UNIVERSITY OF PIRAEUS
Department of International & European Studies
MSc in Energy: Strategy, Law and Economics

Special Issues in energy finance & risk management

"Part A: Training material on power derivatives"
"Part B: Hedging of PPAs with power derivatives"

Sat, 14 nov 2020


Power Derivatives

Power Derivatives: In few words

Structured products

- Offered in PXs or OTC (bilateral)
- Cleared in ECC (Trade Registration of EEX) or bilateral
- Specific period (DA, Weekend, WeekAhead, MA, QA, CAL)
- Specific profile (Baseload, Peak & Off Peak)

Non structured products

- Only OTC (bilateral)
- Cleared bilateral
- Non specific period or profile (modulated)

Power Derivatives in EEX: Basic Characteristics

Futures with NO physical delivery – pure financial contracts

Underlying Asset: the Power index of each country

- *SMP, PUN, etc*

Cleared in ECC through specific margining formulas

- *initial margin + margin call*

Power Derivatives in EEX: Products for IT and GR

- Italian Market (underlying asset PUN)
  - FDBD: Day Ahead Baseload Product
  - FDBM: Month Ahead Baseload Product
  - FDBQ: Quarter Ahead Baseload Product
  - FDBY: Year Ahead Baseload Product

Contract	BidQty	Bid	Ask	AskQty	Last	LastQty	Time	Vol	Settle	Descriptio
FDBM Jun19			49.95		49.50	5	18:00:33	37	49.86	ITALIAN BAS
FDBM Jul19		56.35			56.50	10	18:03:10	30	56.98	ITALIAN BAS
FDBM Aug19		53.00				0	0	26	54.03	ITALIAN BAS
FDBM Sep19						0	0	28	58.87	ITALIAN BAS
FDBM Oct19						0	0	0	62.74	ITALIAN BAS

- Greek Market (underlying asset SMP)
  - FFBM: Month Ahead Baseload Product
  - FFBQ: Quarter Ahead Baseload Product
  - FFBY: Year Ahead Baseload Product

Contract	Pos	Last	NetChg	WrkBuys	BidQty	Bid	Ask	AskQty	WrkSells	Vol	Settle
FFBM May19	5									0	64.21
FFBM Jun19										0	67.00
FFBM Jul19										0	69.50

EEX TT platform: Order window

Market “Language”

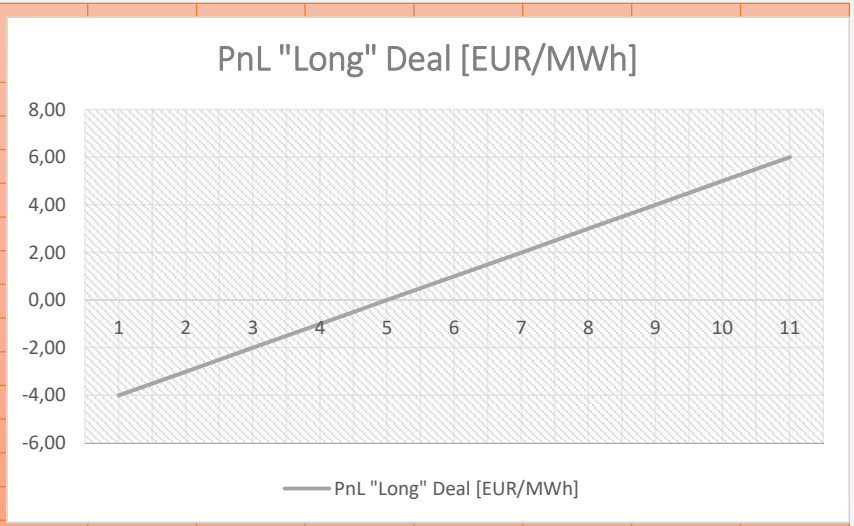
The contract volume is calculated by multiplying the number of delivery hours (h) during the delivery period with the constant output (MW) specified in the respective contract. The maximum amount of power per day is usually 24 MWh, on the day of the switch from winter time to summer time it amounts to 23 MWh, whereas on the day of the switch from summer time to winter time it amounts to 25 MWh. The minimum "lot size" (quantity) that can be traded on **EEX is 1 MW**.

