 80 percent of the total initial costs. The sourcing fee is typically around 0,2-0,4 EUR per MWh for the entire contract period.

6.4 Comparing hedging costs

Table 6-1 below summarised the cost components associated with the different hedging alternatives. Below the table, we also show an example for a 100 GWh hedge contract for one year. Note that the numbers cannot be considered as absolute truths. They are, however, our estimate for the costs market participants experience.

	Exchange	Bilateral	PPA
Annual costs	Member fees Exchange: 13 500 EUR/y Clearing house: 12 500 EUR/y	Initial costs to be accepted as a counterparty. No or insignificant cost compared to alternatives	First year cost for setting up contract: 50 000 EUR or more
Volume costs	Exchange fee: 0,0075 EUR/MWh Clearing fee: 0,0056 to 0,0114 EUR/MWh	Depending on the case, contract price can deviate from 'comparable' exchange price to cover exchange fees, market spread and collateral. Range 2 to 5 EUR/MWh	Sourcing fee to advisor: 0,2 to 0,4 EUR/MWh
Spread cost	0,5 – 2,0 EUR/MWh	See volume costs	Discount or margin, depending on type of PPA, duration, etc.; 10 to 25 % on perceived market price
Collateral	Difference between WACC and short-term floating interest rate; typically 10% on margin requirement from clearing house	From nil or included in volume costs, to a mother or bank guarantee; guarantee cost 0,5% to 2%	From nil to a mother or bank guarantee; guarantee cost 0,5% to 2%
Tenure	SYS: up to 10 years, in practise shorter EPAD/area price: 3 years	Similar to exchange-based, but potentially longer	From a few years to decades

Table 6-1 Cost components for alternative hedging approaches

To better compare the alternatives, we can assume a market participant seeking a hedge of 100 GWh for one year, either directly at the exchange or via a hedge provider.

Using the exchange, this would require a membership cost of 26 000 EUR (but potentially a discount of 10 000 EUR if the participant is registered as a Small clearing customer). The exchange and clearing fees would be 0,0189 (=0,0075 + 0,0114) EUR/MWh, or 1 890 EUR in total (and 0.0277=0.075 + 0.0202 or 2 777 EUR in total for a Small clearing customer). The bid-ask spread is likely to imply that the hedge cannot be done unless the participant is willing to accept a slightly worse price than the previous closing price. Using 1,25 EUR/MWh as a proxy for the spread cost, would result in a cost of 125 000 EUR.

Finally, for the collateral, the margin requirement will depend on market liquidity and prices, as well as the remaining energy in the hedge position. From a start of 100 000 MWh at the beginning of the year, the average remaining energy at any point in time would be 50 000 MWh. If we for simplicity assume the average collateral requirement is set to 10 EUR/MWh, the average collateral need throughout the year is 500 000 EUR. As explained, the cost of this depends on the WACC for the market participant and the short-term interest rate for cash. Using 10% as an example, the cost of collateral would here be 50 000 EUR.

In total, the cost of hedging via the exchange would be 202 890 EUR in this example.

If we alternatively seek a hedge via a hedge provider, there are no annual costs or explicit volume fees. However, the volume and spread costs can be larger than in the exchange alternative, potentially also including the costs of collateral.

Using 3 EUR/MWh as an example, we end up with a total cost of 300 000 EUR. The ‘best case’ is lower, potentially comparable to the exchange example, while the worst case could trigger significant higher costs, in particular if some explicit collateral requirements would be required.

The cost for a hedge provider to hedge itself bilaterally can be much smaller. The spread costs can be much smaller or insignificant if it finds a counterparty also wanting to hedge itself. In addition, no collateral costs if it is seen as a trusted counterparty. However, the counterparty risk remains.

7 WHAT CAN BE THE CONSEQUENCES OF FUTURE DEVELOPMENTS FOR THE HEDGING MARKET?

7.1 Consequences if EEX obtains approval to acquire Nasdaq's Nordic power trading and clearing?

EEX and Nasdaq announced in June 2023 that they have reached an agreement under which EEX will acquire Nasdaq's power business in Europe.

A Member State can request the European Commission to examine a merger that does not have an EU dimension but affects trade within the single market and threatens to significantly affect competition within the territory of the Member States making the request. Denmark and Finland submitted such referral requests to the Commission. Subsequently, Sweden and Norway joined the requests.

