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Super-charged or grid-locked: Battery investment in Belgium

12 June 2025

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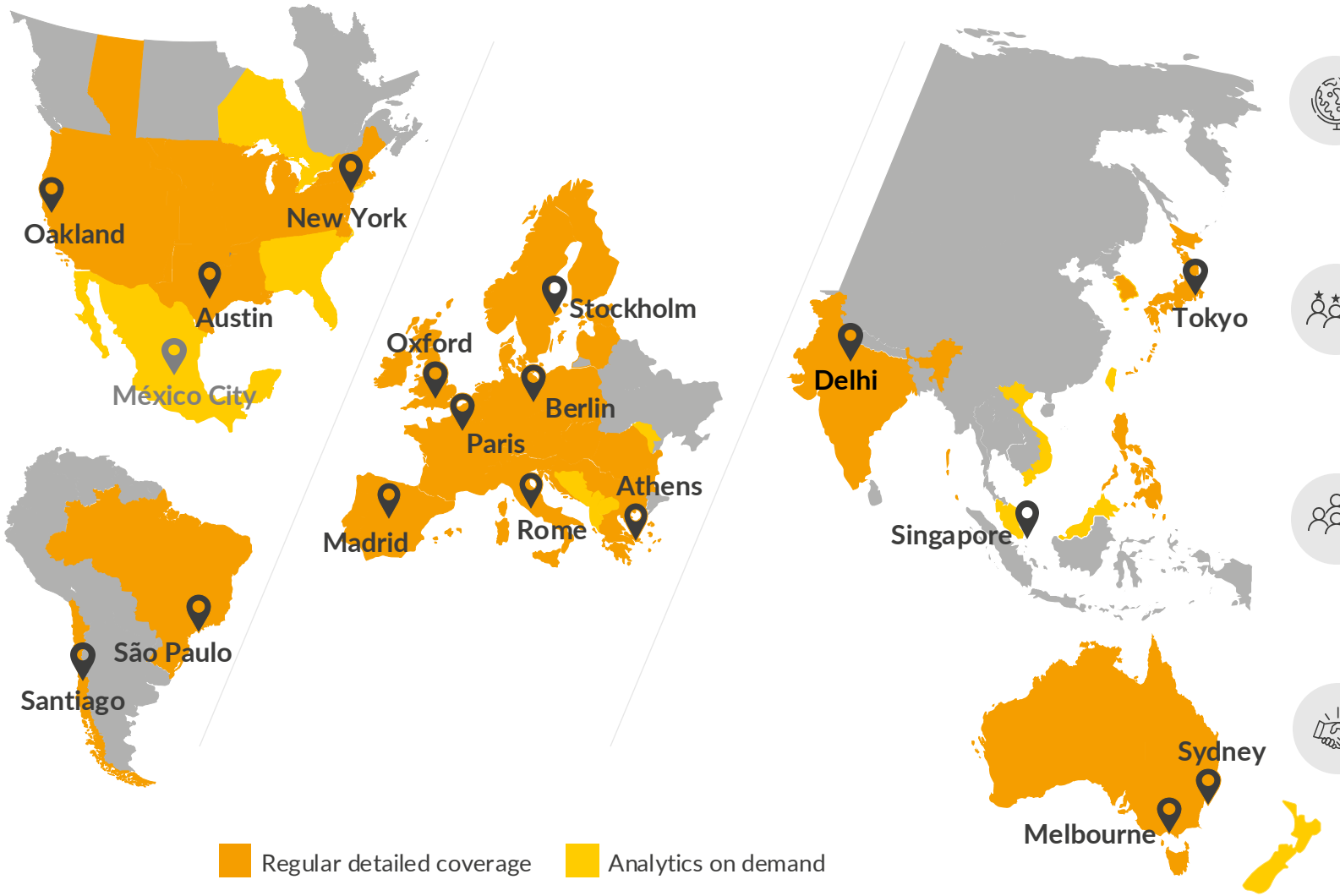

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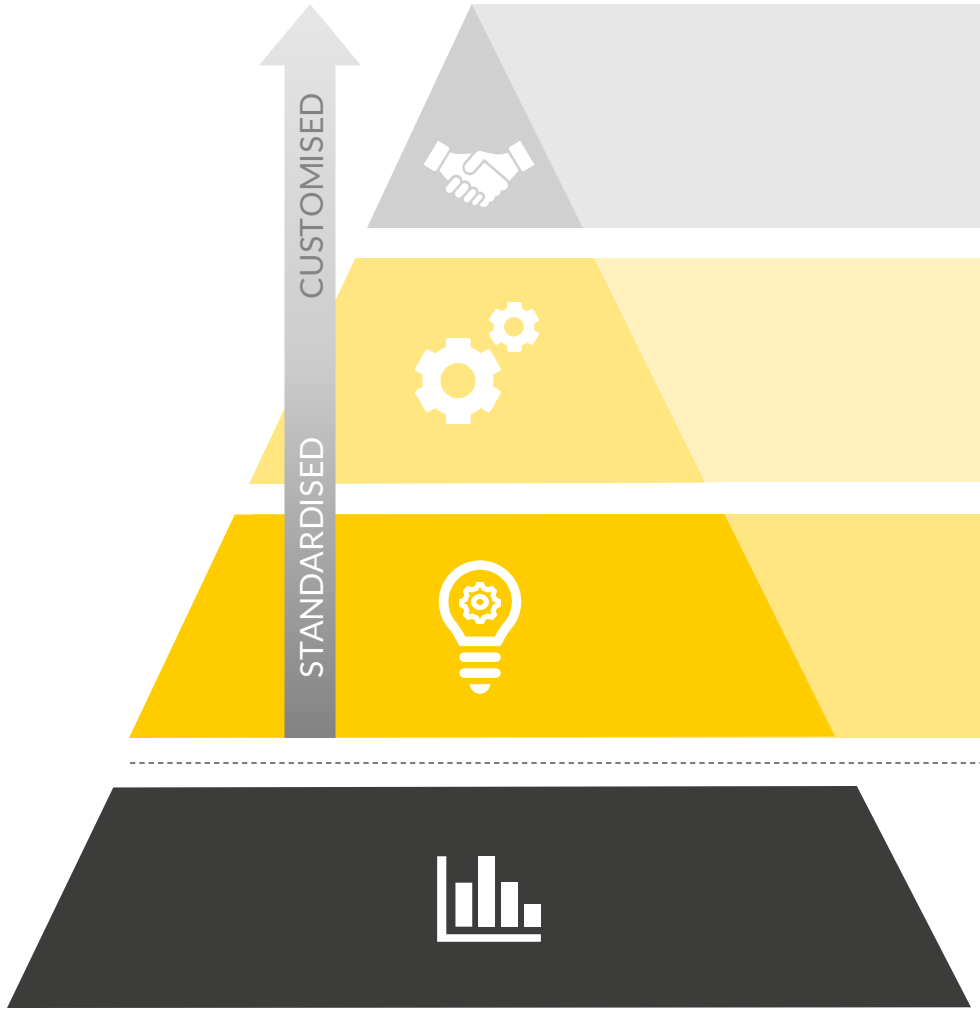

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Join key players from across the Belgian power sector

