

Financing RES and BESS: challenges and learning from the international experience

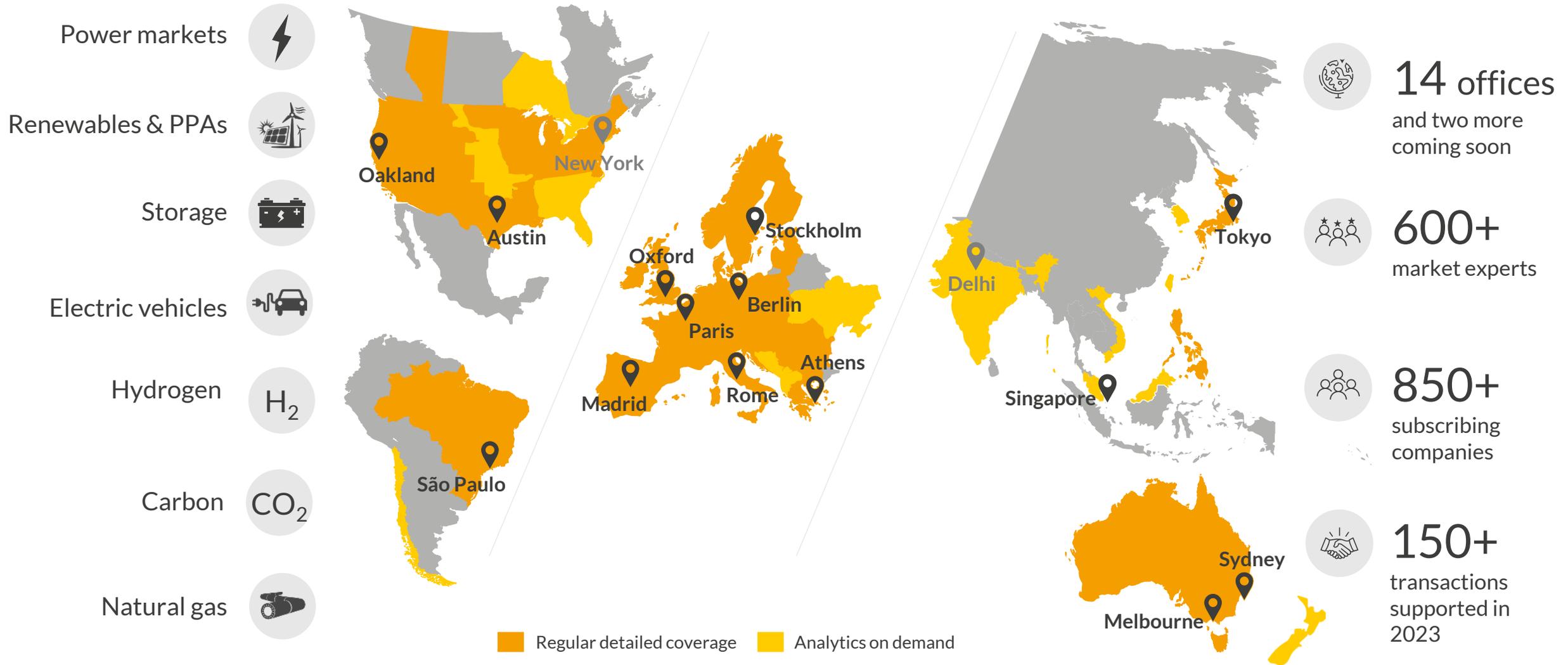
Evangelos Gazis

Head of Southeast Europe

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While CfDs drove the initial RES growth in Greece, many projects are increasingly diverting towards market exposure for higher returns

A

RES subsidy schemes

- CfD and FiT support schemes which provide a fixed price for 20 years
- In the last decade, RES support schemes have been the main route to market in Greece for solar and wind plants

Financing/Risk



- Over 7 GW of projects have been financed over the past decade from FiT and CfDs

Difficulty entering the market



- Projects get grid connection however there is a strong competition in the auctions and licensing

