

KYOS Webinar

BESS Market Update Poland

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28 January 2025



KYOS Webinar – BESS Market Update Poland



Agenda

- 15:00h – 15:10h Welcome and introduction
- 15:10h – 15:35h BESS market update Poland
- 15:35h – 15:45h Q&A

Speakers:

- Lucas Narbondo Alvarez
- Steven Verbeek

KYOS Energy Analytics

- Activities started in 2002, founded in 2008
- 40+ people, head office in Haarlem, The Netherlands
- Specialists in energy & commodity markets: trading, valuation, risk management
- Combine quantitative background with practical solutions
- More than 100 corporate clients across the world using our software services



Our analytics – your advantage



Software for energy valuation & optimization

Solutions for valuation, optimization and risk management, coupled with advanced forecasting and price simulations.

- Power plants
- Renewable generation
- Gas storage
- Gas swing contracts
- Batteries
- Options



Software for multi-commodity exposures

The Commodity Portfolio & Risk Management software combines physical commodity management with financial risk reporting and price analytics.

It swiftly reveals the company-wide financial risks in clear reports.



Consultancy

We offer a wide range of top analytical services to companies in the energy and commodity markets. We are specialists in valuation, optimization and risk management.

Our expert services range e.g. from a one-off deal valuation to a complete solution for the risk management of a portfolio of assets and contracts.



Price data

Live or End-of-day market price forward curves are essential for trading, structuring and risk management.

In addition, we have a fundamental model for long-term (>30 year) power prices..

KYOS approach to energy assets



- Apply advanced financial models combined with experience of the energy market to value and optimize assets.
 - Models developed by experienced quant team, over past 20 years
 - KYOS is at the forefront of new developments, understanding the market's needs.
 - Continuous feedback from our clients helps us to stay ahead
- Calculate the market value of an asset by optimizing it in the market with a range of trading strategies
 - Use realistic scenarios and trading strategies for the valuation of the market value.
 - Use transparent methodologies and scenarios





