

Recent Dynamics of Commodity Prices: Gas, Emission Allowances and Coal

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* *1. Introduction*

Over the years 2020 and 2021 commodity prices experience spike in their volatilities connected to the covid pandemic in 2020 and the recovery of the economies in the following year. The main aim of this paper is to assess impact of the volatility of the commodity prices on power prices. The secondary aim of this paper is to assess movements of prices of gas, emission allowances and coal within this period and factors (events) behind them as they have a direct influence on the power prices. Based on the merit order effect coal and gas power plants should be the marginal power producers for the German power market and hence influence power prices on the forward markets.

Volatility of commodity prices in general can be influenced by instability of macroeconomic situation in the respective country (Bakas, Triantafyllou, 2018). Unlike gas prices can be in short run influenced by political and external factors. However times of macroeconomic uncertainty usually do not increase volatility of gas prices in countries hence the uncertainty from the economical point of view does not tend to be transferred into the price volatility of the commodity. An exception can

be countries with usually low-uncertainty levels for that this kind of an event would be extraordinary (Joëts, Mignon, Razafindrabe, 2017). Despite this fact, gas prices tend to be of the most volatile among all commodities in general (Regnier, 2007).

Volatility (hence uncertainty) in gas prices play an important role not only for energy companies. Over time there is an increasing trend of adjustment of industrial production (responsiveness) to changing gas prices (increased from 7 % in 2008 to 32 % 2018) (Hailemariam, Smyth, 2019). Stability of gas prices (i.e. gas supply) could therefore play an important role for the performance of the whole economy.

As a final transformation volatility of commodities could influence stock returns of energy companies. As proved Oberndorfer (2009) oil and coal price changes have negative impact on the returns. On the contrary impact of gas prices in Eurozone is rather marginal. This can be explained by trend of long term supply contracts in Europe. From the microeconomic point of view more volatile environment on gas markets enhance hedging activity of companies active on the markets as their values at risk for their future cash flows increase (Choi, Kim, 2018).

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→ 2. Methodology

The paper is based on the data of commodity prices from the Intercontinental Exchange and the European Energy Exchange within the period of 2020–2021. Emission allowances EUA price, Dutch TTF gas futures contracts and coal API2 futures contracts are taken as a reference for the commodity prices. Movements of the weekly average prices are connected to relevant events that occurred within the respective time frame. As one of the purposes of the study is to explain events behind a significant price changes in the commodity prices a threshold for such a week was set as a price movement higher than 10 % in case of gas and coal prices and 9 % in case of emission allowances. These weeks are then matched with an events based on public source news data from the respective time frames.

The main task is represented by an analysis of an impact of commodity prices on power prices. For that purpose, a correlation and regression analysis is used. There are 96 values per each commodity in the statistical sample. Descriptive parameters of the dataset are presented in the table 1.

In the second half of the paper a multiple regression analysis is used in order to assess the impact of the commodity prices (gas, emission allowances, coal) to the power prices.

3. Movements in gas prices

Gas prices experienced a very volatile period of the years 2020 and 2021. Dutch TTF gas futures rose from the initial value of 12 EUR per MWh at the beginning of 2020 to its maximum value 180 EUR per MWh in December 2021. This represents increase of almost twelve times of the initial value. At the beginning of the period there was a trend of decline that lasted till the middle of summer 2020. At that point the trend shifted towards bullish market.

However the volatility of gas prices was not constant over the analyzed period as there were specific events that caused movements in the prices. This is visualized by the chart below that shows weekly gas price changes. In some weeks the price remained stable with almost no change and on the contrary maximum value reached almost as high as 50 %.

