

## European Battery Markets

## Attractiveness Report

July 2022

REDACTED



## **European Battery Markets Report:** Assisting you with initial market scanning to identify the most attractive markets in Europe

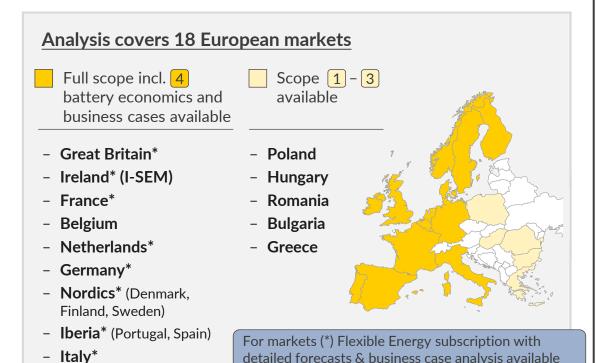


Available July 2022

### **European Battery Market Attractiveness Report - Purchase the full report for:**

- **European Battery Market Trends Market Size and Opportunity** 
  - Installed capacity and near-term pipeline
  - Forecast volumes for battery deployment by year and country
  - Battery investment trends and projected investment needs
  - Summary of leading companies and footprint
- **Policy and Regulatory Environment** 
  - Regulatory framework at European level, and summary of key national strategies, policies and regulations impacting battery build out
  - Policy goals/targets for batteries at European level and at national level
  - Analysis of anticipated regulatory changes impacting battery markets
  - Assessment of policy risks including aggregation of demand side assets and grid connection
- **Battery Storage Business Models and Value Drivers** 
  - Summary of attainable markets and revenue stacking opportunities by country, battery eligibility and barriers to entry
  - Description of relevant battery business models
  - Evolution of value drivers across markets, e.g.
    - Wholesale spreads
    - Ancillary service prices and volumes
    - Capacity markets
  - Assessment of market saturation risk for each country

- Battery Economics and Business Cases (for selected countries)<sup>1</sup>
  - Normalised gross margin stacks for investment cases
  - Investment cases (estimated IRRs) for energy arbitrage and ancillary services-led business models
  - Route to market strategies and implications for cycling and degradation



detailed forecasts & business case analysis available

<sup>1.</sup> High level battery economics (estimated IRR) provided – for all denoted markets (\*) Aurora offers a Flexible Energy subscription service with detailed revenue stream forecasts and battery investment case analysis

## Agenda



- I. Executive summary
- II. <u>Introduction to battery storage</u>
- III. Market size and outlook
- IV. Policy and regulatory environment
- V. Value drivers
- VI. Project economics
- VII. Aurora's Flexible Energy Subscription Services
- VIII. Appendix

This is a redacted sample of the European Battery Markets Attractiveness Report.

If you are interested in the full report, contact Alex Hutcheson, (alex.hutcheson@auroraer.com)

# Aurora's rating combines eleven metrics to derive an overall attractiveness score for 18 European battery markets



The overall market attractiveness score for each European battery market covers four categories and eleven metrics, which are set out in detail in this report.

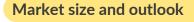
Categories and metrics	Weighting	Rationale	Source of data
Market size and outlook	25%		
1 Current installed battery capacity	40%	Demonstrates current market size and impact on energy security	Aurora fundamental modelling*
2 Battery capacity deployment to 2030	50%	Indicates expected future market size	Aurora fundamental modelling*
3 Battery investment required by 2030	10%	Indicates future investment need, reflecting storage duration	Aurora fundamental modelling*
Policy environment	25%		
4 National battery targets and policies by 2030	20%	Demonstrates policy ambition for battery storage deployment	Aurora analysis*
5 Renewables targets	20%	Demonstrates policy ambition around renewables deployment	Aurora analysis*
6 Availability and contractability of revenue streams	30%	Indicates availability and long term contractability of revenues	Aurora analysis*
<b>7</b> Grid connection risk	20%	Indicates regulatory risks around grid connection	Aurora analysis*
8 Risk of competition from distributed assets	10%	Indicates competition risks around DER¹ aggregation policies	Aurora analysis*
Value Drivers for battery storage	25%		
9 Average daily spreads	50%	Indicates the value available from energy arbitrage	Aurora fundamental modelling*
10 Frequency market saturation risk	50%	Demonstrates the risks of market saturation	Aurora analysis*
Business models and cases	25%		
11 Indicative merchant IRR for project starting in 2025	100%	Captures the commercial viability of new build fully merchant projects for final investment decisions in three years' time	Aurora fundamental modelling*

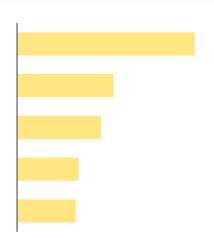
<sup>(\*)</sup> Detailed analysis and forecasts <u>available</u> in Aurora's Flexibility Energy Market subscriptions for individual countries.

<sup>1)</sup> Distributed Energy Resources

## Different markets emerge top across the four key categories, highlighting regional strengths

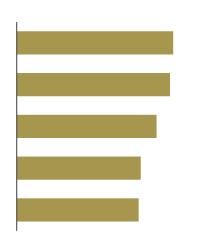






- robust installed capacity today and outlook make it the leading market by size but with significant saturation risk
- Despite minimal installed capacity today, strong market outlook makes it a key market player
- Total expected battery buildout of 5 GW by 2030 make interesting markets to explore

#### **Policy environment**



- ambitious target of 3 GW battery capacity by 2030, coupled with multiple policy enabled revenue streams currently make it favourable policy environment however limited by restrictions for battery storage in the
- The introduction of an in in addition to the GW deployment target indicates strong policy support for battery projects

#### Value Drivers for battery storage



- emerges a top market in the value drivers category due to rising price spreads from increasing penetration of renewables and limited cannibalisation of frequency prices
- also emerge top in this category despite saturation of frequency services due to availability of multiple revenue streams, which mitigates saturation risk

#### **Business models and cases**



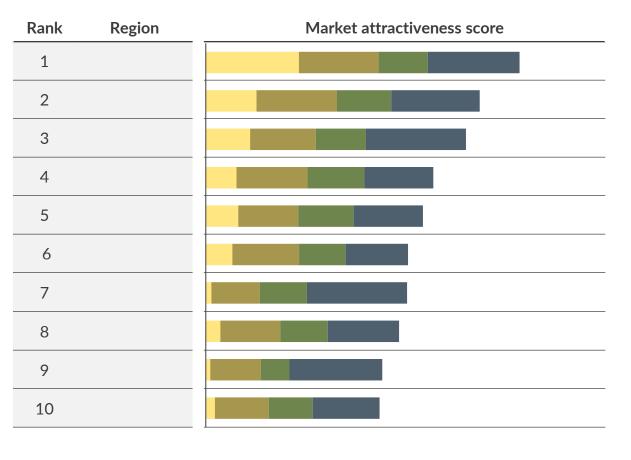
- High frequency response market prices and revenues drive high project IRRs in \_\_\_\_\_, making it the most attractive market for merchant projects
- Strong revenues in drive high project IRRs for batteries, making it an attractive market for merchant projects

## The most attractive European market for battery storage is followed by





Installed capacity of battery storage across Europe currently stands at 4 GW, making up less than 1% of total installed capacity. It is projected to grow at least 7x by 2030, requiring EUR 15 billion CAPEX investment.



