

# COMMODITIES (ENERGY)

INVESTMENT ANALYSIS

NMFP533

MATEJ MIKOVÍČ

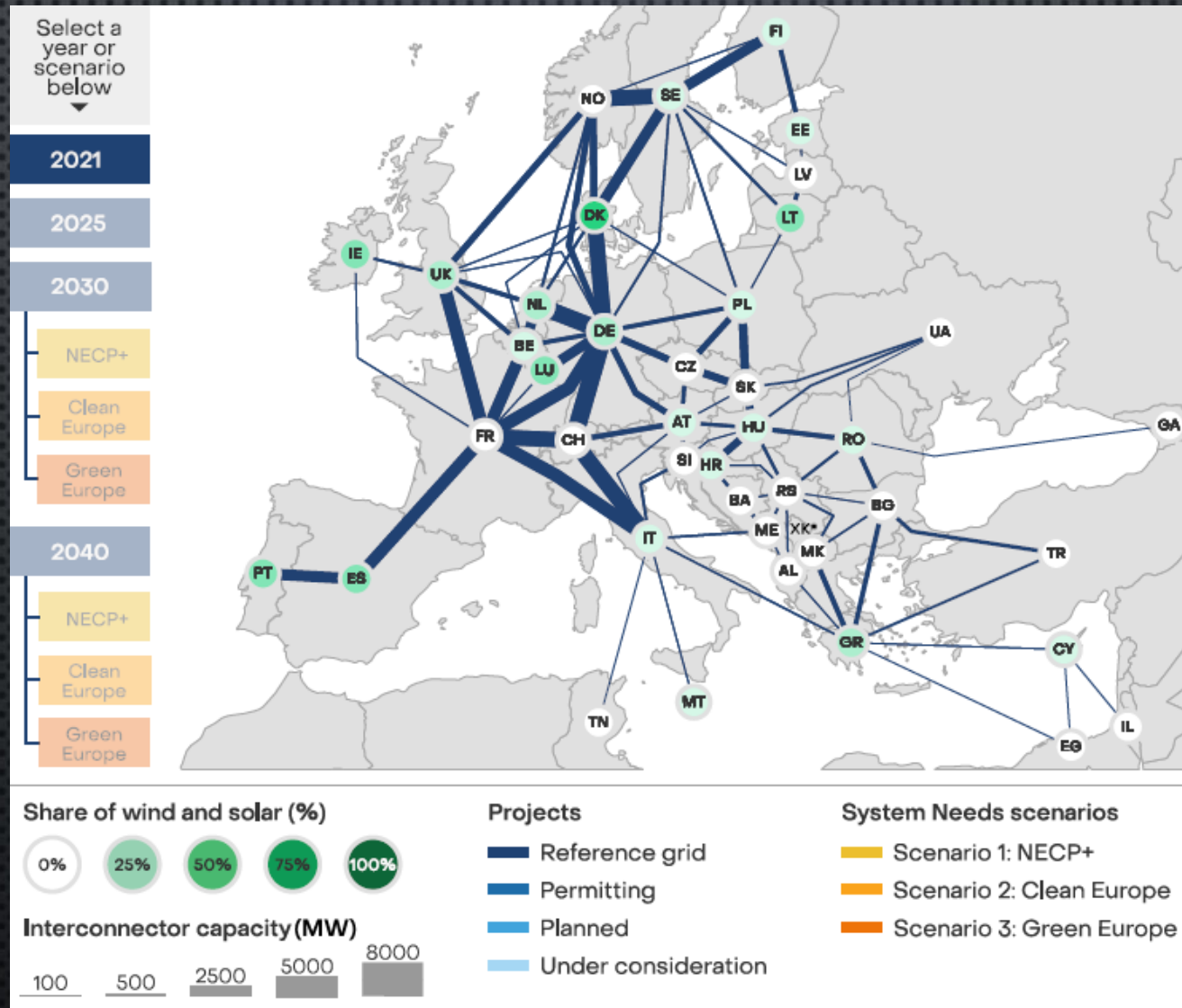
# BASIC INFO

- ESSENTIAL COMMODITY FOR MODERN LIFE – ITS EVERYWHERE
- CANNOT BE STORED IN A SUFFICIENT AMOUNT
- PRODUCTION AND CONSUMPTION NEEDS TO BE IN CONSTANTLY BALANCE – TOO MUCH IMBALANCE  
→ BLACK-OUTS IN POWER GRID (SHORTAGE IS ARGUABLY BETTER THAN SURPLUS – SWITCHING-OFF  
“GRID-ISLAND” IN THE GRID IN TIMES OF SHORTAGE AS A LAST RESORT: SVK - COMMON PRACTICE IN  
90s; WAR IN UA – W/2023)

