



Aurora Introduction to the Flexible Energy Market Service

To learn more about the service, contact Humberto Medrano Mendoza (humberto.medrano@auroraer.com).





Access detailed power market analysis and investment case data for batteries with our French Flexible Energy Market Service

Flexible Energy Market Service

Forecast Reports & Data



Technology and Market Development Reports

- 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 until 2050:

- Hourly wholesale power prices
- Yearly capacity market prices
- 4-hourly FCR market prices
- Hourly aFRR (energy and capacity, upward and downward) prices (from March 2023)



Investment Cases



Standalone battery

- Multiple investment cases per country or zone including:
 - Arbitrage of wholesale market and FRC and aFRR market
- Annual project margins to 2050; IRR and NPV for two entry years

Workshops and Assistance

- 1h Workshop with our Market Experts
- Ongoing analyst support

Agenda

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This report also includes:

- A granular databook with our input assumptions as well as our Central hourly wholesale and 4-hour blocks FCR prices
- An investment case databook with our input assumptions and standalone battery investment cases: considering entry in 2024 or 2025, 1-hour, 2-hour or 4-hour battery duration and either exclusive or simultaneous participation in day-ahead and FCR, aFRR markets

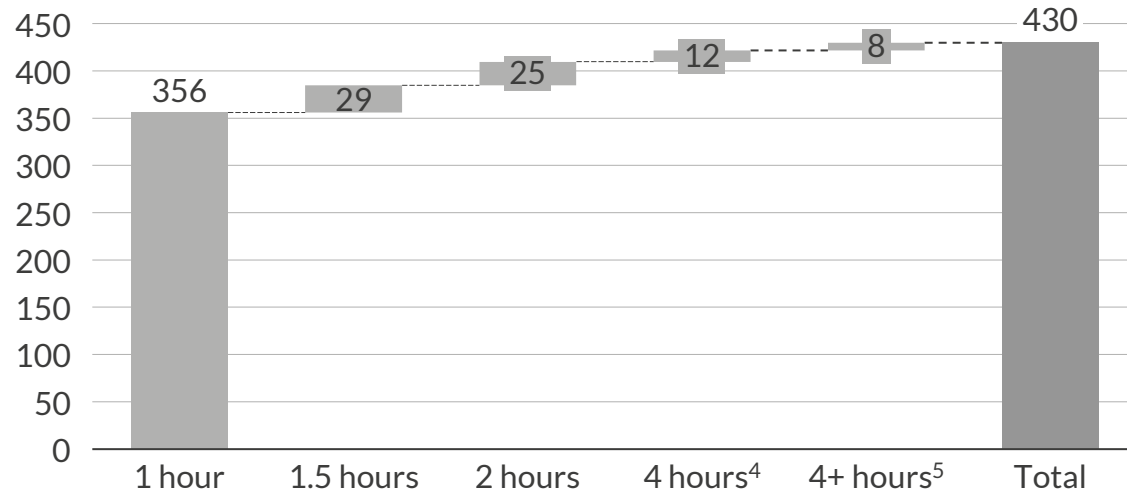
Deployment of grid-scale battery storage in France is dominated by 1-hour batteries, reaching 430 MW total installed capacity

Market context for batteries in France

- Grid-scale battery development started in 2020 in France, reaching 430 MW deployed in December 2022¹
- 253 MW were awarded a contract in the 7-year capacity market auctions ("AOLT" ²) for the 2021-2027 and 2022-2028 periods for 29 k€/MW/y and 28 k€/MW/y respectively
- RTE forecasts grid-scale battery deployment to reach 800 MW by the end of 2023³

