Renewable Energy and PPAs: Hedging with EEX Power Futures
A few key figures

17%

2016 estimated share of renewable energy in the EU's gross final energy consumption

€62bn

Feb 2018: IRENA report of estimated average investment in renewable energy per year to reach 34% capacity in the EU

32%

June 2018: new binding 2030 renewable energy target for the EU

Source: EU Commission, Bloomberg
PPAs: Nothing new, but now a Key Driver of Renewable Energy Investments

Power Purchase Agreement (PPA)
Long term contract between a party generating and selling electricity and a party purchasing electricity. Have existed for decades.

Corporate PPA
Corporate PPAs enable businesses to source electricity from generators at an agreed price, while giving producers a reliable, guaranteed buyer at a stable price.

Utility & Corporate PPAs
Electricity traded between the two parties comes from a Renewable Energy power plant. PPAs are necessary to be in place prior to a RE asset developer securing financing from a bank for their project. Purchasers can be wholesale buyers/Utilities or Corporates, and are attracted by lower prices and the ‘green credentials’ in having their power supply come from 100% renewable sources. RE PPAs are often fixed for long periods, up to 15 years, to ensure revenue security for the developer.
Framework and preconditions for PPAs to be realized in a Power Market

- Decreasing RES LCOE*, increasing competition
- Expectation of sufficient power market revenues to cover LCOE
- Less attractive or no revenue alternatives (from RES support schemes)
- Demand from large consumers for long-term (green) PPAs
- Trust from banks and investors

*LCOE = Levelized cost of electricity generation
Source: enervis energy advisors (Berlin)
Financial / Synthetic PPAs create Spot Price Risk Exposure

Financial PPAs as a first guarantee of revenues for the Generator and long-term price certainty for the Offtaker; but physical flows are executed on the Spot market.

- Future-based agreement from 10 up to 20+ years
- Production is sold at the Spot market, offtaker procures via wholesale market, no physical delivery via balancing accounts
- Different options for structuring such as CfDs, Options, Index-based
- In combination with GoOs to qualify as “green power” as no direct access to renewable power from a certain generator

Due to Spot price risk exposure, a long-term hedge can be made on the Futures market to offset risk, ideally to the same tenor of the PPA.
Synthetic PPAs and Merchant Renewables in the Energy Value Chain

- Wholesale market provides valuation benchmark for revenues (producer) and cost (off taker) that are reflected in a PPA
- Value of the “greenness” is mirrored by value of Guarantees of Origin (GoO)
EEX Power Derivatives are listed in 20 EU market areas and benefit from a wide network of traders.

**Power Futures**
- Belgian Future
- Bulgarian Futures (PXE)
- Czech Future
- Dutch Future
- EEX GB Power Future
- French Future
- German Intraday Cap/Floor Future
- Greek Base Future
- Hungarian Future (PXE)
- Italian Future
- Nordic Future
- Phelix-AT Future
- Phelix-DE Future
- Phelix-DE/AT Future
- Polish Future
- Romanian Future (PXE)
- Serbian Future
- Slovakian Future (PXE)
- Slovenian (PXE)
- Spanish Future
- Swiss Future

**Power Options**
- Phelix-DE Options
- Phelix-DE/AT Options
- French Base Options
- Italian Base Options
- Spanish Base Options

EEX connects 287 trading participants from 30 countries.
It is already possible to **hedge up to 6 years in advance** in most EEX Power Derivatives Markets.
How are EEX Members active in PPAs?

RE Developers sell Power via Long-Term PPAs

EEX Members buy Power via Long-Term PPAs and build RE assets

EEX Members provide balancing services on Spot & hedge via Futures

Banks provide financing once PPA is in place

EEX Members sell Power via LT Corporate PPAs

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Renewable Energy financing extends the hedging profile of EEX Members to the long-term

- EEX Members are now seeking to hedge longer term in order to help secure financing from Banks and/or manage Merchant Risk from RE assets
- EEX is will list further calendar expiries to support long-term hedging of Renewable Energy assets
Renewable Energy and PPA Risks: Price Risk is the most important

Source: enervis energy advisors (Berlin)
How do EEX Power Derivatives help to mitigate Renewable Energy Price Risk?

Market participants who enter into long-term PPAs can register a strip of cash-settled calendar futures out to Cal+6 for clearing with EEX.

This means that sellers can lock in a secure cash flow for up to 6 years, for the sale of electricity in the respective market area.

Buyers lock in a guaranteed price of purchase for up to 6 years, providing certainty on their future electricity price and protecting against upswings.

Therefore the purchase or sale of electricity derivatives provides long-term price risk hedging together with counterparty risk mitigation through the ECC clearing house.

