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PPAs in Iberia: What role do PPAs have in a high wholesale market environment?

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The Iberia Research Team

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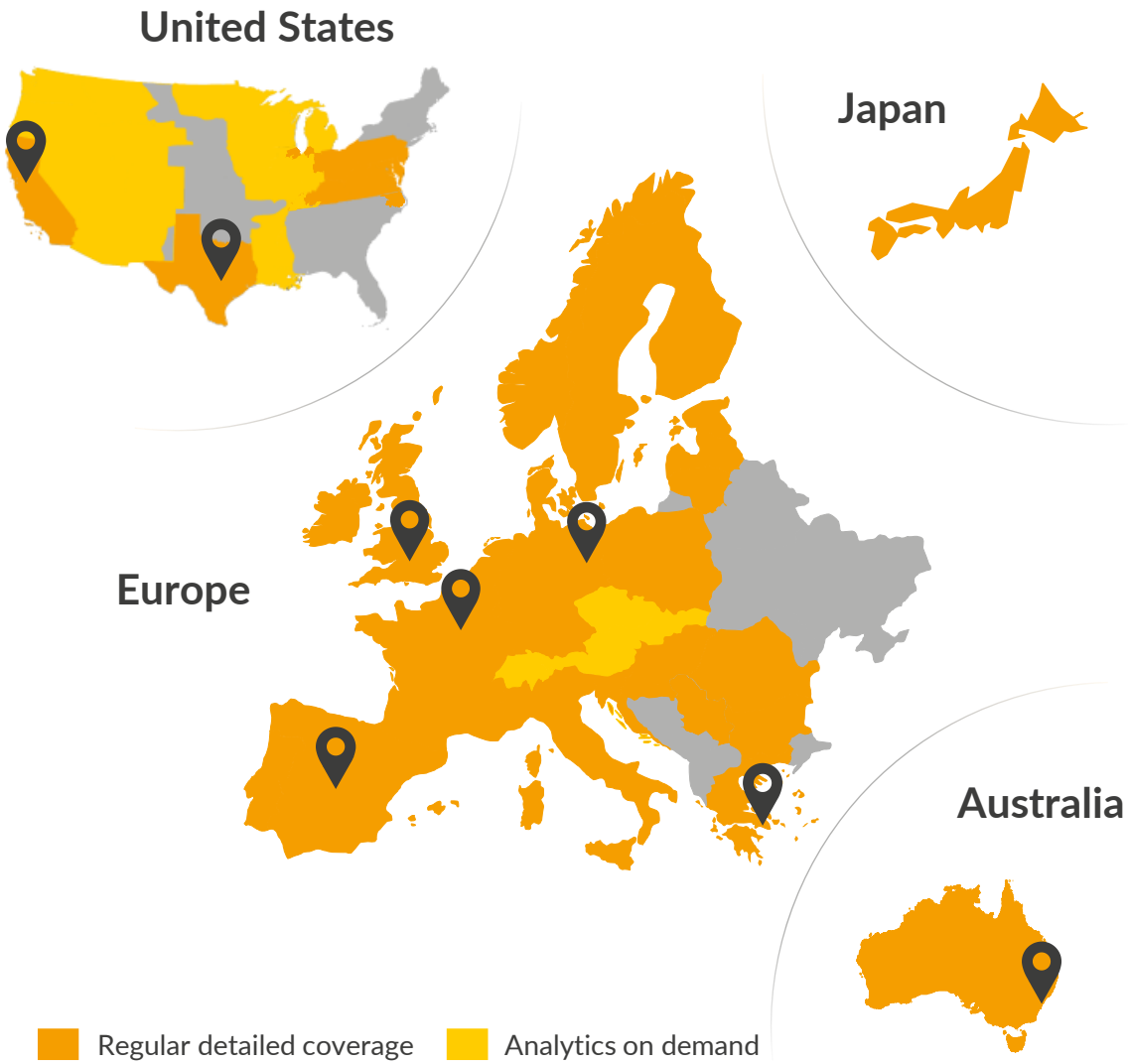

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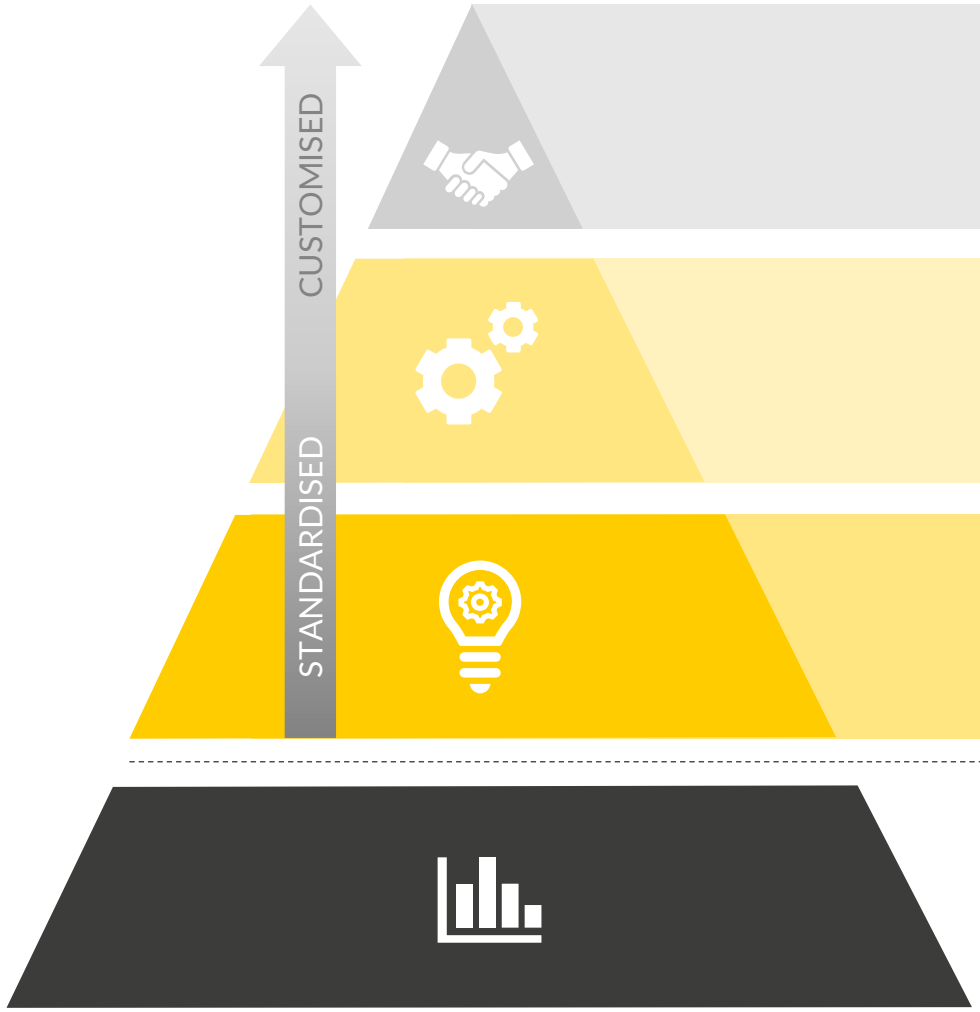

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Source: Aurora Energy Research

Agenda

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I. Iberian PPA Market Outlook

