

Innovative strategies to boost renewable revenues in the Netherlands

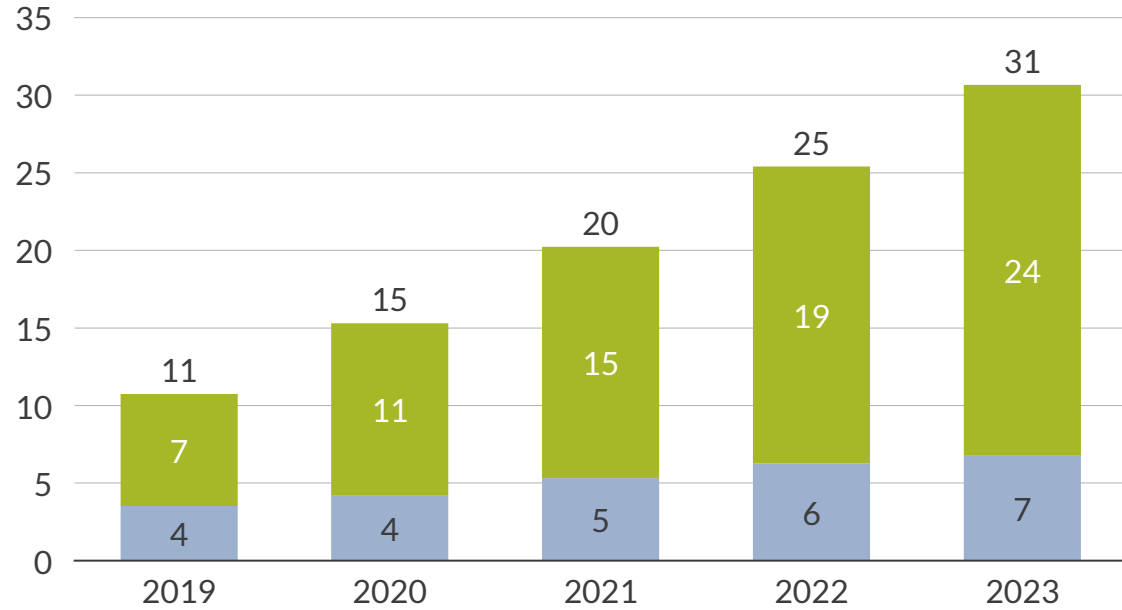
4 April 2025

Dresden



The buildout of renewables in the Netherlands has sped up, especially for solar PV, leading to a strong reduction in capture prices for renewables

Installed renewable capacity¹
GW

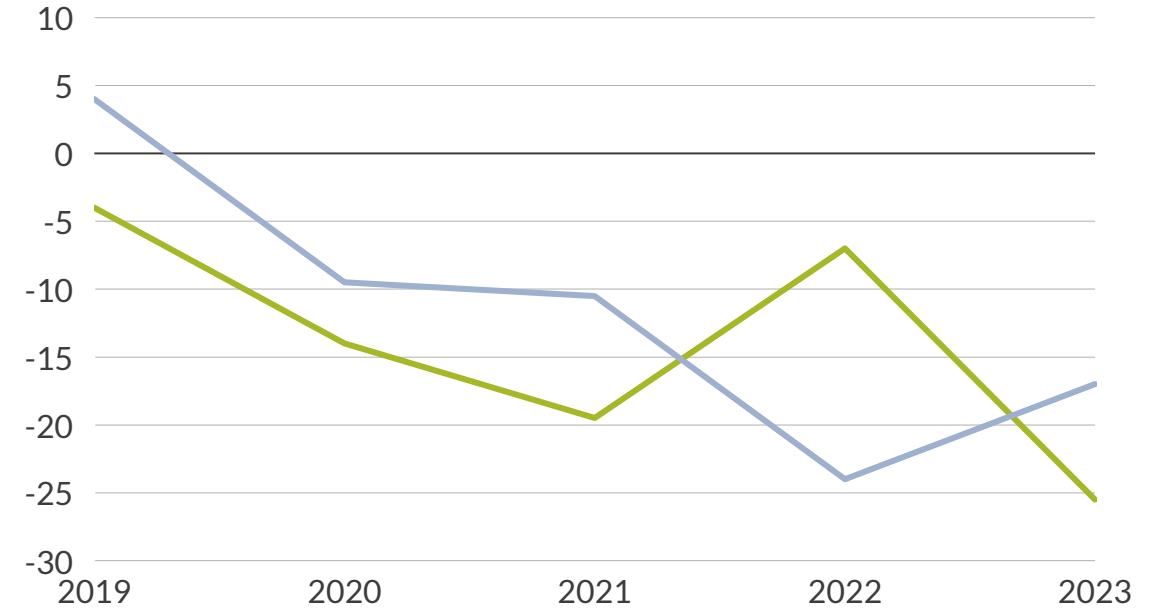


- Solar PV has grown rapidly in the last 6 years, with significant growth in both the residential and large-scale segments. The increased growth rate has led to a tripling in solar capacity since 2019.
- Growth in onshore wind has been steady, driven by SDE support, with more than 3GW of additional capacity installed since 2019.

■ Solar PV ■ Onshore wind

1) Capacity installed at the end of the year.