#### **Top markets**

- has the most robust installed battery capacity and pipeline in Europe of respectively which, supported by favourable revenue streams, make it the most attractive market in Europe.
- An ambitious target of battery by 2030, coupled with favourable merchant project IRRs, make the second most attractive market Europe but only if opens up to grid scale batteries as planned.
- Excellent project economics, underscored by the lucrative programme in the near-term, underpin top 3 ranking. We however expect to provide favourable economics beyond 2025.

#### Markets to watch

- The introduction of \_\_\_\_\_ and \_\_\_\_ deployment target, coupled with high expected market-led build out, points to \_\_\_\_\_ as a sizeable market opportunity.
- Despite its relatively small market size, excellent project economics highlight an opportunity for fast movers to take advantage of its relatively stable and additional fast frequency response products.

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- II. Introduction to battery storage
  - 1. Battery storage drivers and markets
  - 2. Battery costs
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# Rising flexibility needs and corresponding battery storage buildout is primarily driven by decarbonisation and its underlying drivers



#### **Decarbonisation drivers**

Variable renewables (RES) deployment

Growing variable renewables capacity in countries' energy mixes

Thermal generation phase-out

Retirement of traditional baseload and thermal assets in an effort to decarbonise

Electrification of other sectors<sup>1</sup>

Growing electricity demand as a result of greater electrification of transport, heat and greater hydrogen production through electrolysis

Effects on power markets and battery storage requirements

#### **Energy markets (wholesale)**

- Merit order effect: Low marginal cost techs pushing average prices down capture prices for RES assets increasingly decoupled from commodity prices
- Increases the intermittency of energy generation (increasingly reliant on weather patterns) leading to an increase in price volatility

Battery storage complements intermittency of renewables and balances baseload prices by charging in periods of high RES production and discharging in peak periods

#### **Capacity Markets**

- Thermal retirement and non-firm RES contribute to drop in firm capacity
- Increase in peak electricity demand can also increase the need for firm capacity

Battery storage contributes to availability of firm capacity on the system

#### **Balancing and Ancillary Services**

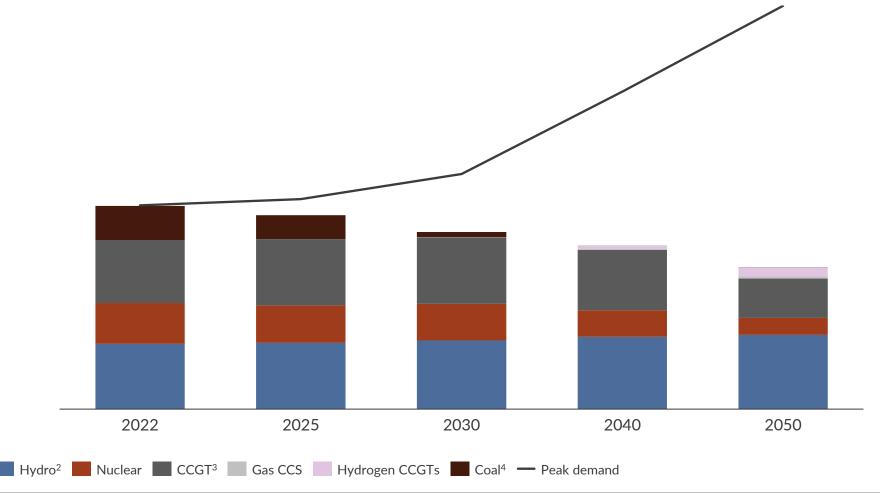
- Variable renewables increase need for energy balancing and system services
- Constraint management<sup>2</sup> and the increasing shift from centralised to distributed generation further drives an increased need for these services
- Thermal retirement also drives a need for independent procurement of grid services

  Battery storage contributes to ensuring operability of the grid

<sup>1)</sup> Growing demand could improve business case for storage if it is dumb demand; but if it is smart demand then detracts from business case for grid scale batteries. 2) Increase in constraint management is further driven by RES deployment outpacing grid capacity.

# Retirement of over conventional assets results in loss of grid services including inertia, driving the need for ancillary services

**Evolution of conventional generation capacities in Europe<sup>1</sup>** GW



<sup>1)</sup> EU27 plus UK and Norway, minus Malta and Cyprus. 2) Includes hydro pump-storage, run-of river and storage dams 3) Includes CCGT CHPs 4) Includes Coal CHPs

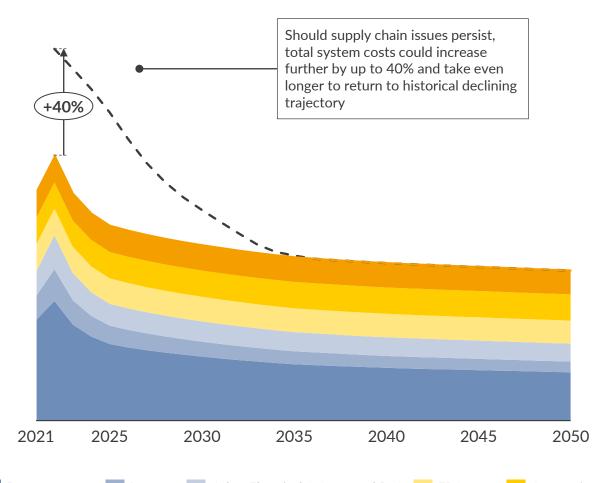
- The rising penetration of nonsynchronous variable renewables contributes to the phase out of synchronous conventional generation capacity from the system
- The retirement of these synchronous generators translates to a loss of grid services including inertia, frequency, voltage which they inherently contribute to the system
- This drives a rising need for independent procurement of ancillary services to maintain grid operability and other considerations will include requirements for dynamic voltage support and Blackout recovery
- The extent of this would however depend on the penetration of baseload low carbon technologies e.g. CCSand hydrogen-enabled gas turbines relative to renewables

## High recent commodity prices increased battery system CAPEX costs as of March, amid evidence of further increases to date



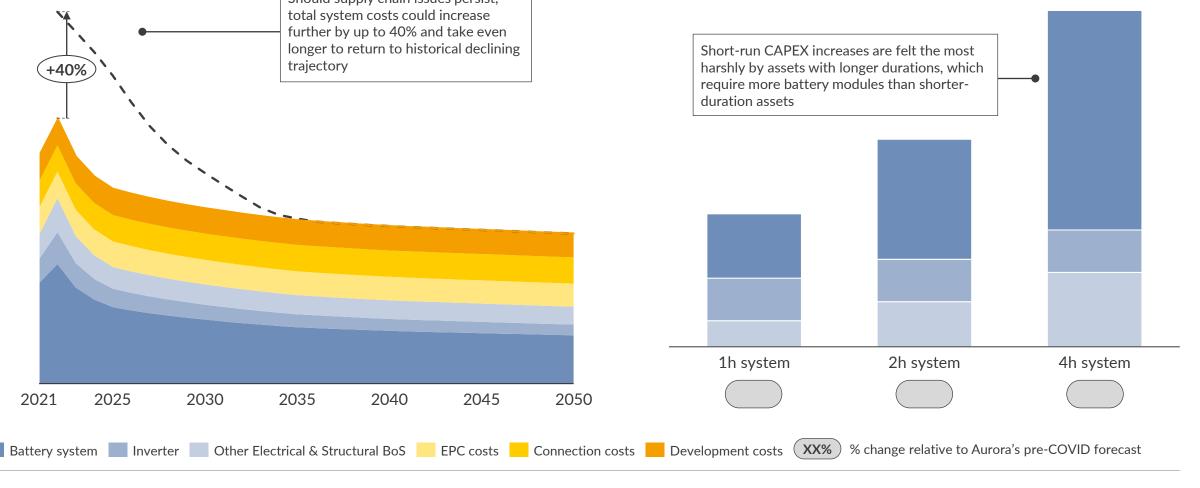


EUR/kW real 2021



#### Implied increases in 2022 CAPEX

EUR/kW. real 2021



## Agenda



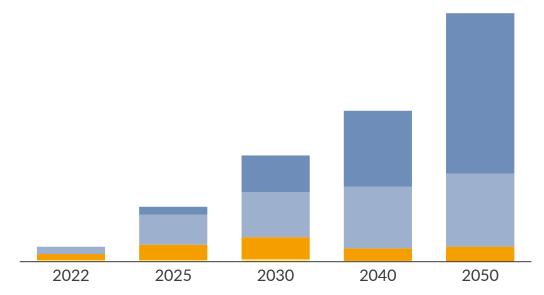
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## Grid scale battery storage could see Europe by 2030 in a Central scenario

