

The Future of PPAs in Poland

Public Report







Lumus, Aurora's transaction-proven PPA pricing engine, empowers you to benchmark, price, and analyse PPAs

Trusted approach: Powered by Aurora's pricing methodology, relied upon in PPA negotiations, transactions, and portfolio valuations across 15+ markets to date

Real-time pricing: Blends short-term market data into Aurora's long-term market outlook, keeping your PPA pricing up-to-date with market movements

At the market's pulse: Continuously calibrated with current PPA price quotes from the market, backed by insights from our on-the-ground market experts

No "black box": Provides a detailed price breakdown from a utility offtaker's perspective, factoring in volume and price-related risks

The Early Adopter Programme is available for the Polish market.





What can Lumus be used for?



Price **Benchmarking**



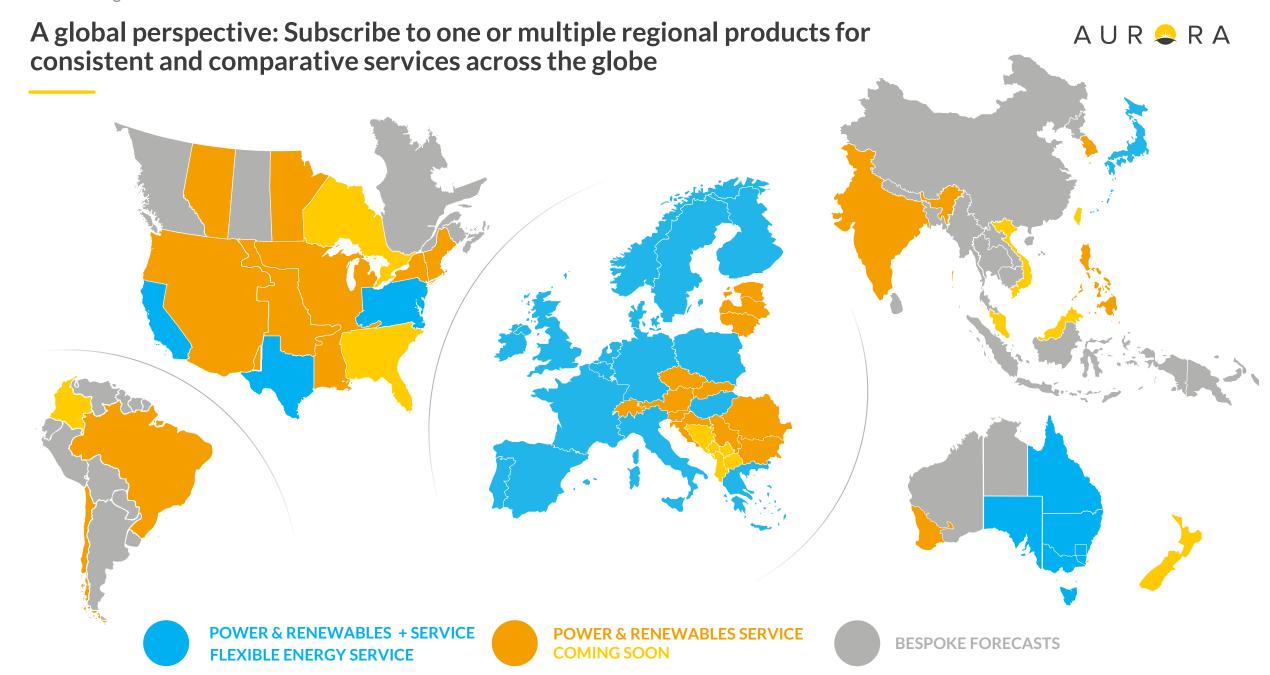
Transaction Due Diligence



Contract **Negotiation**



Asset Valuation





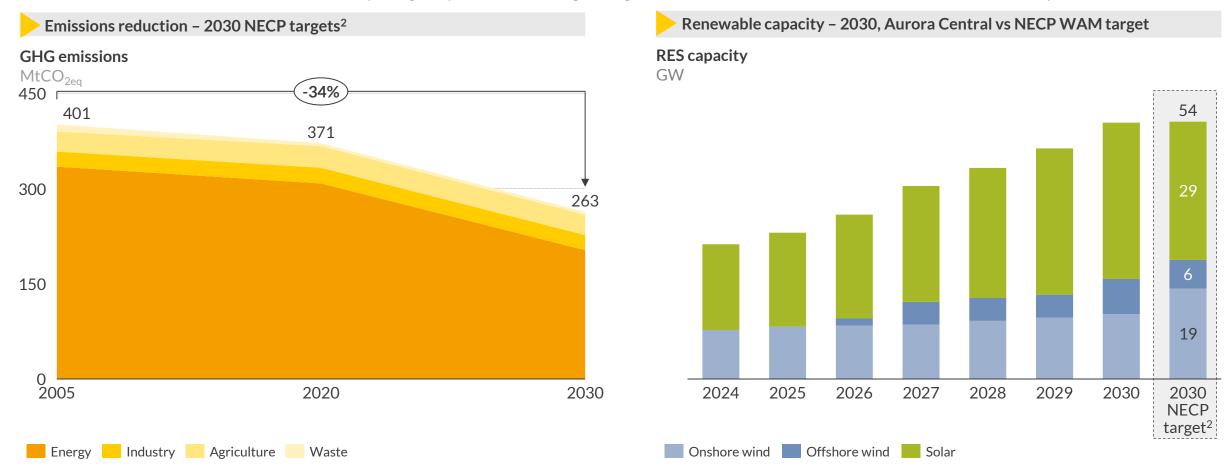
- I. <u>Introduction Routes to Market</u>
- II. PPAs in the European Context
- III. PPA Supply and Demand in Poland
- IV. <u>Projections on PPA Valuations</u>
- V. Additional Analysis on Project Economics
- VI. Key Takeaways

To discuss this report further, and to learn more about our offering in the Polish Power Market, get in touch!

By 2030, an additional 26GW of renewables are likely to enter the Polish power system, totalling at 54GW renewable capacity



- The Polish government presented a NECP update, including an ambitious scenario With Additional Measures (WAM), which supplemented the base scenario With Existing Measures (WEM).