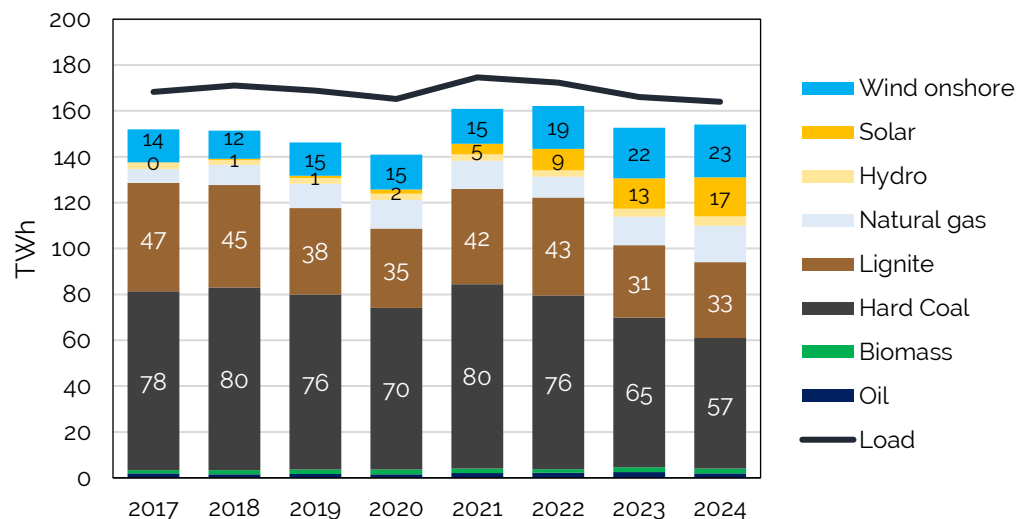
The Polish Power Market

Setting the scene: Poland's electricity supply & demand

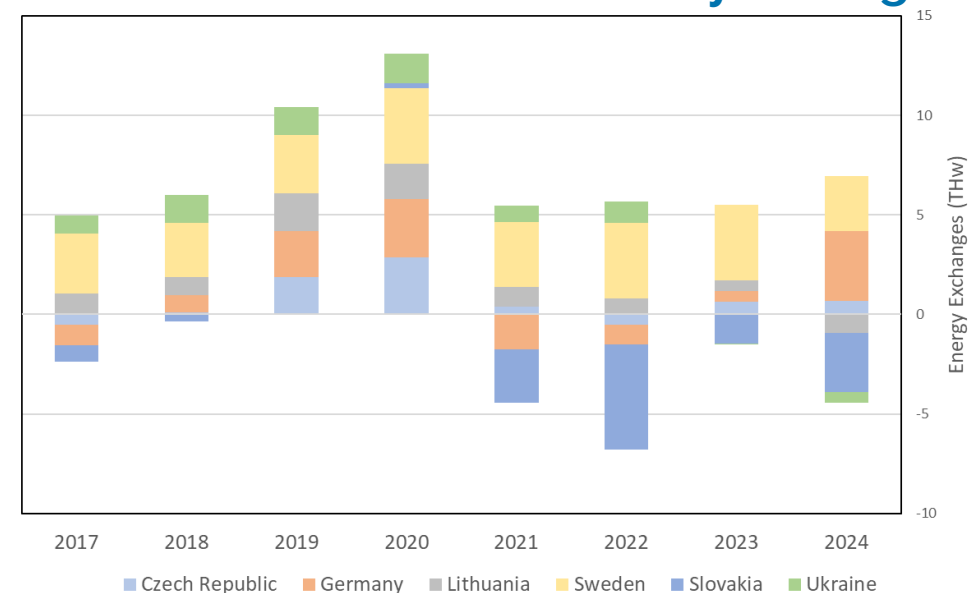


- Demand: Fairly stable over the past 7 years
- Coal & Lignite: Share is decreasing rapidly, still backbone of the Polish electricity mix
- Renewables: Gaining a significant share
- Gas: New plants, new terminals, diversification of supply, less Russian imports, market liberalization
- The gap: filled by cross-border electricity exchanges; net importer of electricity

Historical electricity supply & demand

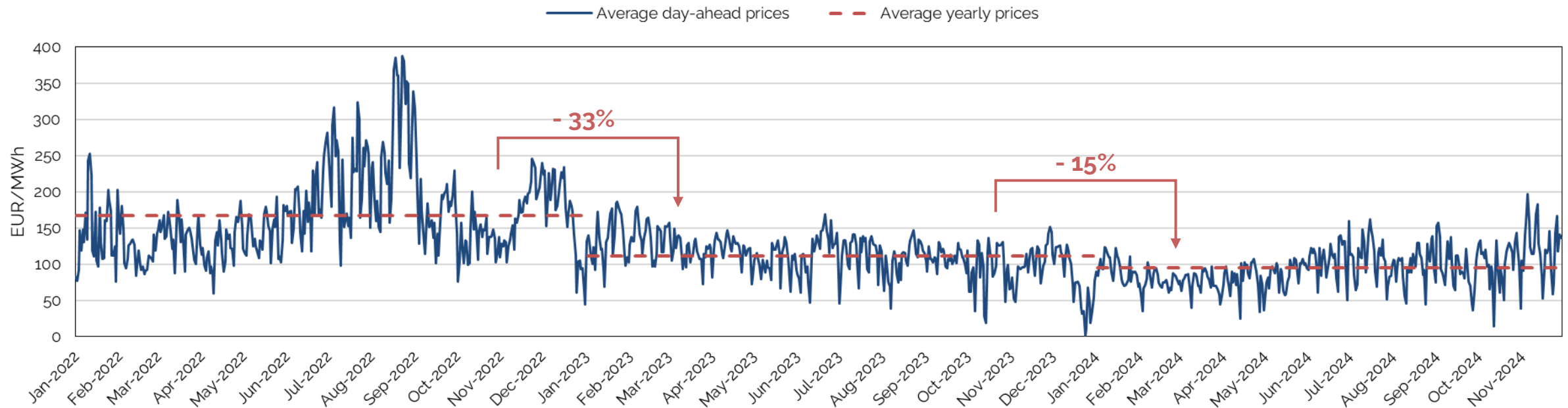


Annual cross border electricity trading



Electricity market price developments

Since the energy crisis in 2022, electricity prices leveled down on the back of demand destruction and strong renewables



2022

- Cuts In Russian gas exports
- Low availability French nuclear
- Polish power prices lower than its neighbors, thanks to large share of lignite & coal-fired power production

2023

- Mild winter
- Demand side reduction
- Nuclear in France back online
- Strong renewables

2024

- Limited demand recovery
- Strong nuclear output & healthy hydro
- Strong growth of solar power production.
- Strong LNG imports
- High gas prices

Drivers

Poland's Energy Policy and recent updates

- **PEP2040:** a "just" transition to a zero-emissions energy system -> More renewables, less coal, introduction of nuclear
- Later revisions (**draft NECP Oct24**) -> substantially faster integration of renewable sources and phase-out of coal



4. KEY ELEMENTS OF PEP2040

<p>Energy transition taking into account electricity self-sufficiency</p> <p>Increase in the share of RES in all sectors and technologies. In 2030, the share of renewable energy in gross final energy consumption will be at least 23%</p> <ul style="list-style-type: none"> - not less than 32% in electricity (mainly wind and PV) - 28% in heating (increase by 1.1 pp per year) - 14% in transport (with a large contribution of electromobility) 	<p>Installed capacity of offshore wind energy will reach:</p> <p>approx. 5.9 GW in 2030 and up to 11 GW in 2040</p>	<p>There will be a significant increase in installed photovoltaic capacity</p> <p>approx. 5-7 GW in 2030</p> <p>approx. 10-16 GW in 2040</p>
<p>Energy efficiency will increase – for 2030, a target of 23% reduction of primary energy consumption (compared to PRIMES2007 projection)</p>	<p>TSOs and DSOs investment programmes will be focused on the development of renewable energy sources, active consumers and local balancing</p>	<p>In 2033, the first power unit of a nuclear power plant will be launched, with a capacity of approx. 1-1.6 GW</p> <p>Subsequent units will be implemented every 2-3 years, and the entire nuclear programme involves the construction of 6 units</p>
<p>By 2040, the heating needs of all households will be covered by system heat and by zero or low-emission individual sources</p>	<p>Natural gas will be a bridge fuel in the energy transition</p>	<p>In 2030, the gas network will be able to transport a mixture containing approx. 10% of decarbonised gases</p>
		<p>The infrastructure of natural gas, crude oil and liquid fuels will be expanded, and the diversification of supply directions will be ensured</p>