## of capacity additions across



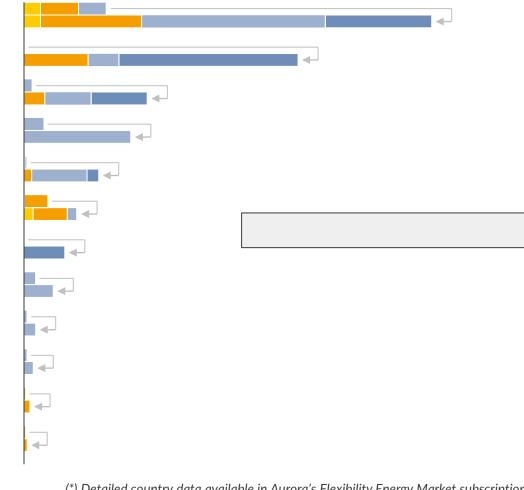
Installed grid-scale battery capacity in Europe (Aurora Central scenario) GW



- Battery capacities increase by more than from 2022-2050, under Aurora's Central scenario
- Total capacity is dominated by longer duration batteries, which comprise over of total capacity in 2030
- The share of 4h batteries increases from of total large-scale batteries in 2025 to by 2050 as increasing penetration of renewables across markets increases the need for longer storage



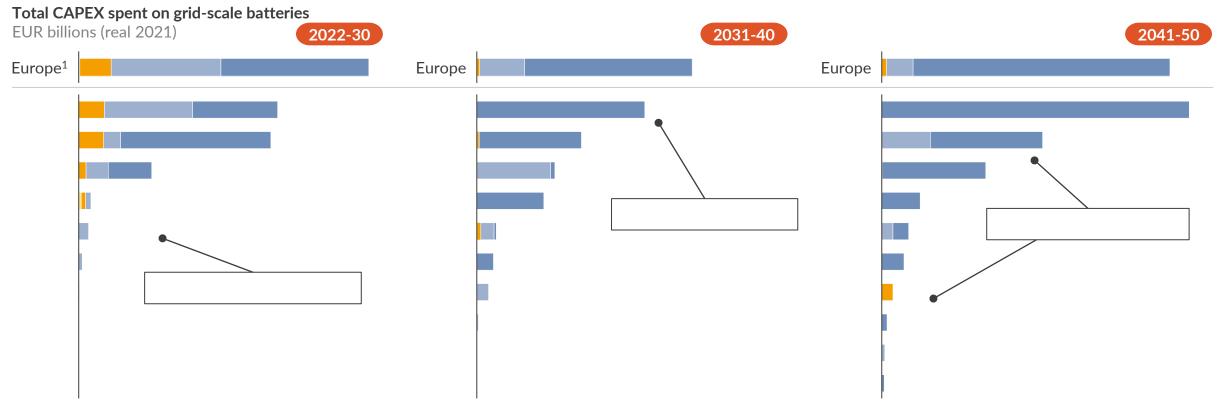
Installed battery capacity in 2022 and 2030 (Aurora Central scenario)\* GW



(\*) Detailed country data available in Aurora's Flexibility Energy Market subscriptions

## These new capacity additions represent a cumulative investment opportunity of up to between 2022-50





- More established markets in Europe see a ramping up of battery buildout in the 2020s
- While longer-duration (2h and 4h) batteries are dominant there is still significant investment opportunity for shorter-duration batteries
- The 2030s see a significant increase in investment opportunity especially for longer duration batteries as increasing RES penetration increases the need for longer storage times and shorter frequency product markets become increasingly saturated
- In the 2040s investment opportunities for batteries are primarily for 4h batteries, which comprise almost of required CAPEX investments

0.5h 1h 2h 4h

<sup>1)</sup> EU27 plus UK and Norway, minus Cyprus and Malta. 2) We assume batteries are eventually allowed to participate in the Mercato per il Servizio di Dispacciamento (MSD)

# is currently the leading market in terms of size and outlook, followed by



#### Market size and outlook

Countries are assessed in terms of their market size and outlook for batteries between 2022-2030, based on three metrics shown below. An overall score for the market size indicator is assigned between 0-10 reflecting the specified weighting of the metrics.

Metric	Weighting	Rationale
1 Current installed battery capacity	30%	Indicates current market size
2 Projected battery buildout by 2030	40%	Indicates expected future market size in the medium term
3 Projected CAPEX spend until 2030	30%	Indicates expected future investment need, taking required battery durations into account

Rank	Region	Market attractiveness score				
1						
2						
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4						
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7						
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9						
10						
Installed	d battery capacity	Projected buildout by 2030 Projected CAPEX spend				

#### **Top markets**

- has the largest installed capacity today which, supported by a robust pipeline, makes it the most attractive market in Europe but with significant saturation risk
- Despite minimal installed capacity today, and high levels of battery build out driven by realized high capacity market payments present a sizeable market to enter if batteries are deemed eligible to participate in the as planned
- Similarly, a strong battery pipeline driven by the large new-builds with CRM contracts make a leading market by market size and outlook
- Total expected battery buildout of by 2030 reflects substantial market opportunities in