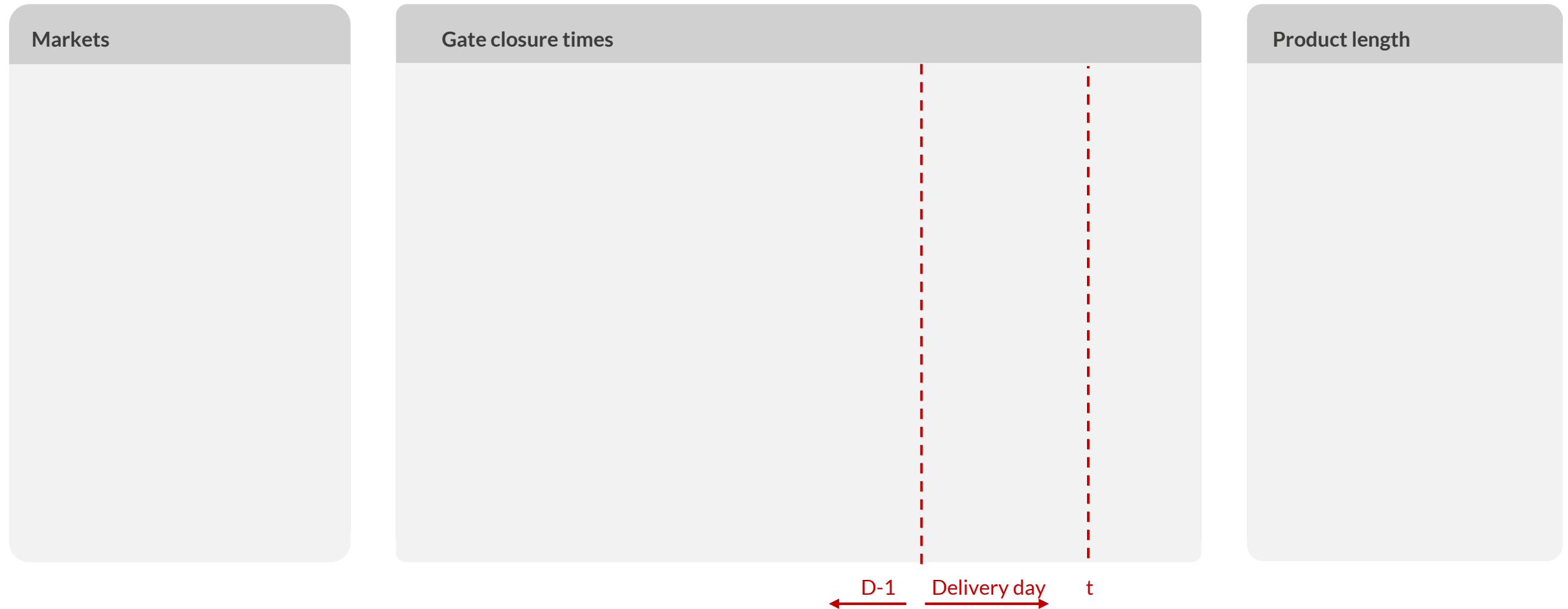
Fleet-average profile discount - solar & onshore wind
%



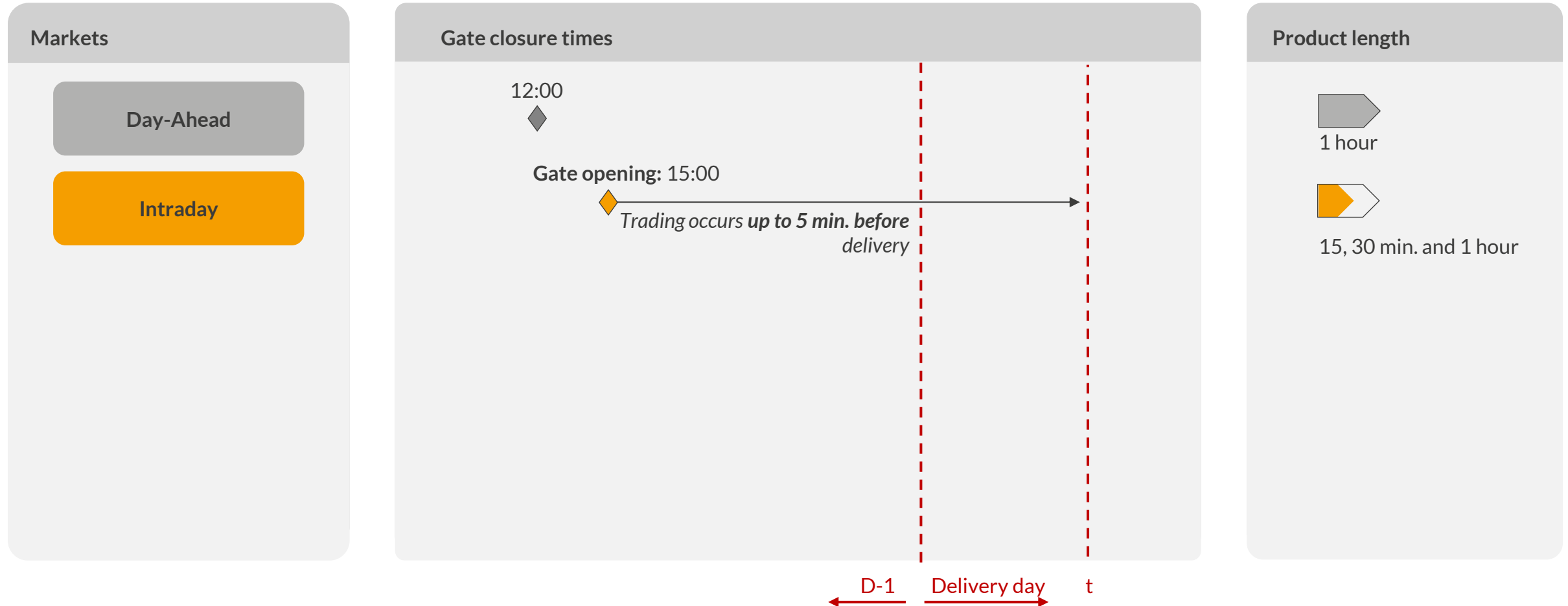
- Correlated production profiles of renewable assets lead to lower power prices in times with high renewable generation. The high build-out of renewables has led to a strong growth in price cannibalisation in recent years.
- This is reflected in an increasing profile discount, which is the difference between the baseload price and the average price captured by the profile of a solar or wind plant during the year.