Calculations	
Contract Horizon	**Volume [MWh]**
Day Ahead	= 24h x 1 lot
Week Ahead	= 24h x 7d x 1 lot
Month Ahead	= 24h x 28/29/30/31d x 1 lot
Year Ahead	= 8.760h x 1 lot

Definitions: Going “Long” or “Buy”

- Meaning **buying** at FIXED price!

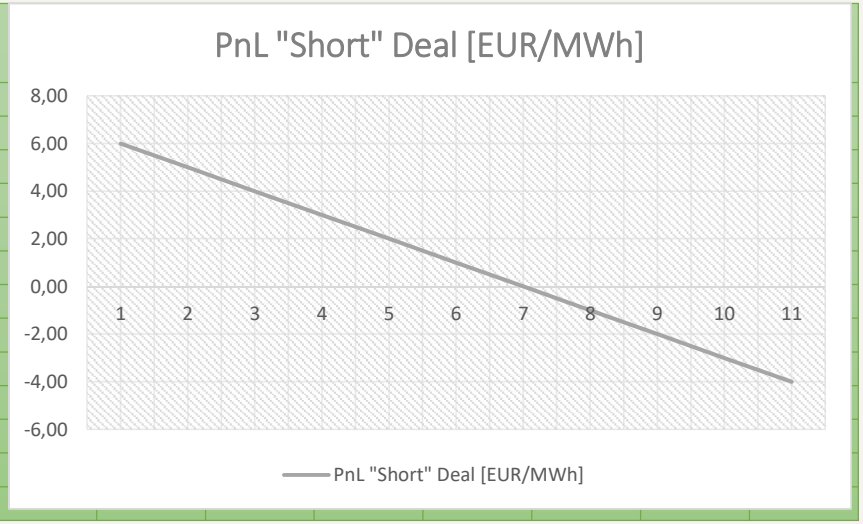
SMP [EUR/MWh]	"Long" Deal Price [EUR/MWh]	PnL "Long" Deal [EUR/MWh]
55.00	59.00	-4.00
56.00	59.00	-3.00
57.00	59.00	-2.00
58.00	59.00	-1.00
59.00	59.00	0.00
60.00	59.00	1.00
61.00	59.00	2.00
62.00	59.00	3.00
63.00	59.00	4.00
64.00	59.00	5.00
65.00	59.00	6.00



Definitions: Going “Short” or “Sell”

- Meaning **selling** at FIXED price!

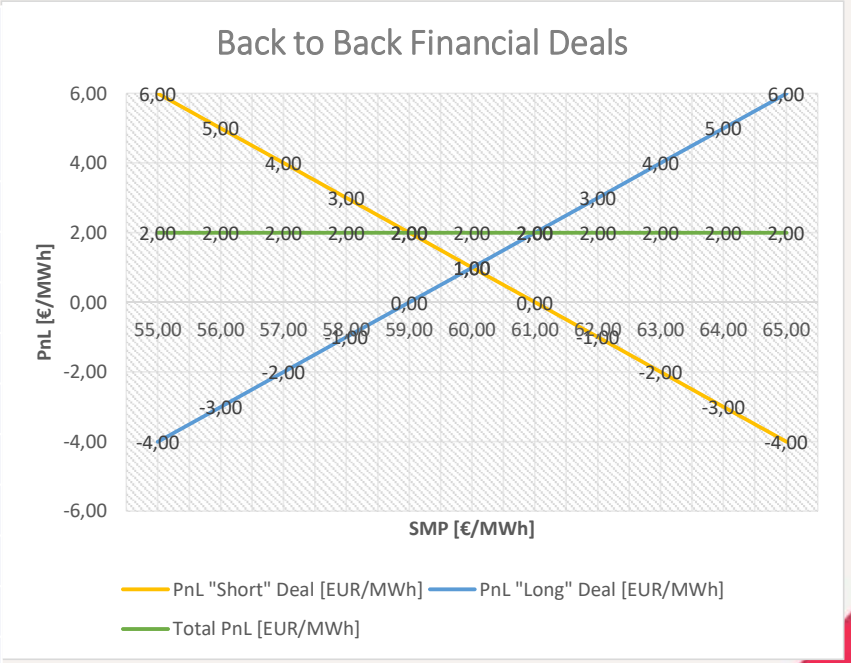
SMP [EUR/MWh]	"Short" Deal Price [EUR/MWh]	PnL "Short" Deal [EUR/MWh]
55.00	61.00	6.00
56.00	61.00	5.00
57.00	61.00	4.00
58.00	61.00	3.00
59.00	61.00	2.00
60.00	61.00	1.00
61.00	61.00	0.00
62.00	61.00	-1.00
63.00	61.00	-2.00
64.00	61.00	-3.00
65.00	61.00	-4.00