II. Risks and mitigations of a Baseload PPA

III. Optimal dimensioning of a PPA

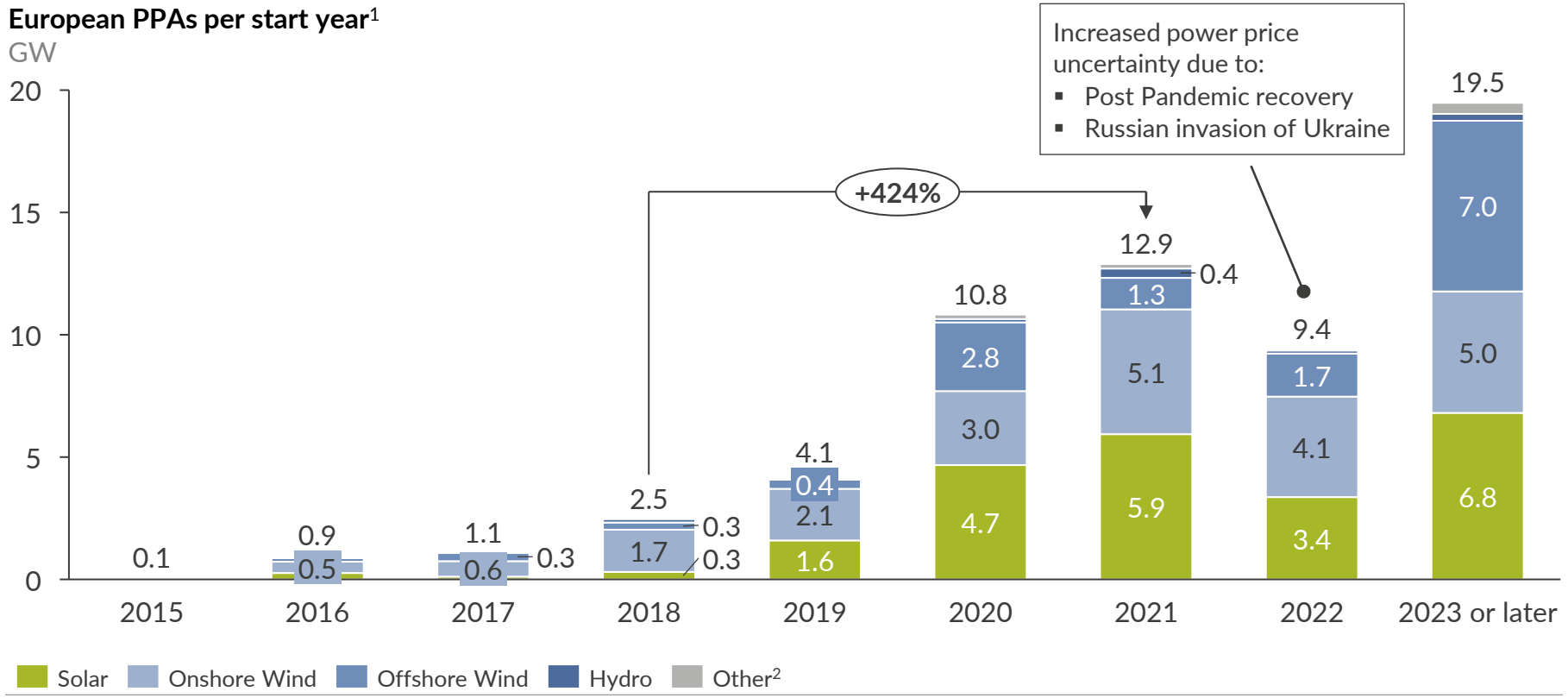
IV. Key takeaways

The European PPA market has increased greatly in size since 2015, mainly driven by increased RES build-out and decarbonisation targets

Drivers for PPA growth

Growth in power demand supported by decarbonisation targets	Phase-out of fossil fuels and emissions reduction targets	Further RES buildout (uncertainty regarding the growth rate)	Additional flexible capacity coming online	Significant price spikes and high price volatility

European PPAs per start year[1]



1) Countries included: Germany, Nordics (Denmark, Finland, Norway, Sweden), Great Britain, Spain, France, Portugal, Netherlands, Italy, Belgium, Poland, Ireland. Based on publicly available information. 2) Other RES and a combination of technologies

Source: Aurora Energy Research

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Comments

- The PPA market has grown remarkably since the first PPAs were observed in Europe in 2015. This has been particularly true since 2018
- While offshore wind had a smaller share of capacity under PPAs until 2021, a large increase is to be noted from 2023 with up to 7.0 GW under PPAs
- Onshore wind PPAs represent 5.0 GW of contracted capacity in '2023 or later' while 6.8 GW of solar under PPA come online from 2023 onwards
- High power price uncertainty led to many contract negotiations stalling in 2022, hindering the rapid development of the PPA market

Spain is the most mature market within Europe; regulatory barriers in Portugal have prevented strong PPA growth

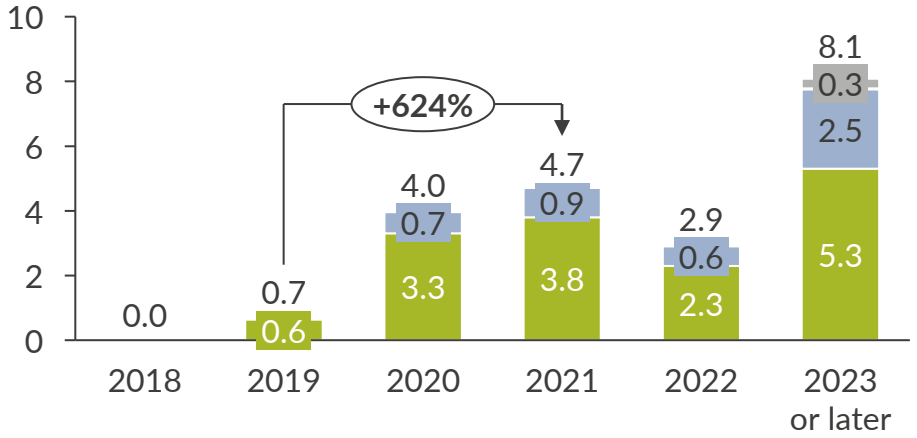
Market maturity

GW

Country	GW under PPA	Market Maturity Stage
	21.4	
	14.8	
	13.1	
	3.9	
	3.7	
	2.1	
	1.6	
	1.6	
	1.1	
	1.1	
	0.7	

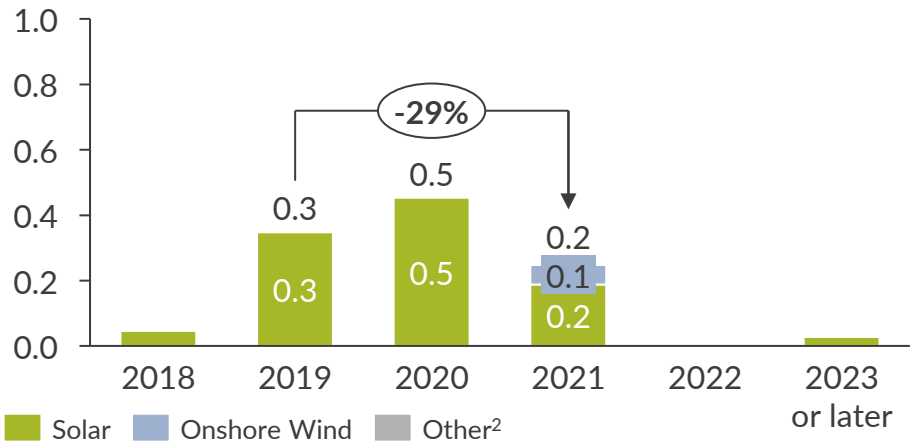
Signed PPA per start year in Spain[1]

GW



Signed PPA per start year in Portugal[1]

GW



1) Based on publicly available information. 2) Other RES and a combination of technologies. 2) The clarification released by ERSE in 2020 also confirmed that PPAs with energy contracts indexed to the market are subject to the clawback tax.

Source: Aurora Energy Research

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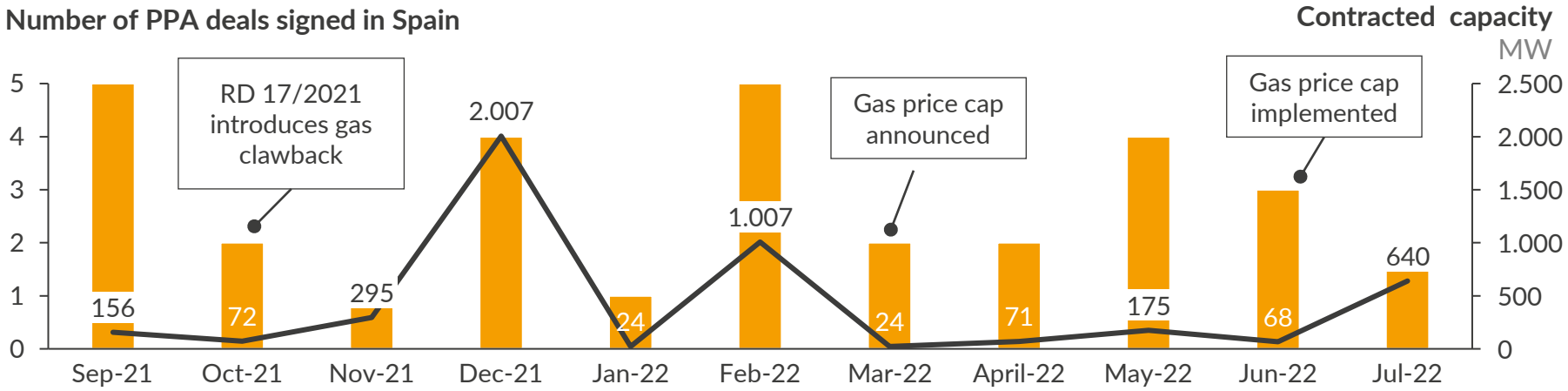
Comments