— Solar PV — Onshore wind

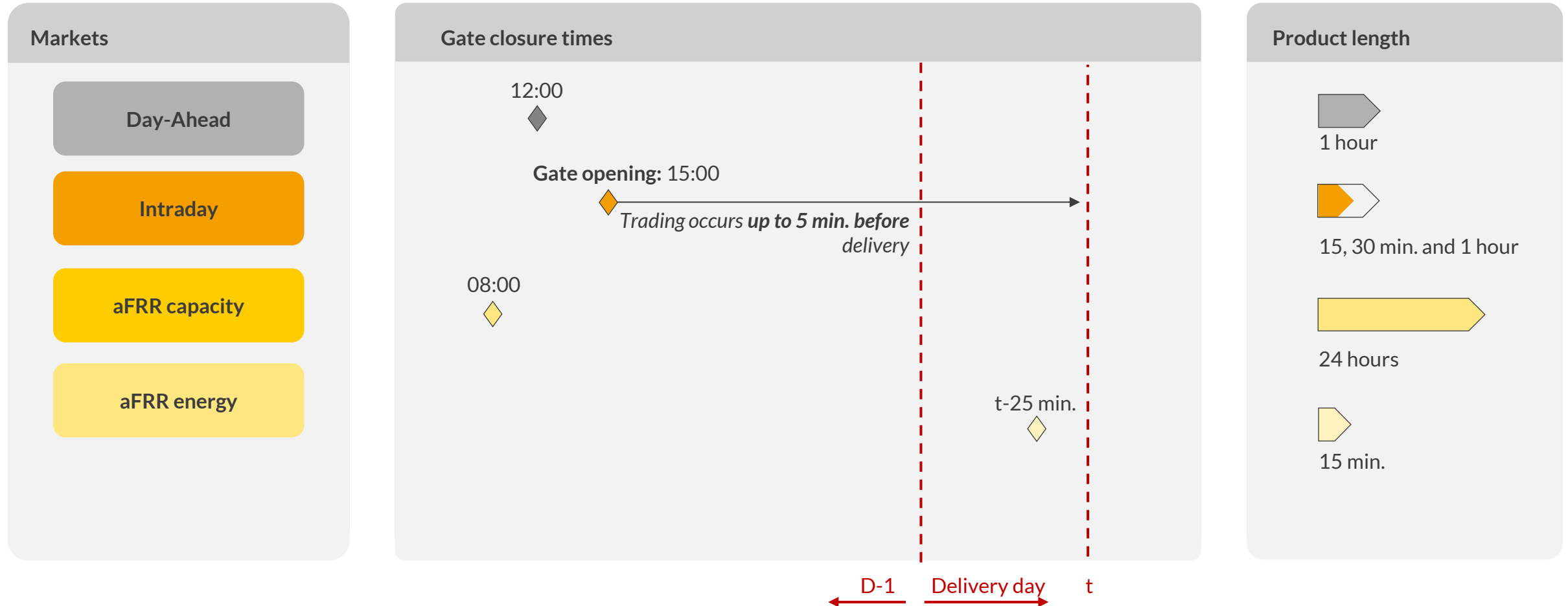
Renewable assets can optimise across markets with different gate closure times, based on estimated generation and forecasted prices