- The WAM scenario accounts for the **Fit for 55**¹ package requirements, leading to a significant reduction in emissions and increase in renewable capacities.



¹⁾ Fit for 55 is the EU's legislative package aimed at reducing greenhouse gas emissions by 55% by 2030 (comparing to 1990). 2) Updated NECP targets for 2030 as submitted to the European Commission in October 2024.

Sources: Aurora Energy Research, revised NECP (Oct '24)

New renewable assets entering between 2025-2030 will have three routes to market to choose from or combine





RES subsidy schemes

- CfD support schemes which provide a fixed price for 15 years.
- RES support schemes have been the main route to market in Poland for solar and wind plants



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



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

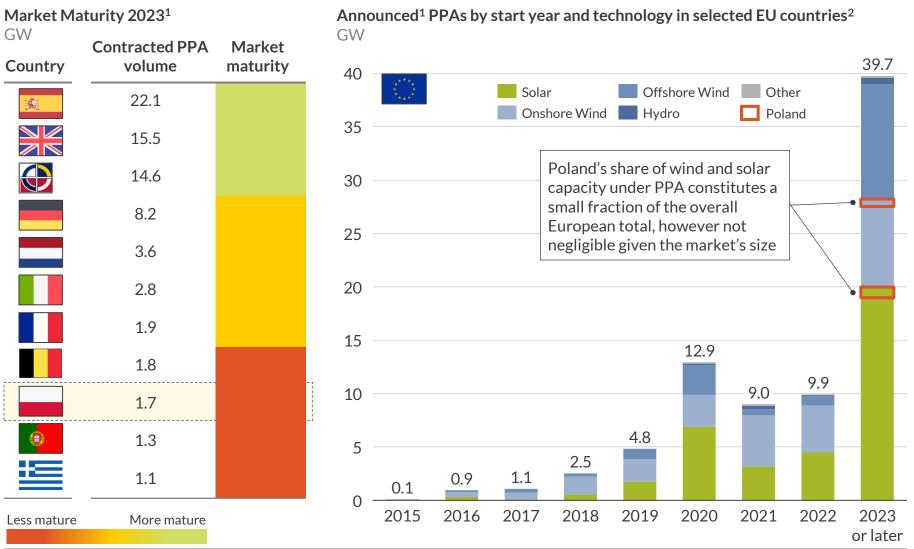
Financing/Risk (Financing/Risk (Financing/Risk - Banks consider significant profile risk remaining Polish banks have not yet financed a fully Subject to significant counterparty risk under CfD, especially for solar plants merchant project Profile risk dependent on the type of PPA Difficulty entering the market Difficulty entering the market Difficulty entering the market (Auctions are available for all assets with grid Apart from licensing and grid connection, the Such projects need trading desks or aggregators connections but can be highly competitive suitable off-taker needs to be identified Potential revenues Potential revenues Potential revenues - The competitive auctions result in low strike - Given our forecast, merchant assets have the PPA revenues are forecasted to be between the prices and therefore lower absolute revenues highest IRRs due to high wholesale prices subsidised and merchant equivalents