# MARKET SPECIFICS

- DEPENDENCE ON UNDERLYING ELECTRICITY-GENERATING COMMODITY PRICE (2022 GAS)
- WEATHER DEPENDENCE
  - E.G. HEATING SEASON (HEATING BY ELECTRICITY + HEATING BY NATURAL GAS) → HIGHER DEMAND FOR ELECTRICITY + LOWER SUPPLY OF GAS (= MORE EXPENSIVE GAS ELECTRICITY PRODUCTION) → HIGHER ELECTRICITY PRICES
- CALENDAR DEPENDENCE AND UNDERLYING ECONOMIC ACTIVITY
  - E.G. PRICES ARE LOWER ON WEEKENDS AND HOLIDAYS
- LARGE INTRA-DAY PRICE VOLATILITY AS WELL AS GENERAL PRICE VOLATILITY OF TRADED DERIVATIVES
- TRADED NON-STOP
- TRADING HORIZON IS EXTREMELY WIDE (INTRADAY TRADING FOR THE NEXT HOUR - CAL-34)
- POWER GRID STABILITY:
  - SYSTEM IMBALANCE (EVALUATED IN 15MIN INTERVALS) – ENERGY PROVIDER IS REWARDED/PENALIZED FOR “GOOD/BAD BEHAVIOR” OF ITS CUSTOMER PORTFOLIO BY THE LOCAL POWER GRID AUTHORITY (SEPS, CEPS) – OVERLOOKED BY THE LOCAL CLEARING AGENT (OKTE, OTE)
- PRICES CAN BE NEGATIVE (WHEN THERE IS HIGH INFLEXIBLE POWER SUPPLY MEETS LOW DEMAND) – AGENTS ARE PAID TO CONSUME ENERGY (E.G. STEEL PRODUCING PLANT WOULD SWITCH ON ALL ITS BLAST FURNACES TO CONSUME ELECTRICITY POWER AND THEY ARE PAID FOR IT)
- (DE)COUPLING MARKETS – TRANSMISSION GRID – DAILY LIMITS ON TRANSFER OF ELECTRICITY BETWEEN COUNTRIES BASED ON AVAILABLE CAPACITY ON CROSS-BORDER CONNECTIONS BETWEEN GRIDS (CAPACITY AND TIMES DETERMINED AT AUCTIONS HELD BY LOCAL POWER-GRID AUTHORITY)

# EUROPE CROSS-BORDER TRANSMISSION GRID



Source: <https://ember-climate.org/data/data-tools/electricity-interconnection-europe/>

# UNDERLYING DERIVATIVES

- FUTURES
  - STANDARDIZED CONTRACTS TRADED ON AN EXCHANGE
  - EU: EEX (EUROPEAN ENERGY EXCHANGE AG – DEUTSCHE BOERSE GROUP)
    - EEX {EU\_COUNTRY} POWER FUTURES / EEX-PXE {EU\_COUNTRY} POWER FUTURES
- FORWARDS
  - OTC CUSTOMIZABLE CONTRACTS WITH SPECIFIC ELECTRICITY SUPPLIERS/ENTITIES\
- OPTIONS
  - PRETTY RARE, USED IN HEDGING
  - ONLY TRADED (EQUITY-STYLED/FUTURE-STYLE) OPTIONS ON EEX ARE GER, FRA, ITA, ESP

SEPARATE CASE: RENEWABLES – SOLAR/WIND OZE (OBNOVITELNÝ/OBČASNÝ ZDROJ ELEKTRINY) – AUCTION ORGANIZED BY LOCAL AUTHORITY (OKTE/OTE) FOR RIGHTS TO PURCHASE THIS ELECTRICITY FROM SELECTED PRODUCERS IN A GIVEN COUNTRY (CZ/SK)

# TRADING HORIZON

- LONG-TERM (EEX, PXE):
  - YEAR: CAL-25
  - QUARTER: 2/24
  - MONTH: JAN/24
  - WEEK: WEEK 1/24
  - WEEKEND: WkEND 06/01
  - DAY: 05/01/2024 (WHOLE DAY)
- SHORT-TERM (OKTE, OTE):
  - DAY-AHEAD (05/01/2024)
  - INTRADAY (04/01/2024) – HOURLY BASIS (IN THE FUTURE MAYBE EVEN 15MIN GRANULARITY)

# “DIFFERENT” TYPE OF ELECTRICITY:

THESE PRICES PLAY ROLE IN ELECTRICITY BILL FOR END-USER (HOUSEHOLD, FACTORY...)

- BASELOAD (0:00 – 24:00)
  - MINIMUM AMOUNT OF ELECTRICAL AMOUNT NEEDED OVER 24H PERIOD (ELECTRICAL NEEDS OF MAINTAINING A HOUSEHOLD: FRIDGE, FREEZER, LIGHTS, WI-FI, ALARM...)
  - RELATIVELY STABLE OVER A DAY, UNLIKELY TO RAPIDLY FLUCTUATE
  - SUITABLE BASELOAD SUPPLIERS (STABLE OUTPUT – CANNOT BE EASILY PUT ON/OFF): NUCLEAR, HYDRO, COAL, BIOMASS
- PEAKLOAD (8:00 – 20:00)
  - SHORTER PERIOD WITH HIGH DEMAND + LESS PREDICTABLE THAN BASELOAD → MORE EXPENSIVE THAN BASELOAD
  - IN HOUSEHOLD TERMS: AC/HEATING, TV, WASHING MACHINE, OVEN...
  - SUITABLE PEAKLOAD SUPPLIERS (EASILY TO BE PUT ON/OFF IN NO TIME): GAS, SOLAR, WIND
- OFF-PEAK LOAD (0:00 – 8:00 & 20:00 – 24:00)
  - COMPLEMENT TO PEAK-LOAD