Definitions: Combi of Long and Short Position

- Meaning **buying** and **selling** at FIXED price!

SMP [EUR/MWh]	"Short" Deal Price [EUR/MWh]	"Long" Deal Price [EUR/MWh]	PnL "Short" Deal [EUR/MWh]	PnL "Long" Deal [EUR/MWh]	Total PnL [EUR/MWh]
55.00	61.00	59.00	6.00	-4.00	2.00
56.00	61.00	59.00	5.00	-3.00	2.00
57.00	61.00	59.00	4.00	-2.00	2.00
58.00	61.00	59.00	3.00	-1.00	2.00
59.00	61.00	59.00	2.00	0.00	2.00
60.00	61.00	59.00	1.00	1.00	2.00
61.00	61.00	59.00	0.00	2.00	2.00
62.00	61.00	59.00	-1.00	3.00	2.00
63.00	61.00	59.00	-2.00	4.00	2.00
64.00	61.00	59.00	-3.00	5.00	2.00
65.00	61.00	59.00	-4.00	6.00	2.00



Definitions: handling an OTC contract

Party A	Party B
• Fixed Price Payor • Buying at fixed price • Going "Long" at fixed price • Selling at Floating price (SMP)	• Floating Price Payor • Buying at floating price (SMP) • Going "Short" at fixed price • Selling at Fixed price

Example: handling an OTC contract

	Party A	Party B
Fixed Price Payor (Going "Long")	YES	NO
Floating Price Payor (Going "Short")	NO	YES
e.g. Fixed Price 60 [€/MWh]	Pays 60	
e.g. SMP Price 62 [€/MWh]		Pays 62
Revenue Stream	Receives 2	Gives 2

RES Price Risk Mitigation

Markets & Contracts

The table below shows the futures contracts listed by EEX for the German Power market. Each number represents the number of available maturities; 14 Days means there is one contract each for D+1 up to D+14, while 6 Years denotes one contract per delivery year up to Y+6. As such, hedging electricity spot prices can already be done **up to 6 years in advance**. EEX is also planning to extend Power Futures up to 10 yearly expiries to enable more long-term hedging.

EEX German Power Base and Peak Contract Expiries

	German Power Base						German Power Peak					
	Day	WkEnd	Week	Month	Quarter	Year	Day	WkEnd	Week	Month	Quarter	Year
DE (Phelix)	14	2	5	10	11	6	14	2	5	10	11	6