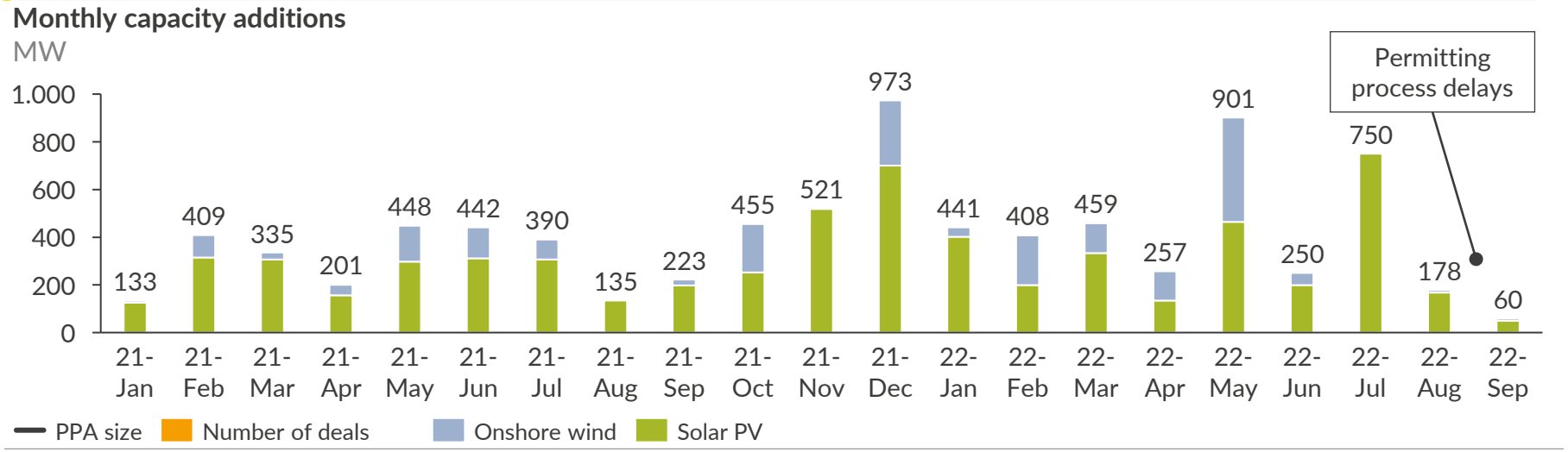
- PPA market maturity varies widely between countries, with the Nordics and Spain being the most mature European markets
- Between 2019 and 2021, there was a more than 600% increase in capacity under PPAs in Spain, as financing under PPAs became more prominent
- Energy sold under PPAs in Portugal is subject to the clawback generation tax, although bilateral contracts closed directly with the final consumer are exempt[2]
- Solar PV is expected to continue to be the leading technology in Iberia for PPAs; onshore wind PPAs represent 2.5 GW of contracted capacity in '2023 or later' compared to 5.3 GW of solar PPAs

However, the PPA market in Spain has also been affected by regulatory developments and delays in projects coming online

1 Regulatory intervention in Spain has delayed PPA negotiations



2 The installation of renewable capacity has stalled in recent months, mainly due to delays in permitting processes



Sources: Aurora Energy Research, REE

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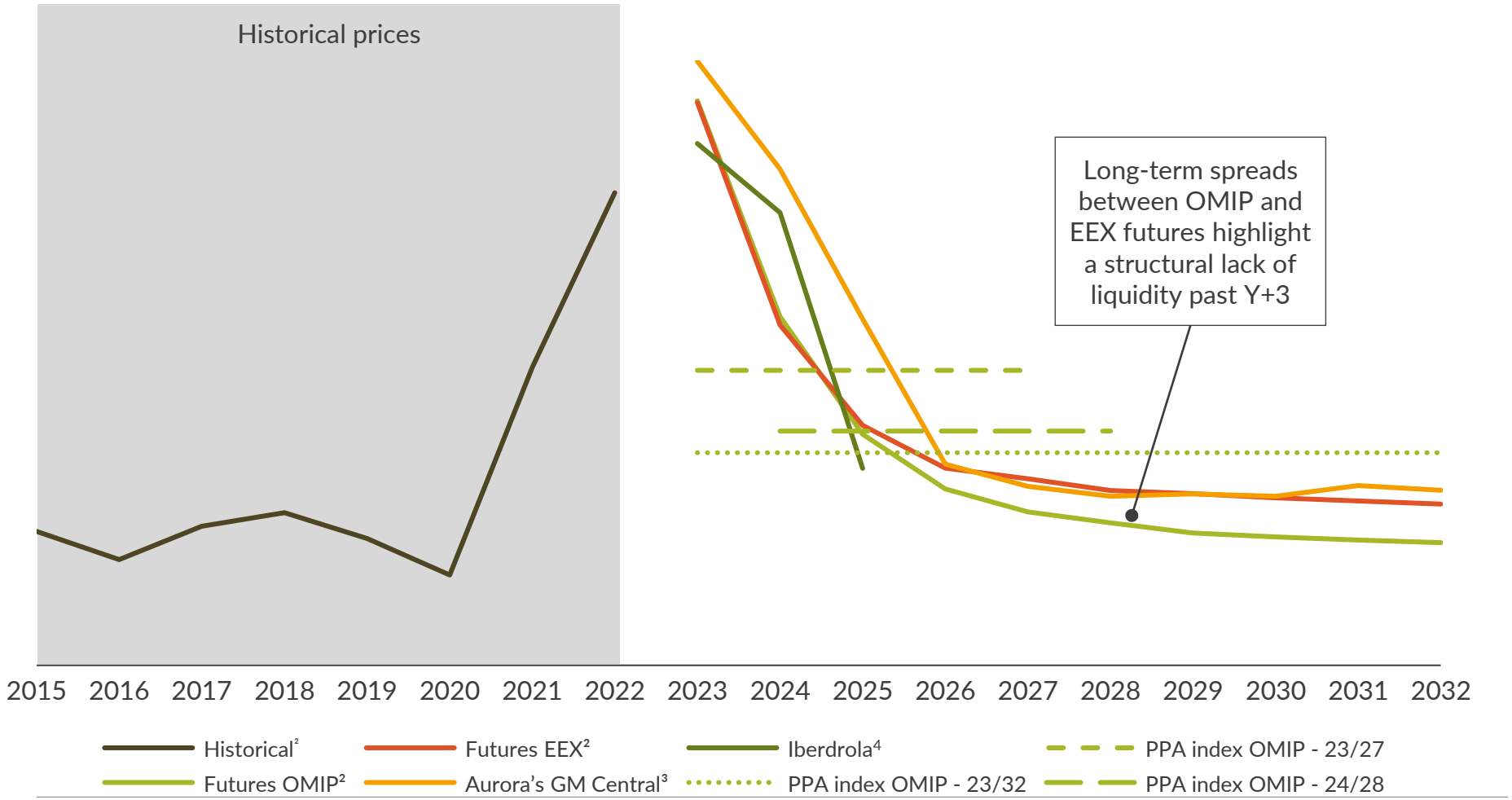
Comments

- Over the last 12 months, the Spanish market has suffered from several regulatory interventions, which have provoked uncertainty in the market and caused PPA negotiations to stall
- The increase in wholesale market prices has led to delays in PPA negotiations, as increased volatility has caused reluctance to lock in long term PPA prices.
- Furthermore, the supply of projects looking to close a PPA decreased as high market prices made fully merchant projects more attractive
- Delays in the permitting process have also reduced the supply of PPAs. A decrease in capacity additions can be observed over the last few months

The standard PPA pricing approach is based on futures, but that approach has limitations in low liquidity markets

Wholesale power prices in Spain
EUR/MWh



1) Data until 14/11/2022, nominal prices. 2) Futures were taken on 28/10/2022, nominal prices. 3) Gas futures for Aurora's scenario were taken based on the 28/10/2022, real 2021 prices.
4) Iberdrola's statement from 10/11/2022. 5) Applicable in Spain.
Sources: Aurora Energy Research,, OMIP, EEX