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Agenda

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I. Introduction

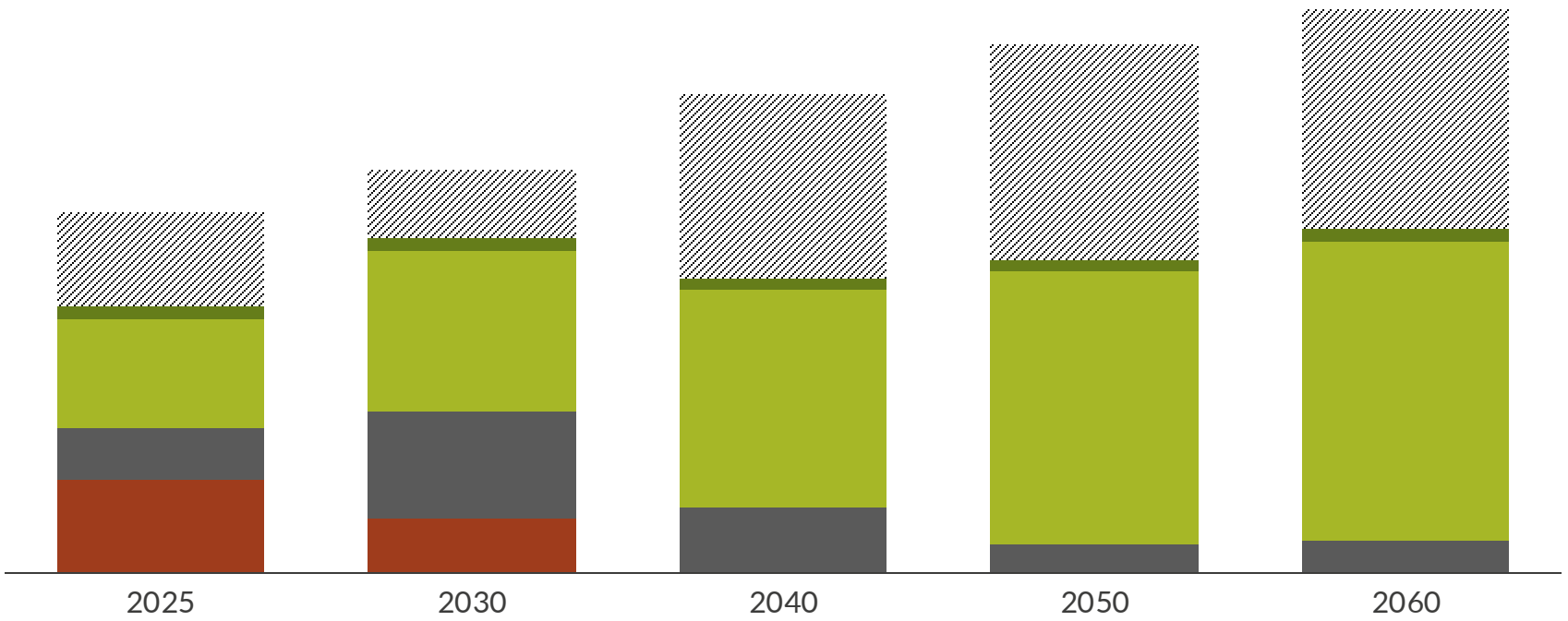
II. Battery investment cases

III. Non-firm grid connections

IV. Key takeaways

The higher share of intermittent renewables and the phase-out of thermal generation create a need for higher flexibility in the system

Electricity production and net imports
TWh



Generation share of total demand met with non-dispatchable generation[1]
%

1) Calculated as the sum of wind and solar generation over demand.

Source: Aurora Energy Research

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Outlook for electricity generation

- Renewable generation almost triples by 2060, mostly driven by solar generation. Space limitations are a barrier for the buildout of onshore and offshore wind capacity, which grows at a slower pace.
- The increase in renewable capacity and concurrent decrease in dispatchable thermal capacity increases the need for flexibility in the system.
- The nuclear phase out after 2035 increases Belgium's import dependency, leading to almost 40% of demand being met by imports by 2040.

While battery buildout in Belgium has grown moderately over the past few years, over 2.7GW of large-scale projects are now in the pipeline

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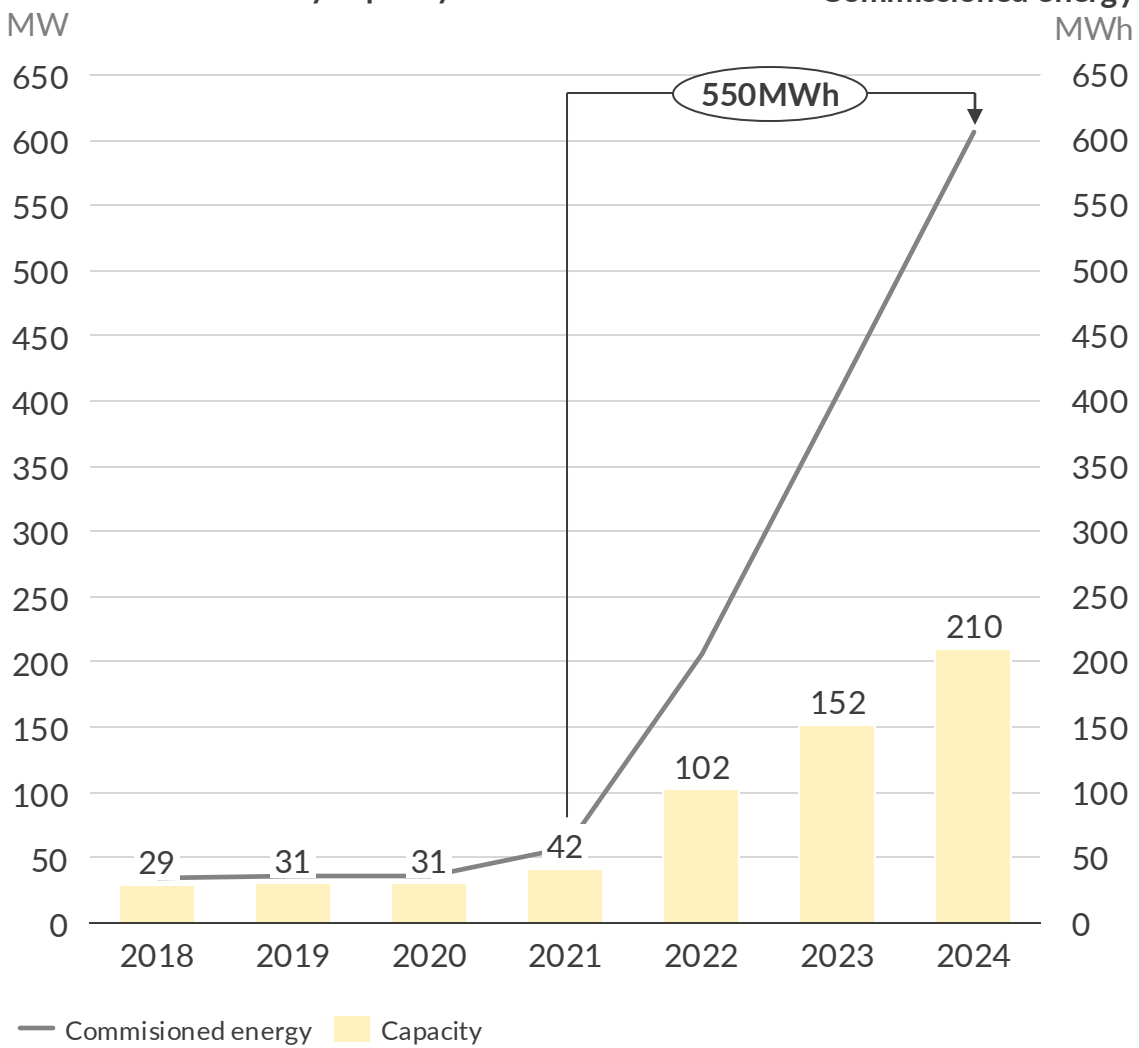
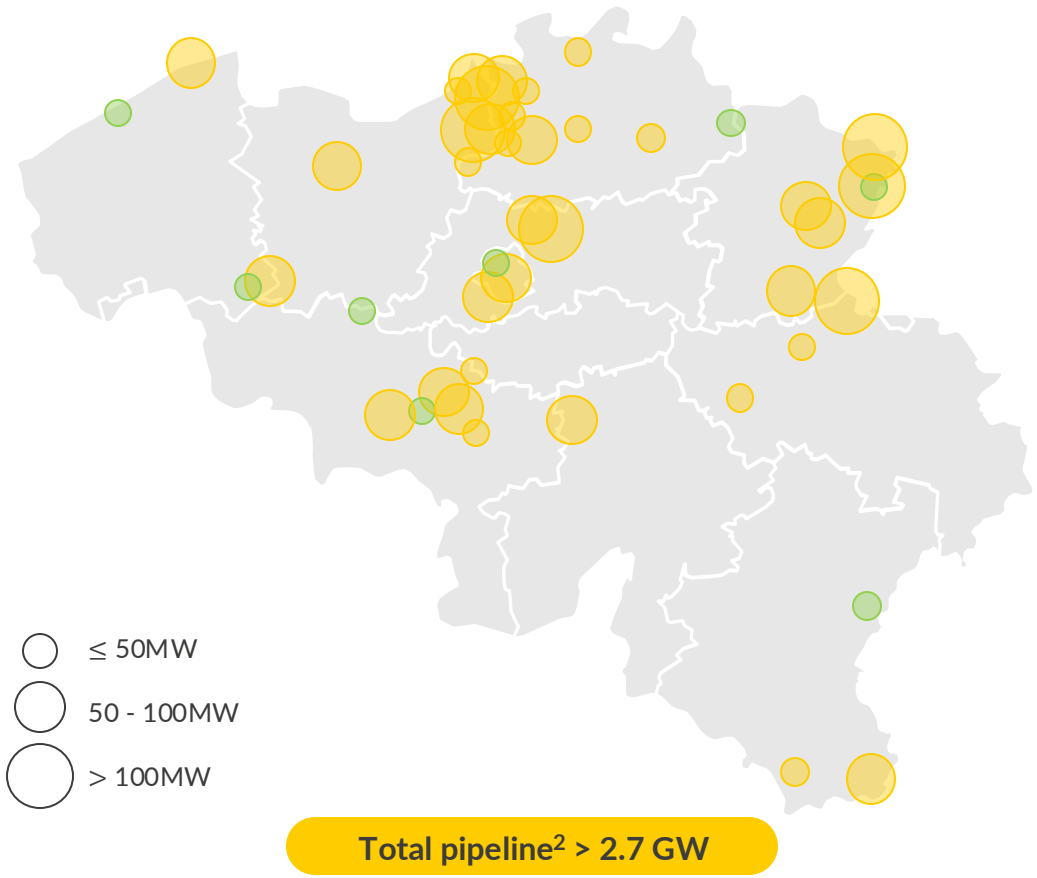
Commissioned battery capacity[1]