Potential revenues



- The competitive auctions result in low strike prices and therefore lower absolute revenues

B

Merchant revenues

- Full market exposure where RES plants participate in the wholesale market and depend fully on market conditions
- Merchant returns particularly attractive in the short-term given the high-price environment

Financing/Risk



- Greek banks have not yet financed a fully merchant project

Difficulty entering the market



- Not in grid connection priority lists
- Such projects need trading desks or aggregators

Potential revenues



- Given our forecast, merchant assets could earn revenues resulting in double digits IRRs

C

Power Purchase Agreement (PPA)

- Bilateral agreements for the delivery of power offering price and volume certainty
- PPAs provide a fixed market-based alternative to subsidies and fully merchant assets

Financing/Risk



- Greek banks consider financing PPA backed assets even with partial merchant exposure

Difficulty entering the market



- Apart from licensing and grid connection, the suitable off-taker needs to be identified

Potential revenues

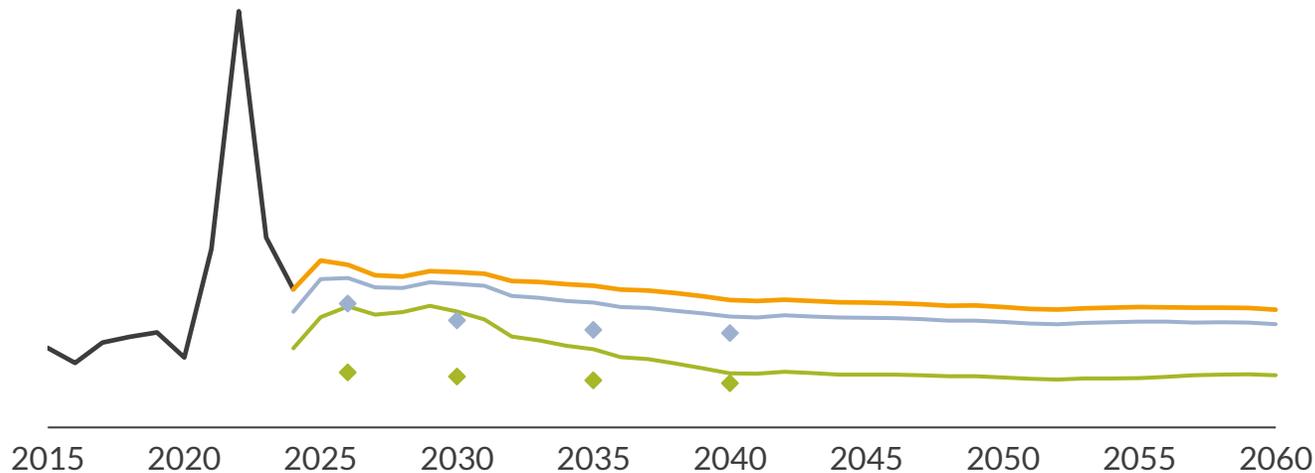


- PPA revenues are forecasted to be between the subsidised and merchant equivalents

Favourable project economics underpin the attractiveness of unsubsidised renewable entry, however price cannibalisation poses risks

1 Capture prices will decline after 2030, especially for solar, however when compared with LCOEs, they provide investable returns in the long run

Baseload and renewables capture prices¹
€/MWh (real 2023)