# MARKET PRICE FORMATION – MATCHING CURVES

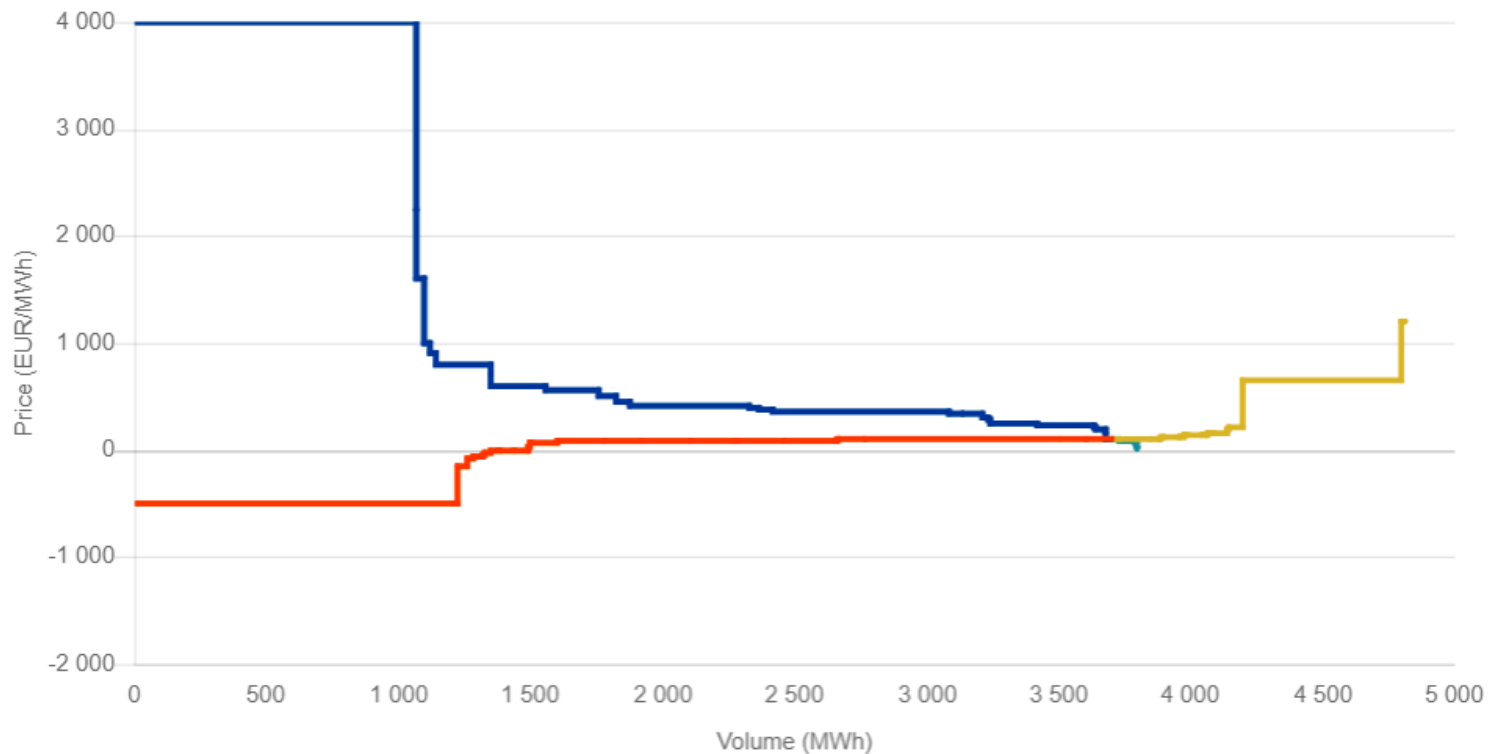
## Matching Curves

◀ 4. January 2024 ▶

Hour 17 ▼

### Matching Curves for Hour 17 (CZ)

Supply matched energy Demand matched energy Supply energy Demand energy





# MARKET PRICE FORMATION – MATCHING CURVES CZECH SHORT-TERM MARKET (OTE)

Bid for Hour 17		
Type	Count	Volume (MWh)
Successfull purchase	52	2 748,2
Successfull sale	28	3 701,5
Unsuccessfull purchase	5	98,4
Unsuccessfull sale	5	1 107,3

Matched price: 105,00 EUR/MWh

MATCHED PRICE FOR MWh OF DAY-AHEAD ELECTRICITY DELIVERED ON 4<sup>TH</sup> JAN 2024 AT 17H

SOURCE: [HTTPS://WWW.OTE-CR.CZ/EN/SHORT-TERM-MARKETS/ELECTRICITY/MATCHING-CURVES?HOUR=17&DATE=2024-01-04](https://www.ote-cr.cz/en/short-term-markets/electricity/matching-curves?hour=17&date=2024-01-04)

