wbcsd

Pricing structures for corporate renewable PPAs

Contents

1 Introduction

1 Introduction

Interest in corporate renewable power purchase agreements (PPAs) has grown exponentially in recent years.

Corporate renewable PPAs enable companies to increase the visibility of their future electricity costs, while simultaneously making progress on carbon reduction goals. For an introduction to corporate renewable PPAs, see the WBCSD Corporate Renewable Power Purchase Agreements: Scaling up globally report. All WBCSD resources on PPAs are also available on our website.

In 2020, the COVID-19 pandemic suppressed wholesale electricity prices in many markets. While prices have recovered in many markets, forecasters predict a lasting medium-term impact to at least 2023 in a few other markets. Despite this, corporate renewable PPAs have continued to show strong growth, as signed capacity in 2020 climbed 18% to reach 23.7 GW (compared to 20.1 GW in 2019).[1]

The objective of this report is to provide an outline of different pricing structures (such as fixed, discount to market, hybrid and their sub-options) and provide commentary on risk impacts, regional variations and settlement considerations to help corporate buyers understand the potential options available to them.

Note that this report is focused on more standard pay-as-produced volume arrangements, with WBCSD's Innovation in Power Purchase Agreement Structures publication covering issues related to volume and shape risk, mitigated by baseload/firmed PPA structures.

In 2020, fixed-price structures remained the norm for corporate renewable PPAs; however, some corporate buyers are showing increasing interest in alternative pricing structures for PPAs, primarily due to fluctuating wholesale power prices and the expectation for further price cannibalization of wind and solar capture prices as a result of increased renewable penetration.

To mitigate initial negative cashflows (relative to depressed wholesale prices) some corporate buyers are opting for stepped pricing, fixed pricing with escalation or fixed pricing with indexation as opposed to fixed (no inflation) price arrangements. Also, some corporate buyers are increasingly favoring discount-to-market and hybrid structures, as well as cap-and-floor add-ons.

As PPAs continue to grow in popularity, we are observing a greater variety of structures to reflect the balance of risks and benefits between parties in different geographies.

[1] Source: BloombergNEF

If anything, the impact of COVID-19 has made PPA pricing structures more complicated as the contracting parties adapt to an increasingly volatile environment. Notwithstanding the above, we expect variants in fixed-price structures to remain the most common structures moving forward, as these enable the greatest bankability for power producers.

We have written this report for the most part from the corporate buyer's perspective, as we expect its main users to be electricity buyers. The content is for general informational purposes only and we do not intend for readers to rely on it for accounting, tax, legal or other professional advice. It is meant for corporate buyers to better understand the introductory concepts before receiving professional advice on their applicability to individual projects.

The report begins with an overview of pricing structures and their impact on risk for each stakeholder in chapters 2 and 3. Chapter 4 addresses regional variations; chapter 5 outlines common buyer and power producer considerations; and chapter 6 examines settlement considerations impacting PPA pricing. The report concludes with an outlook on trends for PPA pricing structures in 2021 and beyond.

2

Overview of PPA pricing structures

2 Overview of PPA pricing structures

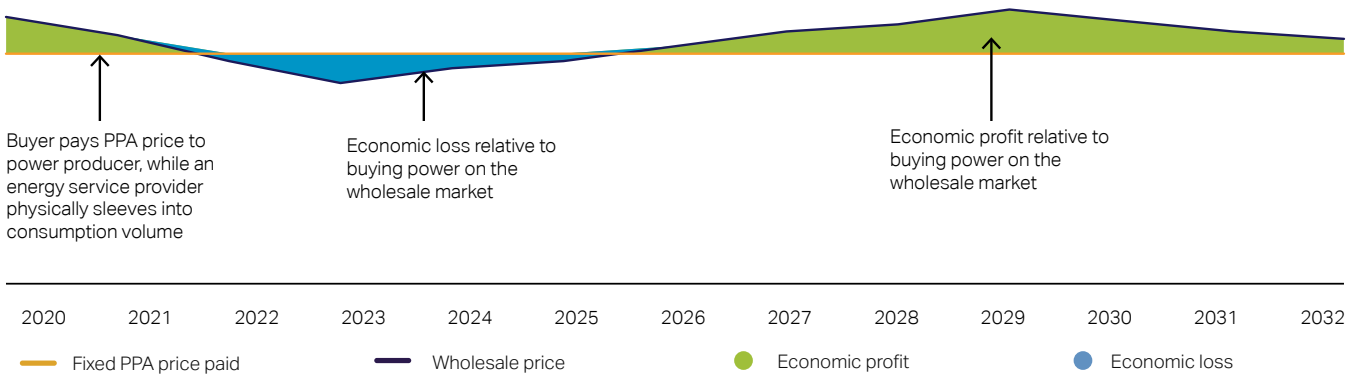
2.1. Introduction to physical & virtual PPA models

Figures 1 and 2 include a brief primer on physical and virtual PPAs. For those unfamiliar with PPAs, we suggest first reading the WBCSD Corporate Renewable Power Purchase Agreements: Scaling up globally report and the Innovation in Power Purchase Agreement Structures report.

Both diagrams take the example of fixed-price PPAs for simplicity. Note that both structures give the power producer the revenue certainty needed to finance the project, thereby ensuring the "additionality" of new projects.

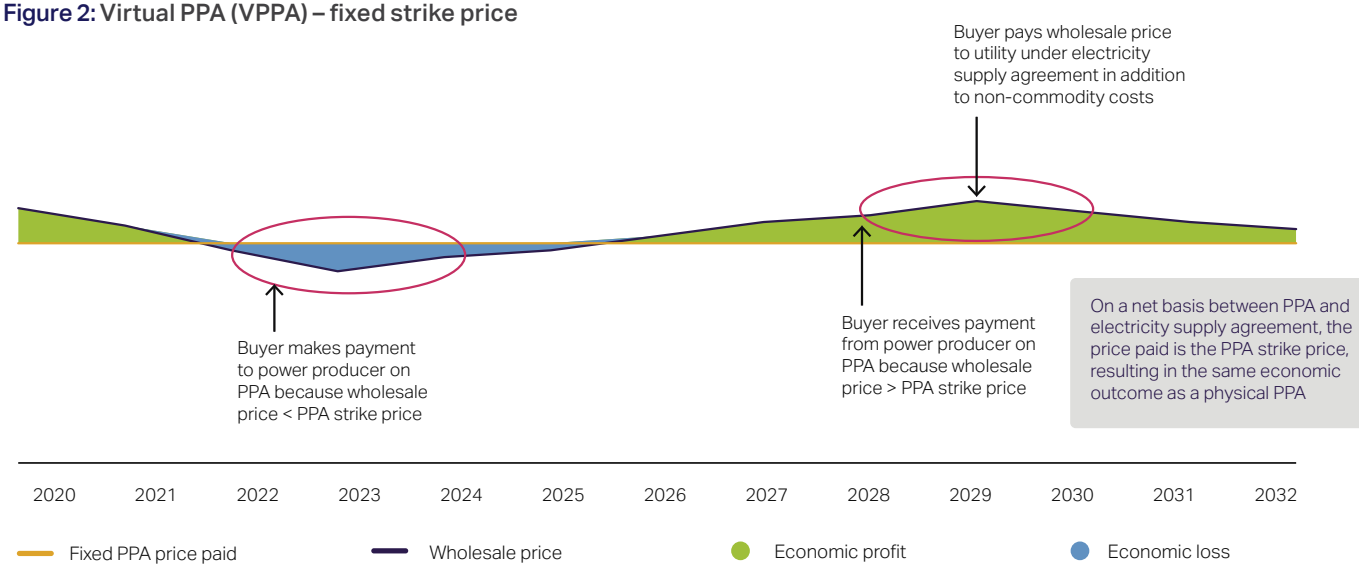
All forward prices in this report are illustrative only and do not represent expected future price trends.

Figure 1: Physical PPA - fixed price



- A physical PPA is a supply of electricity that the energy service provider (e.g., local utility) ultimately feeds to the corporate buyer for consumption. The PPA price and settlement are typically independent of the wholesale price (though floating discount-to-market structures discussed later will follow the wholesale price).
- This has historically been the predominant approach in Europe; however, this is changing due to the complexity and cost needed to sleeve the power through the energy service provider for the corporate buyer's consumption.
- For the most part, physical PPAs enjoy the advantage of being treated as a supply of electricity contract and ongoing cost (i.e., an executory contract under International Accounting Standard 37 (IAS 37) on provisions, contingent liabilities and contingent assets), without the contract being recognized on the balance sheet.

Figure 2: Virtual PPA (VPPA) – fixed strike price



- A virtual PPA is a contract for difference (i.e., derivative contract) whereby the buyer and power producer settle based on the difference between a quoted electricity wholesale price versus an agreed strike price.
- This has been the most common PPA model in the US and is increasingly used in Europe due to the relative simplicity of implementation and the suitability of this structure for procuring power across markets through cross-border PPAs.
- The accounting treatment is, however, typically less favorable under International Financial Reporting Standards (IFRS), where they are treated as derivative contracts and must be recognized at fair value (FV) on the balance sheet.[2] Under US Generally Accepted Accounting Principles (GAAP), contracts that do not include volumetric guarantees may avoid derivative accounting and as such be less of a barrier to VPPAs that decouple project location from electricity load centers.