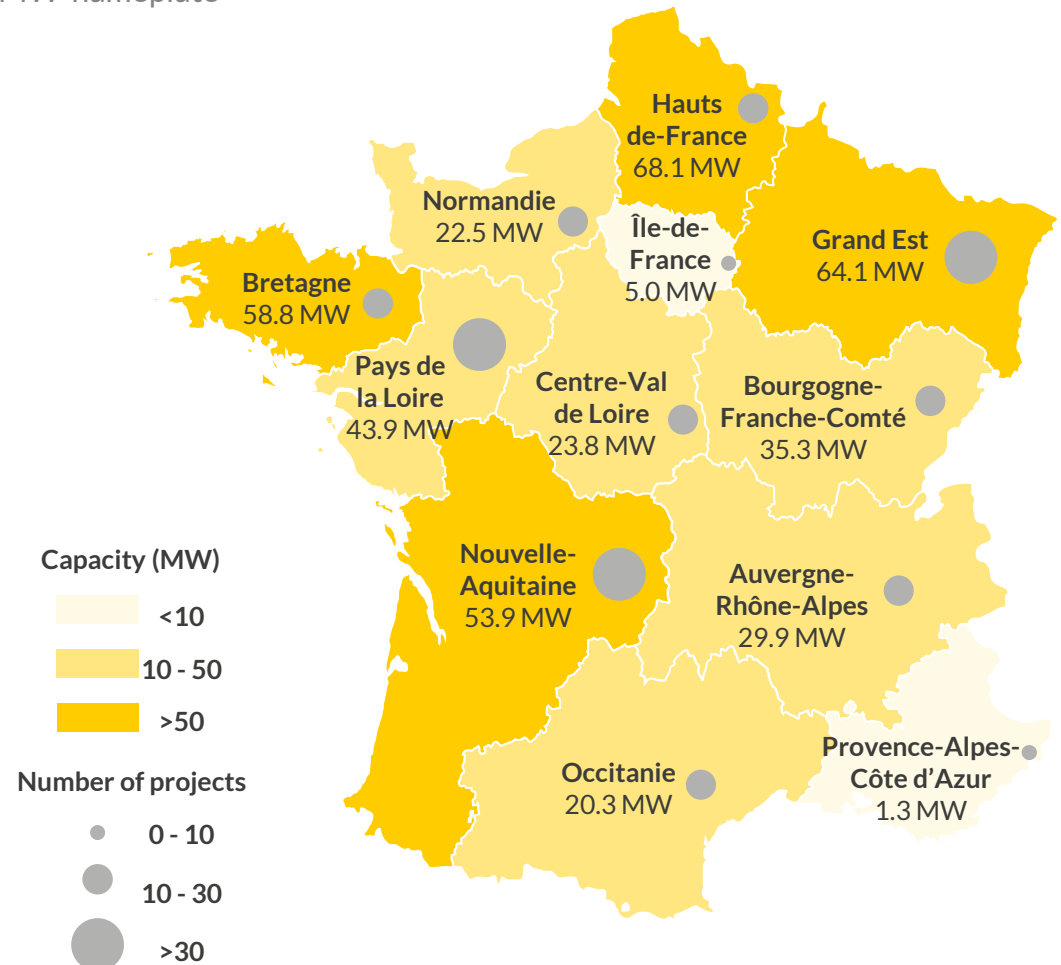
Operational grid-scale battery capacity in France¹