# MARKET FORMATION – MORE COMPACT LOOK

## Day-Ahead Market

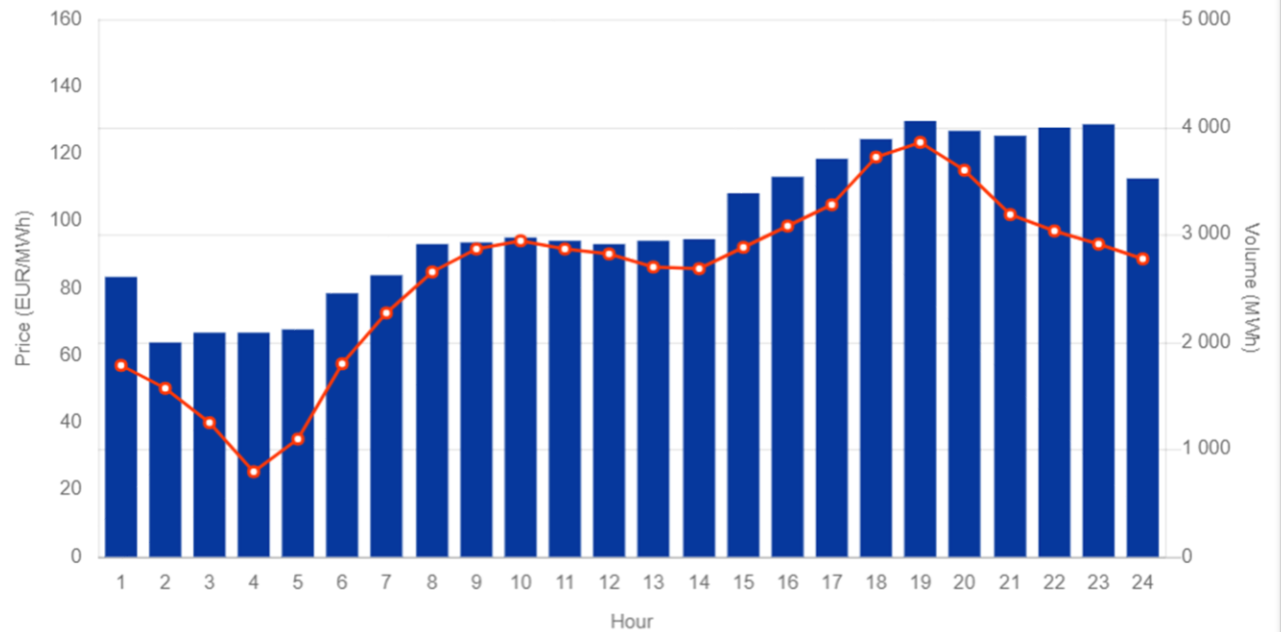


4. January 2024



### Day-Ahead Market CZ Results - 04.01.2024

Price (EUR/MWh) Volume (MWh)



Index	EUR/MWh	Change (%)	Total volume CZ (MWh)
BASE LOAD	83,24	62,87 <span style="color: green;">↗</span>	74 539,0 <span style="color: green;">↗</span>
PEAK LOAD	99,46	45,76 <span style="color: green;">↗</span>	40 173,4 <span style="color: green;">↗</span>
OFFPEAK LOAD	67,03	97,24 <span style="color: green;">↗</span>	34 365,6 <span style="color: green;">↗</span>

Hour	Price (EUR/MWh)	Volume (MWh)	Saldo DM (MWh)	Export (MWh)	Import (MWh)
1	57,30	2 607,1	818,3	1 350,5	-532,2
2	50,46	2 001,5	219,5	944,9	-725,4
3	40,00	2 089,5	50,5	802,8	-752,3
4	25,48	2 094,4	33,8	780,6	-746,8
5	35,00	2 113,7	-24,6	815,6	-840,2
6	57,73	2 454,9	414,4	1 183,7	-769,3
7	72,65	2 629,1	-361,1	550,6	-911,7
8	85,02	2 913,6	-632,0	365,5	-997,5
9	91,47	2 931,6	-542,9	245,9	-788,8



