THE FUNDAMENTALS OF ELECTRICITY MARKETS

From forward to spot

10 November 2026



AGENDA

1. Introduction & key concepts
2. Day Ahead and Intraday
3. Forward Markets
4. Hedging

1

INTRODUCTION & KEY CONCEPTS

WHY?

Fundamentally, energy supply is an engineering challenge. Good market design should give **economic incentives** which **align economics to physics in the short term and physics to economics in the long term.**

Target model: a pan-European electricity market

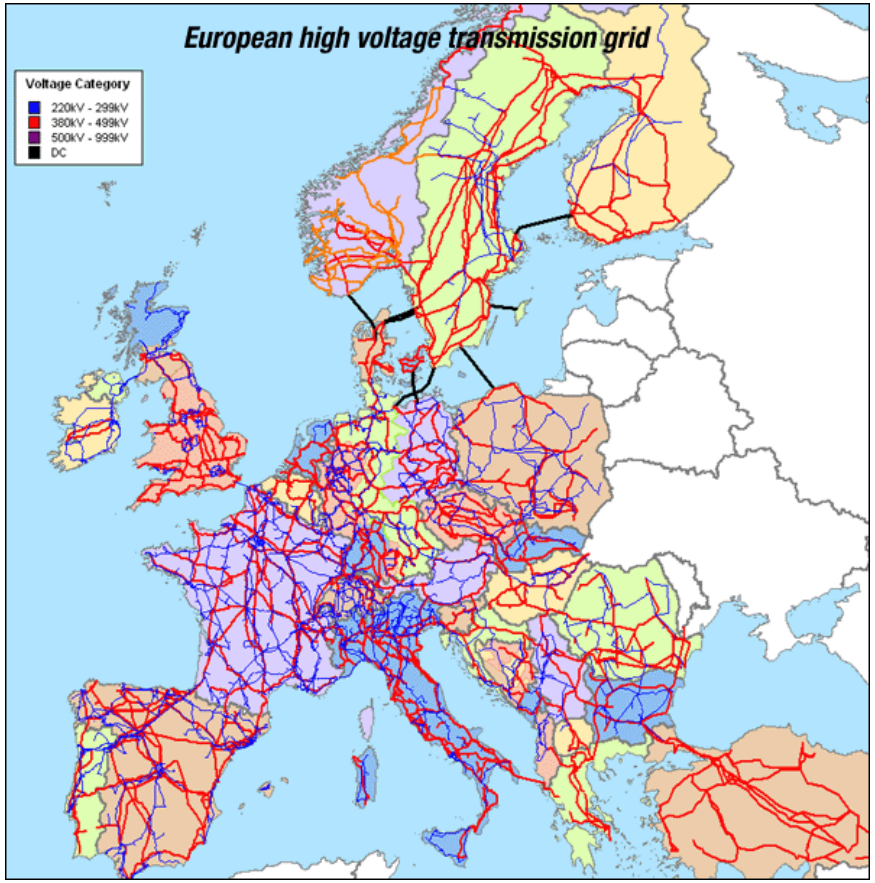
Physically, we are interconnected and interdependent
But almost everything else has yet to follow this physical reality

Which benefits for the global welfare?

Increase efficiency
Increase robustness and liquidity
Integrate new technologies and facilitate the energy transition

Why do we want it as a market participant?

Managing cross-border portfolios
New buying and selling opportunities
Facilitate the integration of new technologies



ELECTRICITY MARKETS: TIMEFRAMES

- Integrated zonal Markets
- From Forward to real time



Forward Market (next weeks, months, years)

Reserve / Ancillary Capacity Markets (next day)

Day Ahead Market Auction (next day)

EU Intraday auctions (next day and within day)

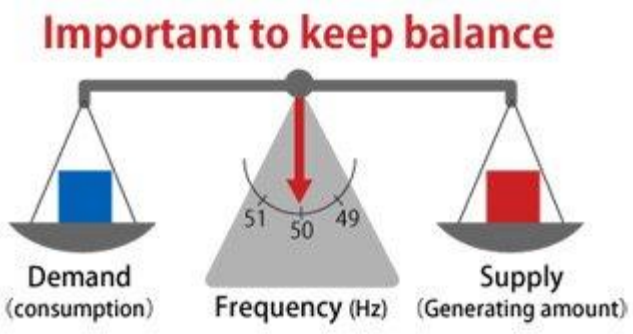
Intraday continuous market (next hours or 15min)

Reserve / Ancillary Energy Markets

Imbalance Settlement

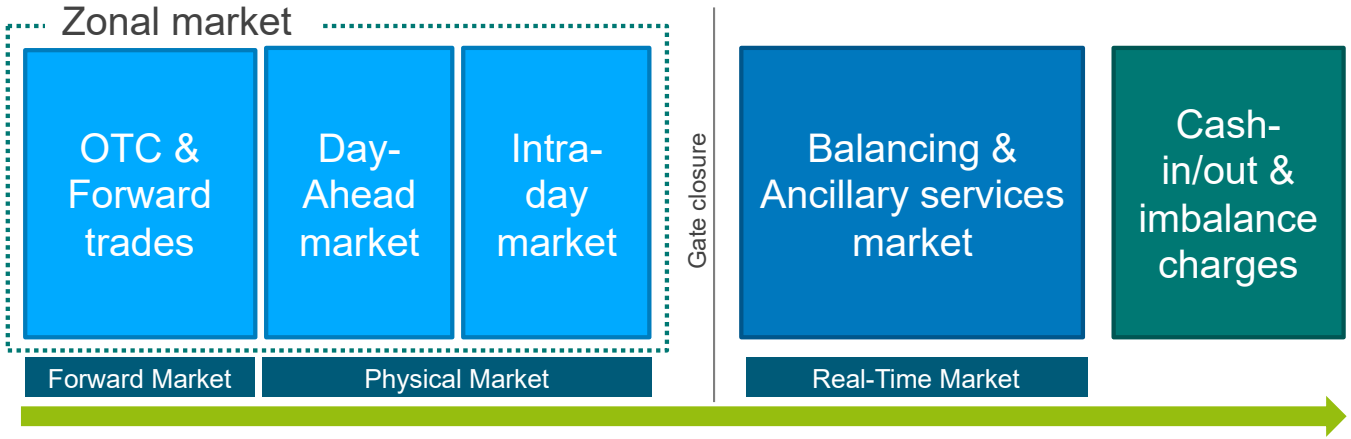
MARKET PRICE: EXPECTATIONS ABOUT FUTURE REAL-TIME PRICE