Settlement Price

Is it a forecast? **NO!**

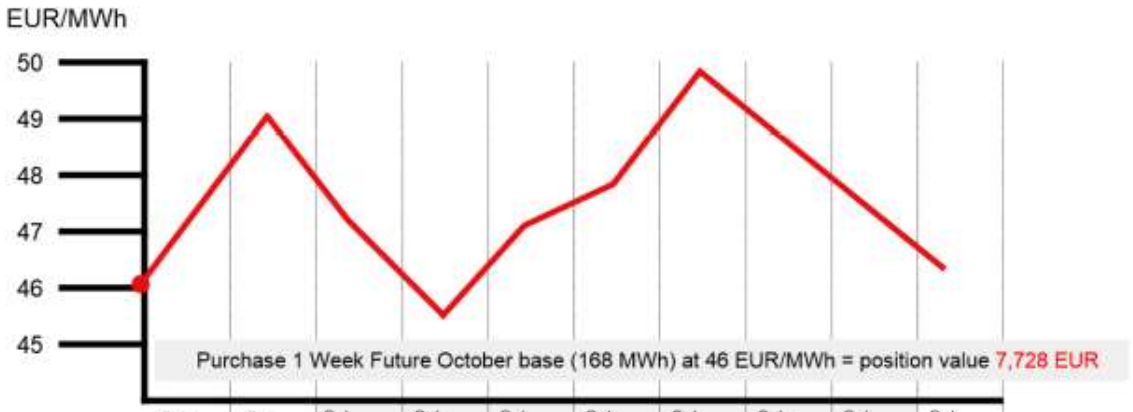
then what is it?

'This price represents where the exchange's members see the value of that underlying for its specified delivery period in the future. The sources for settlement prices are other traded prices, bid/ask orders, and fair values provided by exchange members. The closer to expiry, the more the settlement price of the futures converges with the spot price. Settlement prices for each of the 20 European markets offered for trading are publicly available on the EEX website, and are one of the key ways exchanges like EEX help create transparency in a market. Easy access to market prices helps industry participants answer a very important question: what is a fair price for the product I would like to buy or sell?'

"The Settlement (or Reference) price is the basis for the initial & variation margin calculations"

Example for discussion (1/2)

Example Profit & Loss of an Electricity Month Future 1: Long Position



	Oct 16th Thu	Oct 17th Fri	Oct 21st Mon	Oct 22nd Tue	Oct 23rd Wed	Oct 24th Thu	Oct 25th Fri	Oct 26th Sat	Oct 27th Sun	Oct 28th Mon	Position Result
Trade price [EUR/MWh]	46										
Settlement price [EUR/MWh]	47	49	47	45	47	48	50				
Spot price [EUR/MWh]			*49.25*	*46.55*	*47.51*	*48.20*	*51.31*	*41.58*	*42.60*		
Final settlement price [EUR/MWh]										*46.71*	
Change [EUR/MWh]	+1	+2	-2	-2	+2	+1	+2			-3.29	+0.71
Contract volume [MWh]	168	168	168	168	168	168	168	168	168	168	168
Position (MW)	1	1	1	1	1	1	1	1	1	1	1
Variation margin [EUR]	+168	+336	-336	-336	+336	+168	+336			-552.72*	+119.24

*The last variation margin is called cash settlement

Example for discussion (2/2)

	Oct 16th	Oct 17th	Oct 21st	Oct 22nd	Oct 23rd	Oct 24th	Oct 25th	Oct 26th	Oct 27th	Oct 28th	Result unhedged	Result hedged with EEX Week Future
	Thu	Fri	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon		
Trade price [EUR/MWh]	46											
Settlement price [EUR/MWh]	47	49	47	45	47	48	50					
Spot price [EUR/MWh]			*49.25*	*46.55*	*47.51*	*48.20*	*51.31*	*41.58*	*42.60*			
Purchase price in the auction [EUR]			-1,182	-1,117.2	-1,140.24	-1.156.80	-1,231.44	-997.92	-1,022.4		-7,848	-7,848
Final settlement price [EUR/MWh]										*46.71*		
Change [EUR/MWh]	+1	+2	-2	-2	+2	+1	+2			-3.29		+0.71
Contract volume [MWh]	168	168	168	168	168	168	168	168	168	168		168
Position (MW)	1	1	1	1	1	1	1	1	1	1		1
Variation margin [EUR]	+168	+336	-336	-336	+336	+168	+336			-552.72*		+119.24
Total Costs											-7,848	-7,728