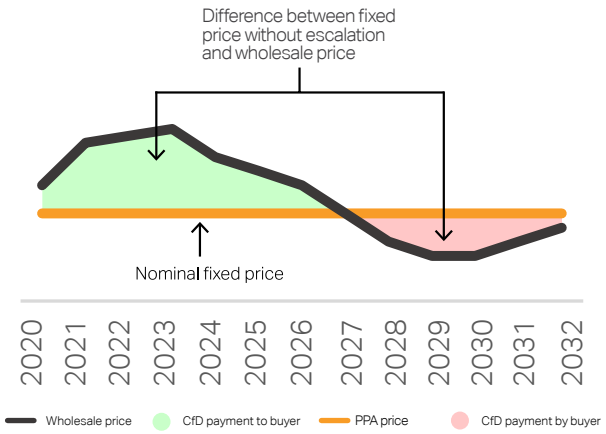
[2] FV movements can create profit and loss (P&L) volatility if there is not an effective hedge and if the company does not elect to use hedge accounting. For more information on the treatment of VPPAs under IFRS, see the WBCSD IFRS accounting outline for Power Purchase Agreements report.

2.2. Overview of PPA pricing structures – fixed, escalation & indexation

This section of Chapter 2 outlines different pricing structures used in PPAs:

- **Fixed, escalation & indexation**
  - Fixed-price nominal PPA
  - Fixed with escalation (stepped)
  - Fixed with inflation indexation
- **Floating price, discount to market with caps and floors**
  - Discount to market with floor
  - Discount to market with collar
- **Collar and reverse collar**
  - Collar
  - Reverse collar (VPPA only)
- **Hybrid structures**
  - Hybrid – % of output
  - Hybrid – over time
- **Clawback**

Figure 3: Fixed-price nominal PPA



We describe each pricing structure and provide commentary on the apportioning of electricity price risk, tenor suitability and when/where such structures are commonly found. It is possible to achieve most structures under either a physical or virtual PPA (with the exception of reverse collar structure), provided there is a liquid power market. Where there are illiquid power markets (e.g., India), only the first three structures can apply and then only as physical PPAs. The text and graphics for the most part assume a VPPA structure; however, the net economic exposure for the corporate buyer under both a physical and virtual PPA is the yellow line. We have included an illustrative example for each structure.

Note all forward prices in this report are illustrative only and do not represent expected future price trends.

2.2.1 Fixed-price nominal PPA

- The buyer locks in a fixed electricity price (with no inflation) for the duration of the PPA contract. This can be achieved through either a physical or virtual PPA structure (see previous slides).
- The buyer bears the electricity price risk – i.e., the contract can be out of the money if market prices fall.
- A fixed-price structure suits all tenors but can be perceived as locking the corporate buyer into a long-term onerous obligation should wholesale power prices decrease (i.e., tenor risk[3]).
- This is the most common structure and is predominant in Continental Europe and the US and where inflation indexation can be volatile.

Illustrative example

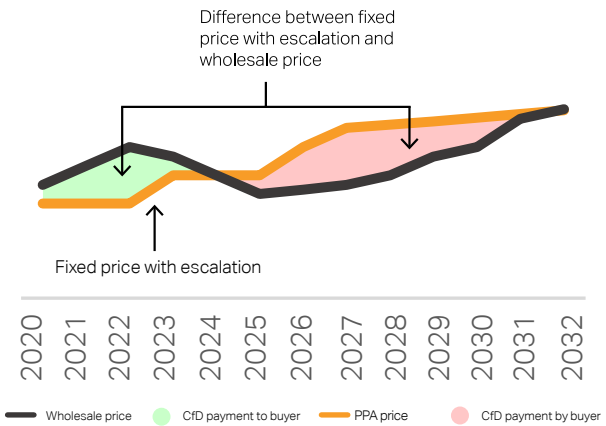
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60.0	75.0	77.5	80.0	70.0	60.0	60.0	50.0	40.0	35.0	35.0	40.0	45.0
	Less: Annual CfD settlement[4]	10.0	25.0	27.5	30.0	20.0	10.0	10.0	0.0	-10.0	-15.0	-15.0	-10.0	-5.0
	= Net power price/ strike price	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Physical PPA	Price paid	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0

[3] For a definition of each type of risk, see the WBCSD Innovation in Power Purchase Agreement Structures report.

[4] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.2.2 Fixed with escalation (stepped)

Figure 4: Fixed with escalation (stepped)



- The buyer locks in a starting electricity price that rises (or less commonly decreases) according to a contractual profile. The steps may be in nominal terms (without inflation) or in real terms with inflation indexation on top. Alternatively, there may be a simple fixed percentage increase per year.
- Despite the different revenue profile, the electricity price risk still resides with the buyer.
- The drivers for such a structure can be to sculpt the strike price to match wholesale price expectations in the future (e.g., rising wholesale prices) and minimize the initial delta to wholesale prices. The structure is appropriate for different tenors.[5]
- Such a mechanism is common in India, observable in the US and increasingly common in a post-COVID-19 world where electricity prices have been suppressed, coupled with the requirement from most buyers for the PPA to be cash positive as early as possible.
- Note while escalating structures are more common overall, in certain markets (e.g., Brazil) de-escalating structures are encountered frequently.

Illustrative example

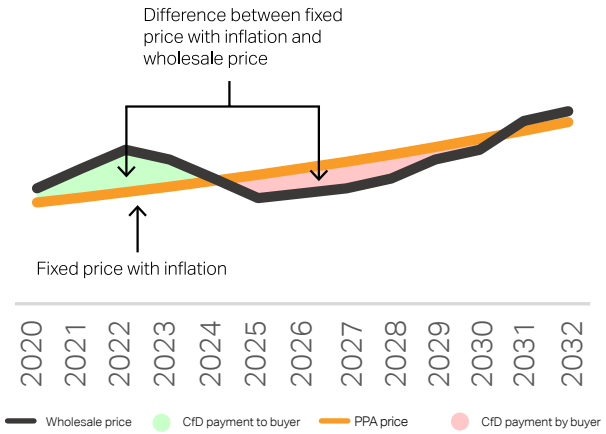
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60.0	70.0	80.0	75.0	65.0	55.0	57.5	60.0	65.0	75.0	80.0	95.0	99.9
	Less annual CfD settlement[6]	10.0	20.0	30.0	10.0	0.0	-10.0	-22.5	-30.0	-26.8	-18.6	-15.5	-2.4	0.5
	=Net power price/ strike price	50.0	50.0	50.0	65.0	65.0	65.0	80.0	90.0	91.8	93.6	95.5	97.4	99.4
Physical PPA	Price paid	50.0	50.0	50.0	65.0	65.0	65.0	80.0	90.0	91.8	93.6	95.5	97.4	99.4

[5] For a definition of each type of risk, see the WBCSD Innovation in Power Purchase Agreement Structures report.

[6] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.2.3 Fixed with inflation indexation

Figure 5: Fixed with inflation indexation



- The buyer locks in a starting electricity price that rises annually with inflation, typically measured by changes in a consumer price index (CPI) or similar publicly produced inflationary index.
- Despite the different profile, the electricity price risk still resides with the buyer. We discuss inflation risk in the next chapter.
- The drivers for such a structure are to minimize the upfront PPA cost relative to current wholesale prices and to keep PPA prices approximately in line with prevailing annual inflation.
- Such a mechanism is most common in the UK and is becoming increasingly common in a post-COVID-19 world where electricity prices have been suppressed, coupled with the requirement from most buyers for the PPA to be cash positive as early as possible.

Illustrative example

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60.0	70.0	80.0	75.0	65.0	55.0	57.5	60.0	65.0	75.0	80.0	95.0	99.9
	Less annual CFD settlement [7]	7.5	14.9	22.1	14.2	1.2	-12.0	-12.9	-13.9	-12.6	-6.4	-5.5	5.2	5.6
	= Net power price/ strike price	52.5	55.1	57.9	60.8	63.8	67.0	70.4	73..9	77.6	81.4	85.5	89.8	94.3
Physical PPA	Price paid	52.5	55.1	57.9	60.8	63.8	67.0	70.4	73..9	77.6	81.4	85.5	89..8	94.3

[7] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

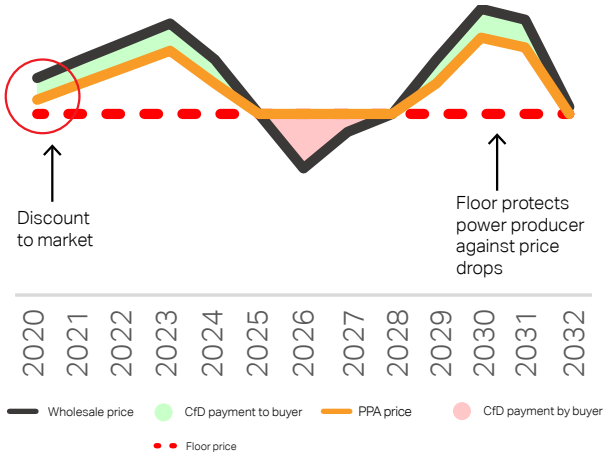
2.3. Overview of PPA pricing structures – floating price, discount to market with caps and floors

Pricing structures with caps, floors, collars and clawback arrangements are less common for corporate PPAs. Buyers can use these structures where electricity prices are a significant operating cost and where prices for their products are more elastic. Utilities, commodity traders and large developers typically offer them, whereas smaller and medium-sized developers typically prefer the visibility of fixed-price arrangements.
The reduced price visibility means such structures are less common for greenfield PPAs where the PPA relates to a new renewable asset and therefore obtaining financing is key.

