



KYOS Energy Analytics

Energy storage report

Benchmark - assessments of battery energy storage value



No 7 • February 2025

Battery revenue projections

Revenues 2026 (k€/MW)	Market	Day-ahead		Day-ahead + FCR		Intraday		Intraday + imbalance	
		Ave	10%	Ave	10%	Ave	10%	Ave	10%
	NL		105.1	96.3	131.7	123.8	302.9	291.0	307.6
BE		93.1	85.6	221.7	216.9	177.5	171.8	192.4	186.3
DE		106.4	93.0	131.2	118.8	172.6	156.5	n/a	n/a
ES		79.9	51.3	n/a	n/a	97.6	71.7	n/a	n/a
GB		74.9	64.4	n/a	n/a	88.9	80.6	88.9	80.9

Battery revenues in k€/MW in 2026 for a stand-alone located, 0.5C battery with a roundtrip efficiency of 90% and a maximum of 730 cycles per year. For more details, see the section 'Explanation' on the back page of this report.

Please note that values are in k€/MW (=€/kW). As we use 0.5C batteries, to understand the figures in €/kWh just divide by two.

for 2026. ES and GB continue to be ranked lower compared to the CWE markets (NL, BE, and DE). This regional spread increased further for our 2026 assessment, further positioning CWE as attractive battery markets.

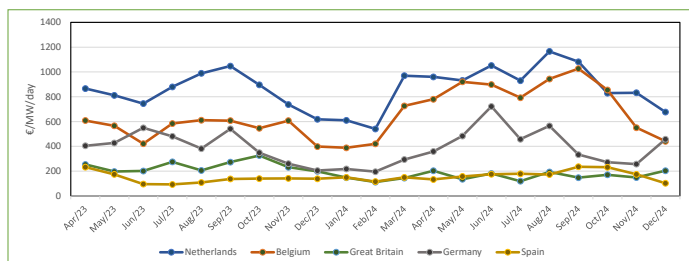
The last three editions of our report focused on the 2025 revenue assessment. This report, with a trading date of January 13th, marks our first 2026 revenue assessment. Compared to the 2025 assessment, the battery revenue valuations for NL, BE, and DE in the day-ahead and intraday markets have increased, as higher spreads are projected

A key change in the 2026 evaluation is that DE has slightly surpassed NL in the day-ahead market. However, intraday trading remains the key revenue driver across all markets and NL continues to lead significantly in the intraday market valuation. In the intraday market, BE's valuation exceeds DE's and benefits from an additional advantage through passive imbalance trading.

KYOS Battery Index

The **KYOS Battery Index** serves as a benchmark for battery optimizers. It shows the average daily revenue in the past months when trading a 2-hour battery in the intraday market. In GB, NL & BE it includes passive imbalance trading with 30% of the capacity. A description of the methodology can be found on page 6 of this report. This index shows the wholesale cashflow potential for batteries, which cannot be directly translated into market attractiveness for batteries as grid fees are not included in the calculation of the index.

The NL and BE markets followed a seasonal pattern, with high battery index values in summer declining into winter. End-of-year 2024 indexes, however, were higher than in 2023, reflecting an upward trend driven by more renewables and slow flexibility adoption. In DE, the post-summer decline was less sharp than in NL and BE, with a noticeable uptick in the December value. For instance, a very tight supply situation characterized by lower renewable generation (or the so-called Dunkelflaute) occurred on the 11th December. During this day, ID1 prices in Germany surged to over 2,000 EUR/MWh. In contrast, the ES and GB markets remained stable throughout 2024, with a mild decrease in indexes compared to 2023 post-summer period, highlighting the impact of higher system flexibility in limiting energy arbitrage opportunities.



Battery revenues in €/MW/day. The index considers a participation in the ID and IB markets (the latter capped to a maximum of 30% of the capacity) for the NL, BE and GB indexes, and an ID only participation for the DE and ES indexes.

From power.kyos.com



Battery revenues report

February 2025

KYOS Battery index vs revenues

Equivalent value (€/MW/day)	Market	Index 12-month average (Sep23-Aug24)	Assessment 2026
	NL	882	843
	BE	729	527
	DE	385	473
	ES	165	267
	GB	159	244

In order to compare the **KYOS Battery Index** and the latest **KYOS Battery Revenue Assessment for 2026** we show them in the same unit: €/MW/day.

The GB, NL and BE figures are based on Intraday + Imbalance, while for DE and ES only Intraday.

