AURORA KEYNOTE

ENHANCING RETURNS AND REDUCING RISKS WITH BATTERIES

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The shift in energy capacity mix and rising electricity demand are driving the need for greater flexibility and battery storage across Europe

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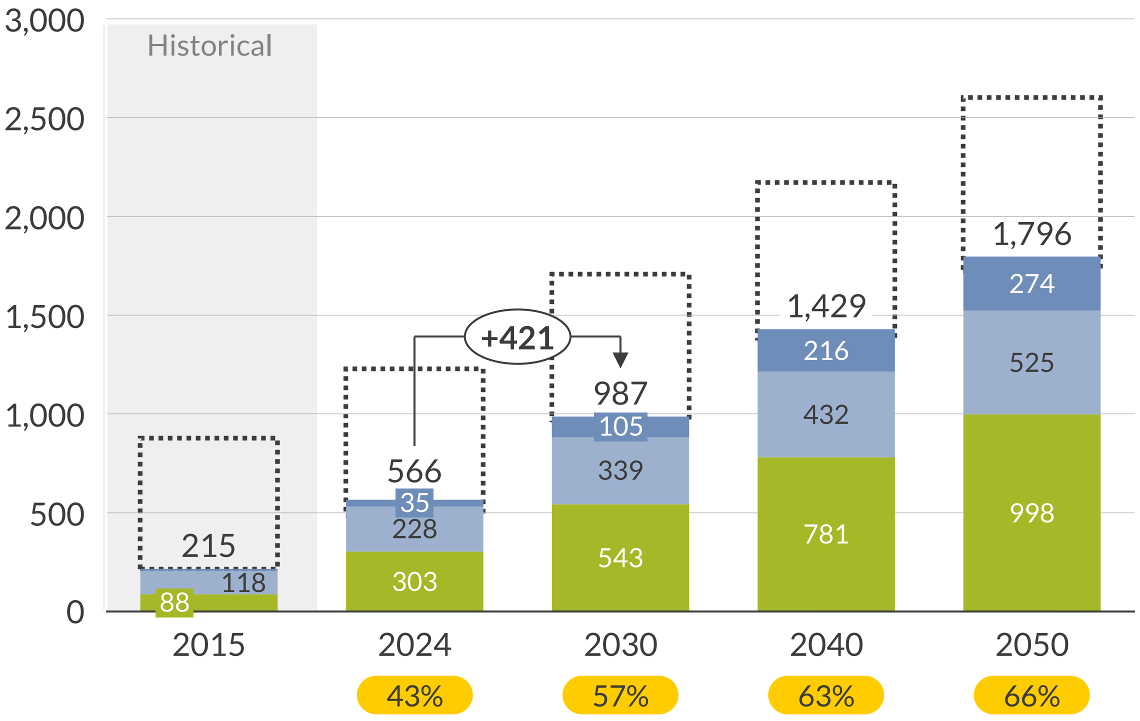
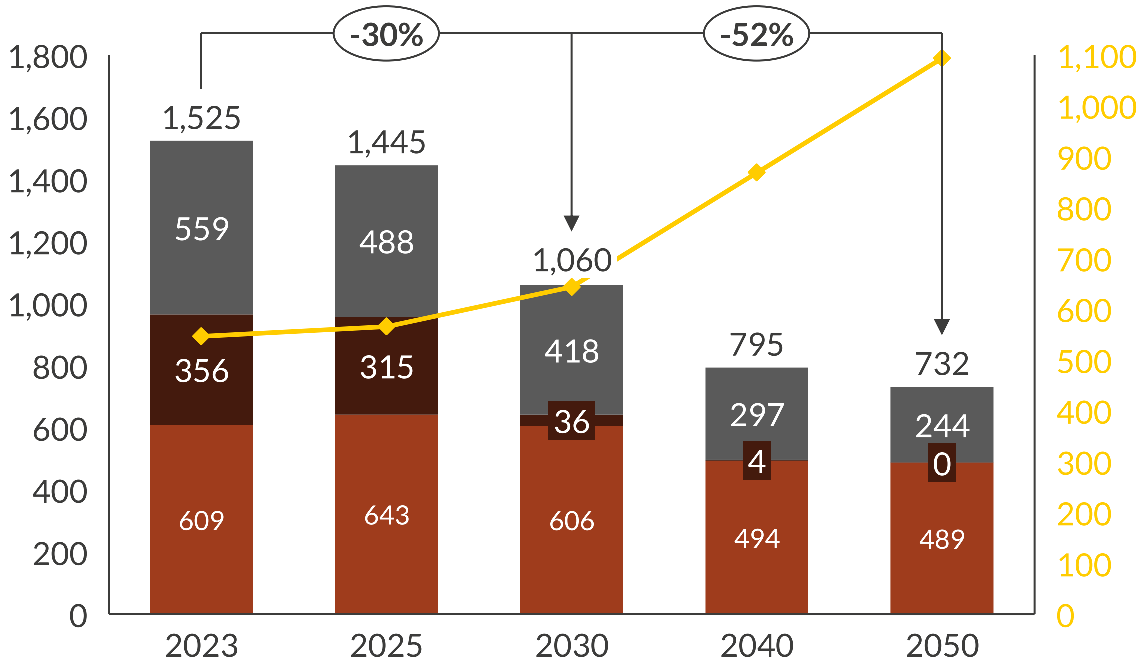
1 Installed variable renewable capacity in Europe (Aurora Central scenario)
GW



2 Evolution of conventional generation in Europe[1]
TWh

Peak demand
GW



- Europe's installed capacity of solar, onshore and offshore wind is forecast to grow over 3 times between 2024 and 2050, resulting in an increase in the variable RES share of generation to 57% and 66% by 2030 and 2050 respectively.

- The rising penetration of renewables contributes to the phase-out of conventional generation capacity and the loss of grid services (including inertia, frequency and voltage control, and black start), increasing the need for flexibility to maintain system security amid the rising peak demand from wider sector electrification

Offshore Wind[2] Onshore Wind Solar PV Total capacity xx% Variable RES share of generation[3]

Nuclear[4] Coal[5] CCGT[6] Peak demand

1) EU27 plus Great Britain and Norway, minus Malta and Cyprus; 2) Includes fixed bottom and floating offshore wind; 3) Considering all low carbon generation, we get to about 95% by 2050 (i.e. including hydro, nuclear, etc); 4) Generation from nuclear increases in the short-term from new capacity additions but decreases in the longer term as nuclear decommissions across Europe; 5) Includes Coal CHPs; 6) Includes CCGT CHPs, Gas CCS and Hydrogen CCGTs. Note that nuclear and abated thermal are still expected to play a long-term role for total generation in certain countries. Sources: Aurora Energy Research, Eurostat

The composition of revenue stacks varies significantly by country and storage capacity, with longer-duration batteries relying less on ancillary services

