

# INFLATIONARY ELEVATED ENERGY PRICES AS THE MAIN FACTOR OF FUELLING ECONOMICALLY VIABLE ELECTRICITY PRODUCTION IN EU FOSSIL FUELS BASED THERMAL POWER PLANTS

## INFLACIJSKO POVIŠANE CENE ENERGIJE KOT GLAVNI FAKTOR POSPEŠEVANJA EKONOMSKO UPRAVIČENE PROIZVODNJE ELEKTRIČNE ENERGIJE V EU FOSILNO GORIVNIH TERMoeLEKTRARNAH

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**Keywords:** electricity production, elevated energy prices, fossil fuels, economically viable energy production, thermal power plants

### **Abstract**

The inflation in the last two years has driven the prices of the materials, goods as well as energy significantly higher. With steep increased inflation from month to month in the last two years, the overall inflation peaked at 9.2%, and core inflation at 6.2% in 2022 for the Eurozone area. This elevated prices are troubling the markets, industry and households, making the everyday business much more difficult for them than it was in pre-inflationary times. Also, additional geopolitical changes happened in the last two years (the war in Ukraine) which impacted the energy supply

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from the east significantly, primarily lowering the inflow of Russian gas to the European states to almost zero and banning the Russian crude from the international markets. This demanding condition on the energy market, as well as the very narrow time frame for building up a sufficient supply of energy for the winter of 2022 resulted in rather unexpectedly favourable conditions for energy generation (electricity or heat) from still operating coal based thermal power plants, which, in some way, is unacceptable, since we are exiting the coal based thermal power plants in EU actively, and trying to substitute them with renewables & alternatives. However, the aforementioned international markets stress test revealed that abandoning the fossil fuels from our everyday life will not be that easy, as we thought a decade ago.

## **Povzetek**

Inflacija je v zadnjih dveh letih bistveno dvignila cene surovin, blaga in energije. Z močno naraščajočo inflacijo iz meseca v mesec v zadnjih dveh letih je skupna inflacija leta 2022 za območje evra dosegla najvišjo vrednost pri 9,2 %, osnovna inflacija pa pri 6,2 %. Te povišane cene povzročajo težave trgov, industriji in gospodinjstvom, ki jim otežujejo vsakdanje poslovanje. V zadnjih dveh letih so se zgodile tudi dodatne geopolitične spremembe (vojna v Ukrajini), ki so močno vplivale na oskrbo z energijo z vzhoda, predvsem so zmanjšale dotok ruskega plina v evropske države na skoraj nič in privedle do prepovedi izvoza ruske surove nafte na mednarodne trge. Te zahtevne razmere na energetskem trgu in zelo ozek časovni okvir za vzpostavitev zadostne zaloge energije za zimo 2022, so povzročile precej nepričakovano ugodne razmere za proizvodnjo energije (elektrike ali toplotne) iz še delujočih termoelektrarn na premog, kar je nesprejemljivo, saj EU aktivno opuša proizvodno električne energije iz termoelektrarne na premog in jih poskušamo nadomestiti z obnovljivimi viri in alternativami. Vendar pa je že omenjeni stresni test mednarodnih trgov pokazal, da opustitev fosilnih goriv iz našega vsakdana ne bo tako preprosta, kot smo mislili pred desetletjem.