2.3.1 Discount to market with floor

- The buyer secures a discount to market (fixed percentage or amount) over the duration of the PPA. In exchange, the buyer provides the power producer with a floor price, guaranteeing a minimum price for plant production that provides bankability to the project.
- For the most part the power producer bears the initial electricity price risk, down to the floor price below which the buyer pays and is at risk.
- Demand for such structures is increasing from a broad range of corporate buyers who desire to lock in energy attribute certificates (EACs) from an additional project without making a long-term fixed-price commitment, instead opting for a discount to market to ensure they are buying below the market for the long-term (subject to the floor). Industry market dynamics may also play a role.
- Note a discount-to-market structure has historically been more commonly employed on physical PPAs but can be executed in a virtual structure.

Figure 6: Discount to market with floor[8]



Illustrative example

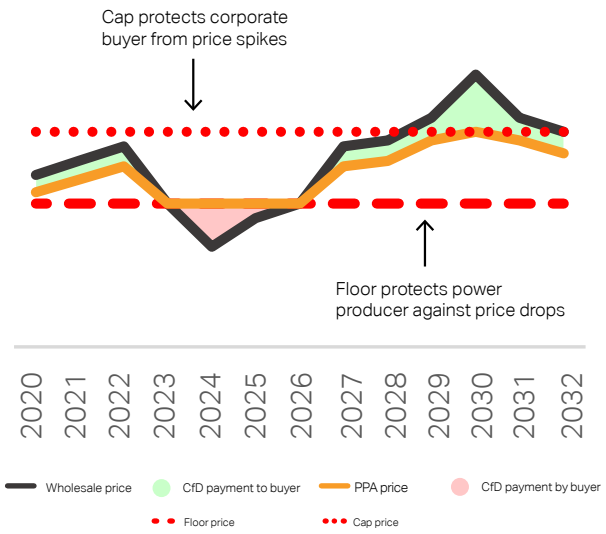
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60	65	70	75	65	50	35	45	50	65	79	76	52
	- Discount to market	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
	Floor	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	Less annual CFD settlement[9]	6.0	6.5	7.0	7.5	6.5	0.0	-15.0	-5.0	0.0	6.5	7.9	7.6	2.0
	= Net power price	54.0	58.5	63.0	67.5	58.5	50.0	50.0	50.0	50.0	58.5	71.1	68.4	50.0
Physical PPA	Price paid	54.0	58.5	63.0	67.5	58.5	50.0	50.0	50.0	50.0	58.5	71.1	68.4	50.0

[8] We illustrate the discount to market as a fixed percentage.

[9] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.3.2 Discount to market with collar

Figure 7: Discount to market with collar



- This structure is similar to above, while also having a cap price, which in effect creates a collar and limits the buyer's exposure to price spikes. As the power producer now has less upside, it is possible that the floor price may also be higher to compensate.
- Again, the power producer bears the electricity price risk within the collar. The buyer is on risk below the floor price but in exchange limits its exposure to rises in electricity prices above the cap.
- Drivers for the structure are similar to the discount to market with a floor, with the added goal of the buyer wishing to cap its exposure to spiking electricity costs.

Illustrative example

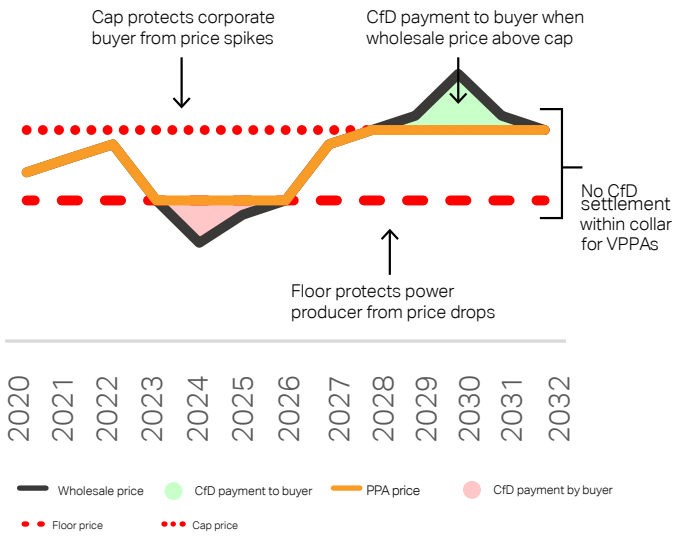
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60.0	65.0	70.0	50.0	35.0	45.0	50.0	70.0	72.0	80.0	95.0	80.0	75.0
	- Discount to market	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
	Floor	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	Cap	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
	Less annual CFD settlement[10]	6.0	6.5	7.0	0.0	-15.0	-5.0	0.0	7.0	7.2	8.0	20.0	8.0	7.5
	=Net power price	54.0	58.5	63.0	50.0	50.0	50.0	50.0	63.0	64.8	72.0	75.0	72.0	67.5
Physical PPA	Price paid	54.0	58.5	63.0	50.0	50.0	50.0	50.0	63.0	64.8	72.0	75.0	72.0	67.5

[10] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.4. Overview of PPA pricing structures – collar and reverse collar

2.4.1 Collar

Figure 8: Collar



- The key difference to the previous structure (discount to market with collar) is there is no discount to market – though the strike place still floats with the market within certain bounds.
- There is no VPPA settlement provided the market price is within the collar (i.e., above the floor and below the cap). The buyer provides a floor price, which protects the power producer from low prices. In exchange, the power producer provides a cap, which limits the buyer's exposure to electricity price spikes.
- Again, the power producer bears the electricity price risk within the collar. The buyer is on risk below the floor price but in exchange limits its exposure to rises in electricity prices above the cap.
- Drivers for the structure are primarily a desire to constrain the electricity price without locking in a price, while procuring renewable power with a claim to additionality.
- The higher the floor price (as with most cap and floor structures) the more bankable the structure.

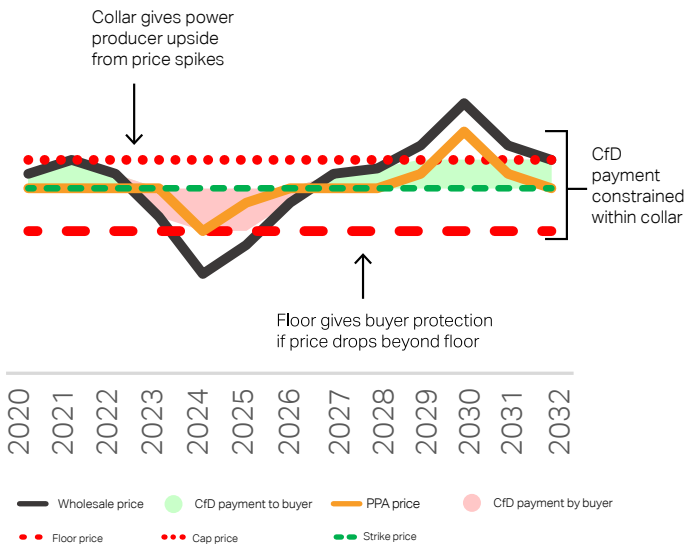
Illustrative example

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60.0	65.0	70.0	50.0	35.0	45.0	50.0	70.0	75.0	80.0	95.0	80.0	75.0
	Floor	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	Cap	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
	Less annual CFD settlement	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
	Less annual CFD settlement[1]	0.0	0.0	0.0	0.0	-15.0	-5.0	0.0	0.0	0.0	5.0	20.0	5.0	75.0
	=Net power price	60.0	65.0	70.0	50.0	50.0	50.0	50.0	70.0	75.0	75.0	75.0	75.0	75.0
Physical PPA	Price paid	60.0	65.0	70.0	50.0	50.0	50.0	70.0	75.0	75.0	75.0	75.0	75.0	75.0

[11] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.4.2 Reverse collar (VPPA only)

Figure 9: Reverse collar (VPPA only)[12]



- The CfD paid by the buyer is the settlement market price less the PPA strike price, provided the market price is within the reverse collar (i.e., above the floor and below the cap). The power producer provides a floor price, which protects the buyer from large top-ups from unusually low market prices. Conversely, the buyer provides a cap that limits payments to the corporate buyer in unusually high market scenarios.
- The buyer bears the electricity price risk within the collar. The power producer is on risk below the floor price but in exchange gains upside when the settlement market rises above the cap.
- Drivers for the structure are primarily a desire to constrain the volatility of the VPPA "deltas" between settlement market and VPPA strike price. However, the higher the floor is, the less bankable the structure is for the power producer – with greater risk, potentially needing a higher PPA strike price.
- This is an extremely rare structure but almost all VPPAs will have a zero-price floor, which protects the corporate buyer against negative pricing in the market and very large top-ups to the VPPA strike price.