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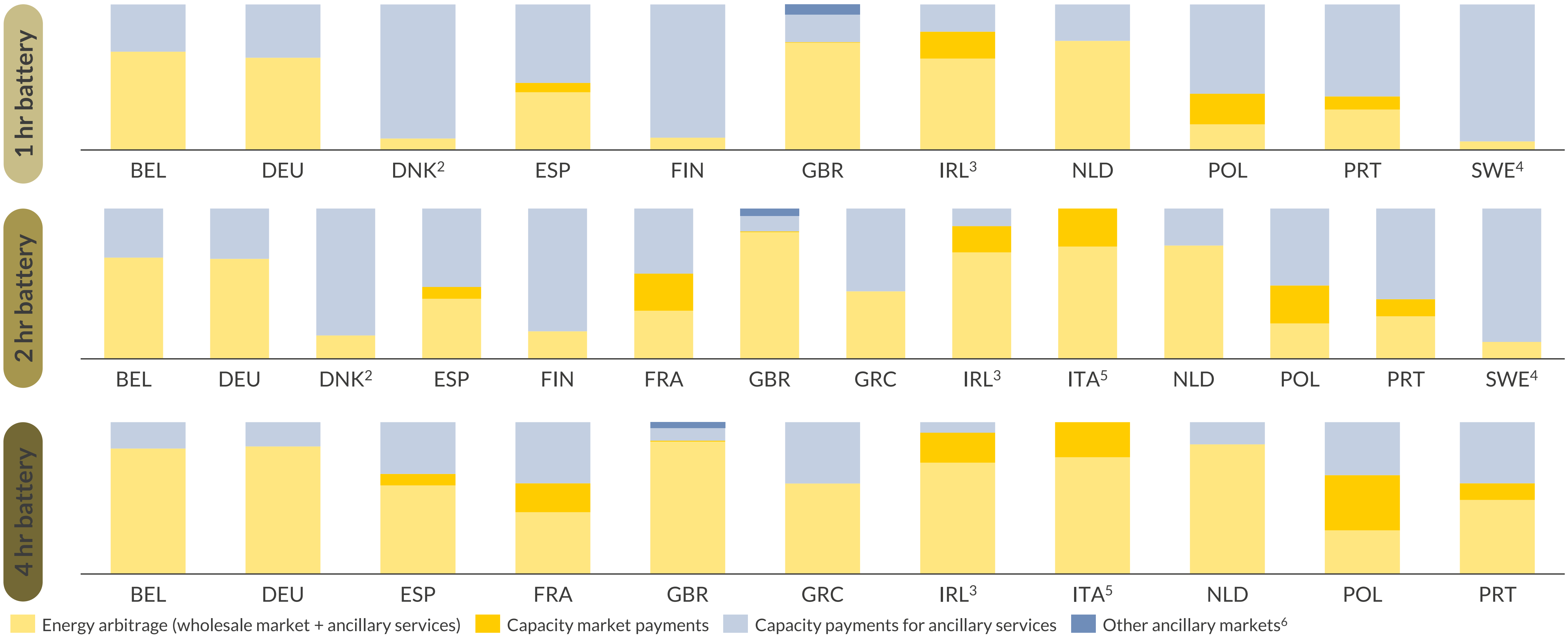
Average composition of gross margin stack[1]

% of 2027 – 2041



1) Shown for a representative battery with 2027 entry year; 2) Represents DK2; 3) Assumes improvements to Irish network communication with generators; 4) Represents SE4; 5) Represents the North zone of Italy. Energy arbitrage is between day ahead market and MSD; 6) Includes Triads and GDUoS benefits in GBR

Source: Aurora Energy Research

Battery business models will rely more on cross-market optimisation as wholesale markets and frequency services face increased saturation risk

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Summary of saturation risks for grid-scale batteries[1]

Region	Wholesale market[2]	Frequency response services[3]	Balancing and Restoration Services[4]
Belgium	Yellow	Yellow	Grey
Denmark[5]	Yellow	Red	Grey
Finland	Red	Red	Grey
France	Green	Yellow	Grey
Germany	Green	Yellow	Grey
Great Britain	Green	Red	Green
Greece	Yellow	Yellow	Grey
Ireland	Green	Yellow	Red
Italy	Yellow	Grey	Yellow
Netherlands	Yellow	Yellow	Grey
Poland	Yellow	Yellow	Grey
Portugal	Yellow	Green	Green
Spain	Green	Green	Green
Sweden[6]	Red	Yellow	Grey

Green: Will take longer to Saturate (> 3)
Yellow: Will saturate within the near term (1-3 years)
Red: Already saturated
Grey: Not relevant for batteries

2h Battery gross margins – Poland

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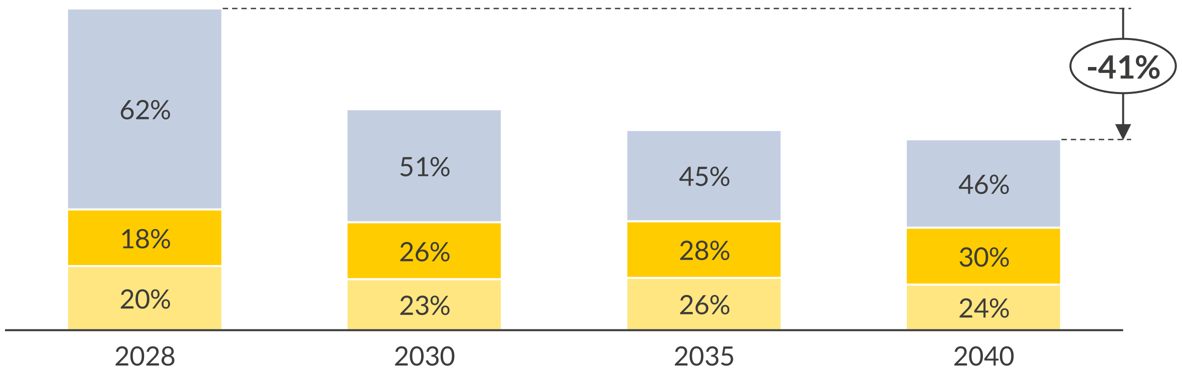
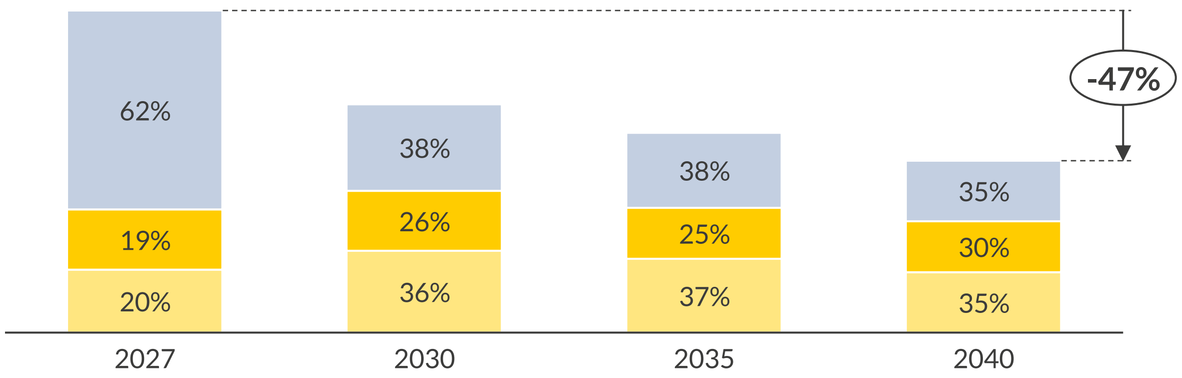
€/kW



2h Battery gross margins – France

€/kW



Energy arbitrage (wholesale + ancillary services)
Capacity payments for ancillary services
Capacity market payments