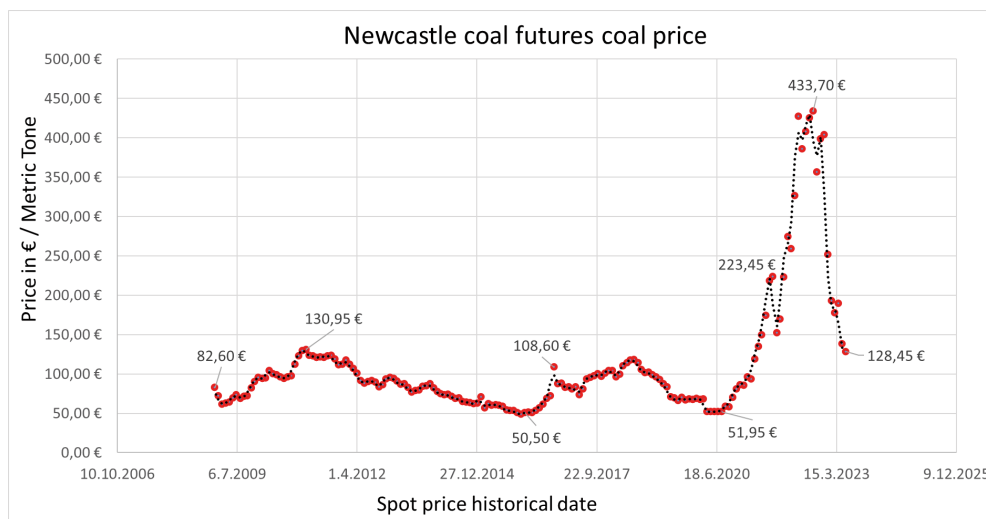
## **1 INTRODUCTION**

The changed conditions on the international markets are the main driver for the completely new outlook with regard to the energy production in the Eurozone area. With closed pipelines for gas from Russia towards Europe and limited Russian crude purchases due to international sanctions, the European Union was, in early 2022, in a tough position regarding the supply of electricity & heat for the domestic markets. With searching for an alternative supplier of the gas from Africa, the Americas and the Middle East, the EU started, or intensified, already operational production from its coal fired thermal power plants, in order to supply a crucial part of the electricity for the domestic market during the winter of 2022. The unexpected inflation emerged during that same time, being only transitional phenomena according to the reassurances of the FED and ECB. Nevertheless, that was not the case, as core inflation peaked at 9.2% and 6.2% correspondingly. This was a surprise for us all, and also for the market regulators who admitted their mistake at the time. The combination of both occurrences resulted in completely new market conditions with elevated prices overall, that made it possible for the thermal power plant to operate within green numbers for them, despite higher fuel, operation, maintenance and carbon dioxide allowances costs. Moreover, even the oil based thermal power plants operated in green numbers, which was a surprise for the energy market, since we are all working actively on the green transition, shifting our energy production from fossil fuels towards renewables and alternatives.

## 2 CHANGED MARKET CONDITIONS

### 2.1 Spike in coal spot prices

As described in the introduction, the changed market condition contributed to the situation, where there was enough of a price elevation for the fossil fuel based thermal power plants to operate within the profitable area for them. With the price of electricity, also the price of fuel and operation & maintenance costs increased significantly. Below, in Figure 1, the spot price for the Newcastle coal is shown, where the spike in the price is seen [1] during the period of 2020 – 2023, which was driven mainly by the inflation pressures on the spot price, as well as very high demand for the particular coal, since thermal power plants were getting into the process of start-up. Newcastle coal is thermal coal exported out of the port of Newcastle (FOB) in New South Wales, Australia. It is the price benchmark for the seaborne thermal coal in the Asia-Pacific region, and is exported worldwide as primary fuel for the thermal power plants.

