Aquila Capital

POWER PURCHASE AGREEMENTS: A EUROPEAN OUTLOOK

Executive summary

- In the last five years, Europe has seen significant growth in the use of PPAs for renewable energy. This is largely due to decreasing costs of renewable energy generation, phasing out of feed-in-tariffs as well as growing corporate demand for green energy.
- Although PPAs are used in several countries across Europe, the majority are concentrated in just a few, where subsidies are limited. However, demand is spreading across the region and several renewable energy projects are seeking PPAs in order to become realised.
- Looking ahead in Europe, generation capacity will be dominated by fluctuating renewable energies such as wind, solar PV and hydropower, which will lead to increased uncertainty in market prices. PPAs are one way to manage this risk as they lock in future energy at a stable or more predictable price for the longterm.

Authors:

Dr. Dirk Brunnberg
Investment Manager
Energy & Infrastructure EMEA
dirk.brunnberg@aquila-capital.com

Joakim Johnsen
Head of Merchant Market Desk
Energy & Infrastructure EMEA
joakim.johnsen@aquila-capital.com

1. Introduction

What is a Power Purchase Agreement (PPA)? It is essentially an arrangement between a generator of electricity and an off-taker to sell and purchase electricity outside of wholesale spot electricity markets. In general, PPAs can be concluded with two different types of off-takers: utilities and corporates.

In the last five years, a tremendous increase in the use of PPAs for renewable energy in Europe can be observed. According to Bloomberg Energy Finance,[1] over 5 GW of corporate PPAs have been signed in the EMEA region since 2013, with a record of 2.3 GW in 2018. Most transactions were concluded in the Nordics, with strong demand from industrials such as Norsk Hydro or Alcoa Corp, but also from international tech companies such as Facebook, Amazon or Google.

The growth of PPAs in Europe has been driven primarily by: (i) Government subsidy schemes being phased out as the levelized cost of energy from renewables is becoming competitive, (ii) increasing interest from corporations in procuring renewable power, (iii) nordic heavy industry entering into PPAs with wind producers rather than traditional utilities, (iv) new players – such as Amazon, Facebook and Google – building renewable PPA portfolios internationally.

PPAs are not a new phenomenon and have been in the market for many years, most importantly in the Nordics. However, a relatively new development is that global companies are buying renewable energy directly from independent electricity generators under a long-term corporate PPA.

While PPAs offer several benefits, the risk factors also need to be considered and managed. Market-based schemes are different from government subsidised markets and include challenges from structuring the right type of PPA to match a project, to finding a suitable off-taker.

A more detailed view of the risks and how to mitigate them will be discussed later in this paper, along with the benefits that PPAs offer. This paper will also discuss different types of PPA structures and the main European PPA markets today.

2. Key PPA characteristics

A PPA defines all the commercial terms of the sale of energy between the generator and the off-taker, from the schedule for delivery of energy, to prices and termination.

This agreement enables the generator to secure a stable revenue stream and increase the bankability of the renewable energy project, while providing the buyer with predictable prices over the long term and the ability to act sustainably. As will be presented later, there are different structures for firm price PPAs according to the relative risk off-taker and producer want to bear, alternatively to firm price PPAs, there is also the possibility of using floor prices, that protect from decreases in prices while allowing for upside potential.

The key elements of a PPA include contractual parties, volume, pricing and tenor. More details on each of the key elements are set out below.

2.1 Contractual parties: power producer and off-taker

Generators can enter into PPAs to secure long term, stable cash flows in order to reduce exposure to merchant risk in the power market and increase the bankability of projects. Off-takers are typically:

- **Utilities which have a significant level of energy generation and demand.** These companies see PPAs as a way of balancing their portfolios while earning balancing fees and collecting margins when re-selling the power, as they have their own end-consumers to whom to sell that power. There are also pure trading firms, which do not have assets.
- **Corporate consumers in energy intensive sectors such as industrial or technology.** It is a relatively new phenomenon that corporates buy directly from energy producers. For energy generators, these contracts, known as corporate PPAs, offer the benefit of diversifying revenue streams and enabling projects that might not otherwise be built. Meanwhile for companies, long-term PPAs provide potentially below-market rates, a long-term hedge against price volatility in the wholesale market, as well as support for business sustainability ambitions.

