Power Purchase Agreements: Hedging with EEX Power Futures

Viviana Ciancibello, Business Developer, EEX

part of eex group

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

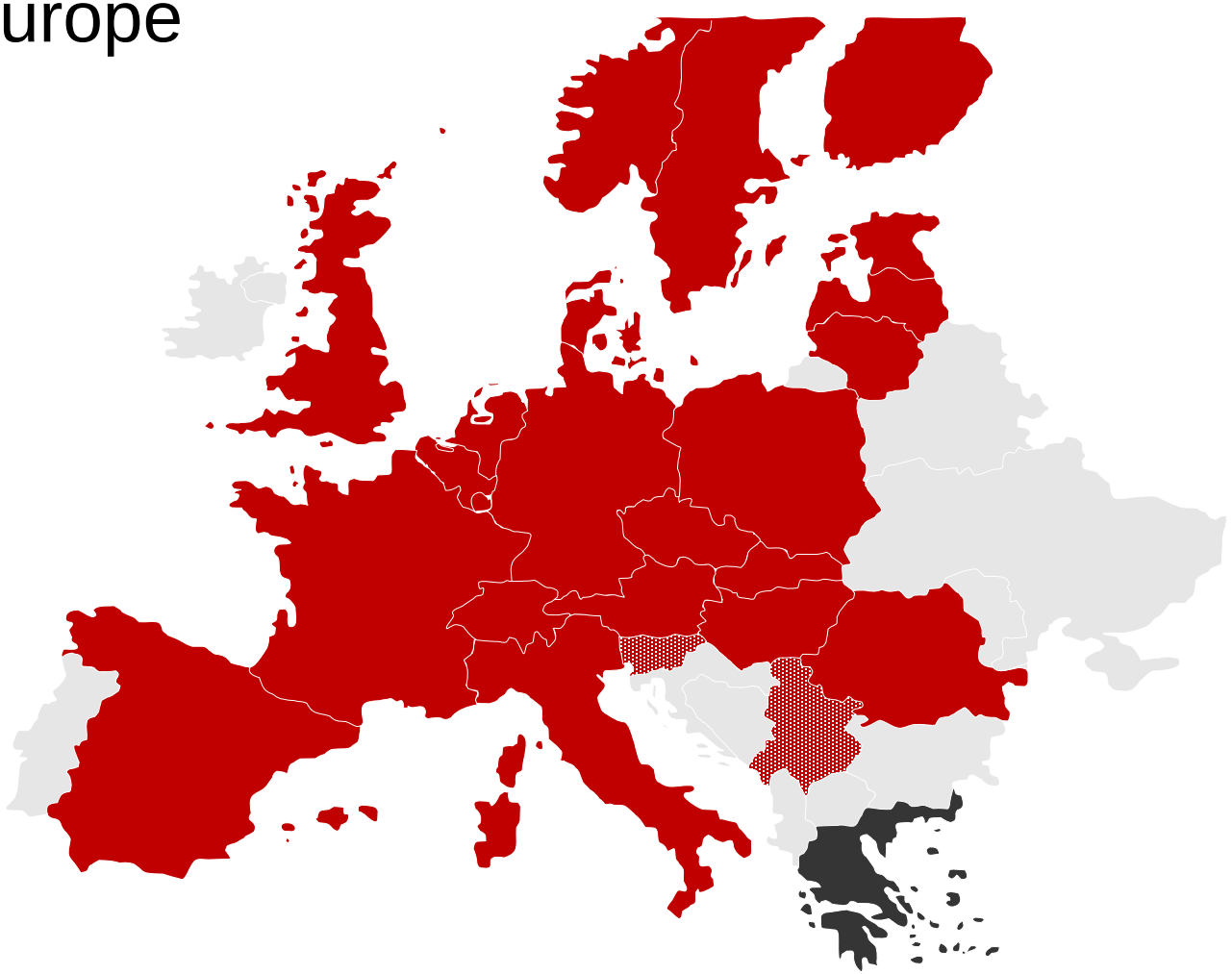
Electricity traded between the two parties comes from a Renewable Energy power plant. **PPAs are necessary to be in place prior to a RE asset developer securing financing from a bank for their project**. Purchasers can be wholesale buyers/Utilities or Corporates, and are attracted by lower prices and 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.**