- The market is based on **supply-demand equilibrium** → each equilibrium point corresponds to a **market price**. This is an equilibrium point (= **imbalance settlement price**) at each period of time (ISP = **imbalance settlement period**)



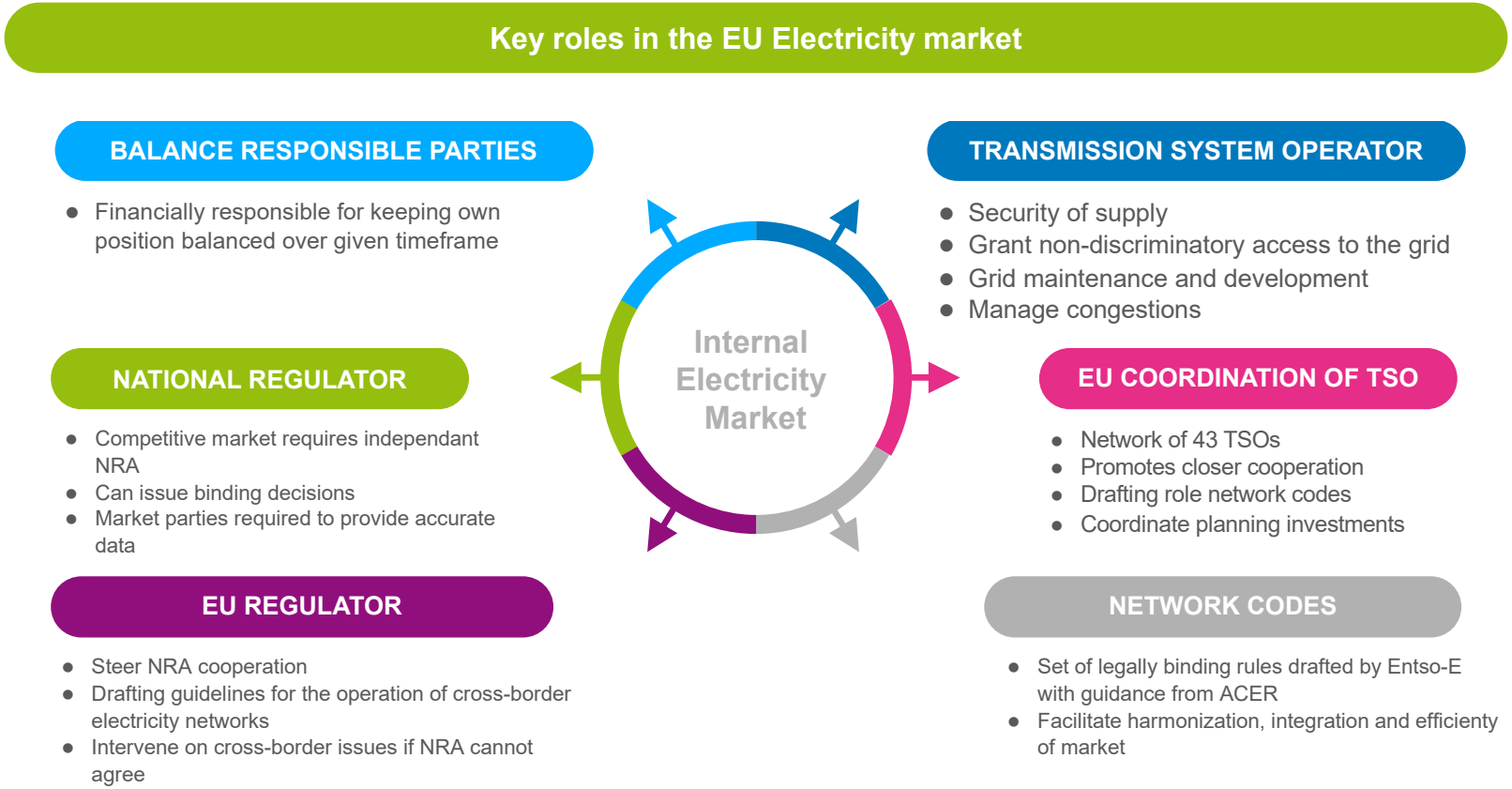
- All actions undertaken by market parties in forward, day-ahead and intraday are based on the **expectation** of this equilibrium point





KEY ROLES IN THE MARKET: WHO DOES WHAT?

1. **Market Participants**
   - Clear roles and responsibilities should be defined
2. **Transmission System Operator**
   - Clearly separated from Generators
3. **Regulators and competition authorities**
   - Independent bodies, whose roles and responsibilities should be clearly defined in appropriate legislative documents