Illustrative example

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	**Wholesale price**	**70.0**	**75.0**	**70.0**	**55.0**	**35.0**	**45.0**	**60.0**	**70.0**	**72.0**	**80.0**	**95.0**	**80.0**	**75.0**
	Strike price	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
	Floor	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	Max payment from corporate	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0
	Cap	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
	Max payment to corporate	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0	+10.0
	Less annual CfD settlement[13]	5.0	10.0	5.0	-10.0	-15.0	-15.0	-5.0	5.0	7.0	10.0	10.0	10.0	10.0
	= Net power price	65.0	65.0	65.0	65.0	50.0	60.0	65.0	65.0	65.0	70.0	85.0	70.0	65.0

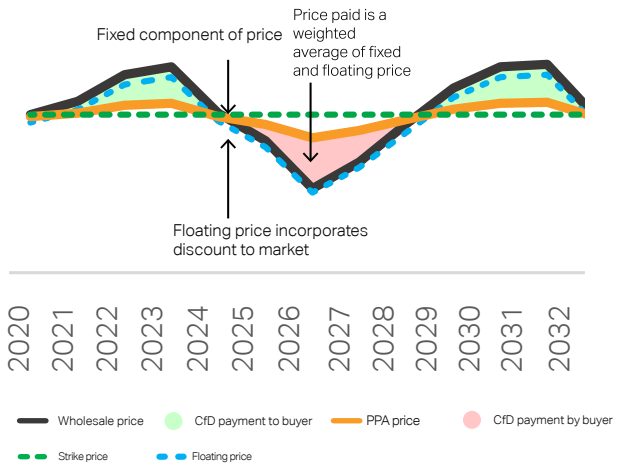
[12] Note the reverse collar may be referred to as a collar, especially in the US.

[13] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.5. Overview of PPA pricing structures – Hybrid structures

2.5.1 Hybrid - % of output

Figure 10: Hybrid – % of output



- A fixed percentage of the output (e.g., 70%) is contracted at a fixed price. The remaining percentage of the output (e.g., 30%) is contracted at a floating price with a discount to market. This proportional output split could be for a single asset or a portfolio of assets (e.g., 2 assets on fixed price, 1 on floating price) where power is sold under different terms (this would also be a hybrid approach).
- The power producer and buyer share the electricity price risk. The buyer takes the price risk on the fixed portion, while the power producer takes the risk on the floating output.
- The need for revenue certainty from the power producer to achieve bankability drives the need for a fixed percentage of output. A buyer could favor such a structure where there is a desire for renewable power, a reluctance to fully lock in electricity costs, a desire to improve upon wholesale prices and sufficient demand to cover the full offtake.
- This structure could be popular with large electricity buyers with a need for renewable power that are also sensitive to power prices.

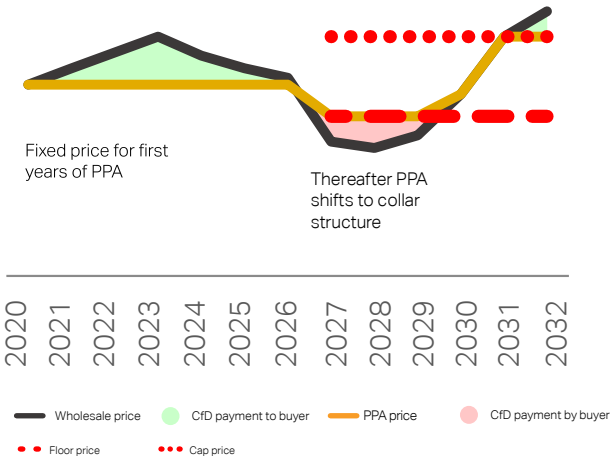
Illustrative example

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60.0	65.0	75.0	78.0	60.5	50.0	32.0	42.0	56.3	70.0	78.0	79.0	60.0
	- Discount to market	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Floating price (30%)	57.0	61.8	71.3	74.1	57.5	47.5	30.4	39.9	53.5	66.5	74.1	75.1	57.0
	Fixed price (70%)	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
	Less annual CfD settlement	0.9	4.5	11.6	13.8	1.3	-6.3	-19.1	-12.0	-1.7	8.1	13.8	14.5	0.9
	= Net power price[14]	59.1	60.5	63.4	64.2	59.2	56.3	51.1	54.0	58.0	62.0	64.2	64.5	59.1
Physical PPA	Price paid	59.1	60.5	63.4	64.2	59.2	56.3	51.1	54.0	58.0	62.0	64.2	64.5	59.1

[14] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.5.2 Hybrid - over time

Figure 11: Hybrid – over time



- A fixed price for a number of years (e.g., 6 years), could be followed by a floating price with a collar (e.g., 6 years). A variety of other permutations are also possible.
- The buyer bears the electricity price risk within the fixed period (e.g., first 6 years), following which the risk within the collar is transferred to the power producer (e.g., for next 6 years).
- Drivers for this structure would be a buyer with a desire or ability to take medium-term price risk and a reluctance to lock-in longer-term prices.
- The shorter the fixed period, and the lower the floor that follows, the less bankable the structure.

Illustrative example

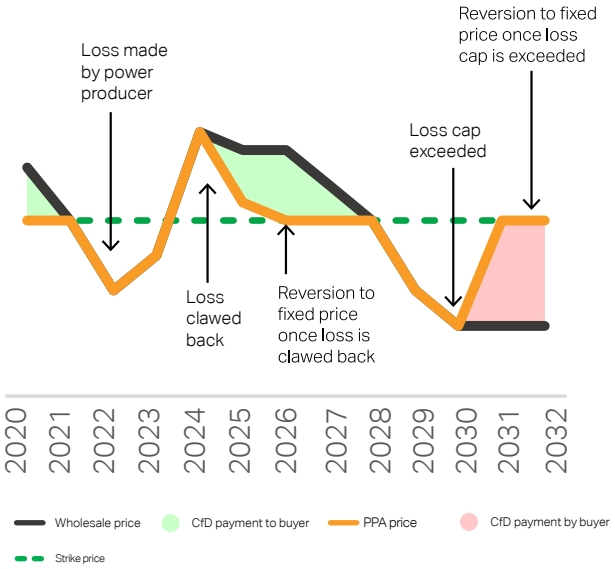
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	60.0	65.0	70.0	75.0	69.0	65.0	62.0	42.0	40.0	44.0	57.0	75.0	83.0
	Fixed price	60.0	60.0	60.0	60.0	60.0	60.0	60.0	-	-	-	-	-	-
	Floor	-	-	-	-	-	-	-	50.0	50.0	50.0	50.0	50.0	50.0
	Cap	-	-	-	-	-	-	-	75.0	75.0	75.0	75.0	75.0	75.0
	Less annual CFD settlement[15]	0.0	5.0	10.0	15.0	9.0	5.5	2.0	-8.0	-10.0	-6.0	0.0	0.0	8.0
	=Net power price	60.0	60.0	60.0	60.0	60.0	60.0	60.0	50.0	50.0	50.0	57.0	75.0	75.0
Physical PPA	Price paid	60.0	60.0	60.0	60.0	60.0	60.0	60.0	50.0	50.0	50.0	57.0	75.0	75.0

[15] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

2.6. Overview of PPA pricing structures – Clawback

2.6.1 Clawback

Figure 12: Clawback



- The buyer locks in a PPA price but benefits from downward market price movements, subject to caveats:
  - Subsequent upward price movements go to the power producer until the power producer has clawed back the amount gained by the buyer (relative to the PPA price);
  - There is a loss cap for the power producer beyond which the price reverts to the PPA price, which provides a floor (also defined relative to the PPA price) to overall project revenues for the power producer;
  - (Not shown) There is sometimes an extension period to extend the clawback if the seller has not recouped the losses in excess of the loss cap.
- The arrangement limits the power producer's upside and leaves it bearing the first-loss of price decreases. Electricity price risk is shared, the risk allocation depends on contractual thresholds.
- Clawback arrangements are appealing for corporate buyers who are sensitive to electricity price movements (e.g., large industrials) or may appeal to corporate buyers because initial price movements in either direction benefit the corporate buyer.

Illustrative example

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
VPPA	Wholesale price	65.0	50.0	30.0	40.0	75.0	70.0	70.0	60.0	50.0	30.0	20.0	20.0	20.0
	Strike price	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	Contractual developer (loss)/ clawback	-	-	-20.0	-10.0	25.0	5.0	-	-	-	-20.0	-30.0	Capped	Capped
	Cumulative loss	-	-	-20	-30	-5	-	-	-	-	-20.0	-50.0	-50.0	-50.0
	Loss cap	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0
	Less annual CfD settlement[16]	15.0	-	-	-	-	15.0	20.0	10.0	-	-	-	-30.0	-30.0
	= Net power price	50.0	50.0	30.0	40.0	75.0	55.0	50.0	50.0	50.0	30.0	20.0	50.0	50.0
Physical PPA	Price paid	50.0	50.0	30.0	40.0	75.0	55.0	50.0	50.0	50.0	30.0	20.0	50.0	50.0

[16] Positive CfD settlement denotes receipt by the corporate buyer; negative CfD settlement denotes payment by corporate buyer.

3

Pricing structure analysis by key stakeholder

3 Pricing structure analysis by key stakeholder

Chapter 3 explores the high-level considerations, risks and position for each stakeholder by pricing structure.