The Commission considered in August 2023 that the announced transaction meets the criteria for referral and asked EEX to notify the transaction. It was noticed by the Commission that the transaction appears to combine the only two providers of exchange trading and subsequent clearing of Nordic power contracts. EEX cannot implement the transaction before obtaining clearance from the Commission.

EEX notified the Commission on 3 May 2024. After a notification, the Commission has 25 working days to analyse the deal during a phase I investigation. Either the merger will be cleared (unconditionally or subject to accepted remedies) or the merger will be found to still raise competition concerns. The Commission will open a phase II investigation if competition concerns are still raised.

7.1.1 Changes in access to the clearing house

The transaction will – according to the press release from June 2023 – involve the transfer of existing open positions at Nasdaq Clearing AB to EEX's clearing house European Commodity Clearing AG (ECC).

Such a transfer requires that participants with open positions with Nasdaq Clearing will have access to ECC.

Only financial institutions can be admitted by ECC as Clearing Members (CM) and hold a licence to clear with ECC. Currently, ECC has 29 clearing members. The Swedish bank SEB is the only Nordic clearing member.

Other market participants than financial institutions can trade on EEX if they are registered as Non-Clearing Member (NCM) and has an agreement with a clearing member for clearing. The clearing member is the counterparty to ECC and takes over the financial settlement with ECC. Currently, six Swedish companies are non-clearing members and have thus already an agreement with a clearing member for clearing.

Another possibility is that a clearing member trades on EEX on behalf of the participant and is the counterparty with ECC. There are no statistics regarding such customer relations. However, our interviews indicate that most of the participants with open positions with Nasdaq Clearing has yet no agreement with a clearing member for ECC clearing.

The ECC membership structure means that other participants than financial institutions have to pay negotiated bank fees in addition to EEX fees and ECC fees. Large companies seem to be confident that they can negotiate with non-Nordic banks and get competitive bank fees and get competitive collateral conditions and that their total clearing cost will be lower than their current. Other participants are more worried about fees and collateral conditions, especially if they don't have SEB as their primary bank today. We expect that a significant number of the current Nasdaq participants will not enter into an agreement with a clearing member.

Such a development will further increase bilateral trade in Sweden. It will also legally complicate the EEX plan to transfer existing open positions at Nasdaq Clearing to ECC.

7.1.2 Zonal futures instead of system price contracts combined with EPADs

EEX will – according to the press release from June 2023 – replace EPAD contracts with zonal futures contracts.

Some interviewees welcome such a change. They appreciate concluding an intended hedge in one zonal price trade instead of the current two trades, one system price trade and one EPAD trade.

However, the first step in hedging is currently often to hedge the system price. Since EPADs are less volatile in absolute terms (EUR/MWh), EPADs can be hedged later in a second step. By contrast, zonal futures are more volatile in EUR/MWh, and it is therefore more risky to postpone a hedge in zonal contracts in order to possibly acquire a more favourable price.

Most participants are worried that the liquidity in zonal contracts will not be better than the liquidity in EPAD contracts and that zonal contracts will dilute the liquidity in system price contracts. They are also worried that this dilution of system price liquidity will make system price trading less attractive for speculative traders and cause a further reduction of liquidity.

Another fear is that the bid-ask spread in zonal contracts will be even worse than the current bid-ask spread in EPADs.

EEX launched zonal contracts on 25 March 2024. Zonal contracts have during the first 50 days been used to a very little extent for hedging purposes. On 15 May, there was no open interest in zonal contracts in 8 of 12 Nordic bidding zones. In DK1 there was 96 MW open interest in month contracts while in DK 2 there was 3 MW open interest in year contracts and 5 MW open interest in month contracts. In SE2 there was 3 MW open interest in month contracts while in SE3 there was 5 MW open interest in year contracts, 20 MW open interest in quarter contracts and 6 MW open interest in month contracts.

7.2 EU electricity market reform

The EU reform of the electricity market is the EU's long-term response to the energy crisis experienced in 2022. The reform aims to ensure better protection for consumers, more stability for companies and increased green electricity.

The European Parliament and the Council adopted the reform in April and May 2024.