2

DAY-AHEAD AND INTRADAY

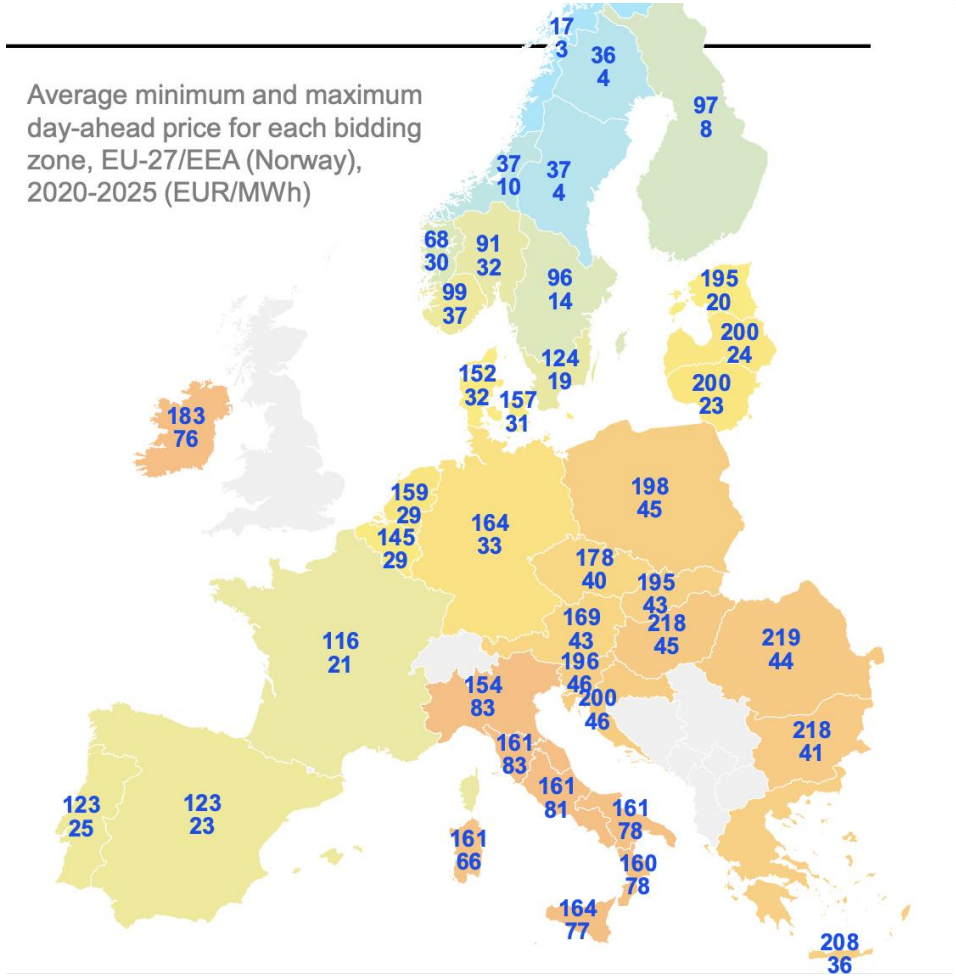
DAY-AHEAD MARKET

1. Zonal market

- Bidding Zone = geographical zone in which traders can buy/sell electricity without having to take into account grid constraints. Between 2 zones, traders have to consider the available transmission capacity.
- For the market: one country= one price = one electrical node
- Not true in reality → TSOs manage the grid

2. In Day-Ahead, one common auction

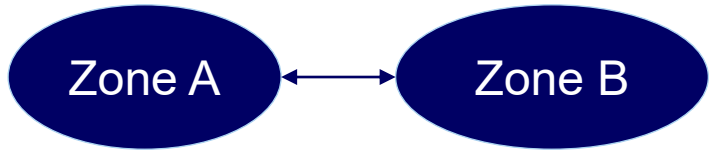
- Electricity market prices are based on a supply-demand equilibrium
- One auction to determine the price for each zone



Source: ACER, 2026

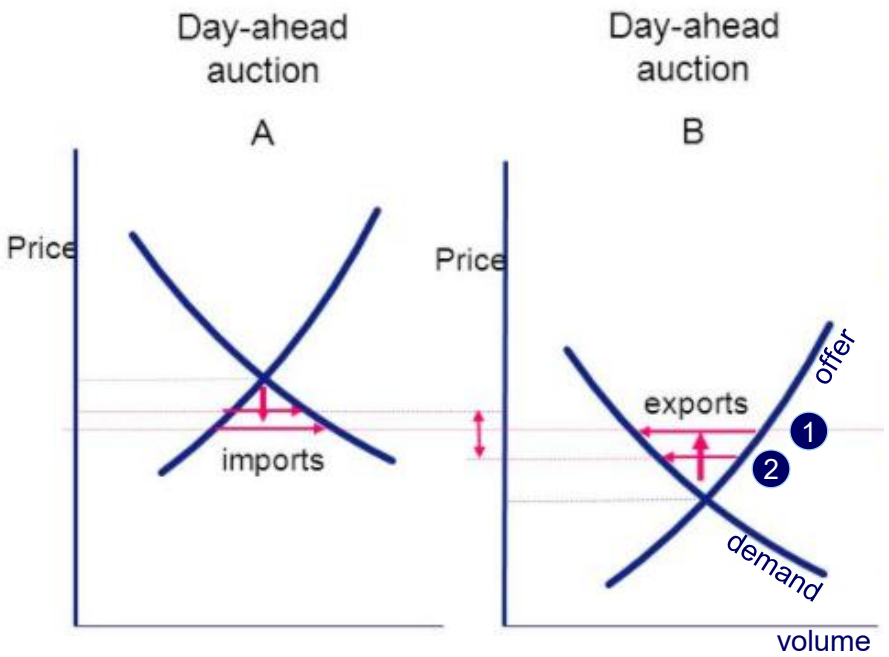
DAY-AHEAD AUCTION

MARKET COUPLING



The day-ahead process **merges capacity (transport) and energy**

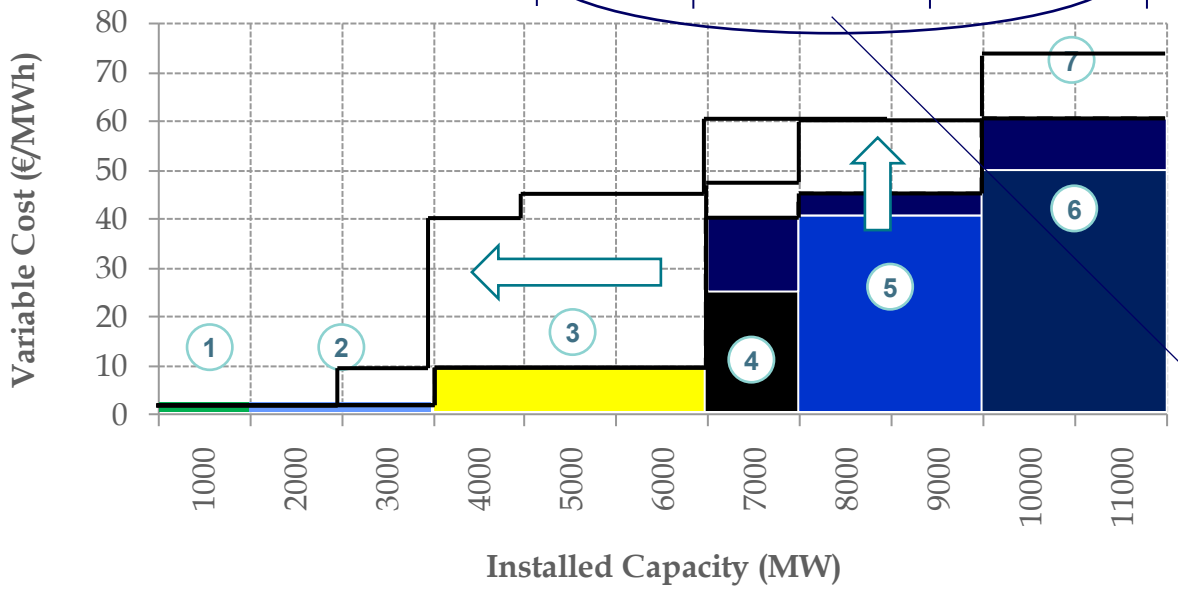
1. Trader bids for energy (bids and offers) in each zone to Power Exchanges
2. TSOs provide the available capacity between each zone
3. The energy bids and offers in the different zones are then matched, depending on the availability of the capacity
   - ❶ If no congestion (i.e., enough capacity): no price difference between A & B
   - ❷ If congestion (i.e., not enough capacity allocated to the market): a price difference between A & B appears