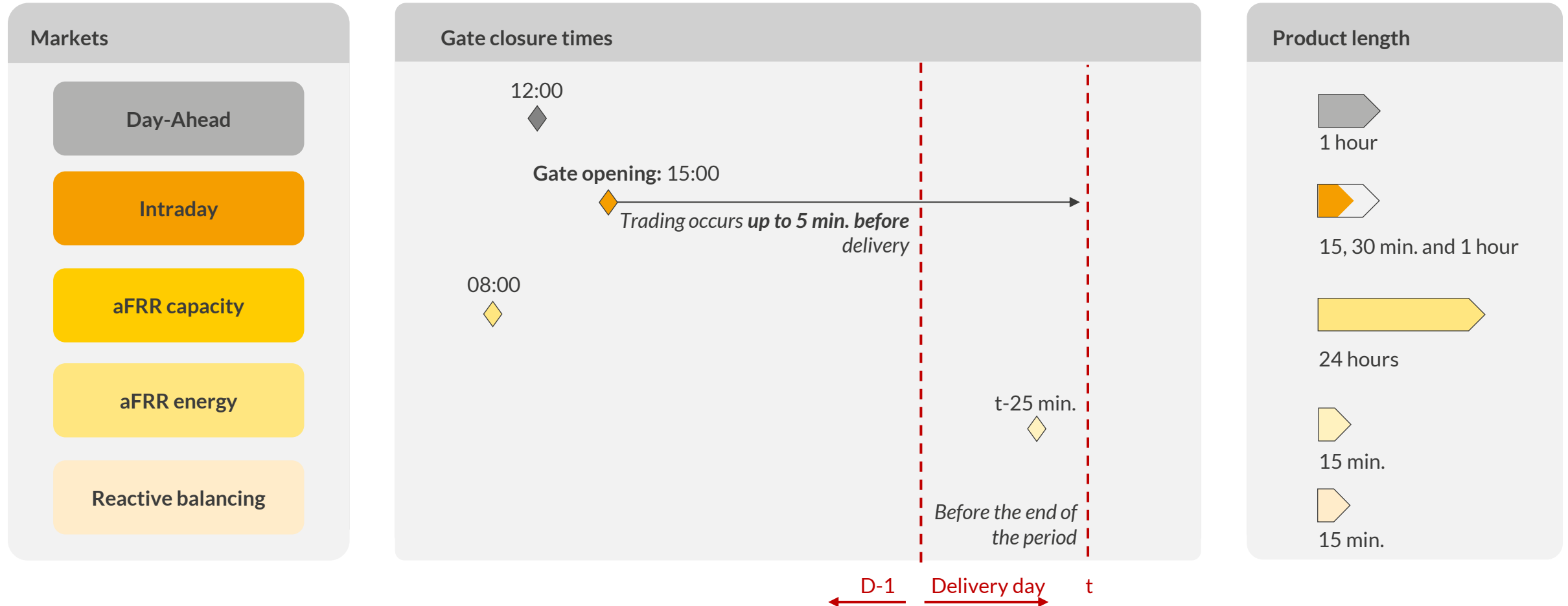
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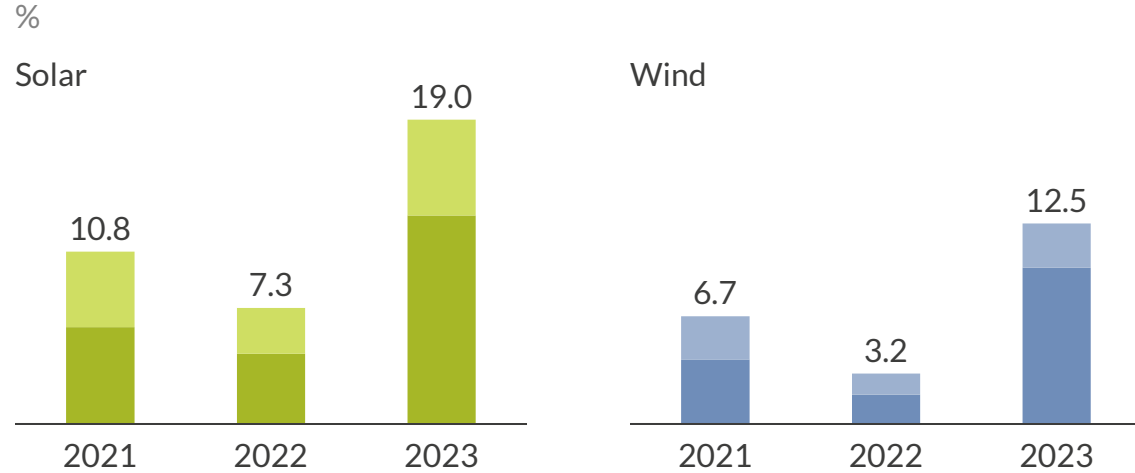
Renewable assets can optimise across markets with different gate closure times, based on estimated generation and forecasted prices



Reactive balancing offers an upside to renewables that contribute to balancing the system, but the risk of dual pricing means that revenues are not guaranteed



Historical upside of RES participation in reactive balancing



- Reactive balancing occurs when the imbalance prices are attractive, and an asset purposely deviates from its schedule to help resolve the system imbalance. After each 15-minute period, the TSO pays the imbalance price to the assets that helped resolve the imbalance.
- Upside from participating in reactive balancing has increased as imbalance prices remained high and other revenues were reduced.
- As solar captures prices had a higher discount to baseload these years, the relative upside is higher, reaching 19% in 2023.

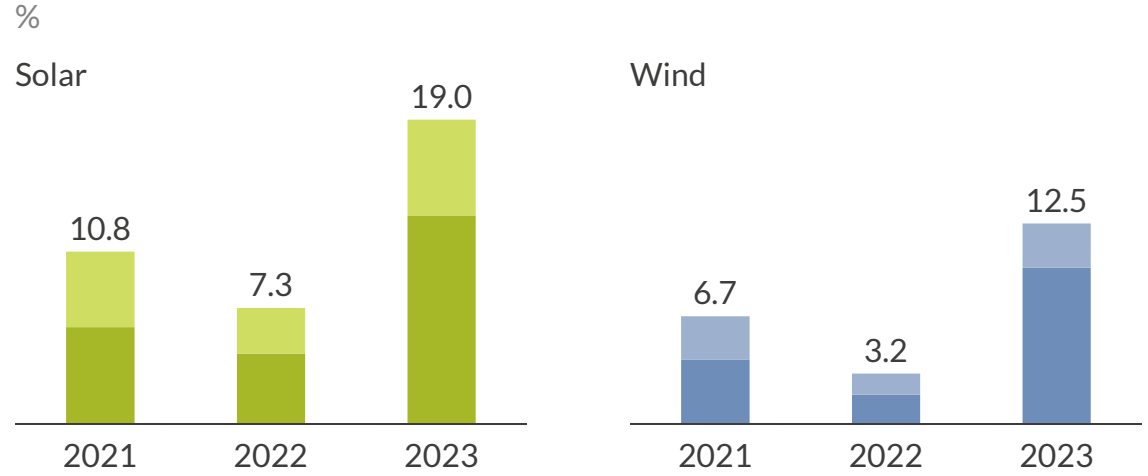
■ Down ■ Up

1) Balancing Responsible Party

Reactive balancing offers an upside to renewables that contribute to balancing the system, but the risk of dual pricing means that revenues are not guaranteed