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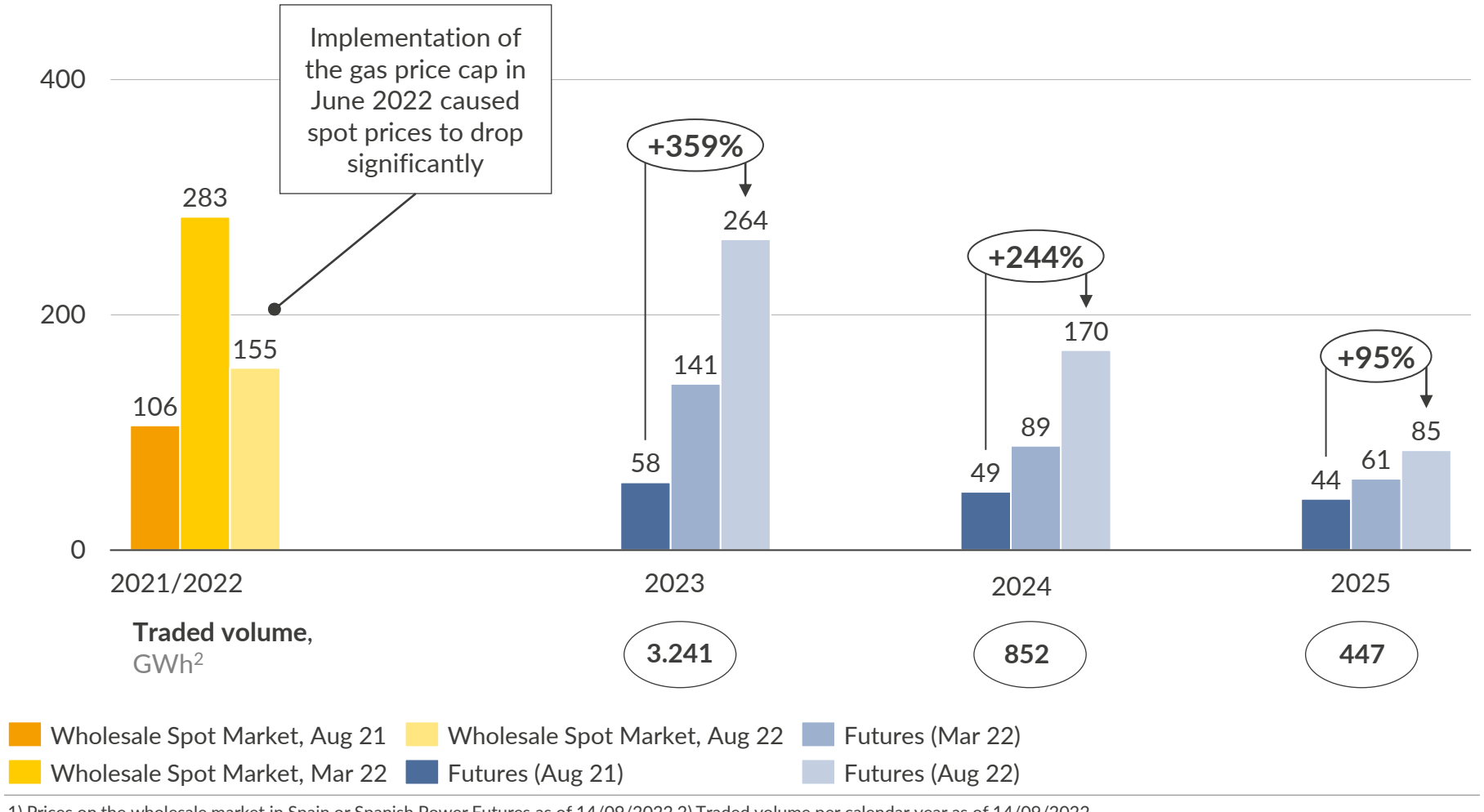
- A prolongation of the Iberian gas price cap measures, or clawback mechanism[5] could fundamentally impact the prices a renewable asset can capture, breaking the link to wholesale price benchmarks
- We have analysed the pricing implications of implementing three different methodologies:
  1. Fundamental approach – driven by long-term market fundamentals whilst also incorporating in the pricing uncertainty in market development (High and Low scenarios)
  2. Futures-based approach – driven by futures prices the PPA tenor and an estimated capture rate
  3. Blended approach – driven by futures in the short term and market fundamentals in the long term

Liquidity in Iberia's futures markets is limited, representing around 0.2% of total demand in 2025 for delivery in that year

Power prices on the spot and futures markets[1]
EUR/MWh



1) Prices on the wholesale market in Spain or Spanish Power Futures as of 14/09/2022.2) Traded volume per calendar year as of 14/09/2022.

Source: Aurora Energy Research, OMIE,

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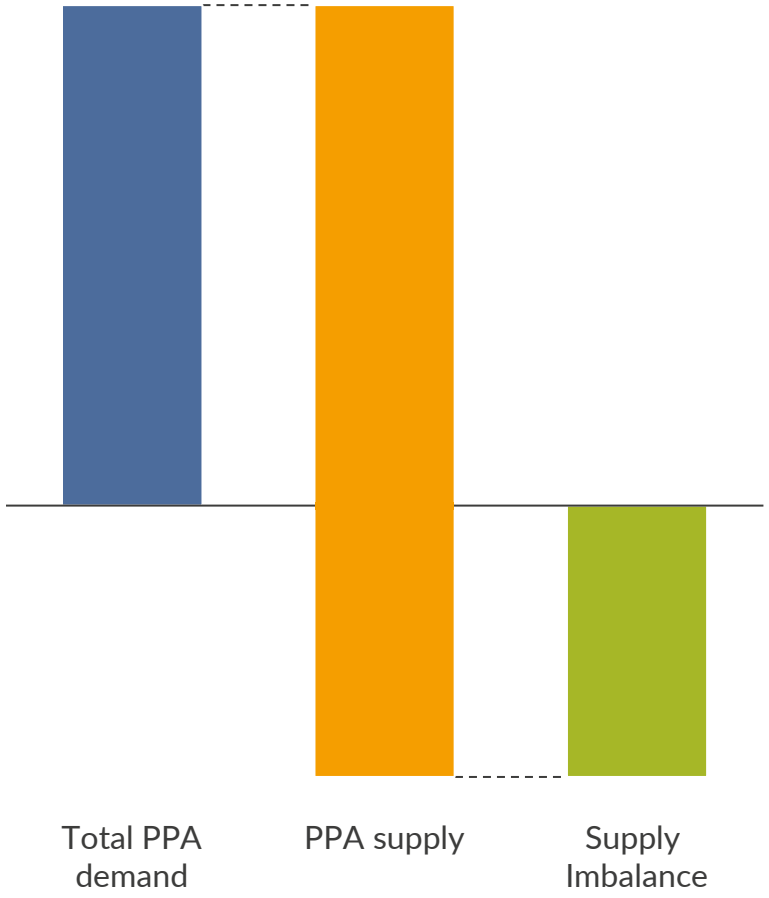
Comments

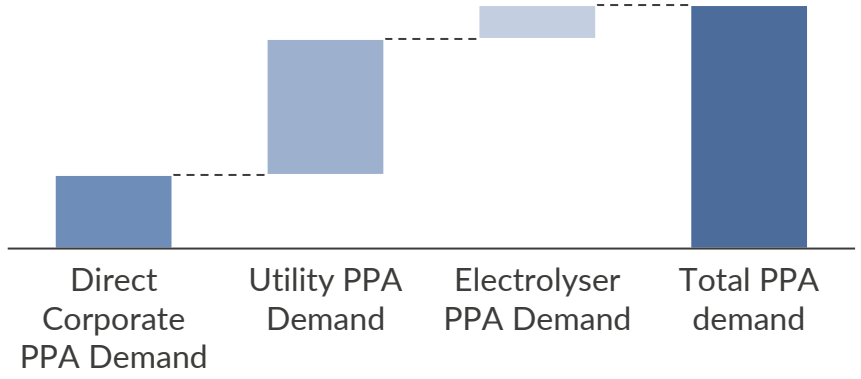
- Futures contracts are usually only liquid over a short horizon of 2 – 3 years and thus do not reflect longer-term developments in the electricity market (expansion of renewables, demand etc.)
- The prices of futures closely follow the volatile prices on the spot market and have increased accordingly over the last few months, making them less useful as a benchmark for long-term prices (i.e. 3+ years)