BUILDING THE MERIT ORDER

In the **merit order** units are **ranked according to their marginal cost of production.**

	1	2	3	4	5	6
Technology	**Wind**	**Hydro**	**Nuclear**	**Coal ST**	**CCGT**	**GT**
Installed capacity [MW]	1000	2000	3000	1000	2000	2000
Variable cost [€/MWh]	0	0	10	25	40	50
7 **CO2 cost [€/MWh]**	0	0	0	15	5	10
Total Variable cost [€/MWh]	**0**	**0**	**10**	**40**	**45**	**60**



The merit order can shift:

a **Horizontally:** due to technical outages, and unavailabilities

b **Vertically:** due to commodity price fluctuations

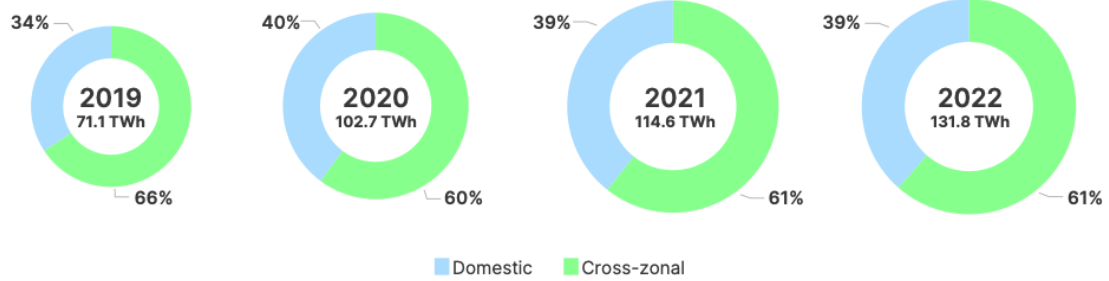
Renewables & NUC may also be offered at a negative price

DAY-AHEAD VS. INTRADAY

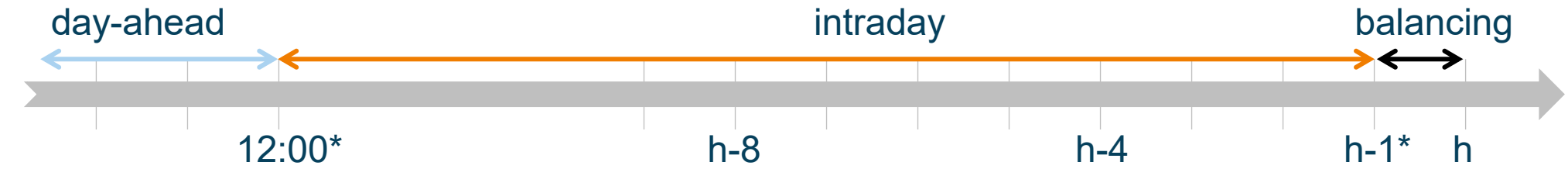
- **Day ahead market:** considered the market giving the reference price in Europe.
  > Link to nomination and scheduling process historically happening in D-1.
  > But... the real price signal for market participants is the imbalance price!

- **Intraday market:** considered the market to optimise/correct positions close to real time.
  > intraday market liquidity increases, product granularity closer to ISP and ability to trade closer to real time!

Share of continuous intraday-traded volumes according to intra-zonal vs. cross-zonal nature of trades in Europe and yearly continuous intraday-traded volumes – 2019–2022 (% and TWh)



