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Beyond the Buzz: Winning Cases for BESS Investments in the Netherlands

20 March 2025

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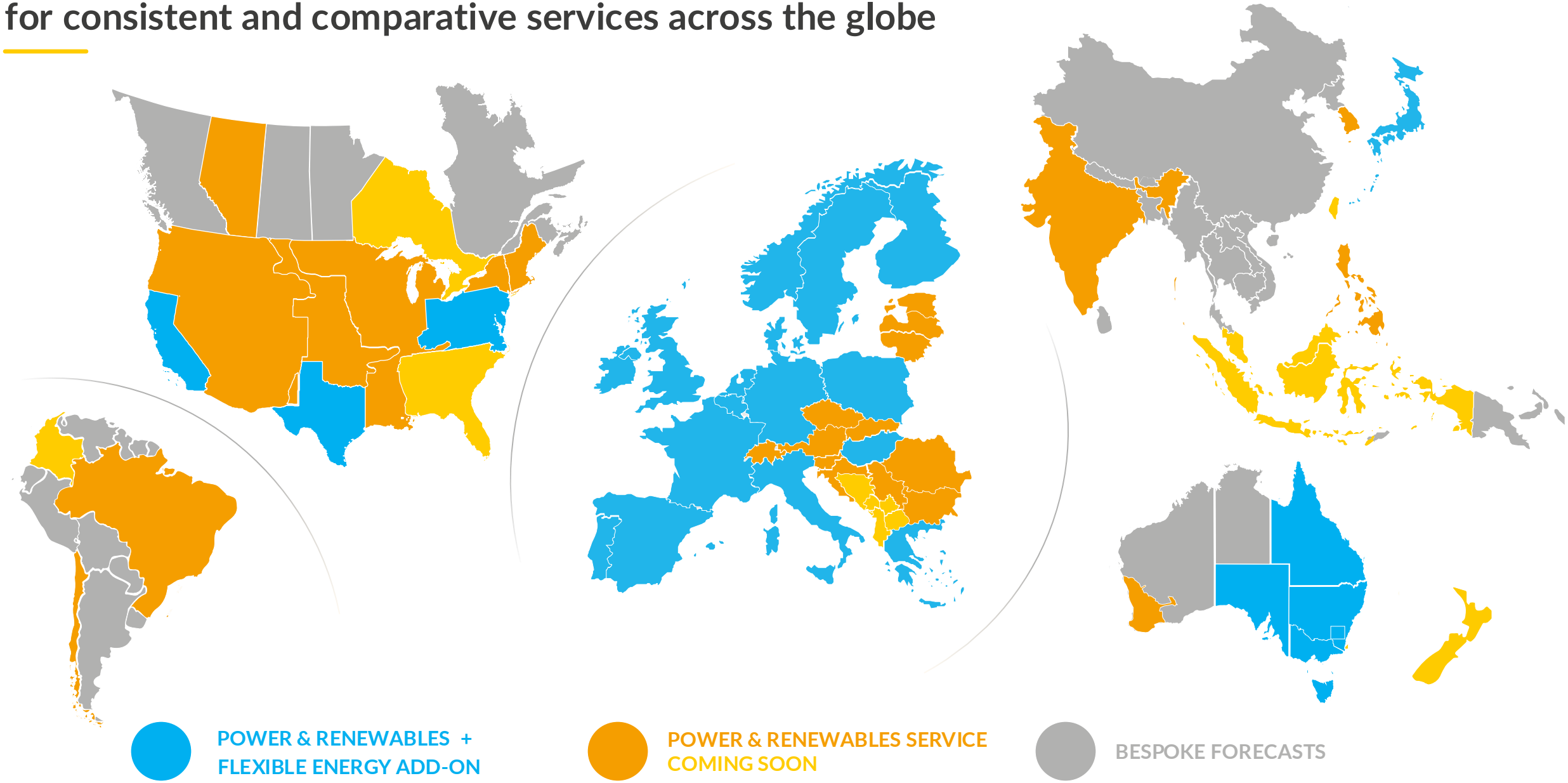

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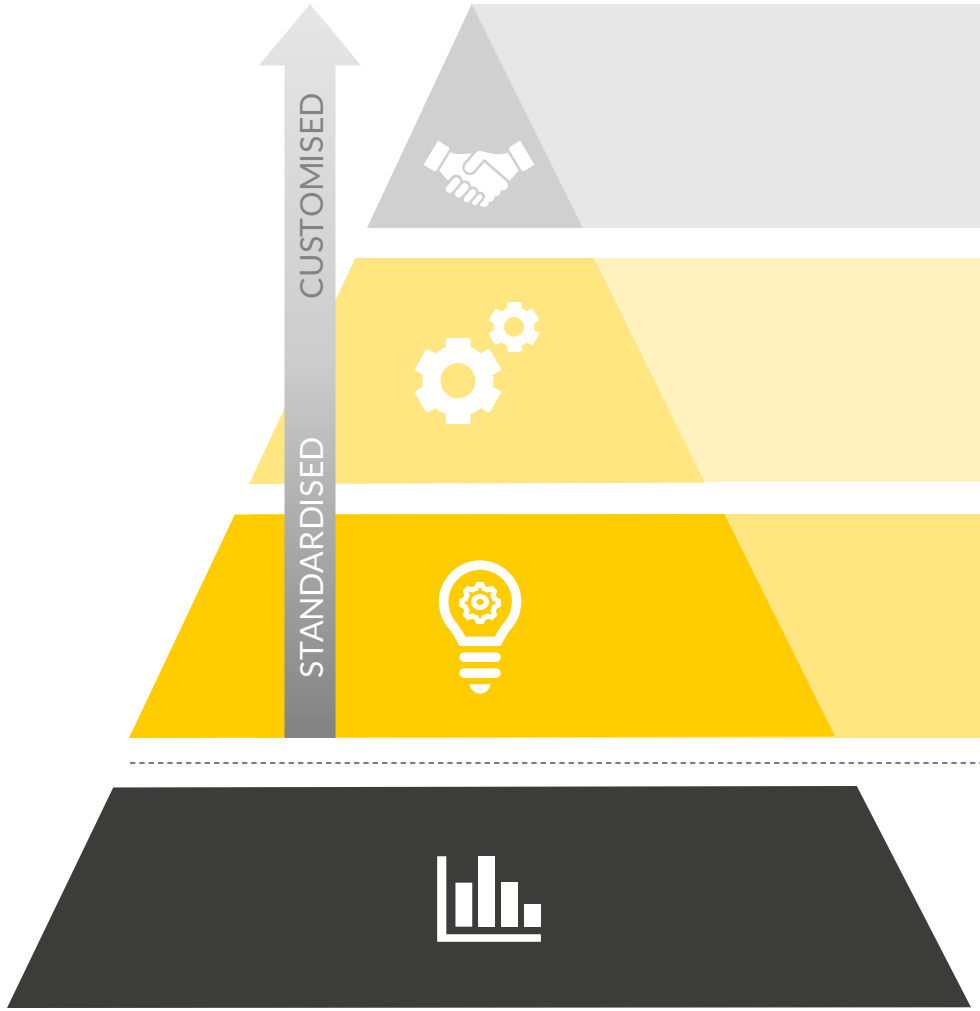

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Source: Aurora Energy Research

Join key players from across the Dutch power sector at our subscriber-exclusive Group Meetings