EEX Power Markets house the benchmark price references for Europe

EEX connects 264 trading participants from 28 countries:

8	Austria	1	Luxembourg
1	Belgium	10	Netherlands
1	Bulgaria	6	Norway
1	Croatia	10	Poland
20	Czech Republic	1	Portugal
7	Denmark	3	Romania
2	Finland	4	Slovakia
13	France	4	Slovenia
57	Germany	14	Spain
2	Greece	3	Sweden
3	Hungary	20	Switzerland
1	Ireland	33	United Kingdom
34	Italy		

5 non-European participants
Canada, Cayman Islands, USA



* As of 31 May 2018

EEX lists Power Derivatives in 17 EU Markets

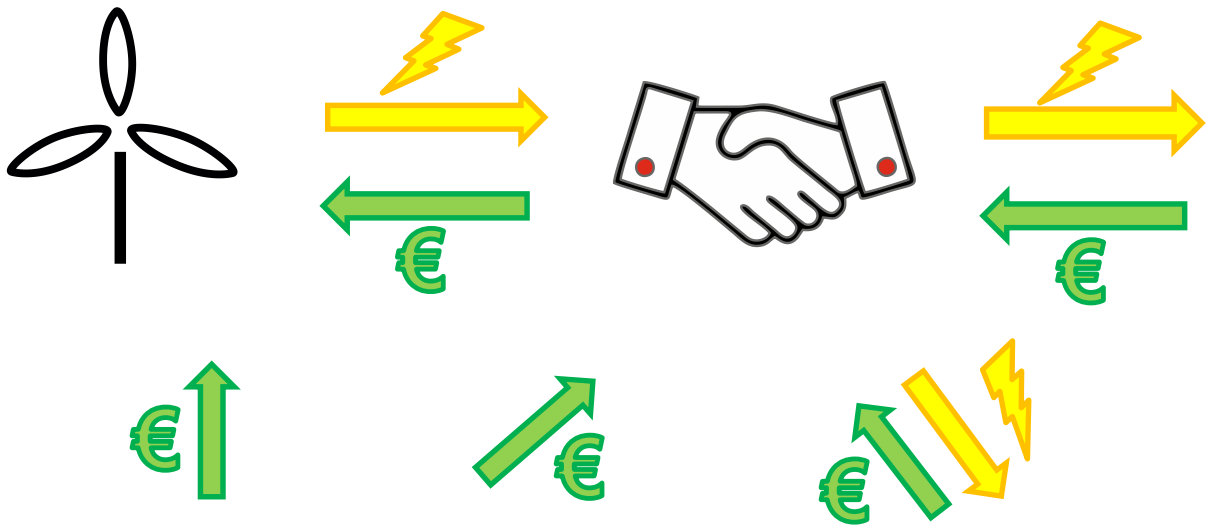
	Base							Peak						
	Day	WkEnd	Week	Month	Quarter	Season	Year	Day	WkEnd	Week	Month	Quarter	Season	Year
DE/AT (Phelix)	14	2	5	10	11		6	14	2	5	10	11		6
DE (Phelix)	14	2	5	10	11		6	14	2	5	10	11		6
AT (Phelix)				10	11		6				10	11		6
FR	14	2	5	7	7		6	14	2	5	7	7		6
IT	14	2	5	7	7		6	14	2	5	7	7		6
ES	14	2	5	7	7		6							
NL	14	2	5	7	7		6	14	2	5	7	7		6
BE				7	7		6							
CH	14	2	5	7	7		6							
Nordic			5	7	7		6							
UK	14	2	5	4	4	4	2			5	4	4	4	2
GR (TR only)				7	7		6							
CZ	14	2	5	7	7		6	14	2	5	7	7		6
PL				7	7		6				7	7		6
SK				7	7		6				7	7		6
HU	14	2	5	7	7		6	14	2	5	7	7		6
RO			5	7	7		6			5	7	7		6
SI			5	7	7		6			5	7	7		7
RS			5	7	7		6			5	7	7		7