1) Assessed quantitatively based on forecast trajectory of the selected market prices relative to historical prices. 2) Wholesale market traffic light not showing near term saturation but rather showing absolute spreads in 2030 relative to the European average. 3) Includes frequency products with full activation time < 10 minutes such as FFR, FCR and aFRR. 4) Includes Balancing Mechanisms in GB and Ireland and frequency products with full activation time > 10 minutes such as mFRR, RR, and Secondary/Tertiary Reserves within Italy's MSD. 5) Represents DK2. 6) Average of SE1-4 products of fast frequency response products. Source: Aurora Energy Research

In a Low market scenario, battery investments are exposed to more market risks including low commodity prices and electricity demand

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Expected profitability for batteries with COD 2027
IRR % (pre-tax, real)

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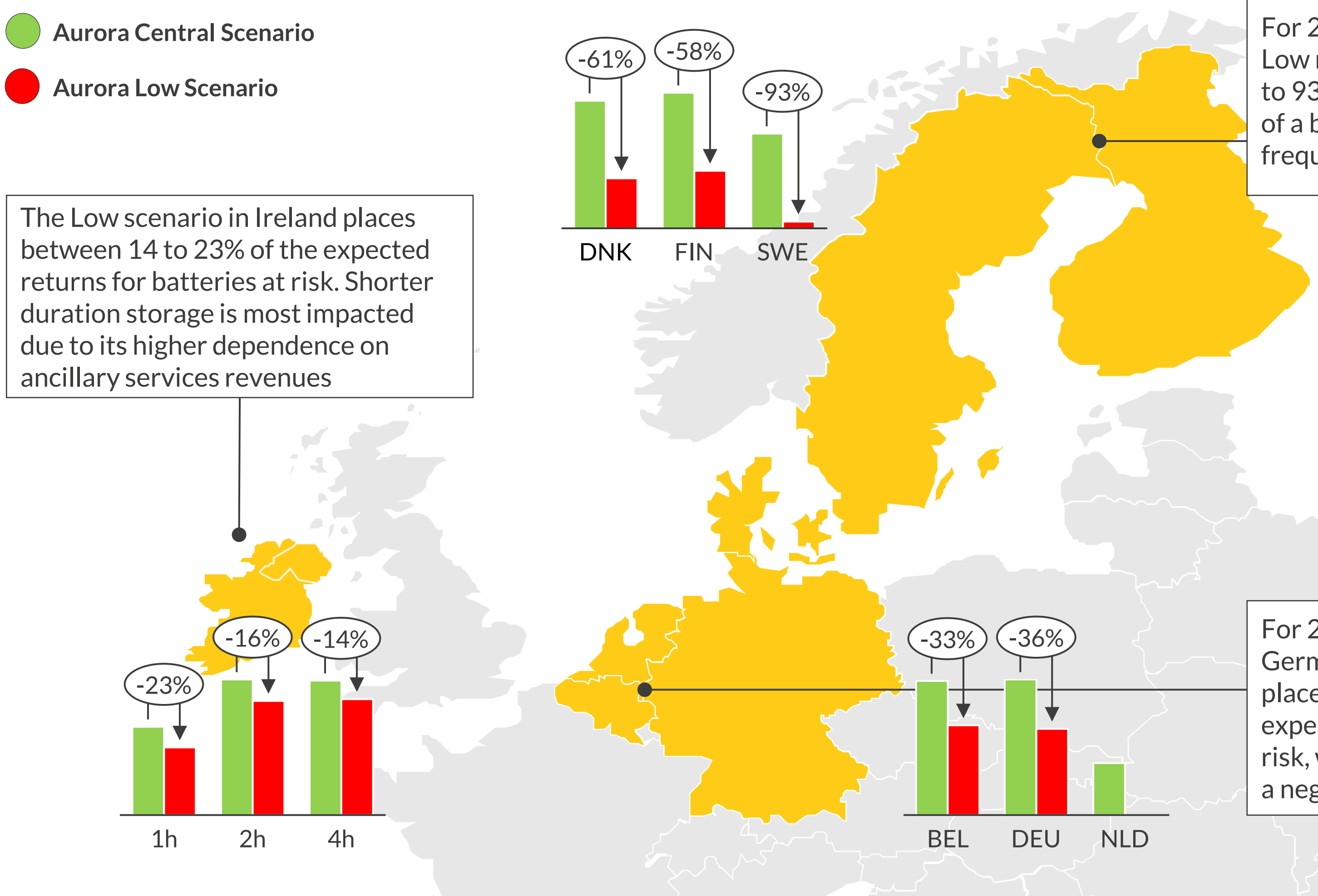

The Low scenario in Ireland places between 14 to 23% of the expected returns for batteries at risk. Shorter duration storage is most impacted due to its higher dependence on ancillary services revenues

For 2h batteries in the Nordics[1], Low market scenarios put 58% to 93% of the expected return of a battery at risk, due to lower frequency service prices.

For 2h batteries in Belgium and Germany, Low market scenarios place around 35% of the expected return of a battery at risk, while the Netherlands sees a negative IRR

- While Aurora Central scenario represents the most likely forecasted outcome, exposure to negative market drivers is a factor
- In Aurora's Low Scenario, low gas prices and electricity demand are assumed, leading to lower power prices and spreads and, therefore, arbitrage revenues, as seen in Belgium, Germany and the Netherlands
- In Low Scenarios, batteries also receive reduced revenues from ancillary markets due to lower prices, as shown particularly in Denmark, Finland and Sweden
- The risk to expected returns can be reduced with more revenue streams available to batteries and the presence of fixed revenue components (i.e. CM) as seen in the case of Ireland

1) Nordic expected profitability figures refers to the price zone DK2, FIN, and SE4.

Sources: Aurora Energy Research

Co-location of RES with BESS can mitigate certain market risks; choosing the correct ratio of assets to grid connection is key to optimise project IRR

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Battery sizing
MW, relative to 1MW grid connection