Battery projects in Belgium by status and project size



1) Cumulative values at the end of the year. 2) Only accounting for publicly announced, large-scale, stand-alone battery projects. Elia's hosting capacity maps indicate that 7.7 GW of grid capacity has been reserved or allocated for large-scale batteries by 2034.
Sources: Aurora Energy Research, Elia, Eneco, Engie, Alfen, Storm, Press Releases

Alongside historically high aFRR and FCR prices, battery business cases benefit from a 10-year TSO grid fee exemption, though changes are expected

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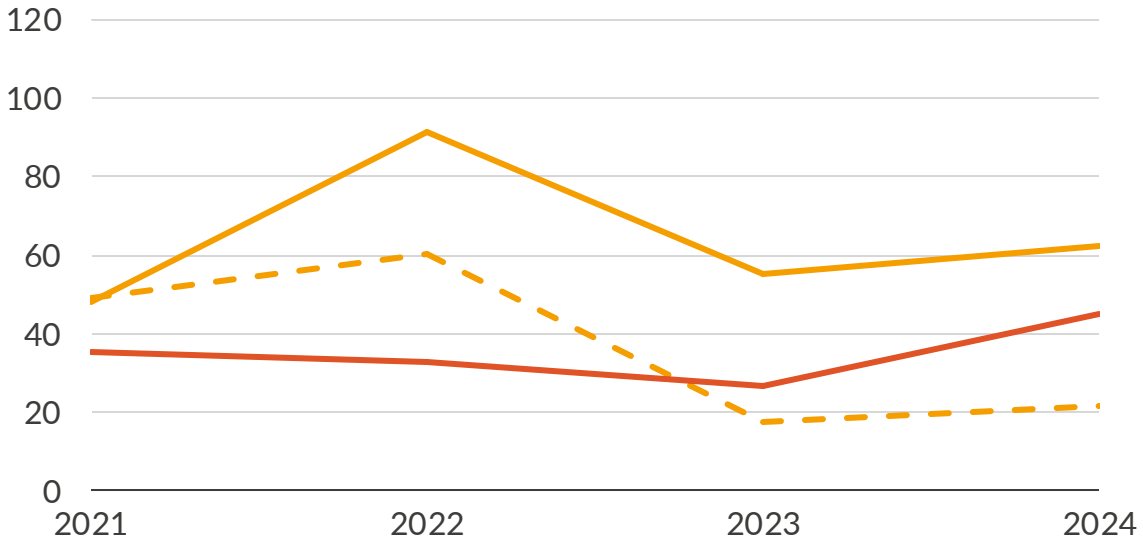
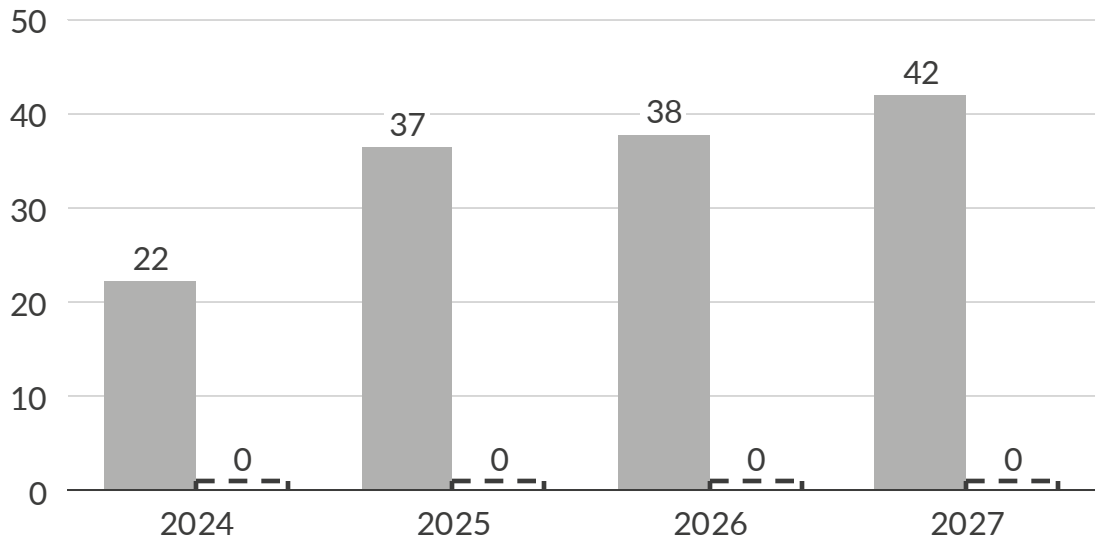
Yearly average FCR and aFRR capacity price
€/MW/h (nominal)



- In 2022, the energy crisis drove up gas plant opportunity costs, leading to a significant increase in aFRR capacity prices which averaged 89€/MW/h.
- As gas prices stabilized and more batteries entered the system, aFRR capacity prices returned to pre-crisis levels, yet have continued to offer attractive opportunities for batteries.
- FCR prices in Belgium have historically been high, often decoupling from the regional cooperation due to limited local capacity to meet the core share.[1]

Transmission grid fees[2]
€/kW/year (real 2024)



- Storage commissioned after July 2018 with its own access point is exempt from grid fees for 10 years, except for a (small) connection tariff.
- The grid fee exemption for storage is particularly favourable as transmission grid fees will more than double between 2024 and 2027, driven by additional investment in the Belgian power grid.

aFRR capacity up | aFRR capacity down | FCR | Grid fees (only applicable after 10 years) | Exemption

1) Minimum amount to be procured locally. 2) In addition to the fees shown, batteries must pay a small annual fee for the operation of the metering point, which is constant regardless of capacity but varies depending on the connection level and the metering operator.