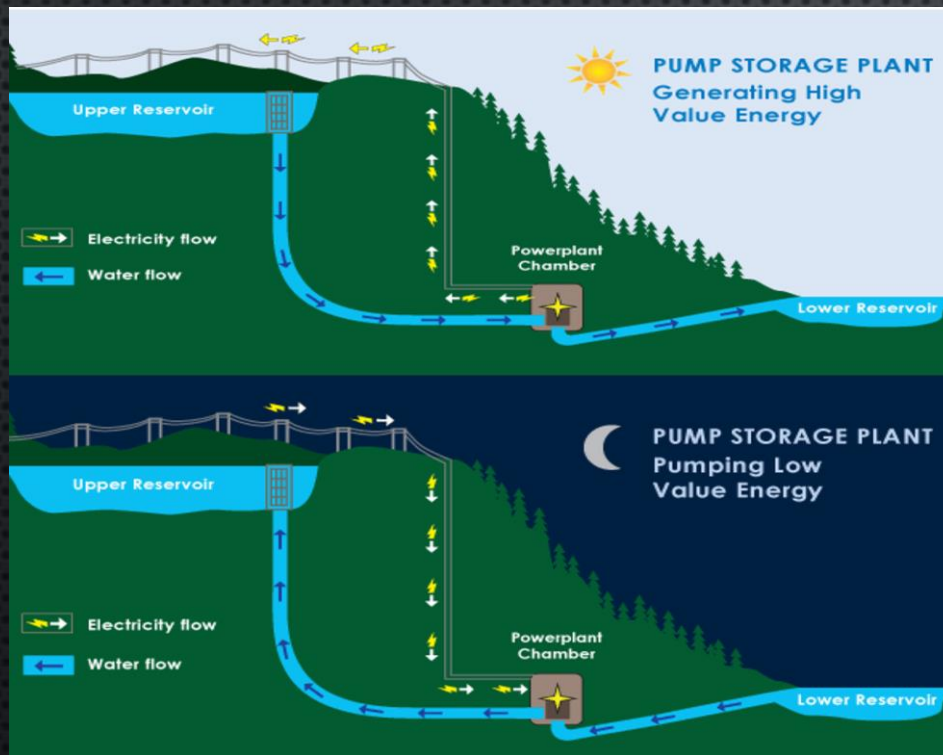
# SHOW ME THE MONEY

- GRID STABILITY – BETTING AGAINST THE SYSTEM

- DIFFERENT OPINION ON THE OVERALL BALANCE IN THE POWER GRID
- REWARDED/PENALIZED BY THE LOCAL AUTHORITY FOR MITIGATING/CAUSING SYSTEM IMBALANCE
- BASIC IDEA: I QUOTE THAT CONSUMPTION OF MY CUSTOMER PORTFOLIO WILL BE  $X$  AT 10H, SYSTEM MEASURES ACTUAL CONSUMPTION  $Y$ , IF THE DIFFERENCE  $X-Y$  SHIFT OVERALL SYSTEM IMBALANCE (CAUSED BY OTHER AGENTS AS WELL) TOWARDS 0 I GET REWARDED, IN OPPOSITE CASE I GET PENALIZED

- OPTIMAL ENERGY PRODUCTION

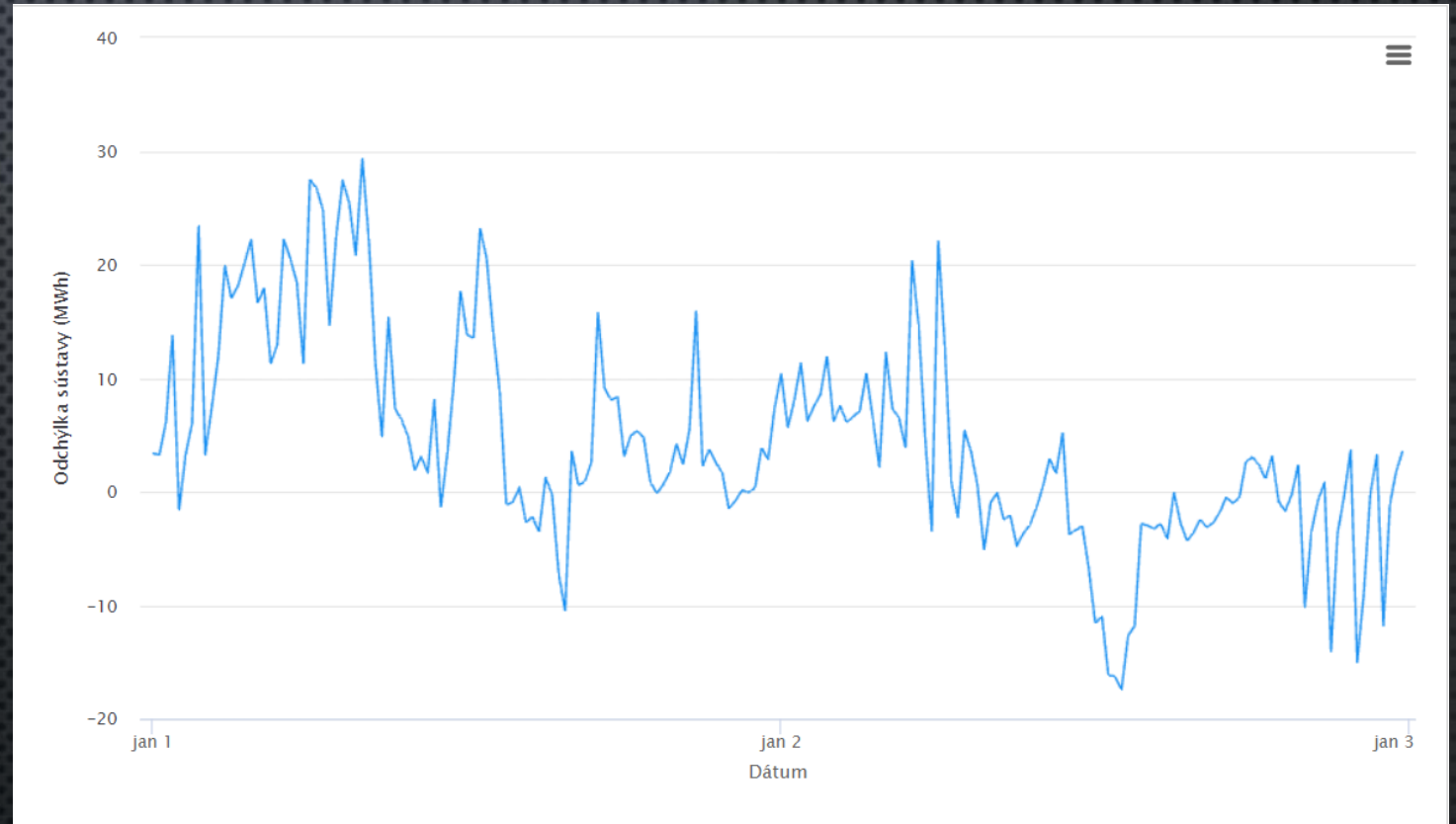
- IDEALLY HAVING POWER PLANT AND TRADING ON ENERGY MARKET AT THE SAME TIME – BIG PLAYERS ONLY: ZSE, ČEZ
- STOCHASTIC OPTIMIZATION
  - PUMPED-STORAGE POWER PLANT (ČIERNY VÁH)
  - COMBINED CYCLE POWER PLANT (MALŽENICE)