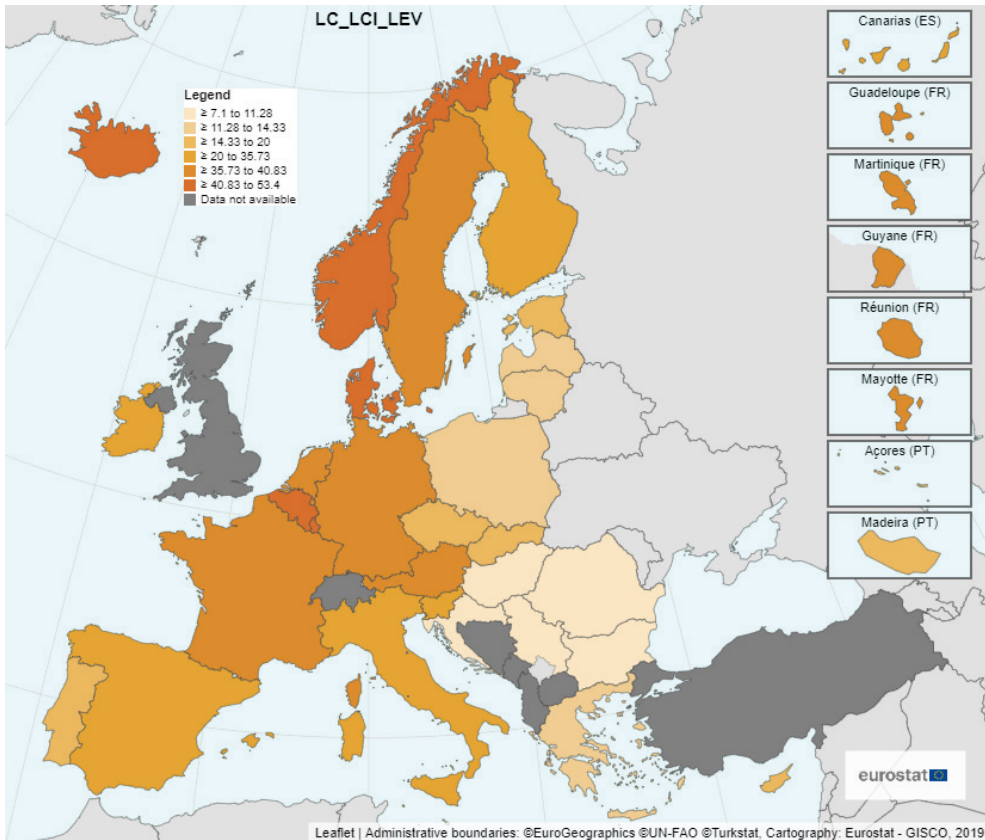


**Figure 1:** The movement for the Newcastle Coal spot price. Note the spike in the spot price during 2020 to 2023. The spike was fuelled because of elevated inflation during this time, as well as the elevated demand for the coal, since the thermal power plants were backing the grid electricity consumption due to low production from gas powered power plants.

From Figure 1 we can observe that the spot price of Newcastle coal increased from its low price of 51,95 € per metric tonne to 433,70 € per metric tonne, meaning that the purchase price of the primary fuel for the operating power plant went up by a factor of 8,3. Consistent with the measures from the central banks to slow and lower the inflation is also the decrease of the Newcastle coal spot price, where normalization of the price took place in the first two quartiles of 2023. Nevertheless, the elevated purchase prices for the coal persisted for almost two years, making the operators of the thermal power plants look very closely for the changes in coal spot prices, to secure the most advantageous price when ordering coal.

## 2.2 Higher maintenance and operational costs

The operational costs of the conventional thermal power plants have risen significantly, due to the higher costs of the fuel and carbon emission allowances, which two present the main reason for the higher operational cost of the thermal power plants. However, also significant is the increase of the cost of the human labour. Due to inflationary pressures on the wages, the average personal income within the European Union increased by 4.4% in 2022, resulting in additional increases in operational costs. In Figure 2, the Eurostat labour cost levels [2] are presented on the EU map.