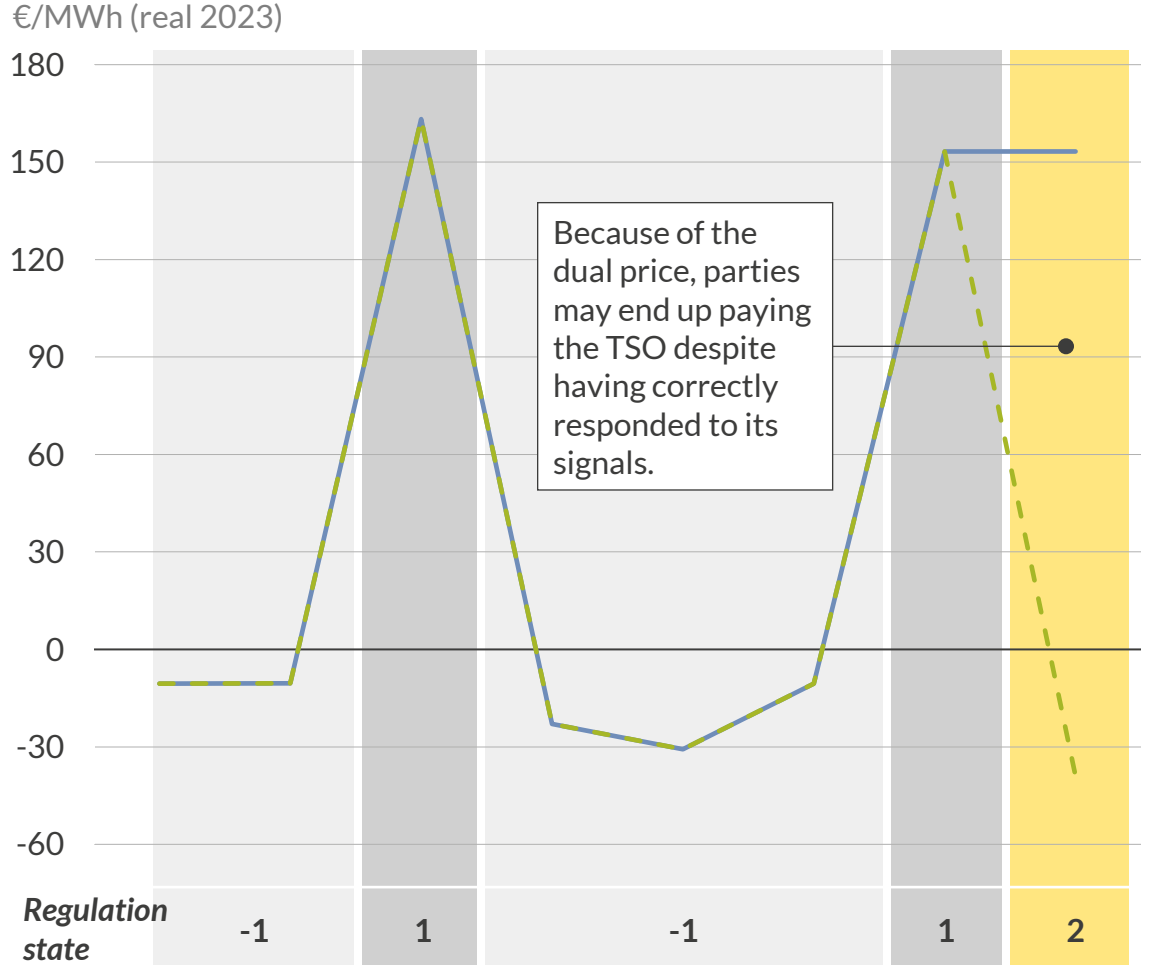


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Quarter-hourly imbalance prices and regulation state

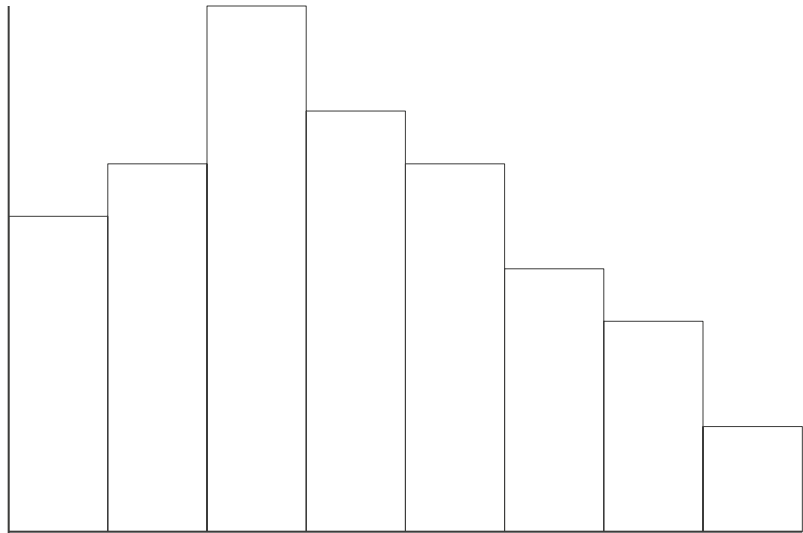


Down Up

Our RES dispatch methodology optimises actions across different markets considering a scheduling and dispatch phase