PRICING STRUCTURE	SUMMARY	CORPORATE BUYER POSITION	POWER PRODUCER POSITION	LENDER POSITION
Fixed-price nominal	The most common and straight-forward of arrangements. This is well understood by all stakeholders. It provides long-term visibility to all; however, fixed-price structures may not be suited to all buyers.	Provides long-term cost visibility. This reduces exposure to commodity and inflation risk and ordinarily makes earnings more stable, which is favorable. However, in certain more competitive industries with unhedged peers, the risk of being locked into a long-term unfavorable price may be too great (i.e., tenor risk).	Provides a high-level of revenue visibility over the PPA term. This is a preferred outcome for many power producers and allows a low cost of capital to be raised from equity and debtholders who perceive less risk.	Visibility on revenue over the PPA term is well understood, increasing the bankability of the project. Lender focus over the PPA term shifts away from forecasted wholesale prices to buyer creditworthiness and the robustness of the PPA contract.
Fixed price with escalation (stepped)	Contractual revenue escalation provides long-term visibility, is easy to communicate, and is well understood by all stakeholders. It can be more competitive with presently low wholesale prices. Again, fixed-price structures may not be suited to all buyers.	Buyers will often prefer such arrangements because the cashflow outflow is lower upfront (as compared to wholesale price). Interest in escalating structures has grown alongside depressed wholesale prices resulting from COVID-19. The trade-off is an increased likelihood that the PPA cost of power exceeds the wholesale price at the end of the PPA term (which can be a competitive disadvantage).	A favored structure for power producers with high revenue visibility. However, power producers may exhibit a marginal preference for the fixed-price nominal structure due to more cashflow upfront.	There is still high visibility over revenue – thus increasing bankability. Perceived as slightly riskier than a fixed-price nominal arrangement as more of the cash-flow is back-dated. thus presenting risks in the event of a buyer insolvency situation.
Fixed price with inflation indexation	Similar to fixed price with escalation structures. How buyer and power producer manage inflation risk is key. The distinction from fixed price nominal and escalating contracts becomes more important in markets with high and volatile inflation.	Similar to fixed price with escalation above. A growing power price often fits well against inflationary pressure on the cost base and on revenues. Suits a corporate buyer wanting a "soft" start in the PPA with relatively low prices.	A power producer will be satisfied to the extent its financing outflows are inflation linked. If debt outflows are all fixed, such an arrangement may not be preferred. Long-term investors seeking an inflation hedge (e.g., pension funds) are increasingly providing equity capital in renewables. To the extent this is the case, a fixed price with inflation uplifts may well be preferred.	The financing package may be adjusted to include more variable rate debt. In a scenario where debt is fixed, a fixed price with inflation may marginally reduce the amount of debt available.

PRICING STRUCTURE	SUMMARY	CORPORATE BUYER POSITION	POWER PRODUCER POSITION	LENDER POSITION
Discount to market with floor	Provides a mechanism for buyers reluctant to lock in a long-term price, but who wish to contribute to additional green power and improve on the wholesale electricity price, typically day-ahead. The placement of the floor is fundamental to level of revenue security that the project achieves. Note utility PPA floors are typically lower than corporate PPA floors (and the projects are therefore almost always merchant projects). Floating arrangements are less common for greenfield PPAs.	Discount-to-market arrangements improve upon the wholesale price without providing a price hedge. Sometimes entered into by companies with high energy intensity for whom locking in electricity cost is not preferred but with a desire to decarbonize supply. Understanding the impact and positioning of caps and floors requires far more domain knowledge and specialist support in the context of increasing renewable energy penetration and price volatility.	Significantly less secure than fixed-price arrangements. Power producers with bullish views on the wholesale price may prefer such an approach as it allows them to achieve a degree of bankability (with the floor) while capturing the upside. A greater proportion of equity financing is needed when compared to fixed-price arrangements. With depressed power prices during COVID-19, power producers have been less willing to provide lower floors.	The floor price provides minimum revenue visibility and bankability. Lender considerations are likely to drive the positioning of the floor price. The level of debt financing available is lower than for fixed-price PPAs.
Discount to market with collar	Risks and drivers are materially the same as the discount to market with floor, with the added benefit to the buyer of a price cap. Caps are more commonly used in corporate PPAs than in utility PPAs.	The cap provides the buyer with price protection from spiking electricity costs. This is again more suited to companies with high energy intensity, who have an in-depth understanding of energy markets. Buyers need to understand price volatility in their contracted settlement window, along with the expected direction of travel in prices.	Cap reduces project upside, so the power producer will typically reduce the discount to market (%) or raise the floor in exchange for the cap.	The lender will seek to understand the cap impact on project cashflows and will consider the mechanism in the round under downside scenarios (i.e., focus is on the floor and discount to market). The level of debt financing available is lower than for fixed-price PPAs.
Collar	Both corporate buyer and power producer take an element of electricity price risk: the corporate buyer takes the risk outside the collar and the power producer inside the collar. The mechanism gives the corporate buyer price spike protection while providing the project with bankability through the floor. The positioning of the cap and floor are key.	Provides corporate buyer with a price hedge where power prices rise above the cap. The floor drives bankability, creating additionality. This is again more suited to companies with high energy intensity, who have an in-depth understanding of energy markets.	Less secure than fixed-price arrangements. Gives power producers with bullish views some upside on the wholesale price (up to cap). The floor gives the project minimum revenue certainty and bankability (by corporate buyer topping back up to the floor).	The lender will seek to understand the collar impact of project cashflows and will consider the mechanism in the round under downside scenarios (i.e., focus in on a higher floor). The level of debt financing available is lower than for fixed- price PPAs.

PRICING STRUCTURE	SUMMARY	CORPORATE BUYER POSITION	POWER PRODUCER POSITION	LENDER POSITION
Reverse collar[17]	Both corporate buyer and power producer take an element of electricity price risk: the corporate buyer takes the risk within the collar and the power producer outside of the collar. The mechanism gives the corporate buyer less CfD volatility but reduces bankability for the power producer. The positioning of the cap and floor are key for balancing risk between parties.	The CFD payments within the collar should provide a corporate buyer with a price hedge. Below the floor the corporate buyer is protected from plummeting prices, while above the cap, the hedge may be insufficient to match increased prices in its retail supply agreement.	Less secure than fixed-price arrangements. Gives power producers with bullish views some upside on the wholesale price (above cap). The floor gives the project less revenue certainty and bankability (the top up is capped at the difference between the floor and strike price). Note that in this context, the lower the floor, the greater the bankability.	The lender will seek to understand the collar impact of project cashflows and will consider the mechanism in the round under downside scenarios (i.e., focus is on a lower floor). The level of debt financing available is lower than for fixed-price PPAs.
Hybrid – % of output	Both corporate buyer and power producer take an element of electricity price risk: the corporate buyer takes the risk on output sold under the fixed price, while the power producer takes the risk on the floating price output. Mechanism gives bankability through the fixed-price output.	This is again more suited to companies with high energy intensity, with a reluctance to contract for full project output at fixed price but a desire to secure additional green power (in a greater quantity to the fixed-price output they are able to contract). Provides the corporate buyer with a price hedge on the fixed output and a possible discount to market on the floating portion.	Power producers commonly contract for less than 100% of output. The fixed-price PPA output creates bankability, while the floating price PPA output (sold to the wholesale market) could capture higher prices (assuming fixed price < wholesale price). This structure is very similar in that there are two different structures for the two portions of the volume, albeit with one offtaker instead of two. If a discount to market on the floating element contracted is included, power producers would typically request a greater fixed price.	Lender will focus primarily on the percentage of output sold at a fixed price, which creates revenue visibility. On this element, as with other structures, attention will shift to the buyer's creditworthiness. A secondary concern, will be the discount to market granted and its impact on revenues (if any). The level of debt financing should be similar to that available under a fixed price structure for the same % of output.

[17] Note the reverse collar may be referred to as a collar, especially in the US

PRICING STRUCTURE	SUMMARY	CORPORATE BUYER POSITION	POWER PRODUCER POSITION	LENDER POSITION
Hybrid – over time	The corporate buyer takes all the electricity price risk upfront, with a portion of the risk being transferred back to the power producer in later years (assuming a transition to a collar structure). Note many other structures are possible.	This is more suited to companies with short-term views on the evolution of power prices or a preference not to lock in long-term prices, and a desire for additional green power. Provides the corporate buyer with a narrower hedge in the medium term and a looser hedge (through the collar) in the longer term.	Less secure than long-term fixed-price arrangements as there is lower visibility over revenue. Gives power producers with long-term bullish views some upside on the wholesale price (below the cap). The floor gives the project minimum revenue certainty and bankability in later years.	The lender will seek to understand the length of the fixed-price arrangement. This will be followed by focusing on the collar impact on cash flows under downside scenarios (i.e., focus is on the floor). The level of debt financing available is lower than for fixed-price PPAs.
Clawback	A relatively new and infrequently used pricing structure. Similar to cap and floor arrangements, as threshold placement is key. The overall power producer loss cap provides the project with minimum revenue certainty and bankability. Ability of prices to reduce initially may help overcome internal stakeholder barriers at some corporate buyers.	The ability of prices to reduce before the loss cap is hit may provide certain corporate buyers with comfort if they are unsure about locking in a long-term price.	Not all power producers may be familiar with the structure and larger power producers will generally be more open to bespoke structures. The PPA strike price will typically increase to reflect the initial downside risk borne by the power producer.	The lender focus is on the sizing of the loss cap and the minimum revenue assured, as well as the overall mechanism design. The structure is not common, which poses a barrier to obtaining financing. The level of debt financing available is lower than for fixed-price PPAs.