# SYSTEM IMBALANCE IN SLOVAKIA (15MIN GRANULARITY)

- SYSTEM IMBALANCE SHEET FOR 1<sup>ST</sup> JAN 2024:  
[HTTPS://WWW.OKTE.SK/EN/IMBALANCE-SETTLEMENT/PUBLISHED-INFORMATION/SYSTEM-IMBALANCE/#DATEFROM=2024-01-01&EVALUATIONTYPE=10&DISPLAYTYPE=0&PAGE=1](https://www.okte.sk/en/imbalance-settlement/published-information/system-imbalance/#dateFrom=2024-01-01&evaluationType=10&displayType=0&page=1)

NOTE: OKTE (SK) EVALUATES SYSTEM IMBALANCE IN 15MIN WHILE OTE (CZ) IN 1H INTERVALS.



POSITIVE VALUE = SURPLUS; NEGATIVE VALUE = SHORTAGE; POSITIVE PAYMENT = PAID BY CLEARING AGENT, NEGATIVE PAYMENT = PAID BY THE SUBJECT OF SETTLEMENT

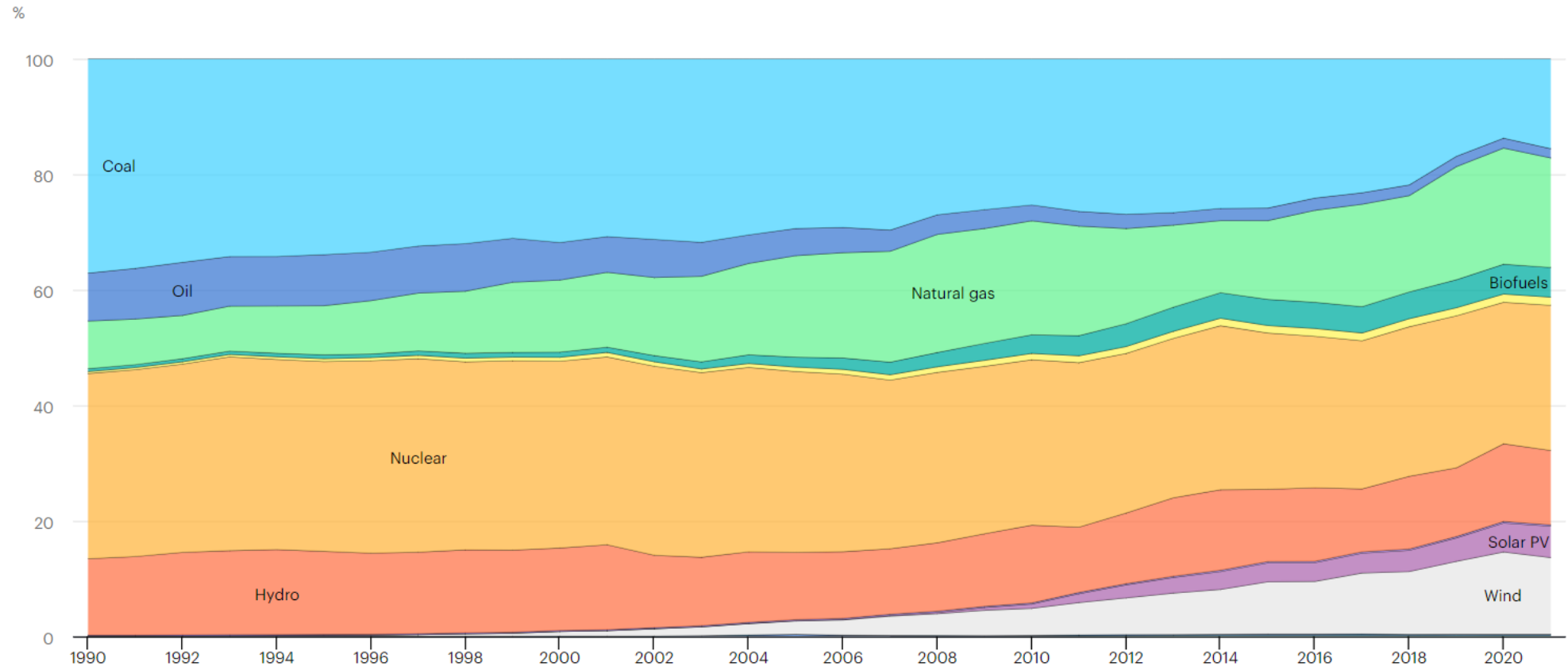
SOURCE: <https://www.okte.sk/sk/zuctovanie-odchylok/statistika/vyvoj-odchylky-sustavy/#dateFrom=2024-01-01&dateTo=2024-01-02&page=1>  
FOR CZECH EQUIVALENT REFER TO: <https://www.ote-cr.cz/en/statistics/electricity-imbalance?version=0&date=2024-01-02>