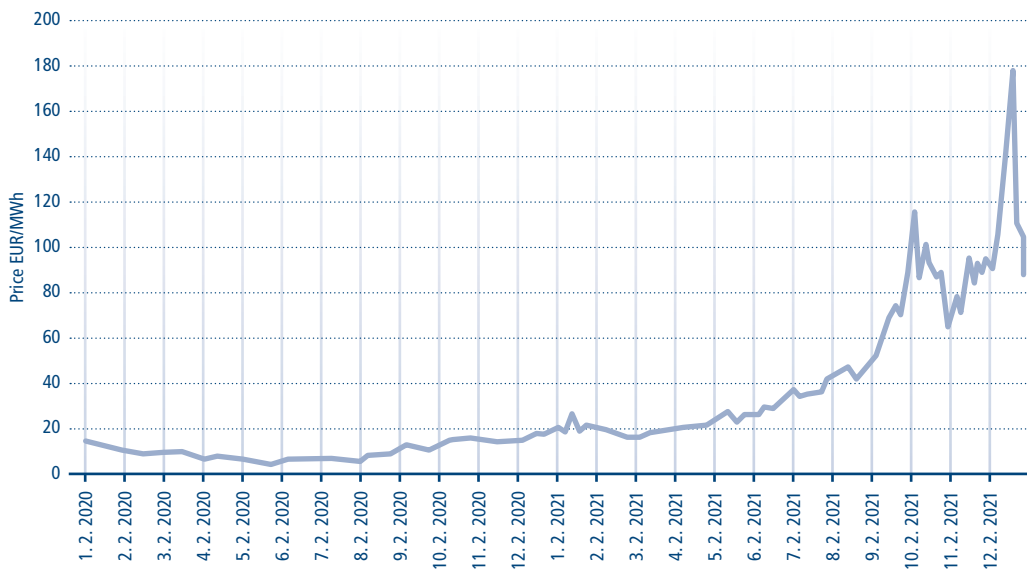
Table 2 presents weeks with TTF gas price changes above 10 %. In the first half of 2020 the market setup was predominantly bearish. Fillings of gas storages across Europe were on high levels. This together with milder winter, stable high level of supply built fundamental factors for the price movement trend. Outbreak of covid pandemic with its impact on energy demand was together with fundamental factors was brought gas prices to the historically low levels.

Table 1 » Descriptive statistics of the dataset

	Power	TTF	EUA	API2
Average	60,12	24,93	37,87	72,41
Median	49,52	16,41	32,84	53,94
Standard Deviation	25,13	24,13	14,81	43,77
Variance	631,71	582,19	219,27	1916,13
Skewness	1,64	1,70	0,46	1,64
Kurtosis	1,86	2,07	-1,19	2,15
Minimum	38,06	4,03	17,06	34,69
Maximum	136,88	101,01	71,85	224,62

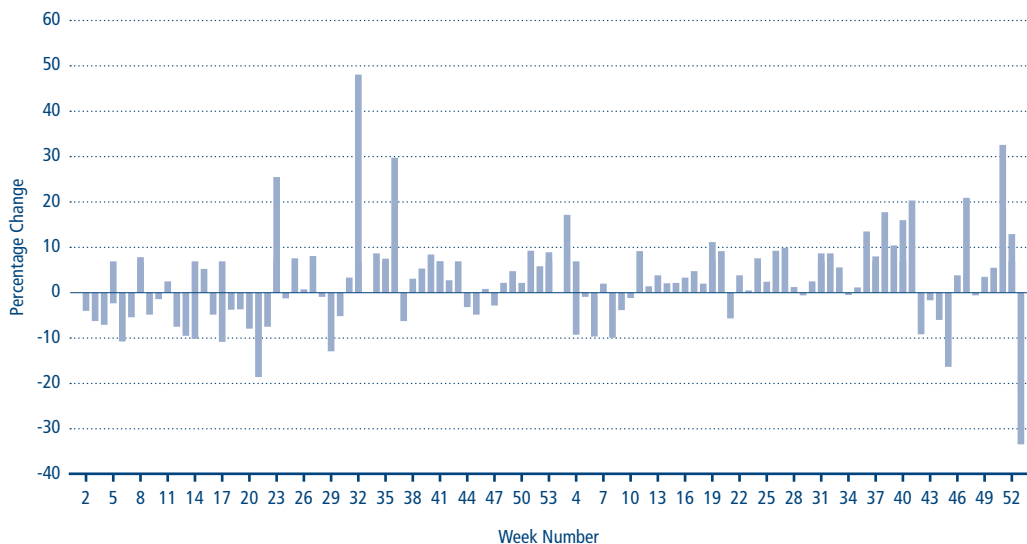
Source: Own compilation based on ICE, 2021, 2022; EEX, 2021, 2022