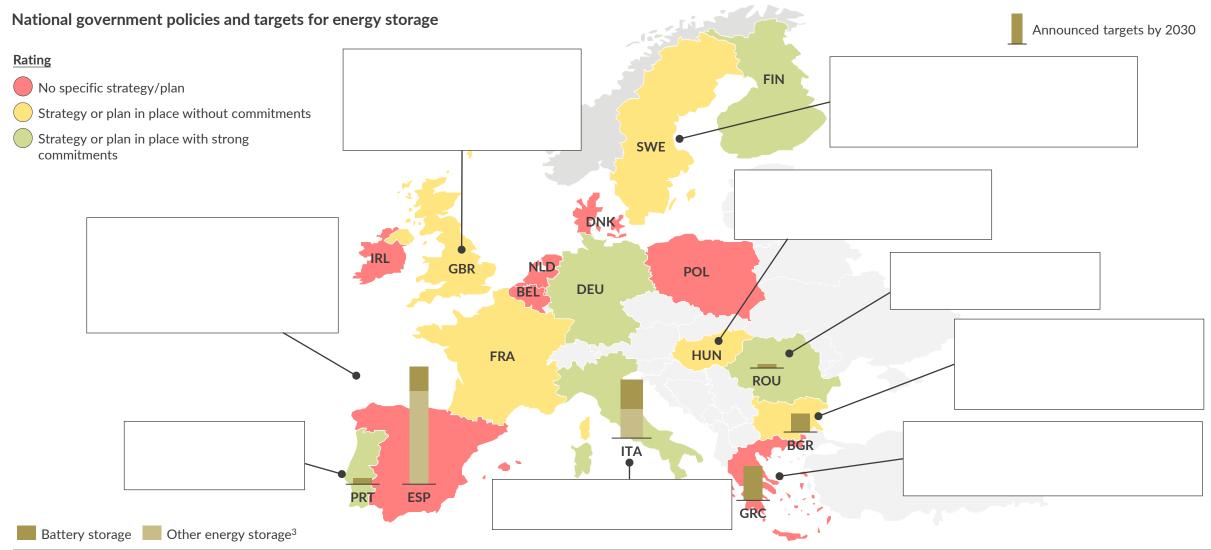
## Agenda



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- II. Introduction to battery storage
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- IV. Policy and regulatory environment
  - A. Flexibility drivers
  - B. Battery storage policies and targets
  - C. Revenue streams
  - D. Regulatory risks
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## Across Europe, a rising number of countries have introduced strategies and targets for energy storage deployment





<sup>1)</sup> Spain's Integrated National Energy and Climate Plan 2021-2030 (PNIEC). 2) Assuming 4hr duration batteries. 3) Includes pumped storage.

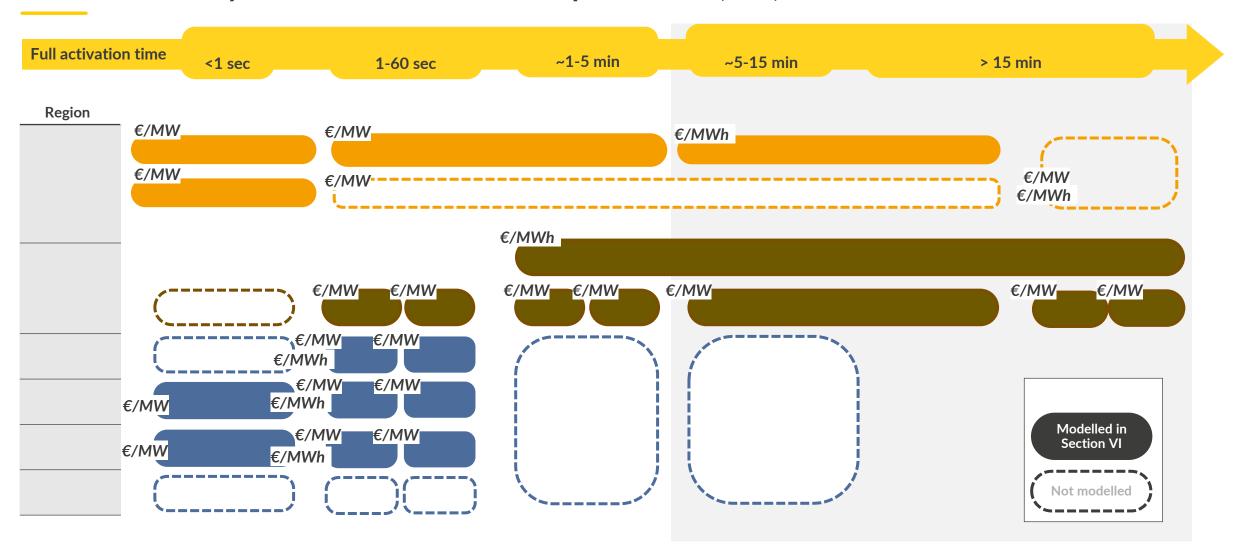
# Most countries allow for stacking of various revenue streams, however contractual revenues are limited (1/2)

Region	СМ	WM	BS <sup>1</sup>	FR <sup>2</sup>	os	A	vailability of long term contractual revenues
Belgium							
Bulgaria							
Denmark							
Finland							
France							
Germany							
Great Britain							
Greece							
Hungary							
Not	available / relevant f	or battery storag	ge	Available/re	elevant and stackable f	for battery storage	

<sup>1)</sup> 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. 2) Includes frequency products with full activation time < 10 minutes such as FFR, FCR and aFRR.

## Frequency markets across Europe are generally fragmented and reflect nationally-determined technical requirements (1/2)





<sup>1)</sup> West Denmark (DK1) region is coupled with European FCR market. 2) Demonstration market launched in 2020/21. 3) automatic Frequency Restoration Reserve 4) manual Frequency Restoration Reserve.

# On-going regulatory developments within certain markets present both opportunities and challenges for battery assets (1/2)

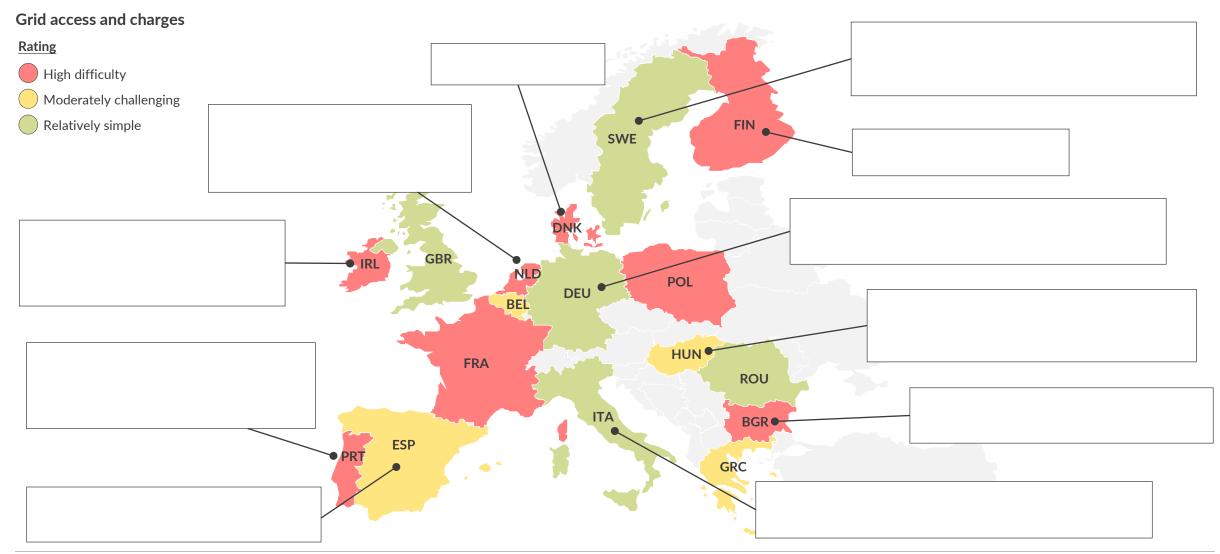


Region	Market development	Likelihood	Impact on battery storage outlook
		•	Introduction of a capacity market allows batteries to realise additional revenues however this is dependent on the rules of the market i.e. eligibility of batteries and potential derating
			While the tender is yet to be confirmed, if realised, it would provide significant support for deployment of grid-scale batteries
		•	Introduction of a capacity market and/or flexibility remuneration allows batteries to realise additional revenues
			A sliding market premium limits the revenue potential that can be realised for batteries in the innovation auction
			The introduction of additional revenue opportunities for battery storage however the older products being phased out are typically more lucrative
			Support for upfront capital costs will significantly improve the business case for battery projects
			New subsidy scheme would create a new capacity-based remuneration for batteries supporting capacity deployment  Participation in would open up a lucrative additional revenue stream for batteries