In the Central scenario, we expect Spain to remain a buyer's market with a supply surplus of 27 TWh by 2030

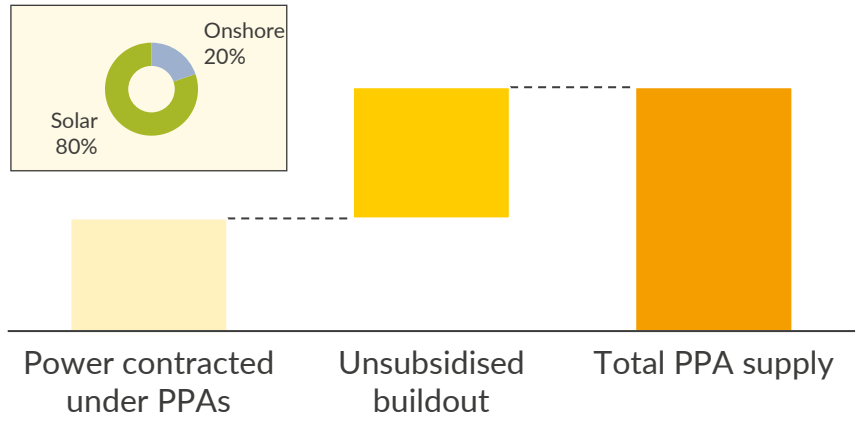
PPA demand and supply potential in 2030, Central
TWh



PPA demand potential in 2030, Central
TWh



PPA supply potential in 2030, Central
TWh



Source: Aurora Energy Research

Comments

- While the current Spanish PPA supply has been affected by regulatory measures and attractive market prices, in our Central scenario, supply would exceed demand by 27 TWh in 2030, leaving the Spanish PPA market in an oversupplied state
- PPA supply is expected to be around 77 TWh– most of it stemming from solar PV which represents 80%
- The largest component of PPA demand of 28 TWh originates from utilities, but electrolyser demand will be a growth vector post-2030

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Each combination of PPA characteristics has an impact on the value of the PPA as different risks need to be priced in

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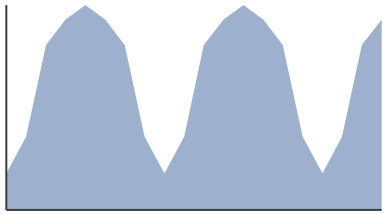
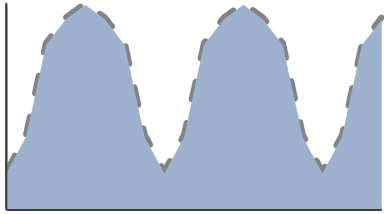
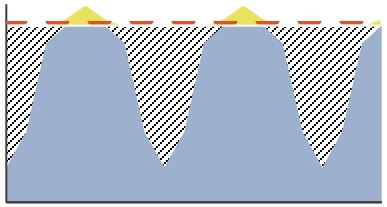
Flows	PPA Delivery profile	Price Structure	Tenor
Physical PPA 	As-Produced 	Fixed Price	Short term ≤ 5 years
Virtual PPA 	As-Forecasted 	Collared	Medium term 6 - 9 years
	Baseload 	Floating / Indexed price	Long term ≥ 9 years

Note: In all cases the offtaker receives a Guarantee of Origin (GoO).

Sources: Aurora Energy Research

In a Baseload PPA, a constant volume of power is delivered, combining power generated from the asset and residual power

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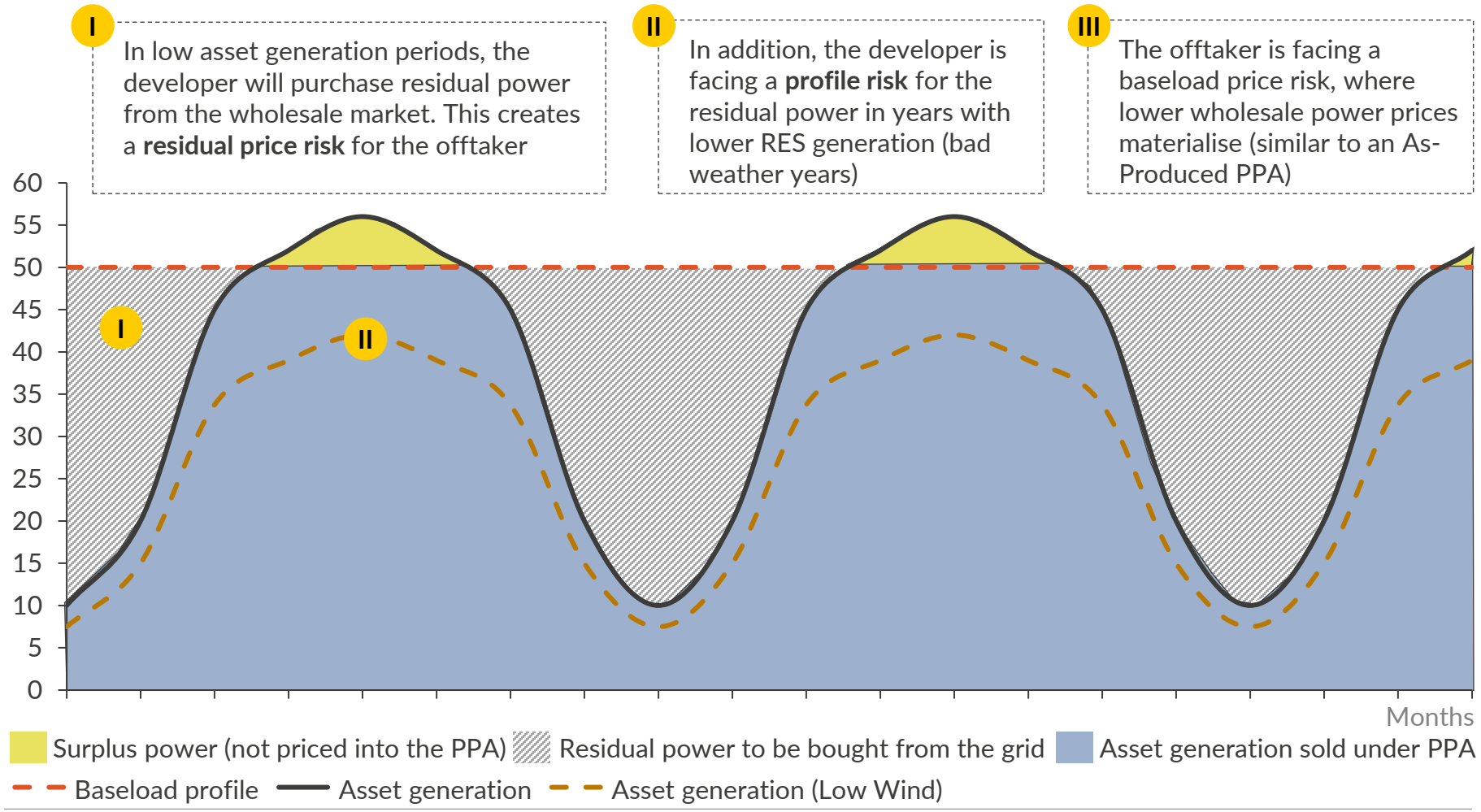
Illustrative | Baseload

Illustrative supplier generation and offtaker demand profile under a baseload PPA

MWh



Note: The Roman numerals refer to the risk/hedge items outlined on the next page of the report

Source: Aurora Energy Research

Comments

- Baseload delivery profiles are sometimes required by offtakers, e.g forelectrolysers
- The baseload profile determines the amount of residual power that needs to be procured from the spot market during any given hour
- Residual power further depends on weather patterns and availability of the asset
- Good weather means less residual power at lower market prices; bad weather means more residual power at higher market prices
- The PPA supplier needs to hedge the residual price and will therefore price the residual power price risk in
- Similar to As-Produced PPAs, the offtaker also has a price risk/hedge relative to the wholesale market development

Baseload PPA profile and price risk assumed by a developer can be partially mitigated by reducing the contracted generation or through hybridisation