7.2.1 Forward markets

One amendment to the Electricity Regulation 2019/943 is a new Article 9 Forward markets. Some key elements are:

- The design of the Union's forward markets shall comprise the necessary tools to improve the ability of market participants to hedge price risks in the internal electricity market (paragraph 3 in the new Article 9).
- Within 18 months from the date of entry into force of this amending Regulation, the Commission shall carry out an assessment of the impact of possible measures to achieve the objective referred to in paragraph 3 (paragraph 4 in the new Article 9).

One basis for this impact assessment from the Commission will probably be the ACER policy paper on the further development of the EU electricity forward market. The ACER paper was published February 2023 and identify problems which prevent achieving the objective of an effective and efficient electricity forward market. The most prominent problems according to ACER are insufficient liquidity, accessibility, competition, and transparency as well as inadequate market structure.

We anticipate that the impact assessment from the Commission will identify a comprehensive list of measures to improve the forward market and ensure sufficient and efficient hedging opportunities for market participants. We expect that the impact assessment will result in a proposal for a new FCA Guideline.

The coming two years will therefore be very important for future developments on the hedging markets.

7.2.2 Power Purchase Agreements (PPAs)

A new chapter IIIa is inserted as an amendment to the Electricity regulation 2019/943. The title of the new chapter is "Specific investment incentives to achieve the Union's decarbonisation objectives". The new Articles 19a and 19b covers PPAs. Some key elements are:

- Member States shall promote the uptake of PPAs while preserving competitive and liquid electricity markets and cross-border trade (paragraph 1 in new Article 19a).
- The Commission shall assess the potential and viability of one or several Union market platforms for PPAs, to be used on a voluntary basis (paragraph 2 in new Article 19a).
- Member States shall ensure that instruments to reduce the financial risks associated to off-taker payment default in the framework of PPAs are in place. Such instruments may include state-backed guarantee schemes at market prices (paragraph 3 in new Article 19a).
- By 31 January 2026 and every two years thereafter, the Commission shall assess whether barriers persist, and whether there is sufficient transparency, in the PPA markets (paragraph 10 in new Article 19a).
- ACER shall assess the need to develop and issue voluntary templates for PPAs, adapted to the needs of the different categories of counterparties (paragraph 2 in new Article 19b).

We have not found any new paragraph that will give an immediate change in the current PPA market. Instead, we interpret the new paragraphs as expressing a support to the PPA market as such, while at the same time understanding that there is a risk that other objectives such as a well-functioning forward market may be jeopardized. The balance between the conflicting objectives is not defined in electricity market reform.

The task to find a balance between conflicting objectives is instead transferred to the Commission and the Member States. Possibly, the task will be part of the Commission impact assessment regarding measures to improve the forward market.

One of the most crucial elements in PPA negotiations, and often one of the major obstacles, is credit guarantees. This is explained and discussed further in chapter 6 above. Therefore, instruments that reduce financial risks such as state-backed guarantee schemes should be an efficient measure to increase PPA volumes.

7.2.3 Contracts for differences (CfDs)

The new chapter IIIa includes a new Article 19d titled "Direct price support schemes in the form of two-way contracts for difference for investments".

Direct price support schemes for investment in new facilities for generating electricity from the sources listed shall take the form of two-way CfDs or equivalent schemes with the same effects (paragraph 1). The list includes wind energy, solar energy, geothermal energy, hydropower without reservoir and nuclear energy.

A two-way CfD normally means a contract that replaces a (volatile) market price with a fixed price, such that the buyer will have to pay to the seller when the market price is below the agreed price, and the seller has to pay to the buyer when the market price is above the agreed price. It is also possible that a two-way CfD has two strike prices – a cap and a floor – as illustrated in Figure 7-1 below. The lower floor price gives a revenue guarantee, and the higher cap price gives an upward limitation of the market revenues of the facility.