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Agenda

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I. Introduction

II. Battery business cases

III. Battery co-location with Solar PV

IV. Key takeaways

For more information, please contact
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Utility-scale battery capacity in the Netherlands has grown almost six-fold since 2021, with a 2.4 GW pipeline set for deployment in the coming years

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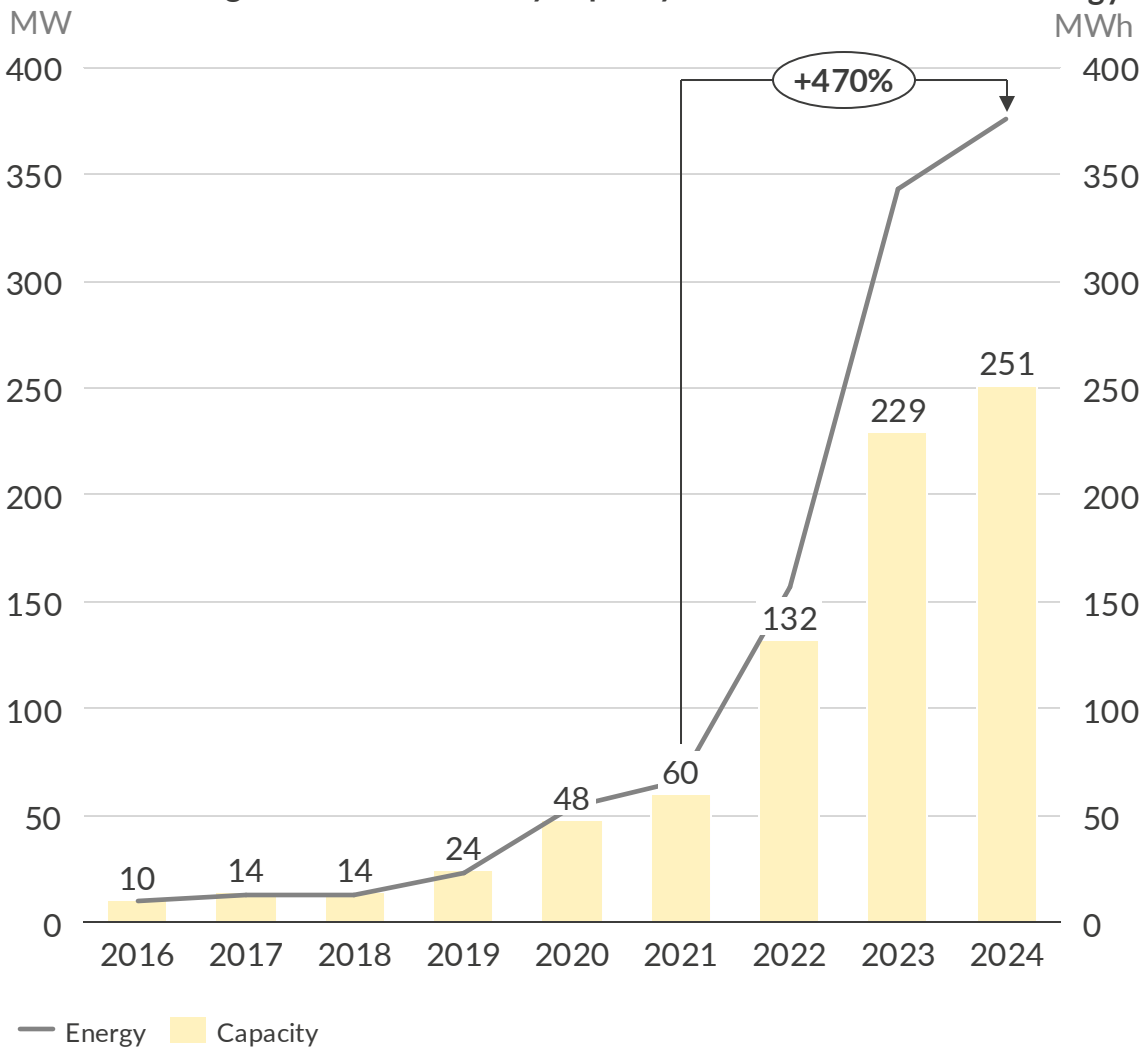
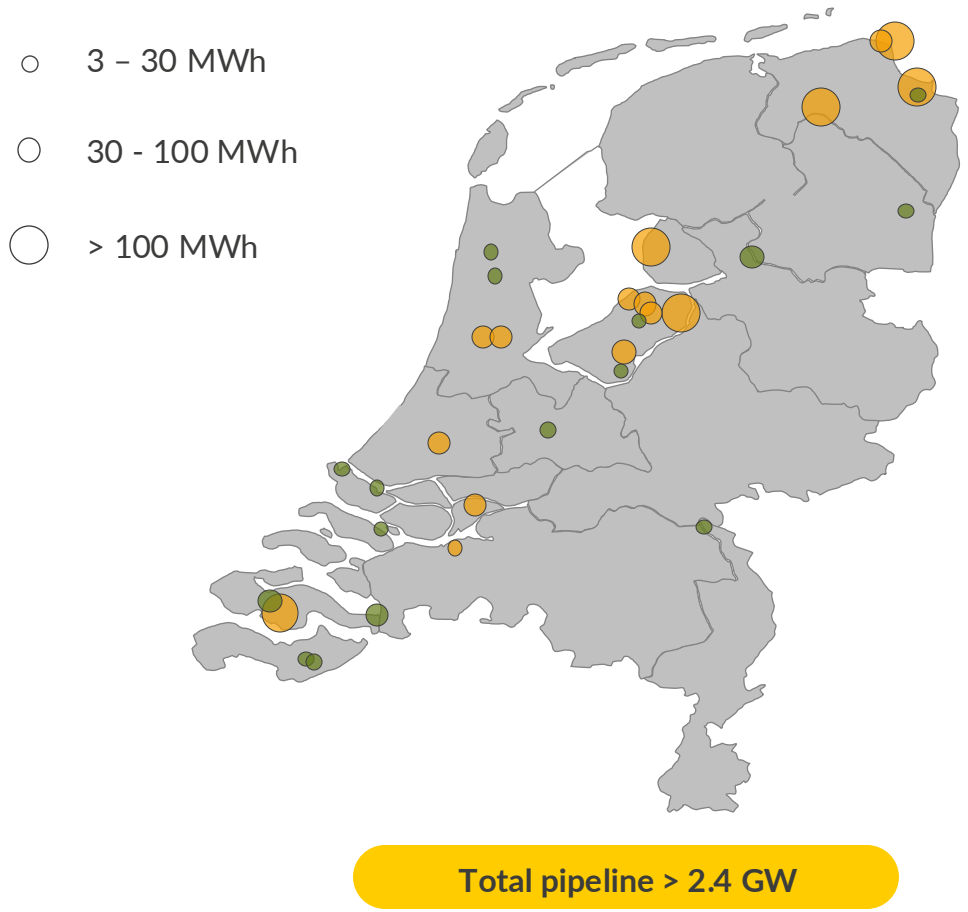
Commissioned grid connected battery capacity[1,2,3]



Commissioned energy[2]