Figure 1 » Daily settlement price of NL TTF gas in 2020–2021 (front month contract) on ICE



Source: Own compilation based on ICE, 2021

Figure 2 » Weekly changes of price of Dutch TTF Futures in 2020 and 2021



Source: Own compilation based on ICE, 2021



→ **Table 2 » Weeks with TTF gas price changes above 10 % and events with an impact to the price in the respective week**

Year	Week	Weekly price change	Reason
2020	6	-10,6 %	Oversupply, warmer weather, coronavirus risks
2020	17	-10,7 %	Oversupply, low demand due to coronavirus
2020	21	-18,5 %	Coronavirus, record high gas storage fillings
2020	23	25,7 %	Higher demand due to coal to gas switching, anticipation of the winter price increase
2020	29	-12,9 %	High level of gas imports from Ukraine to EU
2020	32	48,3 %	Recovery of economies, upcoming winter period
2020	36	30,0 %	Offline terminals in the US and Australia
2021	3	17,4 %	Panic buys in Asia due to cold weather and surge of shipping costs
2021	19	11,5 %	Cyberattack in the US
2021	27	10,2 %	Low gas storage levels, maintenances, economic recovery, buyings in Asia
2021	36	13,6 %	Drop in flow from Russia to EU, Asia demand
2021	38	17,8 %	Low flow from Russia to EU, low storage levels, Asia demand
2021	39	10,6 %	Low flow from Russia to EU, low storage levels, Asia demand
2021	40	16,2 %	Low supply for spot buyers from Russia, low storage levels
2021	41	20,5 %	Low flow from Russia to EU, low storage levels, Asia demand
2021	45	-16,2 %	Restart of gas flows in Yamal pipeline
2021	47	21,3 %	Uncertainty of supplies from Russia, colder weather
2021	51	33,0 %	Reverse flow in Yamal pipeline
2021	52	13,2 %	Reverse flow in Yamal pipeline
2021	53	-33,2 %	Tankers from the US, milder weather

Source: Own compilation based on ICE, 2021; Jaganathan, 2021; Kemp, 2021; Chestney, Twidale, 2020; Buli, 2021a, 2021b; Aizhu, Jaganathan, Disavino, 2021; Soldatkin, Zinets, 2021; Twidale, Chestney, 2021; Golubkova, Kobzeva, 2021; Economic Times, SP Global, 2021, 2020a, 2020b, 2020c; Guardian, 2020; Argus Media 2021; Coklin, 2020; Dobbs, 2020; Mozée, 2021; Ratcliffe, 2021

In spite of such a low gas prices power production mixes started to switch from coal to gas power production that became relatively cheaper resulting into a higher gas demand. Together with upcoming winter period and recovery of industrial production market setup changed to bullish. This was stressed by outage of facilities in Australia and after hurricane Laura in the US in September 2020 resulting in a weekly increase of the price by 30 %.

Another jump in prices occurred at the beginning of 2021 with a combination of cold period,

strong demand in Asia and increase of shipping costs. In May 2021 a cyber attack on the gas facility in the US caused an increase of weekly gas price by 11,5 %. From the period of late spring – early summer an impact of low gas storage levels started to appear as a bullish factor on the European gas markets. This was stressed by prevailing strong demand in Asia. At the beginning of September first decline in gas flows from Russia occurred that caused another spike in prices. This trend of sharp increase of gas prices lasted till the middle of October.