Source: ACER calculation based on NEMOs data



** Exact time of market closure might slightly vary depending on country*

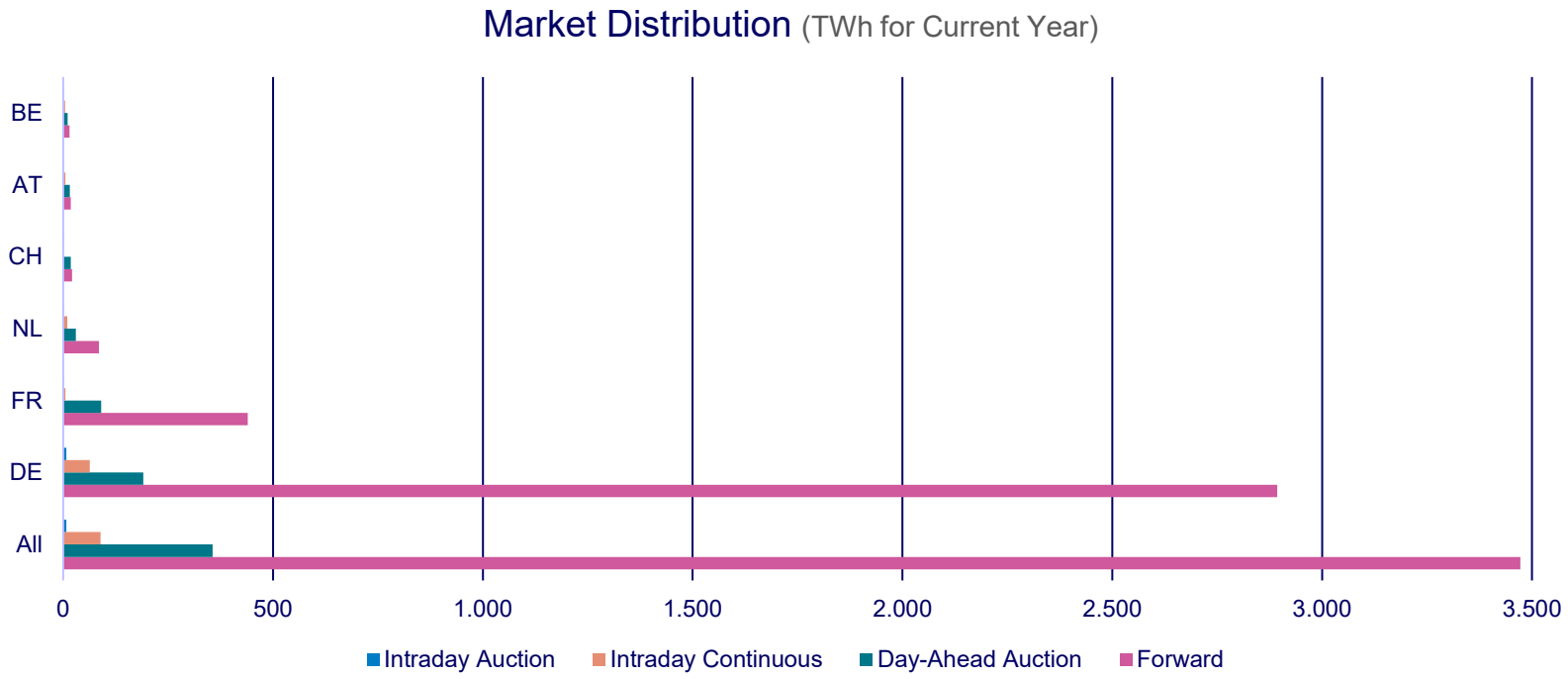
As time passes, uncertainty reduces

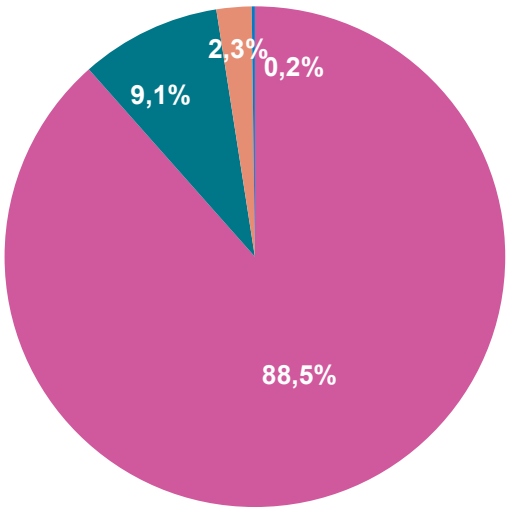
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FORWARD MARKETS

IS THE FORWARD MARKET IMPORTANT?

- Volumes traded in forward represent +/- 10 times more than the volume traded in the short term market (Day-Ahead and Intraday)



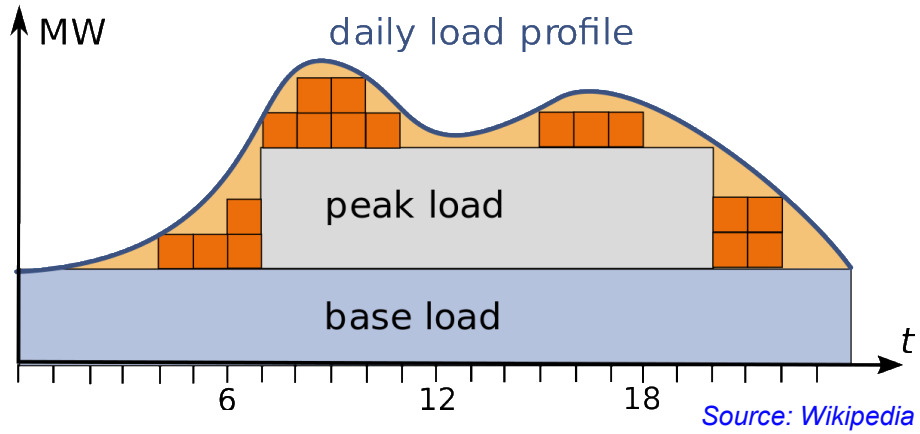


MARKET INSTRUMENTS: SPOT, FORWARD, FUTURE

- **Spot** contract: an agreement to buy or sell an asset today, for a certain price.
  - In the case of electricity, this typically means day-ahead
- **Forward** contract: an agreement to buy or sell an asset at a specific moment in time, for a predetermined price.
  - Normally traded over-the-counter (OTC); a deal between two institutions
- **Future** contract: an agreement to buy or sell an asset at a specific moment in time, for a predetermined price.
  - Normally traded on an exchange; the exchange is the counter-party for both participants

FORWARD PRODUCTS FOR ELECTRICITY

- Daily products: D+1, D+2
- Weekly products: W+1, W+2, W+3
- Monthly products: M+1, M+2, M+3
- Quarterly products: Q+1, Q+2, Q+3
- Yearly products: Cal+1, +2, +3



