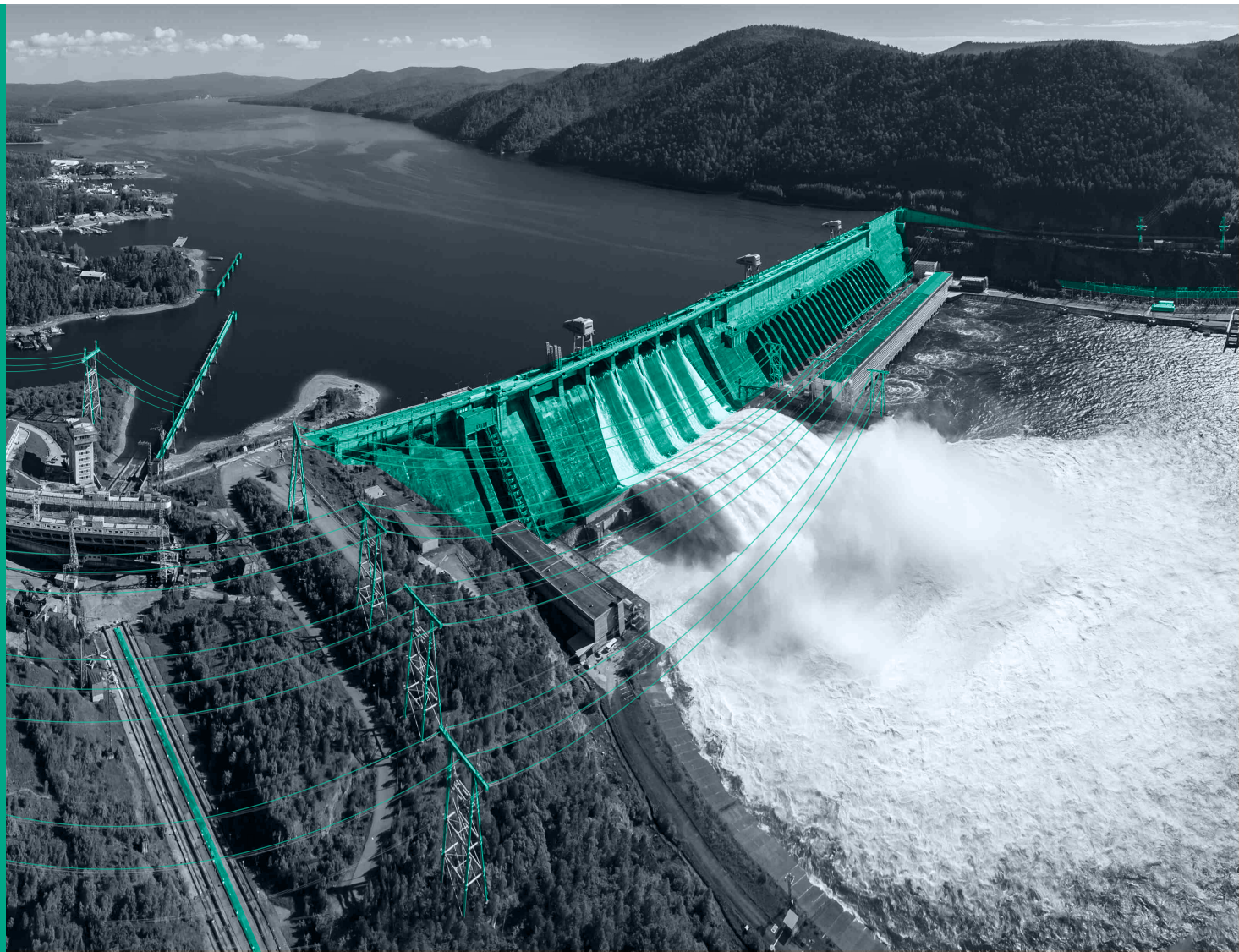
kpler

Power market outlook - Summer 2024

Navigating negative prices and system imbalances



Introduction

Power markets are uniquely characterised by the need for constant balance, which makes them highly volatile and requires specialised adjustment mechanisms to guarantee a reliable supply. Additionally, they are distinguished by the variety of coexisting markets, all aimed at achieving the paramount objective of maintaining this balance. Finally, Transmission Service Operators (TSOs) make use of unique resources that can be activated to adjust the grid frequency close to real time, or react incredibly rapidly in situations where the market failed to fulfil its duty.