Since 29th May 2018, 28 long-term hedges of calendar contracts up to 2024 have been registered OTC in Spanish Power, with a total volume of 14.9 TWh.
Managing Renewable Energy Price Risk with Base Futures requires a Hedging Strategy

- Base Futures are a **best-fit product** and attract the most liquidity, creating a **strong price signal** and opportunities for trading at fair market prices.
- To use the Base Futures to manage the risk of a wind or solar profile, a **Hedging Strategy needs to be designed** to translate the variable generation profile into a constant Base load profile.
- Different Hedging Strategies can be employed, such as a **value-neutral hedge**.
Market Revenues for Wind and Solar Projects takes into account Hourly Capture Prices vs. Base

1 Day-Ahead marketing of Wind production – Status Quo

- **Hourly**: hourly revenue (€) = hourly prices x hourly production
- **Annual**: sum of all hourly revenues, sum of hourly production volume
- **Average Revenue (annual)** = (sum of all hourly revenues/annual production volume) = specific market value (€/MWh)
- **Market value factor (vs. Base)** = Percent Value (…%) x Base price

**Annual revenue** = Base price x market value factor (…%) x annual production

Project-specific!
RES technology and site

Source: enervis energy advisors (Berlin)
Cannibalization of Onshore Wind capture prices

Analysis of technology specific average wholesale capture prices based on historical hourly wholesale prices per bidding zone and historical hourly production data (2018). Graphs show average capture prices relative to Base

- Revenues of Onshore Wind are under pressure with higher penetration rates, resulting in specific average market revenues slightly - and up to two-digits - below Base
- Therefore Market Value Factor for wind is taken at 80%
Example for Hedging Wind Revenues on Futures using a Value-Neutral Hedge

2 Basis for marketing wind production in the Futures market: "Value-neutral Hedge"

- The expected value of the production is sold (risk of market value development)
- Additional risks must be evaluated and priced in and reduce PPA price

Annual Value = Base price x market value factor (…) x annual production volume

560,000 € = 50 €/MWh x 80% x 14,000 MWh

50 €/MWh x 11,200 MWh

Source: enervis energy advisors (Berlin)
Value-Neutral Hedge for Wind is one way of Managing Market Risk

By buying / selling electricity volumes on the futures market, seasonal fluctuations of market value and supply volume can be offset and trading volumes on the spot market are reduced:

- Futures market: 50 €/MWh
- Expected specific market value: 40 €/MWh
- Market value factor (wind profile) 80%

Expected annual production volume: 14,000 MWh
- Expected annual revenue:
  - $14,000 \text{ MWh} \times 40 \text{ €/MWh} = 560,000 \text{ €}$

Corresponding volume of a base product at the Futures market:
- $560,000 \text{ €} / 50 \text{ €/MWh} = 11,200 \text{ MWh}$
  (corresponds to 80% of 14,000 MWh)
- 11,200 MWh corresponds to ~ 1.3 MW base load

Source: enervis energy advisors (Berlin)
Cannibalization of PV capture prices

Analysis of technology specific average wholesale capture prices based on historical hourly wholesale prices per bidding zone and historical hourly production data (2018). Graphs show average capture prices relative to base price.

- PV generally secured revenues around or well above base prices. Varying capture rates reflect different penetration rates, resulting in a range from discounts in southern Italy up to a substantial premium in Poland.

Source: enervis energy advisors (Berlin)
Example for Hedging PV Revenues on Futures using a Value-Neutral Hedge

2 Basis for marketing PV production in the Futures market: “Value-neutral Hedge”

Annual value = base price x market value factor (% x annual production volume

475,000 € = 50 €/MWh x 95% x 10,000 MWh

- The expected value of the production is sold (risk of market value development)
- Additional risks must be evaluated and priced in and reduce PPA price
Motivation for Long-term Hedging from the perspective of the Offtaker: Price Movements

**Generator**

**Price**

- **Without a Hedge:**
  - Increasing procurement cost

- **With a Hedge:**
  - Costs are partly fixed
  - Remaining procurement becomes more expensive

**Offtaker**

- **Without a Hedge:**
  - Decreasing procurement cost

- **With a Hedge:**
  - Limited cost reduction in case of decreasing power prices

Source: enervis energy advisors (Berlin)
A 2 MW long-term hedge was cleared in Spanish Power on 10 January 2019, with an **initial margin requirement of 167,877 EUR**

- The **execution price of each trade** was **52.54 EUR**
- The **Initial Margin percentage** of the notional value of the trade was **3.71%**
Example 2: 26th Long-Term Hedge on Spanish Power cleared on 06.11.19