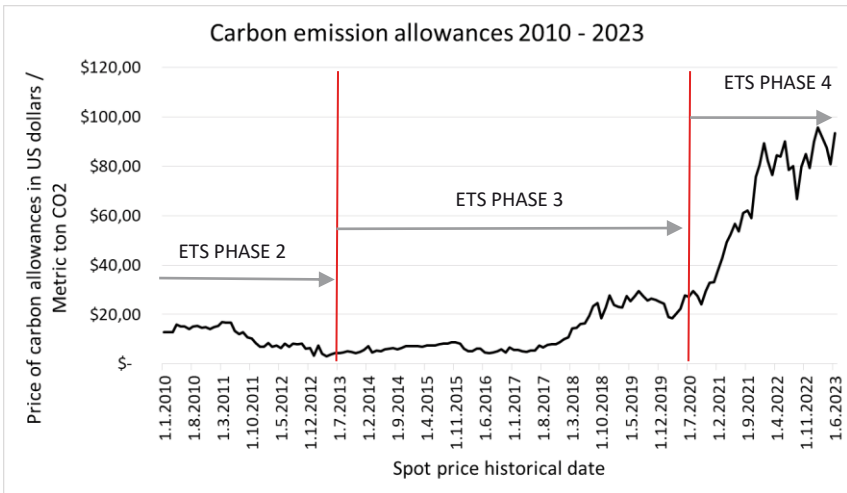


**Figure 2:** The cost of labour within the EU. The densest orange colour marked countries have the highest labour cost within the EU. The labour cost ranges from 7,1 €/hour as the lowest average value to 53,4 €/hour as the highest average value (compensation of employees, plus taxes, minus subsidies). The average labour cost is averaged across all sectors of the industry, and is not only focused on the energy production sector. From Figure 2 we can observe that Iceland, the Netherlands, Denmark & Norway have the highest labour costs.

The source: [https://ec.europa.eu/eurostat/databrowser/view/LC\\_LCI\\_LEV/default/map?lang=en&category=labour.lc.lcan](https://ec.europa.eu/eurostat/databrowser/view/LC_LCI_LEV/default/map?lang=en&category=labour.lc.lcan).

## 2.3 Price of carbon emission allowances

Carbon emission allowances are also an additional cost to the end price of the electricity producers from the fossil fuels. The price of carbon emission allowances dictates the market, and it is dependent on the asking - offer performance of demand. Within the European Union the European Commission is releasing the carbon emission allowances (coupons) as well, as it is also the regulator for that particular market. In Figure 3, the price movement for the carbon emission allowances [3] is presented for the time period from 2010 to 2023.



**Figure 3:** *The movement of the spot price for carbon emission allowances needed for the operation of thermal power plants within the EU ETS.*

From the price movement in the presented graph we see that it is independent of the current international market conditions, since it is regulated as a cap-and-trade market. The rise in the price is achieved by limiting the number of issued and available allowances in every session of releasing the new allowances by the regulator. The spot price of the carbon emission allowances in phase 4 ETS has been fluctuating (after the significant rise of the price) in the area between 70 US dollars – 100 US dollars for a metric ton of emitted carbon dioxide into the atmosphere. The elevated prices of the carbon emission allowances are putting significant pressure on the operational costs of the thermal power plants, making it very difficult for them to operate economically positively. Nevertheless, the high electricity prices on the market were allowing the thermal power plants to operate economically positively within the two-year time period, despite the mechanisms in place to exit the coal-based electricity production gradually in the EU and G-20 countries. The EU regulators are in the process of discussion as to whether the governments across the EU shall also implement the carbon emission taxation for households – the suggested taxation could include additional taxes on the fuel for the transportation & heating of the households. That should give an additional boost to the green transition within the EU, but the regulators were quickly reminded that a lot of people could not afford this kind of additional expenses in the shape of new taxation, since the last overall inflation data for June 2023 is remaining at a high 5,5%, weakening the purchase power of the average European household

from month to month. Because of that, there is not likely to be pressure from the EU regulators for the aforementioned taxation for now.

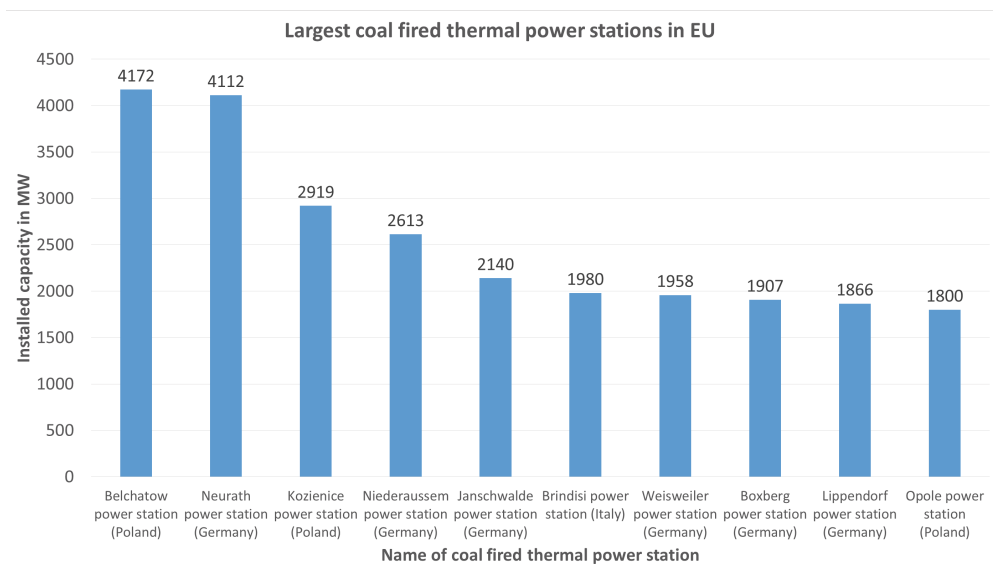
### 3 CRUCIAL ROLE OF THERMAL POWER PLANTS