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The PPA market in Poland is less mature than many other markets in Europe, despite operating for 5 years



Comment

- Despite instances of PPAs appearing in 2019, Poland is one of the least mature PPA markets in Europe.
- The European PPA markets for both wind and solar have grown rapidly in recent years, and there is growth potential for these technologies in Poland.
- The Polish PPA market has faced hurdles in both the development of renewable assets like:
 - the 10H rule for onshore wind
 - grid constraints for solar assets

and PPA demand growth like:

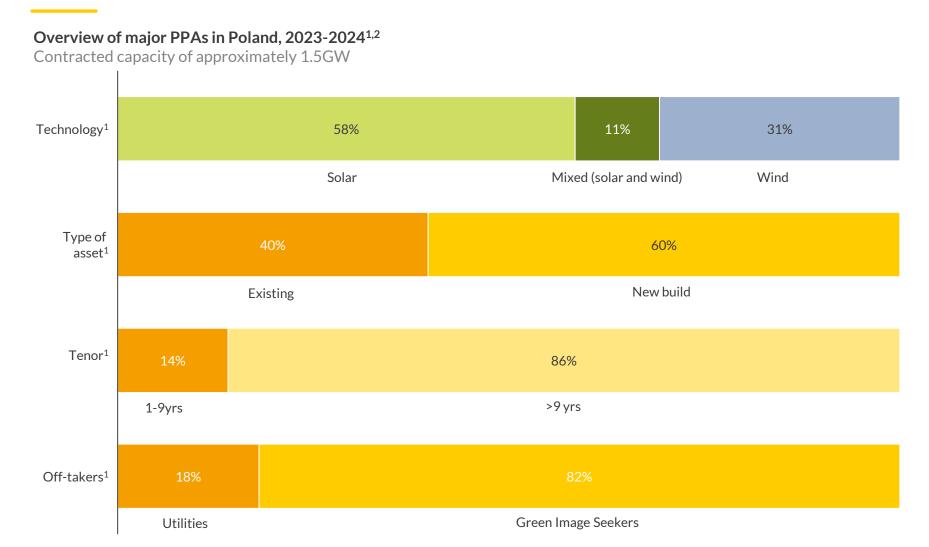
- low numbers of creditworthy offtakers
- low utility participation in PPA markets.

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¹⁾ As of October 2023. 2) Countries in scope: Germany, Nordics (Denmark, Finland, Norway, Sweden), Great Britain, Spain, France, Portugal, Netherlands, Italy, Belgium, Poland, Greece

However, the rapid expansion of solar projects has kicked-started the Polish PPA market with 1.5GW of PPAs signed in the last 2 years





What changes in 2025:

Zoning and permitting changes:

- As of January 1st, the liberalisation of onshore wind distancing rules is expected to come into force³ removing one of the major factors hindering onshore wind projects.
- Wind farms will be able to leverage a simplified planning procedure⁴, facilitating the administrative process. The procedure can be financed by the developer as part of an urban planning agreement.
- Poland plans to introduce Areas of Increased RES Development, where the permitting process would be streamlined and take no more than 12 months.

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¹⁾ Weighted by capacity for all categories. 2) Excluding route-to-market. 3) The liberalisation of onshore distancing rules is expected to be voted on still in Q4 2024 and requires a presidential signature to complete the process. 4) Zintegrowane Plany Inwestycyjne (ZPI).