  The typical corporate off-takers in Europe are in energy intensive sectors such as heavy industry and technology. Companies in the aluminium, smelters and pulp and paper industry consume a significant amount of electricity and their objective is to procure cheap power irrespective of the source of production. Technology companies have also been attracted by the cheaper power price for the consumption of their data centres.

[1] *Source: BNEF Corporate PPA Deal Tracker*

In the context of sustainability goals of corporates, the RE100 project, a global initiative bringing together over 100 of the world's most influential businesses which are committed to procuring 100 % renewables power for their energy consumption, has encouraged more companies to focus on sustainability. The keyword here is 'Additionality'[2] – corporates facilitate PPAs through their long-term off-take commitment. Google for example has contracted around 450 MW of renewable wind PPAs in Sweden since 2012,[3] due to its focus on securing predictable energy prices and demonstrating its ambition for clean energy procurement. Renewable energy PPAs play a significant role in the fight against climate change and global warming. These contracts can be used as an instrument to tackle these issues, when creditworthy PPA off-takers enable project financing for renewable energy assets.

Windfarm in Sweden

2.2 Structure: volume and prices

PPAs are typically structured with one or more of the following features depending on the risk appetite of the generator and off-taker, considering volume delivery obligations (how much to deliver) and delivery production profile (when to deliver):

Figure 1: PPA pricing structures

Types of PPA		Volume delivery obligation & delivery profile	Volume risk	Production profile risk	Merchant risk
Fixed Volume	**Baseload**	■ Predefined volumes according to a predefined hourly profile ■ Delivery profile obligations for every hour ■ Pre-agreed fixed or floor price	✓	✓	✗
	Fixed Volume for defined period	■ Annual/quarterly/monthly pre-defined volumes ■ Delivery profile obligation within the predefined timeframe but no matter when ■ Pre-agreed fixed or floor price	✓	✗	✗
Variable Volume	**As-Produced ("As-Produced")**	■ Pre-agreed % of production at a pre-agreed fixed or floor price ■ No volume delivery obligation or delivery profile obligation	✗	✗	✗
	Route-to-Market	■ Pre-agreed % of production at market spot price ■ No volume delivery obligation or delivery profile obligation ■ No fixed or floor price	✗	✗	✓

**merchant exposure depends on the percentage of production covered by the PPA*

[2] *The International Renewable Energy Agency (IRENA) defines additionality as: "The net incremental renewable capacity deployed or renewable energy generated as a direct result of corporate sourcing of renewable energy beyond what would occur in its absence".*
[3] *Source: Aquila Research*

i. Fixed Volume PPAs

Under this arrangement, the generator agrees to a predetermined production volume that must be delivered in a specified time interval which is sized according to the generator's seasonal P50 production[4] profile, in exchange for a pre-agreed fixed price per MWh for delivery over the term of the PPA. If the actual production is below the predetermined production volume, the generator would be responsible for procuring the missing volumes from the market. Prices under this type of arrangement tend to be higher to reflect the volume delivery obligations, i.e. the generators bear volume risk.

The most common time interval when delivery is required is hourly (**"Baseload"**). Generators can earn a comparatively higher sales price under a Baseload PPA because it has a strict hourly delivery obligation and therefore the generator bears a higher degree of under-producing risk.

It is also possible to structure a Fixed Volume PPA with a more flexible delivery profile, for example quarterly and annual time intervals (**"Fixed Volume For Defined Period"**), in which the generator agrees to deliver certain volumes in a certain time frame in exchange for a pre-agreed fixed price. The generator has the obligation to deliver the total predetermined volumes in the specified timeframe, but is not constrained in terms of the timing of the delivery, i.e. no production profile risk. This type of PPA is less common and usually set at a lower price than Baseload PPAs.

ii. Pay-As-Produced PPAs

Under a Pay-As-Produced PPA, the off-taker agrees to purchase all or a percentage of the produced volumes at a pre-agreed fixed price, regardless of the level of the actual production. As there is no target production volume, the generator does not take any volume or profile risk. Pay-As-Produced PPAs are less common than Fixed Volume PPAs as under this arrangement the off-taker bears the volume risk in the event of underproduction. Where available, Pay-As-Produced PPAs are appropriate for up to 100% of P50 production. However, these PPAs are generally rare or usually set at a significantly lower price than Fixed Volume PPAs.