# 2022 EU ENERGY CRISIS

- BUILD-UP:
  - LONG-TERM:
    - TIGHTENING GREEN POLICIES
      - INCREASE IN PRICE OF TRADEABLE CO<sub>2</sub> PERMITS – INCENTIVIZING TRANSITION TO CLEAN ENERGIES (AT ALL COSTS...)
      - INCREASING ROLE OF RENEWABLES IN THE EU ENERGY MIX
    - POST-FUKUSHIMA NUCLEAR AGE:
      - GROWING SKEPTICISM (EVEN HYSTERIA) OF THE PUBLIC – GER SHUTTING-OFF ALL NUCLEAR PP (LAST TO SHUT IN 4/2023 – PURELY POLITICAL REASONS)
      - INCREASING COST BY TIGHTENING ALREADY TIGHT REGULATORY STANDARDS (IMPOSSIBLE TO BUILD A NUCLEAR PP SOLELY FROM PRIVATE INVESTMENT)
    - INCREASING DEPENDENCE ON RUSSIAN GAS (GERMANY, NS1, NS2, LOBBYISM)
  - SHORT-TERM:
    - SUMMER 2021 – EXTREME DROUGHTS IN FRANCE – LOW RIVER LEVELS – REDUCED OUTPUT OF NUCLEAR POWER PLANTS (COOLING COMPROMISED)
    - Q1 – Q3 / 2021 – NS1 “TECHNICAL” ISSUES (GAZPROM’S WAY ON INCREASING PROFIT MARGIN – CREATING BUDGET SURPLUS – RU PREPARATION FOR WAR (LIKELY)