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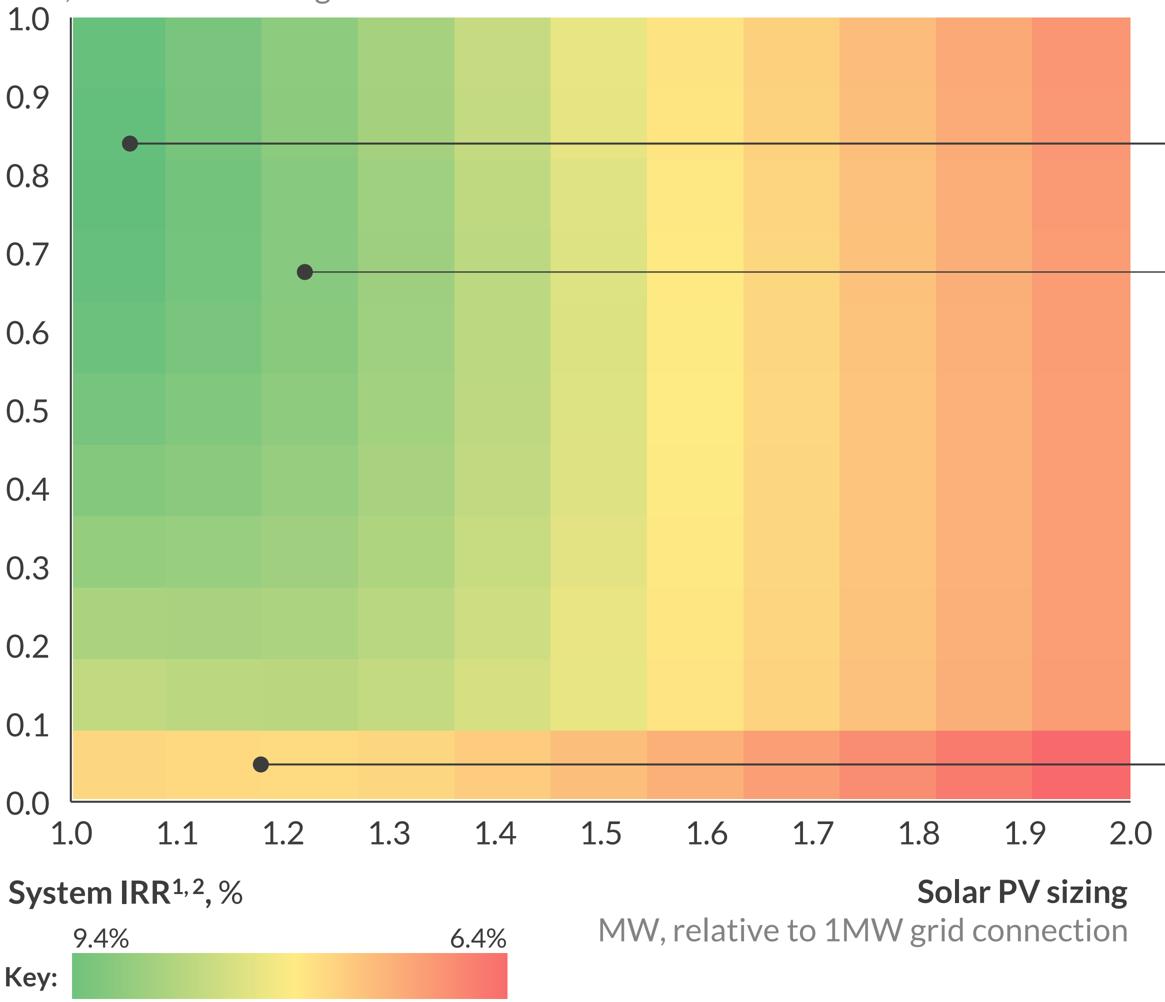

Key insights for three different sizing configurations

Note that analysis shown here is exemplary for a single market[3]; specific insights and optimal set-up will vary by country, depending on market dynamics

1 **Optimal sizing configuration to achieve the highest project IRR**

- The highest project IRRs are currently achieved in the context of a larger battery relative to a smaller solar PV asset. This is caused by a higher IRR of a standalone battery compared to the solar asset
- Further increase of either the solar or battery asset would overstrain the limited grid connection capacity, which would result in curtailment or limited battery activity, thereby reducing the project IRR

2 **Oversizing the solar asset in a co-located configuration**

- If the solar asset is to be oversized compared to the grid connection, adding a smaller battery compared to the optimal case yields the highest project IRRs

3 **Oversizing a stand-alone solar asset**

- For standalone solar, oversizing of the asset with 1.2 yields the highest IRR as this setup makes most efficient use of the grid connection

1) Assuming a combined WACC of 8% for co-located assets and of 5% for stand-alone solar assets; 2) Optimising for total NPV of an asset might yield different results, as a bigger solar asset yields higher absolute revenues; 3) Example from German market

Source: Aurora Energy Research

Contracting can reduce the revenue risk for developers, thereby enabling additional debt financing and decreasing cost of capital

Debt lenders in project financings are primarily concerned with the ability of the project to service debt payments from its revenues

- A widely-used metric is Debt Service Coverage Ratio (DSCR), computed as the ratio of i) Cash Flow Available for Debt Service (CFADS) to ii) debt scheduled for repayment in each period

Illustrative project cashflow

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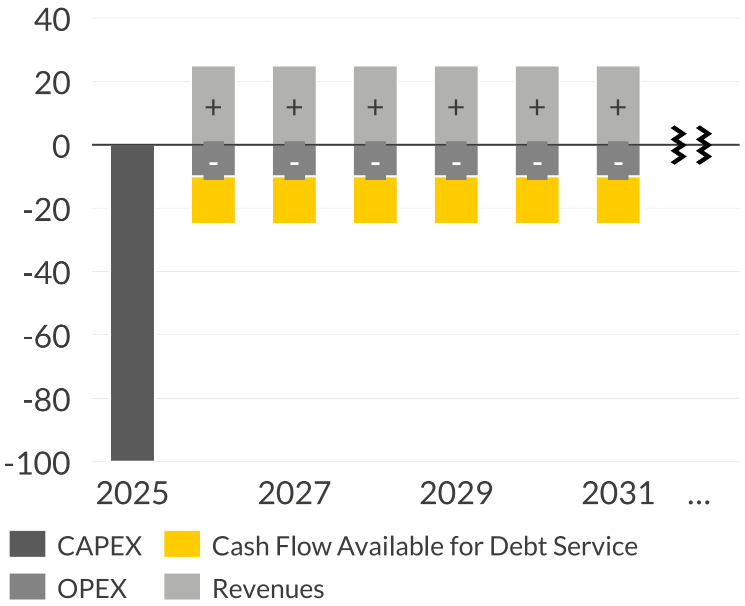


Lenders view stable revenues more favorably than merchant revenues

- Lenders apply conservative assumptions when assessing merchant revenues, such that contracting results in higher CFADS
- Lenders require higher DSCRs for projects with significant merchant risk, and a lower DSCR enables additional debt

Illustrative Debt Service Coverage Ratios

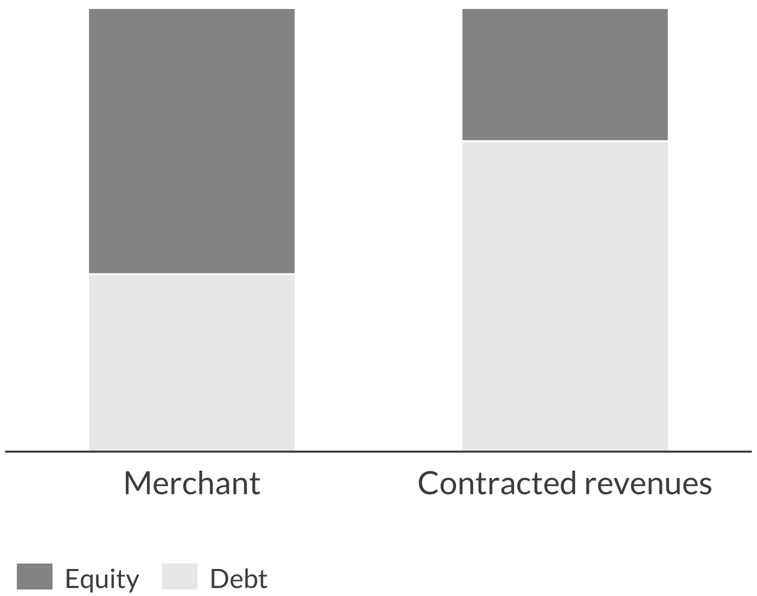
Fully merchant	2.0
Combination of merchant and contracted revenues[1]	1.7
Fully contracted revenues over debt tenor	1.3

Thus, revenue contracting results in a higher willingness of banks to provide lending and a lower cost of capital

- Debt is generally a cheaper source of capital than equity, so increasing leverage tends to decrease the overall cost of capital

Illustrative financing structure

%



1) For instance, a battery with a long-term Capacity Market contract but merchant exposure to energy and ancillary service prices

Source: Aurora Energy Research

Different contracting paradigms have emerged with the aim to stabilise battery revenues and enable debt financing