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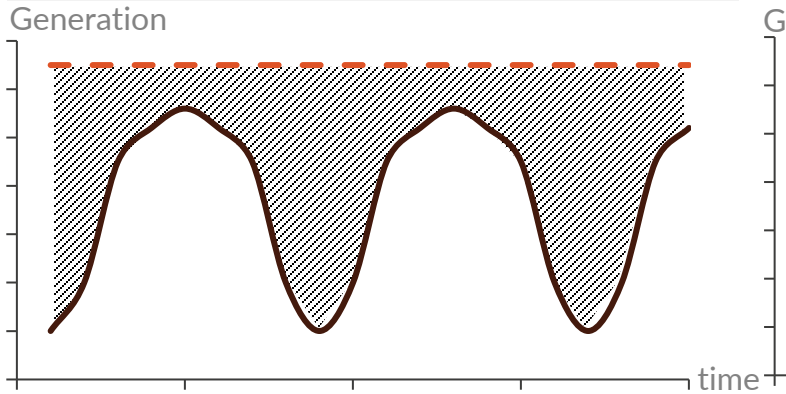
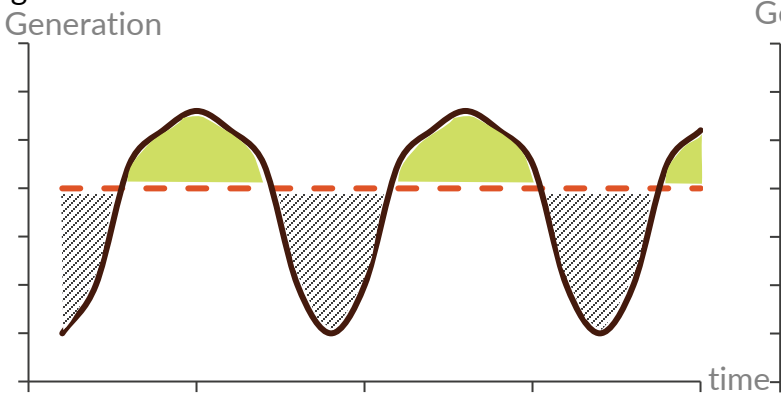
A Asset size relative to power delivery

Risk: Low asset generation vs. baseload volume

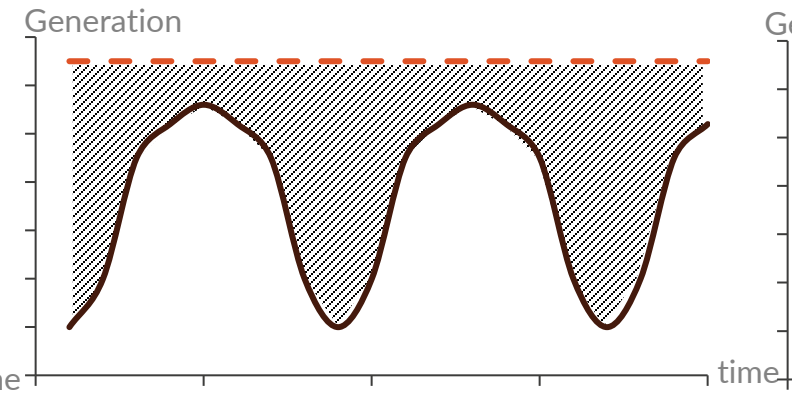


Mitigation: Contracting a percentage of asset generation vs. baseload volume

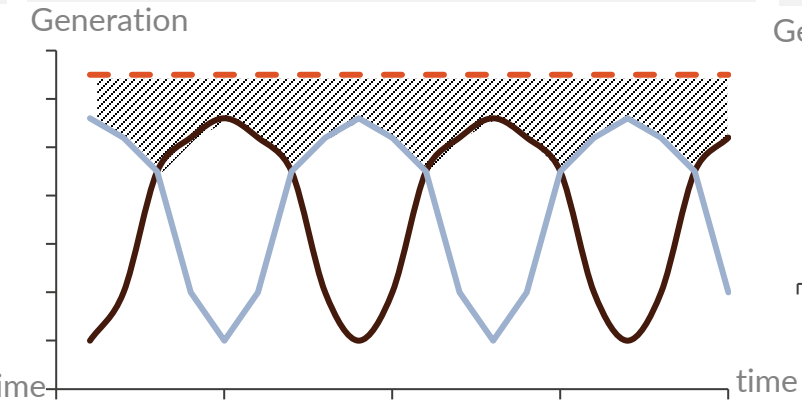


B Combination of generating assets

Risk: Low generation from single asset

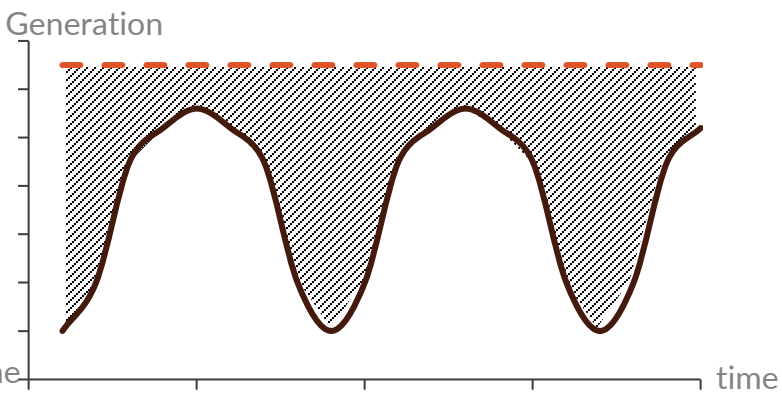


Mitigation: Generation from two assets

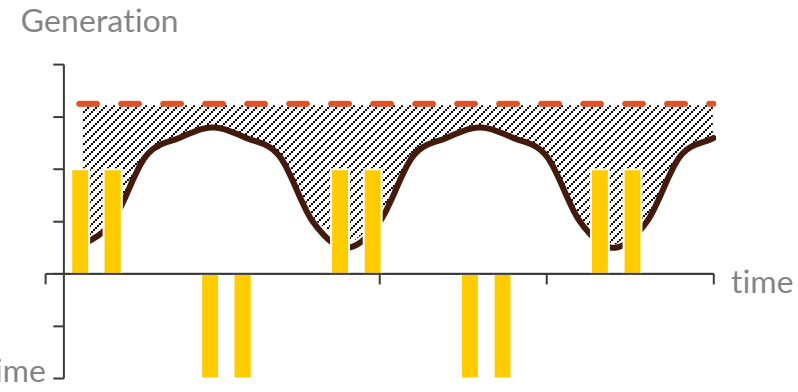


C Combination of RES assets and a battery

Risk: Low generation in a specific hour



Mitigation: Adding a battery



Residual power | Surplus power sold on the market | Baseload volume | Generation of RES asset (s) | Generation shifted | Battery charging and discharging