#### 3.1 Changed energy market conditions

After the first price elevation the normalisation of electricity price was performed, mainly because of the cap regulated electricity price, decided by the governments. Gradually, the cap on the electricity prices is expected to be removed. However, the prices of electricity can stay elevated or can even rise further. The reason for that is the EU's significant increase investment in renewables during the latest energy crisis as a response to the shrinking gas and crude oil imports from Russia. Due to the significant increase of electricity production from renewables, the instability of the grid is rising, making the distribution planning of grid operators even more difficult. That is resulting in a new way for how to adapt to the current energy market conditions, enforcing the electricity end users to change when to save and when to use electricity.

#### 3.2 Thermal power plants crucial for energy supply

In autumn 2022 it became evident that the shrinking supply of the Russian gas and crude would not cover the winter energy needs of Europe. Therefore, the safety plan of putting big thermal power plants [4] back in operation was launched, as presented in figure 4. Consequently, the thermal power plants went from stand-by mode to full operation, resulting in high domestic coal demand. Thermal power plants supplied the electricity as well as needed heat to consumers and end-users, enabling them to save stored gas and oil for later.



**Figure 4:** Largest coal fired thermal power plants in the EU as of 2021.

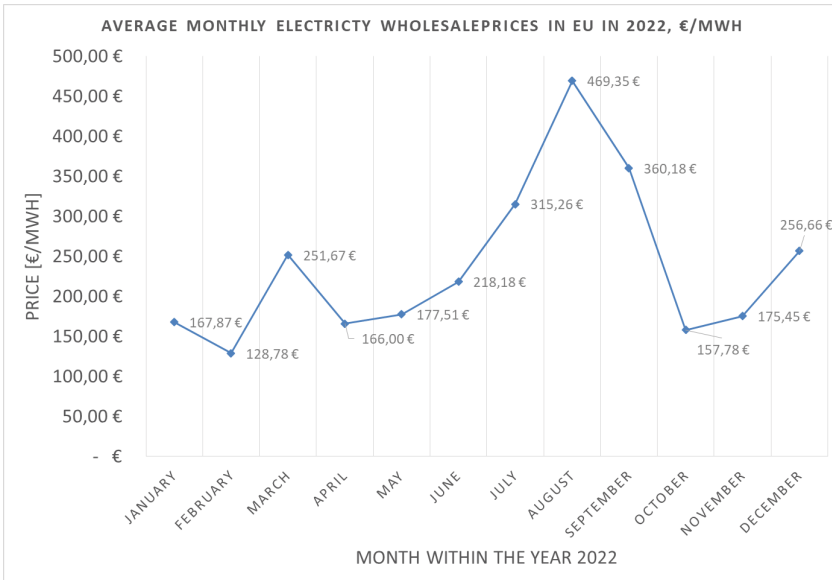
Since some nuclear power plants in the EU, particularly in France, were in regular maintenance shut down procedure during that time, the coal fired thermal power plants backed Europe's

electricity network and prevented it from collapse. From that aspect, the coal fired thermal power plants had a crucial role in energy supply, as well as stabilising the distribution network, proving once again that they are very important for our energy supply, and that they should stay in the energy mix for the foreseeable future.

