

May, Nils G.; Neuhoff, Karsten; Richstein, Jörn

Report

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Europe's power system in transition: What are the evolving roles of future markets and hedging?

Report on key elements of the debate at the workshop "Meeting on Hedging and Futures Markets"
of the Future Power Market Platform¹,
Berlin, 22th March 2019
Jörn C. Richstein², Karsten Neuhoﬀ³, Nils May²

Introduction: Why do we need hedging in power markets?

Market actors can use hedges and future and forward markets to protect themselves from risk exposure, for example power price risk exposure or exposure to a volatile demand. They can stabilize their revenues and/or their costs by signing contracts with other actors that either have a complementary hedging demand or a willingness to take over the associated risks. Another role of hedging products and future markets is to provide price signals, which can then for instance form the basis for evaluating investments into new capacities or flexibility.

Different market actors have different motivations and, consequently, trading strategies and needs for hedging products:

1. **Existing electricity consumers:** Where spot prices normally are not directly passed through to final consumers, hedging reduces the risk exposure of retail companies, especially if these have long-term contracts with their customer base (e.g. via price guarantees). Similarly, industrial customers might sell their products on future markets and need to close open positions (i.e. positions for which they do not have a countertrade yet) of their input factors, such as electricity. Different product types are needed depending on the time profile and flexibility of demand.
2. **Generation asset owners:** They hedge their power sales in order to lock in and thus stabilize their revenue streams – and at the same time their (fuel and CO₂) inputs are also hedged in order not to have open positions.⁴

➔ **Resulting trading behavior for 1. & 2.:** Both the traditional generation owner hedging and the consumer hedging result in a trading strategy of typical hedgers: they look for indexed products, and try to offload their volumes with simple strategies. Owners of larger portfolio of assets may become more active in the market, taking a view on the market, having a forward curve. These can be categorized as asset optimizers and active traders, which contains a speculative element, based on specialist knowledge.
3. **New investments (and divestments) in conventional generation capacity:** Hedging markets (i) provide long-term price signals to calibrate the market perspective of players (ii) have a limited role to stabilize revenue stream as new investments into conventional/nuclear technologies usually take considerably longer than typical contracts durations (however,

¹ We thank all participants for their participation and particularly those that provided comments on this report. All previous reports can be found at www.diw.de/fpm.

² Research Associates, Department of Climate Policy at DIW Berlin, jrichstein@diw.de, nmay@diw.de.

³ Head of Climate Policy Department at DIW Berlin and Professor for Energy and Climate Policy TU Berlin, kneuhoﬀ@diw.de

⁴ Schopp, A., Acworth, W., Huppmann, D. and K. Neuhoﬀ (2015): Modelling a Market Stability Reserve in Carbon Markets. DIW Discussion Paper 1483.

hedges may still start before the end of realization) (iii) as way of reducing volatility of ongoing revenue during operation (see 2: Generation asset owners)

4. **New investments in demand side flexibility:** Hedging markets ideally (i) could help provide long-term price signals to calibrate the market perspective of market actors (if prices depict the price spreads relevant for demand response) (ii) allow investors to stabilize their revenue streams, as available contract durations cover their relative short investment periods and pay back periods. .
5. **New investments in renewable energies:** Such investments are mainly backed by publicly-guaranteed long-term stable revenue streams, commonly sliding premia or contracts for difference (CfDs). Therefore, there is a very limited role for hedging. Private mid-term contracts are emerging for retrofits of existing installations. Where revenues streams are not backed by public entities, e.g. in Scandinavia, long-term hedging for far longer than usually available is required by project developers.

➔ **Resulting trading behavior for 3. to 5.:** All investment activities result in one-off trading activities to secure investment decisions, potentially with specialized products (more so for categories which would have very dirty hedges, such as renewable energies and demand side flexibility). After the investment stage, hedging evolves to hedging behavior in operation.

What contract types and actors facilitate hedging?

Currently only a few hedging products are liquidly traded and only over a certain period into the future:

Basic contract types

Trading is focused on a few standard products. The most common products are calendar year base load and to a lesser degree peak load futures. Moreover, products for shorter-term hedging (monthly, weekly and daily products) exist⁵. They are most liquidly traded for the following period (one year ahead for yearly products, one month ahead for monthly products). After that, liquidity drastically decreases, such that annual products are barely traded more than three years in advance. Liquidity also differs across countries, with many contracts of neighboring countries referring to German future products.