Within this framework, negative prices can be seen as a market-driven adjustment tool, utilising price signals to indicate to market participants that the system is at risk of oversupply. Such repeated situation can be costly to the TSOs, and can result in costs falling onto the end consumer. In the end, the overall cost of running the grid can paradoxically increase with more negative price hours, and will do if no more flexibility is added to the grid.

Negative prices can be found at every market level, this paper will focus on the day-ahead. At this stage, market participants submit bids and offers to provide power to the grid over the next day. Prices may fall negative if too much power is offered without enough demand on the market. The reason why this can happen is that power demand is not elastic to spot prices so much, and is therefore driven by exogenous factors that are independent from the main supply-side drivers. The recent uptake in renewable energy sources (RES) has indeed not been followed by an equivalent increase in power demand, paving the way for a structural supply and demand disequilibrium. 2022 was marked by the energy crisis, as well as serious under-supply of French nuclear power. Early 2024, French nuclear is back to healthy production levels and France exports to the rest ofEurope. Gas and power futures remain high, but get closer and closer to healthier levels.

In this paper, we will explore the degree to which a high frequency of negative price hours represents a structural shift. Subsequently, we will examine the relationship be-tween balancing markets and wholesale spot prices, aiming to identify potential sources of increased costs for Transmission System Operators (TSOs).

Negative prices: A new trend?

In 2023, Europe experienced an unprecedented number of negative price occurrences, as illustrated in **Figure 1**. Germany encountered 315 hours of negative pricing, nearly doubling the average of the preceding five years. Until 2020, the Netherlands rarely recorded negative prices; however, in 2023, it led the region with a 600% surge in negative price hours compared to the five-year average prior to that year.

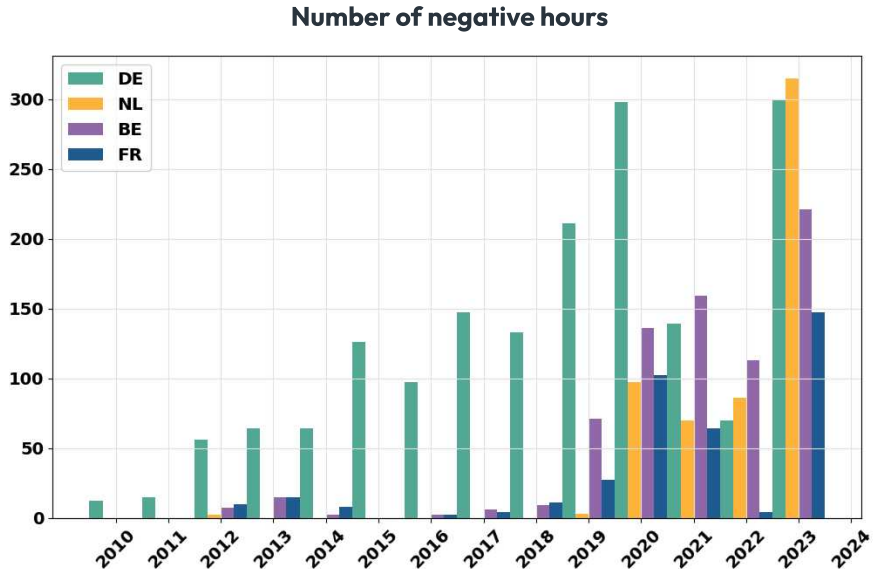


Figure 1: Count of negative hours

The daily distribution of those negative prices shown in **Figure 2** suggests that solar power played a crucial role in this recent increase. However, it is really the combination of demand destruction and new renewable capacities that brought this new regime. **Figures 3b and 3c** detail the expansion of solar energy production capacities within the EU in recent years, alongside future projections.