MW-nameplate



Operational grid-scale battery capacity by region

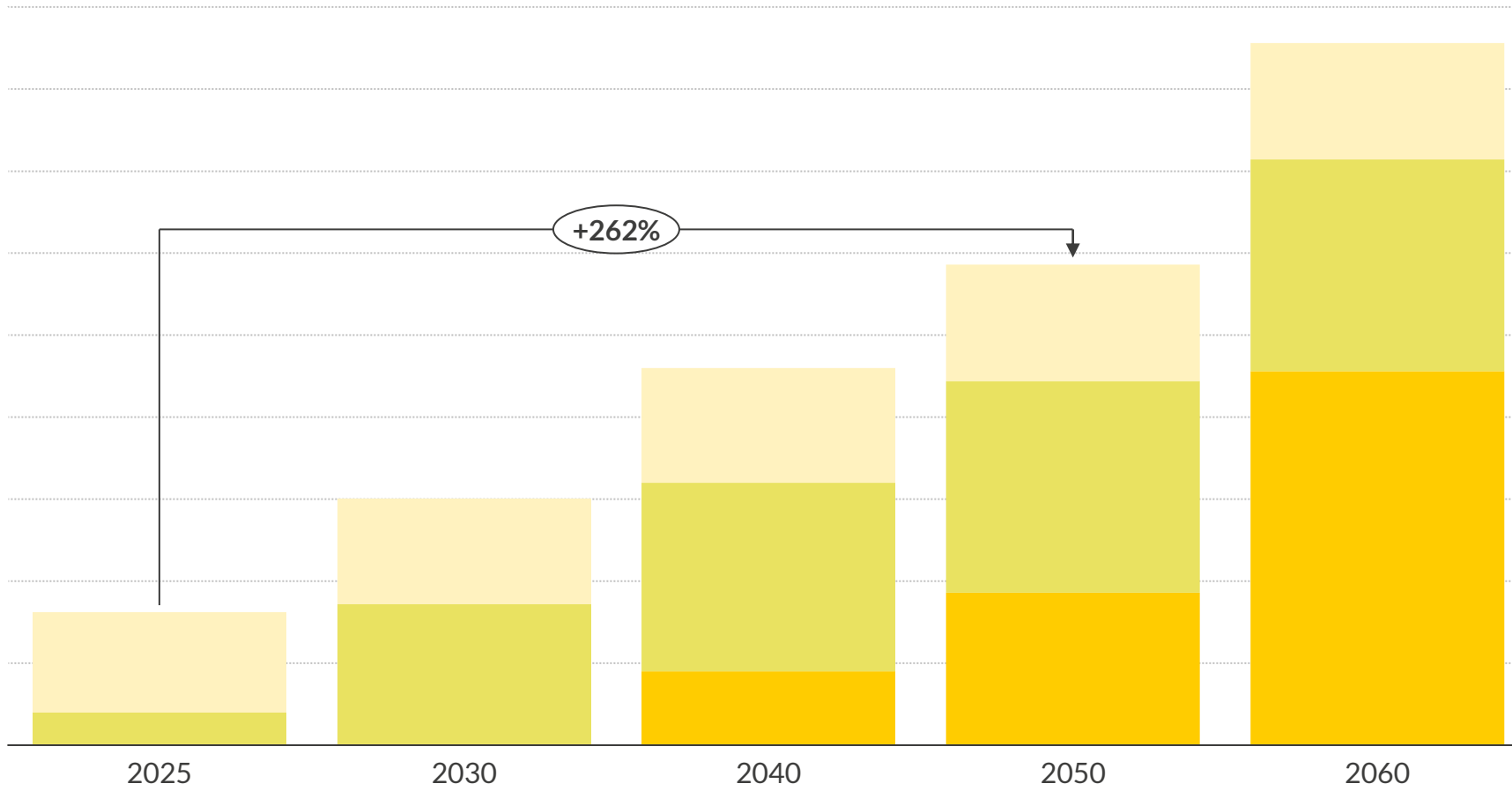
MW-nameplate



1) Data published on 18/10/2022 on the Open Data Réseaux Energies "Registre national des installations de production et de stockage d'électricité website; 2) "Appel d'Offres Long-Terme"; 3) RTE "Atelier Stockage Electricité" (05/06/2022); 4) Ringo project in Fontenelle, Hauts-de-France; 5) Renault battery in Cuincy, Hauts-de-France.

In Aurora's Central scenario, battery capacity in France increases by 262% between 2025 and 2050

Battery capacity in Aurora Central¹
GW



1h Battery 2h Battery 4h Battery

1) Aurora January 2023 Central Scenario; 2) According to the deliberation published on the 30th of June 2022, the Energy Regulation Commission (CRE) has granted RTE a derogation of up to 3 years for contractualisation of aFRR through the PICASSO platform.