Sources: Aurora Energy Research, ENTSOE, Nord Pool, EPEX, Elia

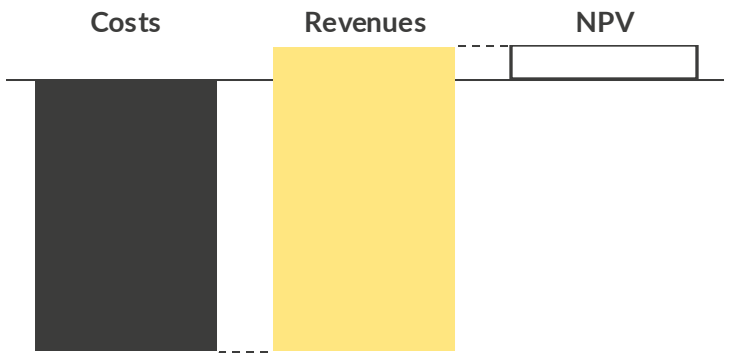
In this session, we will deep dive in battery investment cases in Belgium, analyse the risks linked to grid contracts and discuss additional revenue streams

II Battery business cases

Deep dive into battery business cases:

- Backcasting of battery revenues
- CRM revenues
- Impact of the grid fee exemption on the business case

Battery present value
€/kW (real 2023)



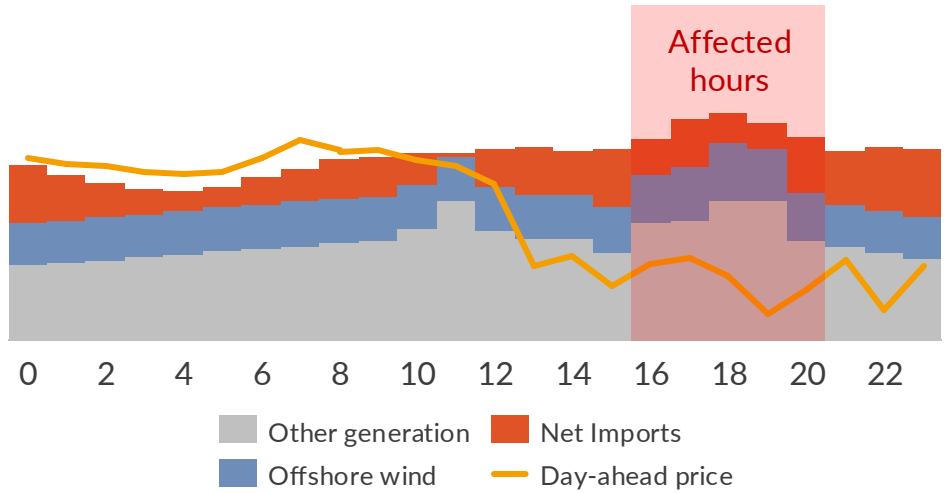
III Non-firm grid connections

Deep-dive into grid fees and non-firm connections:

- Update on the ongoing regulatory process on non-firm connections
- Scenario analysis of the revenue impact of non-firm grid connection

Average hourly generation
GW
2024

Day-Ahead price
€/MWh, real



Source: Aurora Energy Research

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Aurora models battery business cases based on our fundamental market price forecasts and Chronos, our battery dispatch software

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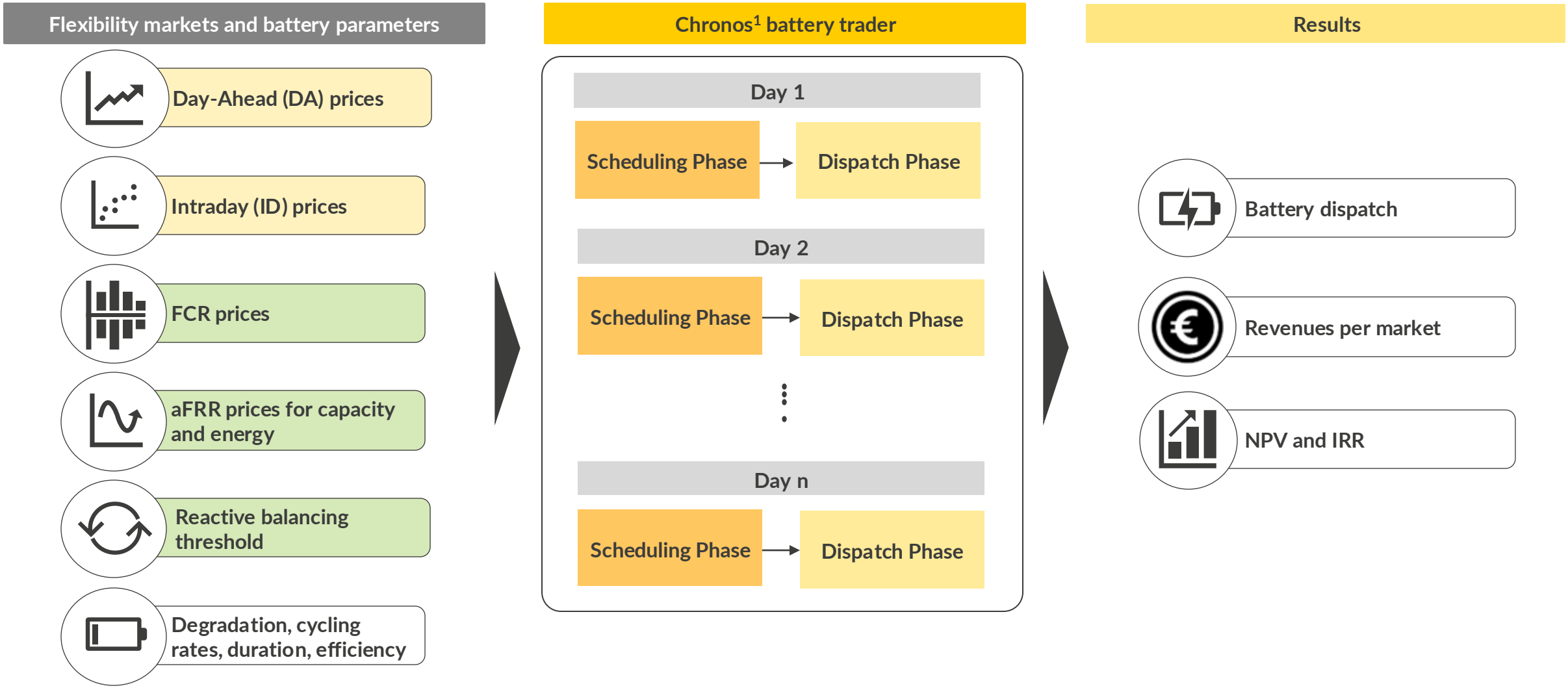

1) Includes intermarket optimization but does not include intra-market optimisation through asset backed trading such as continuous trading of 15-minute products on the ID and trading the same quarter hour multiple times.