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

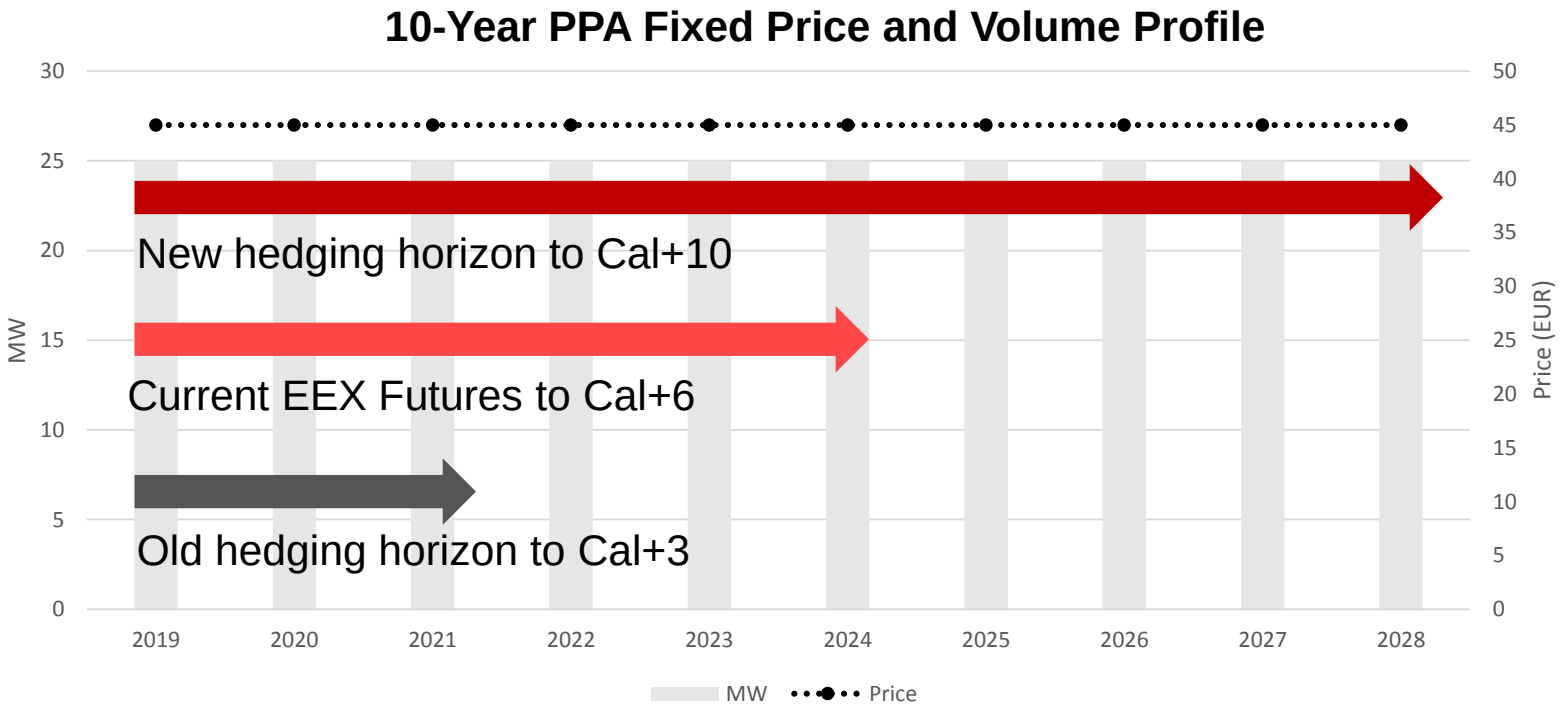
EEX Members provide balancing services on Spot & hedge via Futures