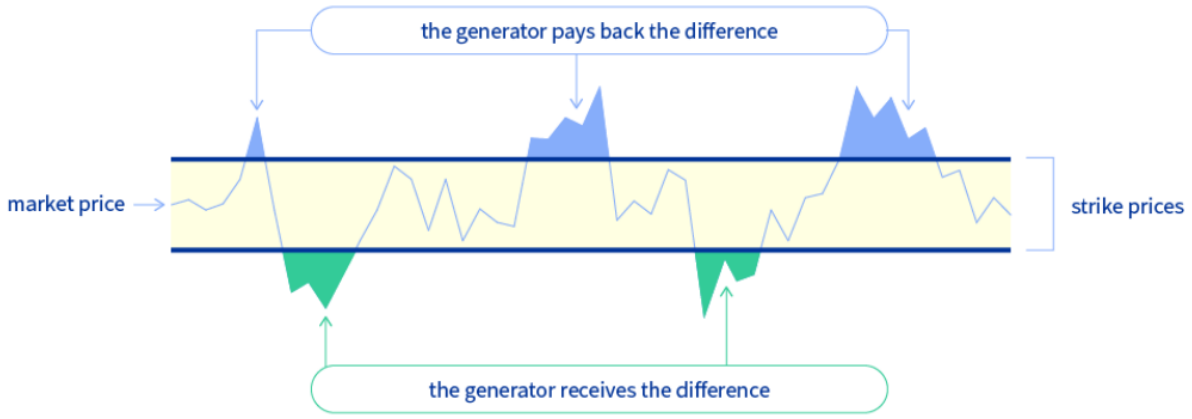

Figure 7-1 Illustration of two-way CfD, source: Council of the European Union

All direct price support schemes in the form of two-way CfDs and equivalent schemes with the same effects shall be designed to:

(a) preserve incentives for the power-generating facility to operate and participate efficiently in the electricity markets, in particular to reflect market circumstances;

(b) prevent any distortive effect of the support scheme on the operation, dispatch and maintenance decisions of the power-generating facility or on bidding behaviour in day-ahead, intraday, ancillary services and balancing markets (paragraph 2).

According to Article 108 of the Treaty, the Commission shall keep under constant review all systems of aid in the Member States. In the assessment of two-way CfDs or equivalent schemes with the same effects, the Commission shall ensure compliance with the design principles pursuant to paragraph 2 (paragraph 3 in the new Article 19d).

Nothing is said in the regulation of how two-way CfDs can be designed to achieve the goals prescribed in paragraph 2. It will thus be a task for the Commission, in cooperation with the Member States, to elaborate possible designs.

Our understanding is that the new regulation excludes two-way CfD that gives a guaranteed price for every MWh production. Such a scheme would mean that it is profitable to run the plant even at the minimum day-ahead price since the revenue for the plant will never be lower than the floor price.

One way to partly circumvent the problem is that day-ahead prices are changed to 0 EUR/MWh in the settlement in hours with negative prices. The floor price will then limit the magnitude of negative bid prices for the plant to the day-ahead market.

Another way to partly circumvent the problem is that the settlement is not versus the hourly day-ahead prices but instead versus an average price, e.g. monthly prices. It will then be profitable to bid the plant at negative prices if the expected average price for the month is under the floor price. However, the plant will never be bid to the day-ahead market at a negative price of the same magnitude as the floor price.

It is not evident that the best way to support fossil-free investments is to support the MWh production in the plants. In such a case, the investor will have no support if the plant breaks down or if a network issue prevents it from dispatching. A potential investor has to include this volume risk in his investment decision. The consequence is a higher cost for the state, the taxpayers and/or the final customers than if the support is directly related to the MW investment. Such support can be done as an investment grant in EUR/MW or probably even cheaper as a credit guarantee from the State.

A considerable risk and disadvantage of a CfD scheme is that it will likely reduce the potential for industry and other electricity consumer to hedge their future electricity costs and even to fulfil EU renewable electricity sourcing criteria. A

two-way CfD gives the power plant owner no incentive to hedge in the forward market. Thus, the liquidity and potential counterparties for industry and other consumers will be limited with the outlined CfD scheme in place. Furthermore, with a CfD the power plant owner has no interest in (or even possibility to) making a PPA with an (industrial) end user. Thus, it will be much harder for Swedish industry to find suitable counterparties for long-term renwable power sourcing. Since PPAs are also mandatory for some industry, for example those producing renewable hydrogen and transport fuel in SE3 and SE4, it will make it harder for this industry to fulfil EU requirements.

If support is instead provided as an investment grant or as a credit guarantee, the incentives for the plant owner to hedge in the forward market, or to contract a PPA with an industrial end-user, are approximately the same as current.

8 POSSIBLE MEASURES TO IMPROVE HEDGING OPPORTUNITIES

In our interviews, we asked market participants how they assess their hedging opportunities and if they have proposals for measures to improve hedging opportunities.

We have found a rather common view among well-established retailers, consumers and producers. We found other views among companies that are investing in renewables or the new intensive use of electricity. We will describe their views in section 8.3 below.