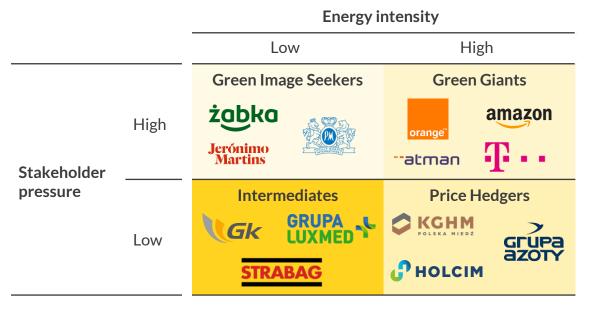
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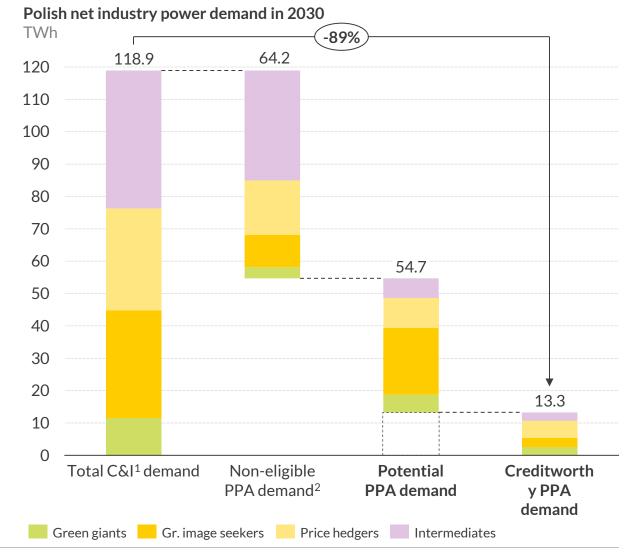


Decarbonisation ambitions could lead to 54.7TWh of potential corporate $A \cup R \Leftrightarrow R A$ PPA demand by 2030, of which 24% is considered creditworthy

Potential corporate PPA off-takers in Poland



- Green Giants: Fast rising power demand and strong pressure from consumers/lenders/regulators requires green power for business expansion
- Green Image Seekers: Sell to end consumers and therefore focus on Corporate Social Responsibility
- Price Hedgers: Energy intensive industry that competes on price of endproducts and shows increasing interest for fixing prices long-term
- Intermediates: Relatively low pressure to decarbonise, power market not part of the core business



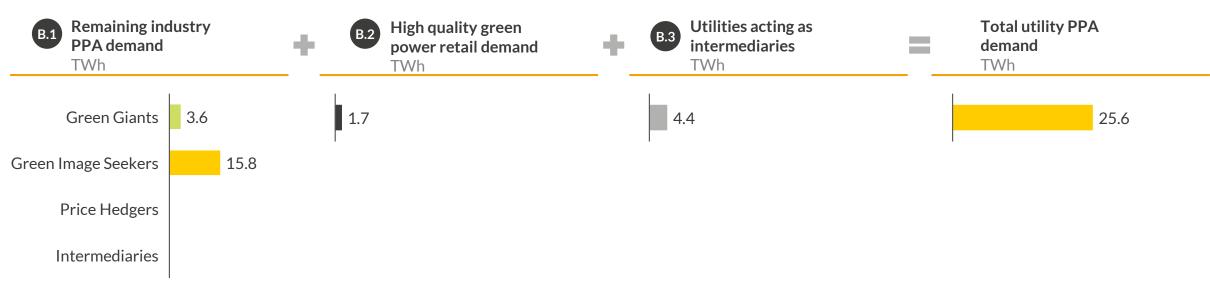
Sources: Aurora Energy Research, Eurostat, RE100

¹⁾ Commercial and industrial demand. 2) Non-eligible demand after filtering for PPA ambition. Analysis on next slide.