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Developers and lenders seek different types of contracting to mitigate revenue volatility

1 Capacity Markets

- ⬆ Long-term contracted revenue stream based on installed capacity
- ⬆ Secure counterparty enhances battery bankability
- ⬇ Remuneration depends on the derating factor and storage capacity
- ⬇ May restrict participation in other markets

2 State Contracts for Difference

- ⬆ "Strike Price" as bid by developer including Wholesale markets and Ancillary Services
- ⬆ Potential for upside retention
- ⬇ Dispatch optimisation essential to prevent downside

3 Offtake Agreements

- ⬆ Pre-determined fixed or floating contract price
- ⬆ Potential for revenue sharing mechanism
- ⬇ Shorter tenor, usually less than 10 years
- ⬇ Higher offtaker risk

Sources: Aurora Energy Research

1 The EU market reform includes the expansion of capacity mechanisms, which will benefit battery development across Europe

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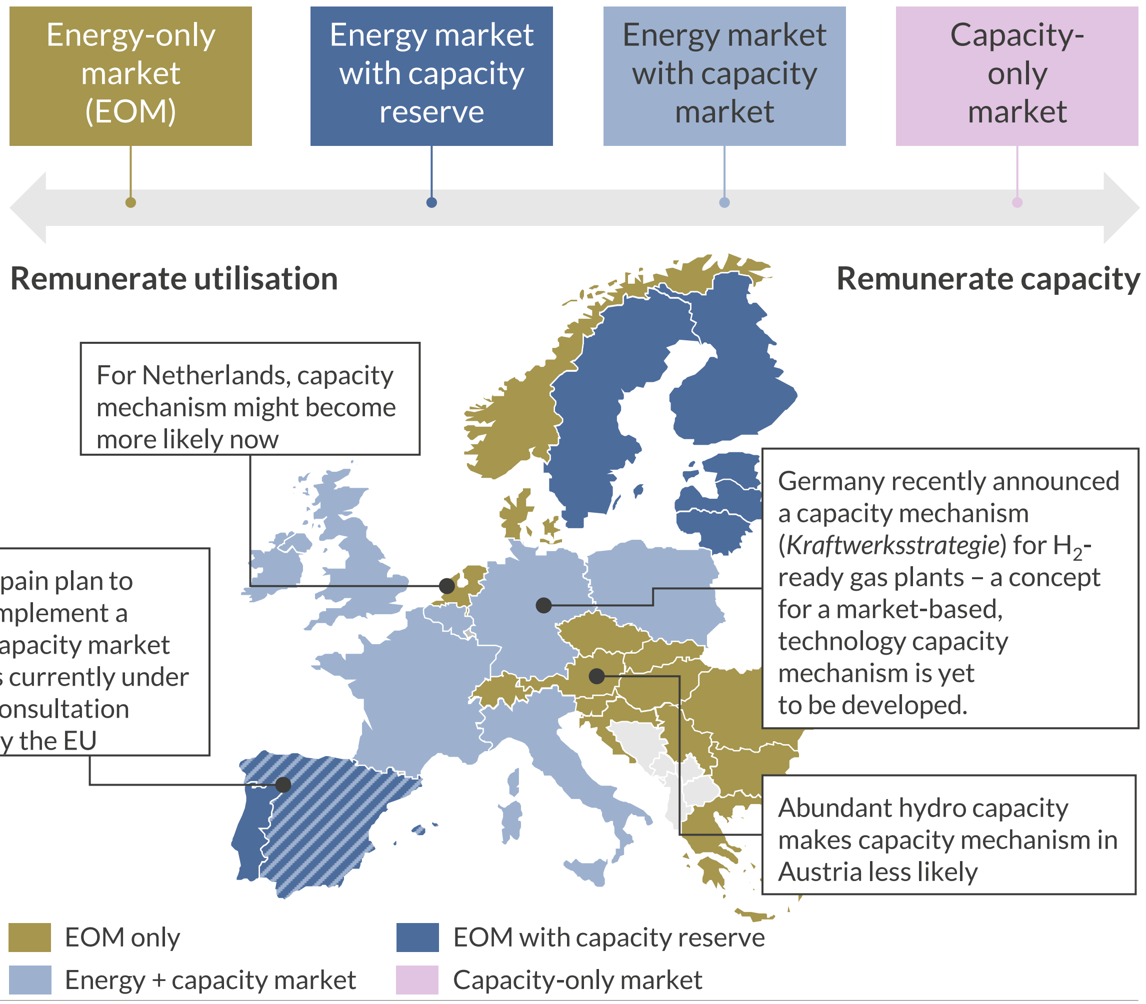
Capacity mechanisms are now included as a general measure to address resource adequacy concerns

- Previously, capacity mechanisms were only included as a measure of last resort to solve remaining resource adequacy concerns
- Now, **capacity mechanisms are explicitly included** as one of the general measure to solve resource adequacy concerns
  - If they meet the capacity mechanism criteria outlined in Regulation 2019/943, they can be approved up to 10 years
- The design rules for capacity mechanisms **restrict emission-intensive plants**[1] from participation
  - However, an exception is granted **if the capacity mechanism was approved before Regulation 2019/943** came into force and plants started commercial operation before 2019, they are exempted

What are the implications?

- The new reform opens the door for an easier adoption and thus a broader roll-out of capacity markets in Europe, which can increase security of supply
- At the same time, existing capacity markets will not be impacted, but should become easier to extend
  - Due to the exemption from the emission limit for already authorised capacity, Polish coal plants continue to receive payments under current scheme

Capacity mechanisms in Europe



1) Emitting more than 550 gCO2/kWh and 350 kgCO2/year

Sources: Aurora Energy Research, European Commission

1 The potential impact of a capacity market for batteries highly depends on the derating factor, which may limit their power generation capacity

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Battery de-rating factors

- De-rating factors for batteries depend on two main aspects:

Duration
- The lower the duration, the lower the de-rating factor
- Battery contribution to security of supply is limited by their ability to respond to long-lasting stress events

Capacity
- The more batteries are active in the capacity market, the lower their de-rating factor
- The benefit of having additional batteries in the system decreases

- As market saturation of batteries is relatively high in Great Britain and Ireland, their battery de-rating factors are lower than in the rest of Europe (⇨ 1)
- The case of the Irish capacity market highlights the growing importance of capacity in determining de-rating factors, with de-rating factors for 2h batteries converging with shorter-duration batteries as buildout increases (⇨ 2)