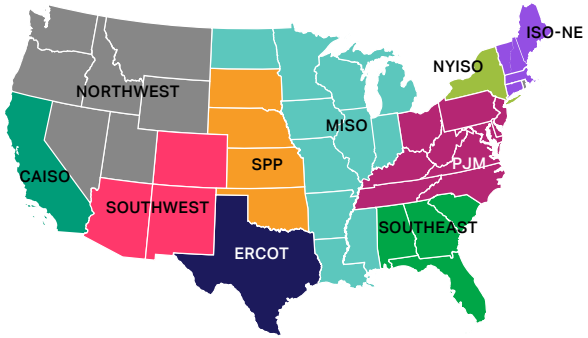
4

Pricing structure variation by region

4 Pricing structure variation by region

This section of chapter 4 outlines which pricing structures are most common in which geographies. It also outlines some of the drivers leading to certain structures (e.g., subsidy mechanism, financial reporting rules, etc.)

US



MARKET STRUCTURE

- The US electricity market is relatively complex and fragmented due to mixed levels of deregulation.
- Only certain regions have a competitive wholesale market with liquid trading hubs that can more easily accommodate PPA contracting – these are represented by seven independent system operators (ISOs[18]).
- ISOs are comprised of hundreds or even thousands of nodes (individual points on the grid where generating assets connect and prices are set), which aggregate into a smaller number of regional hubs.
- By contrast, the northwest, southwest and southeast[19] regions remain fully regulated.

IMPACT ON PPA MARKET

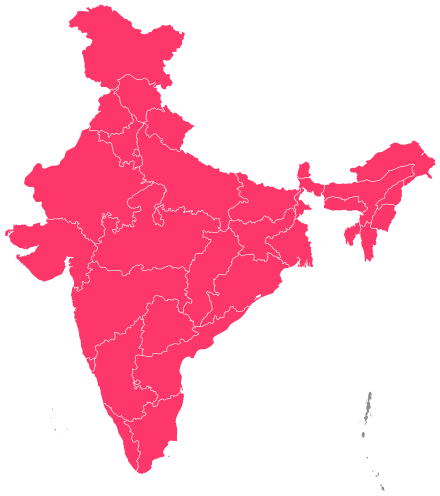
- The majority of corporate PPAs to date (and VPPAs in particular) have been in ERCOT, SPP, MISO and PJM.
- Fixed price nominal arrangements are most common but other pricing structures are possible.
- Given the relative volatility of nodal pricing, corporate PPAs are typically designed to settle on hub pricing.
- Given mixed levels of deregulation, accounting treatment considerations and a frequent desire by corporate buyers to aggregate their consumption load across multiple regions, VPPAs have become more common than physical PPAs in the US.
- The US comprises a range of mandatory and voluntary markets for renewable energy certificates (RECs), resulting in differential REC pricing and arbitrage potential.[20]

[18] ISOs: CAISO, ERCOT, SPP, MISO, PJM, NYISO, ISO-NE

[19] Northwest, southwest and southeast are not ISOs

[20] See section 5 for further discussion of REC considerations

India



MARKET STRUCTURE

- The power market is run at a state level.
- Most volumes are contracted under a long-term power purchase agreement structure (~90%) with only the remainder being traded on power exchanges. Bilateral power purchases agreements with independent power producers are possible up to ~80% of volume.
- Power distributors and retailers have regulated tariffs, which vary by activity and volume (i.e., a progressive slab tariff is common).
- The Green Term Ahead Market (GTAM) launched in August 2020 for the trading of renewable power on an exchange.
- Multiple states have rolled back or are in the process of rolling back Open Access benefits such as a yearly banking facility, low/nil cross-subsidy and additional surcharges for renewable electricity plants.

IMPACT ON PPA MARKET

- PPAs are limited to sleeved/physical arrangements, which largely confines buyers to in-state purchases.
- Fixed-price structures with fixed escalation are most common.
- Pricing structures that rely on a wholesale reference price are not used (i.e., discount to market, cap and floor structures).
- GTAM provides an alternative to physical PPAs for buyers and may lead to virtual PPA uptake in India.
- Corporate buyers may opt for captive (behind-the-meter) or group captive (local network) models instead of third party power procurement, to avail of benefits on exemption for cross-subsidy and additional surcharges.

Australia

MARKET STRUCTURE

- The power market comprises one of the largest interconnected power systems in the world, the National Energy Market (NEM). The NEM covers Queensland, New South Wales (including the Australian Capital Territory), Victoria, South Australia, and Tasmania. Western Australia and the Northern Territory are not connected to the NEM due to physical distance.
- The NEM encompasses >75% of national consumption.
- There is a physical spot market matching supply and demand and a financial market to hedge commodity risk.
- The market is structured with 5-minute settlement intervals.
- The market is undergoing a transition from predominantly thermal generation to more variable supply. This includes reconfiguring the grid to accommodate new renewable capacity in regions with strong wind and solar resources.

IMPACT ON PPA MARKET

- The typical PPA structure is virtual due to high sleeving costs.
- Fixed price with partial or full CPI escalation are typically observed, while fixed price with fixed escalation and a flat nominal fixed price with no escalation agreements have also been observed.
- The settlement price interval used is a 30-minute block comprised of the settlement of 5-minute dispatch and pricing intervals. The market is moving to a 5-minute settlement in October 2021.
- The contracted production is typically post transmission and congestion losses.
- Contracts will typically include large-scale generation certificates (akin to EACs/RECs), which have significant value due to statutory demand from liable entities (e.g., utilities), which is charged onwards to large electricity buyers.

United Kingdom

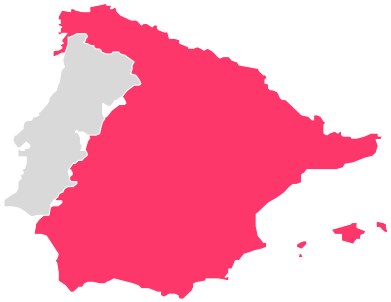
MARKET STRUCTURE

- The power market in Great Britain covers the entirety of the United Kingdom excluding Northern Ireland.
- The market is deregulated, with the exception of transmission and distribution.
- There is both a physical and forward (financial) market.

IMPACT ON PPA MARKET

- Physical PPAs were most common, aided by IFRS accounting rules which typically require on balance sheet recognition of VPPAs. However, VPPAs are becoming increasingly common.
- The most common pricing structure is a fixed price with CPI escalation.
- Note that the power producer typically bears balancing costs in a VPPA and the buyer bears the costs in a physical PPA.
- The PPA price typically includes EACs called REGOs.[21]
- The most common settlement market is the day-ahead market (which is also the most liquid).

Spain



MARKET STRUCTURE

- MIBEL is the Iberian Electricity market.
- OMI (Iberian market operator) manages the entirety of the markets (day-ahead and intraday) for the whole of the Iberian Peninsula.
- The Spanish market was deregulated in 1998 and integrated with the Portuguese market in 2007.

IMPACT ON PPA MARKET

- Physical PPAs were most common, aided by IFRS accounting rules, which typically require on balance sheet recognition of VPPAs. However, VPPAs are becoming increasingly common, especially to support pan-European cross-border PPAs.[22]
- The most common pricing structure is a fixed-price nominal structure; tracking PPAs or indexed PPAs are less common.
- Note that the power producer typically bears balancing costs.
- The PPA price typically includes EACs called GOs.[23]
- The most common settlement market is the day-ahead market (which is also the most liquid).
- During 2019 and 2020, 180 corporate renewable PPAs were signed in Europe – Spain represents 32% with 57 agreements.

[21] Energy attribution certificate (EAC)/renewable energy guarantees of origin (REGO)

[22] For more information, see the WBCSD Cross-border renewable PPAs in Europe: An overview for corporate buyers report.

[23] Guarantees of origin

South America

MARKET STRUCTURE

- South America has a number of independent national electricity markets; however, there are various overriding similarities.
- Spot markets for power do exist, while future derivatives marketplaces are either absent or illiquid and trades are usually executed in an over-the-counter (OTC) manner.
- Economies are often closely tied to the US dollar, with the dollarization of certain industries (including the electricity price market) due to more volatile local currencies.
- Inflation is relatively high and more volatile than in more developed markets such as the US and Europe.
- Hydroelectricity forms a significant component of generation; power markets are therefore more affected by changes in seasonal and annual precipitation. For VPPA contracts, hydroelectric variations could cause more volatility in contract for difference payments than in other markets.
- The structure of markets also differs. For example, the Colombian market is a single node; Brazil has 4 nodes; while Chile has many nodes.
- There is a mismatch in areas with high renewable potential and population centers. For instance, in Brazil much of the renewable potential is in the northeast while the largest population centers are in the southeast. A similar issue exists for Chile.
- There is a capacity market in Chile, Colombia and Peru but not in Brazil (although it is being considered).