Our historical analysis (KYOS Battery Index) and prospective assessment (2026 Assessment) consistently rank the Netherlands as having the highest wholesale cashflow potential, with Spain and Great Britain ranked lowest. As noted in the previous report, the most notable contrast between the two metrics is the magnitude of the difference between Belgium and Germany, driven by Germany's intraday spreads surpassing Belgium's during the last summer. While the gap remains large, it is narrowing, as Belgium regained its lead for the remainder of the year, except in December (see Intraday Daily Spreads on the right).

The table shows that for the BE and NL markets, 2024 values were relatively high, exceeding the projected 2026 values, whereas GB, DE, and ES markets are expected to achieve higher values in 2026 than in 2024. It is mainly driven by the market view of higher spreads in 2026, suggesting that the market expects more need for flexibility going forward in those countries.

Great Britain's 12-month average index decreased again, consistent with the previous report, while Germany experienced a negligible 0.8% decrease. In contrast, all other markets saw increases in their 12-month average indexes, reflecting broader trends of rising volatility and opportunities for battery trading.

Day-ahead daily spreads

Country	Average daily spread in the Day-Ahead prices (€/MWh)		
	Last 36 months	Last 12 months	Last 3 months
NL	141.7	113.2	118.1
BE	126.5	92.5	94.3
DE	133.6	116.0	118.4
ES	79.7	71.2	78.1
GB	107.6	71.7	102.0

The daily Day-Ahead (DA) power price spread is the highest DA price of the day minus the lowest DA price of the day, averaged hourly. The table shows data for the latest N months, up to December 2024 (incl).

Trend: There is an upward trend in the last 12 months for all markets, mainly driven by higher volatility during Q4-24. The low wind and solar generation and the rise of gas prices results in higher daily spreads this winter. This dragged up the 12 months average values

used for the 2026 battery assessment simulations.

Regional Comparison: In a regional comparison, CWE countries exhibit significantly larger spreads than GB and ES. However, during the last three months, daily spreads in GB exceeded those in BE. The high GB DA spreads during the last three months originated from a few occasions with tight supply/demand situations.

Software - KyBattery

- 1) State of the art tool to provide energy storage valuations
- 2) Based on Monte Carlo price simulations and Least-squares Monte Carlo to perform realistically optimal trading strategy
- 3) Supports wide range of battery configurations
- 4) Supports different technologies: Li-ion, pumped hydro, flow batteries, compressed air energy storage
- 5) Supports different set-ups: standalone assets, co-located assets
- 6) Participation in multiple markets day-ahead, intraday, imbalance, FCR and aFRR (also combined strategies).

Consulting - Examples

- 1) Valuation of battery cashflows with different market participation approaches to develop business cases
- 2) Independent assessment of expected revenue streams for third parties
- 3) Comparison between different storage assets and types to identify competitive advantages per market
- 4) Battery sizing for optimal network use in combination with co-located generation assets
- 5) Benchmarks to validate performance of energy storage optimizers

Across all European markets, for all energy storage techniques

Intraday daily spreads

The daily Intraday (ID) power price spread is the highest intraday price of the day minus the lowest intraday price, averaged hourly

Trend: NL, BE, and DE follow a seasonal pattern, with high spreads during summer and low spreads during winter. As a result, spreads over the past three months were lower compared to the previous report. This seasonal trend does not apply to GB and ES, where higher spreads were observed in GB during the last three months.

Regional Comparison: Looking at the 12 months averages, NL is still the market with the most attractive ID spreads. BE and DE followed at some distance. Compared to our previous report, DE overtook BE. This was caused by high observed ID spreads in DE during Q4-24; the result of a couple of tight situations in the grid due to periods of low renewable production.

Country	Average daily spread in the Intraday prices (€/MWh)		
	Last 36 months	Last 12 months	Last 3 months
NL	344.5	428.8	404.5
BE	233.1	297.0	299.2
DE	255.3	287.1	219.8
ES	95.2	85.8	94.3
GB	134.9	84.1	106.2

Imbalance daily spreads

The daily Imbalance (IB) power price spread is the highest imbalance price of the day minus the lowest imbalance price, averaged hourly.

Trend: Imbalance prices in NL and BE have increased in the long and medium term but decreased in the last three months. As for the ID spreads, imbalance spreads follow a seasonal pattern. Imbalance spreads are higher in Summer when more imbalance actions are required due to higher penetration of

renewable production in the electricity mix.

Regional trend: GB presents significantly lower IB price spreads than NL and BE. On the other hand, GB is the only market where IB price spreads increased (+23%) in the past 3 months, while both NL and BE decreased (-24%).

Country	Average daily spread in the Imbalance prices (€/MWh)		
	Last 36 months	Last 12 months	Last 3 months
NL	894.6	1369.9	1207.2
BE	594.3	792.7	694.6
GB	211.1	137.1	168.4

FCR prices

Netherlands and Germany: After the increase in FCR prices in Q3-24, FCR prices have decreased again over the last three months. Lower renewable production increased the merit order position of conventional power plants, leading to more available FCR volumes. Observed FCR prices during Q4-24 were back again to long term average price levels.

