THiNK

RENEWABLE ENERGY PROCUREMENT IN GERMANY

February 2023

Introduction

Aim / Structure of the Study

This Study was developed by Think RE GmbH for investigating the structure of the renewable energy market in Germany and to investigate economically feasible solutions to decarbonize the corporate Scope 2 footprint. Therefore, the document is divided in five chapters without registers and appendix.

In Chap. 1, the German electricity market is described with regards to generation mix, geographic distribution of RE assets and RE development scenarios.

Chap. 2 covers the electricity market design in Germany. This chapter provides an overview of major market players in the German PPA market and systematizes them according to various criteria. An overview of the availability of post EEG plants in the forthcoming years is also given.

Chap. 3 describes important regulations of the German renewable energy market. The focus here is to describe the issuance, transfer, and the cancellation of guarantees of origin to document the corporate decarbonization progress. An important aspect of the German GoO regulation – the double marketing ban – is also covered.

Chap. 4 introduces power purchase agreements (PPAs) as an alternative contract type to the existing standard utility products. PPAs are medium- to long-term contracts between a renewable energy (RE) asset owner and a corporate end-consumer which can be structured as a physical RE supply contract as well as a financial hedge (so-called Virtual PPA) which serves as an add-on to the existing procurement structure of a corporate.

Finally, Chap. 5 focuses on the development of the levelized cost of electricity for different renewable energy technologies in Germany and analyses components of PPA prices.

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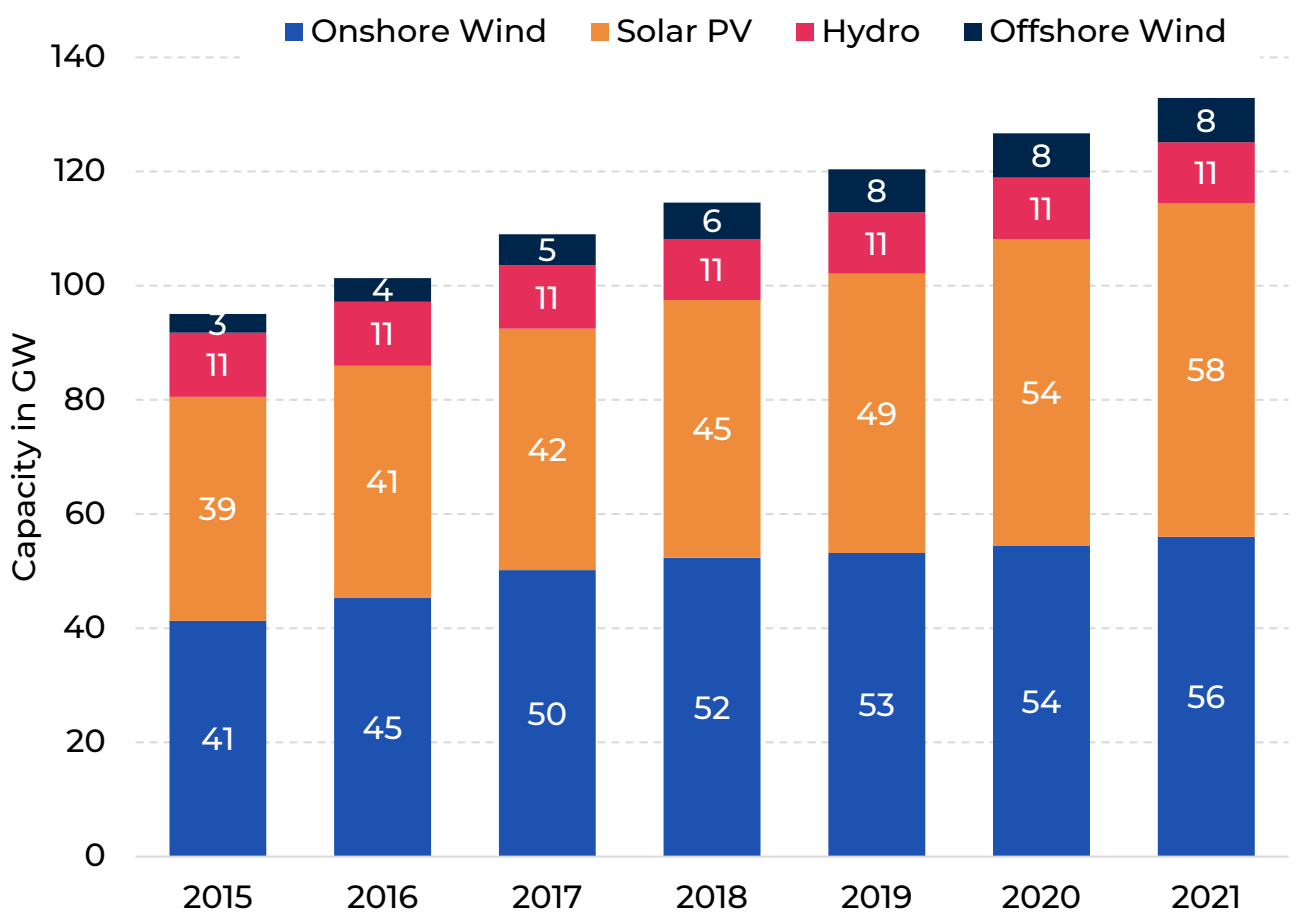
INVESTIGATING THE GERMAN RENEWABLE ENERGY MARKET