Source: Wikipedia

Base-load vs. Peak-load

	Germany Baseload*					France Baseload*					Holland Baseload*					Belgium Baseload*					Germany Peaks*					France Peaks*				
	Qty	Bid	Ask	Qty	Last	Qty	Bid	Ask	Qty	Last	Qty	Bid	Ask	Qty	Last	Qty	Bid	Ask	Qty	Last	Qty	Bid	Ask	Qty	Last	Qty	Bid	Ask	Qty	Last
Tue 28/03/23					113.50					123.00															115.00					120.00
Wed 29/03/23	15	110.00	112.50	25	112.00	5	109.50	115.00	25		25	100.00	125.00	25		25	104.50	125.00	25		1	50.00					157.50	25		
Thu 30/03/23	9	66.00	78.00	25		25	70.00	84.00	25		25	50.00				25	65.000	94.000	25								153.00	25		
WkEnd 01-02/04/23	15	74.50	75.00	25	74.50	15	78.50	79.50	25	78.25	15	78.00	87.00	25		25	74.00	89.500	25											
WkEnd 08-09/04/23	25	66.00	82.00	25		25	73.00	85.00	25																					
Wk14-23	25	103.00	104.00	25	103.50	15	111.00	112.75	25	112.00	25	105.00	110.50	25		25	106.00	114.75	25		25	110.50	113.00	25	111.00	5	110.00	122.00	25	
Wk15-23	10	99.05	101.00	5	100.25	10	107.50	110.00	25		25	100.00	111.00	5		25	97.50	115.00	25		5	102.00	106.00	5	105.00	25	107.00	120.00	5	
Apr-23	1	103.98	103.90	3	103.80	2	112.30	112.65	3	112.25	1	105.60	106.00	4*	107.50	1	110.00	110.50	5	110.50	5	109.00	110.00	5	110.00	25	120.00	122.00	5	
May-23	1	106.08	106.00	2	106.00	2	111.00	111.74	1	112.25	1	103.09	103.75	2	104.00	1	106.84	109.50	5		5	107.00	111.00	5	110.00	2	115.00	122.50	5	
Jun-23	1	114.98	114.90	5	115.00	5	120.00	124.25	2		1	111.33	112.90	5		1	112.83	119.38	1		5	120.00	122.00	4	123.00	3*	133.29	148.00	5	
Q223	1	108.27	108.25	2	108.25	1	114.75	116.29	1		1	106.75	107.55	2*	107.50	2	110.00	112.00	1		5	112.01	114.42	4	114.50	3*	126.00	129.00	1	
Q323	1	121.80	122.06	1	122.00	1	130.75	132.00	2	131.00	2	115.00	116.25	1	116.00	5	116.00	119.25	1		1	138.25	139.20	1	139.20	3	150.00	177.77	2*	
Q423	5*	143.75	143.75	1	143.80	1	262.00	266.75	1	265.00	5	134.50	136.75	1		1*	137.75	141.75	1		2	181.50	182.50	7	181.50	1	425.00	480.00	3*	
Q124	1*	150.25	150.54	1	150.00	2	355.00	359.50	1	357.00	5*	139.00	141.04	1		1	140.00	145.00	2		1*	183.10	186.00	1		5	550.00	650.00	5	
Q224	1	119.50	119.79	1*	121.00	1	113.75	116.25	1	116.00	1	96.500	125.00	1		1	96.500	112.00	1		1	120.70	147.00	1						
Q324	1	123.75	124.00	1	124.00	2	117.00	121.50	1	120.00	1	100.00	129.00	1		1	100.00	116.00	1		1	129.10	155.00	1						
Q424	1	140.25	140.53	1*	141.00	1	182.75	186.27	1	186.00	1	112.25	138.00	1		1	122.25	133.00	1		1	164.10	190.00	1				325.00	3	
Q125	1	142.00	143.78	1		1	160.00																			5	260.00	315.00	5	
2024	1*	133.42	133.50	1	133.38	1	194.60	195.00	1	194.50	1	121.25	123.50	1		1	120.00	122.00	1	125.00	1	163.00	164.00	4	163.00	1	280.00	314.00	1	
2025	1	114.00	114.85	2	114.50	1	125.00	128.00	1	128.00	1	111.50	115.35	2		1	115.50	123.85	1		1*	145.50	145.50	5	145.50	1	190.00	210.00	1	
2026	1	103.80	105.60	1	104.00	1	106.80	113.35	1		2*	100.00	110.00	2*		1	100.75	107.00	2		1	125.00	132.00	1		1	140.00			

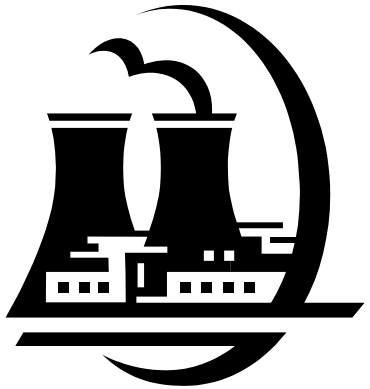
MARKET LIQUIDITY & TRADED VOLUMES

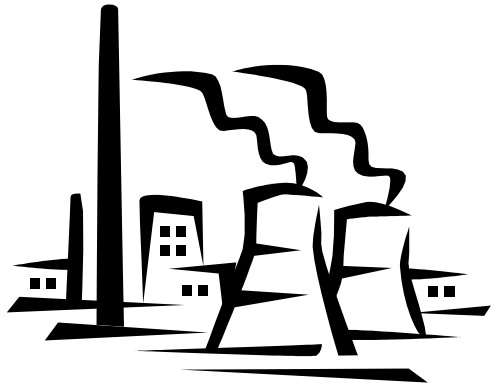
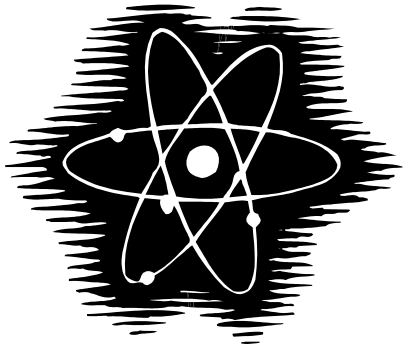
- Market **liquidity** reflects the ability to buy or sell an asset without causing a significant movement in the market price of that asset
  - In less liquid markets, we expect the bid-ask spreads to be wider than in more liquid markets. The bid-ask spread represents the transaction cost
- The German electricity market, for example, is a relatively liquid market, especially when compared to the Belgian or Dutch electricity markets
- Where liquidity is limited, there is a greater risk that it may not be possible to close a position at a favourable price
- Short term products are in general more liquid than long term products