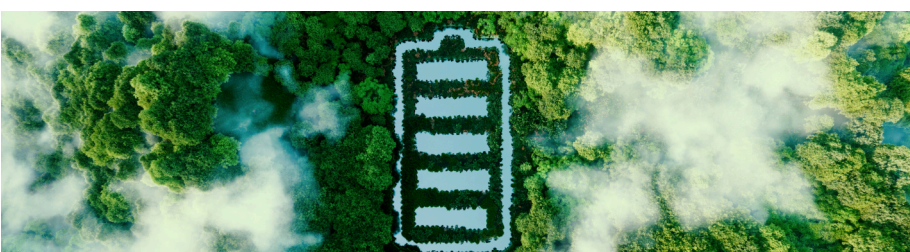
Belgium: FCR prices here increased in the last 3 months and are significantly higher than its neighbors (around 250%),

sustained by a lack of committed flexible thermal generation capacity.

Spain and Great Britain: These countries are not part of the FCR market. They use their own mechanisms for frequency regulation.

Country	Average daily spread in the Imbalance prices (€/MWh)		
	Last 36 months	Last 12 months	Last 3 months
NL	16.93	17.24	13.28
BE	32.51	43.69	45.58
DE	16.43	16.26	12.95

*Note: The NL 2023-11-02 FCR price of 77,777 EUR/MW between 16 and 20hrs was removed out of the sample





Explanation and methodology

Description of the valuations

- The **KYOS Battery Index** reports cashflows in a specific past month for the defined battery and market.
- The index is a single value per market and expressed in EUR/MW/day. A detailed description can be found on the next page.
- The **KYOS Revenue Assessment** simulates and optimizes expected cashflows in 2025 for the defined battery and markets.
- All future (2025) price simulations are arbitrage-free to the forward prices in the market and have been generated with the KySim model. Values are reported in k€/MW.
- All trading strategies have been optimized by the KyBattery model.

Battery definition

- The batteries are of type 0.5C; this means that the battery can be fully charged or discharged in 2 hours
- Passive imbalance trading is limited to a maximum of 30% of the total battery capacity
- No degradation is assumed
- Batteries have a round-trip efficiency of 90%, based on 94.9% charge and discharge efficiency
- The number of cycles per year is limited to 730
- All assets are stand-alone.
- In both valuations, we allow only 30% of the battery capacity in Passive Imbalance Trading (PIT), because of the limited liquidity (due to cannibalization effect).

Description of the valuations

- Day-Ahead (DA): trading in the Day-Ahead market, hourly granularity.
- Day-Ahead and FCR (DA+FCR): offering capacity in the FCR market (4 hours) or trading in the Day-Ahead market, hourly granularity.
- Intraday (ID): trading in the intraday market, 15 min granularity for NL, DE, BE, 30 min for GB, and 60 min for ES.
- Intraday and imbalance (ID+IB): trading in intraday, combined with passively trading imbalance. Only where passive imbalance trading is allowed (NL/BE 15 min, GB 30 min).

Battery Index Methodology:

Data sources: EPEX (ID1) for NL, BE, DE, GB. TenneT, Elia and Elexon for Imbalance in NL, BE and GB. OMIE for ES.

Intraday trading is done with perfect foresight of the prices, based on dynamic programming optimization. This means the battery charges/discharges in the optimal moments.

The passive imbalance trading strategy creates a short (or long) position whenever the forecasted IB take (feed) price in the next hour falls (rises) sufficiently below (above) recent IB take (feed) prices. The thresholds are defined independently for each market in a way that it maximizes the revenue.

A multi-linear regression based on historical imbalance and intraday prices is used to generate the imbalance price forecasts. The income from passive imbalance trading is calculated on the imbalances times the actual imbalance prices.

To explain the interaction with the intraday market, pretend there are two independent traders operating in each market:

- **Intraday Trader:** This trader optimizes battery dispatch based on expected price developments in the intraday market. The primary trader's decisions are made 1 hour ahead of the imbalance trader.

• **Imbalance Trader:** After the primary trader makes her decision, the imbalance trader reviews the battery's current state and the primary trader's positions. He then decides on trades based on recent imbalance prices and forecasts for the next period.

- Finally, the imbalance trader must ensure that any trades he makes do not exceed the battery's capacity limits. He updates the primary trader on the new state of charge, which she will consider in her next decision-making cycle.



This is just a brief overview of what we can offer you. Have a look at our website www.kyos.com for more detailed information.

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