Agenda

1. GENERAL MARKET OVERVIEW

Generation Mix

RE Capacity Development



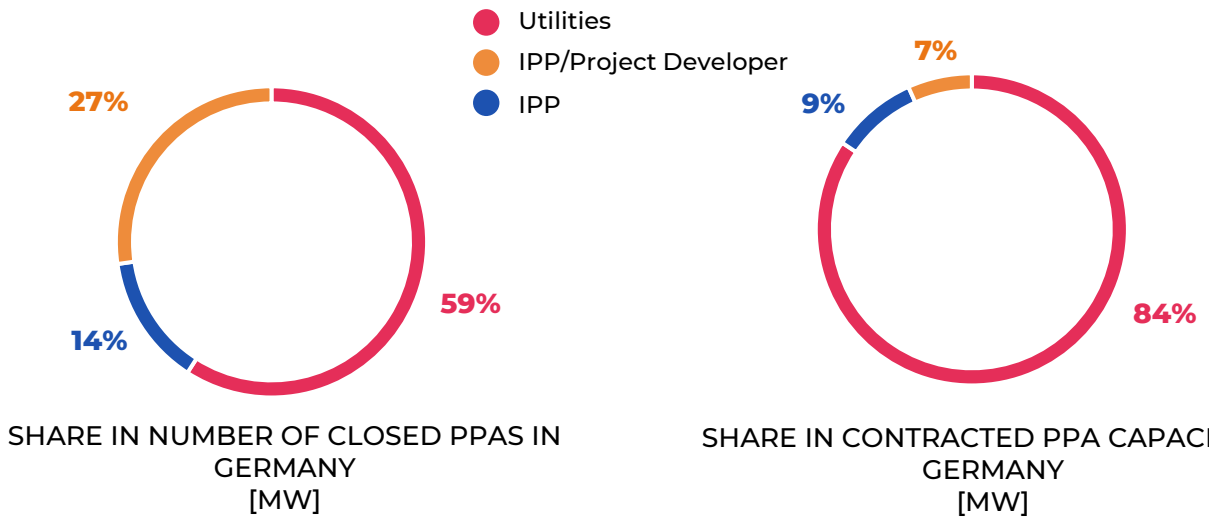
- The Renewable Energy Sources Act (EEG) has contributed significantly to this rapid growth in RE capacities. In 2021, photovoltaic systems with a capacity of 4 gigawatts were added. The total installed photovoltaic capacity in Germany thus rose to 58 gigawatts, with photovoltaics overtaking onshore wind power (56.1 GW) at the end of the year. This is mainly due to the faster approval and installation processes for solar energy compared to wind energy. Given the current supply chain conditions and disruptions, we expect this trend to intensify in the future. However, if offshore and onshore wind energy are counted together, wind still was the most important green energy resource in Germany in 2021, measured by the installed capacity of 64 GW as well as the actual electricity production of 122 TWh.
- As shown on slide 23, in 2020 and 2021 a total of around 6.6 GW of onshore wind capacity will be phased out of the EEG because the subsidy period has expired. Measured against the total installed onshore wind capacity of 56 GW in 2021, post-EEG installations thus account for a share of around 12 % of the total market.

Source: IRENA (2022).

2. ELECTRICITY MARKET DESIGN

Market Players

Systematization of PPA Sellers (3/5)



SHARE IN NUMBER OF CLOSED PPAS IN GERMANY [MW]

SHARE IN CONTRACTED PPA CAPACITY IN GERMANY [MW]

- The slide shows completed and publicly announced PPAs in Germany and the institutional belonging of the sellers. In the German PPA market, project developers and IPPs are underrepresented compared to utilities due to the attractive EEG subsidy.
- However, due to the high electricity price level on the energy market, intermediaries in particular, such as municipal utilities, are affected by liquidity bottlenecks and payment difficulties due to the increased margin calls to hedge their energy purchases on the wholesale market. From the buyer's perspective, the attractiveness of IPPs and project developers as contracting parties in a PPA is therefore increasing.

SELLER	INSTITUTIONAL TYPE	CONTRACTED PPA CAPACITY GERMANY [MW]
Statkraft	Utility	408
Engie	Utility	312
Orsted A/S	Utility	250
EnBW	Utility	233
RWE Innogy	Utility	176
Luxcara	IPP	172
Enerparc AG	IPP/Project Developer	84
Vattenfall	Utility	70
Energiekontor	Utility	70
Verbund AG	Utility	50
ANE Energy	Utility	21
Getec Energie	Utility	20
MaxSolar GmbH	IPP/Project Developer	10
CEE Group	IPP/Project Developer	10
BayWa r.e.	IPP/Project Developer	9
European Energy	IPP/Project Developer	8
GP Joule	IPP/Project Developer	7
Axpo	Utility	5
Sunnic Lighthouse	Utility	5
Energy Air GmbH	IPP	Not reportet