IMPACT ON PPA MARKET

- In practice, the market is limited to physical PPAs. In other words, contracts are for the physical delivery of power to the end-consumer.
- Not all purchasers can contract directly for power (i.e., there are consumption thresholds below which corporate buyers cannot contract directly for power).
- Power producers therefore typically bear transmission, curtailment and grid congestion risks.
- The most common price structure is flat escalated with inflation; however, decreasing real price structures may compensate for higher long-term inflation (and escalation with inflation).
- Contracts in Chile, Peru and Argentina are typically dollar denominated, while those in Colombia and Brazil are denominated in the local currency (i.e., currency risk resides with different parties).
- Indexation in Brazil, Colombia and Peru is based on local inflation measures. In Chile, indexation is not based on local inflation. Contracts in Argentina are typically not escalated (i.e., nominal fixed price). In other words, different parties in different markets bear inflation risk by convention.
- Nodal considerations are less relevant for corporate buyers as the power is sleeved.
- The transition in Brazil of the electricity spot market away from weekly pricing (with time bands) to hourly pricing will impact pricing.
- International RECs (I-RECs) are typically included in the purchase price.

5

Corporate buyer and power producer considerations

5 Buyer and producer considerations

Chapter 5 explores buyer and power producer considerations that drive pricing structure and PPA decisions.

POWER PRODUCER CONSIDERATION	COMMENTARY
Source of financing	Power producers relying more extensively on debt financing will typically gravitate to pricing structures that provide greater revenue visibility and bankability (e.g., fixed price or relatively narrow collars).
Size of power producer	Larger power producers are typically better able to offer a wider range of pricing structures and varying levels of risk transfer due to a larger balance sheets and lower reliance on project finance. Smaller power producers may prefer simpler structures with more risk transfer (typically fixed price).
Industry structure/competitor actions in local market	Local market conventions and competitor actions can play a significant role in determining favored pricing structures.
Level of vertical integration	Power producers with a retail arm may be more amenable to floating price structures, as their retail offtake provides a natural price hedge to some of the floating price exposure
Forward price expectations	All else being equal, power producers with upward price expectations will be more willing to accept floating structures, while those with downward price expectations will opt for fixed structures.
Other PPA terms (e.g., % of output and term)	All else equal, power producers generally prefer fixed-price structures because they carry lower risk. However, a power producer may prefer a tracking structure (e.g., discount to market with floor) if it is for a greater percentage of the project output. The PPA term is also a key pricing variable. The longer the term, the greater the price certainty for the power producer, which is generally preferred; however, we have observed power producers with bullish views on forward prices preferring shorter durations.

BUYER CONSIDERATION	COMMENTARY
Energy intensiveness of industry	Companies in energy-intensive industries (e.g., metals, minerals, data centers, chemicals, etc.) use PPAs as tools to manage their electricity cost base. This can drive decisions to enter into fixed-price agreements to hedge against upward cost movements or discount to market with floor arrangements to maintain competitivity with the market.
Volume contracted	Larger projects and corporate PPA volumes can benefit from economies of scale.
Percentage of electricity contracted	The size of unhedged corporate consumption relative to project output may play a role in choosing a pricing structure. Corporate buyers are generally more accepting of a fixed price where the output is a smaller proportion of consumption.
Industry structure	Certain industries pass through electricity costs either directly or indirectly (e.g., electric utilities, property and data center companies). This can reduce incentives to lock in a fixed price and lead buyers to cap and floor arrangements (with or without discounts to market). The preferences of the end-users (e.g., technology companies for data centers) and the company's contractual arrangements with its customers (i.e., contractual length) can be key determinators of the preferred price structure.
Credit standing	Creditworthy companies find it easier to secure long-term competitive pricing.
Competitor actions	Certain industries have been leaders in procuring PPAs (such as pharma, consumer products, telecommunications and banks). Competitor actions and announcements create pressure to follow suit. Industries may congregate on an approach, typically involving a permutation of the fixed-price mechanism, which is the most common structure.
End-consumer proximity	Consumer perception of sustainability is a key driver for companies with end-consumer proximity that rely on branding (e.g., consumer products and financial services, etc.). The focus on brand and additionality can drive corporate buyers to accept higher risk PPA arrangements (e.g., longer tenor) to secure a greenfield project.
Sophistication and forward price expectations	Corporate buyers with teams focused on electricity purchasing (and their advisors) may have forward price expectations. This may drive corporate buyers to pursue PPAs and/or non-fixed-price structures. All else being equal, upward price expectations typically drive demand for fixed-price structures, while downward price expectations drive demand for floating structures
Risk aversion	A risk management strategy may drive demand for shorter PPAs or floating structures; conversely it may drive other buyers to seek to lock in longer term wholesale prices.

6

Settlement considerations impacting PPA pricing

6 Settlement considerations impacting PPA pricing

Chapter 6 looks at further considerations on pricing, including the geographical structure and timeframe for which the settlement is established, which is relevant for a fixed-price arrangement under a VPPA and cap/floor/collar/discount-to-market/clawback arrangements under a physical PPA. It also looks at the settlement market and reference price.

In general, the corporate buyer is drawn to the option that most closely matches its consumption footprint (e.g., national electricity price as opposed to zonal; and daily settlement as opposed to hourly). These options, however, place risk back onto the project. We recommend engagement with a number of power producers to ascertain what is available in the market and which solutions hit the right commercial balance.

SETTLEMENT STRUCTURE	SUMMARY	CORPORATE BUYER POSITION	POWER PRODUCER POSITION	LENDER POSITION
Zonal vs national	Many electricity markets are subdivided into power zones (e.g., Sweden and Italy) with separate power prices. On a merchant basis, the asset will typically achieve zonal pricing. It is quite common to settle on a national electricity price due to enhanced transparency, liquidity and reduced volatility. As interconnections between power zones and countries grow, we expect spreads (basis risk) to decrease.	Buyers typically prefer to settle on the national price as this price is usually more strongly correlated to their consumption footprint than a zonal price (which would result in overexposure to a single power zone).	Power producers will often offer buyers a choice of price benchmark, taking a pragmatic approach. The offer prices will, however, vary depending on the benchmark selected. Power producers will typically prefer the price benchmark to closely correspond to the revenue stream from the generation asset – i.e., zonal price settlement preferred above national for VPPA – so settlements more closely tie in with physical PPA revenues.	Lenders will be interested in understanding the residual risk on the project (i.e., zonal to national spreads).
Cross-border	Regulations, subsidies and revenue stabilization mechanisms (i.e., CfD auctions) may preclude PPAs in certain markets where the corporate buyer has material electricity demand. This leaves corporate buyers looking to green their electricity supply to do so through PPAs in neighboring markets, which are well correlated, leading to an increase in cross-border virtual PPAs (in the US this is cross-region). The strength of the correlation determines the level of basis risk in pursuing a cross-border PPA.	Corporate buyers may enter into PPAs with renewable assets in neighboring/correlated markets that correlate well with their electricity demand and where EAC transferability across borders complies with carbon reporting protocols. Buyers reporting under IFRS accounting standards may be more concerned with hedge effectiveness and correlation than entities reporting under US GAAP where the derivative contract is typically an off balance sheet electricity supply agreement. The latter has facilitated more projects located in a different regional wholesale market to the corporate buyer's offtake.	Certain larger power producers with cross-border operations may be in a position to take some of the basis risk for a premium in the PPA price or offer a cross-border portfolio of PPAs.	Where the corporate buyer bears the cross-border basis risk (which is often the case), lenders are typically less concerned.

SETTLEMENT STRUCTURE	SUMMARY	CORPORATE BUYER POSITION	POWER PRODUCER POSITION	LENDER POSITION
Energy attribute certificates (EACs) – also known as RECs, I-RECs, GOs and REGOs in different geographies	EACs are tied to the generation of a specific project and can either be assigned to the corporate buyer as such or sold into the tradable EAC market. In most markets (e.g., most European markets), EACs are low value; project-specific EACs are typically bundled into the PPA price and retired by the corporate buyer as proof of additionality. However, where sold, they represent an effective subsidy to the underlying PPA price (i.e., reduces PPA price). EACs have different values in different markets based on a range of factors, including the extent to which it is considered a compliance market driven by mandated renewable portfolio standards (RPS) (e.g., in the northeast and mid-Atlantic regions in the US and in Australia), which typically pushes up the EAC value.	The norm is for EACs to be bundled into the PPA price and subsequently retired. The EACs are the key proof of additionality. Corporate buyers with consumption in compliance EAC markets (i.e., those with RPS), will often retain project- or market-specific EACs to avoid an onward charge from their utilities for EAC RPS compliance costs. In certain circumstances (e.g., most commonly seen in the US), where the corporate buyer is seeking to retire project-specific EACs, projects located in regions with higher EAC values (due to RPS) will typically be less competitive for them compared to projects in regions with no or less prescriptive RPS requirements and lower EAC values. This is because the developer requires a higher PPA price to recover value lost from the EAC retirement. Corporate buyers can look to lower PPA pricing through EAC swap arrangements that unbundle the project-specific EACs for sale and in turn purchase cheaper generic EACs. However, many corporate buyers have additionality as a core objective of their renewable power purchasing strategy, which offset claims from non-project specific EACs can undermine. There are potential implications for emissions reduction reporting.	In most markets, power producers offer bundled project-specific EACs as standard. However, power producers in high-cost EAC markets may prefer to have the option of EAC swaps or similar to enhance the competitiveness of their pricing, although in doing so, they absorb the risk and reward of such EAC arbitrage. Most power producers also now recognize the importance of additionality to corporate buyers.	Lenders are typically unconcerned by the value of EAC, especially in low-value EAC markets. However, where the power producer is participating in EAC arbitrage (less common as described) in a high-cost EAC market, the lender will in turn be exposed to additional EAC price risk.