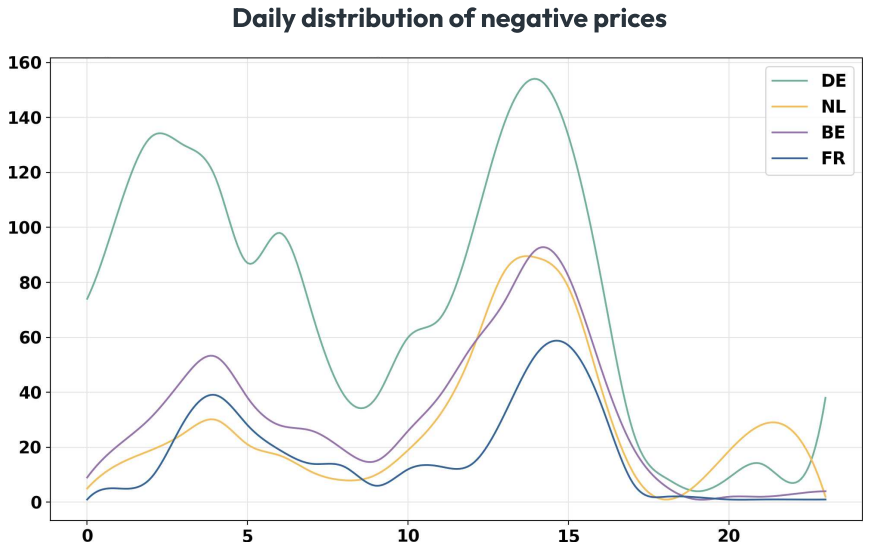


Figure 2: Negative prices distribution

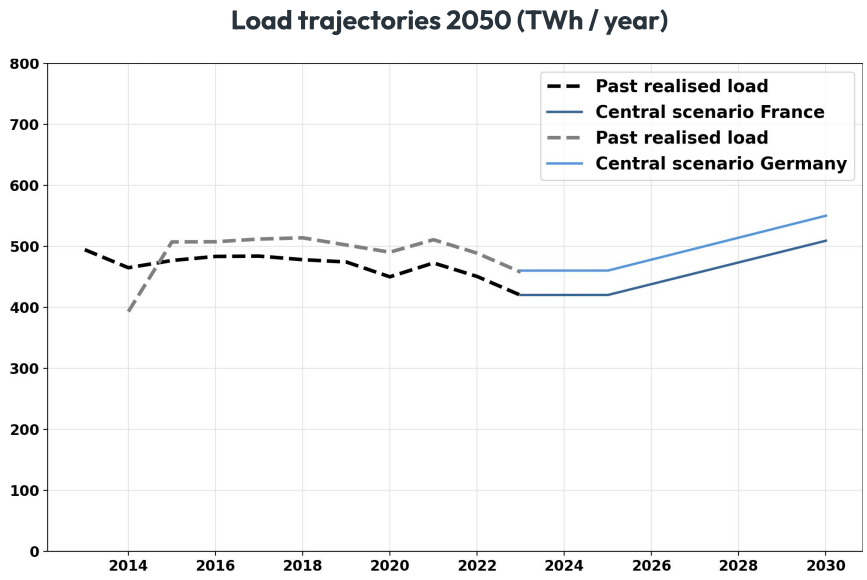


Figure 3a: France and Germany load projection

In France, the latest policy revision, known as the "Stratégie Nationale Pour le Climat & PPE3," has set a goal to at least double the existing solar capacity. Meanwhile, Germany's aspirations are even more ambitious. The "Photovoltaik-Energie" strategy aims for a target of 215 GW of installed capacity by 2030, starting from a current capacity of 77.5 GW.

This surge in capacity coincides with a period of structural stagnation in Europe's power demand, despite TSOs predicting a counter-cyclical surge that would match the incoming capacities. As of early February 2023, Europe is experiencing an ongoing 8% reduction in demand. This decline is attributed to high futures prices (with the French calendar year 2025 product still trading above 70 €/MWh), the implementation of a new energy conservation framework, and the industrial impacts of the 2022 energy crisis. Kpler's consumption forecast for 2024 remains pessimistic, casting doubt on the TSOs' ambitious projections.

Solar official projected installed capacities France (GW)

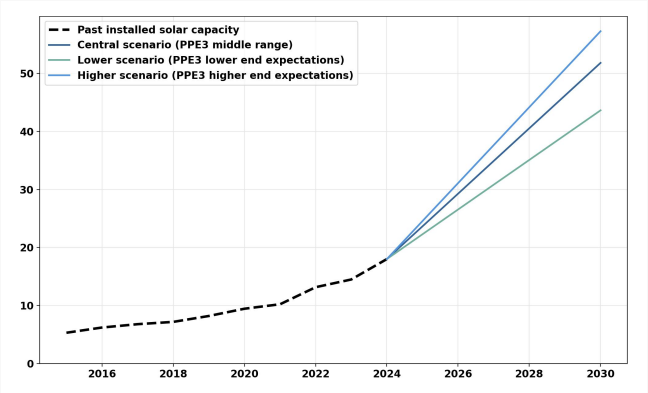


Figure 3b: French projected solar installed capacity

Solar official projected installed capacities Germany (GW)