- A 2 MW long-term hedge was cleared in Spanish Power on 6 November 2019, with an initial margin requirement of **345,768 EUR**
- The Initial Margin percentage of the notional value of the trade was **2.45%**
## EEX Spanish Power Derivatives
### Long-term Hedges

<table>
<thead>
<tr>
<th>Trade Date</th>
<th>Product</th>
<th>Trade Price</th>
<th>Lots</th>
<th>Trade Volume in MWh</th>
<th>Notional Value in €</th>
<th>Initial Margin in €</th>
<th>Initial Margin in % of Notional Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>29/05/18</td>
<td>Q3 up to Cal24</td>
<td>€ 48.75</td>
<td>20</td>
<td>1,139,760</td>
<td>€ 55,563,300</td>
<td>€ 1,876,198</td>
<td>3.38%</td>
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<tr>
<td>18/06/18</td>
<td>Cal20 up to Cal24</td>
<td>€ 45.50</td>
<td>20</td>
<td>876,960</td>
<td>€ 39,901,680</td>
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<tr>
<td>28/06/18</td>
<td>Cal19 up to Cal24</td>
<td>€ 47.10</td>
<td>10</td>
<td>526,080</td>
<td>€ 24,778,368</td>
<td>€ 1,079,420</td>
<td>4.36%</td>
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<tr>
<td>05/07/18</td>
<td>Aug18 up to Cal24</td>
<td>€ 48.90</td>
<td>20</td>
<td>1,125,720</td>
<td>€ 55,047,708</td>
<td>€ 2,594,360</td>
<td>4.71%</td>
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<tr>
<td>12/07/18</td>
<td>Aug18 up to Cal24</td>
<td>€ 49.85</td>
<td>50</td>
<td>2,814,300</td>
<td>€ 140,292,855</td>
<td>€ 6,543,286</td>
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<td>20</td>
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<td>€ 46.60</td>
<td>5</td>
<td>505,165</td>
<td>€ 24,778,368</td>
<td>€ 1,079,420</td>
<td>4.49%</td>
</tr>
<tr>
<td>19/07/18</td>
<td>Cal20 up to Cal24</td>
<td>€ 46.60</td>
<td>5</td>
<td>505,165</td>
<td>€ 24,778,368</td>
<td>€ 1,079,420</td>
<td>4.49%</td>
</tr>
<tr>
<td>31/07/18</td>
<td>Cal20 up to Cal24</td>
<td>€ 46.70</td>
<td>20</td>
<td>876,960</td>
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<tr>
<td>10/09/18</td>
<td>Cal20 up to Cal24</td>
<td>€ 49.60</td>
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<tr>
<td>13/09/18</td>
<td>Q3 up to Cal24</td>
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<td>50 &amp; 25</td>
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<td>€ 4,529,442</td>
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<td>12</td>
<td>631,296</td>
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<td>Cal19 up to Cal24</td>
<td>€ 48.65</td>
<td>7</td>
<td>306,936</td>
<td>€ 14,932,436</td>
<td>€ 732,396</td>
<td>4.90%</td>
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<tr>
<td>23/10/18</td>
<td>Cal19 up to Cal24</td>
<td>€ 51.65</td>
<td>5</td>
<td>263,040</td>
<td>€ 13,566,016</td>
<td>€ 606,360</td>
<td>4.46%</td>
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<tr>
<td>16/11/18</td>
<td>Cal20 up to Cal24</td>
<td>€ 48.50</td>
<td>4</td>
<td>175,392</td>
<td>€ 8,506,512</td>
<td>€ 394,667</td>
<td>4.64%</td>
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<tr>
<td>07/12/18</td>
<td>Cal19 up to Cal24</td>
<td>€ 51.35</td>
<td>5</td>
<td>263,040</td>
<td>€ 13,507,104</td>
<td>€ 516,204</td>
<td>4.15%</td>
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<tr>
<td>12/12/18</td>
<td>Cal19 up to Cal24</td>
<td>Variable</td>
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<td>315,648</td>
<td>€ 16,367,134</td>
<td>€ 672,391</td>
<td>4.11%</td>
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<tr>
<td>12/12/18</td>
<td>Cal19 up to Cal24</td>
<td>€ 51.85</td>
<td>5</td>
<td>263,040</td>
<td>€ 13,638,624</td>
<td>€ 560,326</td>
<td>4.11%</td>
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<tr>
<td>20/12/18</td>
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<td>€ 52.05</td>
<td>1</td>
<td>52,608</td>
<td>€ 2,738,246</td>
<td>€ 112,679</td>
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<tr>
<td>27/12/18</td>
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<td>Variable</td>
<td>10</td>
<td>526,080</td>
<td>€ 24,738,852</td>
<td>€ 1,233,678</td>
<td>4.99%</td>
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<tr>
<td>27/12/18</td>
<td>Jan19 up to Cal24</td>
<td>€ 51.25</td>
<td>10</td>
<td>526,080</td>
<td>€ 26,961,600</td>
<td>€ 1,233,678</td>
<td>4.58%</td>
</tr>
<tr>
<td>10/01/19</td>
<td>Feb19 up to Cal23</td>
<td>€ 52.54</td>
<td>2</td>
<td>86,160</td>
<td>€ 4,526,846</td>
<td>€ 167,877</td>
<td>3.71%</td>
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<td>1</td>
<td>43,848</td>
<td>€ 2,188,015</td>
<td>€ 76,482</td>
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<td>02/08/19</td>
<td>Cal 20 up to Cal24</td>
<td>€ 51.00</td>
<td>3</td>
<td>131,544</td>
<td>€ 6,708,744</td>
<td>€ 159,708</td>
<td>2.38%</td>
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<tr>
<td>06/11/19</td>
<td>Cal 20 up to Cal25</td>
<td>Variable</td>
<td>5</td>
<td>263,040</td>
<td>€ 12,731,160</td>
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<td>Variable</td>
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<td>219,120</td>
<td>€ 10,408,476</td>
<td>€ 146,165</td>
<td>2.26%</td>
</tr>
</tbody>
</table>