Restart of flows in Yamal pipeline from Russia to Europe caused a drop in the prices by 16 %. However shortly after that uncertainty about the gas flows from Russia rose again driving the prices up again by over 20 % in combination with expectations of colder weather. This culminated before the Christmas period of 2021 with the news about reverse flows of gas in the Yamal pipeline with a spike of prices by 33 % up. In the last week of 2021 the weekly gas price fell down by one third due to liquified gas delivery by vessels from the US that were originally destined to Asia and milder weather.

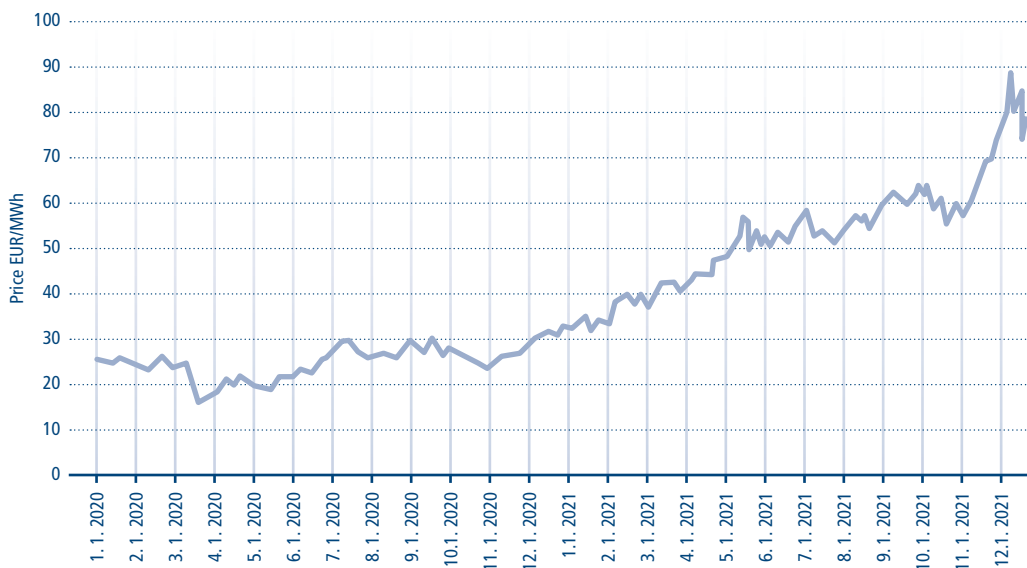
4. Movements in EUA prices

Similarly to gas price of emission allowances have experienced a very dynamic period over the last two years. At the beginning of 2020 the price oscillated in the area around 25 EUR. In the end of this two year period the Dec 21 futures contract settled at price above 73 EUR that represent an increase by 190 %.

Weekly average price changes were quite volatile during the analyzed period however the weekly movements were lower than in case of gas prices. Maximum weekly spike in prices recorded a value of 18 % and on the contrary maximum drop reached a value of 25 %.

Table 3 shows selected weekly emission's allowance price changes in 2020 and 2021 together with events with influence on the prices. First significant event was an outbreak of covid-19 pandemic followed by the restrictions with an impact on the industrial production. In spite of an expected drop in demand the EUA price dropped by one quarter in week 12. After this first shock, the price of allowances started to increase slowly with the slow recovery of the economies. A spike in the price came in the second half of May when the weekly price rose by over 10 %. One of the bullish factors was an agreement to extend emissions trading system by heating and transport in Germany with an expected opening price 25 EUR that was 6 EUR above the current traded price at that time.