<sup>1)</sup> Programmation pluriannuelle de l'énergie (PPE), Réseau de Transport d'Électricité (RTE). 2) Dynamic Containment (DC), Dynamic Moderation (DM), Dynamic Regulation (DR), Firm Frequency Response (FFR). 2) Delivering a Secure, Sustainable Electricity System (DS3)

# Battery storage faces regulatory hurdles in grid access and fees, complicating deployment of capacity





<sup>1)</sup> Article 2(59) of Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity 2) Special exemptions apply to grid tariffs for storage in Germany and Belgium 3) Baseload price

Source: Aurora Energy Research, Eurostat

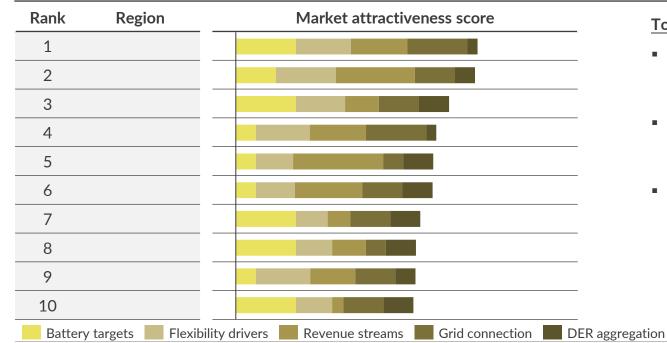
# sees the most attractive policy environment for grid-scale battery deployment, followed by



#### **Policy environment**

Countries are assessed in terms of their policy environment for battery storage between 2022-2030, based on five criteria shown below. An overall score between 0-10 is assigned for each country reflecting the following weighting of assessment criteria.

Metric	Weighting	Rationale
4 National battery targets and policies by 2030	20%	Demonstrates policy ambition for battery storage deployment
5 Renewables targets (i.e. driver of flexibility needs)	20%	Demonstrates policy ambition for renewables deployment
6 Availability and contractability of revenue streams	30%	Indicates availability and long term contractability of revenues
<b>7</b> Risks from grid connection and charges	20%	Indicates regulatory risks around grid connection and charges
8 Risks from distributed assets	10%	Indicates competition risks around DER¹ aggregation policies



#### **Top markets**

- ambitious target of battery capacity by 2030, coupled with multiple policy enabled revenue streams make it the most favourable policy environment
- Revenue stacking opportunities coupled with multiple favourable revenue streams and for battery projects
- The introduction of an deployment target indicates strong policy support for battery projects however, the lack of batteries remains an important barrier for batteries

<sup>1)</sup> Distributed energy resources

## Agenda

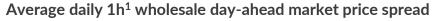


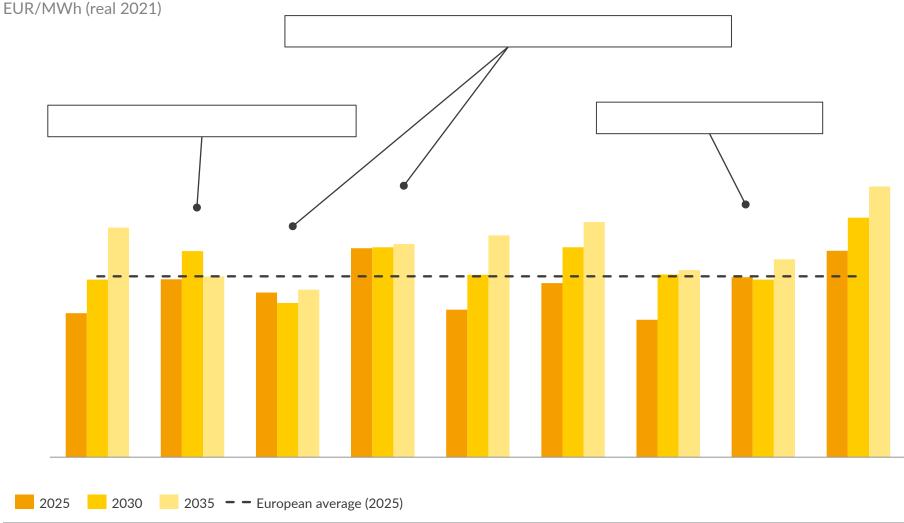
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- 3. Other balancing services
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## Wholesale market price spreads rise in some European countries due to higher renewables penetration and rising commodity prices...





<sup>1)</sup> Yearly average of the daily spreads. The daily spreads are the difference between the average of the highest 1h and the lowest 1h for each day. 2) Average across price zones

- Wholesale market price spreads represent the revenues that battery assets are able to capture through energy arbitrage activities
- These price spreads are expected to be higher in countries with high penetration of renewables (RES) which increase the frequency and levels of low price periods
- Conversely, rising fuel and carbon prices raise the power price in top periods by increasing the short run marginal cost of thermal plants



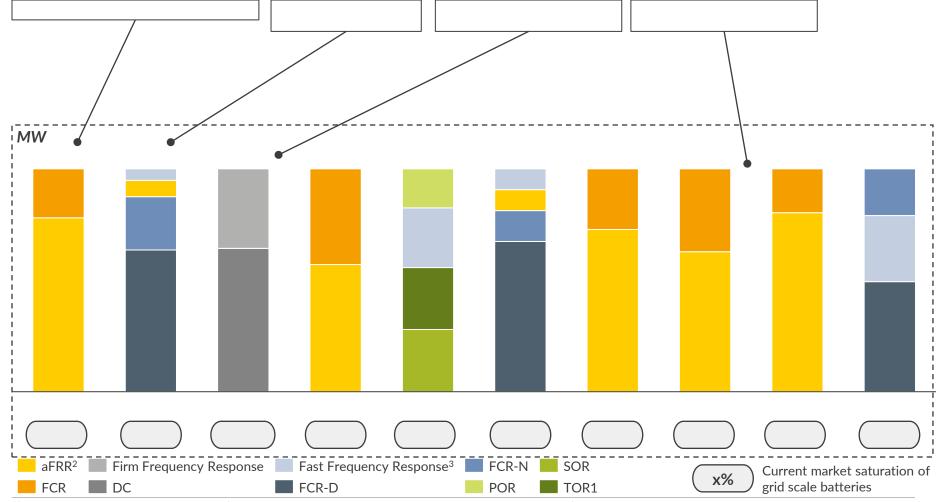


# shows highest demand for fast frequency services while are the most saturated

AUR 😂 RA

Annual volume procured by fast frequency services (indicative average)