Banks provide financing once PPA is in place

EEX Members sell Power from their own RE assets via LT Corporate PPAs

Synthetic PPAs affect the hedging profile of EEX Members and extends it to the long-term



- EEX members have been using **Power Futures to hedge merchant risk from conventional power plants** for years
- EEX is investigating **listing further calendar expiries to Cal+10** to support long-term hedging of Renewable Energy assets

How do EEX Power Derivatives help to mitigate PPA 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, 23 long-term hedges of calendar contracts up to 2024 have been registered OTC in Spanish Power, with a total volume of 13.9 TWh.

How to calculate RES revenues

1 Day-ahead marketing of wind production – status quo

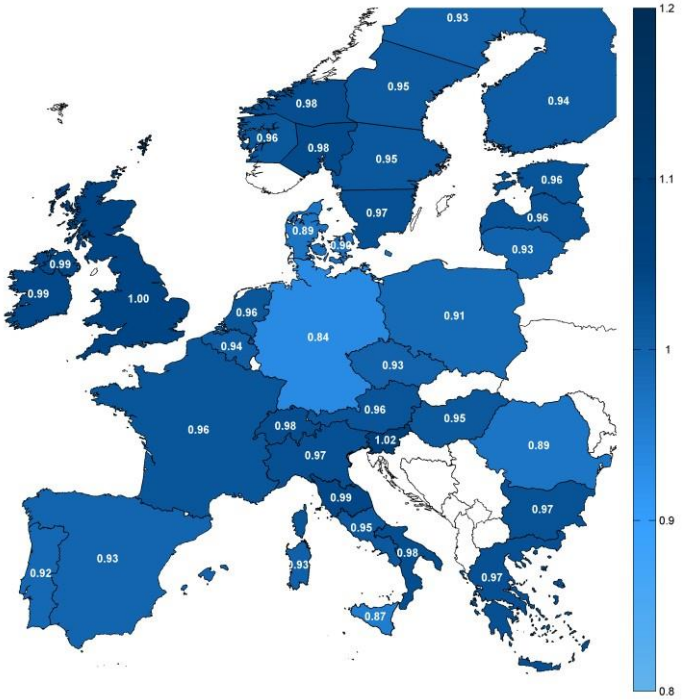
- Hourly: hourly revenue (€) = hourly prices x hourly production
- Yearly: sum of all hourly revenues
- Average revenue (yearly) = (sum of all hourly revenues/annual production volume) = specific market value (€/MWh)
- Compared to average power price (base) Wind market value = ~80% x base price

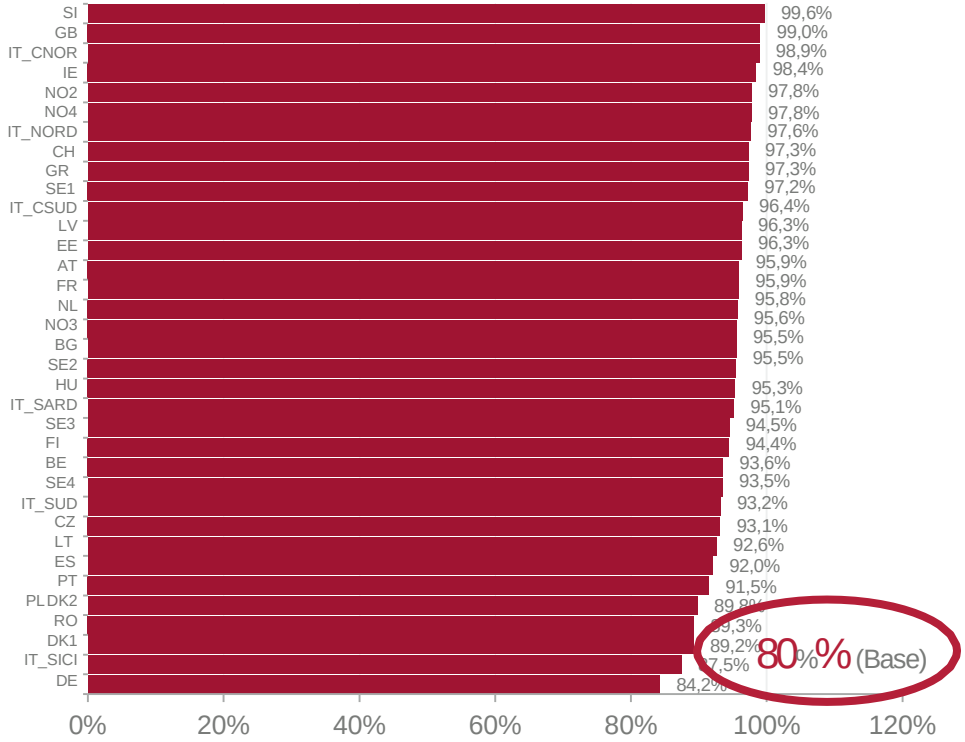
- Annual revenue =base price x market value factor (…%) x annual production