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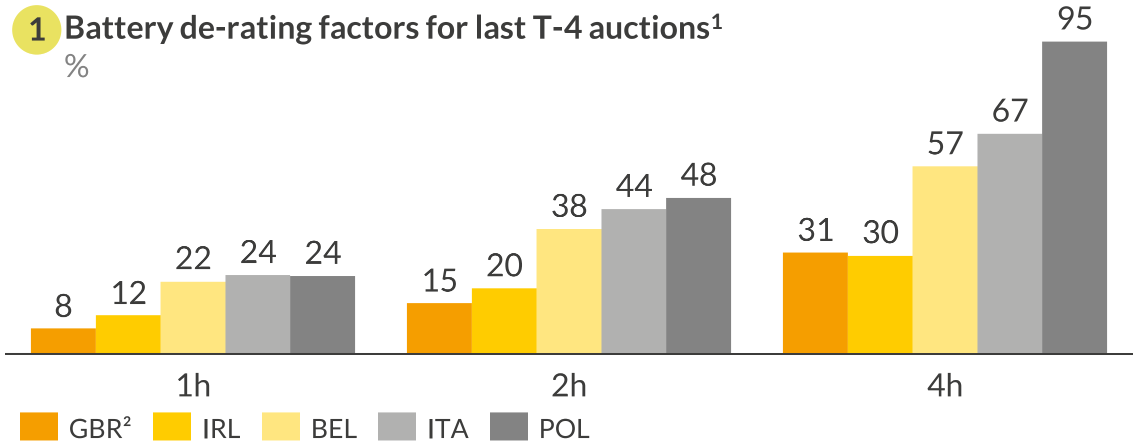
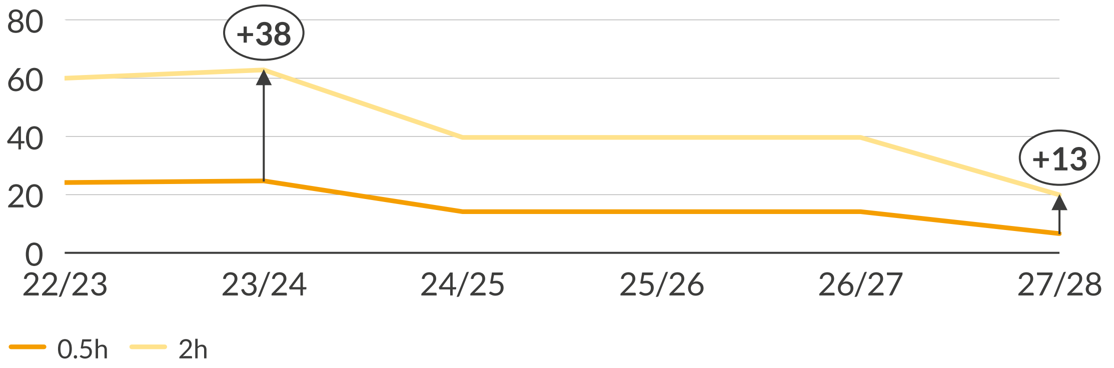
1 Battery de-rating factors for last T-4 auctions[1]

%



2 Irish battery de-rating factors by T-4 auction

%



1) GBR, IRL: 2027/28 T-4 auction, ITA: 2024 T-4 auction, BEL: 2024 Y-4 auction, POL: 2028 T-5 auction

Sources: Aurora Energy Research, PSE, Ministry of Climate and Environment, Elia, Terna, ARERA, EirGrid, SONI, National Grid

1 The value and duration of capacity market contracts vary significantly across European markets, impacting project bankability

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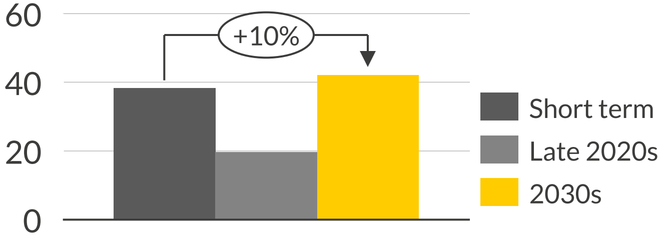
Great Britain

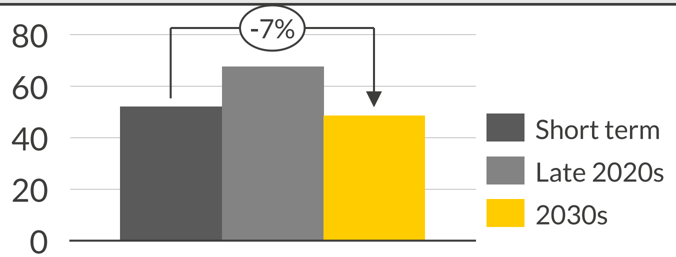
Clearing price €/kW (real 2022)



CM contract tenor[1]: **15 years**

Ireland

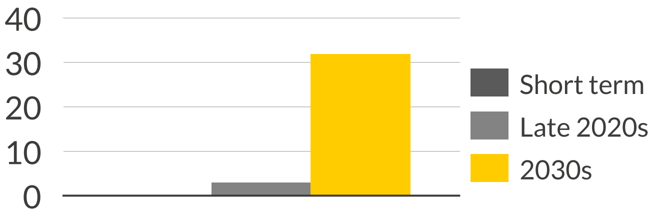
Clearing price €/kW (real 2022)



CM contract tenor[1]: **10 years**

Belgium

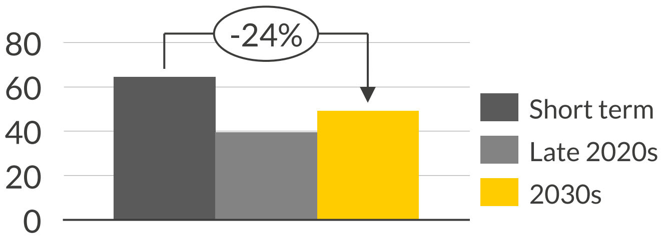
Clearing price €/kW (real 2022)



CM contract tenor[1]: **3,8 or 15 years**

Italy

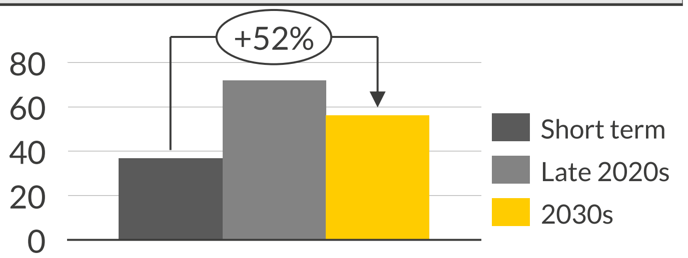
Clearing price €/kW (real 2022)



CM contract tenor[1]: **15 years**

Poland

Clearing price €/kW (real 2022)



CM contract tenor[1]: **15 - 17 years[2]**

- CM prices are largely driven by the evolution of firm capacity in each country, as well as the "missing money" for new capacity to come online
- Higher de-rating factors for thermal technologies reduces the need to procure new build capacity in certain geographies, exerting downward pressure on CM prices
- The retirement of ageing CCGTs and nuclear capacities later on necessitate the entry of new-build firm capacities, pushing CM prices up

1) For new build assets; 2) Assets with emissivity less than 450gr will get 17 year contracts and otherwise get 15 years. Storage unit emissivity is calculated based on single cycle efficiency. 17 years is relevant for batteries

Source: Aurora Energy Research

2 The Greek BESS auctions will provide 10-year revenue stability to over 1.5GW of projects in total, kick-starting the BESS market in the country