Increased renewable electricity generation targets: at least 50% electricity generation from renewable sources in 2030



Accelerated coal phase-out: coal's share in electricity generation to decrease to 22% by 2040



Expansion of solar capacity: aim for 29 GW installed solar by 2030 and 46 GW by 2040



Expansion of onshore wind capacity: "Distance Act" relaxed; targets 19 GW capacity by 2030 and 25.8 GW by 2040



Expansion of offshore wind capacity: target is 9 GW by 2030 and 17.9 GW by 2040



Enhanced energy storage integration: role of energy storage (batteries + hydro PS) emphasized, projected at 4% of electricity generation mix by 2040.



Delayed nuclear commissioning: the first nuclear plant to come online in 2040 compared to the initially planned 2033.

Poland: BESS incentives framework

Key support schemes for new BESS projects:

- the Capacity Market
- EU grants and loans to cover capital costs.

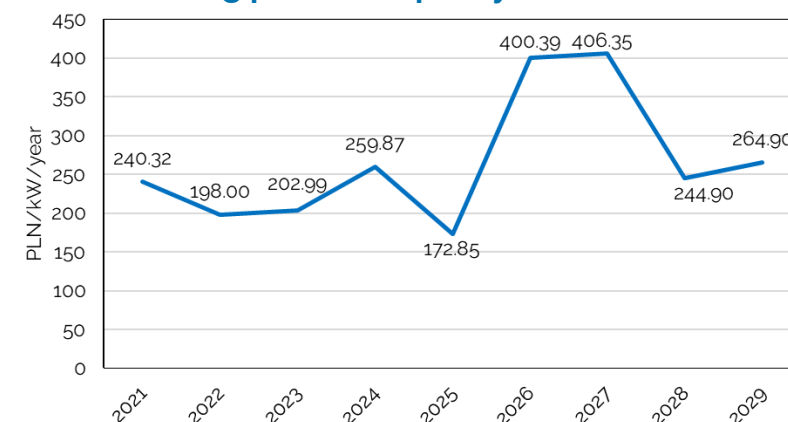
Capacity Market

- Dutch auction system
- Remunerated at a fixed price per kW/pa for a 17-year period.
- Dec 24 auction: 2.5 GW of BESS capacity awarded (operational in 2029). Versus 1.7 GW of BESS (2023) and 165 MW in 2022.
- Dec 24 auction: Closed at 264.90 PLN/kW/year (~62 EUR/kW/year).

EU grants & loan

- Since Oct24: €1.2 billion (PLN 5 billion) Polish state aid scheme to support the transition to net-zero
- Open to all technologies relevant for energy transition
- Direct grants and loans to help cover the investment cost

Closing price of Capacity market auctions



4 MWh

Minimum energy storage capacity

5.4 GWh

Energy storage capacity expected to benefit

45%

Maximum share of investment costs

Poland: BESS Capacity and major projects

Modest installed battery capacity but poised for remarkable growth in the upcoming years.

- 8 Operational front-of-meter storage assets in Poland, totaling 197 MW / 335 MWh
- Largest battery projects awarded during the 2023 and 2024 capacity auctions:

 greenvolt Power

1.2 GW of capacity spread across six different BESS projects, ranging from 85MW to 510MW each.

 PacificGreen

50 MW / 200 MWh BESS project in Platerówka, with commissioning targeted for 2028

 edp
Renewables

Two standalone BESS projects totaling 160 MW / 640 MWh, commencing operations by 2026 and 2029

 OX2

Two BESS projects totaling 200MW / 400MWh, expected to be commissioned in 2027-2028.

 R Power
RENEWABLES

Four BESS projects totaling 655MW / 2300MWh

The Polish electricity market within the European landscape



Part of several initiatives and further efforts toward full harmonization ongoing.

Day-Ahead market

Poland full part of the Single Day-Ahead Coupling (SDAC)

Intraday market

Poland full part of the Single Intraday Coupling (SDIC)

FCR

Poland manages its FCR market independently. No immediate plans to join any FCR procurement initiative

aFRR

Non-operational member of PICASSO. Go-live to enter full operation planned for May 2025

mFRR

Non-operational member of MARI but the go-live date has not yet been set

Recent developments on the Polish Balancing market

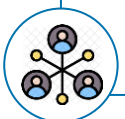
June 2024: Reduction of the imbalance settlement period from 60 to 15 minutes.