I. Scheduling phase: Capacity allocations

Asset capacity



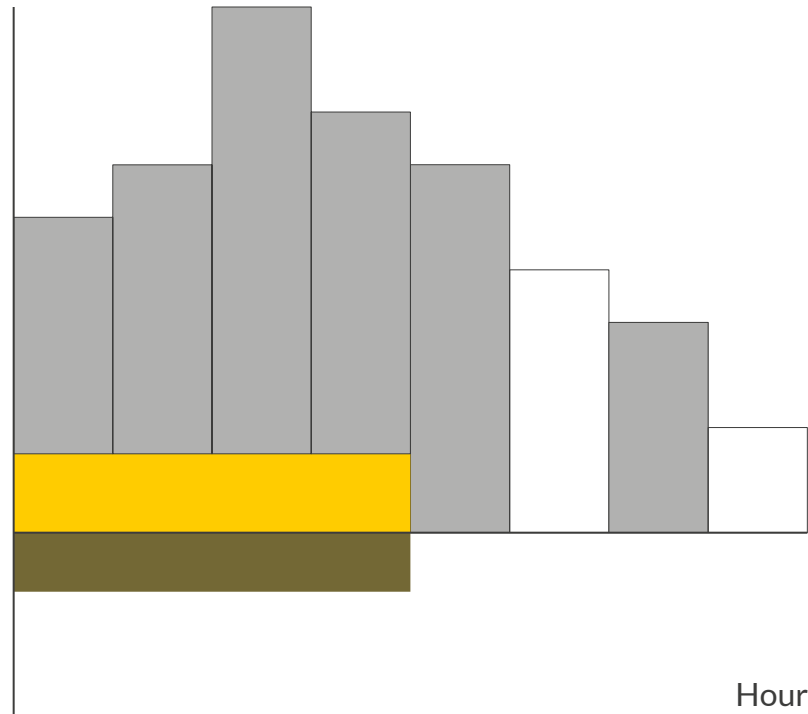
Hour

- Day-ahead
- Intraday
- aFRR capacity up
- aFRR capacity down
- aFRR energy up free bids
- aFRR energy down free bids
- Reactive balancing
- aFRR capacity not dispatched

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I. Scheduling phase: Capacity allocations

Asset capacity split by market

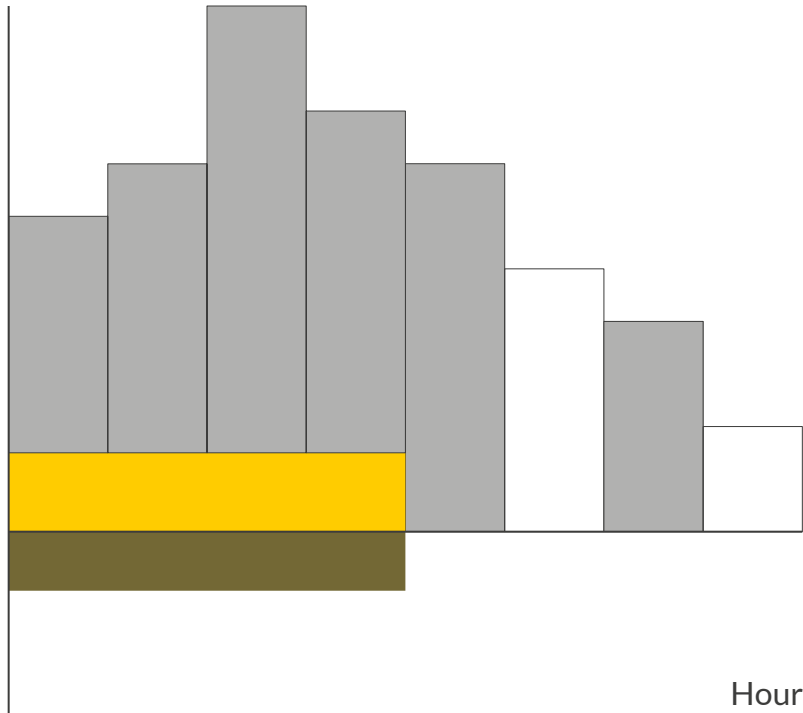


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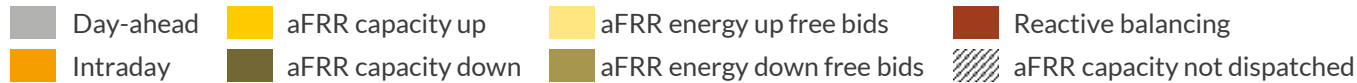
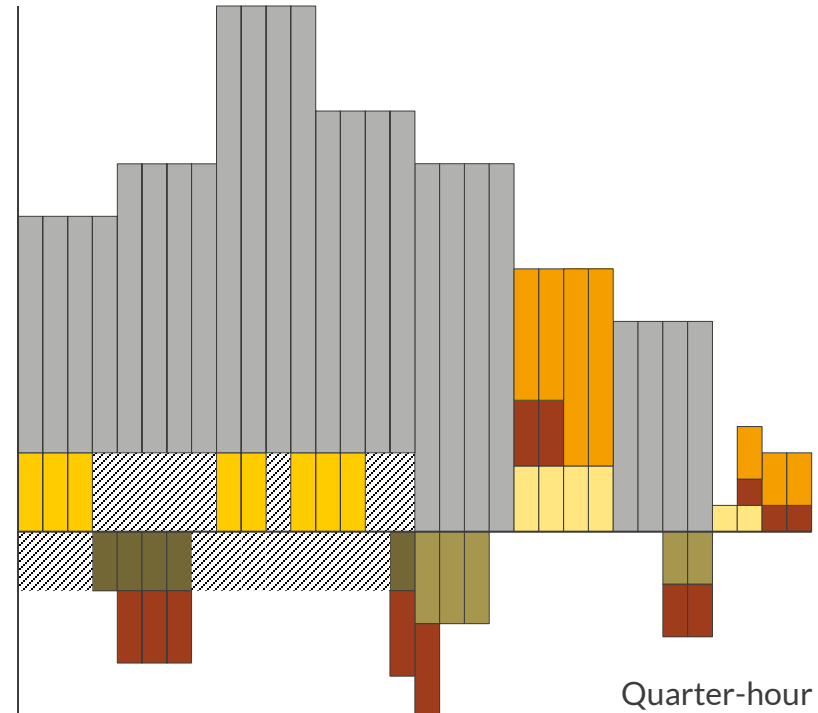
I. Scheduling phase: Capacity allocations