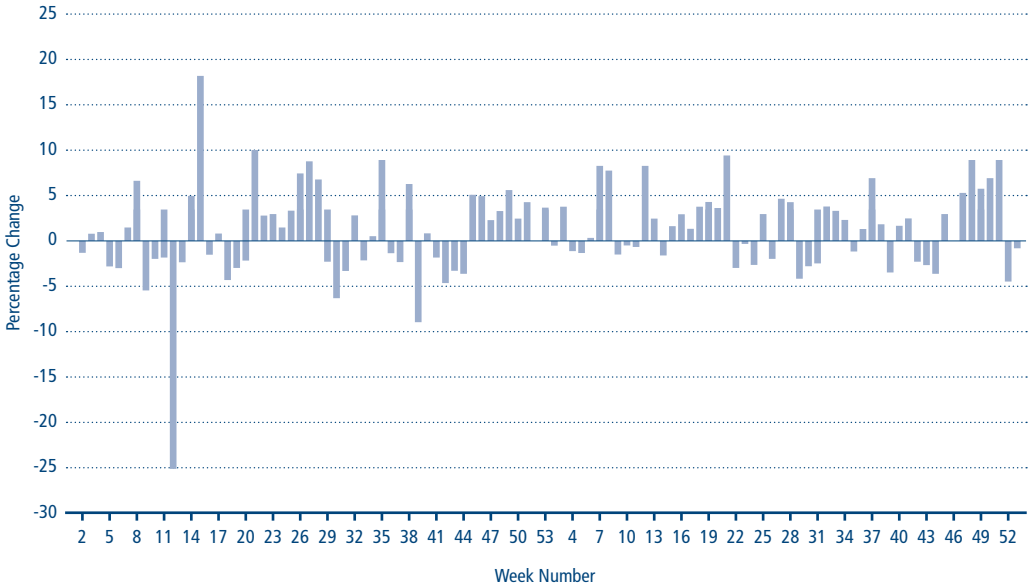
Figure 3 » Daily settlement price of EUA in 2020–2021 (Dec contract) on EEX



Source: Own compilation based on EEX, 2022



→ **Figure 4 » Weekly changes of price of EUA Futures in 2020 and 2021**



Source: Own compilation based on EEX, 2022

Table 3 » Selected weeks with EUA price changes of at least 9 % and events with an impact to the price in the respective week

Year	Week	Weekly price change	Reason
2020	12	-25,2 %	Coronavirus pandemic
2020	21	10,3 %	Agreed carbon price for heating and transport in Germany
2021	20	9,6 %	Financial institutions investments, proclamations of necessity of higher EUA prices
2021	47	9,0 %	Higher fossil fuels generation
2021	52	9,0 %	Higher fossil fuels generation, discussions of the EU carbon reduction policy

Source: Own compilation based on EEX, 2022; Reuters, Financial Times, 2021a, 2021b; SP Global, Meredith, 2021

In 2021 a rally of the emission allowances started. There was ready stable continuous increase of the price than sudden spikes. Highest weekly price increases reached 9 %. The first one occurred in the middle of May. Reason behind the whole period of continuous increase was interest of financial investors in this commodity that would offer a profit with relatively low risks as its price needed to increase in order to serve its purposes in the en-

ergy transition process. This was supported by proclamations of necessity of sharper and faster increase of the price in order to speed up the whole process by the EU politicians.

The rally continued in November and December with an increase of price from the area around 60 EUR to levels between 80 and 90 EUR. Behind this bullish trend stood on one side more progressive policy from the new German government that

moved the deadline for lignite phase out in addition to more ambitious plans of the whole EU. On the other side there were market factors connected to the increase of gas priced that increased EUA demand due to higher production of coal and lignite power plants.

5. Movements in API2 prices

As in the cases of both previous commodities the rally hit coal prices as well in the past year. At the beginning of 2020 the API2 coal was traded at prices above 50 EUR per metric tonne. The price was rather stable during 2020 with an exception of one spike by 18 %. However in 2021 there was a huge increase in price reaching a maximum weekly average level of 224 EUR per metric tonne.