The reform: part of a broader effort to align Poland's energy market with the European Union's energy regulations



Reduction of imbalance settlement period for balancing energy from 60 minutes to 15 minutes, crucial for better integration of RES



Reduction of minimum capacity requirements and definition of BSP and BRE



Market consequences

- Improvement for the Polish Balancing market
- Integration with the European markets
- BESS profitability
- Increase in price volatility likely



Drivers of Polish BESS Value

Poland: Market volumes

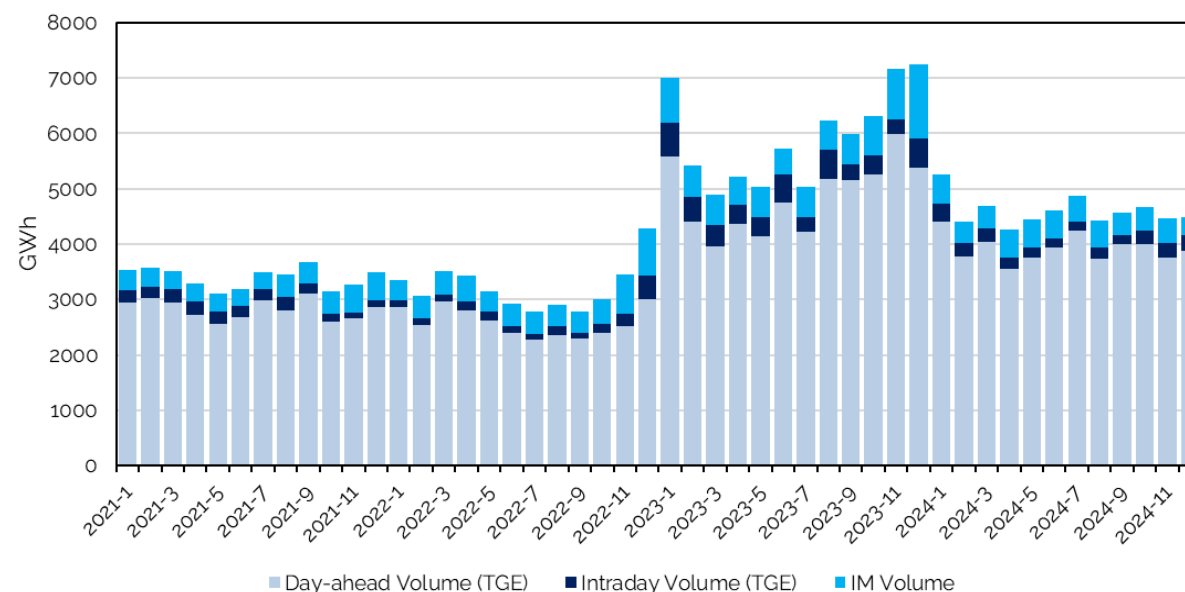
The Day-Ahead market is the most liquid of the spot markets and its traded volumes peaked during 2023 before stabilizing in 2024. The Intraday market has very low liquidity compared to the Day-Ahead.

Trading Platforms: Day-Ahead and Intraday trading in Poland occurs primarily on TGE (most liquid), as well as EPEX Spot and Nord Pool. All are part of the Single Day-Ahead (SDAC) and Single Intraday (SIDC) Coupling.

Growing Intraday Interest: Increasing renewable production makes post-Day-Ahead balancing more challenging, driving interest in Intraday and Imbalances markets.

Short-Term Opportunities: Higher volumes in Intraday and Imbalances enable players with flexible operations to quickly adjust and capitalize on short-term price movements.

Monthly traded volumes on the Polish market



Sources: TGE, ENTSO-E Transparency Platform, EPEX Spot

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The Day-Ahead market

The spread between the max and the min Day-Ahead hourly prices surged in 2022 before decreasing once again in 2023. The reform of the Balancing market introduced in June 2024 increased price volatility once again.

2022 Price Spreads Surge

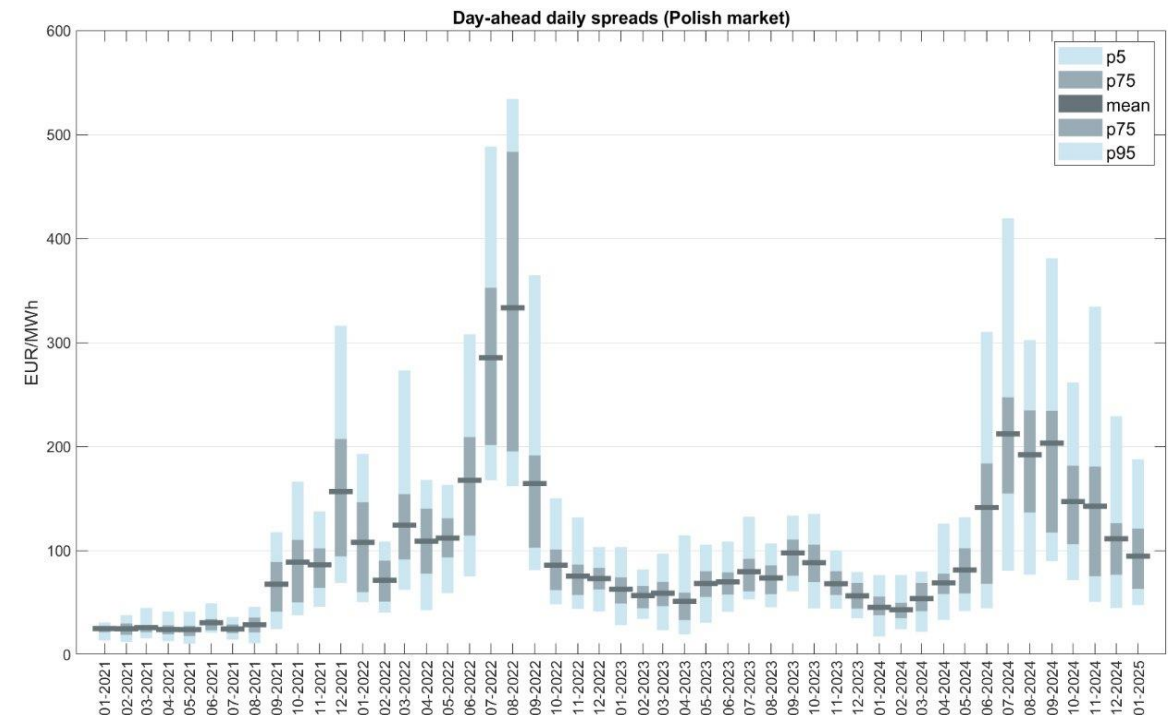
- Driven by tight supply and extreme gas prices, Day-Ahead price spreads peaked in 2022.