Sources: Aurora Energy Research

A 4h battery could have made over 400€/kW in 2024, with significant revenues from ancillary markets and higher revenues with increasing aFRR participation

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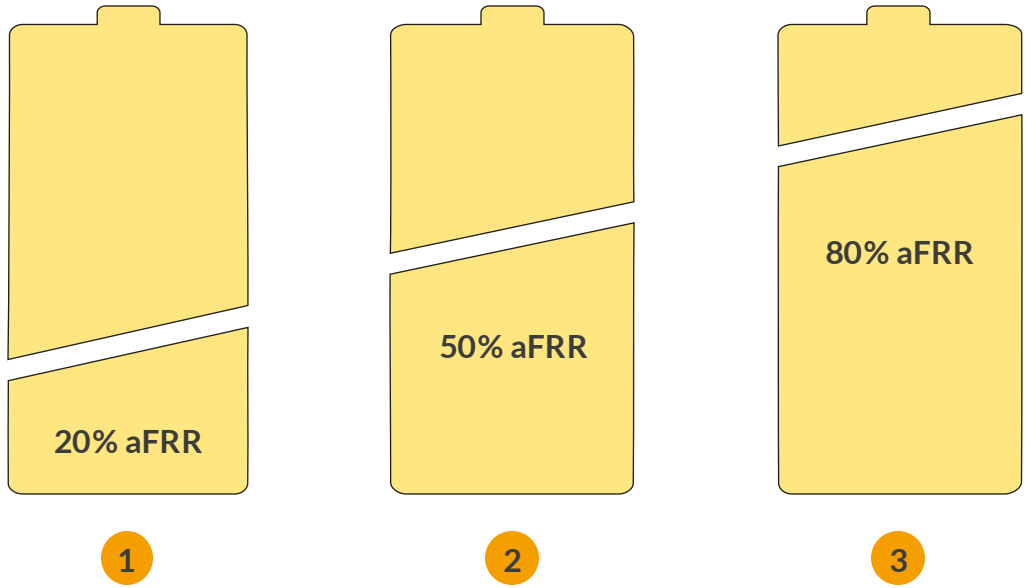
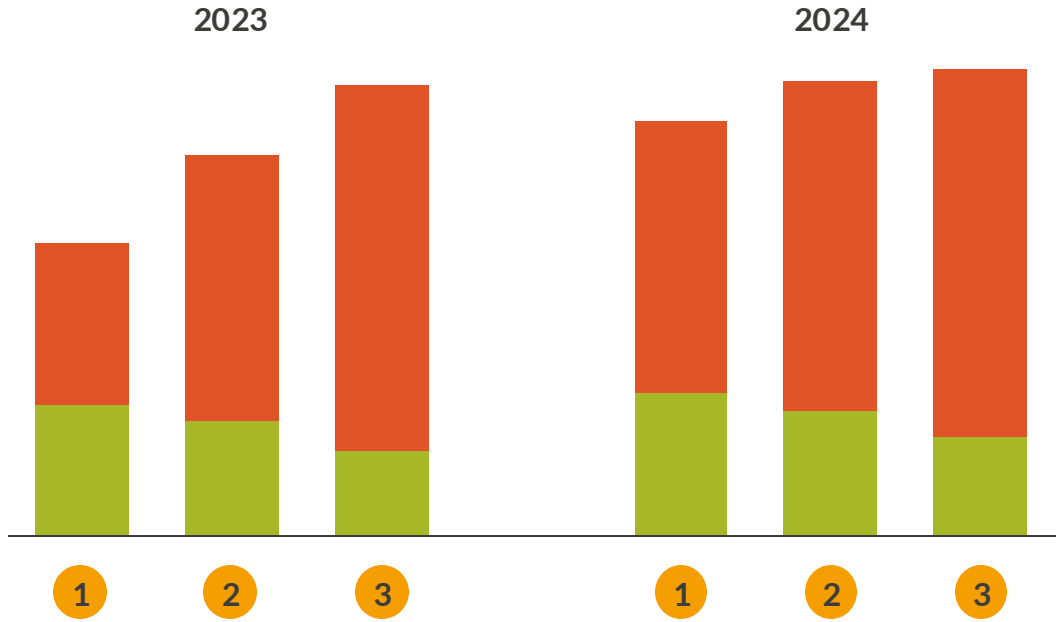
Different aFRR participation shares



- The share of the battery's capacity that can participate on the aFRR market varies based on the trading strategy.
- The aFRR capacity market is shallow, with Elia procuring only about 120MW of capacity for aFRR up and aFRR down. A significant increase in battery participation could quickly saturate these markets.

Backtest gross margins - 4h BESS, 1 cycle per day

€/kW (nominal)



- In our dispatch model using historical market prices, increasing the share of the simulated battery's capacity that can be reserved on the aFRR capacity market significantly increases its total revenues.
- As participation in the aFRR capacity market increases, energy arbitrage revenues decrease.

Wholesale markets[1] Balancing markets

1) Energy arbitrage includes the Day-Ahead and Intraday market.

Source: Aurora Energy Research

The Y-4 CRM will support 1 GW of new battery capacity with capacity contracts creating significant revenues for a battery coming online in 2028

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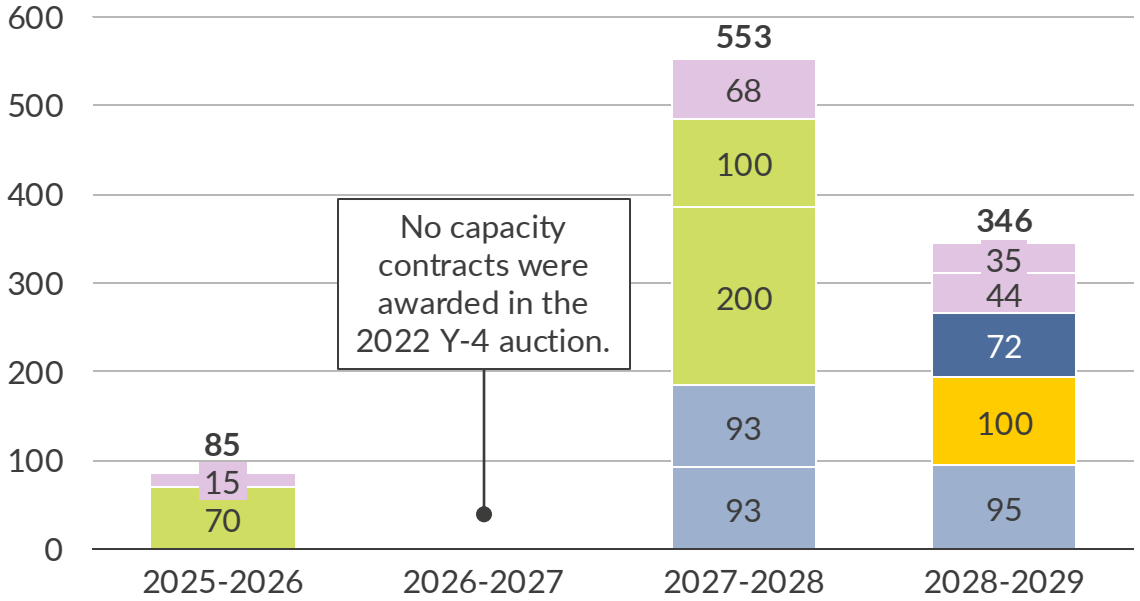
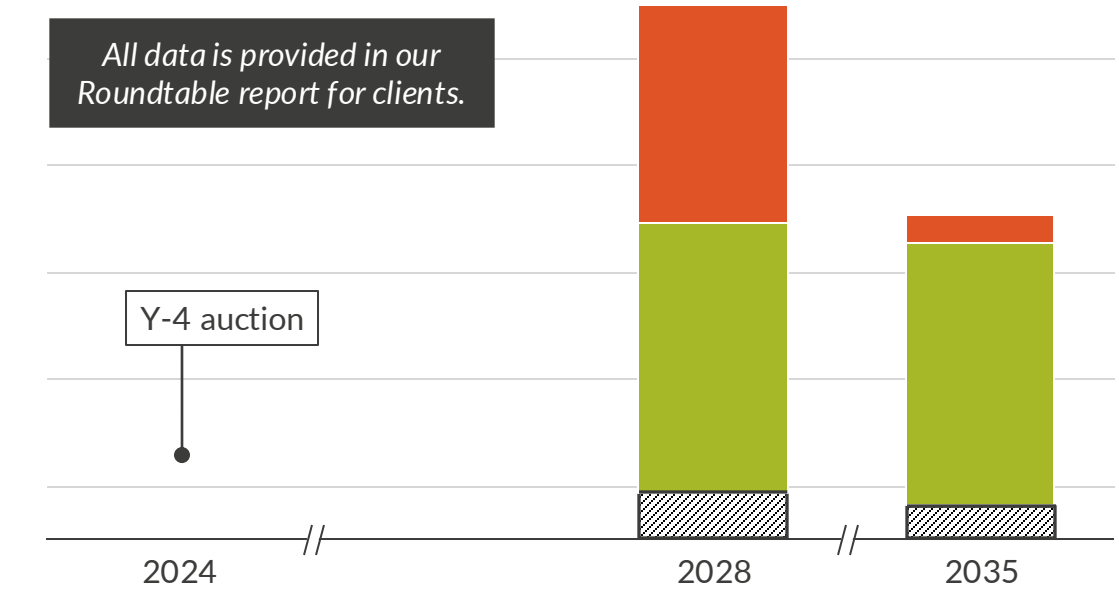
Capacity of new build large-scale batteries[1] selected in past Y-4 auctions
MW