In general, hedging products have historically grown to a few liquidly traded products as there is trade-off between on the one hand large liquidity, small bid-ask spread and even large actors being price-takers, and on the other hand the perfect fit of products for the individual purpose, that can exactly reduce and eliminate the hedged risk. The optimal availability of products comprises neither hundreds of products with perfect fits for all individual actors, but no liquidity, nor a single product with huge liquidity but with no appropriate fit for many market actors. Instead the optimal product mix will comprise a limited number of products with sufficient liquidity.

As a result, most actors need to enter a “dirty hedge” if they use the standard hedging products in order to hedge their revenue and cost streams. This means that their actual revenue streams are not perfectly aligned to the hedging product, so that there is a residual risk remaining after buying the hedging product. An example of a dirty hedge is for example the usage of German calendar future products in neighboring countries – while the prices are strongly correlated due to common fuel prices, as well as transmission between countries, there nonetheless remains a risk that due to

⁵ Even intraday trading could be counted as future trading.

transmission constraints and local conditions prices will deviate. In the following, sources of imperfect hedging are discussed and who can carry these remaining risks.

How are matches between specific time - / production - / locational-profiles “dirty”?

Two principal sources of imperfect (“dirty”) hedging exist:

- The **referred-to volumes** may differ from the hedged volumes, and the hedged (exact) production times (which MWh is the contract referring to). An example are the historic hydrological-season-aligned futures products in the Nordics and the shift to European standards, in order to improve liquidity. The historically traded products better reflected the nature of hydrological power supply and availability; however, adhering to European standards increased liquidity.
- The **hedge’s prices** may differ (day-ahead prices, intraday prices etc.), as well as the location (Germany vs Austria etc.). For example, Germany’s future contract prices are used in neighboring countries despite potential price differentials between countries.

Moreover, the fundamental supply and demand of these standard products may not perfectly match. Other market parties may provide the missing “gap”.

Who carries the risk of imperfect hedges and gaps in demand and supply?

The risks of imperfect/dirty hedges can be carried by:

- A **speculator or financial entity taking open positions** can carry the risks. In the short-term, as temporary holder of open position, such speculation provides value to the market. It provides liquidity and efficiency to the market, as there is always a buyer/seller for standard products, which reduces bid-ask-spreads. In the medium term, speculators can take over risks through tailored contracts to the needs of specific market actors. An example is the experience in Scandinavian countries with Enron and other financial entities providing a lot of liquidity. Long-term, financial entities can take over such risks by dirty hedging across portfolio of contracts.
- A **pool of assets** can carry the risks, by offering tailored contracts to other market parties, or holding open positions. There is a physical backing of the risks, and asset pool owners thus act as asset optimisers with regard to remaining risks. This is often operated by owners of large conventional fleets of generators, who take both short-term and long-term positions.
- The **final user** can carry the risk of the dirty hedge herself.

What are additional hedging needs in a renewable power system?

Increasing shares of variable renewable energies, less conventional thermal generation and growing flexibility needs lead to evolving hedging requirements.

The current base load and peak contracts might provide worse hedges for many market actors in the future as contracts are mostly structured to meet demand profiles (peak / off-peak), assuming that generation follows suit and serves either as baseload or is readily dispatchable. Thus, this also served the needs of generators because their production profile followed the demand pattern and could thus be hedged with peak/off-peak contracts. Hedges based on base and peak contracts might become ever dirtier with increasing renewable production, as time-defined standard products may become less suitable for some generation, especially for wind and to a lesser degree for solar power

(which on the one hand follows a daily pattern corresponding to peak/off-peak times, but on the other hand has a strong seasonal component).

With increasing weather-dependent generation (including behind-the-meter PV), peak and off-peak prices lose relevance. This is, because generation profiles like for wind are not nearly as strongly correlated with times of the day as current load patterns. The weather conditions influence the electricity price to a larger extent, with increasing flexibility needs and price peaks. Therefore, price-profile-based contracts provide better hedges in power systems around volatile renewable energies. Thus, these type of contracts would be particularly important for new entrants like investors into renewable energies and investors into flexibility, who prefer to produce or consume at very high or very low prices. If prices do not follow clear time-based patterns, this is a challenge for peaking power plants, demand response and storage options.

What hedging products can address the new needs?

New hedging products need to be sufficiently liquid, so they necessarily will – like peak and off-peak contracts today – serve as dirty hedges rather than as perfect hedges. They can in principle be based on underlying physical contract or be derived from prices of a combination of contracts. Disadvantage of such a derivative would be (i) restraints on trading for non-financial actors due to compliance laws and reporting requirements (ii) dependence on continued liquid trading of the underlying physical contracts. Several options have already entered the debate, broadly categorized into three pathways: Price-quantile-based products, technology-specific products and option-based products.