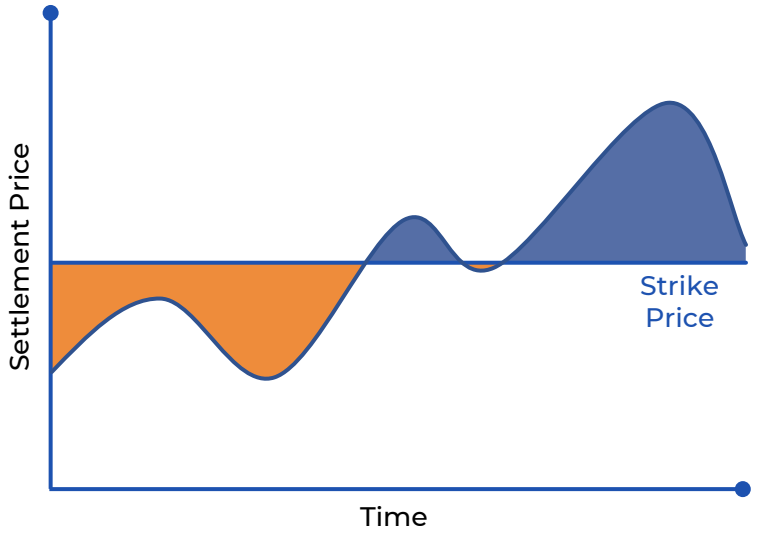
Source: Think RE (2022).

4. POWER PURCHASE AGREEMENT MARKETS

PPA Pricing Structures

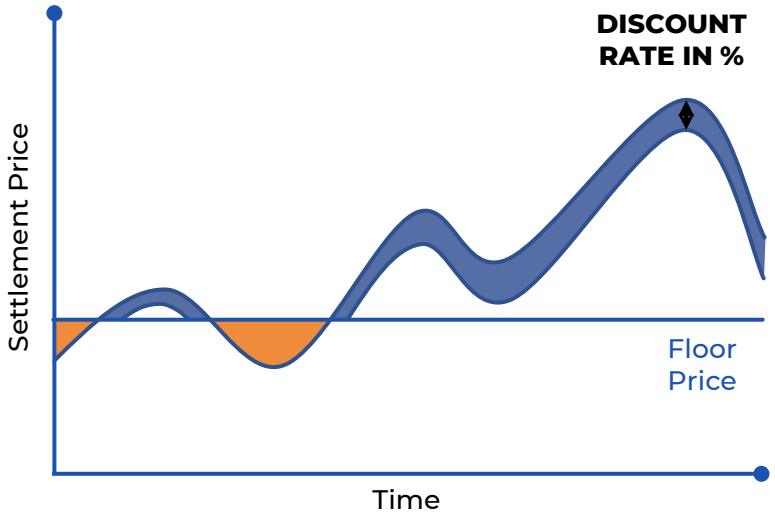
Overview

FIXED FOR FLOATING PPA



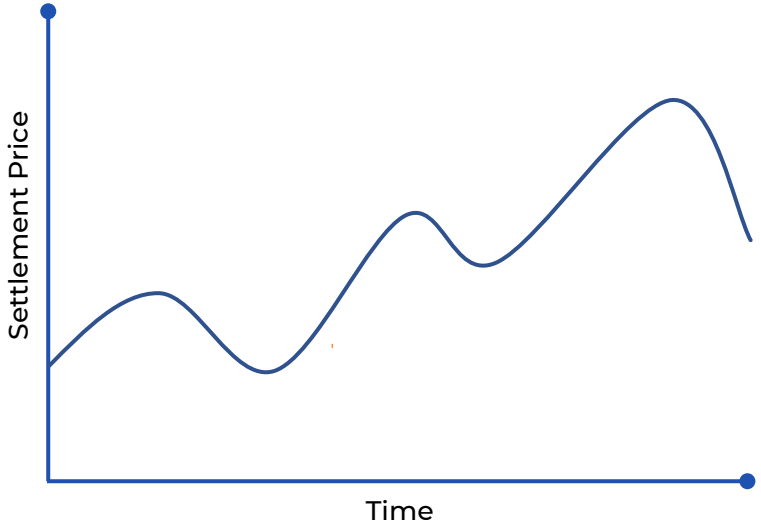
A CfD/Fixed for Floating PPA provides the highest level of revenue security and is therefore the most attractive option from a lender's point of view. The strike price is usually higher than the floor price in a market following PPA.

MARKET FOLLOWING PPA



Market Following PPAs increase the chance for sellers to benefit from increasing market prices while reducing the payment risk for buyers. However, the floor price is usually lower than the strike price agreed in the CfD, meaning less revenue certainty from the lender's point of view.

MERCHANT PPA



Selling the electricity output at variable market prices ("full merchant") at an electricity exchange exposes the SPV completely to market price risk. Due to the volatility of electricity prices, this sales strategy is considered as being risky by potential lenders, so that debt financing becomes hard to obtain.

Source: Think RE (2022).