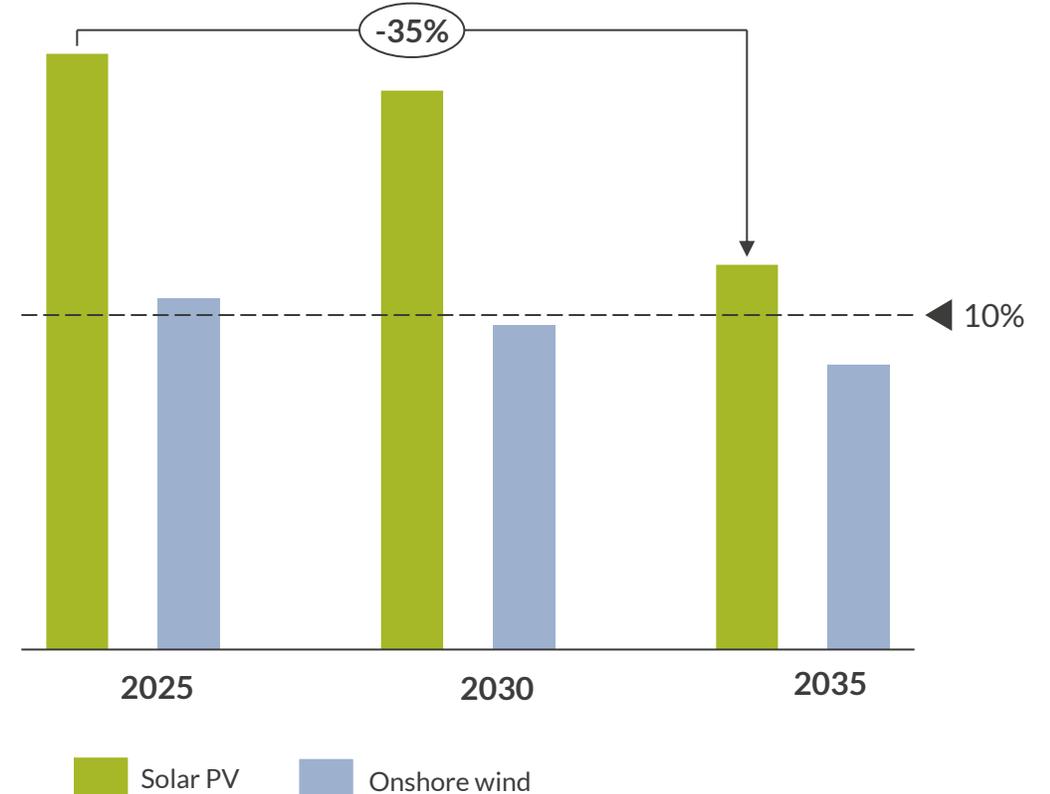
Average discount to baseload
10-year averages

Period	Onshore wind	Solar PV
2025-30	8%	26%
2031-40	12%	46%
2041-50	12%	58%
2051-60	12%	58%

— Historical baseload — Onshore wind ◆ LCOE² Solar PV
— Baseload — Solar PV ◆ LCOE³ Onshore wind

2 Solar PV project IRRs are above 10% for CODs ranging from 2025 to 2035 which underpin the attractiveness of unsubsidised plants