Price-Quantile-based products are defined on, for example, the 5% highest / 95% lowest prices (or 10% highest prices and 90% lowest prices), reflecting that price peaks occur at different hours than under simple peak-products and that price volatility is expected to grow with increasing renewable energy penetration and less thermal generation.

Technology-specific products and contracts are based on technology- or asset-specific production profiles and correlation with overall supply. An example are Power Purchase Agreements (PPAs) based on wind resource indices.⁶

Option-based products are defined on a certain strike price and give the buyer the right to pull the option of exercising the contract. An example are the new products introduced on the EEX, such as cap futures. The reason for their introduction was the non-existence of hedging products for intraday prices, which, however, matters particularly as wind power is sold on the day-ahead market due to the definition of the remuneration system (which bases remuneration on day-ahead prices). Then, when the wind blows more or less than expected, wind power operators need to balance their positions on the intraday market with very inelastic demand. However, no hedge for this intraday price risk existed, even though its prices exhibit fat tails. The introduced cap-futures, implemented as hourly call options on the ID-price, provide such a hedge against high intraday prices and were initially regarded quite highly. However, they did not turn out successful and are not actively traded. During the workshop various potential reasons were discussed: they are rather complex to understand for small market actors, who might also shy away from them – or are legally unable to sign them – as these contracts are derivatives and could be viewed as financial speculation. Large market actors, on the other hand, may, using their own pools of assets and contracts, conduct comparable hedging within these pools. The associated price indices (ID1, ID3 etc.) for continuous trading became however very popular, and show how exchanges can shape and aid markets.

⁶ <https://business.nasdaq.com/trade/commodities/products/renewables.html>

Conclusion: Will the new hedging products emerge?

Hedging products reveal (1) market information, (2) address risk aversion, by allocating risks to actors with complementary portfolio, or the willing to bear risks and (3) financially secure income streams. They thus increase market efficiency and stability. Increasing renewable energy penetration, lower thermal generation and behind-the-meter generation mean that traditional peak / off-peak pricing reflects price profiles increasingly worse, such that contracts based on them provide ever dirtier hedges even for conventional portfolios. At the same time, investments into new flexibility options (such as demand response and batteries), as well as into renewable energy where no (public) hedges are available, face additional hurdles, as suitable hedging products with the associated benefits are missing and investment appraisal is more difficult.

Yet, several aspects may inhibit or delay the emergence of new products. Product liquidity is path-dependent and initial illiquidity often results in higher costs than “dirty hedging” thus limiting the use and contributing to a lock-in with traditional products. At the same time existing products continue to fulfil requirements of at least a part of the market, e.g. of conventional demand, which continuous to follow typical peak/off-peak consumption patterns. The negative experience with cap-futures by the EEX showcases this, where the initially-welcomed new products were never actively traded due to their complexity and frictions, such as the restricted ability to trade such option contracts on the interface of energy and financial regulation.

When no appropriate hedges are traded, more generation and flexibility gets concentrated in pools of generation and flexibility assets that are fully owned or contracted by a few actors (aggregators, utilities). This reduces the transparency of pricing of the value of individual flexibility types (e.g. seasonal, daily, ramping capabilities, balancing) since quoted prices are not public and may reflect the strategic value of the hedge to the pool owner. This creates barriers to market entry and inhibits investments in new technologies on the supply and demand side. Absence of liquidly traded underlyings (e.g. as dirty hedges), also affects market actors that pool risks. The absence of prices of relevant traded products complicates assessment of the exposure of a portfolio and may require a more conservative appraisal. The inability to off-load at least some of the exposure using dirty hedges furthermore constrains their ability to take open positions.

Several approaches can contribute to the emergence of new hedging products. A combination of new products could synthetically recreate old products (for example both a combination of a 10%-peak quantile + 90% bottom-quantile, as well as a combination of a put and call option on the same strike price equal a base-load future), providing both the availability and liquidity of traditional base products while enabling new hedging strategies. The gradual adoption and creation of liquidity via more and more standardized OTC products can support the uptake of new products. Utilities can be motivated to trade to reduce risks in their portfolios, allowing them to offer additional and longer contracts.

Policy design could catalyze the emergence of new, liquidly-traded hedging products. For example, the Australian Cap Contract was initially mandatory as a vesting contract and then continued to be used by market participants to hedge after it was no longer mandatory. This indicates the chicken-and-egg dilemma: Do we first require volatile prices to create demand for hedging products or do we need to catalyze hedging to ensure that the system is robust to volatile prices?

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