2023 Normalization, but Still Elevated

- Spreads returned to lower levels yet remain higher than pre-crisis.
- Notable seasonal pattern: wider spreads in summer than winter.

2024 Market Reform & Volatility

- Balancing market reform in June 2024 increased volatility in both imbalances and Day-Ahead.
- Limited liquidity and shifting bidding behavior contribute to these volatility spikes.



Sources: TGE, ENTSO-E Transparency Platform, EPEX Spot

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The Intraday market

Spreads on the Intraday market are in line with those on the Day-Ahead market; this is due to the (as yet) low penetration of intermittent generation sources within the Polish electricity system.

Intraday Market Segments

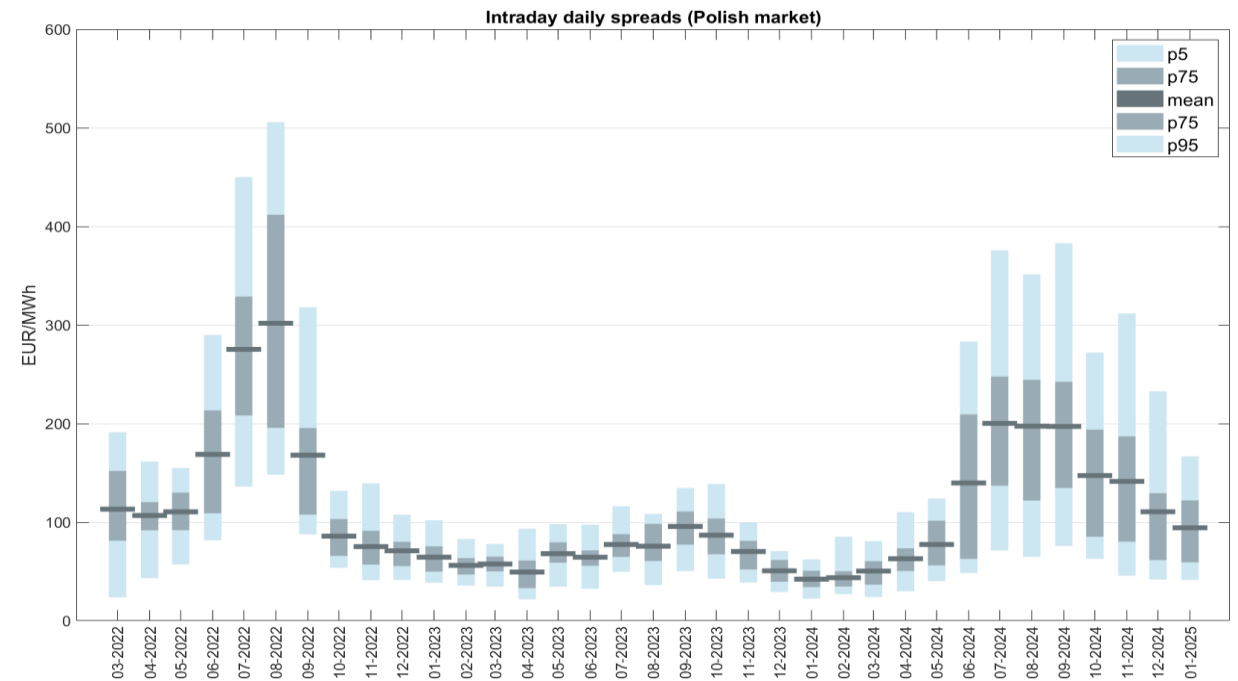
- **Intraday Auction:** Set times, bids submitted, market-clearing price determined.
- **Continuous Trading:** Real-time trades up to 5 minutes before delivery; higher volumes than auctions.

Price Spreads

- Intraday spreads mirror the high Day-Ahead spreads, due to limited intermittent generation.

New Quarter-Hourly Products

- Polish intraday was previously hour-based.
- TGE introduced quarter-hourly continuous trading in June 2024, alongside the balancing market reform.



Source: EPEXSpot

The aFRR market

Because of the high volatility in imbalances prices and the fast response times required, aFRR is an important revenue stream for BESS operators.