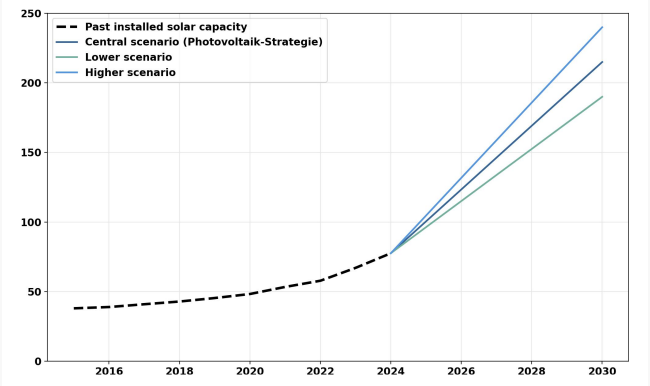


Figure 3c: German projected solar installed capacity

Weather scenarios

To evaluate the structural nature of the trend in negative prices and to anticipate developments in the coming years, Kpler employs weather scenario-based forecasts for day-ahead prices. Provided forward curves for installed capacity, we use specific weather years for the underlying fundamentals.

The load forecast is constrained by the assumptions presented above, and the RES generation comes from the combination of load factors and our forward installed capacity curves. We will look at the aggregated residual load from France and Germany.

Figure 4 depicts the correlation between the aggregated residual load and the average price across the two countries in question. It shows that negative prices have historically occurred in at least one of the two countries whenever their combined residual load fell below 60 GW.

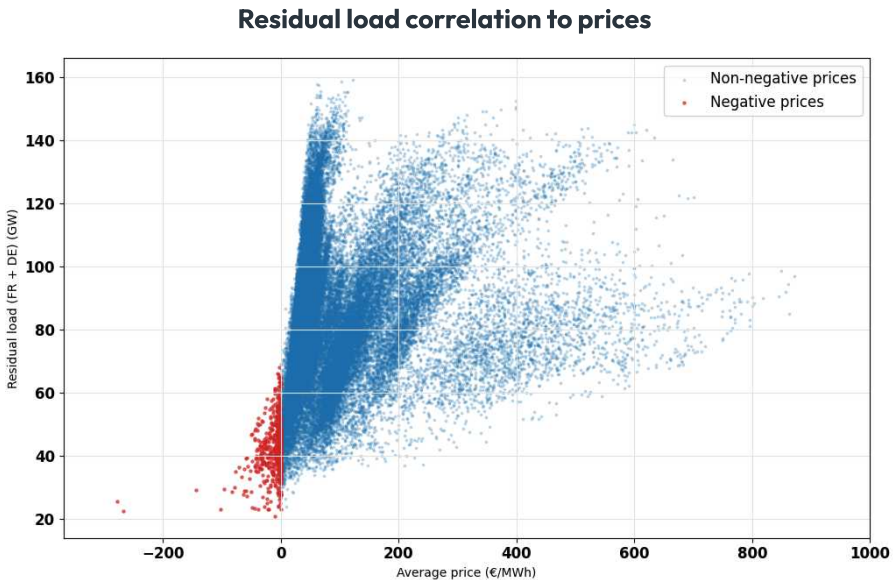


Figure 4: Aggregated residual load and day-ahead prices

Leveraging historical data, we will utilise Kpler's generation models to construct hourly production forward curves. These models depend on detailed weather data at the grid level and a comprehensive catalog of production units to forecast generation at the country level. By integrating the introduction of new capacities and applying load factors that adhere to a realistic hourly distribution, we can delineate the production profiles. Solar load factors are relatively consistent from year to year. We have chosen the year 2020 for our analysis due to its slightly higher-than-average wind generation levels.

Our simulation outcomes for 2024 are illustrated in **Figure 5**. Based on nearly seasonal weather inputs, along with our forward curves for Renewable Energy Sources (RES) installed capacities and load, we anticipate that 2024 will experience a similar number of negative price hours as 2023. The persistent rise in RES over the last four years has initiated a market transformation that appears to be structural. It's important to note that these simulations also assume no demand increase over the upcoming year.