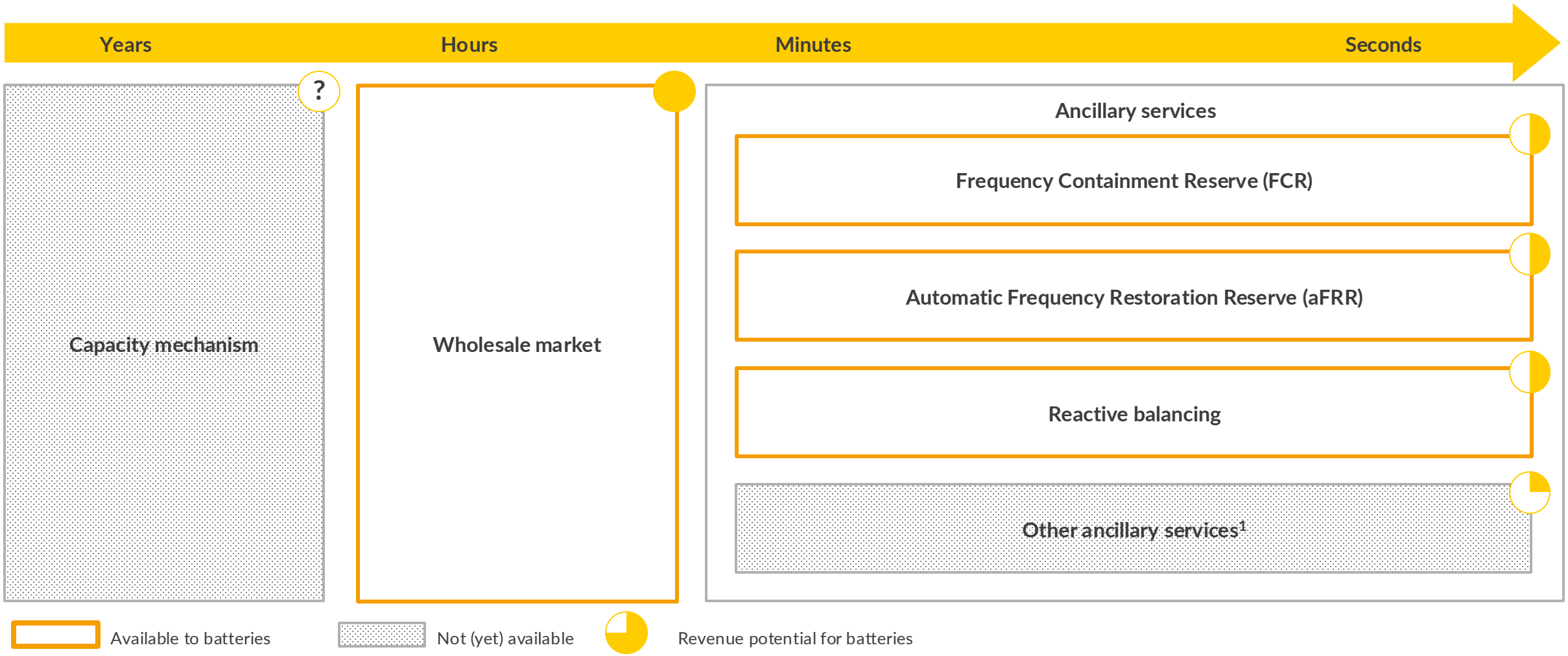
Battery projects in the Netherlands by status and project size



1) Grid-connected utility scale battery capacity. 2) Cumulative. 3) Capacities for the year 2022 and 2023 based on Centraal Bureau voor de Statistiek (CBS)

Sources: Aurora Energy Research, SemperPower, Solar Magazin, Giga Storage, RWE, Ventolines, Centraal Bureau voor de Statistiek (CBS)

Batteries can simultaneously participate in diverse markets, offering opportunities for revenue stacking under different trading strategies



1) Next to the mentioned ancillary services, there is also mFRR which is less attractive for batteries with expected lower prices and low activation rates. Additional to these markets, TenneT is also procuring and tendering reactive power.

Sources: Aurora Energy Research

While stand-alone battery investments enable flexible dispatch, co-located solutions offer cost savings and potential grid fee reductions

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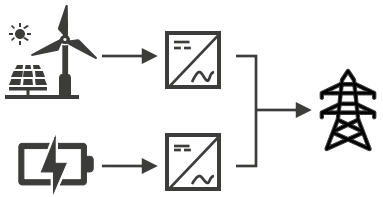
I Stand-alone

The battery asset has its own site, which is metered and managed individually



II AC co-location

RES and battery assets require separate inverters to connect to the grid

	Stand-alone	AC co-location
Costs *CAPEX & OPEX*	No shared costs	Cost savings on development, balance of system, and OPEX
Portfolio diversification *Diversification of risk and revenue*	Can offer benefits when managed as part of a larger portfolio	Directly reduces revenue risks for renewable generation asset
Asset oversizing *Oversize renewable asset relative to grid connection*	-	Energy that would otherwise be curtailed can be stored, this depends on the inverter capacity
Battery dispatch *Charging/discharging profile of the battery asset*	Full asset flexibility	Asset output is constrained by inverter and grid connection
Grid fees *Grid fees applicable for import capacity*	Battery is subject to grid fees	If the battery doesn't charge from the grid, grid fees can be avoided
Grid connection access *Point of interconnection with to the grid*	Battery has an individual grid connection	Grid connection is shared between the assets

Full benefit | Partial benefit | Neutral | Partial downside | Full downside

Sources: Aurora Energy Research

In this session, we will discuss investment cases for stand-alone batteries and batteries co-located with solar PV in the Netherlands

II Battery business cases

Deep dive into battery business cases:

- Stand-alone battery business case
- Impact of different grid fee tariffs
- Trading on the continuous Intraday market

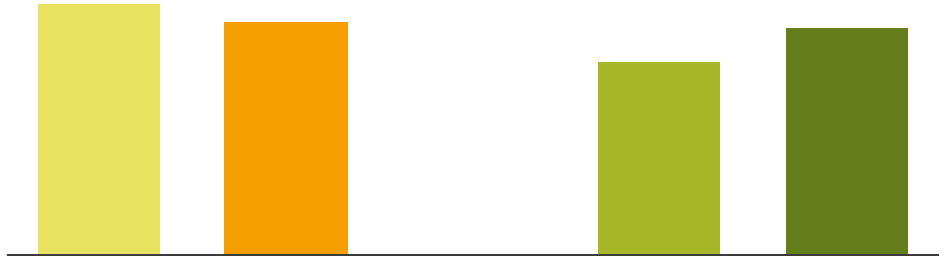
Battery present value
€/kW

III Battery co-location with solar PV

Deep dive into co-location with solar PV:

- Drivers for co-location with solar PV
- Advantages for co-location with solar PV
- Co-located battery business cases:
  1. Retrofit without grid charging.
  2. Retrofit with grid charging.

Project IRR for different configurations
%



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With Chronos, our in-house dispatch software, we model investment cases using our price forecasts, considering market rules and asset characteristics

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Flexibility markets and battery parameters

- Day-Ahead (DA) prices
- Intraday (ID) prices
- FCR prices
- aFRR prices for capacity and energy
- Reactive balancing threshold
- Degradation, cycling rates, duration, efficiency

Chronos[1] battery trader

Day 1
Scheduling Phase → Dispatch Phase

Day 2
Scheduling Phase → Dispatch Phase

...