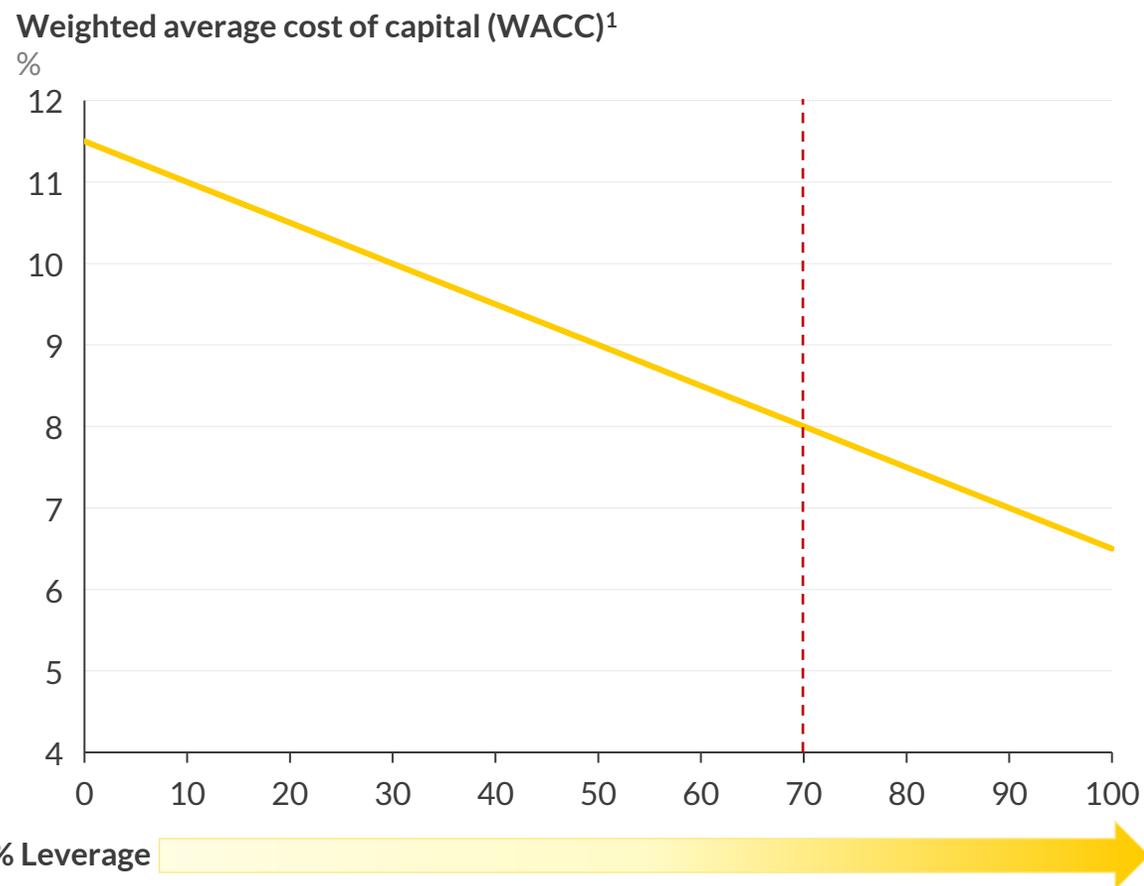
Project IRR⁴ based on different CODs
%



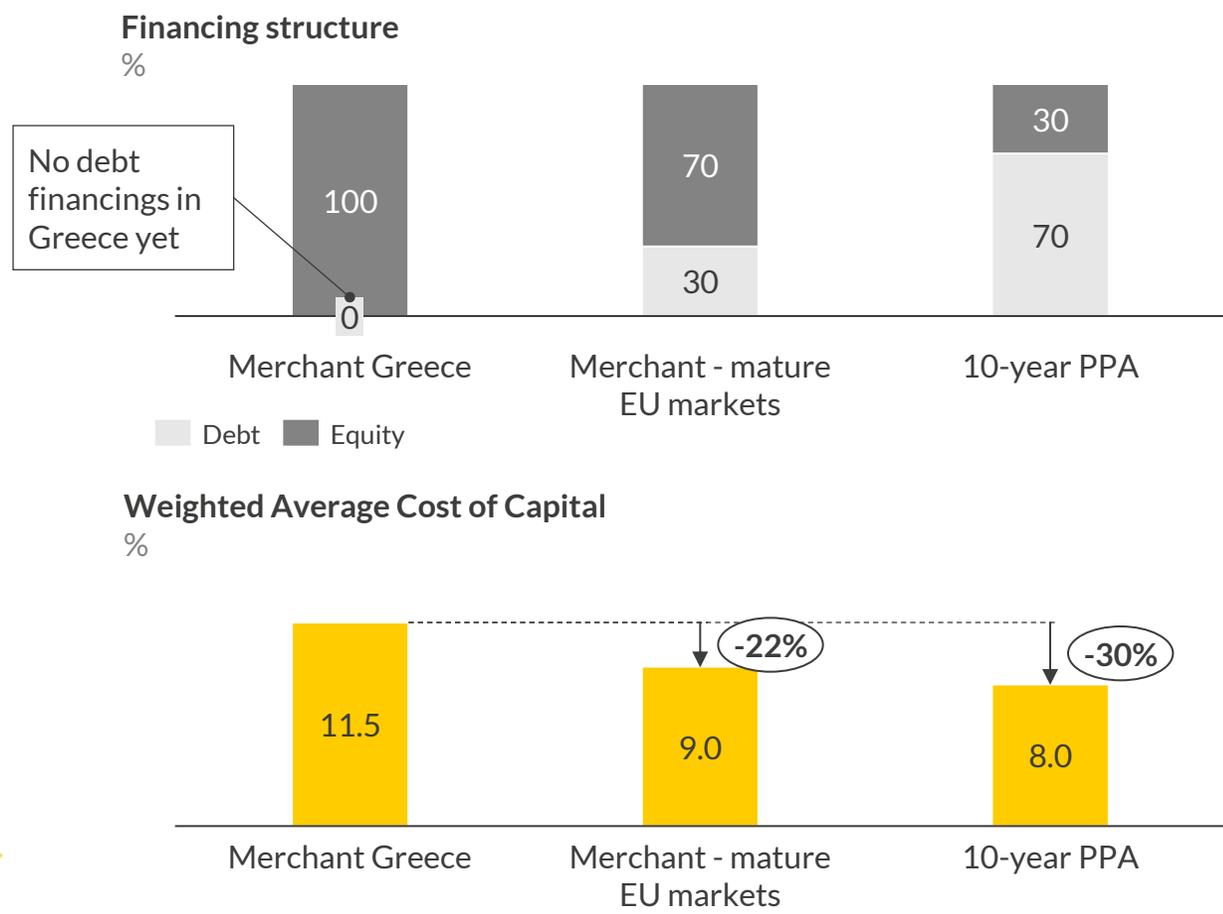
1) Generation weighted average prices for wind and solar 2) Tracking solar PV with a load factor of 22-24% and a discount rate of 8.5%. 3) Onshore wind with a load factor of 29-32% and a discount rate of 8.5%. 4) Unlevered IRR.

Due to higher revenue certainty, PPAs can tap into higher debt/equity ratios leading to 30% lower WACCs compared to merchant projects

1 By increasing the debt share of the capital structure, developers can achieve lower cost of capital