Sources: Aurora Energy Research, CRE

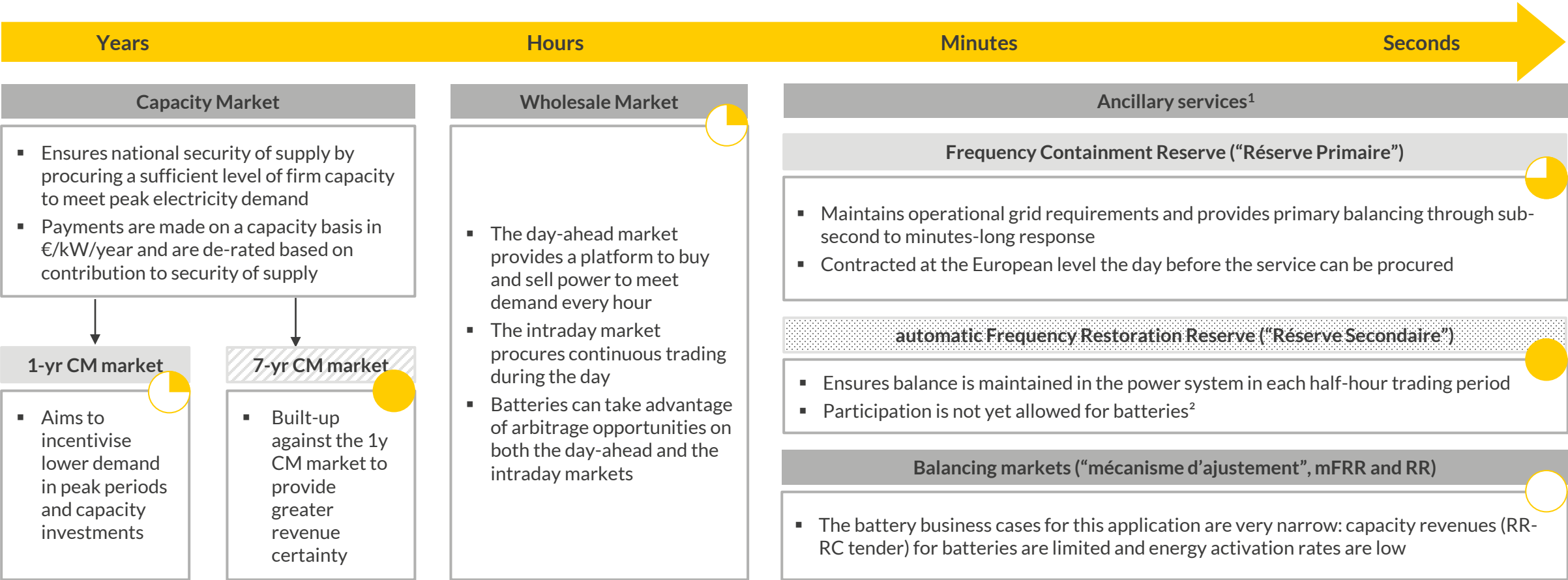
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- We expect the majority of batteries entering the market at the beginning of the forecast to be 1 and 2-hour batteries, with business models relying mostly on ancillary services: FCR market and aFRR market once it is opened²
- 4-hour batteries will develop from 2031 participating in ancillary services and energy arbitrage while CAPEX of those systems decline

Diverse revenues streams will be available for batteries, with ancillary services, wholesale and capacity markets as main sources

Response time

Delivery



1) Tertiary Reserves (mFRR and RR) are not relevant for batteries due to the required duration of these products: 120 minutes for the manual Frequency Restoration Reserve (mFRR) and 90 minutes for the Replacement Reserve (RR); 2) aFRR is not procured through a market yet in France and will be from July 2024.

2-hour batteries achieve the highest IRRs when participating in a hybrid trading model, participating in wholesale market, FCR and aFRR