Day n
Scheduling Phase → Dispatch Phase

Results

- Battery dispatch
- Revenues per market
- NPV and IRR

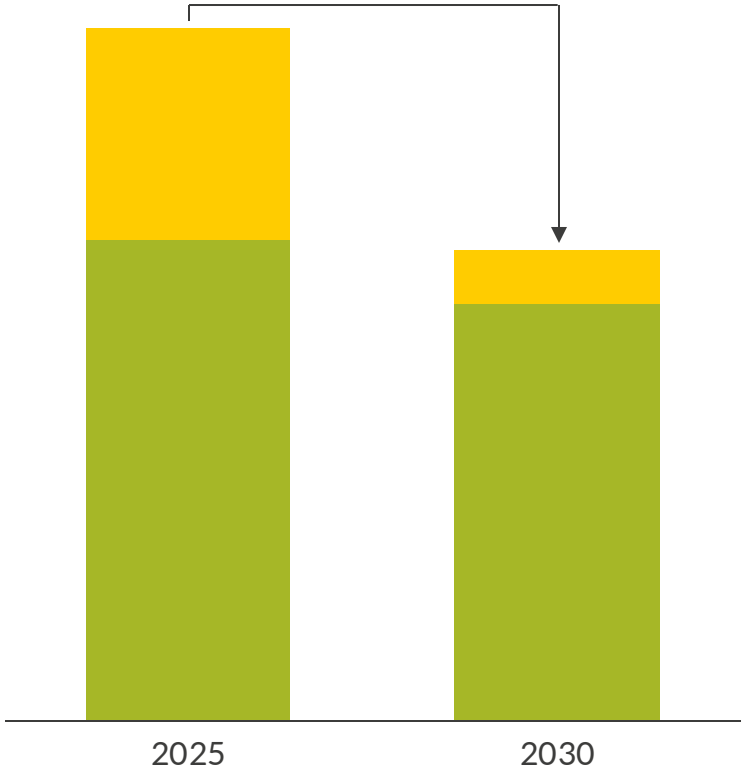
1) Includes intermarket optimization but does not include intra-market optimisation through asset backed trading such as continuous trading of 15-minute products on the ID and trading the same quarter hour multiple times.

Sources: Aurora Energy Research

Dutch batteries can capture attractive wholesale and ancillary market revenues, but high grid fees lead to low project returns

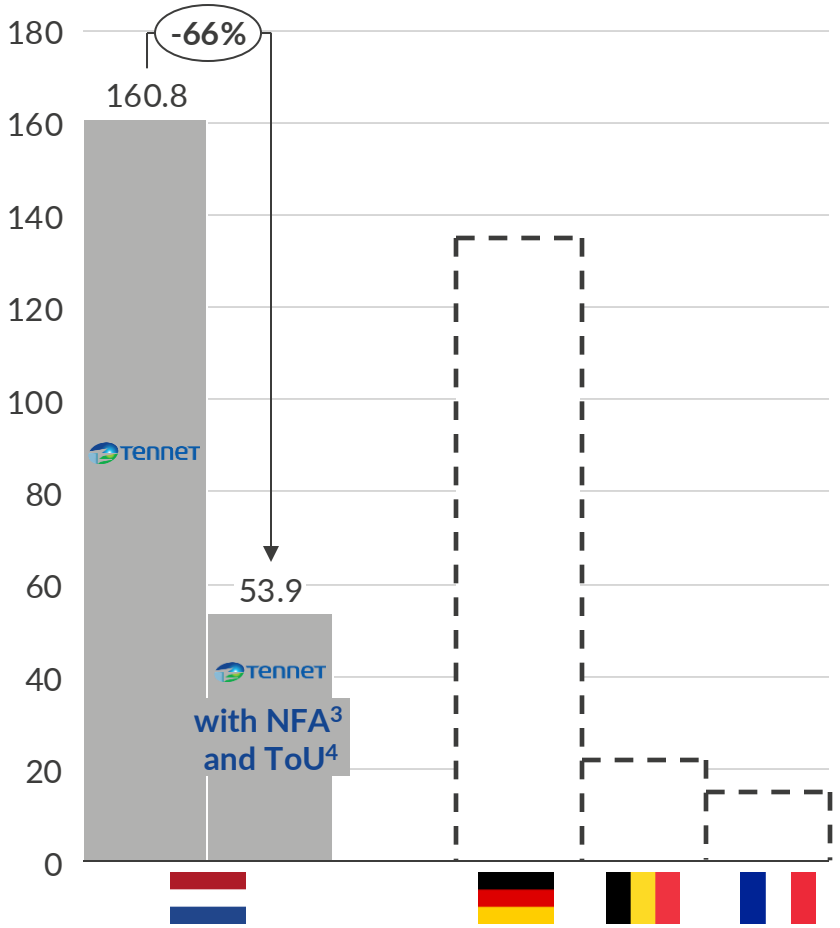
Gross margins for a 4h battery system – Illustrative
Present value €/kW

All data is provided in our Group Meeting report for clients.



Energy arbitrage[1] FCR and aFRR capacity markets

Yearly grid fees for the year 2024[2]
€/kW (real 2023)



No grid fee exemptions Potential grid fee exemptions

1) Energy arbitrage include Day-Ahead and Intraday market revenues 2) Calculated based on a 30MW battery with 2h duration, 1.5 cycles per day with a firm connection 3) Non-firm connection and transmission agreement. 4) Time of Use (ToU).
Sources: Aurora Energy Research

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Comments

- In 2025, batteries are expected to make a significant share of their revenue on the aFRR and FCR market.
- By 2030, with more batteries entering the system, prices on the FCR and aFRR capacity markets are expected to go down, leading to reduced revenue opportunities.
- While wholesale market revenues are also projected to decline, the impact will be less significant due to the depth of these markets.
- While batteries in neighbouring countries are eligible for discounts or exemptions on grid fees, the Netherlands currently does no offer a complete grid fee exemption for battery storage.

The recent grid fee proposals offer attractive discounts but also restrict battery dispatch