2 A 10-year PPA project in Greece could achieve at least 20% lower WACC compared to fully merchant projects depending on market maturity



1) Assuming a cost of equity of 11.5% and a cost of debt of 6.5% for a solar PV PPA project.

The composition of revenue stacks for BESS varies significantly by country and storage capacity; longer-duration batteries rely less on ancillary services

Average composition of gross margin stack¹
% of 2027 - 2041

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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

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

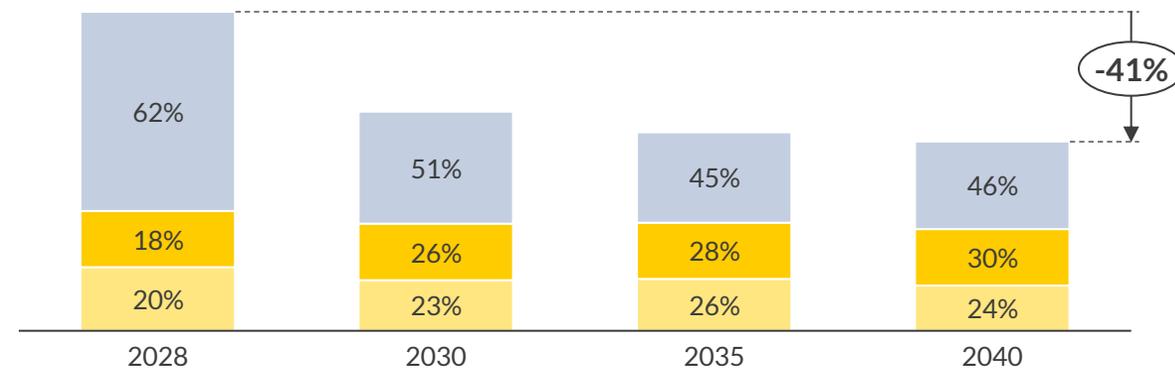
Summary of saturation risks for grid-scale batteries¹