4

HEDGING

FROM A PHYSICAL PORTFOLIO…

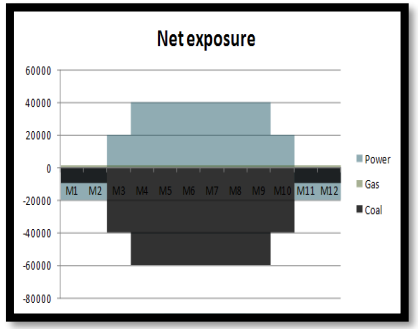




… TO HEDGING STRATEGIES

1. Risk Mapping: - Forecast - Position modelling	2. Definition of Hedging Strategy	3. Execute Strategy

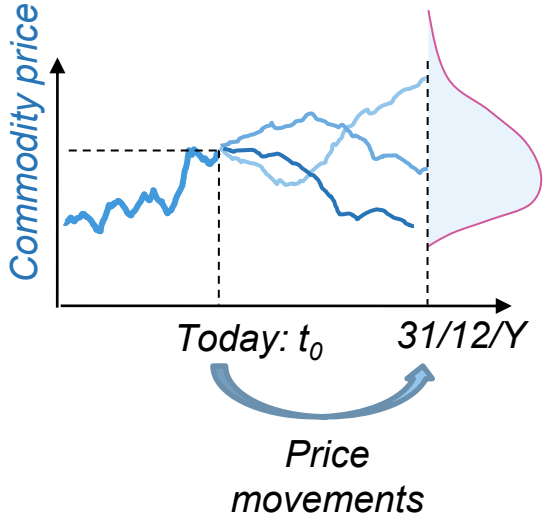


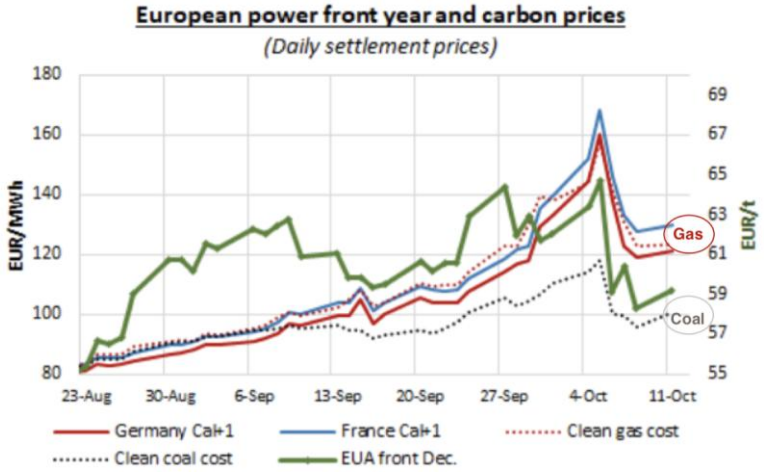




RISK MAPPING

- A portfolio of asset is **by definition "risky"**→ what is risk for a portfolio manager?
  - Uncertainty on future revenues generated by the assets in the portfolio (power plants, procurement contracts)
  - Different kinds of risk
    - ✓ Price risk
    - ✓ Volume risk
    - ✓ Regulatory risk
    - ✓ Counterparty risk





- How to tackle price risk?
  - First step is to accurately **forecast the positions** of each asset and contract A
  - Second step when trying to mitigate risk is to **identify** and classify/organise the risk factors B
  - To mitigate the price and volume risks, market participants can then perform **hedging** actions C

A FORECAST: KEY PRINCIPLES

Portfolio information









Market prices



Constraints

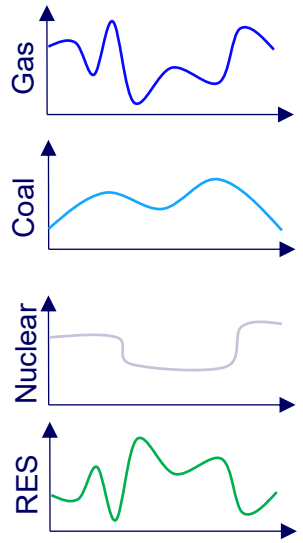
Technical constraints (Revision planning, max power, ….)

Contractual constraints (reserves, fuel contracts,..)

Fleet information, market prices, and constraints are used as input for the optimisation model

Optimisation model

The output of the model is the forecasted production and fuel consumption, which maximises S-P (cashflow) while respecting the constraints.



Maintenance planning
Choosing the best moment to place a maintenance (while respecting the technical constraints) is also a possibility to optimise S-P results.

Forecasting exercise: to be done for all contracts (industrial and residential customers) and assets (power plants including RES, storage…)

RISK MAPPING CASE STUDY
FORECASTING (A) AND MODELLING (B) A GAS POWER PLANT

Gas Market

20 EUR/MWh

Natural Gas

EU CO_2 market

5 EUR/ton

CO2 Certificates

Gas-fired power plant



Efficiency = 50%

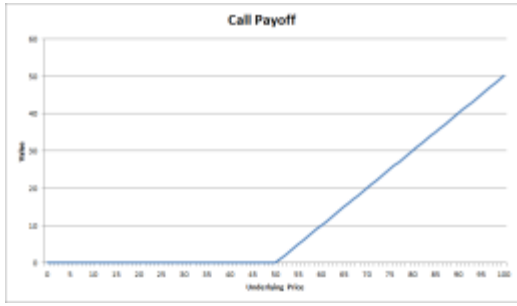
Production cost
20 €/MWh_gas **/ 50% +**
5 EUR/ton *** 0.185** ton/MWh_gas **/ 50%**
= 41.8 €/MWh_elec

Option
"run or stop"
CSS > O&M : Run
CSS < O&M : Stop

Electricity



Local Electricity Market
40 EUR/MWh



Fuel Costs
Powerplant is **short** Fuel (Gas, CO2)
If fuel prices increase →Asset S-P decreases

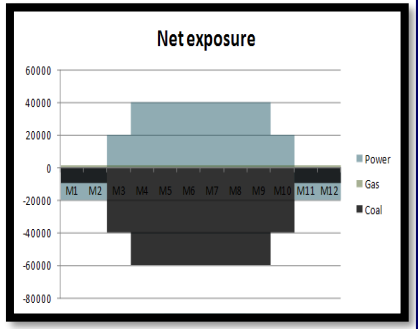
Power Revenues
Powerplant is **long** Power
If Power prices increase → Asset S-P increases