Project-specific!
RES technology and site

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 / 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.

How to hedge RES revenues - wind

Value-neutral hedge for a PPA

2 Basis for marketing wind production in the futures market: „value-neutral hedge“

40 €/MWh x 14,000 MWh — Producer

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 — Trader

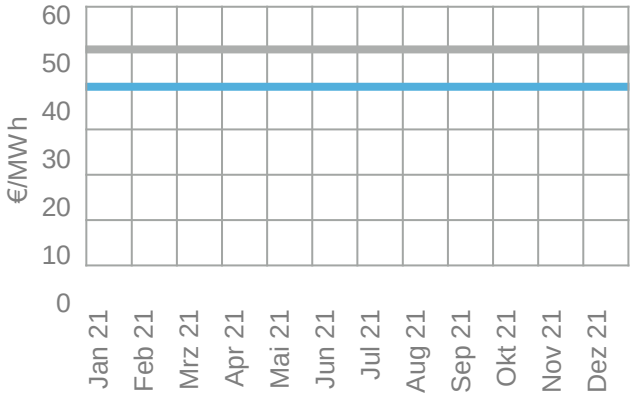
Futures product

Sales volume (base load of ~ 1.3 MW)

- 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

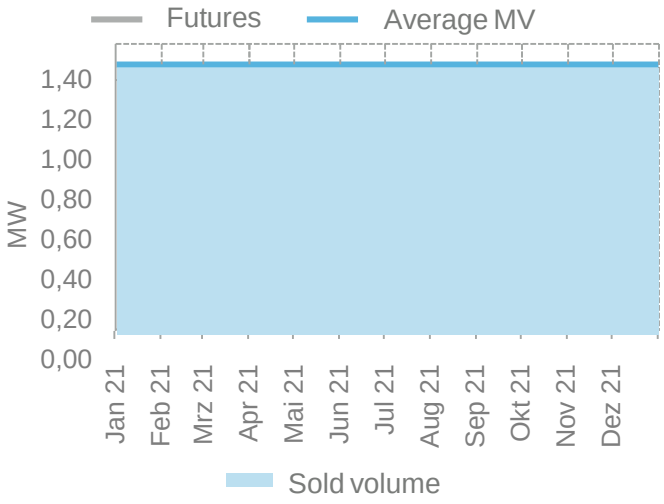
Sample: value-neutral hedge for wind

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 MWh x 40 €/MWh = 560,000 €



- Corresponding volume of a base product at the futures market:
  - 560,000 € / 50 €/MWh = 11.200 MWh (corresponds to 80% of 14.000 MWh)
- 11.200 MWh corresponds to ~ 1.3 MW base load