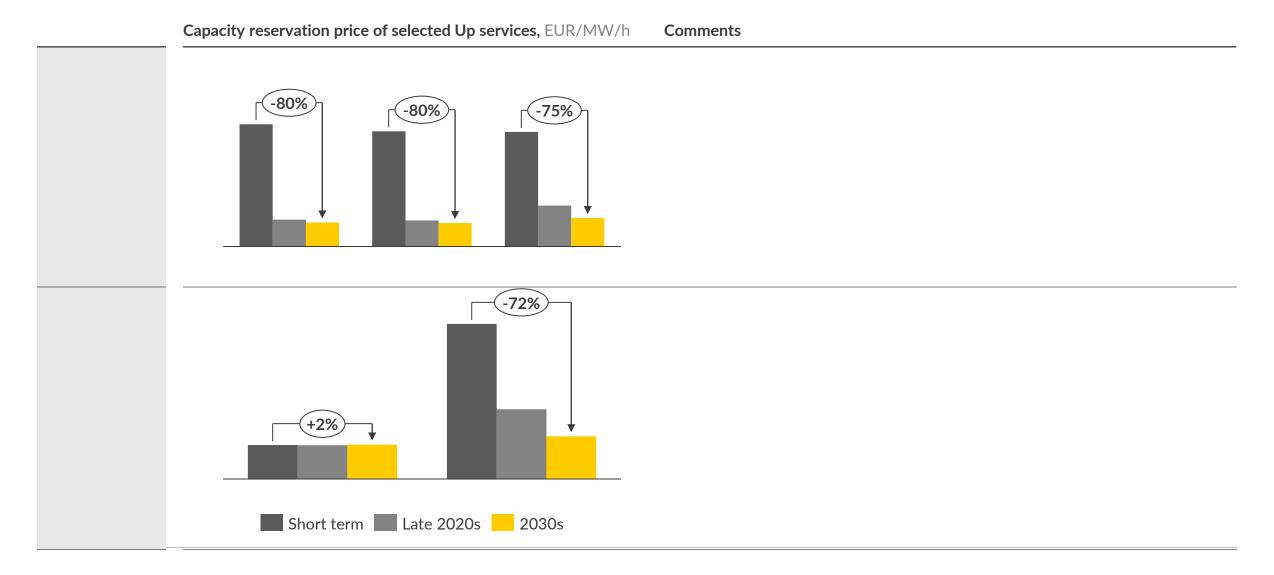




<sup>1)</sup> Volumes procured in Gate 5 and 6 of DS3 2) Note that aFRR in continental Europe and Nordics are distinct markets 3) Note that Fast Frequency Response in Ireland and Nordics are distinct markets

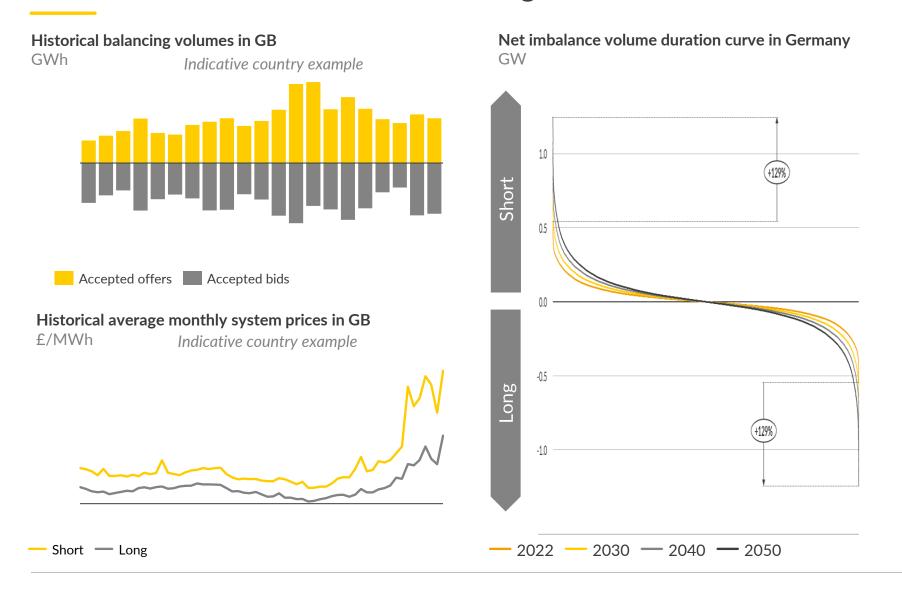
# ...which drives key fast-acting frequency service prices down rapidly in the short term in most markets (1/2)

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### AUR 😂 RA

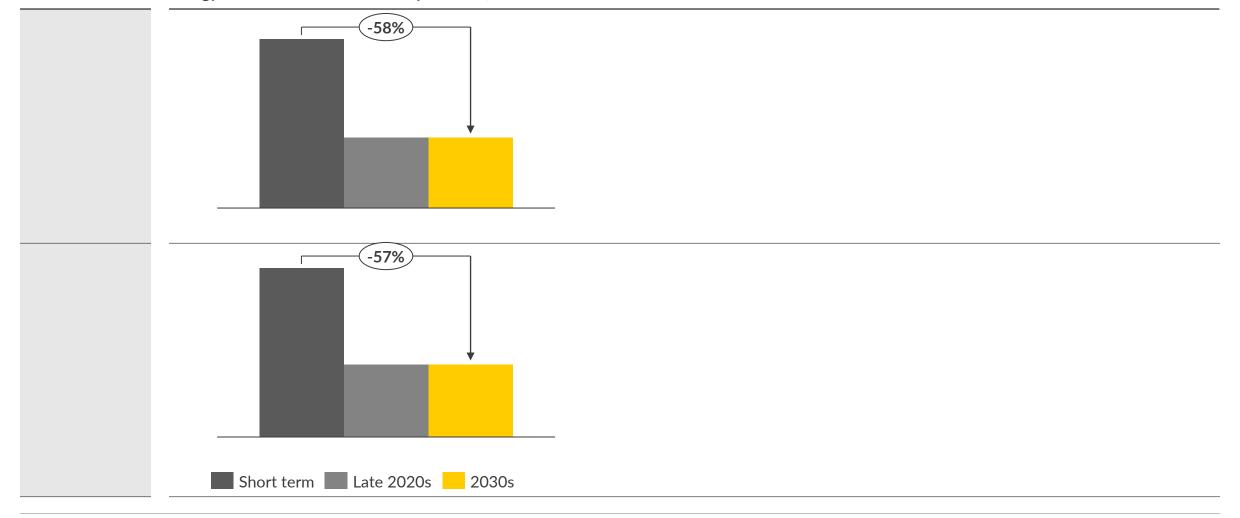
# While demand for balancing services will increase due to increasing demand and intermittent renewables generation...



# ...prices for such balancing services are also expected to come down by the late 2020s in most markets (1/2)







# sees the most attractive value drivers for battery storage, followed by



#### Value Drivers

Countries are assessed in terms of their value drivers for batteries between 2022-2030, based on two criteria shown below. An overall score between 0-10 is assigned for each country reflecting the following weighting of assessment criteria.

Metric	Weighting	Rationale
Average wholesale market daily spreads	50%	Indicates the value available from energy arbitrage in the wholesale market
10 Frequency market saturation risk	50%	Assesses the risk of market saturation in frequency services due to other batteries

Rank	Region	Market attractiveness score
1		
2		
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_		

#### **Top markets**

- emerges a top market in the value drivers category due to rising price spreads from increasing penetration of renewables and limited cannibalisation of frequency prices
- Despite frequency markets in they also emerge top in this category due to lucrative wholesale market spreads and availability of multiple revenue streams
- Limited market saturation risk in the near term see the countries make it into the top five ranking