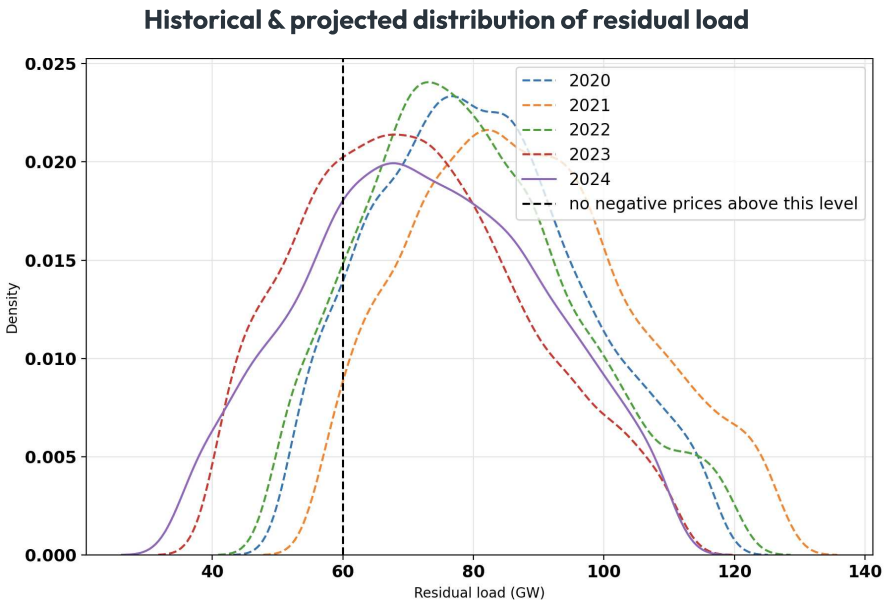


Figure 5: Historical & forecasted residual load

Europe's balancing markets: What is the response?

Negative prices signal an increased risk of supply temporarily outstripping demand. To address these scenarios, the EU market depends on services designed to swiftly reestablish grid balance. The anticipated rise in system imbalances, coupled with the early development stage of these markets, presents opportunities for batteries and flexible assets.

Frequency response services are crucial for addressing grid disturbances. Among these, the Frequency Containment Reserve (FCR) serves as the primary response to frequency deviation, and acts to quickly prevent further frequency drift. In this market, only capacity is remunerated, and the auction takes place before the day-ahead auction. FCR is procured at the EU level, however, a specific set of rules has a very strong impact on the price setting mechanism at the country level.

The first of those is the core share constraint, that impacts significantly the price in countries with fewer flexible capacity. In Europe, Belgium is notable for its frequent shortage of flexible capacity offerings in the market, resulting in FCR prices that are often significantly higher than the common EU price, as illustrated in **Figure 6**. This is both an opportunity for flexible assets projects and a cost for the end consumer and market participants. Indeed, balancing prices directly influence the imbalance penalty as well as the distribution fee, which makes it increasingly important for market stakeholders to forecast those over the medium and long run.

Monthly average of FCR prices (€/MW/h)

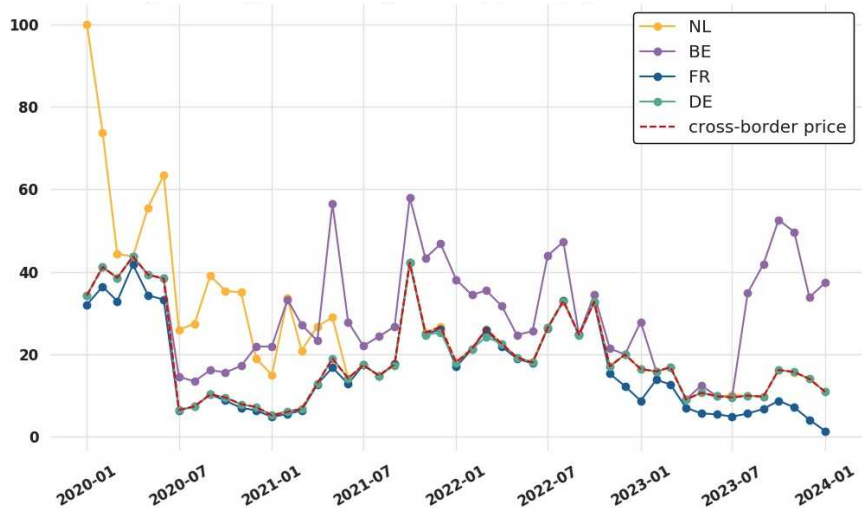


Figure 6: FCR Prices in the EU

In order to understand the dynamics behind the frequency response pricing, one needs to have a deep knowledge of market rules, related projects and fundamentals. Kpler's models project future FCR and aFRR prices for all EU countries, considering different penetration rates of batteries. This way, we are able to capture how the structural aspects of the market will impact prices in the long-run.