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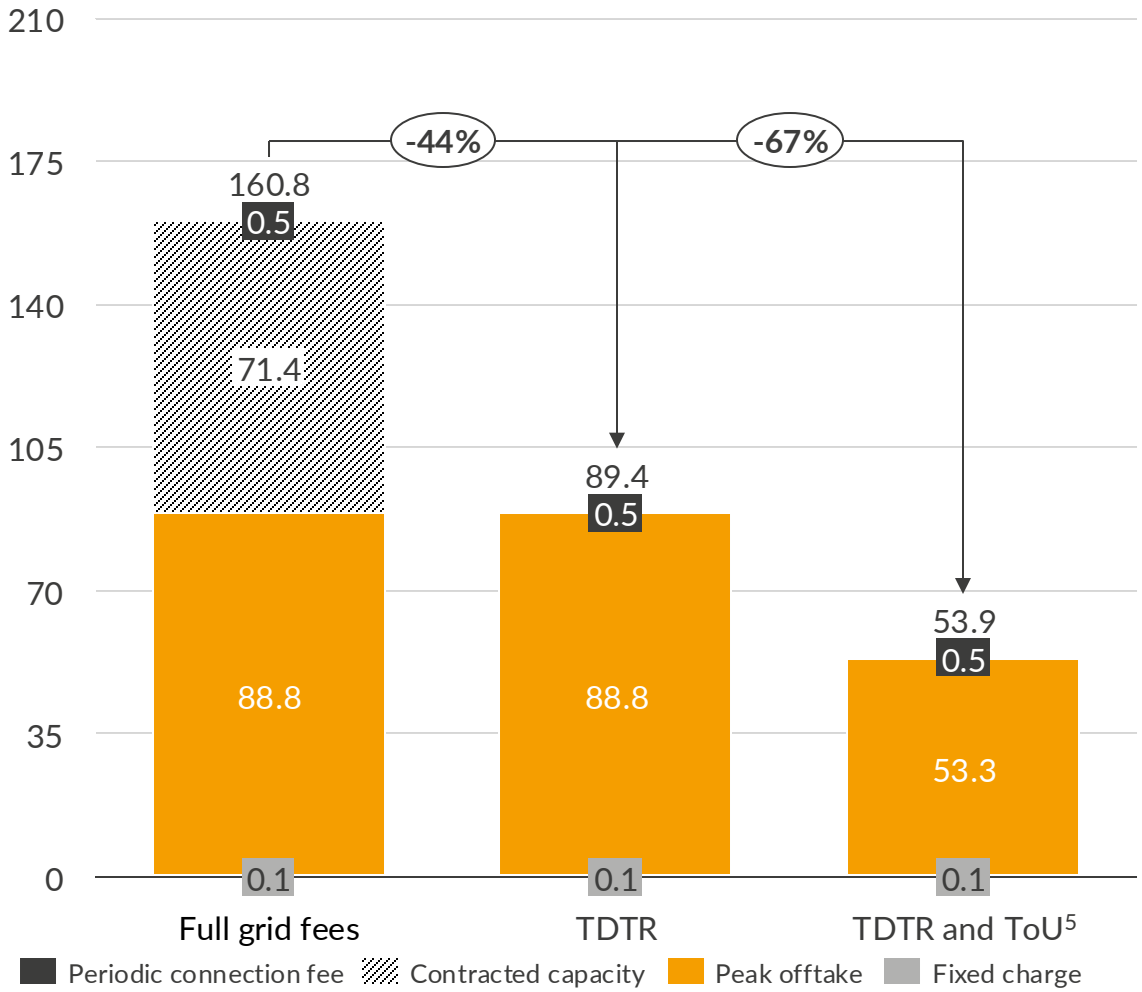
Grid fee structures in the Netherlands

		Grid operator	Restriction on	Status
Flexible contracts	1 **Non-firm ATO[1]**	All networks	Import and export	Available from 1 February 2024, and mandatory from 1 February 2025 in congested areas
	2 **Fixed duration[2] (e.g. TDTR[3])**	TSO (contracted capacity)	Import and export	Effective from 1 April 2025, available at all sites by 1 October 2025 at the latest
	3 **Fixed time block (TBTR[4])**	DSO (contracted capacity)	Import and export	Effective from 1 April 2025
Rates	4 **Time of use (TSO)**	TSO (peak offtake)	Import	Effective from 1 January 2025
	5 **Time of use (DSO)**	DSO (peak offtake)	Import	In preparation

Tennet (TSO) 2024 grid fees under different structures

€/kW/year (real 2023)

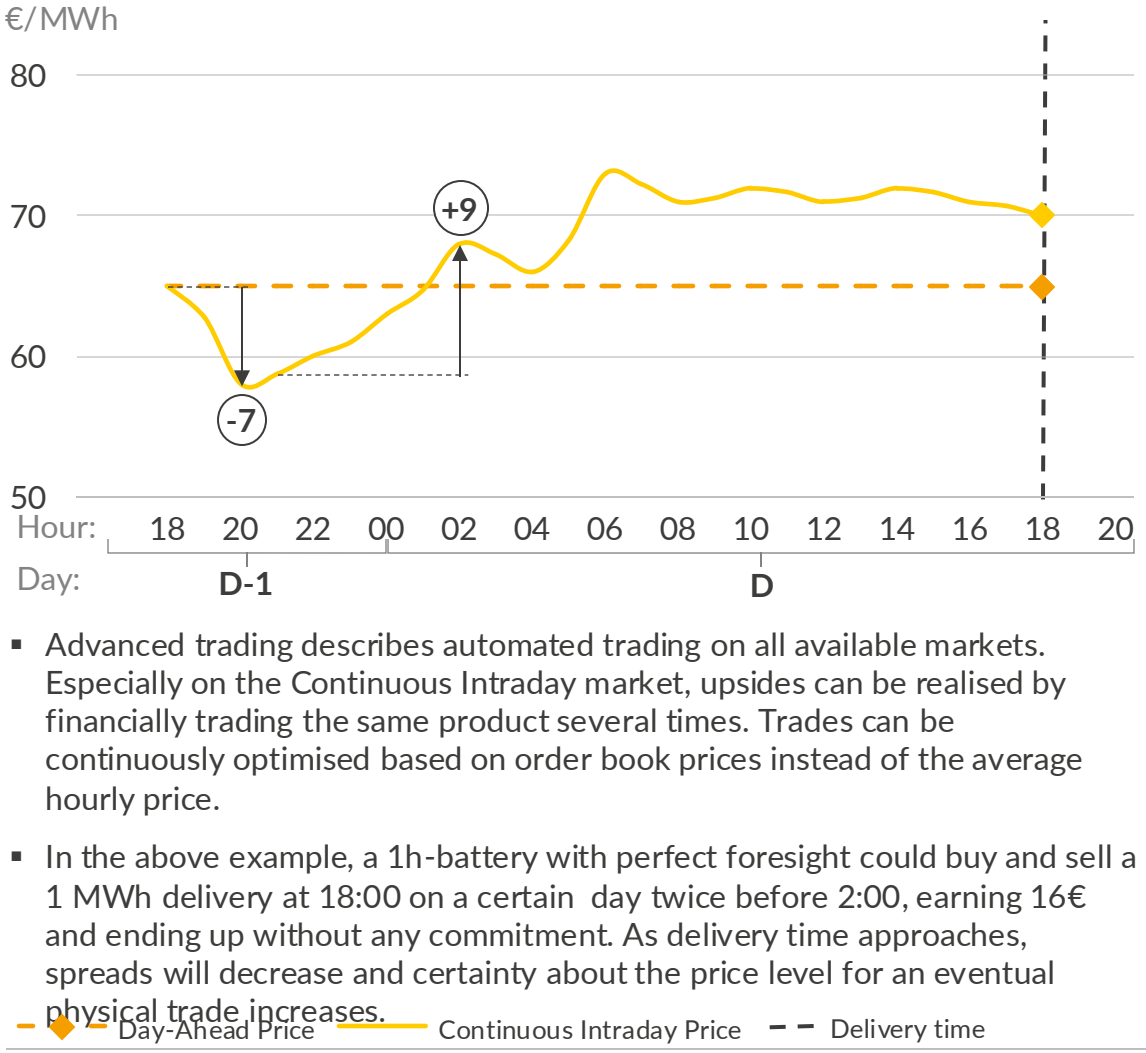


1) Contract without a fixed (firm) transport capacity are called non-firm ATO (Aansluit- en transportovereenkomst) 2) We assume that TenneT will only make use of the restrictions during 5% of the year. Calculated based on a 30MW battery with 2h duration, 1.5 cycles per day 3) Time dependent transport right (TDTR) 4) Time block transport right (TBTR) 5) Time of Use (ToU)