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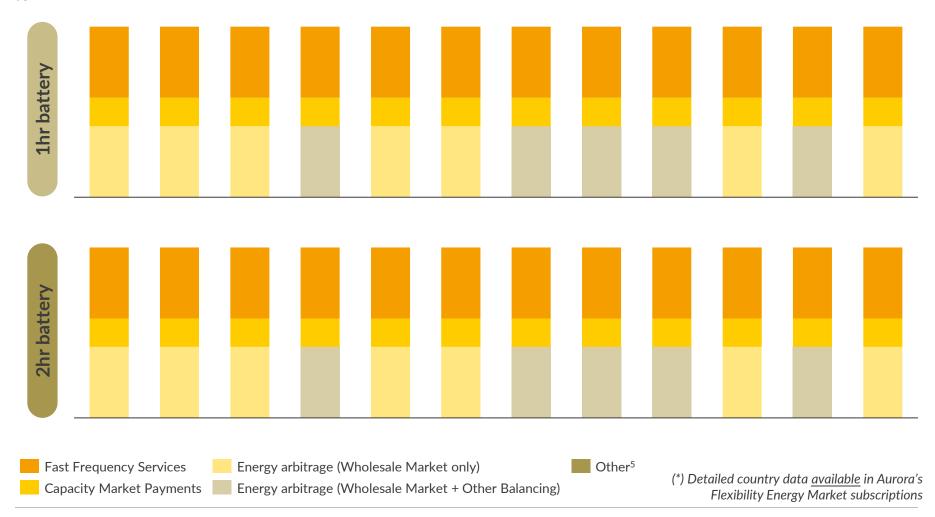


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## The gross margin stack is largely formed by frequency response revenues in most countries, particularly in

Average composition of gross margin stack (2025 – 2040) $^{1*}$ 

%



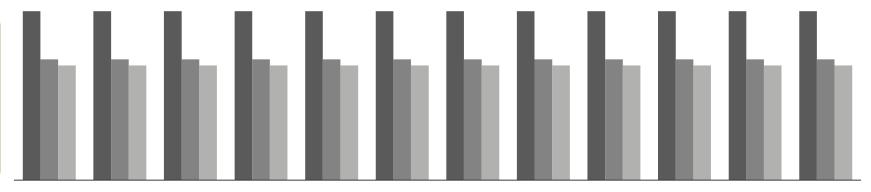


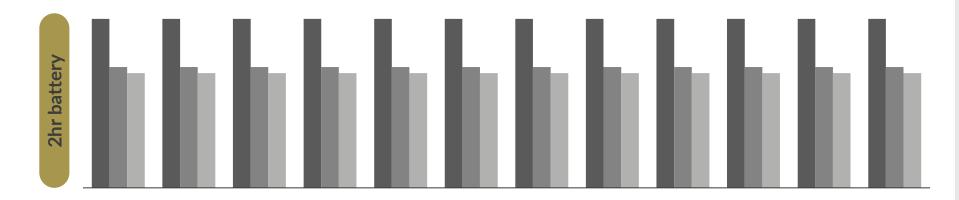
## Gross margins tend to decrease over time due to market saturation and asset degradation, see lowest relative decrease



Central scenario









(\*) Detailed country data <u>available</u> in Aurora's Flexibility Energy Market subscriptions

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Recent extreme commodities

term margins for batteries

 Prices are expected to fall from current extremes as the market normalises over the next few years, resulting in a drop in battery gross margins

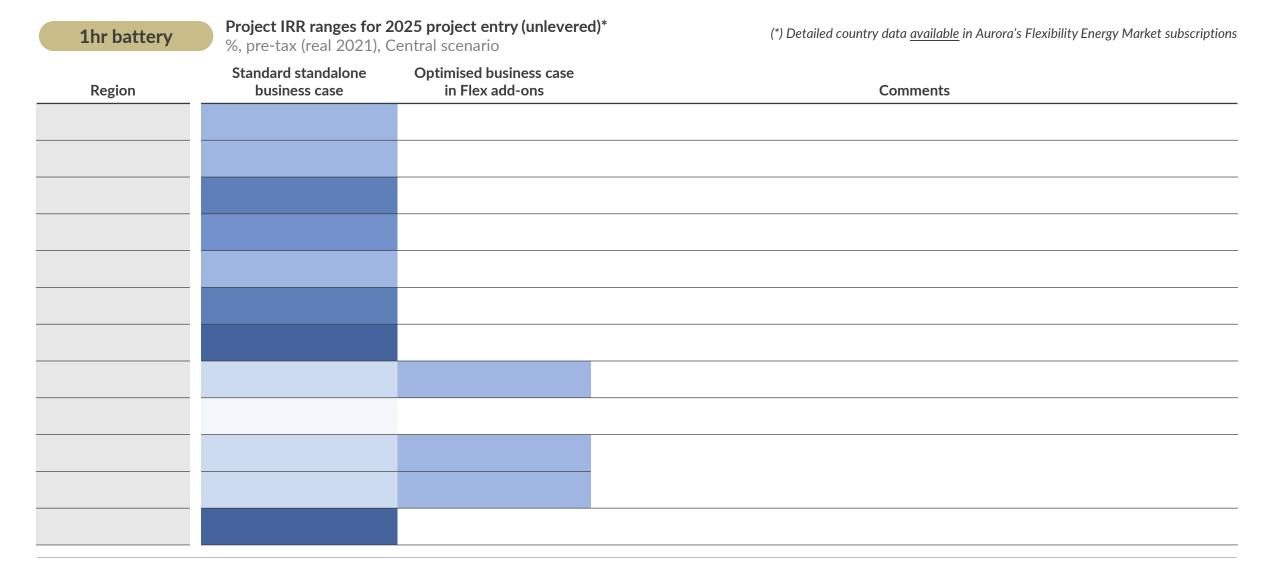
prices have pushed up energy arbitrage spreads and frequency prices, driving significant short-

<sup>1)</sup> Shown for a representative battery with 2025 entry year

# 1hr batteries are expected to achieve IRRs higher than countries; achieve the highest IRRs







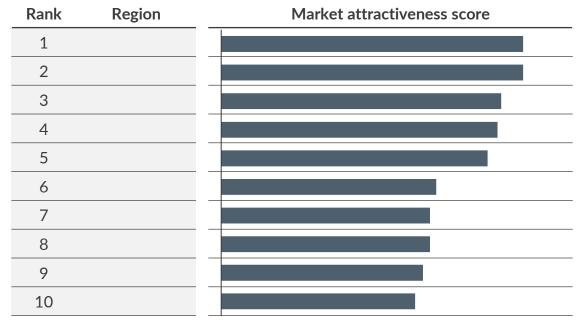
## sees the most attractive IRRs for battery storage, followed by



#### **Project economics**

Countries are assessed in terms of their economic outlook for renewables, reflected through indicative fully merchant IRRs, with scores assigned between 0-10 where the maximum IRR = 10 and minimum = 0.

Metric	Weighting	Rationale
8 Indicative fully merchant IRR for project starting in 2025	100%	Captures the commercial viability of new build projects for final investment decisions in three years' time based on fully merchant business models



#### Top markets

- excellent project economics is underscored by the lucrative programme in the near-term. While are expected to change in the next few years, we expect the avourable economics beyond 2025 albeit to a lesser extent than current .
- High frequency response market prices and revenues drive high project IRRs in making them top attractive markets for merchant battery projects.
- coupled with energy arbitrage opportunities between the wholesale and balancing markets make very attractive for battery investments

Indicative fully merchant IRR for project starting in 2025

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## Aurora is the market leader in complex transaction support involving flexible assets accessing multiple revenue streams





Price forecasts provided to Santander to finance battery storage project – the first project financing of battery storage in the UK



Battery storage, sell side advisory of the largest operational battery storage portfolio within the frequency containment reserve in Europe (90 MW)



Aurora helped to raise £380m in debt for Gresham House's battery portfolio



Neoen obtained AUS \$50m in debt financing for 50MW extension of its Hornsdale Power Reserve (HPR) battery by CEFC through Aurora's modelling of battery economics forecasting wholesale price volatility and ancillary service prices in Australia



Aurora helped Field Energy raise £77m in debt for their battery portfolio



Supported Close Brothers in their lending for gas engines and battery storage, providing revenue forecasts for their financial models and presenting our analysis to their credit committee. The bank now provides regular loans to gas engine projects and is entering the battery storage market



Sell-side advisory for UK Power Reserve's 500+ MW portfolio of gas peakers and battery storage. Deal eventually confirmed with buyer (Sembcorp) acquiring portfolio for £216m.