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

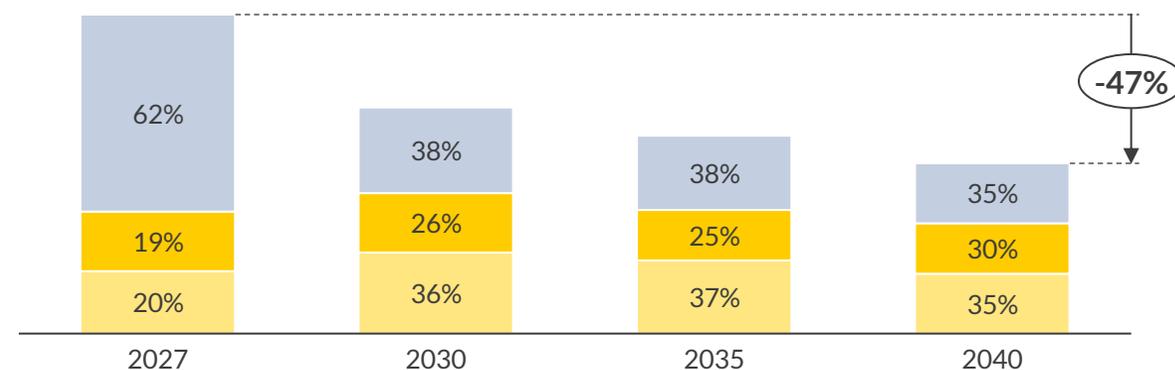
■ Will take longer to Saturate (> 3)
 ■ Will saturate within the near term (1-3 years)
 ■ Already saturated
 ■ Not relevant for batteries

2h Battery gross margins - Poland
€/kW

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2h Battery gross margins - France
€/kW



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

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

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

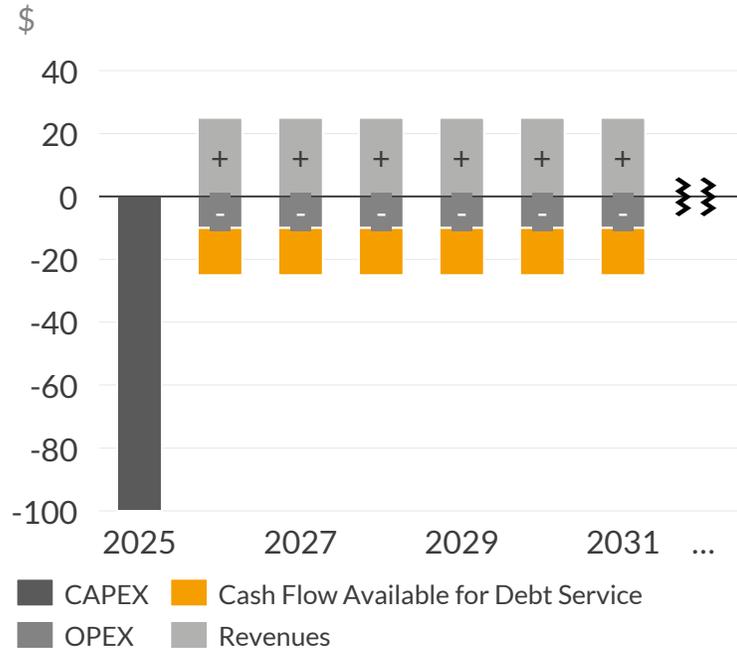
Lenders view stable revenues more favorably than merchant revenues