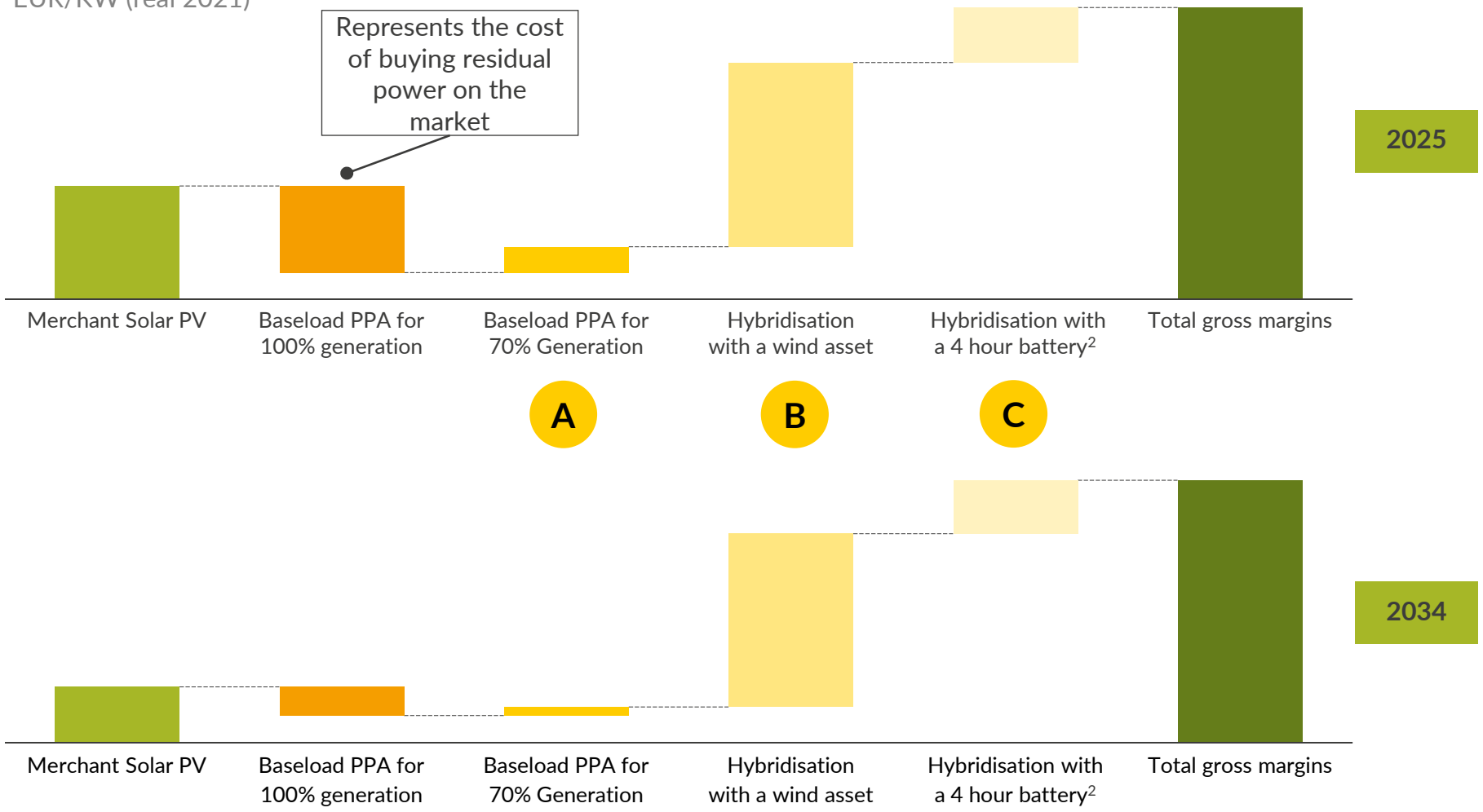
1) Depending on the market, the associated profile hedge can decrease again with a very undersized asset

Source: Aurora Energy Research

Under a Baseload PPA, the asset is subject to price risk when market prices are high, which is best mitigated by hybridisation

10-year Baseload PPA[1] gross margins per mitigation scenario

EUR/KW (real 2021)



1) Considering a PPA price of 50€/MWh under the Aurora Central scenario. 2) Considers gross margins from the Wholesale Market, Secondary Reserve and Balancing Markets (Tertiary and Replacement Reserve). Does not include Capacity Market revenues.

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- A Baseload PPA for 100% of an assets' generation results in a decrease in gross margins compared to the merchant case. This cost increases the higher the power price is compared to the PPA price
- Mitigating the price risk of a Baseload PPA by contracting a lower percentage of generation still results in an reduction of gross margins compared to the fully merchant scenario
- However, hybridisation with a wind asset substantially reduces the cost of buying residual power on the market, and therefore gross margins increase
- Adding a battery provides further mitigation, albeit on a lesser scale than hybridisation with wind

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PPAs will continue to be necessary to achieve attractive debt conditions; optimal structures will need to capture short-term upside and be bankable

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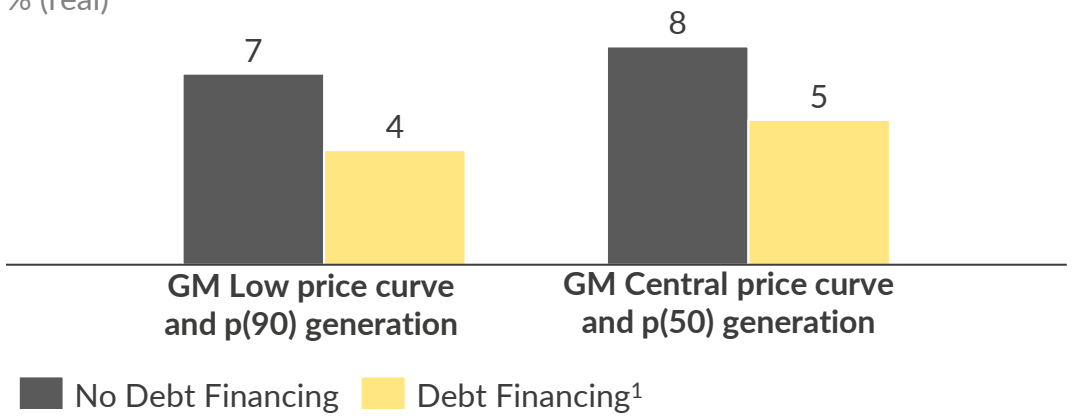
1 With current high wholesale market prices, higher profitability is achieved for fully merchant projects without Project Financing

Equity IRRs
% (real)



2 However, there is still not sufficient appetite from investors to finance large fully merchant portfolios

- Whilst some banks are willing to finance fully merchant projects, tickets tend to be smaller, and therefore more banks are involved and debt conditions are generally more conservative due to the additional negotiations required
- Large portfolios still require PPAs, both as a risk management strategy but also to get financing
- Calculating the fixed and merchant revenue mix for optimum Project Finance conditions and IRRs is key

3 Three main PPA variables that impact the debt sizing case are production contracted, tenor and price

Price
- If the PPA price is below expected wholesale market prices, then merchant projects can achieve higher returns

Tenor
- Shorter tenors are desirable if wholesale market prices are expected to be high long term

Contracted Production
- To capture the upside of high wholesale market prices, the less production contracted under a PPA, the better

4 To find the optimal PPA structure we have run various scenarios for a Solar PV project with COD in January 2024

Inputs	Optimisation	Outputs
▪ Technical asset assumptions ▪ Max leverage ▪ Max debt tenor ▪ Interest rate ▪ DSCR[2]	▪ Debt amount ▪ PPA tenor ▪ PPA price ▪ Production Covered	▪ Leverage ▪ Unlevered IRR ▪ Levered IRR

1) Levered IRR based on merchant debt financing conditions, for more detail see next slide. 2) Debt Service Coverage Ratio.

In order to evaluate the optimal PPA structure for Debt Financing, we ran three optimisation scenarios

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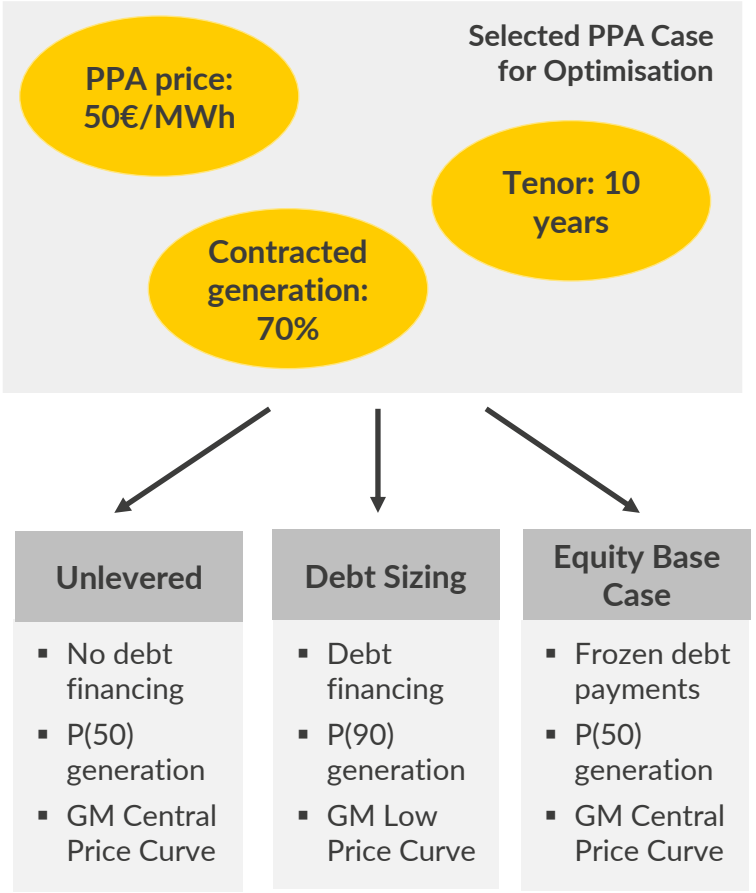
1 We assumed the following debt sizing conditions for the "Aurora Low" scenario

	Merchant	PPA[3]
Generation	P(90)	
Price Curve	GM Aurora Low	
Maximum Tenor	16	18
Maximum Leverage	65%	80%
DSCR PPA	N/A	1.15
DSCR Merchant	1.4	
Debt Margins		
Years 1-5	2.75%	1.80%
Years 6-10	3.00%	2.00%
Years 11-15	3.25%	2.20%
Years 16-18	3.50%	2.40%

2 We calculated the resulting IRRs for three optimisation scenarios



1) Commercial operations date. 2) Projections consider 1.5% annual inflation. 3) Considering an Investment Grade Offtaker.