Sources: Aurora Energy Research

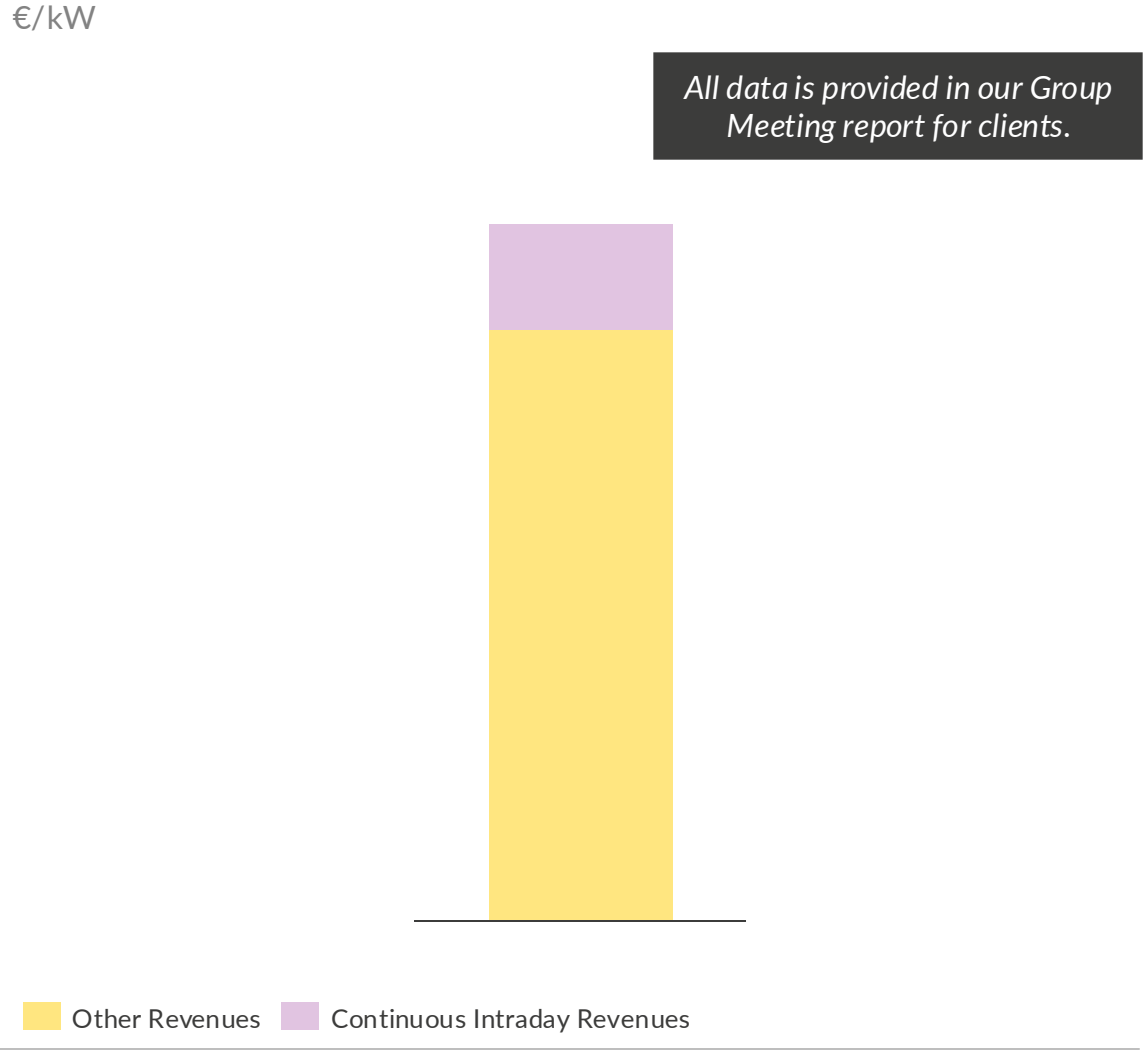
Financial asset backed trading on the Intraday market can improve the battery business case, but cannibalisation of the upside is expected

Day-Ahead and continuous Intraday price – sample day



- Advanced trading describes automated trading on all available markets. Especially on the Continuous Intraday market, upsides can be realised by financially trading the same product several times. Trades can be continuously optimised based on order book prices instead of the average hourly price.
- In the above example, a 1h-battery with perfect foresight could buy and sell a 1 MWh delivery at 18:00 on a certain day twice before 2:00, earning 16€ and ending up without any commitment. As delivery time approaches, spreads will decrease and certainty about the price level for an eventual physical trade increases.

Present value of battery revenues – Illustrative



Sources: Aurora Energy Research

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The growing interest in co-location in the Netherlands has been driven by decreasing capture rates for solar and grid access constraints

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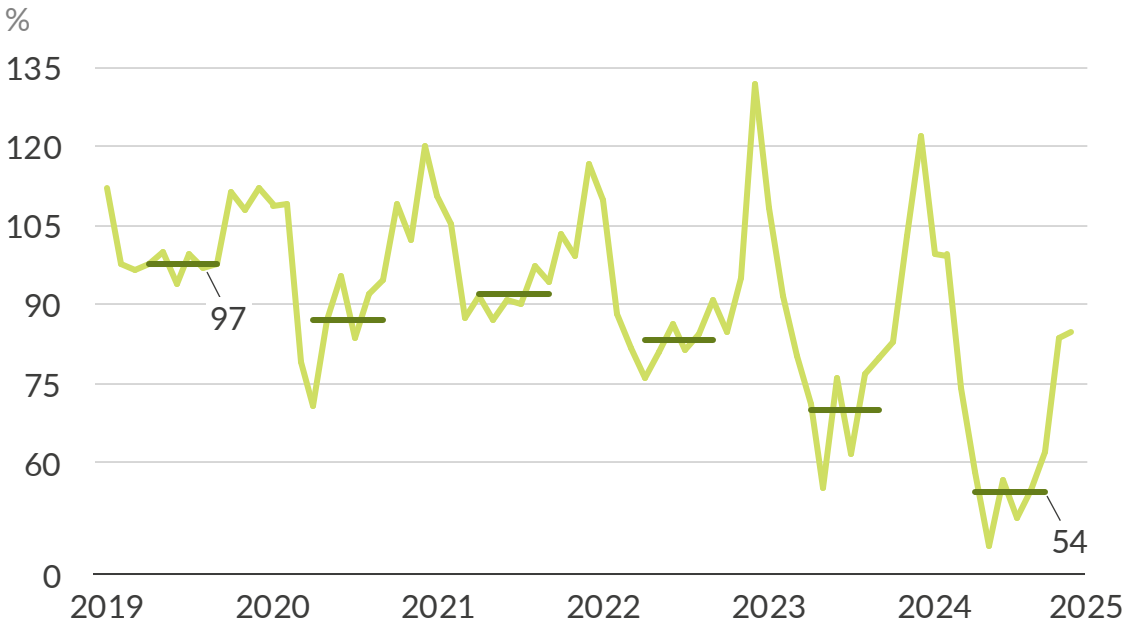
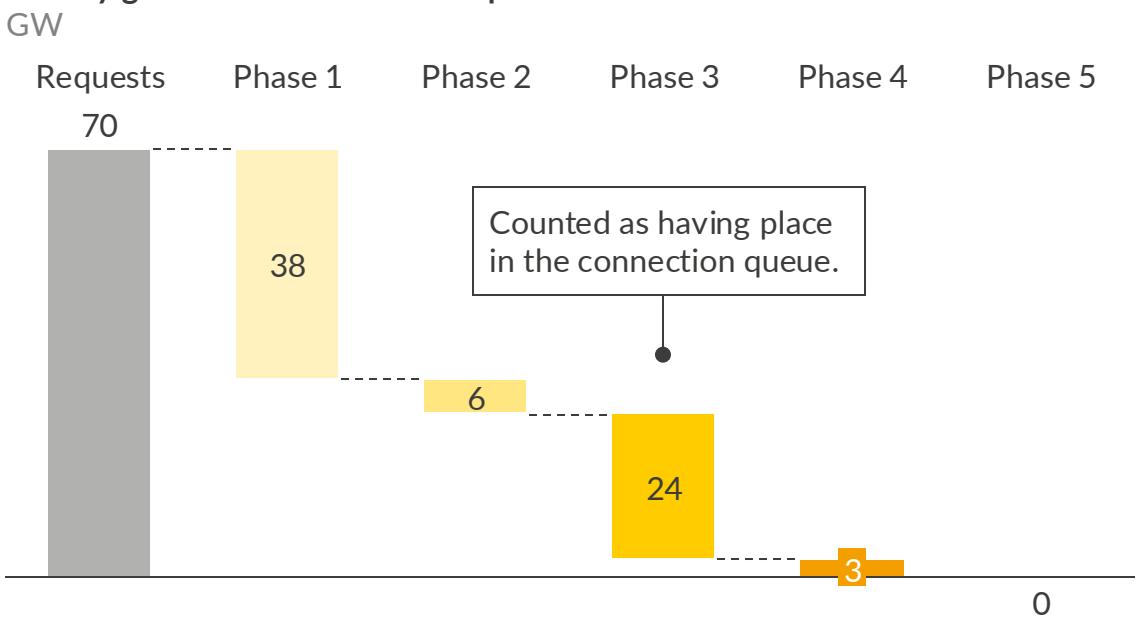
Historic solar PV capture rate