**Total Trade Volume in MWh 14,982,264**
The 28 deals have contributed to EEX achieving record volumes and market share in Spanish Power.
First ever Long-Term Hedge in Polish Power cleared on 18 December 2019

- A 2 MW long-term hedge was cleared in Spanish Power on 6 November 2019, with an initial margin requirement of **933,294 EUR**
- The Initial Margin percentage of the notional value of the trade was **10.2%**

<table>
<thead>
<tr>
<th>Trade Date</th>
<th>Product</th>
<th>Expiry Year</th>
<th>Expiry Month</th>
<th>Trade Price</th>
<th>Initial Margin per Contract</th>
<th>Lots (MW)</th>
<th>Initial Margin (in EUR)</th>
<th>Trade Volume (in MWh)</th>
<th>Notional Value (in EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18/12/2019</td>
<td>Polish Power Base Year</td>
<td>2022</td>
<td>12</td>
<td>52.19 €</td>
<td>12,264 €</td>
<td>5</td>
<td>61,320 €</td>
<td>43,800</td>
<td>2,285,922 €</td>
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<tr>
<td></td>
<td>Polish Power Base Year</td>
<td>2023</td>
<td>12</td>
<td>52.19 €</td>
<td>58,078 €</td>
<td>5</td>
<td>290,390 €</td>
<td>43,800</td>
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<td>Polish Power Base Year</td>
<td>2024</td>
<td>12</td>
<td>52.19 €</td>
<td>58,238 €</td>
<td>5</td>
<td>291,190 €</td>
<td>43,800</td>
<td>2,285,922 €</td>
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<tr>
<td></td>
<td>Polish Power Base Year</td>
<td>2025</td>
<td>12</td>
<td>52.19 €</td>
<td>58,079 €</td>
<td>5</td>
<td>290,394 €</td>
<td>43,920</td>
<td>2,292,185 €</td>
</tr>
</tbody>
</table>

**Initial Margin in % of Notional Value**: **10.2%**
Long-Term Hedging in Polish Power demonstrates trust in EEX and ECC as its Clearing House

EEG Polish Power Volume and Open Interest
Daily Settlement in Illiquid Contracts and Legacy Trades

- In illiquid long-dated contracts where there have been no order book trades, EEX uses two methods to determine settlement prices

  - **Fair Value Providers**: ask chief traders from select members what their fair values are for settlement

  - **Market Structure**: take the daily price dynamic of the last liquid expiry and apply it to the illiquid expiries (ex. Cal21 increases by 30 €ct, then Cal22 – Cal24 will increase by 30 €ct)

- **Legacy Trades** are possible at EEX, in order to “roll over” a long-term hedge at the previously traded price, once a new Cal is open

- Prices which are out of range must be approved by the respective General Clearing Member
Merchant Renewables are the Next Phase in the Energy Transition

PPAs are one enabler of new Renewable Energy investments.

...but the market is in need of more standardisation and better risk management products in order to grow and meet the EU's ambitious targets.

Major energy players are already starting to hedge their long-term price risk with standard EEX products.

EEX will ensure we remain part of our Members’ long-term hedging strategy, and explore opportunities to build new products for risk management of Renewable Energy.
Thank you!

Viviana Ciancibello
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European Power Derivatives
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