iii. Route-to-Market PPAs

Under a Route-to-Market PPA, the generator establishes a contract with an off-taker which has the appropriate trading capabilities, e.g. a utility or corporate with in-house trading capability or a third-party service provider, to sell on electricity produced at the prevailing market price, without any volume or production profile risk. The off-taker applies a service fee to the achieved sales price for selling the electricity. Under this arrangement, the generator does not have a price hedge and is exposed to market prices. The exposure to merchant risk provides the generator with the opportunity to achieve the highest electricity sales price. The appropriate share of revenues under a Route-to-Market PPA depends on the generator's view on the development of the electricity prices and its risk appetite.

2.3 Tenor

In the Nordics, the majority of off-takers for long term PPAs has been heavy industry, such as aluminium smelters. Companies such as Hydro and Alcoa have locked in PPAs that range from 15 to 29 years. In the wind industry, some of the utilites and traders being active buyers, with typical tenors ranging from 10 to 15 years. The tenors that utilities and traders offer also depend on the liquidity of the forward market, which quotes prices up to 10 years, although liquidity is limited at the far end of the curve.

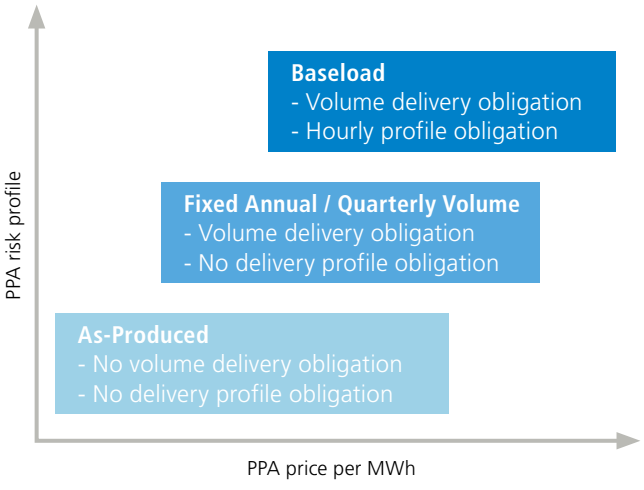
In Iberia, which is still a relatively new PPA market, we see that tenors are typically up to 10 years. There are fewer industrial consumers interested in hedging long term and the forward market is less liquid and extends to only six years. Professionalized power purchasing from industrials is still in their infancy, focusing on very short tenors – typically up to a maximum of 3 years.

Although from a generator's perspective, longer PPA tenors are beneficial for debt structuring and terms, they limit access to merchant upside from potential power price growth in the future. Thus, in every hedging decision, individual characteristics and requirements need to be considered.

2.4 Volume and profile risk

Overall, PPAs with stricter delivery obligations tend to be balanced with a more attractive remuneration for the generator. While the stricter the delivery obligation, the better the price for the generator, the risks of being unable to meet the delivery obligations and merchant exposure also increase. Appetite for merchant exposure derived from volume and profile risks is usually the key deciding factor for generators to develop an optimal structure for PPAs.

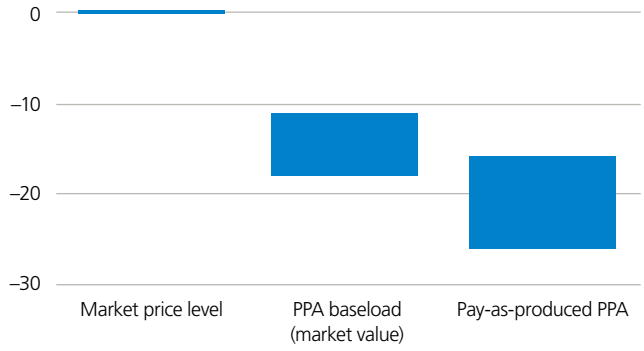
Figure 2: Risk-Price profile of different PPA structures



[4] The P50 numbers equals to the estimated production volume that is created with a probability of 50 percent (based on energy yield assessments).