SETTLEMENT STRUCTURE	SUMMARY	CORPORATE BUYER POSITION	POWER PRODUCER POSITION	LENDER POSITION
Negative price floors (VPPA only)	Most PPAs are typically signed with negative price floors. This protects the corporate buyer against large top-ups to the PPA strike price (i.e., the top up payment is limited to the PPA strike price). This is increasingly important as renewable penetration in liberalized markets increases, especially where the subsidy or revenue stabilization regime (e.g., production tax credits in the US or the previous CfD mechanism in the UK over shorter periods) encourages renewable production at zero/negative pricing. Production-linked subsidies (e.g., production tax credits in the US, renewable obligation certificates (ROCs) in the UK[24] and similar subsidies that are compatible with PPAs can incentivize the power producer to produce even when prices are negative.	The increased penetration of renewables, coupled with certain subsidy regimes that allow production at negative prices, both exacerbate and reinforce the need for the corporate buyer to protect against negative prices through a negative price floor.	The power producer is typically best placed to manage the risk around negative pricing by curtailing output (e.g. for day-ahead market). It should be noted that under a plain-vanilla fixed-price PPA, the power producer is still incentivized to produce at low negative prices (even with a negative price floor).	A negative price floor is a typical concession to the buyer in PPAs. It should have a limited impact on the availability of debt financing because most projects financed with a PPA have such a clause attached.
Hub vs nodal (US-specific)	Within each organized wholesale electricity market in the US, electricity prices are set at nodes – the individual point on the power grid where specific generating assets are connected. There are hundreds if not thousands of nodes within a market. Nodal prices are then aggregated via a weighted average formula into a handful of regional hubs or zones. These aggregated values are typically less subject to local fluctuations in electricity markets and are therefore more stable over time.	Since hub prices are typically less volatile, most corporate buyers choose to negotiate their VPPA so that it settles at the hub, meaning that the cashflows the buyer receives/pays for each MWh generated are based on the regional hub price rather than the local nodal price.	Hub settlement requires that the power producer, project owner or a third party absorb any price discrepancies between the nodal and hub prices for each MWh (known as basis risk).	Given that the power producer takes on the basis risk associated with the more typical hub settlement-based contracting arrangement, lenders are likely to consider the level of risk as part of their assessment of project bankability and deliverability.

[24] Note both regimes above are being phased out.

SETTLEMENT STRUCTURE	SUMMARY
Settlement market (VPPA only)	Key drivers are finding an agreed upon liquid and transparent settlement benchmark price. For instance, in Europe using day-ahead national pricing is most common as it is more liquid, less volatile and more transparent than the spot market (within-day market) price. In the US, settling based on the spot market is more common.
Pricing interval (VPPA only)	Possible options are 15 minutes, 30 minutes, hourly, daily, monthly or even annually. Wind and solar projects where output is sold on a pay-as-produced basis tend to use the smallest liquid and transparent settlement market price window. This is for the most part tied to the power market pricing windows of the project. We note that PPAs selling on a pay-as-produced basis most often settle on an hourly or daily basis. This becomes appropriate where the power producer can control (i.e., hydro and biomass) or could control (through the installation of collocated storage) the timing of dispatching power to the grid. In such cases, a pay-as-produced fixed PPA settled every 5/15/30/60 minutes may simply not incentivize the operator to maximize the wholesale price achieved. With an increasing risk of wind/solar price cannibalization, capture prices are expected to decline compared to baseload (note this is factored into the PPA price); however, an acceleration in renewable energy deployment and price cannibalization ahead of forecasts could potentially leave virtual PPA buyers exposed to increasing top-up payments. Operators (rather than buyers) are in the best position to manage such daily profile/shape risk. The use of monthly and annual benchmarks is more typical when contracting for baseload blocks in physical PPAs.
Computation of averages (VPPA only)	Where the time unit used to settle the PPA is not the smallest time unit possible, the question arises of how to aggregate such prices into a larger window of time (i.e., day, month, year). Options include simple averages, generation/volume-weighted averages and technology-weighted averages. It is worth noting that the reported/quoted market convention (i.e., published prices) will often dictate the average settlement price used. For example, settlement on an arithmetic (i.e., unweighted) daily average of hourly prices will lead to less VPPA payment volatility than settling on an hourly (i.e., weighted) average basis. And as described above, it may well also reduce exposure to an increasing cannibalization risk for hourly capture prices for wind and solar. This choice also has particular ramifications for structures with collars and floors because shorter periods produce greater price volatility and therefore greater CfD payments.
Settlement currency	For certain emerging markets, the buyer and power producer may reach an agreement to denominate the PPA price in a hard currency (typically USD or EUR). This is one way to reduce country level macroeconomic risk as well as foreign exchange exposure. As an example, PPAs in Argentina are typically denominated in USD (see WBCSD's Power Purchase Agreements in Argentina publication). This may be a particularly attractive option for multinational companies with manufacturing operations in developing nations but revenues in developed countries.

7 Where to next?

IMPACT OF COVID-19 ON PRICING DECISIONS

The COVID-19 pandemic suppressed wholesale electricity prices in many markets in 2020. Despite a fairly quick recovery in many markets, forecasters predict a lasting medium-term impact to at least 2023 in a few other markets.

To mitigate initial negative cashflows (relative to depressed wholesale prices) some corporate buyers are opting for stepped pricing, fixed price with escalation or fixed price with inflation as opposed to fixed-price nominal arrangements.

INCREASED RENEWABLE ENERGY MARKET SHARE

With expectations of increased renewable penetration and forecasts for further price cannibalization of wind and solar capture prices, some corporate buyers are also increasingly favoring floating structures with caps and floors, which were previously less common. Some markets might even see the growth of deescalating price structures to keep pace with the decreasing cost of renewables and their increasing share of generation.

SETTLEMENT DECISIONS

We have observed a move by corporate buyers towards hub prices from nodal pricing and to national pricing from zonal pricing. Larger markets are typically more transparent, allowing comparability between PPA offers from different power producers, and are likely better correlated with the corporate buyer's consumption profile.

While the market standard for solar and wind projects remains pay-as-produced hourly settlement, we expect a move by some more risk-averse companies towards the use of daily or weekly average pricing. This is closer to the comparatively flat consumption profile of corporate buyers, as opposed to variable generation from wind/solar.

CONCLUSION

We expect that fixed-price structures will remain the norm for most PPAs globally; however, as this report illustrates, there is a huge variety in alternative structures and settlement conventions for both physical and virtual PPAs. There is also wide variety by region and by corporate buyer preferences.

Looking to the future, it is unlikely that the available menu of pricing structures will get any simpler – as they need to reflect a bespoke balance of risks and benefits between power producers and corporate buyers. This presents an opportunity for all parties to a PPA to choose the approach that aligns best with their needs and helps to adapt to volatility in the wholesale power market.

List of acronyms

CfD	Contract for differences
CPI	Consumer price index
EAC	Energy attribute certificate
FV	Fair value
GAAP	Generally Accepted Accounting Principles
GO	Guarantee of origin
GTAM	Green Term Ahead Market (India)
IAS	International Accounting Standard
IFRS	International Financial Reporting Standards
I-REC	International renewable energy certificate
ISO	Independent system operators
NEM	National Energy Market (Australia)
OTC	Over-the-counter
PPA	Power purchase agreement
REC	Renewable energy certificate
REGO	Renewable energy guarantees of origin
ROC	Renewable obligation certificates
RPS	Renewable portfolio standards
VPPA	Virtual power purchase agreement

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This publication is released in the name of the World Business Council for Sustainable Development (WBCSD). It is the result of a collaborative effort between WBCSD, EY and representatives from companies participating in the WBCSD Corporate Renewable PPA Forum. A range of WBCSD members reviewed the material, thereby ensuring that the document broadly represents the majority view of the Corporate Renewable PPA Forum. It does not mean, however, that every company within the forum agrees with every word.

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ABOUT WBCSD'S RESCALE PROJECT

REscale brings together leading companies representing the full renewable energy value chain to accelerate the deployment of renewables and the transition to a low-carbon electricity system. REscale members share the ambition to scale up renewable deployment beyond average growth.

This report It builds on previous reports on corporate PPAs including Corporate Renewable Power Purchase Agreements: Scaling up globally (26 October 2016) and Innovation in Power Purchase Agreement Structures (27 March 2018), How multi-technology PPAs could help companies reduce risk (7 March 2019) and Cross-border renewable PPAs in Europe: An overview for corporate buyers (7 December 2020). The WBCSD Corporate Renewable PPA Forum is the platform undertaking this work.

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