Example Long-Term hedge cleared on Spanish Power on 23.10.18

Trade Date	Product	Expiry Year	Expiry Month	Trade Price	Initial Margin per Contract	Lots	Initial Margin (in EUR)	Trade Volume (in MWh)	Notional Value
23/10/2018	Spanish Power Base Year	2019	12	51.65 €	18,133 €	5	90,665 €	43,800	2,262,270 €
	Spanish Power Base Year	2020	12	51.65 €	14,317 €	5	71,585 €	43,800	2,262,270 €
	Spanish Power Base Year	2021	12	51.65 €	12,614 €	5	63,070 €	43,800	2,262,270 €
	Spanish Power Base Year	2022	12	51.65 €	19,535 €	5	97,675 €	43,800	2,262,270 €
	Spanish Power Base Year	2023	12	51.65 €	26,280 €	5	131,400 €	43,920	2,268,468 €
	Spanish Power Base Year	2024	12	51.65 €	30,393 €	5	151,965 €	43,920	2,268,468 €
							606,360 €	**263,040**	**13,586,016 €**
								Initial Margin in % of Notional Value	**4.46%**

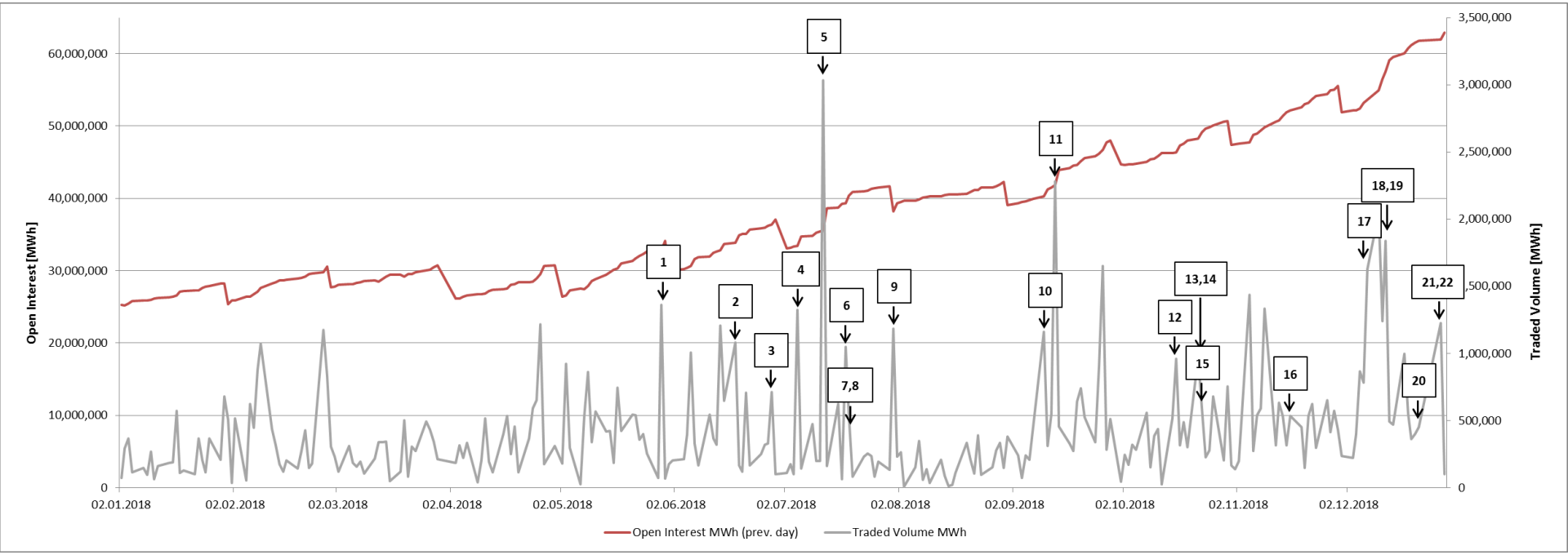
- A 5 MW long-term hedge was cleared in Spanish Power on 23 October 2018, with an **initial margin requirement of 606,360 EUR**
- The **execution price of each trade** was **51.65 EUR**
- The **Initial Margin percentage** of the notional value of the trade was **4.46%**