The weekly price movements remained (with an exception of week 23) below 10 % in 2020. In

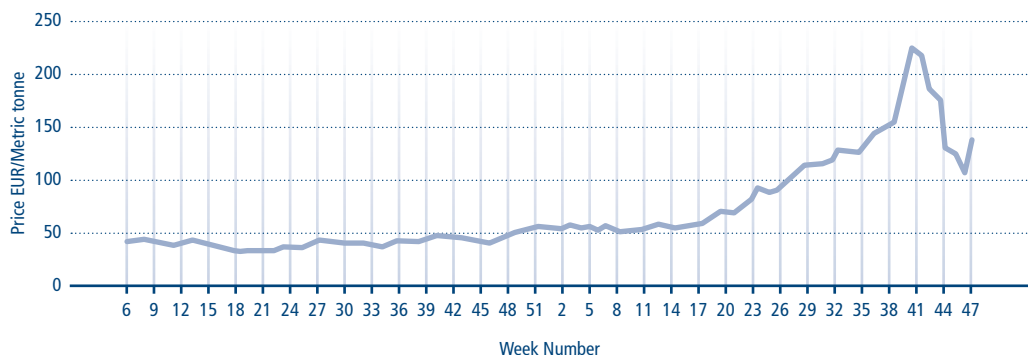
the second analyzed year price volatility increased and several times reached values above 20 % and in two weeks above 30 %.

In 2020 there was one week with a significant price movement in API2 price. A spike of 18 % occurred in week 23 when gas prices spiked due to bullish fundamentals on the market. This was a drawback factor for coal to gas switching in power production (that was happening at spring 2020) increasing demand for coal.

Year 2021 was generally full of bullish fundamentals for energy commodities. In June 2021 price of coal increased sharply by 14 % due to spike in gas prices. This rising trend prevailed for the whole summer of the year. Later in autumn several spikes occurred due to factors on the side of coal commodity itself. From October on there was a coal shortage in China combined with floods in local mines that pushed prices up. After interven-

On the contrary impact of gas prices in Eurozone is rather marginal. This can be explained by trend of long term supply contracts in Europe. From the microeconomic point of view more volatile environment on gas markets enhance hedging activity of companies active on the markets as their values at risk for their future cash flows increase.

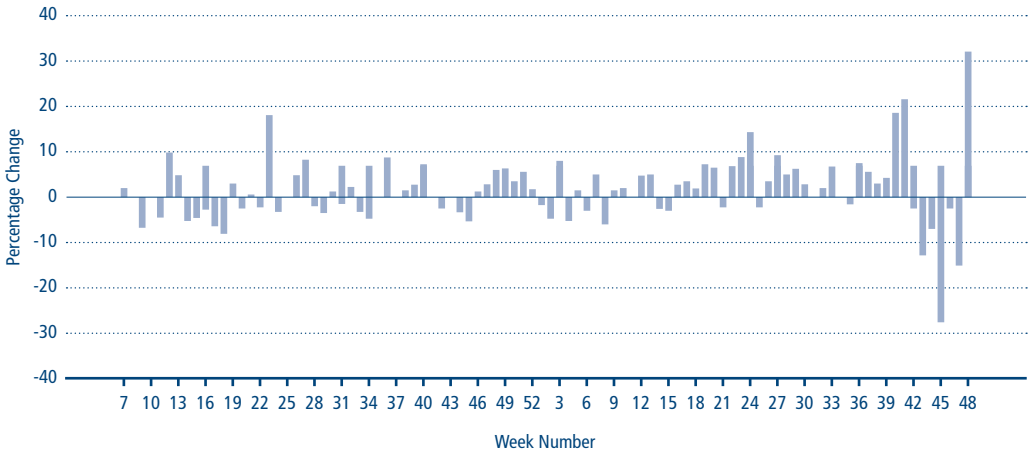
Figure 5 » Weekly settlement price of API2 in 2020–2021 (current month contract) on ICE



Source: Own compilation based on Intercontinental Exchange — API2 Futures



→ **Figure 6 » Weekly changes of price of API2 Futures in 2020 and 2021**



Source: Own compilation based on ICE, 2022

Table 4 » Selected weeks with API2 price changes of at least 10 % and events with an impact to the price in the respective week

Year	Week	Weekly price change	Reason
2020	23	18,2 %	Gas-Coal switching (increase of gas price)
2021	24	14,4 %	Shortage in gas supplies
2021	40	18,6 %	Coal shortage
2021	41	21,8 %	Coal shortage
2021	43	-12,9 %	State intervention in coal market in China
2021	45	-27,3 %	Improvement of China coal supplies

Source: Own Compilation based on S&P Global, Dezem, Starn, Almeida, 2021; Financial Times, CGTN, 2021; Argus Media, 2021

tions of local government with an impact on mining extension the prices relaxed in November.