- 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

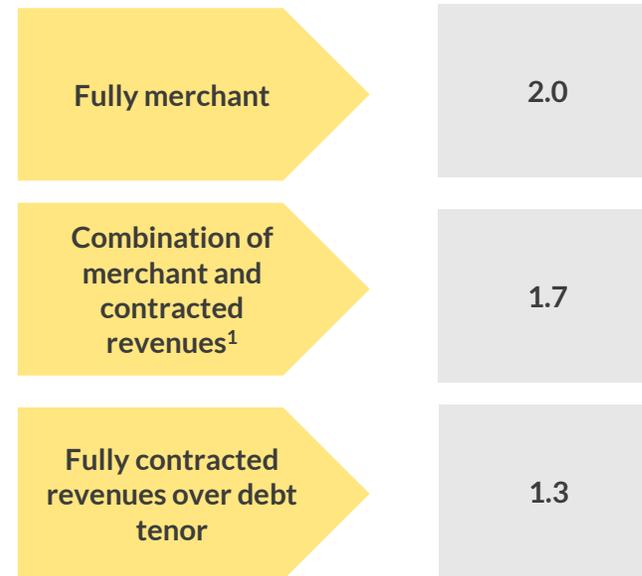
Thus, revenue contracting results in a higher willingness of banks to provide lending and a lower cost of capital

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

Illustrative project cashflow



Illustrative Debt Service Coverage Ratios



Illustrative financing structure



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

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

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



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

Battery de-rating factors

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

Duration

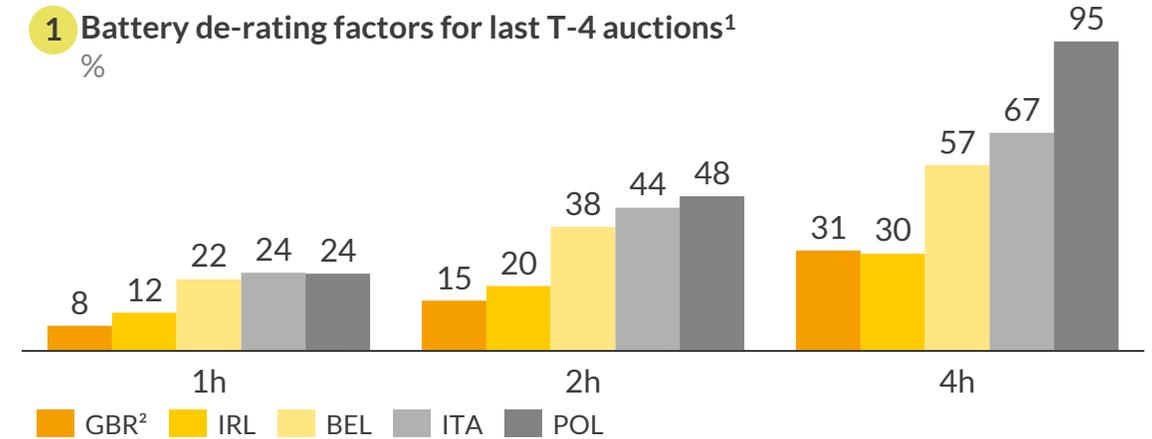
- The lower the duration, the lower the de-rating factor
- Battery contribution to security of supply is limited by their ability to respond to long-lasting stress events

Capacity

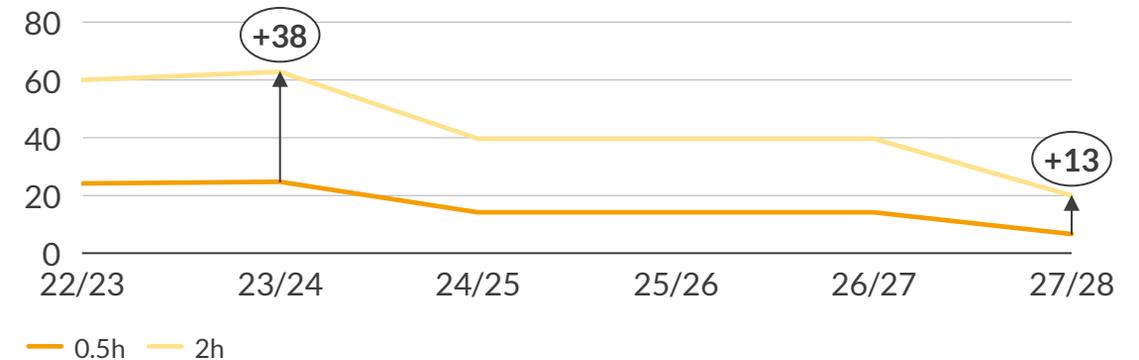
- The more batteries are active in the capacity market, the lower their de-rating factor
- The benefit of having additional batteries in the system decreases