PPAs for RES & Power Derivatives

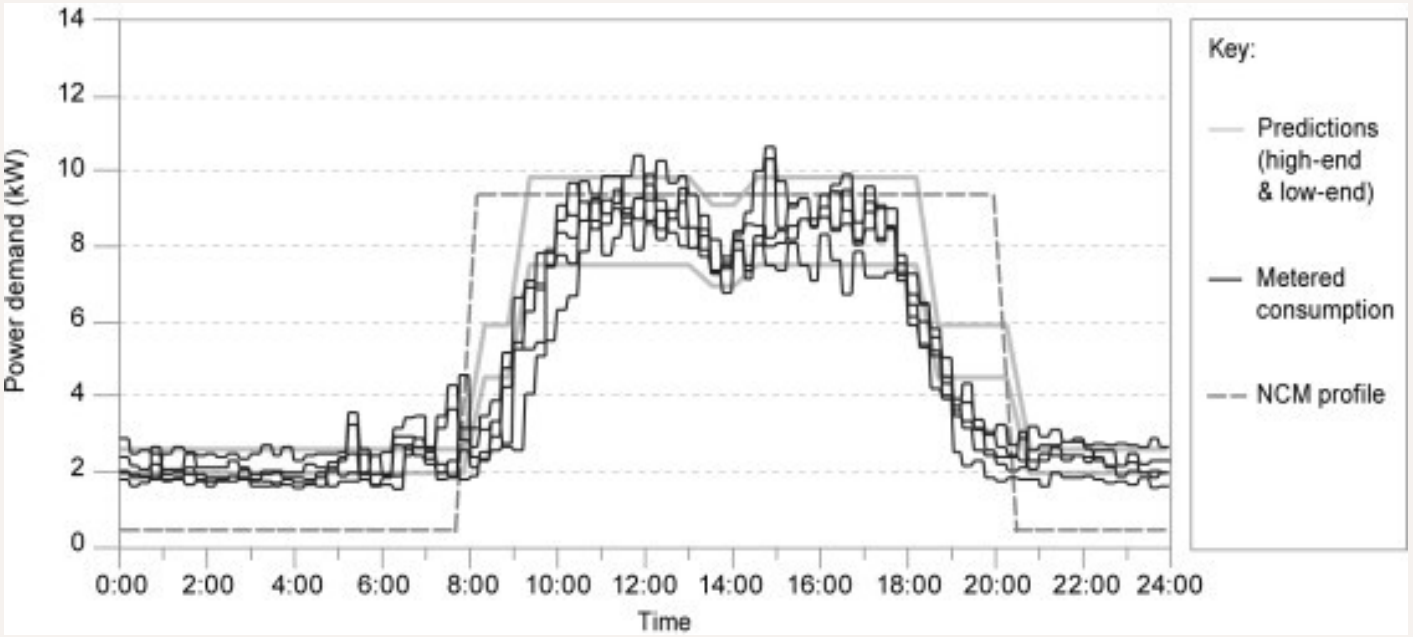
- **PPAs** (Power Purchase Agreements) have emerged as a key driver of investment in new wind and solar projects
- In the case of financial or virtual PPAs, where the physical electricity flows are transacted via the wholesale spot market, an inherent price risk is created

Seller's Risk (normally generators)	Buyer's Risk (normally suppliers or traders)
You may sell the future amounts of electricity generated at a lower price than expected, which could impact cash flows and profit margins.	The is risk that the wholesale price may fall below the PPA price, which results in higher payments to the renewable generator.