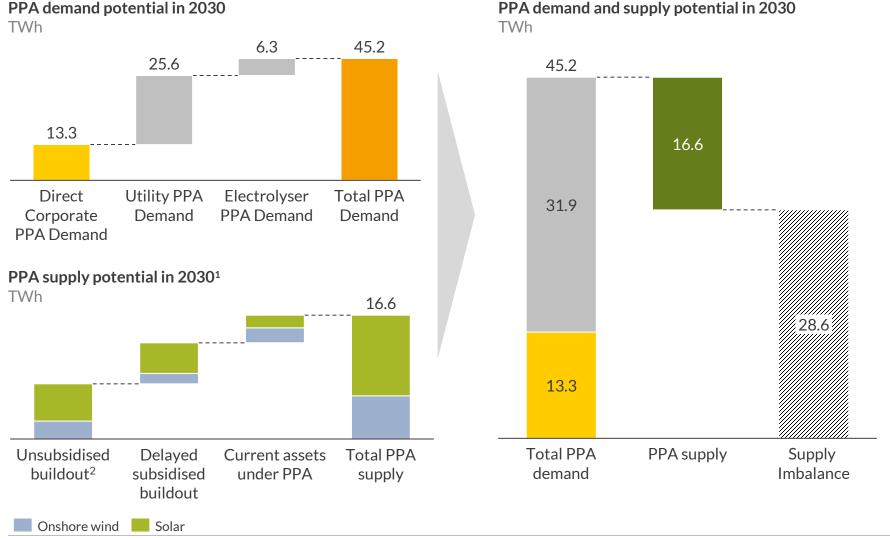
PPA demand coming from utilities is expected to be 25.6TWh in 2030, with most of the demand coming from large Polish utilities





- We assume that 80% of noncreditworthy demand from green giants and green image seekers could be satisfied through utilities.
- We assume that 5% of residential power demand (approximately 35TWh in 2030) is willing to pay in their tariffs an extra-cost to contract green energy through PPAs.
- Additionally, we expect utilities to handle 25% of the calculated TWh creditworthy corporate demand
 - We reduce direct corporate PPA demand by this amount.
- This stems from companies that want to decarbonise via PPAs and have the credit rating to do so but are not willing or able to manage the risk themselves.
- With 26TWh, PPA demand from utilities makes up for almost 50% of the total expected PPA demand in 2030.
- Large portion of the demand will need to be covered by domestic DSOs¹, therefore this volume depends on them.

The Polish PPA market is likely to be undersupplied as long as Polish utilities and electrolysers enter the market



Comments

- Current market dynamics indicate a significant supply and demand imbalance in the future PPA market, but this is dependent on whether utilities participate in the PPA market and on the speed with which electrolyser projects develop.
- The largest component of PPA demand originates from utilities, accounting for 25.6TWh.
 However, electrolyser demand could become a growth vector post-2030.
- Direct corporate PPAs are a potential steady source of 13.3TWh of demand.
- In comparison, the PPA supply is expected to be around 16.6TWh
 most of it stemming from solar PV which represents over 65%.

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¹⁾ Assuming standard load factors for solar and onshore wind. 2) Unsubsidised buildout includes both new assets and existing PPA assets with contracts that terminate before 2030.



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Fixed-price long-term PPAs following a pay-as-produced pattern are most desirable for sellers