To achieve maximum leverage, a PPA should be priced at 45€/MWh or above and have a tenor of at least 10 years

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1 Price: Whilst higher priced PPAs result in the highest profitability, PPA pricing dynamics in Iberia make this difficult to achieve

- Maximum leverage is achieved in all contracted generation scenarios where the PPA price is 45€/MWh or above
- Fundamental analysis would suggest that a PPA price of 45€/MWh or above is attainable, however, as long as the market remains oversupplied, and futures remain illiquid, this will be a challenge for developers
- In any case, there is still a regulatory risk to be considered when signing PPAs for a price above 67€/MWh, as the gas clawback would apply should it be further extended [1]

45€/MWh is the price which is required to achieve maximum leverage in the majority of the simulations run

2 Tenor: Shorter tenors may be more common in the market, but they are often not sufficient if the objective is maximising leverage

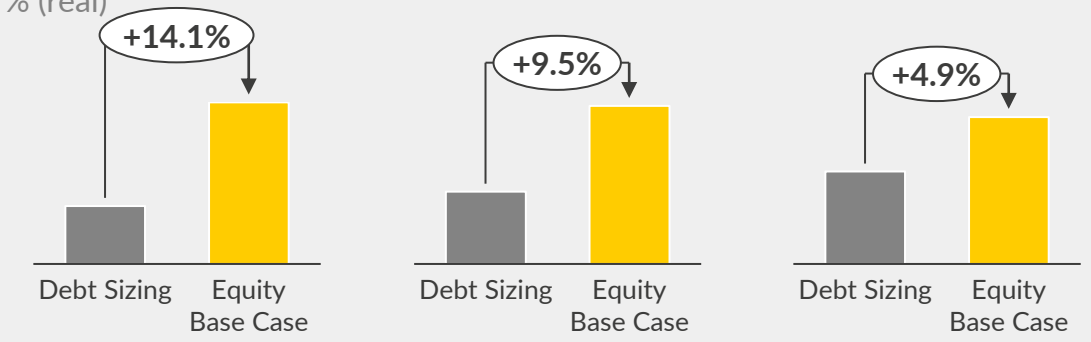
- Three year PPA tenors only result in maximum leverage if the price is 75€/MWh or above, when covering 70% of the generation. For five years the threshold is 60€/MWh
- Additionally, banks may require a minimum PPA tenor to consider financing the project with an Investment Grade offtaker structure
- Maximum leverage is achieved in all contracted generation scenarios where the tenor is 10 years or above

As the increase in IRR from 10 to 15 years in the Equity Base Case is approximately 0.1%, the optimal tenor for a 45€/MWh PPA is 10 years

3 Contracted Generation: For a 10-year PPA with a price of 45€/MWh, the optimal contracted generation will depend on market outlook

Equity IRRs for a 10-year 45€/MWh PPA

% (real)



50% contracted generation | **70% contracted generation** | **100% contracted generation**

- Covering 100% of generation only results in an 0.4% rise in IRRs, however this increases to almost 9% in the Equity Base case. Therefore, the biggest upside is achievable when hedging 50% of the asset's generation
- However, banks may require a minimum percentage of generation to be contracted in order to consider financing the project with an Investment Grade offtaker structure; this is an important negotiating point

For a 45€/MWh 10-year PPA, optimal Equity Base Case IRR is reached for the minimum percentage of contracted generation that is bankable

1) RD 18/2022 extended application until 31/12/2023.

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Key takeaways

1. There has been large growth in the number of PPAs signed in Iberia; Spain has seen the highest increase whilst Portugal has been affected by the uncertainty surrounding the clawback generation tax over recent years. The market in Spain is oversupplied on the generation side, whilst creditworthy offtakers are scarce on the demand side, applying downward pressure on PPA prices.

2. The additional price risk for developers is priced into a Baseload PPA, as it is necessary to buy power on the wholesale market if the Baseload requirement is not met by the asset's generation. This risk is best mitigated by the hybridisation of assets, especially the hybridisation of a solar PV asset with a wind asset.

3. The optimal contracted production of a PPA depends on the future perspective for wholesale market prices. In the Equity Base Case, the highest IRRs are achieved when a lower percentage of generation is contracted; however, the opposite is true for the Debt Sizing case, as less merchant exposure is desirable from a lender's perspective to protect against lower wholesale market prices.

Sources: Aurora Energy Research

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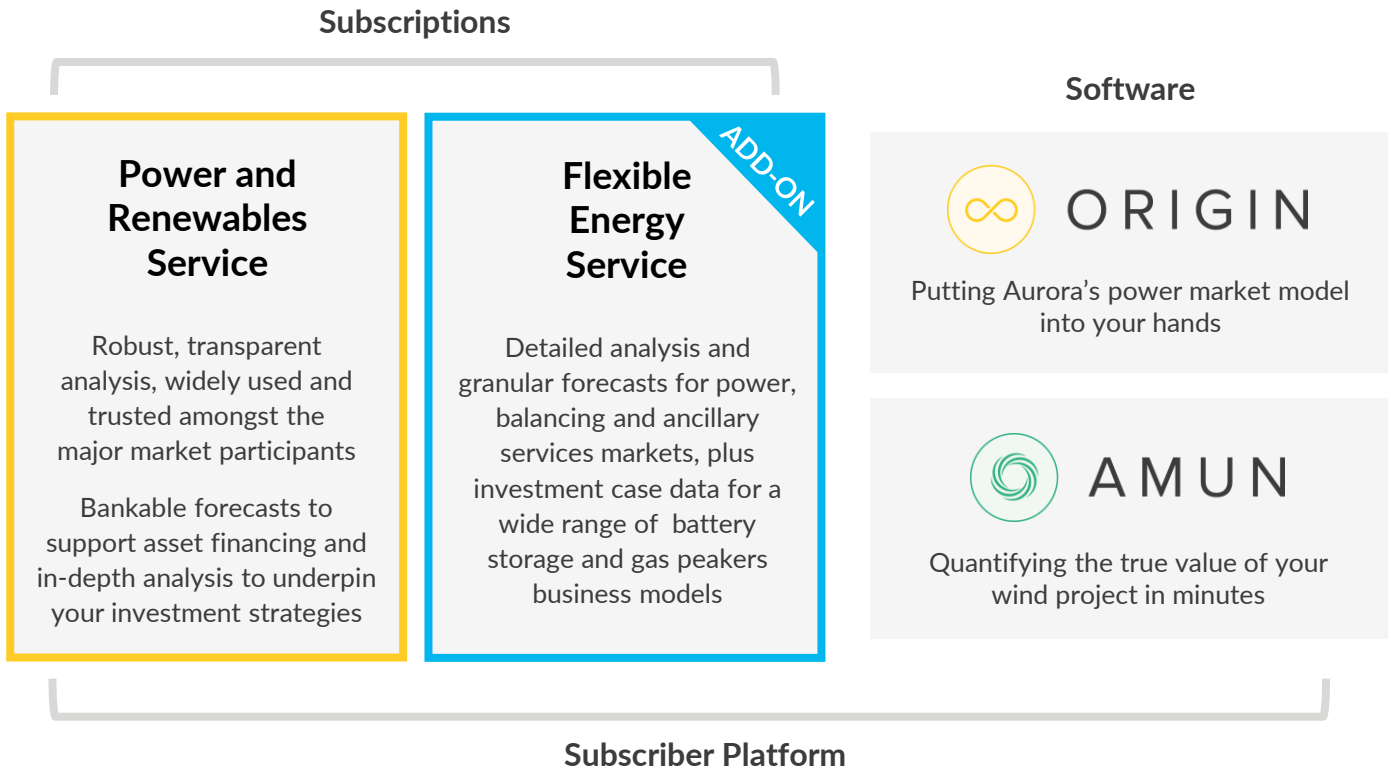

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