- In the past two Y-4 auctions, batteries made up nearly all the new build capacity selected.
- A total of 12 large-scale battery projects were selected over the past Y-4 auctions, with ENGIE, Storm and GIGA Storage securing the largest contracts.

ENGIE · GIGA Storage · Other developers · Storm · Auvelais Energy Storage

Gross margins for a new-build 4h battery under the CRM, 1 cycle, entry 2028
€/kW (real 2024)



- The CRM provides fixed annual payments over 15 years, offering long-term revenue stability that supports debt financing for battery investments.
- The capacity payments represent a significant share of the total revenues.
- To access Y-4 CRM revenues, developers must commit to be available before the project is operational, exposing them to development and permitting risks.

Capacity market payments · Balancing markets · Wholesale markets

1) Un-derated capacity. 3) This is the volume-weighted average bid for new-build capacity that was realised in the 2024 Y-4 auction. 4) We assume that CRM revenues are then reduced each year by the asset's actual degradation.

Sources: Aurora Energy Research, Elia

The TSO grid fee exemption could be discontinued in the 2028-2031 tariff period, raising costs and lowering IRRs of batteries installed after 2027

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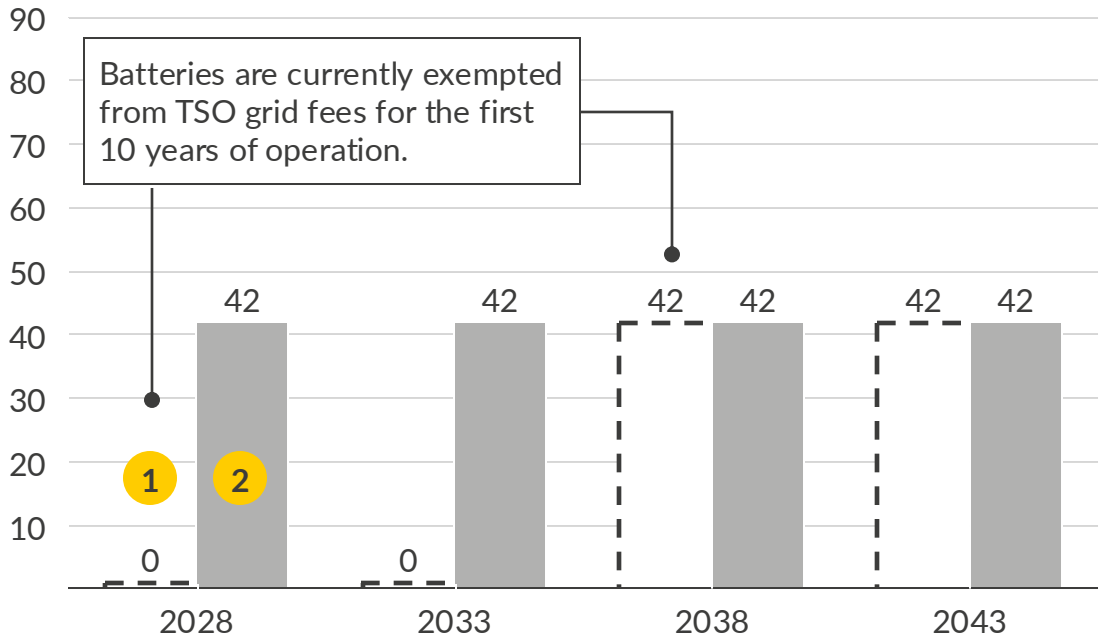
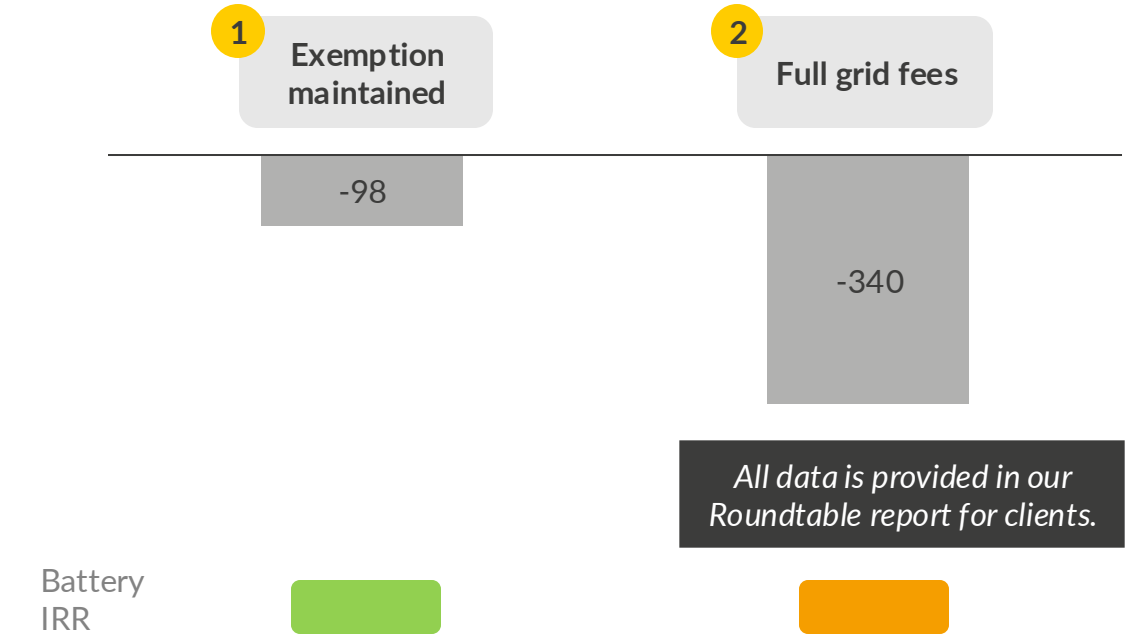
Annual high voltage grid fee projections[1]
€/kW (real 2024)



- The grid fee exemption was originally introduced to incentivise battery investments when the technology was immature, and costs were high. Given the current substantial project pipeline, the need for this exemption is now under review.
- Grid fee levels could also increase in the next regulatory cycle to reflect the significant investments needed to strengthen the transmission network

Present value of grid fees for a 4hr battery – 2028 entry year
€/kW (real 2024)



- The discontinuation of the grid fee exemption would significantly impact project economics and leads to a stark drop in IRR.
- If the exemption were to be discontinued, further buildout of batteries could be discouraged, which in turn could lead to higher price spreads and ancillary market prices, and thus higher revenues for batteries

Exemption maintained | Full grid fees | Grid fees | Profitable | Unprofitable

1) Based on Aurora's H2 2024 Flexible Energy Market Add-On, which includes grid fee prices for 2027. We assume that grid fees from the current regulatory cycle are extended.