PPAs Risk Elements

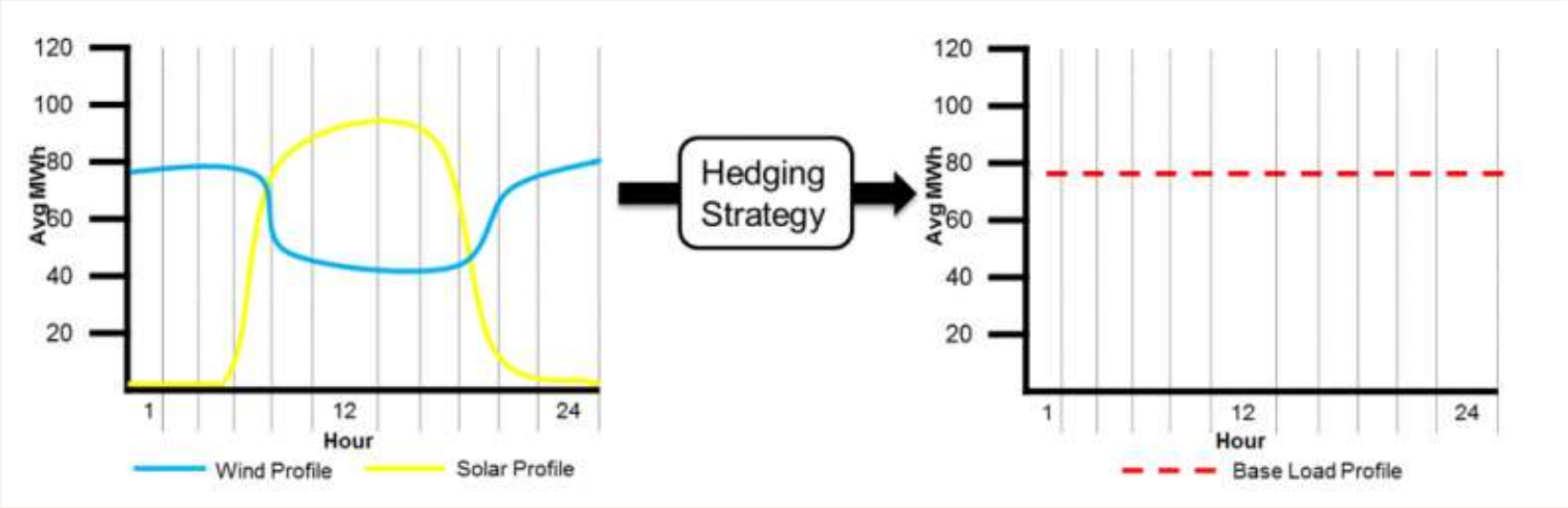
- Risk Elements of a PPA depend on the structure of the PPA
- Corporate buyers (big consumers) may wish to hedge any remaining purchase volume, which may not be covered by the agreement → In this case, they would hedge against having to buy electricity at higher prices than expected
- Whilst the PPA contract serves to manage price risk to a certain extent by setting a baseline price value, the volatility of the electricity markets is significant enough that it is prudent to manage the exposure to the highs and lows of fluctuating spot prices and hedge any remaining generation or procurement risk exposure not covered by the PPA. Furthermore, due to the long-term tenor of PPAs resulting in a price risk exposure out to 10 or 15+ years, the risk is very much considerable

Power Consumption Profile



- *Typical 24hours power consumption profile for a small office building*
- *Imagine this small office building willing to go GREEN by entering into a PPA…for its 'BASELOAD' consumption…*
- *Question: What is its BASELOAD consumption?*

Hedging of RES output



*Different hedging strategies can be employed to do this smoothening. It is often the job of a **Risk Manager** to study the overall risk profile of the generator and determine the best hedging strategy; although increasingly, renewable energy producers are outsourcing this task to utilities' trading desks and energy trading companies.*

Example

Example Long-Term Hedge on EEX Spanish Power Base Futures

Trade Date	Product	Expiry Year	Expiry Month	Trade Price	Initial Margin per Contract	Lots (MW)	Initial Margin (in EUR)	Trade Volume (in MWh)	Notional Value
10/01/2019	Spanish Power Base Month	2019	2	52.54 €	2,903 €	2	5,806 €	1,344	70,614 €
	Spanish Power Base Month	2019	3	52.54 €	2,608 €	2	5,216 €	1,488	78,180 €
	Spanish Power Base Quarter	2019	4	52.54 €	6,880 €	2	13,759 €	4,368	229,495 €
	Spanish Power Base Quarter	2019	7	52.54 €	7,264 €	2	14,529 €	4,416	232,017 €
	Spanish Power Base Quarter	2019	10	52.54 €	6,163 €	2	12,326 €	4,416	232,017 €
	Spanish Power Base Year	2020	12	52.54 €	15,196 €	2	30,393 €	17,568	923,023 €
	Spanish Power Base Year	2021	12	52.54 €	13,140 €	2	26,280 €	17,520	920,501 €
	Spanish Power Base Year	2022	12	52.54 €	11,826 €	2	23,652 €	17,520	920,501 €
	Spanish Power Base Year	2023	12	52.54 €	17,958 €	2	35,916 €	17,520	920,501 €
							167,877 €	**86,160**	**4,526,846 €**
							Initial Margin in % of Notional Value		**3.71%**