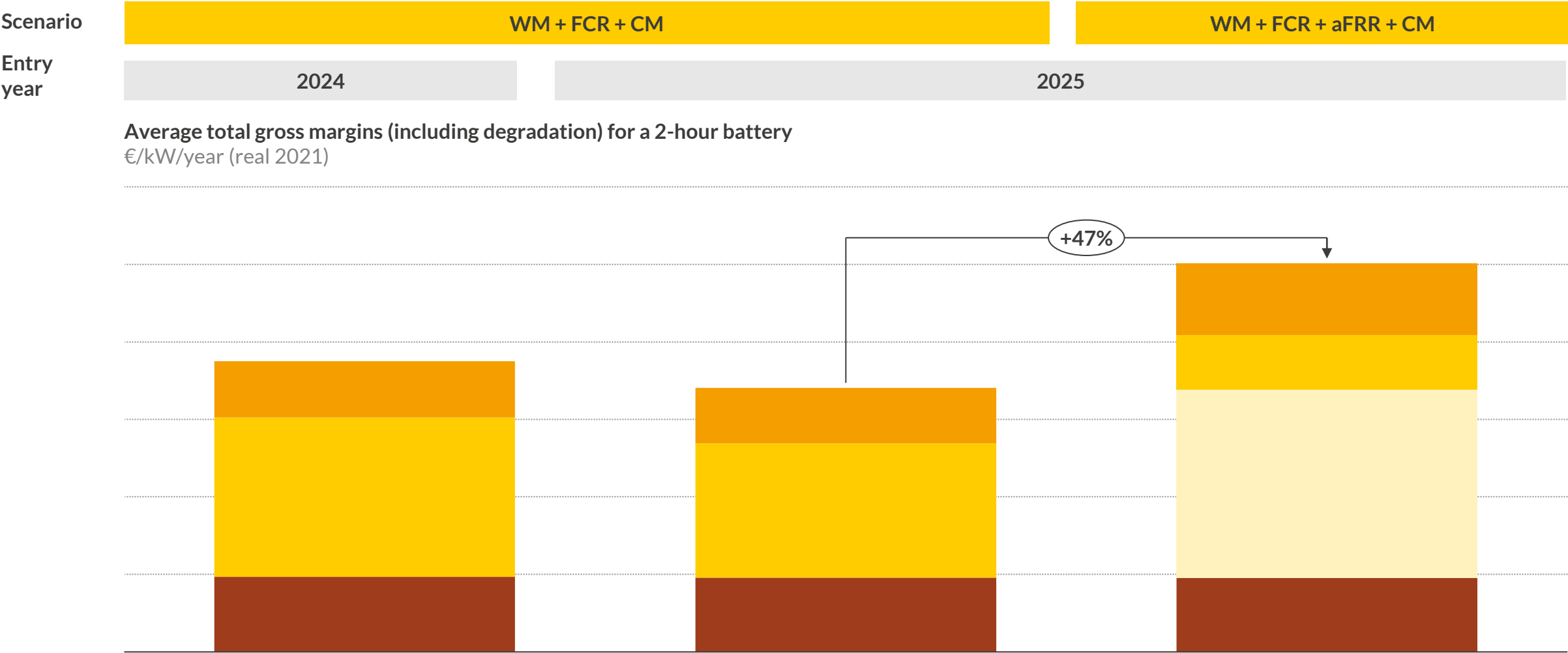
Battery Internal Rate of Return¹ (pre-tax real and unlevered), %

Entry Year	Scenario	Duration	IRR
2024	A WM + FCR + CM ²	1 hour	
		2 hour	
2025		1 hour	
		2 hour	
2025	B WM + FCR + aFRR + CM	1 hour	
		2 hour	
		4 hour	

- In the scenario A, 1-hour batteries are significantly more profitable than 2-hour batteries as the additional energy of a 2-hour battery only permit to have more arbitrage opportunities on the day-ahead market but do not increase FCR opportunities
- When batteries can participate in aFRR capacity and energy (scenario B), we observe much higher revenues and so IRRs
- Larger batteries benefit from greater revenues from aFRR capacity reservation and more energy arbitrage (although import costs due to TURPE reduce it)
- Lower duration batteries achieve higher IRRs as the increase in CAPEX is not compensated by the upside in gross margins

1) Representative 15-year battery project IRR with an availability of 99%, a round-trip efficiency of 87.5% and a degradation per cycle of 0.0048%; 2) Wholesale market + FCR market + Capacity market.

Batteries that can participate simultaneously on day-ahead, FCR and aFRR markets achieve higher gross margins



1) Represents a 15 year IRR for the battery. Does not assume repowering; 2) Refers to Wholesale market and aFRR energy trades.

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