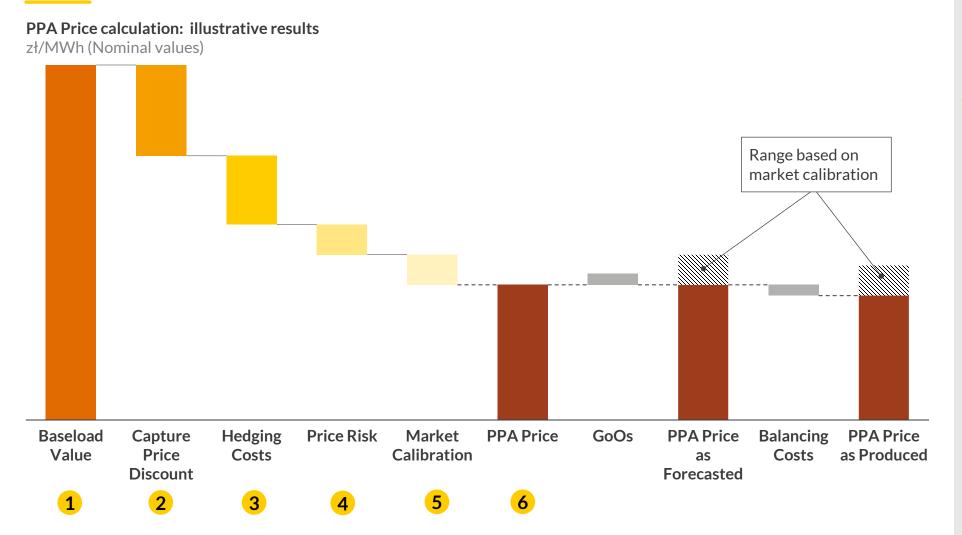


		Who holds the risk?	
Commercial clause	Description	Seller	Offtaker
Price clauses _			
Fixed price	Fixed long-term price, offtaker takes on full price risk		村
Collared	Price follows capture price, contract guarantees a max/min price	竹	
Floating/Indexed price	Price linked to baseload index, offtaker only takes on capture price cannibalisation risk	竹	
Tenor clauses			
Short term (<=5 years)	Suitable if no debt financing required or secured differently (e.g. via CfD)	村	
Medium term (6 - 9 years)	Allows debt financing for smaller merchant projects with low leverage	শ	
Long term (>9 years)	Allows for highly debt-leveraged finance		竹
Volume clauses			
Baseload	Asset delivers power at a pre-agreed fixed pattern	竹	
Monthly % of P90	Asset(s) guarantees minimum pattern	竹	
As produced / as forecasted	Offtaker receives asset generation profile		竹

<u>Seller's perspective</u> – desired clauses

- Sufficient creditworthiness of the counterparty.
- No/low penalties for COD delays.
- No/low availability requirements.
- Balancing costs carried by the offtaker (in case of a physical PPA).
- Option of self-defined economic curtailment.
- High penalties for breaking the contract.

PPA prices are determined by the expected baseload prices, capture price discount as well as hedging costs and various other risks





- 1 Expected revenues from the sale of a baseload profile.
- 2 Difference in value of assetspecific generation profile vs. baseload profile, including weather-driven deviations from the expected asset profile.
- 3 Expected costs of hedging the generation profile on the futures market (stack-and-roll strategy).
- 4 Risk discount reflecting the uncertainty in realising the expected baseload price, based on alternative price scenarios and offtaker's risk aversion level.
- 5 Risk discount/upside reflecting risk factors not explicitly priced into previously-mentioned risk factors, calibrated based on PPA price quotes from the market.
- 6 PPA Price result (excl. GoOs¹ and balancing cost).

¹⁾ Guarantees of Origin



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In the short term, merchant revenues remain higher than CfD guaranteed remuneration and pay-as-produced PPA revenues

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PPA projects profitability is assessed against current alternative routes to market for renewables, namely participation in the previous subsidy schemes and a fully merchant route to market.



 Aurora's capture price projections were used for calculating the revenue streams



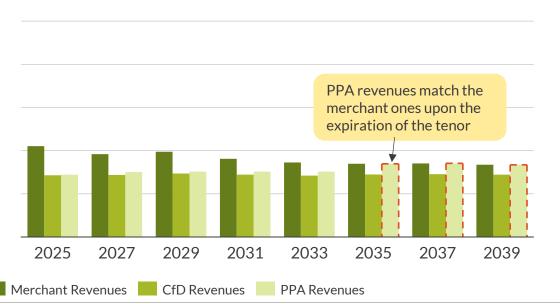
Average strike price of the last tender¹



Based on Aurora's fair price calculations

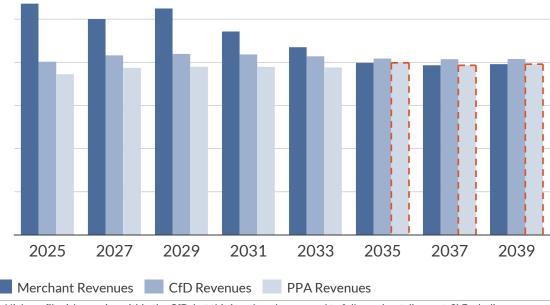
Solar PV revenues in Poland, 10-year tenor COD 2025

k zł/MW (real 2023)



Onshore wind revenues in Poland, 10-year tenor COD 2025

k zł/MW (real 2023)



¹⁾ The CfD payment is calculated as the difference between the CfD auction strike price and the average daily day ahead market (DAM) price. High profile risk remains within the CfD, but this is reduced compared to full merchant discount. 2) Excluding imbalance costs and GoOs.