- 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)

1 Battery de-rating factors for last T-4 auctions¹
%



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

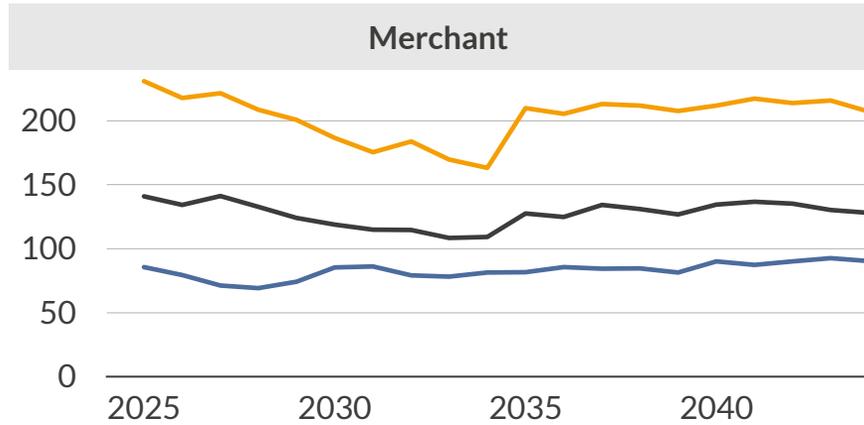


1) GBR, IRL: 2027/28 T-4 auction, ITA: 2024 T-4 auction, BEL: 2024 Y-4 auction, POL: 2028 T-5 auction

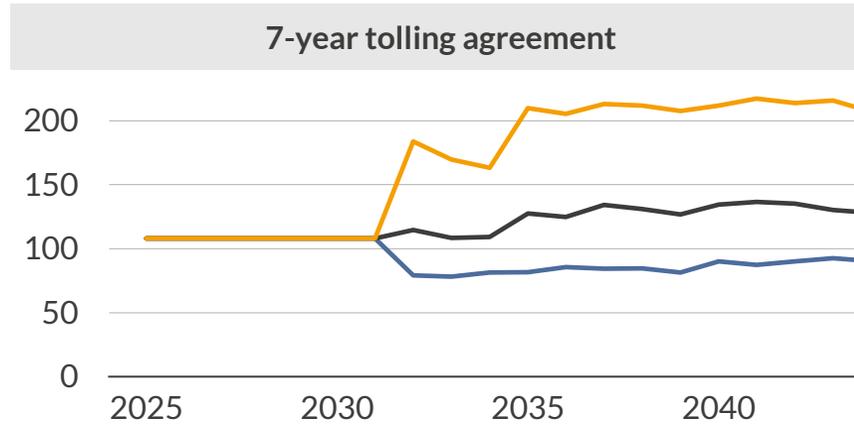
3 Worked Example: tolling agreements can help increase leverage by 30 p.p., at the expense of merchant returns in an upside case

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 — High³

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

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

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

- 1** Project IRRs are superior for fully merchant assets however PPAs offer a balance between access to finance and investable revenues
- 2** Fixed-price PPAs can positively impact the bankability of renewable projects by ensuring higher revenues certainty, thereby increasing the project's cash flow available for debt service and resulting in a lower cost of capital. PPAs increase the potential debt component to over 70% of the capital structure for RES, reducing the Weighted Average Cost of Capital by as much as 30%
- 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** 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

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