# EU - ENERGY MIX

Electricity generation by source, European Union (EU27) 1990-2021



SOURCE: <https://www.iea.org/regions/europe>

# EU Carbon Permits



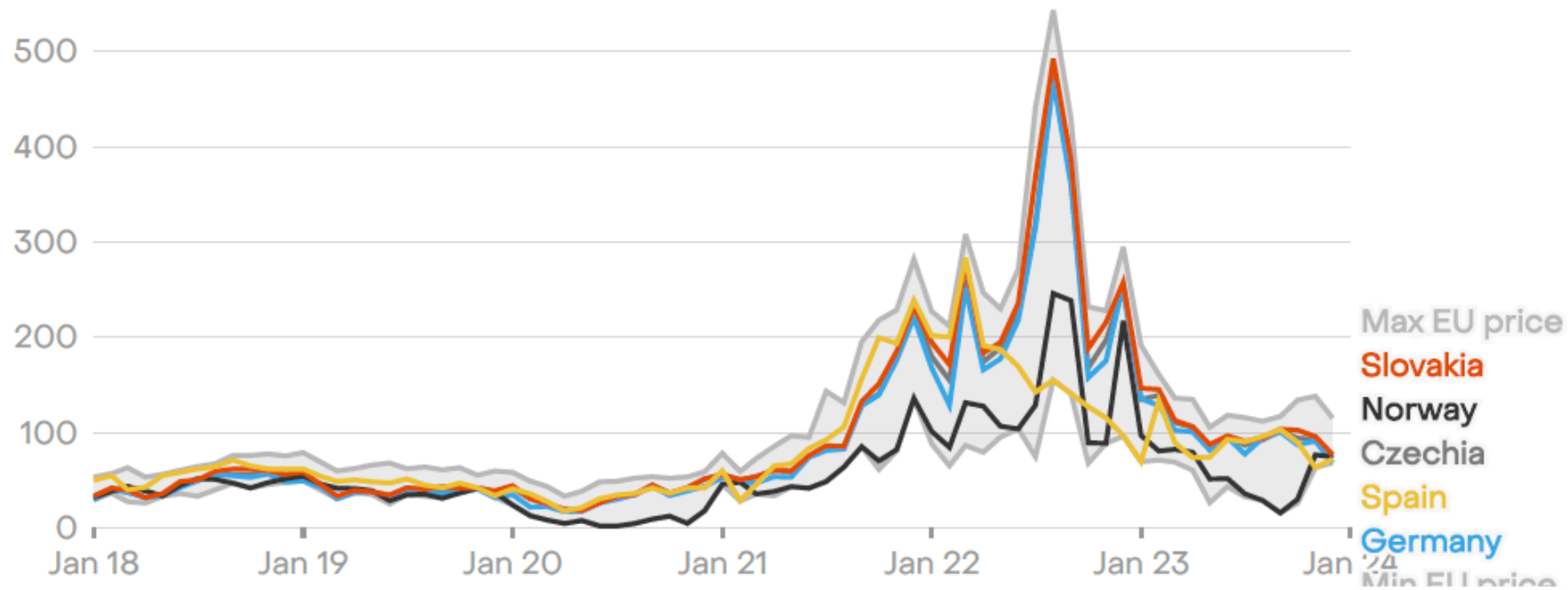
source: tradingeconomics.com

# Wholesale electricity prices in Europe

€ per megawatt hour

Monthly Daily (1 year) Daily (3 months)

Min EU price | Max EU price | Spain | Germany | Czechia | Slovakia | Norway | Enter countries to show



SOURCE: <https://ember-climate.org/data/data-tools/europe-power-prices/>

NOTE: Prices are average day-ahead spot prices per MWh sold per time period; Max and min prices refer to the highest and lowest average values of any country in the EU in that period.



# TAKEAWAYS

- DIVERSIFY
  - ENERGY MIX
  - SUPPLIERS OF ENERGY-GENERATING COMMODITY (LNG TERMINALS) – EU CAN BE SURPRISINGLY SWIFT IN PASSING LEGISLATIVE AND REMOVING BUREAUCRATIC BARRIERS IF PUSHED AGAINST THE WALL STRONG ENOUGH
- EVEN IF SUFFICIENTLY DIVERSIFIED, DO NOT BECOME OVERLY DEPENDENT ON 1 SUPPLIER OF ENERGY-GENERATING RESOURCE
- 2<sup>ND</sup> CHANCE FOR NUCLEAR ENERGY IN EU (ALTHOUGH EXPENSIVE AND PAINFUL)

# FUTURE DEVELOPMENTS AND CHALLENGES

- ESG AND ITS IMPACT ON EU (ENERGY) INDUSTRY
- VIRTUAL BATTERIES (INFANT STAGES) / PHYSICAL MEGA BATTERIES (SCI-FI AS OF NOW)
- HYDROGEN (BY-PRODUCT OF LNG PROCESSING) – CHEAP SOURCE OF ELECTRICITY GENERATION
- NEW APPROACHES IN EXTRACTING ENERGY-GENERATING RESOURCES: FRACKING (RISK X REWARD)
- ULTIMATE CLEAN, SAFE AND STABLE SOURCE OF ENERGY – FUSION (SCI-FI AS OF NOW)
  
- MAINTAINING GRID STABILITY IN INCREASINGLY MORE VOLATILE ENVIRONMENT (INCREASINGLY DEPENDING ON RENEWABLES)
- GERMANY MOVING FROM NET EXPORTER TO NET IMPORTER ON A WORSE DAY (NO SUN, NO WIND)
- EXTRACTING ENERGY-GENERATING RESOURCES AVAILABLE ON EU SOIL (NL – GRONINGEN – SELF-SUFFICIENCY FOR 50+ YEARS) – MORE OF A MENTAL THAN PHYSICAL BARRIER (NYMBY)
- INCREASING PRICE VOLATILITY DUE TO RENEWABLES
- (ONCE AGAIN) BUILDING TOO STRONG DEPENDENCE ON AN OUTSIDE PLAYER PROVIDING ELECTRICITY-GENERATING COMMODITIES (CHINA, RUSSIA, ARAB COUNTRIES...)

# SOME USEFUL SITES

- [HTTPS://WWW.EEX.COM/EN/](https://www.eex.com/en/)
- [HTTPS://WWW.EPEXSPOT.COM/EN/](https://www.epeexspot.com/en/)
- [HTTPS://PXE.CZ/CS/](https://pxe.cz/cs/)
- SK (DA/INTRADAY TRADING; SYSTEM IMBALANCE):
  - [HTTPS://WWW.OKTE.SK/](https://www.okte.sk/)
  - [HTTPS://WWW.SEPSAS.SK/](https://www.sepsas.sk/)
- CZ:
  - [HTTPS://WWW.OTE-CR.CZ/](https://www.ote-cr.cz/)
  - [HTTPS://WWW.CEPS.CZ/CS/](https://www.ceps.cz/cs/)

THANK YOU FOR THE ATTENTION!