Price forecast to bank consortium to finance battery project



Provided Zenobe (formerly BESS) the forecasts to support their debt and equity raise for their battery storage portfolio. Our client was successful in funding their projects

To find out more about our track record and how we can help support your complex transactions, contact Alex Hutcheson, (alex.hutcheson@auroraer.com)

# We offer Power & Renewable and Flexibility Market subscription services, across key markets in Europe, Australia and the USA



•		Power and Renewables	Flexibility Market Add-on
	Great Britain	•	Offered as a standalone
	Ireland	•	•
	France	•	• Q3 '22
	Iberia	•	•
	Germany	•	• Q4 '22
	Poland	•	
	Netherlands	•	• Q4 '22
EUROPE	Belgium	•	
	Nordics	•	•
	Baltics	Oct 22	
	Italy	•	•
	Greece	•	
	Bulgaria	•	
	Romania	•	
	Hungary	•	Q3 '22
	ERCOT	•	• Q3 '22
USA	CAISO	•	•
	РЈМ	•	
AUSTRALIA	NEM	•	•

# Our Flexible Energy Add-on Service provides you with detailed power market analysis and investment case data for batteries



#### **Market Forecasts:**

#### **Technology and market development reports**

- Overview of battery pipeline development
- Overview of regulatory framework for batteries
- Revenue stacking models for batteries
- Projections for battery CAPEX and OPEX by delivery year
- Reports and datasets follow the same format with content tailored to specific markets

#### Forecast data

- Central case forecast prices provided at settlement period granularity until 2050
  - Wholesale power prices
  - Balancing market prices
  - Ancillary services prices

#### Investment cases

- Standalone battery
- At least six investment cases per country or zone including:
  - Arbitrage of wholesale market and balancing market
  - Focused participation in frequency control market (if applicable)
- Annual project margins to 2050. IRR and NPV for entry ears 2023 and 2025

#### Co-location

- Provided in markets with favourable economic or regulatory opportunities
- At least two investment cases for battery co-located with solar PV and/or onshore wind
- Annual project margins to 2050. IRR and NPV for entry ears 2023 and 2025



#### Ask an Analyst:

Ongoing analyst support, bi-annual workshops and interaction with our market experts.

## **Explore what's included in each region's Flexible Energy Service**



	Flexibility Market add-on	Battery pipeline development	Regulatory framework	Battery cost projections	Revenue stacking models	Wholesale prices	Balancing Market	Ancillary Services
	Great Britain	Pipeline and	Policy	overview &		Half-hourly granularity	Half-hourly granularity	FFR – annual DC – annual
	Ireland	transactions	regular notes					DS3 – annual
	Italy						Hou	rly granularity¹
	Iberia					Hourly granularity	Hourly granularity	Secondary reserve <sup>2</sup> - annual
EUROPE	France							FCR (EU) - 4 hr
	Nordics <sup>3</sup>		•	CAPEX & OPEX	Overview of 2-3 models		N/A	FFR, FCR (EU) - annual FCR-D, FCR-N - 4 hr
	Germany	Pipeline overview			Hou 5mi		Hourly granularity	FCR (EU) – 4 hr aFFR – 4hr
	Netherlands							FCR (EU) – 4 hr aFFR – 4hr
LICA	ERCOT					Hourly & 15 min granularity		RRS - Reg up/dn -
USA	CAISO					Hourly, 15min & 5min granularity	N/A	Spinning res – Reg up/dn
AUSTRALIA	NEM					Half-hourly granularity		FCAS (8 markets) - half-hourly

The Italian Mercato dei Servizi di Dispacciamento (MSD) is used by the TSO Terna to procure both balancing and ancillary services. Secondary Reserve "regulation band"

<sup>3)</sup> Scope includes Sweden, Finland and DK1; Norway and DK2 excluded

## Explore what's included in each region's Flexible Energy Add-on Service (cont) AUR QRA

	Flexibility Market add-on	Standalone battery investment cases	Co-location investment cases
	Great Britain	CM + WM arbitrage + BM arbitrage, 1 $\&$ 2 hour duration CM + WM arbitrage + BM arbitrage + DC, 1 $\&$ 2 hour duration	Solar co-location distribution connected Solar co-location transmission connected
	Ireland	CM + WM arbitrage + DS3; 1,2 & 4 hour duration	Solar co-location Onshore wind co-location
	Italy	CM + WM arbitrage + BM arbitrage <sup>1</sup> ; 1,2 & 4 hour duration Battery pilot + WS arbitrage + BM arbitrage <sup>1</sup> ; 1,2 & 4 hour duration	Solar co-location
FURCES	Iberia	CM + WM arbitrage + BM arbitrage; 1,2 & 4 hour duration CM + WM arbitrage + Secondary reserve; 1,2 & 4 hour duration	Solar co-location Onshore wind co-location
France  Nordics <sup>3</sup> Germany	France	CM + WM arbitrage + BM arbitrage; 1 & 2 hour duration CM + WM arbitrage + FCR; 1 & 2 hour duration	
	Nordics <sup>3</sup>	Sweden/Finland: FFR+FCR-N/D-up; WM arbitrage; 1 & 2 hour duration Denmark (DK1): FCR; WM arbitrage; 1 & 2 hour duration	
	Germany	WM arbitrage + BM arbitrage; 2 & 4 hour duration WM arbitrage + FCR; 2 & 4 hour duration	Solar co-location Onshore wind co-location
	Netherlands	WM arbitrage + BM arbitrage; 2 & 4 hour duration WM arbitrage + FCR; 1 & 2 hour duration	
LICA	ERCOT	WM arbitrage + AS arbitrage; 1, 2, & 4 hour duration	Solar co-location Onshore wind co-location
USA ————————————————————————————————————		CM + WM arbitrage + AS arbitrage; 4, 6, & 8 hour duration	Solar co-location Onshore wind co-location
AUSTRALIA	NEM	WM arbitrage + FCAS; 1, 2 & 4 hour duration for all states	Solar co-location Onshore wind co-location
	CM: Capacity Market WM: Wholesale market BM: Balancing market		FCAS: Frequency Control Ancillary Services AS: Ancillary Services

<sup>1)</sup> BM arbitrage refers to battery operativity in the Italian Mercato dei Servizi di Dispacciamento (MSD), which is used by the TSO Terna to procure both balancing and ancillary services.

## Agenda



- I. Executive summary
- II. Introduction to battery storage
- III. Market size and outlook
- IV. Policy and regulatory environment
- V. Value drivers
- VI. Project economics
- VII. Aurora's Flexible Energy Subscription Services

VIII. Appendix



# Details and disclaimer

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Prepared by
Anuoluwa Omojola
(Anuoluwa.omojola@auroraer.com)
Joke Steinwart
(Joke.Steinwart@auroraer.com)
Linus Beer
(Linus.Beer@auroraer.com)

Approved by
Ryan Alexander
(Ryan.alexander@auroraer.com)
Richard Howard
(Richard.howard@auroraer.com)

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