A general impression from our interviews with the more well-established segments is that most participants have a good and broad understanding of the market and the risks. They see problems, but they still find that the forward market gives important value to them. They do not want drastic changes.

No specific measures related to the bilateral market were proposed. Participants recognise that stricter reporting requirements for bilateral trades could increase transparency, although there would likely be a significant time-lag between deals being reported and some sort of index being made publicly available. Still, there is a worry that administrative costs will outflank the possible benefits.

A dominant view is instead that the functioning of the bilateral market is dependent on the functioning of the exchange-based market. There seems to be a shared view among our interviewees that the recent EPAD auctions have significantly improved price and market transparency and thus improved price discovery.

Measures mentioned to improve the bilateral market are in fact measures to improve the liquidity in the exchange-based market.

8.1 Measures to improve liquidity in the exchange-based market

In section 4.3.2, we have reported occurrences mentioned by interviewees that contributed to falling liquidity in exchange-based trading.

The stop in 2016 for bank guarantees as collateral for non-financial counterparties meant that many participants left or reduced exchange-based trading to avoid rising collateral costs.

Increased margin requirements have driven many participants to have a significant share of non-cleared contracts.

The risk that very high prices, as in 2022, may occur is not absent. The temporary decision to authorize Riksgälden to issue credit guarantees for loans to market participants calmed the near panic at that time. A permanent authorization to Riksgälden would take away the risk of very high prices in the future as a driver for a significant share of non-cleared contracts. Probably no company will apply for a guarantee. Still, the existence of the possibility for a credit guarantee would change market participants' risk assessment.

The liquidity offered by traders has been reduced. Increased margin requirements increase the necessary profit margin on a trade. Lower liquidity in the exchange increases the risks that a trading position cannot be closed fast and must be held for a long time, perhaps until delivery.

The aim for traders is to profit from market volatility. The objective of fundamental market participants is on the other hand to reduce risks from market volatility – not to profit from market volatility. The liquidity offered from traders is thus an important lubricant for the forward market. A higher trade frequency reduces the bid-ask spread and creates a more efficient market.

It is understood that it is a long and complicated process to attract more traders and get a higher trade frequency. However, if the process starts, it is much self-reinforcing. In the same way as a worsened liquidity gives an even worse

liquidity, a better liquidity gives an even better liquidity. Every possibility of reducing barriers for traders and reducing unnecessary risks for traders should be examined.

8.2 Views regarding EPAD auctions

We have asked about views regarding the EPAD auctions performed by Svenska kraftnät. The review presented in April by Svenska kraftnät presented a very positive response from participants in the auctions.[9] We received the same positive responses from our interviewees – also from those who have not participated in the auctions.

All transactions in the auctions were cleared at Nasdaq Clearing. This meant that only market participants with access to the clearing house could participate in the auctions.

Some interviewees told us that they had also taken part in the auctions through bids given by their hedge providers.

Others who have not participated were also positive since the auctions have given them better transparency and price discovery.

It is interesting to note in the review by Svenska kraftnät that the auctions have not led to a reduced turnover in the continuous market. The turnover was about the same in SE2 and increased significantly in SE3 and SE4. Our interpretation is that some of the transactions in the auctions were not aimed at hedging but at opening or closing trading positions.

If our interpretation is correct, the auctions have not only improved hedging opportunities. They have also reduced barriers and risks for traders and enabled more liquidity from traders in the continuous EPAD market. The existence of an auction means that a trading position in EPAD contracts has not to be held until delivery. It can be closed in an auction at market price.

8.3 Views from companies investing in renewables or new intensive use of electricity

The companies investing in renewables or new intensive use of electricity are often focused on long-term hedging opportunities. The possibilities to use exchange-based instruments for such long-term hedging are limited, both from a cost perspective and due to the relatively short tenure of exchange-listed contracts. However, the alternative long-term bilateral hedging is also challenging.

There is a mismatch between pay-as-produced PPAs, preferred by renewable producers and pay-as-consumed or near-baseload PPAs wanted by new end-users, e.g. within “power to X”. There are also different price expectations and differences regarding many other terms that must be settled in an agreement. The process before a PPA can be signed is challenging and complicated, if it is at all possible. Some companies have also discovered that a signed PPA can generate new huge volume or counterparty risks.