Understanding these future trends is crucial, given the significant differences between countries within Europe. France, for example, has seen its FCR price falling way below the EU common price as the market is already saturated. The direction that FCR requirements will take, as well as the amount of new projects coming online will be key determinants in shaping the direction of prices across EU countries.

In addition to those structural questions, it is also crucial to understand day to day variations in prices, which are partly fundamentally based. Weather-year based analysis, as illustrated in the previous section, can help predicting the levels and volatility on those markets. Kpler's models undergo daily evaluations as they forecast the outcomes of balancing markets in Europe, utilising a fundamental and structural approach to these markets.

Conclusion

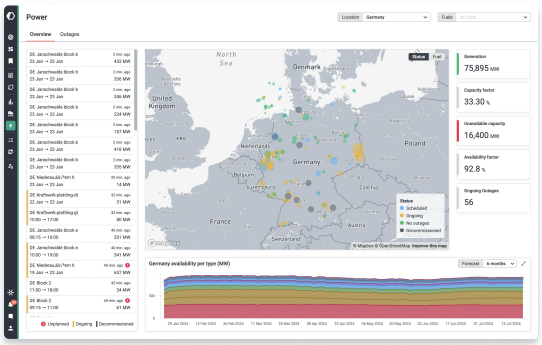
The power market in the European Union has experienced significant transformations in recent years, largely due to the energy crisis, which resulted in an important decrease in demand from both the industrial and residential sectors. At Kpler, we think that those changes will persist over time. A most important shift is the growing imbalance on the grid, largely attributed to the rising penetration of RES in the market. We anticipate that more capacity will be added in the coming years, likely extending this trend even further.

The increasing imbalance will impact different countries in various ways. Our solutions provide a comprehensive understanding of the market, offering country-specific forecasts for all frequency response services. As part of our service, these forecasts are delivered and evaluated daily, aligning with the most recent market trends and enabling the optimal operation of flexible assets.

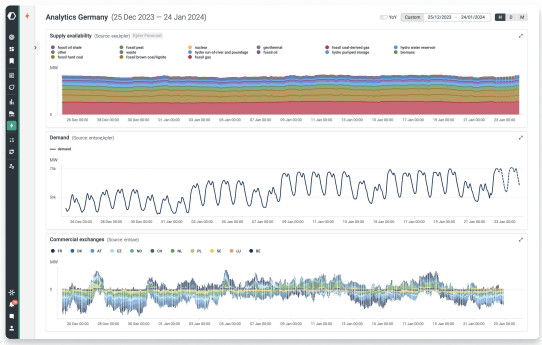
Kpler products

Power market intelligence through a variety of data and analytics tools.

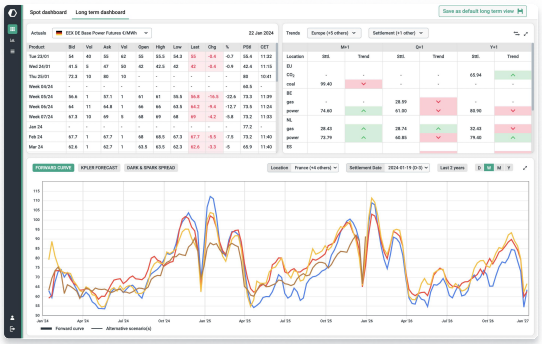
Real-time outages and availabilities



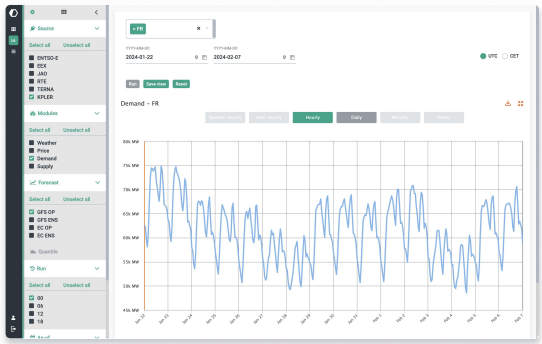
Supply and demand modelling



Proprietary fundamentals forecasts



Post-processed market data



Use cases

- Build better supply and demand models with fuel availability curves, renewable generation forecasts, and demand forecasts
- Ingest robust post-processed market and weather data for building your own models and systems
- Anticipate market movements with real-time outage alerts
- See price trends for power, gas, and carbon to shape procurement strategy
- Get hourly forward curves for modelling asset and portfolio performance

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