C HEDGING

1. Risk Mapping:
   - Forecast
   - Position modelling

2. Definition of Hedging Strategy

3. Execute Strategy







Hedging can start…
After step 1, portfolio managers have an accurate view on their EXPECTED positions (long, short) in the different commodities, for the full trading horizon (real time to Y+4/5)

HEDGING CASE STUDY: HEDGING A GAS POWER PLANT

Example:

Power plant with 50% efficiency: input of 2 units of gas to produce 1 unit of power (no CO2)

(1) Strategy ***"hedge and sleep"***

T1: forward gas 22 €/MWh ; power 50 €/MWh

⇨Forecast: Plant margin: 6 €/MWh => plant will run

⇨ Hedging: Sell power, buy gas, margin of 6 €/MWh

T2: forward gas 24 €/MWh ; power 45 €/MWh

⇨ Forecast: Plant margin: -3 €/MWh, but already hedged at 6 €/MWh

T3: forward gas 23 €/MWh ; power 48 €/MWh

⇨ Forecast: Plant margin: 2 €/MWh, but already hedged at 6 €/MWh

P&L: 6 €/MWh

(2) Strategy **"Option Value"**

T1: forward gas 22 €/MWh ; power 50 €/MWh

⇨Forecast: Plant margin: 6 €/MWh => plant will run

⇨ Hedging: Sell power, buy gas, margin of 6 €/MWh

T2: forward gas 24 €/MWh ; power 45 €/MWh

⇨ Forecast: Plant margin: -3 €/MWh, but already hedged at 6 €/MWh

⇨ Sell gas, buy power, additional margin 3€/MWh

T3: forward gas 23 €/MWh ; power 48 €/MWh

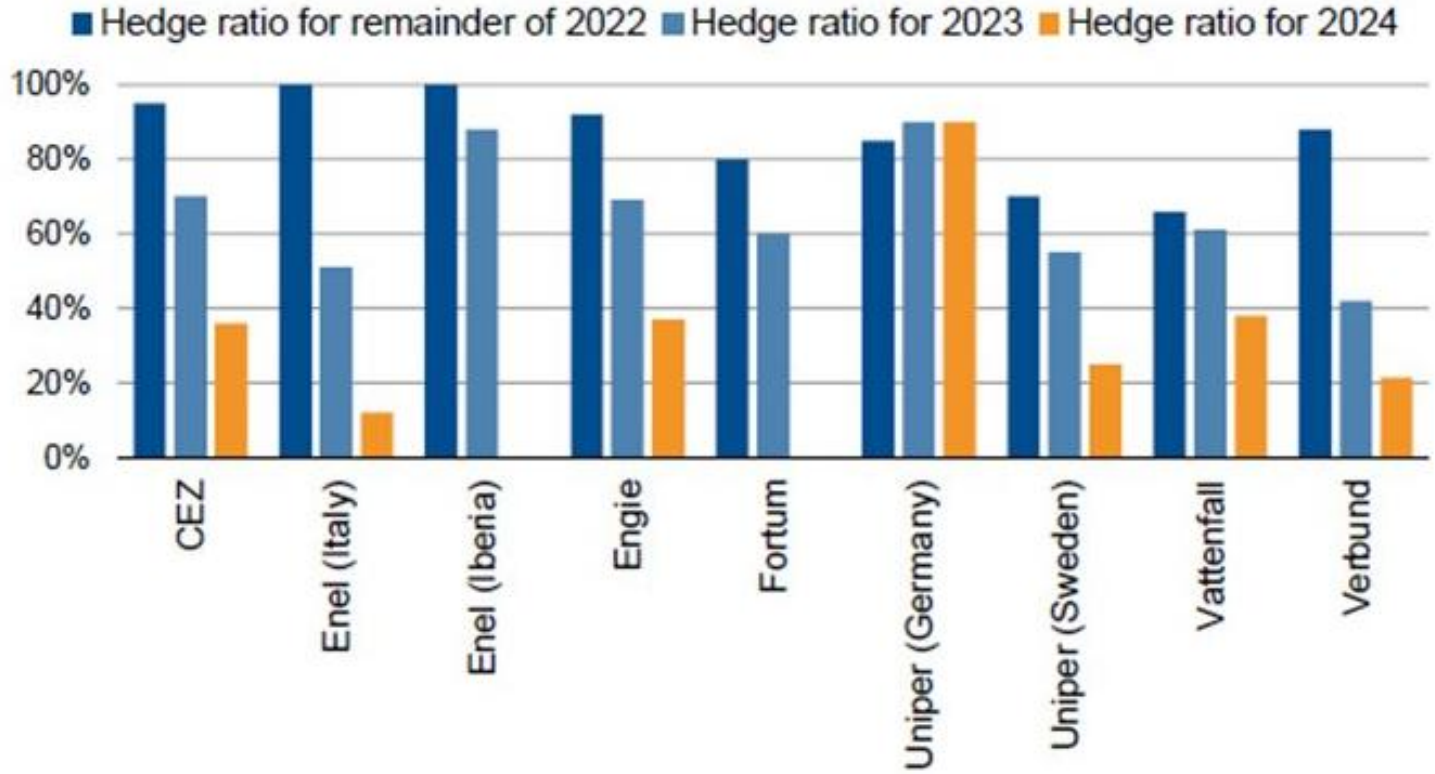
⇨ Forecast: Plant margin: 2 €/MWh, but already hedged at 6 €/MWh

⇨ Sell power, buy gas, additional margin 2€/MWh

P&L: 11 €/MWh

WHY DO WE HEDGE?





Sources: companies' investor presentations for H1 2022, Scope

Hedging ratios observed in June 22, as published in the annual reports

SUMMARY

HEDGING IS A MEAN TO REDUCE ITS PRICE/VOLUME RISK EXPOSURE

Forwards allow locking in the price of a commodity today, even if it will be bought or sold in physical form in the future.

Good reasons to hedge

- Secure affordable prices for customers
- Secure your P&L
- Avoid adverse mismatches with competitors
- Meet shareholders expectations
- Comply with your communication to the market

Good reasons to NOT hedge

- Avoid too expensive or inefficient hedging
- Avoid hedging uncertain positions
- Due to expectations about price evolution

Conclusion

Forward markets are crucial for the efficiency of electricity systems.
They are key to ensure a competitive price for the final customers.

THANK YOU