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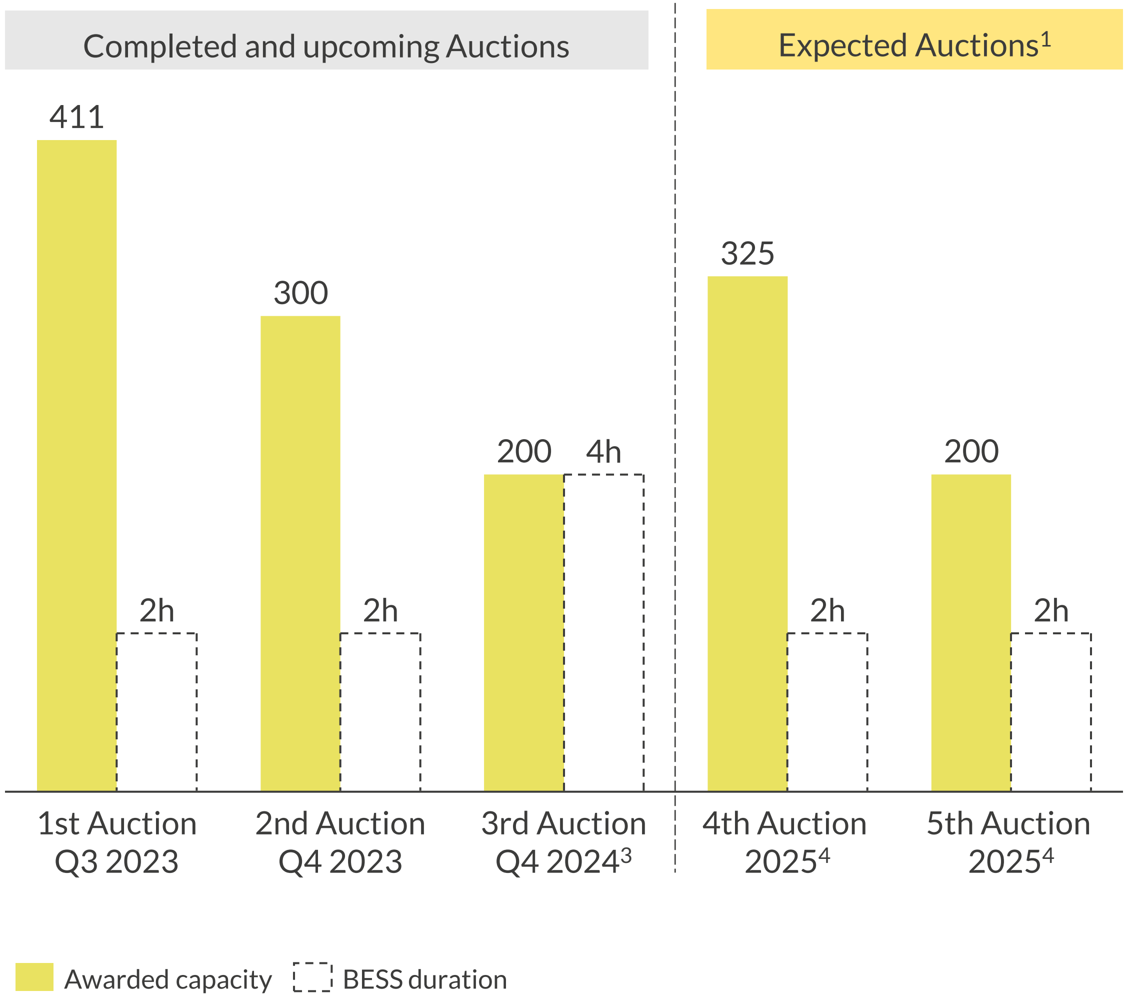
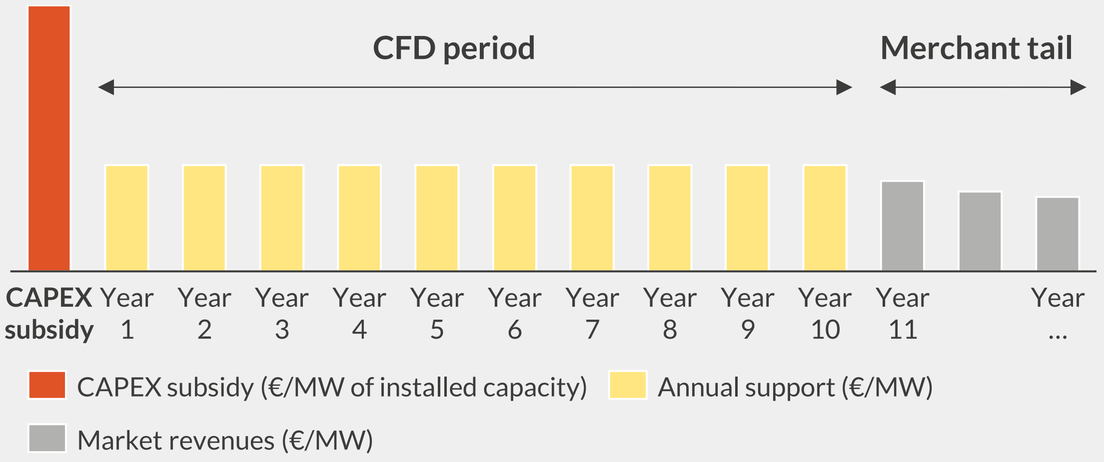
Overview of BESS capacity to be awarded through auctions
MW



Remuneration methodology

- Winning projects from auction 1 & 2 will receive an **investment grant** of 200,000 €/MW and 100,000 €/MW accordingly. The CAPEX support for the 3rd auction will be at 200,000 €/MW
- An annual operating support is also foreseen, and is calculated based on the assets performance and the offer submitted in the BESS auction



- The support scheme offers upfront investment support and 10-year revenue stability, facilitating project financing
- The operational support will be based on a Reference Price which will reflect average market operation, incentivising battery owners to optimise dispatch

1) Based on announcements in media sources. 2) € 85 million will be secured by the Repower EU. 3) Projects to be deployed in ex-lignite areas. 4) Possibly to be funded by the EU Modernisation fund

Sources Aurora Energy Research, Ministry of the Environment and Energy, Regulator of Energy Waste and Water – RAAEY (FEK 3328/2023 & FEK 6399/2023), media sources

3 Route-to-Market providers offer third party optimisation and risk management services which can help mitigate merchant risk

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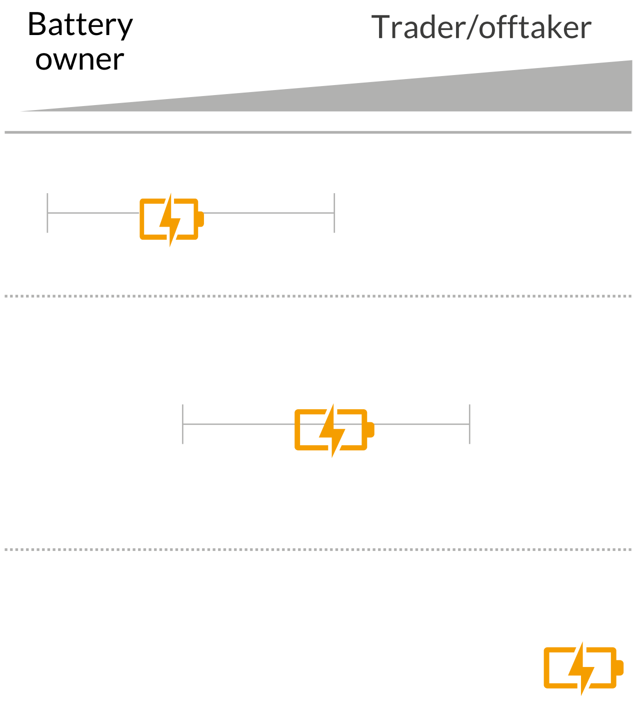
Price clauses

Commercial Clause	Description
Variable fee	The revenues are split between the battery owner and the trader
Price floor	The price floor guarantees fixed revenues while incentivising the trader to maximise the performance
Fixed fee	The battery owner receives a fixed payment; all risks and upsides lie with the trader