## 4 COAL AS AN ECONOMICALLY VIABLE FUEL

### 4.1 Price of electricity as the positive impact factor

The electricity price averaged from the lowest position in February, 128,78 €/MWh to 469,35€/MWh in August 2022, making more than 3 times higher prices during the summer months. The high peak of the electricity sale price has, consequently, boosted the thermal power plant operation into the economically positive area, despite elevated fuel and carbon emission allowances costs. The average monthly electricity wholesale prices in the EU are presented in Figure 5 [5].



**Figure 5:** Average monthly electricity wholesale price in the EU in 2022, €/MWh.

The high electricity prices have caused the needed action from the governments in order to determine the price cap for households & industry to maintain the normal electricity prices. That action was crucial to keep the industry in good shape and not exposed to the high energy prices too much. The cap also enabled the households to cope through the winter, when the energy usage is higher, especially in the cooler parts of Europe.

### 4.2 Elevated costs of fuel & carbon emission allowances

The prices of the coal have been elevated during 2022, mainly as the result of the lower imports of gas and crude from Russia. Some EU countries decided that it was best to start the thermal

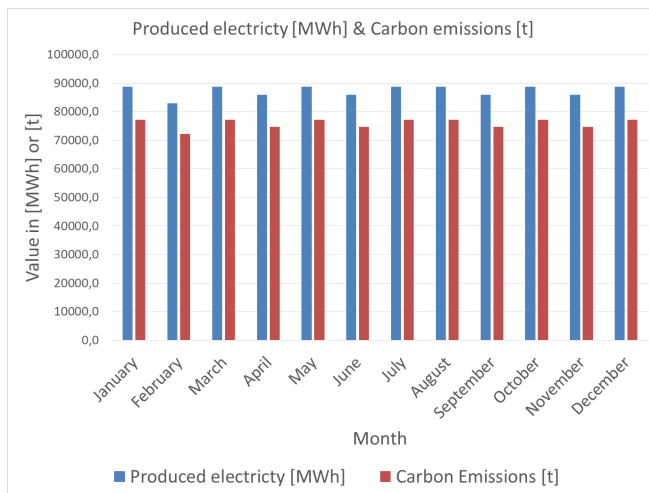
power plants for the time being, and to wait for the situation to be stabilised on the energy market. The applicable input factors for the thermal power plant operation evaluation are presented in Table 4.1 below.

**Table 4.1:** Main applicable input factors for the calculation of the economic performance for an example thermal power plant.

Input Factor	Quantity	Unit
Peak Coal Price	433,70	€/t
Carbon Emission Allowances	100,00	€/t
Boiler Fuel Consumption	6,30	kg/s
Generated CO2 Emission	0,87	kg/kWh
Operation & Maintenance	43	€ / kWh installed

### 4.3 Thermal power plant economic performance

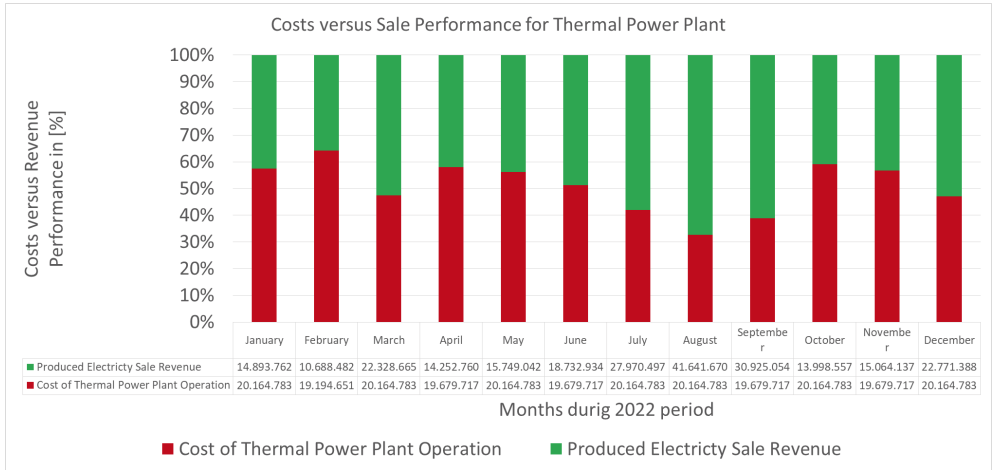
As aforementioned, a thermal power plant with an installed capacity of 119 MW<sub>e</sub> has consumed through the year 2022 altogether 199,221.00 tons of coal. Taking into consideration the assumed average coal price of 433,70 €/t, the total expenditure for fuelling the thermal power plant with coal throughout the year is accounted for at 86,402,199.70 € as presented in Figure 6.