Summary of Long-term Hedges in Spanish Power Derivatives

	Trade Date	Product	Trade Price	Lots	Trade Volume in MWh	Notional Value in €	Initial Margin in €	Initial Margin in % of Notional Value
1	29/05/18	Q3 up to Cal24	€ 48.75	20	1,139,760	€ 55,563,300	€ 1,876,198	3.38%
2	18/06/18	Cal20 up to Cal24	€ 45.50	20	876,960	€ 39,901,680	€ 1,831,118	4.59%
3	28/06/18	Cal19 up to Cal24	€ 47.10	10	526,080	€ 24,778,368	€ 1,079,420	4.36%
4	05/07/18	Aug18 up to Cal24	€ 48.90	20	1,125,720	€ 55,047,708	€ 2,594,360	4.71%
5	12/07/18	Aug18 up to Cal24	€ 49.85	50	2,814,300	€ 140,292,855	€ 6,543,286	4.66%
6	18/07/18	Cal20 up to Cal24	€ 46.40	20	876,960	€ 40,690,944	€ 2,036,400	5.00%
7	19/07/18	Cal20 up to Cal24	€ 46.60	5	505,165	€ 10,216,584	€ 505,165	4.94%
8	19/07/18	Cal20 up to Cal24	€ 46.60	5	505,165	€ 10,216,584	€ 505,165	4.94%
9	31/07/18	Cal20 up to Cal24	€ 46.70	20	876,960	€ 40,954,032	€ 1,840,080	4.49%
10	10/09/18	Cal20 up to Cal24	€ 49.60	2	87,696	€ 4,349,722	€ 217,154	4.99%
11	13/09/18	Q3 up to Cal24	€ 53.35	50 & 25	1,424,700	€ 76,007,745	€ 4,529,442	5.96%
12	16/10/18	Cal19 up to Cal24	€ 45.91	12	631,296	€ 28,982,799	€ 1,508,724	5.21%
13	22/10/18	Cal21 up to Cal24	€ 47.70	7	245,616	€ 11,715,883	€ 630,945	5.39%
14	22/10/18	Cal20 up to Cal24	€ 48.65	7	306,936	€ 14,932,436	€ 732,396	4.90%
15	23/10/18	Cal19 up to Cal24	€ 51.65	5	263,040	€ 13,586,016	€ 606,360	4.46%
16	16/11/18	Cal20 up to Cal24	€ 48.50	4	175,392	€ 8,506,512	€ 394,667	4.64%
17	07/12/18	Cal19 up to Cal24	€ 51.35	5	263,040	€ 13,507,104	€ 561,204	4.15%
18	12/12/18	Cal19 up to Cal24	Variable	6	315,648	€ 16,367,134	€ 672,391	4.11%
19	12/12/18	Cal19 up to Cal24	€51.85	5	263,040	€ 13,638,624	€ 560,326	4.11%
20	20/12/18	Cal19 up to Cal24	€52.05	1	52,608	€ 2,738,246	€ 112,679	4.11%
21	27/12/18	Jan19 up to Cal24	Variable	10	526,080	€ 24,738,852	€ 1,233,678	4.99%
22	27/12/18	Jan19 up to Cal24	€ 51.25	10	526,080	€ 26,961,600	€ 1,233,678	4.58%
23	10/01/19	Feb19 up to Cal23	€ 52.54	2	86.160	€ 4,526,846	€ 167.877	3.71%

Total Trade Volume in MWh: 13,860,120

Long-term Hedges contribute to overall Open Interest in Spanish Power



- Long-term hedges cause **volume spikes** and contribute to 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

Renewable Corporate PPAs are the dawn of a new era in the Energy Transition

PPAs are an enabler of new Renewable Energy developments….

…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 PPA-related products.

Thank you!

Viviana Ciancibello
Business Developer
European Power Derivatives
Viviana.Ciancibello@eex.com

part of eex group