Single Imbalance Price

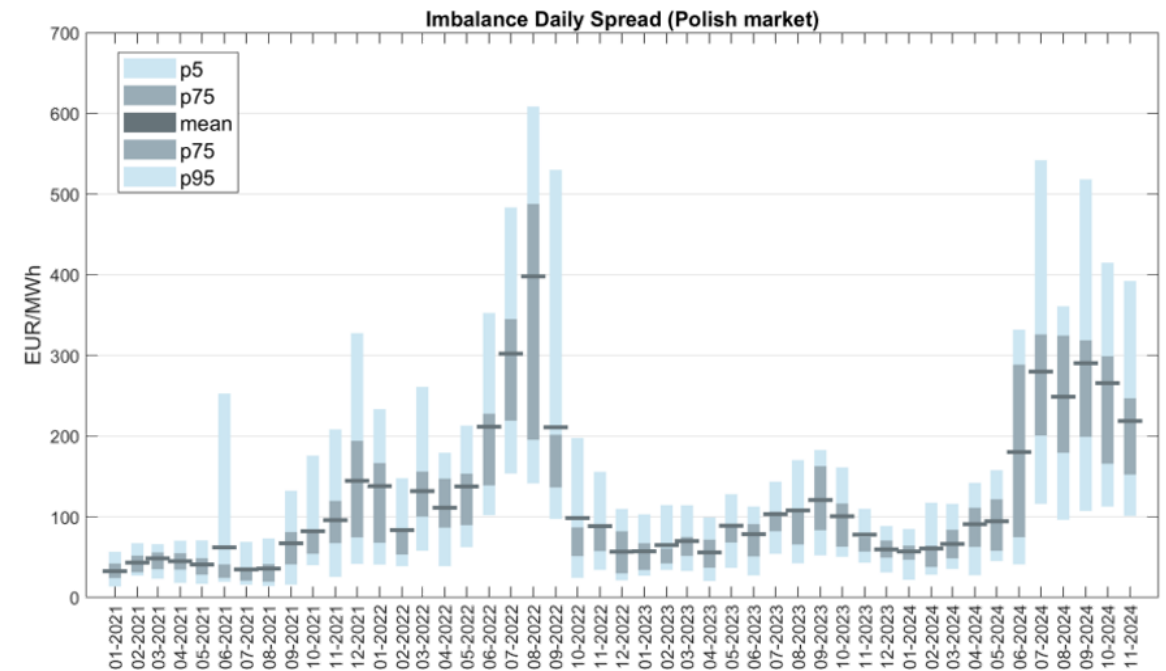
- One price for both shortages and surpluses per 15-minute interval.
- Upwards balancing = generation increase; downwards balancing = curtailment.

Marginal Pricing

- Balancing price equals the highest (or lowest) accepted bid for that period.

Impact of Renewables

- Growing intermittent generation increases demand for flexible capacity, pushing balancing prices higher.



Source: EPEXSpot

The FCR market

Frequency Containment Reserve (FCR) requires extremely fast response times and could represent a good occasion to help increase BESS earnings.

FCR Market Introduction (June 2024)

- Requires full activation within 30 seconds.
- Participants must qualify by demonstrating responsiveness.

Auction Structure

- TSO procures 1-hour “Up” and “Down” products.
- Cleared at marginal price, with stable volumes of 177 MW/h per direction.

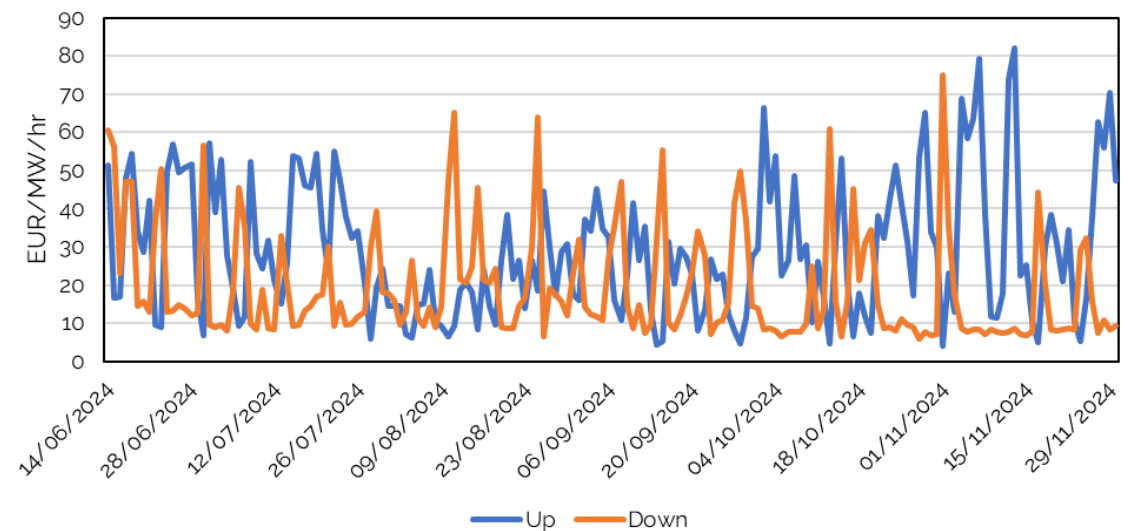
Observed Prices

- Avg. Up: 29 EUR/MW/h; Down: 19 EUR/MW/h (June–Nov 2024).