Sources: Aurora Energy Research, Elia, CREG

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Non-firm connection contracts could unlock up to 6.5 GW of BESS capacity for connection to the Belgian grid, strained mostly by offshore wind

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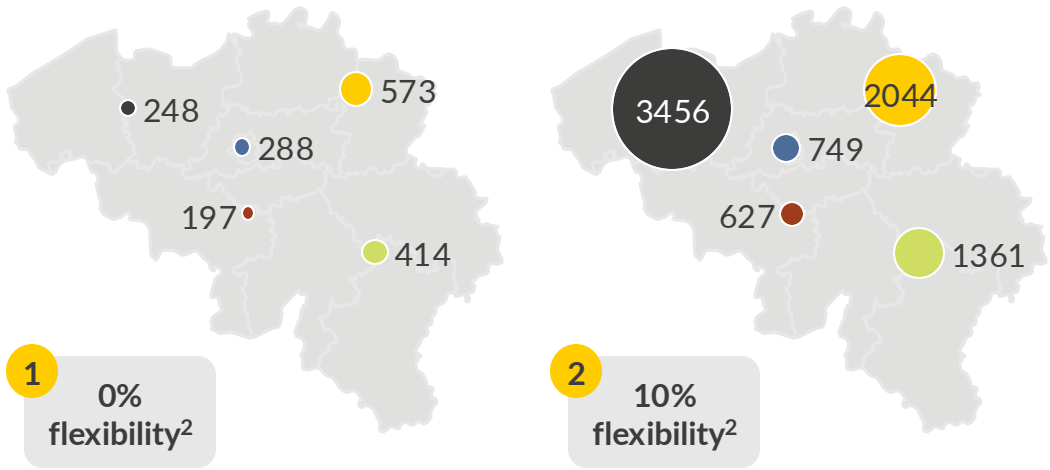
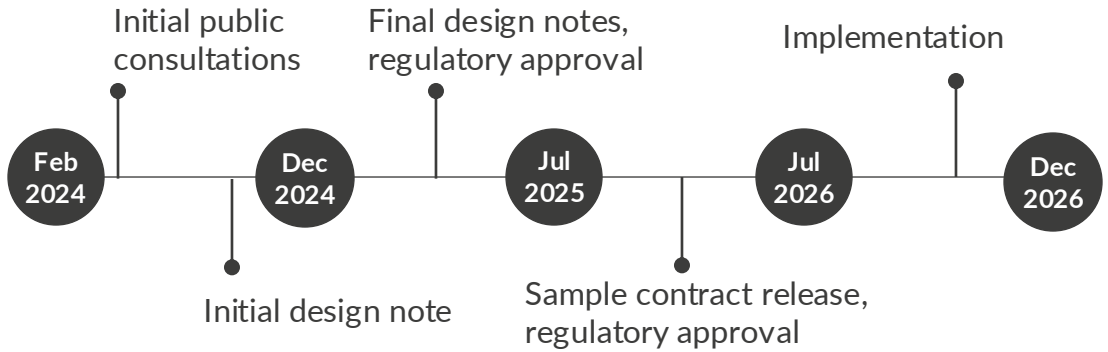
Reported battery storage grid hosting capacity[1] – 2027
MW



- The grid hosting capacity is particularly strained in the West of the country, where grid expansion projects are currently ongoing.
- Restricting up to 10% of a battery's total exported energy could increase the hosting capacity from 1.7 GW to 8.4 GW of batteries, leading to 6.5 GW of potential additional battery capacity
- This increase would be particularly notable in the West of the Flemish region, where injection of offshore wind power from the Princess Elisabeth zone could lead to grid congestion.

Flanders - West[3] Brussels region[5] Wallonia - East[7]
Flanders - East[4] Wallonia - West[6]

Timeline and context around flexible grid connections in Belgium



- As grid capacity becomes a bottleneck for the growing battery pipeline providing much-needed flexibility, non-firm connections offer earlier access while maintaining grid security.
- Discussions on the final design are still ongoing, but several key principles are already decided:
  - Connections will become firm when identified grid work is completed
  - Batteries will not be compensated for lost revenues when curtailed
  - Curtailment can occur in real time
- Some design elements remain under discussion, including the treatment of missed balancing commitments (e.g. penalties). A final decision is expected in mid-2025, when Elia is also expected to publish an example contract.

1) As reported in Elia's Hosting capacity data, for the year 2027. 2) Flexibility is defined by Elia as: "the maximum percentage of yearly energy curtailment allowed, relative to the yearly total generated or consumed energy, and for a set of underlying assumptions (planned infrastructure, evolution of other grid users […])" 3) West Flanders and East Flanders provinces. 4) Antwerp and Limburg. 5) Flemish Brabant and Brussels region. 6) Hainaut and Walloon Brabant. 7) Namur, Liège and Luxembourg province.
Source: Aurora Energy Research, Elia

We analyse the possible impacts of non-firm connections on battery revenues, particularly discharging restrictions

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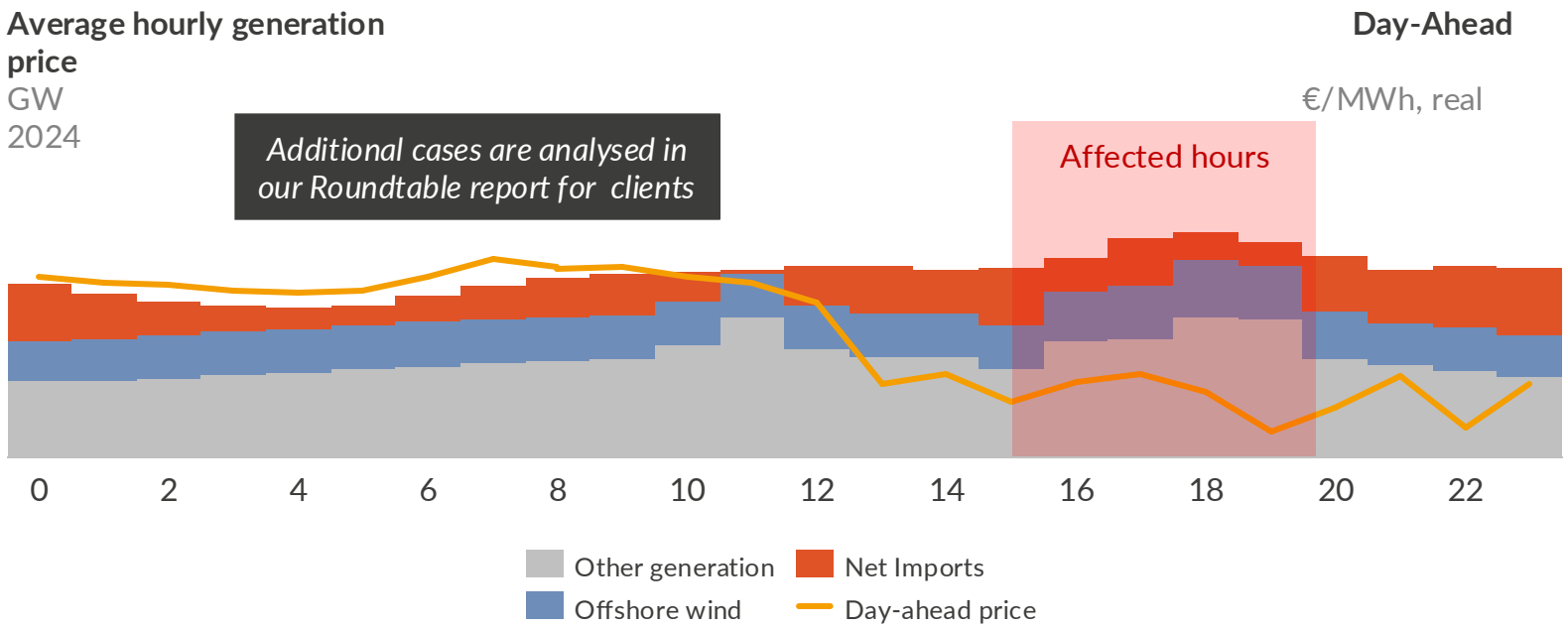
Dynamic discharging restriction