It is therefore very hard to develop sufficient hedging opportunities with efficient products for these types of companies. Maybe it should not be the State's duty to ensure such a development regarding hedging opportunities for truly long-term risks. Markets and market participants need to work on business models and business strategies to find an equilibrium. Flexibility, storage, ancillary services and other additional revenue streams, risk sharing contracts, and other instruments and structures to add potential "win-win" shared revenue streams will be key. However, public investment grants and/or credit guarantees or similar instruments can reduce credit risks and long-term risks as barriers in the PPA market.

[9] A review of Svenska kraftnät's EPAD Pilot 2023, Svenska kraftnät, 2024

It can be noted that according to paragraph 3 in new Article 19a of the Electricity regulation, the State shall ensure that instruments to reduce the financial risks associated with off-taker payment default in the framework of PPAs are in place. Such instruments may include state-backed guarantee schemes at market prices. Credit risks are currently a major barrier to close bilateral contracts.

An alternative approach is that companies with long-term risk seek financing by risk-accepting capital. It can now be seen that e.g. shipping companies and risk capital funds are engaged in developing wind energy. Such owners are from history used to accept long-term risks while using the existing forward market to hedge short-term and mid-term risks.

APPENDIX A
Questionnaire for online survey

Please use only the white cells for your answers

1 Company name and contact details:

Name:	
Company:	
E-mail:	
Phone:	
Your role:	
Can we call for an interview?	

2 What is the underlying volume of production and/or consumption for your activity?

Please specify GWh/year	**2018**	**2023**	**2030**
Production			
SE1			
SE2			
SE3			
SE4			
Consumption			
SE1			
SE2			
SE3			
SE4			

3 We are analysing how hedging is split between bilateral and exchange based products, and how this has evolved over the past years. Please indicate which products and venues are most relevant for your hedging activity

Approximate size of hedge portfolio at end of year (GWh)	Exchange based	Exchange based products, via broker or bilaterally	Structured products, via broker or bilaterally	Hedging via retail contract or portfolio management
Hedging of production 2018				
Hedging of production 2023				
Hedging of consumption 2018				
Hedging of consumption 2023				

4 If you are using non-clearable products, we would like to know which types of products are being used

	Please indicate if you use these types of products		**Please *indicate* the share (%) of total hedge portfolio**	
Instrument	**Short-term**	**Long-term**	**Short-term**	**Long-term**
PPAs	Less than 5 years	5 years or more	Less than 5 years	5 years or more
Bilateral flat baseload PPAs				
Bilateral monthly profiled PPAs				
Bilateral, as-produced PPAs				
Bilateral, as-consumed PPAs				
Other				
Structured contracts				
Contracts with tailored volume profile				
Contracts with tailored duration				
"Reseller" agreements				
GoOs only				
Other				
Standardised contracts not listed on exchanges				
SYS or EPADs in SEK				
Other				

Alternatives in the menu:
We use such contracts
We would like to use such contracts
We do not use such contracts
Not relevant for us

5 **Consider your hedge portfolio at the end of 2023. How is the achieved hedge ratio split across years? Please indicate either the volume (GWh) of the hedge portfolio per 31/12-23 or alternatively the hedge ratio for each timeframe (hedge ratio here refers to the hedge volume relative to the (expected) underlying production or consumption)**

Please indicate the hedge ratio (%) or the volume (GWh) of the hedge portfolio	Next 12 months	2-3 years forward	4-9 years forward	Ten or more years forward
Hedging of production (%)				
Hedging of consumption (%)				
Hedging of production (GWh)				
Hedging of consumption (GWh)				

6 **Looking at the previous question, do you consider the (implicit) hedge ratio as satisfactory? If not, please complete the same table as in previous question, but now with your desired volumes or ratio.**

Please indicate the volume	Next 12 months	2-3 years forward	4-9 years forward	Ten or more years
Hedging of production				
Hedging of consumption				

7 **If you are not satisfied with the hedge ratio, please provide the most important reasons for the gap between the actual and a satisfactory hedge ratio**

8 **Looking at the previous question, would you say that your desired hedge ratio has changed over the past five years?**

Yes or no	
If yes, please provide a short comment	

9 **If you have assets under development, please provide the *desired* hedge ratio**

	Next 12 months	2-3 years forward	4-9 years forward	Ten or more years forward
Hedging of production				
Hedging of consumption				

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