6. Volatility and power price

All of the analyzed commodities have experienced volatile past two years due to different factors presented earlier. Table 5 shows volatility measured by a standard deviation of daily price changes (weekly in case of coal) of the respective commodity.

In 2020 the most volatile of the commodities was gas with over 5 % standard deviation followed by coal with 5 %. In 2021 the most volatile commodity was coal with over 9 % standard deviation, gas reached almost 6 % and emission allowances were oscillating around 3 % in both years. Highest volatility of coal prices is given not just by the fundamental factors but also by its lowest liquidity (hence highest spreads) out of all three commodities.

Increase and volatility of the commodities affected power prices as well. As these commodities

represent inputs for power production they necessarily must have an impact on the marginal costs of power plants that build afterwards background for pricing on the power exchange. Futures contract for calendar year 2022 for Germany on the EEX in-

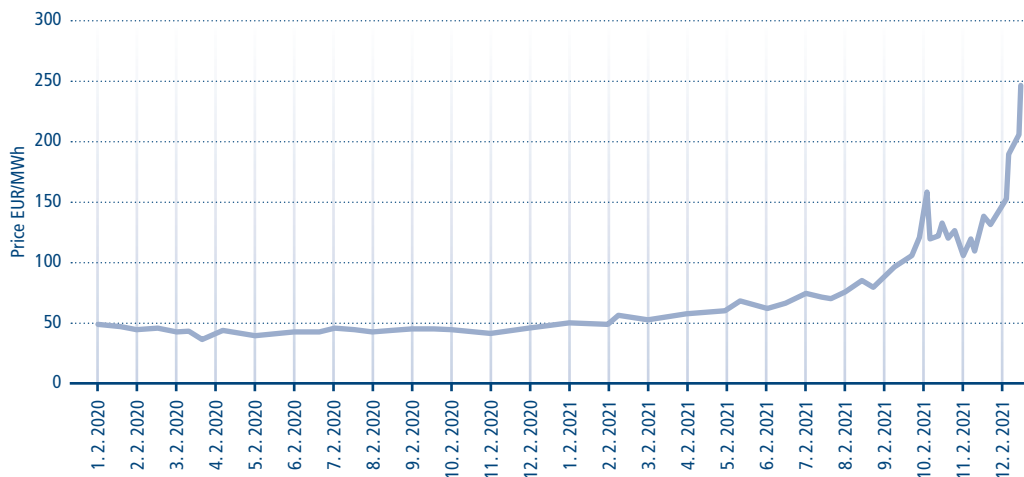
creased from its initial value of 47 EUR per MWh to the values around 240 EUR/MWh in December 2021. Impact on the power prices suggest values of correlation coefficient with its values for correlation above 0,5 for power with gas and emission al-

Table 5 » Standard deviation of commodity price movements in 2020 and 2021

	2020	2021	Total
Gas TTF	5,13%	5,82%	5,49%
EUA	3,16%	2,70%	2,94%
API2	4,99%	9,05%	7,36%

Source: Own compilation based on ICE, 2021, 2022; EEX, 2021, 2022

Figure 7 » EEX German power futures daily settlement price — Cal 22



Source: Own compilation based on EEX, 2021, 2022

Table 6 » Correlation matrix of analyzed commodities

Commodity	Power	TTF	EUA	API2
Power	1,00	0,53	0,54	0,36
TTF	0,53	1,00	0,19	0,41
EUA	0,54	0,19	1,00	0,06
API2	0,36	0,41	0,06	1,00