Merchant risk exposure



Larger portfolios of assets under management may enable RtM providers to **lower the service fees** they can offer, due **to economies of scale benefits**

Key considerations for a price floor structure

- Asset owners without internal trading and optimisation capabilities can contract optimisation and risk management services from route-to-market providers
- Within these services, floor structures have been essential for obtaining non-recourse financing in more mature markets such as Great Britain
- Although structures can vary, the standard contracts guarantee a revenue floor per MW of connected capacity
- Tenors typically range between 7 and 10 years, although structures of up to 15 years are available
- Whilst floor structures provide certainty around future revenue streams, fees charged by the RtM provider are typically higher than a merchant model

Source(s): Aurora Energy Research

3 Case study: In a recently-approved tolling agreement in MISO, a utility provided a ~$10/kW-month price for a 100MW battery

Tolling agreements – Fixed price

Sep 2022

- Consumers Energy, a utility in Michigan, issued an RFP seeking "clean" generation eligible to provide capacity in MISO Zone 7

Dec 2023

- Consumers Energy signed a tolling agreement with Jupiter Power's Tibbits Energy Storage, a 100 MW 4-hour battery in Branch County, Michigan

Apr 2024

- The Michigan Public Service Commission approved the contract, noting that based on the materials submitted by Consumers Energy, the agreement "will not result in an increase in costs to customers"

May 2025

- The Tibbits Energy Storage unit is expected to commence commercial operations

Summary of key contract provisions	
Contract products	▪ Energy ▪ Ancillary Services ▪ Capacity ▪ MI Storage Incentive Renewable Energy Credits
Contract start date	▪ May 2025
Contract term	▪ 20 years
Contract price	▪ $9.6 to $10.6/kW-month (depending on asset availability)
Asset availability[1]	▪ Seller is required to maintain availability of at least 90%, or pay a penalty
Asset dispatch and operational restrictions	▪ Offtaker is responsible for asset dispatch and must pay for all charging energy ▪ Offtaker is prohibited from discharging the battery for more than one cycle per day, on average over each 12-month period

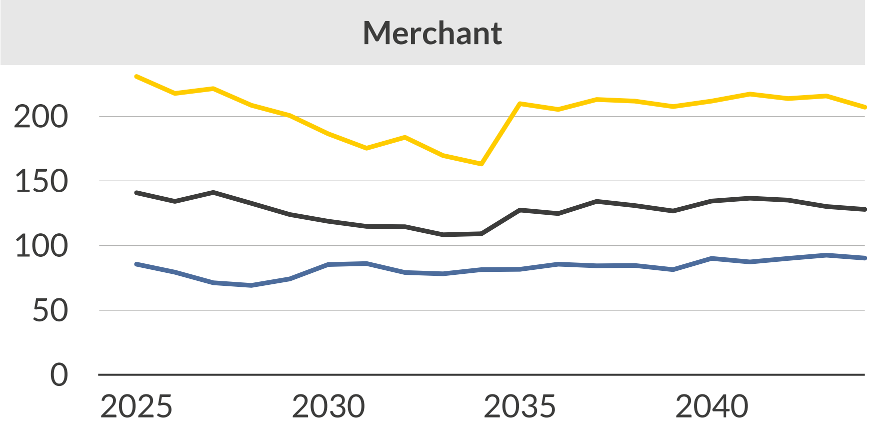
1) Asset availability refers to the proportion of hours during which the battery is available to charge or discharge (i.e., is not experiencing an outage).

Sources: Aurora Energy Research, Michigan Public Service Commission, Consumers Energy

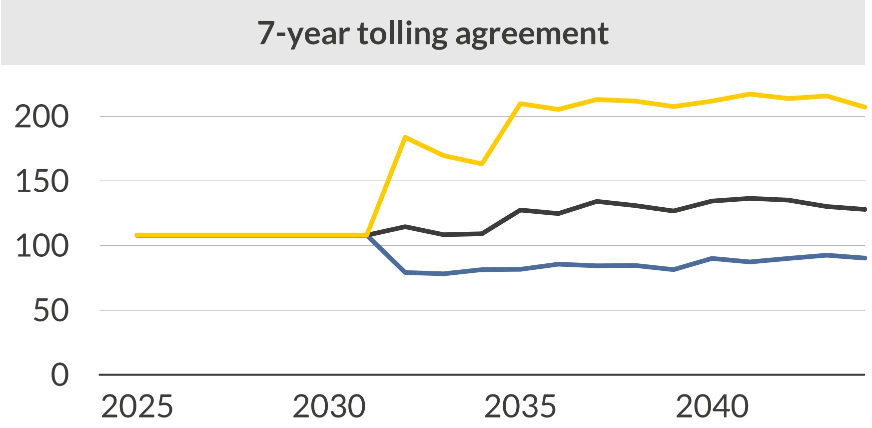
3 Worked Example: tolling agreements can help increase leverage by 30 p.p., at the expense of merchant returns in an upside case

ERCOT: 2-hour battery, West hub

Annual gross margins
$/kW/year, nominal



	Low	Central	High
DSCR	2.0		
Debt sizing	~20%		
Equity IRR[1]	5%	15%	31%



	Low	Central	High
DSCR	1.3		
Debt sizing	~50%		
Equity IRR	9%	14%	18%

Low — Central — High[3]

Key input assumptions for the analysis

Debt tenor	Cost of debt	Entry year	Contract price[2]	CAPEX, net of ITC[4]	OPEX
7 years	7.0%, nominal	2025	$9.0/kW-mo	$664/kW	$21/kW/year

1) Pre-tax, nominal IRR. 2) Selected to fall between lower bound price of $8.6 and upper bound price of $11.1/kW-month for a 7-year tolling agreement for a 2-hour West Hub battery with an entry year of 2025. 3) "High" case assumes 2011 weather year conditions. 4) Assumes CAPEX of $1,037 and 36% ITC
Source: Aurora Energy Research

Impact of tolling agreement on battery financing

- With no offtake agreement, lenders would apply conservative debt sizing assumptions (DSCR of 2.0) and size debt based on downside case revenues
- With a tolling agreement in place, lenders would likely permit a lower DSCR and consider contracted revenues when sizing debt
- A 7-year tolling agreement increases the debt share of capital from 20% to 50%, increasing equity IRR in the Low case, and leading to a similar equity IRR in the Central case
- Conversely, a tolling agreement decreases equity IRR in the High case, as the equity owner receives the fixed tolling price over the first 7 years of operation

Key takeaways

1 Driven by increased deployment of renewables, declining thermal capacity and growing electricity demand, investment in battery storage has proliferated. Aurora anticipates **over 40GW of new battery storage capacity** across Europe by 2030

2 Battery business models will rely more on **revenue stacking** as Ancillary Services across Europe face increased saturation risk and spreads in Wholesale Markets become more volatile. **Co-location** of RES with BESS can provide a significant boost to IRRs due to cost savings; optimal sizing of the assets is key

3 **Contracting of revenues** can reduce revenue volatility risk for developers, thereby enabling additional debt financing and decreasing cost of capital. Emerging contracting paradigms include **Capacity Markets**, **state CfDs** and **Offtaker Agreements**

4 **Capacity Markets** may offer long term revenue security and significantly increase bankability. The value and duration of Capacity Market contracts vary significantly across European markets

5 A **tolling agreement** could boost debt sizing by 30 percentage points and significantly increase IRR in a low market scenario, but may also reduce IRRs in the event of a high market outcome

Sources: Aurora Energy Research

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