Asset capacity split by market



II. Dispatch phase: Energy dispatch

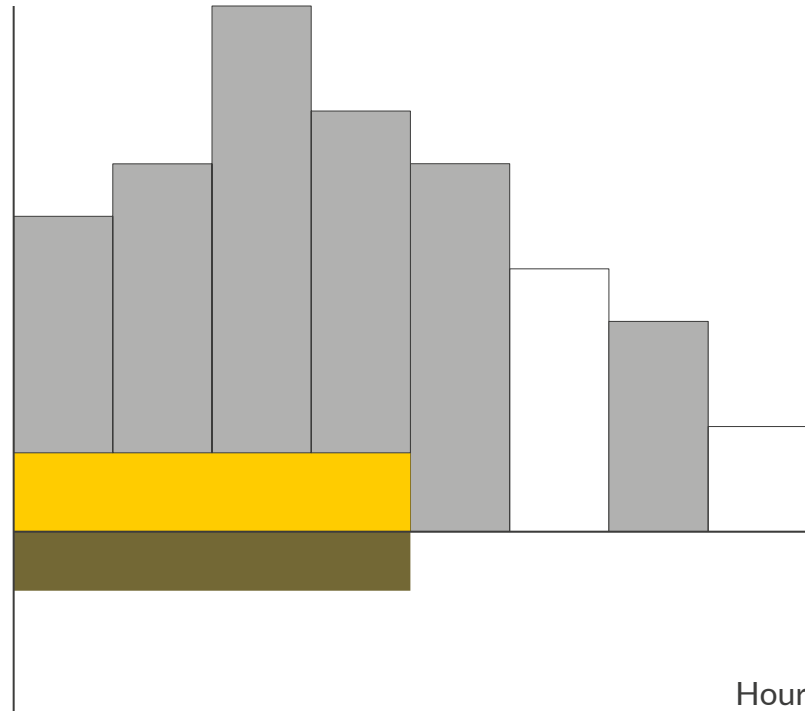
Asset generation split by market



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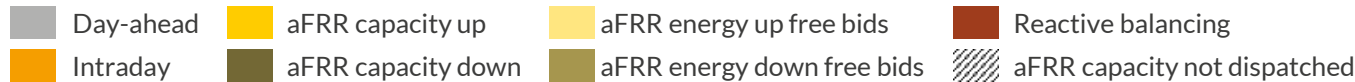
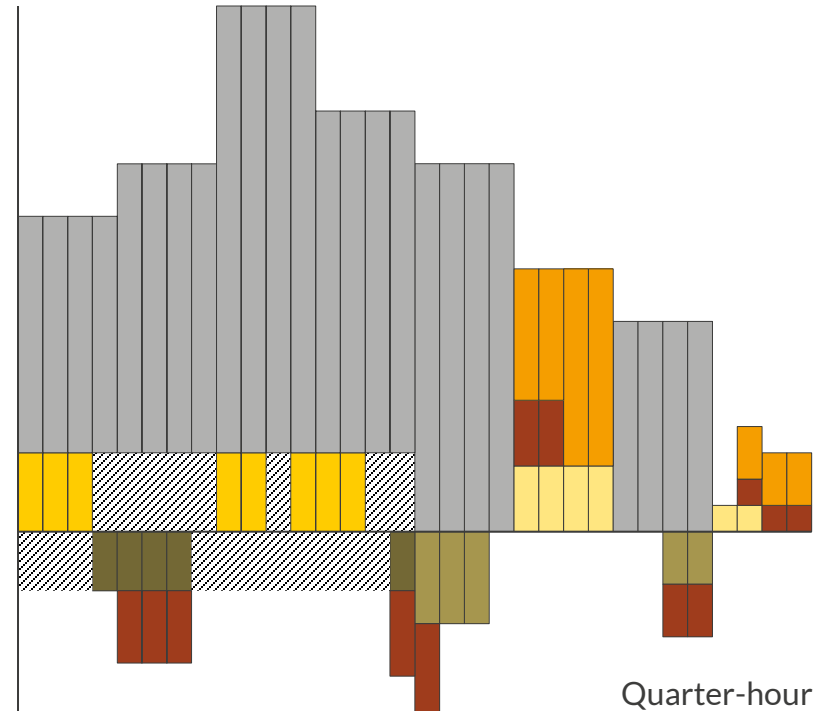
I. Scheduling phase: Capacity allocations