When considering the structure of PPAs, views on market risk and outlook are the key driver behind approaches to power purchase, given the trade-off between security (e.g. price certainty) and potential upside (e.g. long-term prices in merchant market). Analysis of the risk profile of different products and consideration of visible, long term revenue and the potential to capture potential upside on long term prices are key to determine the right balance between risk and return.

Figure 3: Comparison of solar PV PPA price discounts across European countries (Italy, Spain and UK) for 10 years in %



Source: Pexapark (2019)

Figure 3 above illustrates the PPA price discounts for solar PV projects across different European countries for a tenor of ten years. The main implication is that the final PPA price is dependent of the risk allocation between the producer and the off-taker. While baseload structures have a discount between 11 and 17 percent, a higher discount between 16 and 26 percent is assumed for pay-as-produced structures. The discounts are country- and product-specific and might deviate if the underlying assumptions are changing over time.

3. Common contract structures

PPAs for new build projects are typically structured as either 'Physical' or 'Virtual'. A virtual PPA is a financial contract and has been widely adopted in larger markets around the world. Moreover, 'Direct PPA' is another form of physical contracts, where the generation asset is located next to the point of consumption. Direct PPAs are not discussed in this paper, as this is not a common structure.

3.1 Physical PPAs

In a physical PPA, the generator delivers and the off-taker receives the power physically in the same grid, although not necessarily at the same point. The generator can appoint a licensed utility or energy trading firm to physically transfer the power on its behalf. The off-taker and the generator agree on a price structure, as well as on handling any renewable certificates. The off-taker uses the service of a utility or energy trading firm in order to transfer the bought electricity through the grid to the consumption site.

[5] *Source: Wind Europe (2019)*

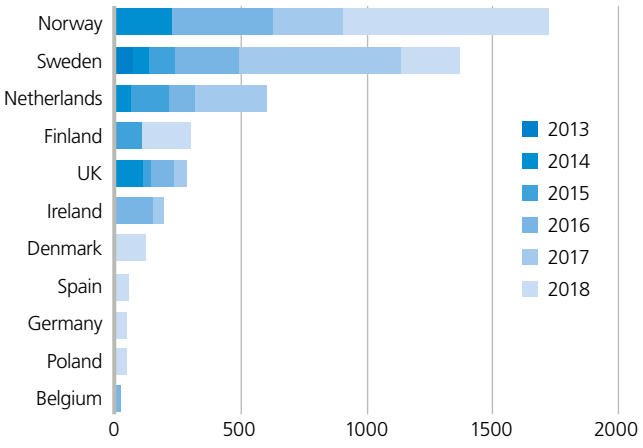
3.2 Virtual PPAs

Unlike a physical PPA, this form of agreement is a financial contract which aims to create a similar economic impact for both parties. The off-taker and generator agree on a price structure and the transfer of any renewable certificates. The generator delivers the energy to the grid and is paid a variable spot price. The price difference between the variable market and the strike price/price structure is settled by the generator and the off-taker – when the variable price exceeds e.g. an agreed fixed price, the generator passes the positive difference to the off-taker. When the market price is below e.g. an agreed fixed price, the off-taker pays the generator the difference (this example is known as a contract for difference). The generator also delivers the renewable certificates to the off-taker, if contracted. The off-taker continues to purchase power from at a variable market price, however the PPA acts purely as a financial hedge against fluctuations in prices.

4. A comparison of PPA markets across Europe

In Europe, PPAs are used in several countries, however the majority are concentrated in just a few countries where subsidies are limited (Figure 4).

Figure 4: European wind PPA volumes[5]



PPAs are expected to be increasingly prominent across all renewables in Europe as developers and investors seek alternative structures. So far, the most active markets have been Norway and Sweden up to 2018. But demand for PPAs in Europe has taken off due to decreasing costs of renewable energy generation, the phasing out of feed-in-tariffs as well as corporate demand for green energy. For example, there were already a couple of larger-scale PPA transactions in Spain in 2019, such as with Statkraft (50 MW Solar PV) and Holaluz (500 MW Solar PV).