**Figure 6:** Produced electricity from a thermal power plant & carbon emissions to the atmosphere.

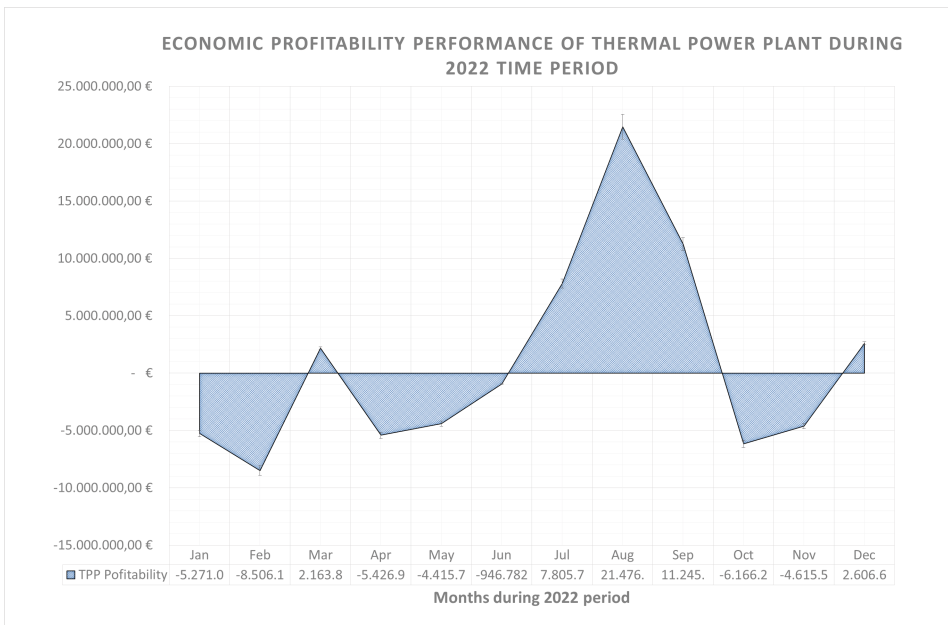
Figure 7 is presenting the costs versus monthly expenses for operating the thermal power plant during the 2022 period. The red bars represent the expenses and the green bars the positive net electricity sale by the price that the market dictated. From the Figure it is obvious that the third quarter of 2022 was the most profitable for the thermal power plant operators.





**Figure 7:** Costs versus Electricity Sale Performance for a thermal power plant during the 2022 period.

Figure 8 presents the negative and positive operating months for the thermal power plants and their net monthly result. From the Figure we can see that, for 5 months out of 12 months in the year, the operation of the thermal power plants was positive. Especially positive was the third quarter of the year 2022. The net profit of the observed case was 9.94 million € on a yearly basis.