Source: Own compilation based on ICE, 2021, 2022; EEX, 2021, 2022



→ **Table 7 » Regression Analysis models based on variables**

Regression model	Coef of Determination
TTF	0,98
EUA	0,78
API2	0,89
TTF-EUA-API2	0,99
TTF-EUA	0,99

Source: Own compilation based on ICE, 2021, 2022; EEX, 2021, 2022

Table 8 » ANOVA results

	df	SS	MS	F	Significance F
Regression	2	59278,610	29639,310	3713,950	1,07E-88
Residual	92	734,209	7,981		
Total	94	60012,820			

Source: Own compilation based on ICE, 2021, 2022; EEX, 2021, 2022

Table 9 » Regression coefficients for the selected model

	Coefficients	Standard Error	t Stat	P-value
Intercept	28,60	1,03	27,80	1,51814E-46
Gas	0,91	0,02	39,01	5,02544E-59
EUA	0,23	0,04	6,14	2,08131E-08

Source: Own compilation based on ICE, 2021, 2022; EEX, 2021, 2022

lowances (however there are other factors that affect power prices such as production capacities of different power sources, weather etc.)

In order to evaluate the influence of the selected commodities on the power price a regression analysis for different combination of commodity variables was conducted. Dependent variable was the power price and independent variables gas, emission allowance and coal price. The highest coefficient of determination was reached for models TTF-EUA-API2 and TTF-EUA. However in the first case the p-value of API2 variable reached 0,35 on the set level of confidence 95 % and did not allow to reject null hypothesis. Hence the TTF-EUA mod-

el was chosen as the most reliable one. F value for the selected model reached 3714 while significance F level 1,07E-88.

Based on the model the fitted regression power price for the analyzed period would be defined as follows:

$$\text{Power} = 0,91 \times \text{TTF} + 0,23 \times \text{EUA} + 28,6$$

7. Conclusion

Years 2020 and 2021 represent times of volatility and unpredictability of movements of prices of energy commodities. Sudden sharp movements can

however harm subjects on the energy markets as they pose risks for any cash flow predictions. Therefore it is important to analyze them take into account in the future predictions.

All of the analyzed commodities were in spring 2020 affected by Covid-19 pandemic and the following restrictions as a bearish factor for their demand. However the prices started to increase as soon as the initial restrictions were loosened.

The rally occurred in 2021 with a sharp spikes in all commodity prices. Gas prices rose due to low fillings in gas storages in Europe that were combined with troubles with imports from Russia through Yamal pipeline. In addition to that demand in Asia proved to be strong during these times. Emission allowance prices increased during most of the time of the year based on several factors. Proclamations of the political leaders within the EU made it clear that the prices to EUAs have to

increase to ensure fast transition of the energy sector in combination with reviews of the EU energy policy (Fit for 55). As a result institutional investors built a certain part of the demand as EUA represented quite a secured instrument. Furthermore spikes in gas prices increased demand even further with buying of conventional power producers that were able to deliver power because of its increased price. In case of coal the most significant spikes occurred during autumn 2021 due to coal shortage in China in combination with higher coal demand because of higher gas prices.

Commodity price movements impacted power prices as well. Highest correlation with power prices proved to have gas and EUA prices. This was confirmed by the regression analysis where a model TTF-EUA was the most suitable one with a coefficient of determination of 0,99.

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Recent Dynamics of Commodity Prices: Gas, Emission Allowances and Coal

ABSTRACT

Commodity prices have experience turbulent period recently due to different factors. This study analyzes movements in prices of gas, emission allowances and coal within the past two years and explains potential factors that stood behind. Gas prices increased by 1 400 % during this period mostly due to low storage fillings in Europe and problematic imports from Russia. Emission allowance prices almost tripled mostly as a result of energy transition in Europe and expectation connected to the process. Coal prices quadruplet in 2021 mostly because of shortages in supply. All these factors had impact on power prices that increased accordingly with a significant influence of gas and emission allowance prices.

KEYWORDS

commodity markets; power prices; gas markets; commodity price volatility; emission allowances price; coal prices

JEL CLASSIFICATION

P18; E32; M00