We are.

We are.

An experienced team of Energy and IT experts operate under E-ntelligence ltd umbrella since 2013.

<u>The founder & Owner:</u>

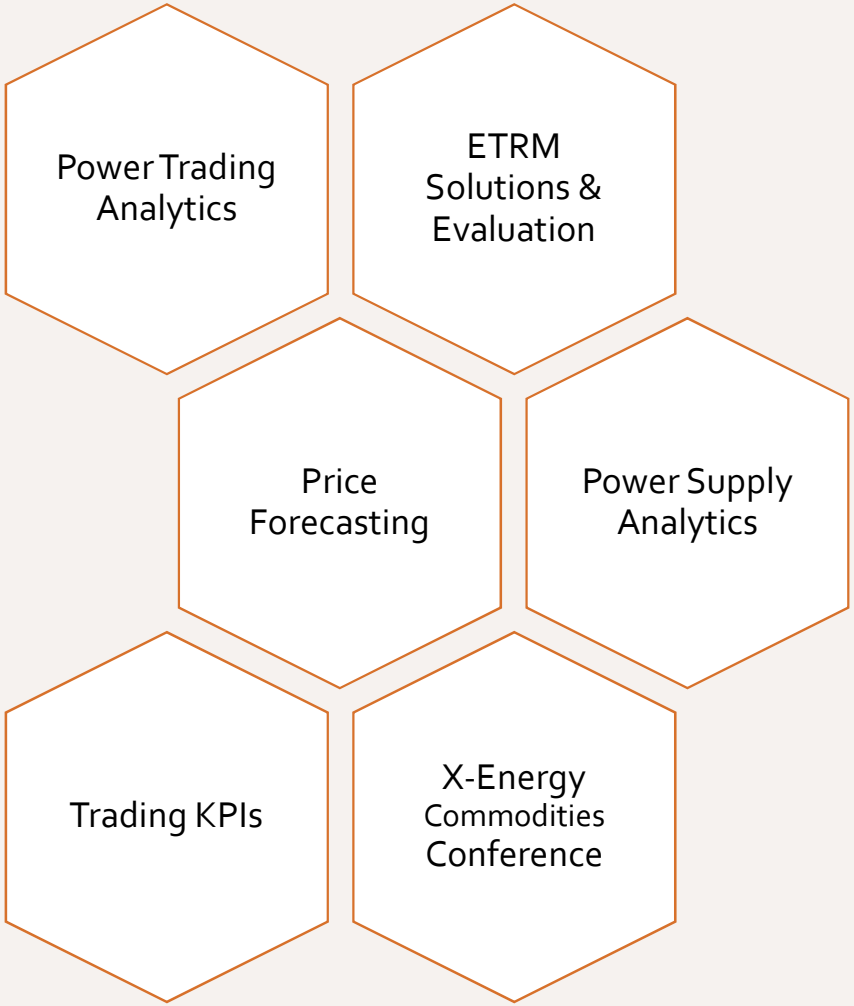
- ***Ioannis Psarros**, Power Trader since 2008*

Linkedin profile:

https://www.linkedin.com/in/ioannis-psarros-85017712?lipi=urn%3Ali%3Apage%3Ad_flagship3_profile_view_base_contact_details%3BK7uO%2FQ7uTeG2TrMP5ScAOA%3D%3D


We do.

We do.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Thank you!

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