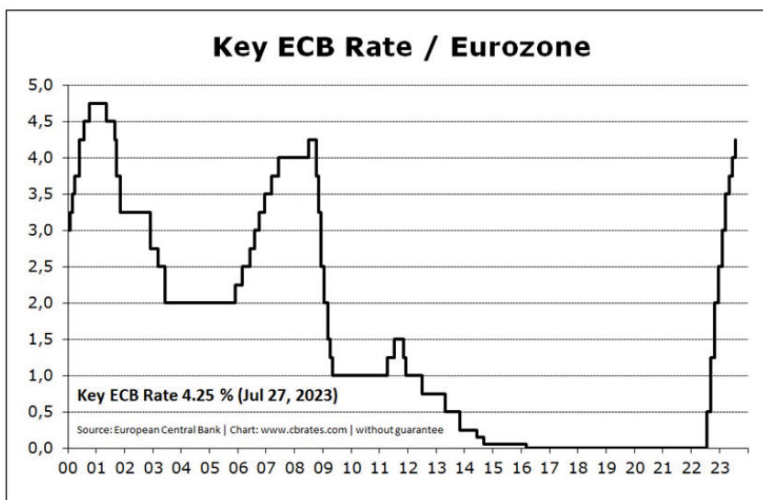


**Figure 8:** Economic profitability performance of a thermal power plant during the 2022 time period.

## 5 EXITING THE INFLATION & ENTERING THE RECESSION ERA

### 5.1 Transitory versus lasting phenomena

The starting inflation, being labelled as a transitory one, was present through the major part of 2021. With the beginning of 2022 it was more than obvious that inflationary pressures were starting to accelerate the inflation itself, consequently lifting the core inflation well above 5%. At that point the central banks and other regulators were forced to react to the situation, mainly by lifting the bank rates, but also with some other actions, such as, for example, capping the energy prices, in order to retain the price control across the energy market. Figure 9 below shows the rising of the bank interest rates due to the hard inflation environment [6].



**Figure 9:** Rising of the ECB rates during 2022 & 2023 due to inflationary pressures. The source: <https://tradingeconomics.com/euro-area/interest-rate>.

### 5.2 The future aspect of inflation presence

The current elevated interest rates are keeping the prices of material costs as well as other services relatively high. The ask – demand ration has not been restored fully. Therefore, some inflationary pressures are still present, despite raising the interest rates. There are forecasts that, by the end of the year 2023, some additional interest rates raising will be put in place, leading the current market situation towards a stricter monetary policy, with the intention to lower the overall and core inflation to the desired levels by around 2% on a yearly basis. Big efforts by the regulators are in place to avoid a recession at the end of the rates` hikes. Instead of that, a so-called soft landing is expected, meaning that the markets and economy overall will be able to survive the transitory time of increased interest rates, without shrinking itself and consequently falling into a recession. From the aspect of the raw materials` price movement, the strict monetary policy is expected to slower the ask – demand ratio, leading to the normalisation of the prices. It is crucial to secure the stable prices of the energy sources (derivates) before

the winter 2023 – 2024, since another price spike of the derivatives would mean relatively high pressures on the economies of the EU, which are already facing additional problems, such as broken supply chains, elevated cost of the raw materials, and, as aforementioned, elevated costs of the energy. As expected, the recession possibility is increasing further with the less positive market data feedback. Should the current situation continue, an overall recession in the EU economy is imminent, meaning that the conditions for the viable thermal power plant operation will end, mainly because of slower activity of the production industries that will, consequently, consume less energy as a result of the lower goods demand from the market and end customers.

## 6 CONCLUSIONS

The demanding period of the last few years showed us that, although the green transition is in progress, the dependence on fossil fuels is still very much present in our everyday life. The regulators and decision makers shall establish the system in which the green transition decisions have support – social as well as economical. Returning to the usage of the fossil fuels shall be as crucial backup only in a case of demanding electrical network conditions and when the imminent stabilisation of the network is required. In the last two years the combination of geopolitical and economic factors helped to establish the environment in which the existing thermal power plants with a high CO<sub>2</sub> emission factor were able to operate economically viably, which is in contradiction of the green transition policies. The regulators of the electricity production and distribution shall subsidise the green electricity production, so that it would have economical advantage in comparison with the price of electricity produced in conventional power plants.

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## Nomenclature

EU	European Union
FED	Federal Reserve Board
ECB	European Central Bank
FOB	Freight on Board
US	United States
ETS	Emission Trade System
CO2	Carbon dioxide
MWe	Megawatt electric
MWh	Megawatt hour
kWh	Kilowatt hour
t	Tonne
kg	Kilogram
s	Second
%	Percentage
€	Euro