Future Outlook

- Growth depends on renewable expansion vs. storage capabilities.
- FCR provides additional revenue but wholesale/imbalance markets remain primary sources.

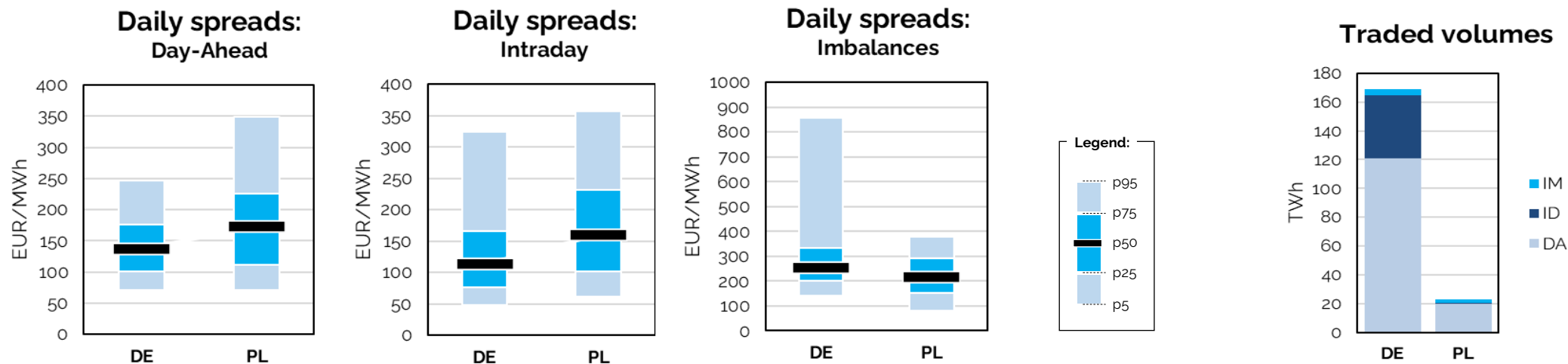
Average daily FCR price



Source: ENTSO-E Transparency Platform, PSE

Poland: A comparison with Germany

To put into perspective the data shown in the previous slides for Poland, we compare some reference price and volume figures against Germany for the period after the reform of the Polish balancing market (June 24).



Prices:

- **Poland:** Already high daily spreads in Day-Ahead, similar levels in Intraday/Imbalances.
- **Germany:** Lower Day-Ahead spreads, higher Intraday/Imbalances price spikes.

Volumes:

- **Poland:** Lower Intraday liquidity drives more imbalance trading (relative to total volumes).
- **Germany:** Larger market, higher Intraday volume share.

FCR:

- **Contracted volume:** 177 MW (PL) vs. 564 MW (DE).
- **Avg. FCR price:** ~24 EUR/MW/h (PL), ~18 EUR/MW/h (DE).

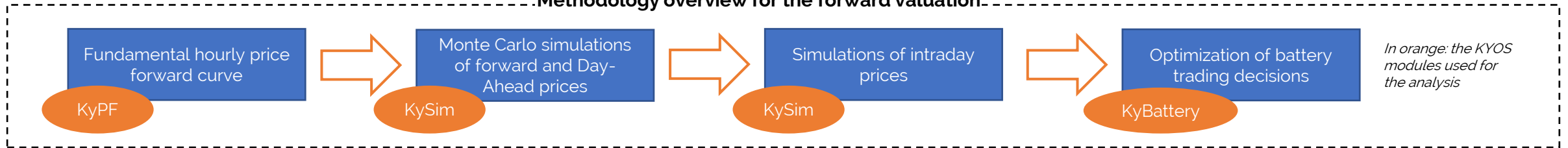


Poland BESS Battery Valuation

KYOS' BESS Valuation approach

The valuation is performed with a suite of models in the KYOS Analytical Platform and is largely reflecting the behavior of battery traders active in the wholesale markets .

Methodology overview for the forward valuation



1. Run a forward valuation

- Based on market conditions before the reform
- This assesses the undiscounted gross margin of the battery (revenues minus costs of operating in the market and excluding investment and financing costs) over a 10-year period
- We use KYOS Power Fundamental model (KyPF) to simulate forward curves. The model uses a detailed pan-European dataset.
- The trading strategy is evaluated on Monte Carlo price simulations of Intraday power prices. The methodology to generate the simulations is implemented in the KySim model.
- The optimization of the trading strategy takes place in the KyBattery module of the KYOS Analytical Platform. KyBattery finds the optimal (though realistic) trading strategy with the battery in the Intraday market.

2. Run two separate backtests

- Using our KyBattery valuation model.
- Backtests assume perfect foresight of all realized prices within the backtesting period.
- Before and after the reform
- Allows us to evaluate the impact of the reform

Poland BESS forward valuation (pre-reform)

The results of the forward valuation are quite low, driven by the low daily spreads and volatility characterizing the Polish market before the reform of the balancing market.