Optimizing CfD reporting boosts revenue potential, combining it with a short PPA would provide stability during the high price period

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Unoptimised 50% CfD schedule

The Polish CfD scheme contracts volume generated...

- Volume contracted is usually increased towards later years to hedge against long-term uncertainty.
- In the initial years, operators aim to leverage the period of high prices and increase merchant exposure.

Reporting-optimised 50% CfD schedule

...which can be allocated retrospectively...

- Selecting the most optimal hours allocated under the CfD scheme has significant revenueboosting potential.
- Polish CfD allows for the underdelivery of up to 15% of the contracted volume without incurring penalties.

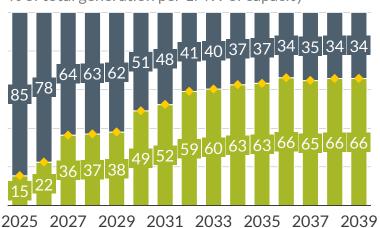
PPA-CfD blended schedule

... and revised to accommodate a shortterm PPA

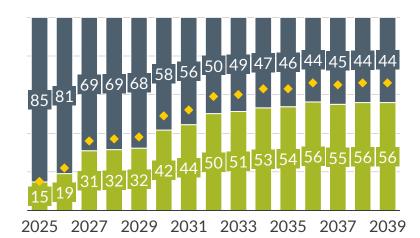
- Short-term high merchant exposure may make it difficult to secure project financing.
- Securing a short-term PPA provides an opportunity to finance the project under better conditions.

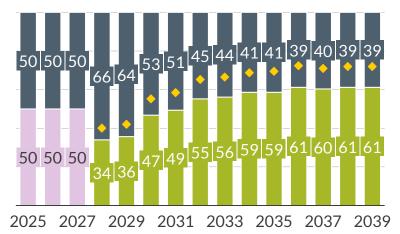
Exemplary CfD schedules for a 50% contracted volume

% of total generation per 1MW of capacity



Merchant generation CfD generation 🔶 CfD commitment 🔲 PPA





Key takeaways

- The majority of current PPAs in Poland pertain to newly constructed solar PV plants and typically span over 10 years. New onshore wind PPAs have been slower to enter as the project pipeline is still significantly hampered by the 700-meter rule and continued permitting burdens.
- As we approach 2030, we anticipate that the Polish PPA market will be significantly undersupplied if utility and electrolyser demand increases as expected. If direct corporate demand remains the only offtake for PPAs, the PPA market will start to face oversupply.
- PPAs on the Polish market are currently primarily fixed price pay as produce contracts with long tenors. But PPA market development may lead to a growing number of more complex contracts like collared or floating/index priced PPAs.
- The most beneficial routes to market differ between onshore wind and solar PV. For onshore wind, the CfD scheme offers significantly higher revenues than PPAs as they do not suffer from inflationary risks. Solar PV sees higher revenues from PPA contracts as the CfD scheme exposes solar to significant cannibalization risks.
- The RES support scheme in Poland is well suited to be combined with PPAs or merchant exposure. Strategies that combine subsidies with an increased degree of merchant exposure, especially in the next few years, enhance project profitability. For example, adding a short-term PPA to an optimized CfD with 50% of contracted volume, can help capture merchant upsides but ensure revenue certainty.

Polish Power & Renewables Service:



Dive into key market analysis and forecasts for the Polish power and renewables markets

Power & Renewables Service

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Biannual forecast reports with quarterly data updates

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- Data under Central, Low, High, and Net Zero Scenarios
- Quarterly updates to reflect near term commodity price changes
- Capacity development, generation mix, interconnector capacity, capacity buildout, and exports
- Capture prices and evaluation of profile risk remaining within CfD for wind and PV
- Utilisation rates of key thermal technologies along different efficiencies
- Capacity market clearing price forecast and entries delivered by the mechanism by technology
- EU-ETS carbon price forecasts
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Analyst Support

Biannual workshops and support from our bank of analysts, including native speakers and on-the-ground experts



Details and disclaimer

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