1. NORDICS: This market has a significant number of corporates with high electricity demand and sustainability objectives. Sweden and Norway both have a liquid, sophisticated, well-developed PPA market, driven by large industrial buyers, a well-functioning power market, a stable grid system, and regional interconnection.

The power market has historically been highly fragmented, with many local utilities taking small market shares, particularly in hydro-electricity generation. To ensure the sale of power produced, these market participants began to explore PPAs as an instrument long before PPAs moved to the forefront of the renewable energy agenda. The liquidity of the Nord Pool spot market and, in particular, the longer tenor (up to 10 years) of the electricity futures in Nord Pool traded on Nasdaq Commodities, enabled electricity generators to explore different arrangements with off-takers for part or all of their power production. Complementary to the Nord Pool market, the power grids in Nordic and Baltic countries are interconnected, enabling the trading of electricity between countries. This also contributed to the development of a liquid market in Sweden and Norway. The region is home to some of the largest corporate PPA deals.

2. IBERIA: In Portugal and the wider Iberian region, there has been recent growth in the PPA market driven by the increasing focus on renewables installation in the absence of governmental subsidy schemes. Without the reliance on government subsidies, developers are motivated to explore options to enter into fixed price arrangements to ensure price certainty and bankability of projects. In 2017, Portugal announced a solar plan, Plano Nacional Solar, to identify solar projects and create a remuneration scheme based on market prices. One such project is a 28.8 MWp plant being developed by Hyperion, from which Axpo Energy has agreed to buy electricity for 10 years. Additionally, the largest unsubsidised solar PV plant in Europe, the 221 MWp Solara 4 Vaqueiros Solar PV Park, is being planned in Portugal.

In Spain, market barriers have prevented the widespread use of PPAs. However, the market is now emerging and is expected to be one of the fastest adopters of PPAs in 2018, due to relatively high power prices (energy mix with a notable participation of CCGTs (combine cycle gas turbines)), and strong renewable energy resources. Moreover, the Foresight Group announced the first corporate PPA in Spain in December 2017, entering into a 10-year deal, and subsequent to this a number of deals have been signed in 2018. Buyers of PPAs tend to be domestic retailers and foreign trading companies. Similar to the UK, deals are contracted for a shorter term.

3. UNITED KINGDOM: PPAs have been in the UK for some time, but only started to gain traction around 2011. Key fiscal incentives such as Feed-in-Tariffs (FiT) and Renewable Obligation Certificates (ROC) provided a significant portion of revenue certainty for projects, which led to power generators mainly entering short-term PPAs with utilities. More recently however, PPAs have grown due to a rise in wind and solar projects in the UK. In addition, the closure of the ROC scheme to new participants (from 31 March 2017) has encouraged generators to seek an alternative route-to-market. A PPA with a creditworthy corporate, coupled with competitive pricing (as costs of generating renewable energy continue to fall), has expanded the UK corporate PPA market to include large companies such as Shell. Unlike the Nordics, deals have often been contracted for shorter tenors as companies are less energy intensive. However, recent years have seen longer tenors emerge. Marks and Spencer agreed a 20-year PPA to purchase 6.1 MWp of solar power, while McDonald's UK signed 15 to 20-year deals to procure renewable energy from wind and waste gasification projects in the UK. Additionally, Rolls-Royce agreed a 25-year solar energy corporate PPA with Belectric UK.

Holmen in Norway

4. THE NETHERLANDS: Due to ambitious renewable energy targets set up by the EU, the Dutch government implemented a variety of regulations and measures to support renewable energy projects. In this market, PPAs without the need of a utility are frequent, as are longer tenors. The majority of PPAs that have been concluded have focused on onshore wind projects – in September 2015 Dutch utility Eneco opened its largest onshore wind farm in Delfzijl Noord, and Google agreed to purchase the total output for 10 years. And a year later, a new development in the corporate PPA market emerged: AkzoNobel, DSM, Google and Philips announced that they had formed a consortium in order to buy energy directly from renewable energy producers in the Netherlands.

5. ITALY: Italy's renewable energy market has also been transforming in recent years and as above, deals are contracted for the shorter-term (typically up to five years). In 2018, French corporate Engie and UK corporate Octopus Investments each secured 5-year deals. The market is expected to gain maturity over the next couple of years however, in part due to changes in regulation and the launch of more online trading platforms.