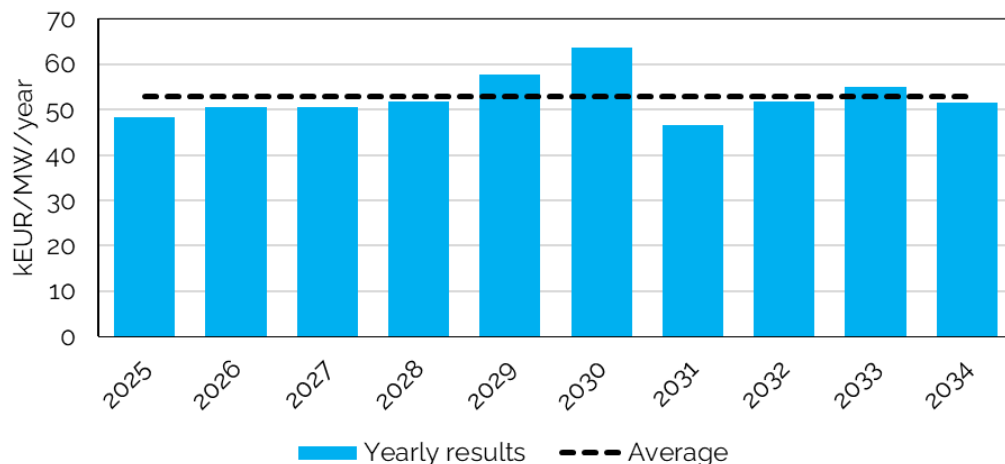
Battery Settings:

- Energy storage capacity: 2 MWh – 2hour battery
- Roundtrip efficiency: 90%
- Max number of cycles per year: 730
- Not included: battery degradation, variable costs, transmission costs

Average of 53kEUR/MW/year

- Approximately 150 kEUR/MW in Belgium and Germany and approximately 270 kEUR/MW in The Netherlands. For more info, see the quarterly “Energy storage reports” published on the KYOS website.
- **Important:** this valuation is based on market conditions before the balancing market reform; the low value derives from the low daily spreads and volatility characterizing the market at the time.

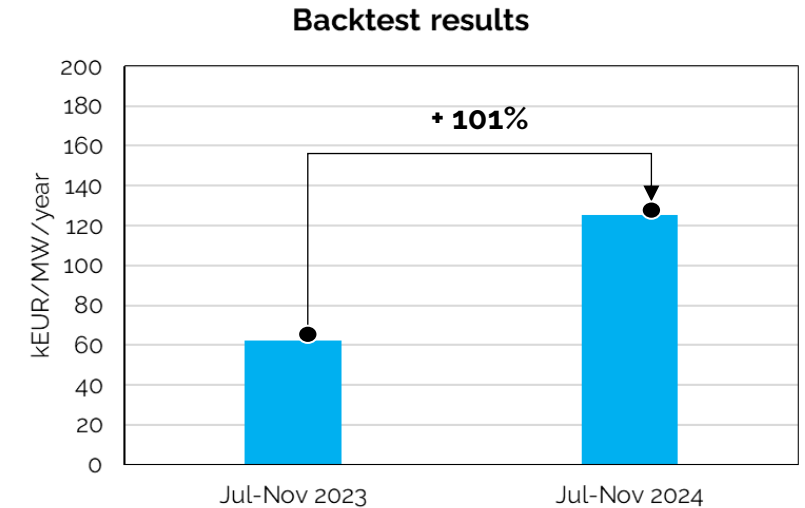
Forward valuation results



The backtests and the adjusted forward valuation

The backtests show a remarkable increase in value from the period of Jul-Nov 2023 to Jul-Nov 2024. If we adjust our forward valuation, we expect BES revenue levels in Poland to be in line with those of other European markets.

- The backtest results before and after the reform are:
62.28 vs 125.11 kEUR/MW/year. A 101% increase
- We believe our valuation can be considered conservative because of the following reasons:



- 1) Intraday market:
 - Quarter-hour ID launched with reform (more volatile than hourly).
- 2) Trading assumptions
 - KyBattery model currently makes one trading decision per PTU.
 - Continuous ID trading offers more opportunities to capture volatility.
- 3) Revenue stacking potential
 - ID-only strategies miss additional revenue from Day-Ahead, aFRR, and FCR markets
 - KyBattery can optimize across all these markets
- 4) Poland's Transition & Future Outlook
 - Ongoing phase-out of coal/gas and increasing renewables will likely increase price volatility.
 - Greater volatility and ancillary services participation can elevate BESS revenues to levels seen in other European markets

Summary: Good potential for BESS in Poland



Upside



Strong base of coal-fired Baseload replaced by intermittent RES

Expect structural increase in volatility and spreads in ID & IM markets



Increasing alignment with EU Energy Markets structure

Increasing regulatory and political support for BESS



Under post-reform market conditions, and using revenue stacking (DA, ID, IM, aFRR), we expect BESS revenue to catch up with other European markets.

For a detailed Poland BESS forward valuation under KYOS' post-reform assumptions, please contact us for our (paid) full:

[KYOS Country BESS Report: Poland](#)

Risk



Coal-fired BL generation remains (longer), or is replaced by Nuclear



Discontinuation of regulatory and political support for coal phase-out, RES, BESS

Some useful publications

Free publications & Information:



See: <https://www.kyos.com/knowledge-center/>

Paid publications:

- KYOS Country BESS Reports

Questions and Answers



Q&A!

We look forward to supporting you with the right tools and advice in the rapidly changing energy sector!



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