Battery grid connection access requests – TenneT[1]



- The historical capture rate for solar PV has declined, particularly between April and September, and is expected to stay low in the coming years.
- This decline has been driven by increasing solar penetration, which lowers wholesale prices during peak generation hours, and by the rising presence of negative price hours. In 2024, there were 456 negative price hours recorded in the Netherlands throughout the year.

- A 70 GW pipeline of BESS grid connection requests was disclosed by TenneT in August 2024. This reflects the high interest in batteries in the Netherlands but also indicates potential limitations in the available grid capacity and potential delays in connection timelines.
- A similar challenge is present today at the DSO level, where the expected application time for a grid connection averages 2 years[2] .

Discount to baseload Average April to September

1) Presented by TenneT in August 2024. 2) According to Liander, more details can he found under: Maatschappelijk prioriteren | Liander

Sources: Aurora Energy Research, TenneT, Liander

Retrofitting a battery to a solar PV asset can lead to cost savings and significantly reduces solar PV curtailment

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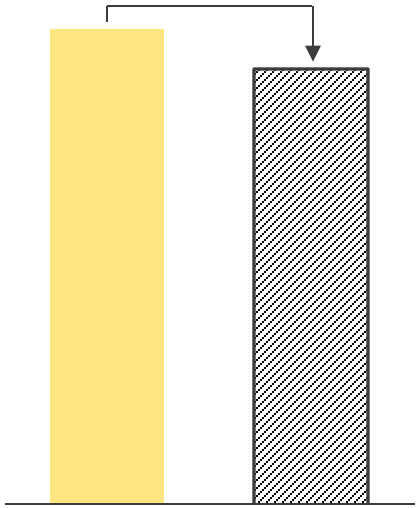
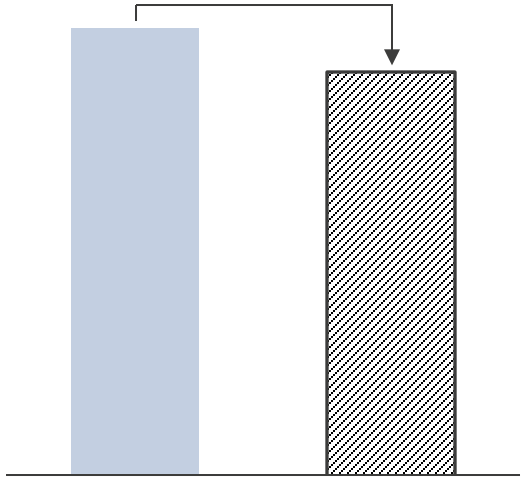
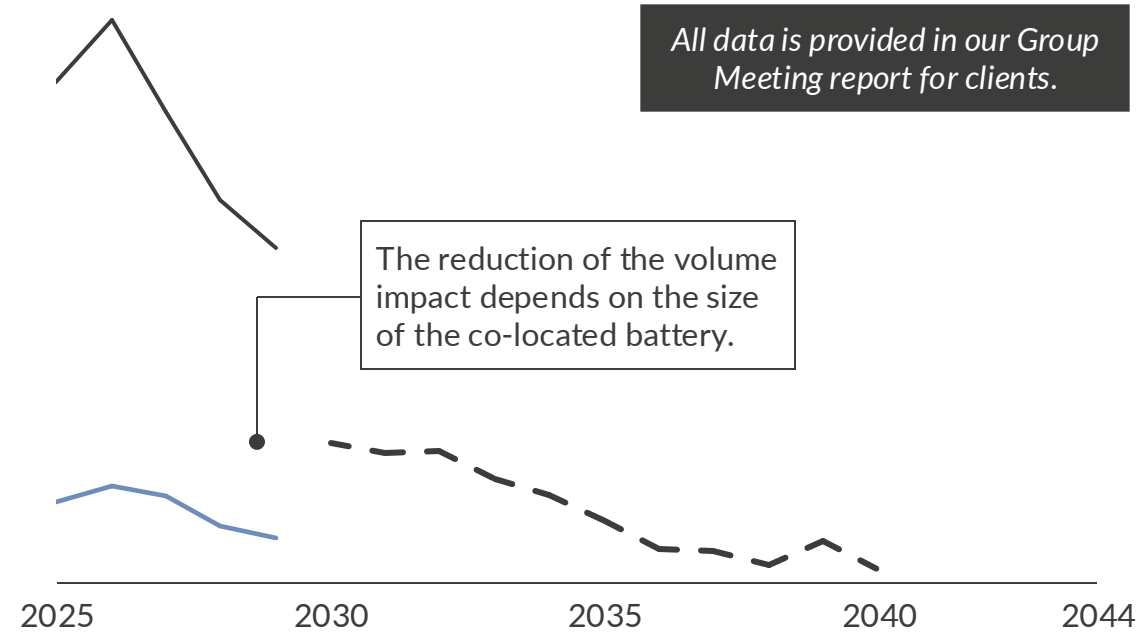
Retrofit battery CAPEX
€/kW



Retrofit battery OPEX
€/kW/year



1h-rule volume impact for the solar PV asset with a retrofit battery
%



- In a retrofit setup, the battery benefits from the existing grid connection at no additional cost. Additional CAPEX savings come from synergies in sharing cabling, control, protection, monitoring, and structural elements of the site.
- OPEX savings arise from shared business rates, insurance, and reduced overhead or administrative costs.