6. GERMANY: The German PPA market is limited, but interest and awareness for PPAs is growing. Due to an attractive support scheme for renewable energy and traditional electricity supply agreements that also include the sale of certificates of origin for renewable energy, corporates have been able to buy renewable energy for a fixed price. However, amendments to the Federal Renewable Energy Act in 2017 are set to make fixed price PPAs attractive to electricity generators.

Eggebek in Germany

7. IRELAND: Supply and demand dynamics in the Irish market are expected to catalyse corporate PPAs in the country. Historical barriers for renewable projects are beginning to lift, and there is a growing pipeline of wind and solar projects. The market design change, from a compulsory pool market (SEM) where the main incumbent (ESB) exerted a dominant position, to a bilateral market (iSEM) based on balance responsible parties has been a key driver in this transition. Demand is also apparent with over 60% of the RE100 project group's companies based in Ireland. For example, Microsoft and General Electric entered into a 37 MW 15-year corporate PPA for wind energy. Another example for international activity is a 41 MW wind farm PPA that the Norwegian utility Statkraft signed in 2018.

8. POLAND: Poland is another emerging European market with the potential to use PPAs as a way to support the development of wind energy in the country. The first deal was agreed in August 2018 – Mercedes-Benz signed a PPA to buy energy for its manufacturing facility in Jawor, Poland, from a 45 MW wind farm. This first corporate PPA in Poland is also the first corporate PPA from an automotive corporate in Europe. However, current PPA capacity in Poland is still limited and according to the Polish deputy energy minister, Tomasz Dabrowski, this low demand is primarily expected from the energy intensive industry.[6]

[6] *Montel News as of 14 March 2019.*

So far, demand for long term PPAs has been limited to some European countries. However, demand is spreading across the region. Moreover, many renewables projects are looking for PPAs in order to become realised. Knowing the structures and risks involved is therefore a key capability and skill that successful infrastructure investors must master for the future.

Going forward, according to the European Commission's Energy Outlook 2050, generation capacity will be dominated by fluctuating renewable energies (wind, solar PV and hydropower), which will in general lead to more volatile prices and thus to increased uncertainty in market prices. Recently, wholesale energy prices for gas and electricity have fallen in Europe, but price increases are anticipated due to increasing gas prices from 2020 until 2030. The main factor behind this is the higher demand for gas, since carbon-intensive generation (such as coal) is phased out and banished from the grid.

These factors have encouraged market participants to find ways to lock in future energy at a stable or more predictable price for the long-term, using a variety of derivative contracts. PPAs are one of the ways to manage risk, as they are essentially a forward contract (an obligation to buy or sell a fixed amount of electricity at an agreed price structure for a specific date or timeframe in the future). However, they are unique in the way that they cover long term market risk of up to 20 years.

5. Aquila Capital's expertise: our approach to PPAs

Aquila Capital has structured over 1200 MW of PPAs in the last five years. We have a team of dedicated resources – the Merchant Market Desk – working on sourcing and structuring PPAs for all our projects across Europe. We have a proactive PPA strategy in relation to our projects, which means that when we enter into a transaction, we already know whether it is feasible to structure an attractive PPA for that particular project. We believe that having a solid network and understanding our off-takers is critical, as PPAs are not standardised and each transaction requires customised solution.

We see the PPA as an integral part of our energy risk management process. We use quantitative analysis to optimise hedging decisions throughout the lifetime of the project. Our Merchant Market Desk is supported by our dedicated Energy Risk Management analysts to ensure that the PPAs are structured optimally throughout the lifetime of each project.

For more information please contact:

Aquila Group
Valentinskamp 70
20355 Hamburg
Germany
Tel.: +49 (0)40 87 50 50 - 199
E-mail: info@aquila-capital.com
Web: www.aquila-capital.com

Follow us on

Hamburg · Frankfurt · London · Luxembourg · Madrid · Oslo · Zurich · Invercargill · Singapore · Tokyo

A publication of Aquila Capital Investmentgesellschaft mbH. As of October 2019. Authors: Dr. Dirk Brunnberg, Joakim Johnsen