- We model a dynamic feed-in restriction applying to 10% of the time, aligned with the hours of highest annual offshore wind generation.
- We assume that restrictions are published before the day-ahead auction, such that participants can freely dispatch into wholesale and ancillary markets.
- Charging from the grid is not restricted.



Sources: Aurora Energy Research, ENTSO-E

Restricting discharge during high offshore wind production hours results in lower margins, particularly due to lost opportunities on ancillary markets

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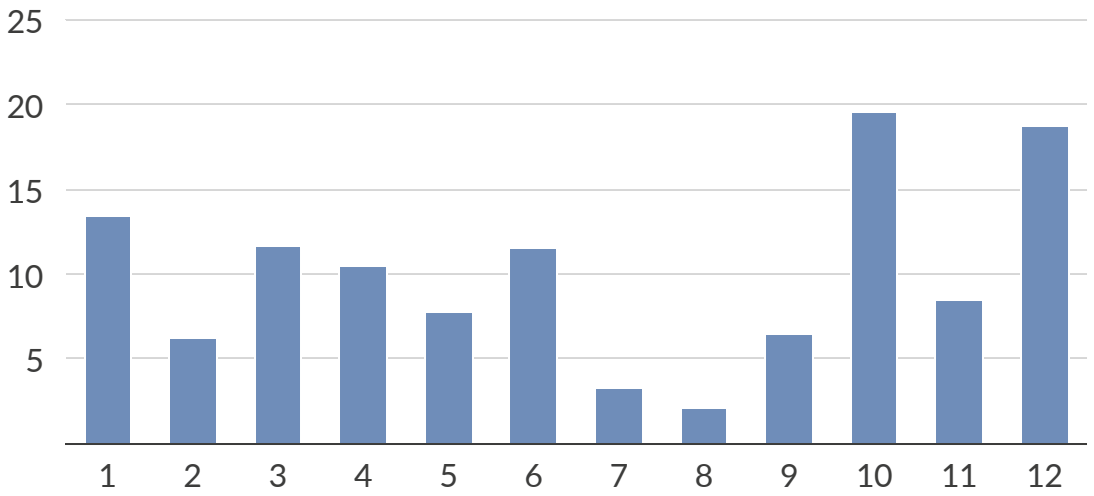
Share of hours restricted per month

%

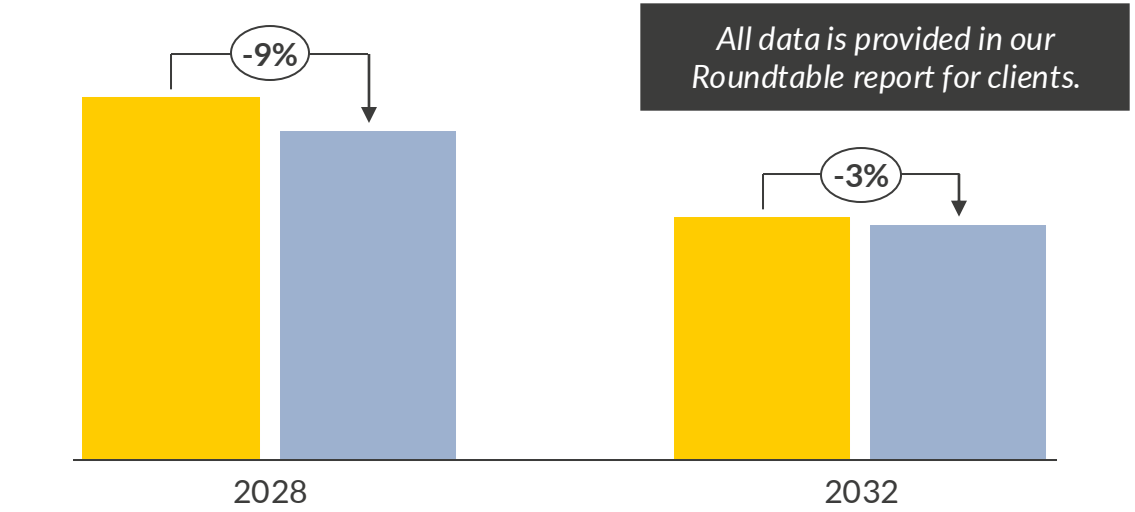


- A dynamic grid feed-in restriction can prevent batteries from intensifying grid congestions in hours of high offshore wind generation.
- Curtailment risk is well distributed across the year due to the wide generation profile of offshore wind, with some more occurrences in the fall and in winter.
- The flexible connection is assumed to apply during the first five years of operation, after which the battery transitions to a firm grid connection.

Restricted hours

Gross margins for a 4h battery system with 1 cycle/day, COD 2028

€/kW, real 2024



All data is provided in our Roundtable report for clients.

- In hours of restricted discharging, batteries can usually charge at low costs, limiting the impact of the flexible grid connection on energy arbitrage.
- Applying offshore wind-based constraints on injection during the first 5 years of operation leads to a loss of 5% of yearly gross margins on average.
- Margins are most affected during the early years of operation, when prices on ancillary markets are highest, with 9% of margins being lost to curtailment in 2028. In 2032, only 3% of margins are lost, as ancillary market prices decline.

No restrictions Including restrictions

Source: Aurora Energy Research

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Key takeaways

1 Battery capacity is booming in Belgium, with 2.7 GW of projects currently in the pipeline. There are high revenues opportunities in the wholesale and flexibility markets, and current grid fee exemption creates a very favorable context for new projects. As a result, batteries built in the coming years are expected be profitable.

2 While revenues from ancillary markets are currently high, they are expected to become saturated. Spreads on wholesale markets are expected to become the main revenue driver in the long run, especially during the summer. The potential end of the grid fee exemption by 2028 could lead to a significant increase in yearly fixed costs, making the business case for batteries more difficult. Participating in the capacity remuneration mechanism could bring additional revenues for both incoming and existing battery capacity.

3 Increasing grid congestion and limited connection capacity are expected to change the regulatory framework for batteries. While the introduction of flexible grid connection agreements could offer earlier grid connection, it would come at a cost of possible curtailments that lead to a reduction in revenue of 5% on average, during the years in which it is in force.

Sources: Aurora Energy Research

Details and disclaimer

Publication
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