- Negative price hours have become more frequent in recent years, impacting the generation of solar PV during these hours. This trend is expected to persist with the volume impact remaining high before falling after 2035.
- A 4-hour battery, with a size equal to the solar PV inverter can almost entirely eliminate the volume impact of negative price hours.

Stand-alone battery Retrofit battery - Co-located

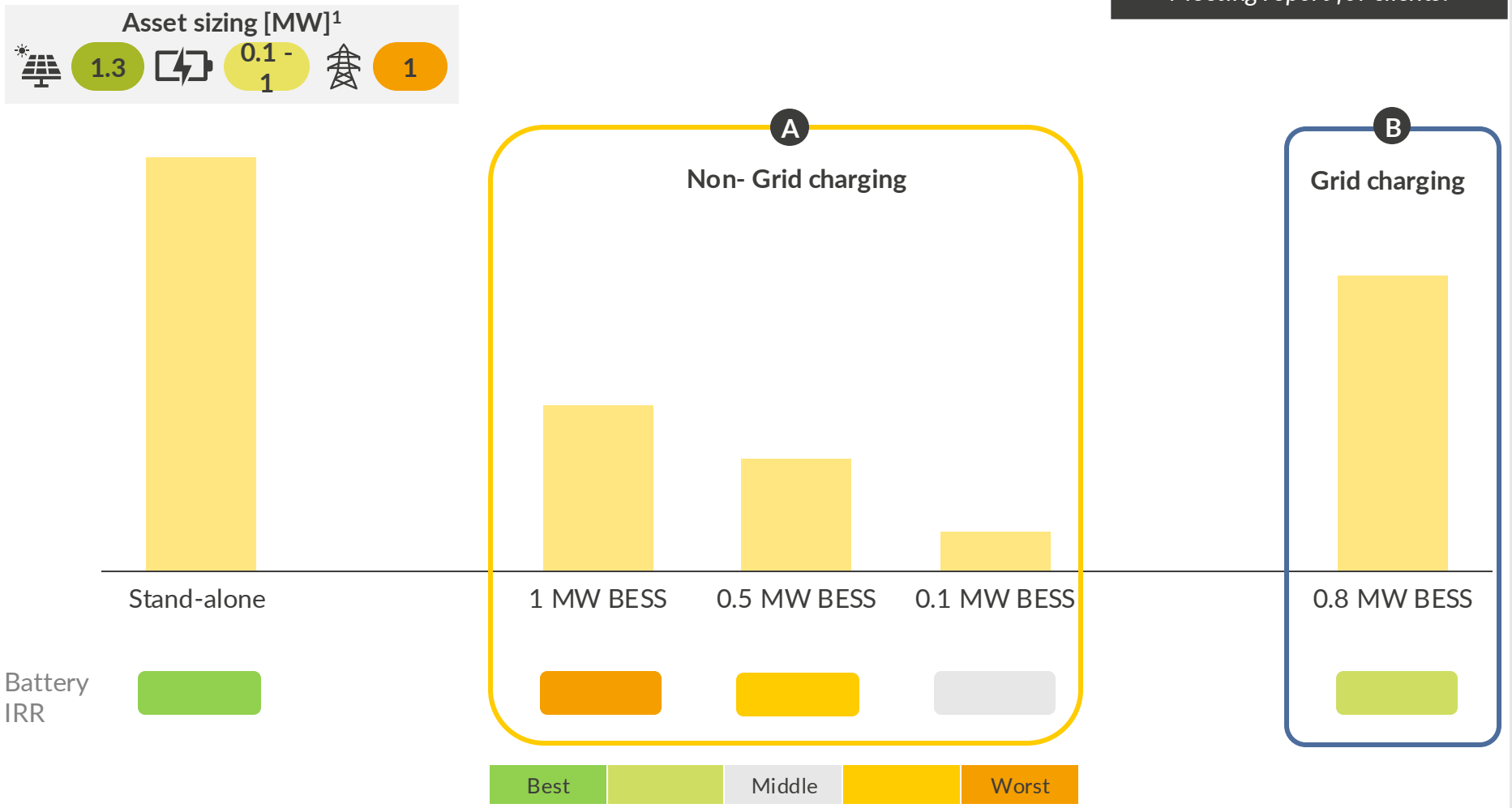
Stand-alone solar 0.5 : 1 BESS to Grid ratio

Sources: Aurora Energy Research

However, retrofitted batteries are not profitable without grid charging; when charging from the grid they can achieve higher IRR

Revenues for a retrofit battery - Illustrative
Present value k€

All data is provided in our Group Meeting report for clients.



1) For solar PV this reflects the MWp capacity, the asset has an inverter capacity of 1 MW.

Sources: Aurora Energy Research

Comments

A Non-grid charging

- Grid fees are avoided as the asset doesn't charge from the grid.
- This comes with the hurdle of not being able to participate in FCR and in the down-regulating ancillary service markets.
- The battery is not able to achieve profitability as the battery can only depend on the solar PV infeed to arbitrage.

B Grid charging

- The retrofitted BESS achieves a similar IRR compared to a stand-alone BESS.
- A battery size of 0.8 MW is the optimal size under this setup.

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Key takeaways

1 The Dutch market presents high revenue opportunities for stand-alone batteries, but also imposes significant grid fees, even under the new grid fee proposals. As a result, IRRs for batteries built in the coming years remain below the assumed WACC. As a result of the saturation of ancillary service markets, batteries will make most of their revenues on wholesale markets after 2030. Looking ahead, further increases in grid fees could pose a serious risk to the economic viability of battery projects.

2 Advanced trading strategies, particularly in the continuous intraday market, can significantly enhance battery revenues, by financially trading the same product several times. This highlights the importance of active trading and market participation in maximising returns. However, participation of additional batteries is likely to cannibalise this upside in the future.

3 Co-locating a battery with an existing PV installation is only a financially interesting option if the battery is allowed to charge from the grid. Relying only on excess solar generation limits the revenue potential significantly, especially during winter. The financial returns for co-located batteries with grid charging are similar to those of stand-alone batteries.

Sources: Aurora Energy Research

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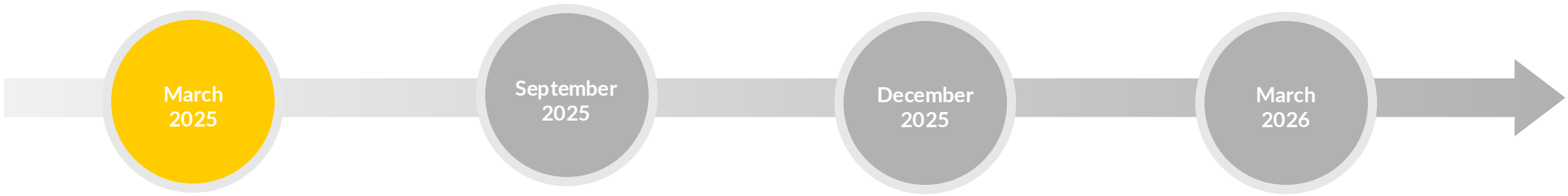

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