Asset capacity split by market



II. Dispatch phase: Energy dispatch

Asset generation split by market



Base case

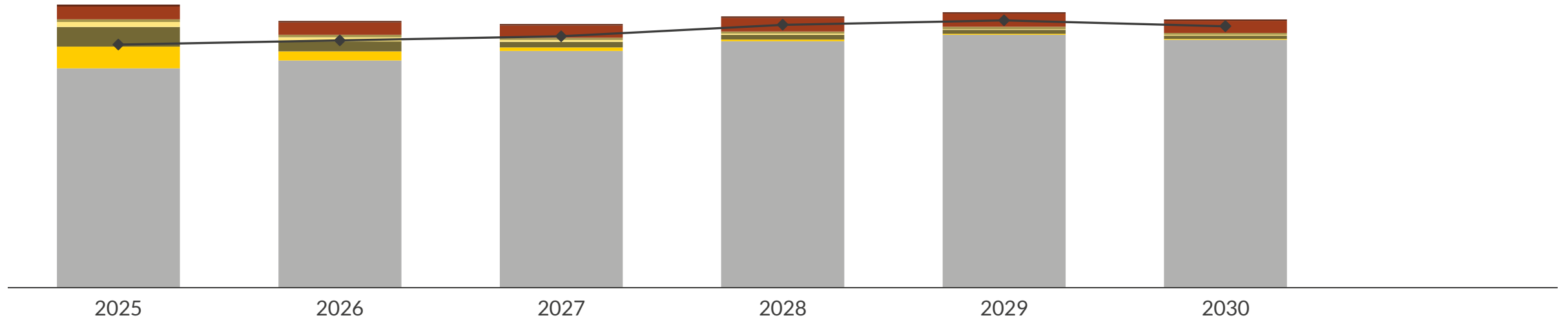
- Bid 100% of production in Day-Ahead market (DA), or curtail if DA price below Guarantees of Origin price
- Curtailed energy can be traded in real-time in Intraday (ID) market

Flexible trading

- Bid 70% of production in DA market as described in base case
- Optimise available capacity in aFRR capacity market and reactive balancing in both directions
- Real time dispatch of energy in ID and aFRR energy.
- We consider 4h aFRR capacity product length.

Flexible dispatch of solar assets leads to 16% additional revenues in 2025, but upside decreases sharply as prices in these markets decline

Solar PV revenue breakdown - Base case vs. Flexible trading
 €/MWh (real 2023)



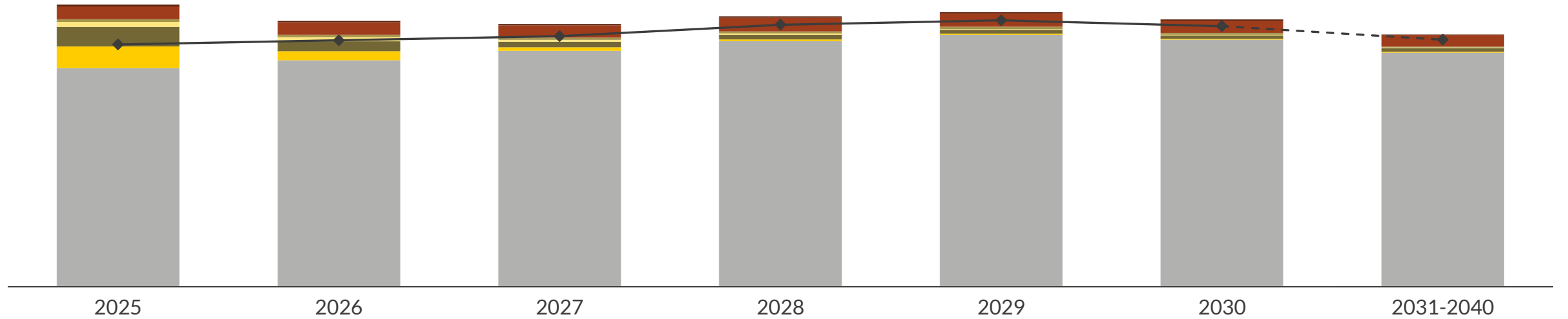
Upside vs base case
 %



- Wholesale markets
- aFRR capacity up
- aFRR capacity down
- aFRR energy up
- aFRR energy down
- Reactive balancing up
- Reactive balancing down
- Base case

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ENERGY RESEARCH

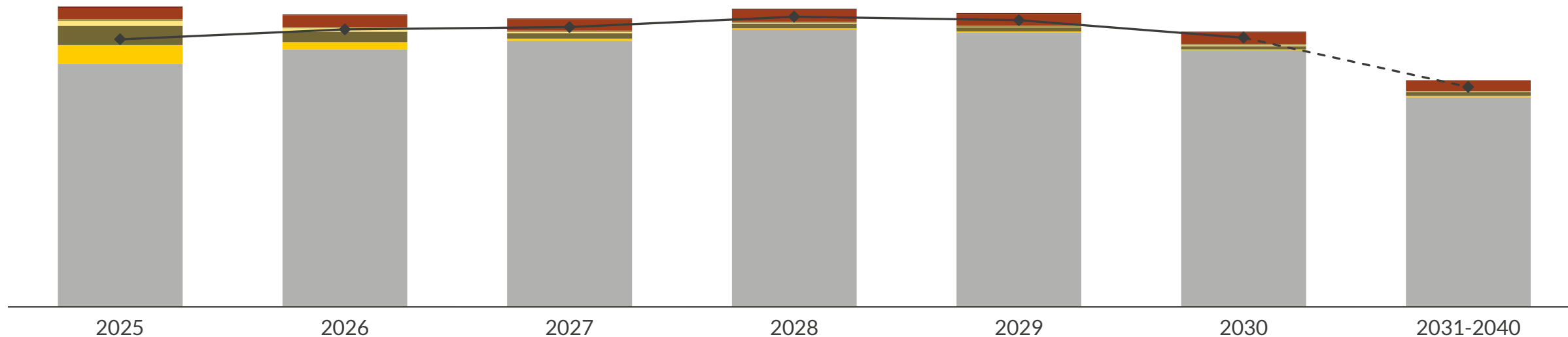
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ENERGY RESEARCH

The upside for wind plants participating in ancillary services is 12% in 2025, lower than solar PV plants in the short term

Solar PV revenue breakdown - Base case vs. Flexible trading
 €/MWh (real 2023)



Upside vs base case
%



Wholesale markets
 aFRR capacity down
 aFRR energy down
 Reactive balancing down
 aFRR capacity up
 aFRR energy up
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 Base case