

Return of Coal: A Short Visit or a Long Stay?

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Academic editor: M. Sheresheva | Received 10 September 2022 | Accepted 13 November 2022 | Published 23 December 2022

Citation: Medzhidova, D. (2022). Return of coal: a short visit or a long stay? *BRICS Journal of Economics*, 3(4), 209–229. <https://doi.org/10.3897/brics-econ.3.e94712>

Abstract

Despite the existence of global targets to slow the pace of climate change, coal remains one of the most commonly used fuels that accounts for over 25% of the global energy supply and consumption. Multiple factors explain why coal is still widely used: its relatively low prices, availability in developing countries, low transportation costs and path dependence, i.e. the existing energy infrastructure. Coal consumption in developing (non-OECD) countries has been rising thanks to the processes in India and China but in 2021, however, it increased in the OECD countries as well. The uneven and often atypical post-COVID-19 recovery driven by manufacturing created disruptions in energy markets with high and volatile prices of coal's main substitute - natural gas. The first in history and hence unexpected slowdown in the RES supply in 2021 added to the reversal of trends exactly at the time of the COP26 in Glasgow.

The goal of our study is to examine the coal markets in the new complex environment determined by both economic and political factors: high commodity prices, rising inflation, decelerating economic growth, and sanctions against exporters. In this paper we analyze the major trends before 2020, the current processes, and their implications for the future in the context of choice between economic development and energy transition including the issue of stranded assets and their possible reopening.

1. Introduction

In today's world, coal is often used as a symbol of the dangers to the global climate and environment, and its phasedown is the crux of many national strategies on climate

change mitigation. However, there is no commonly accepted agreement on a complete phaseout. On the contrary, the Glasgow climate pact (November 2021) urged the world to phasedown coal consumption, which is in sharp contrast to the message of the latest IPCC report, which promotes coal-free energy balance in order to accomplish Paris Agreement targets.

2021 showed that the game is not yet over for coal. Both developing and developed countries used it as a reserve fuel during the post-pandemic recovery and as an instrument of strengthening energy security in times of crisis. In our view, it is a good starting point for rethinking the role of coal in the future of global energy and understanding whether 2021 (and quite probably 2022) witnessed the fundamental reverse of trends or only a brief exemption from coal-free policies.

According to V. Smil, the first energy transition happened when people began to use coal instead of wood and watermills. Although the crucial role of coal during the first industrial revolution has been called into question (Clark & Jacks, 2007), it was the engine of growth in different parts of the world for long periods of time.

There are several characteristics that enabled coal consumption across the globe. Firstly, coal was (and still is) available, i.e. many industrial countries were either rich in coal (the UK, the USA, Germany) or could easily import it. Secondly, coal is relatively easy to transport; it does not require tankers, pipelines or transmission lines. Coal is usually transported via railways or by sea, and trucks can be used for smaller distances. Thirdly, coal is affordable, which is vital for developing countries, lowering the final prices of products. In recent years coal prices have sometimes been higher than gas prices on international markets, but here we refer to domestic prices in the producing economies. Finally, the use of coal does not require complex technologies in upstream, midstream or downstream segments. Although coal mines and the role of coal business in the developed world differ greatly from those in the developing, sophisticated technologies and equipment are not indispensable. It is these features that, in our opinion, provided grounds for coal domination of energy balances in the 19th and first half of the 20th century.

However, there is the other side of the coin. Coal is believed to impact the environment negatively; the spillovers of coal's production and consumption include consequences for the land, water, air and people's health, as well as vibration and noise, fires and socio-economic factors (Katoria et al., 2013); land reclamation involves significant efforts and financial resources. Moreover, although all fossil fuels affect the global climate, coal is the most detrimental one (Edwards, 2019) and climate change mitigation therefore requires policies and regulations that aim to phase out coal.

Yet, coal remains an essential part of the global energy balance with a share of around 27% even in pre-COVID-19 period in 2019, according to IEA. Over 80% is consumed by industry, mainly for electricity and heat generation. In terms of costs, coal consumption retains a comparative advantage, particularly for developing economies.

Differences in energy balances of OECD and non-OECD countries are striking: in non-OECD countries, coal's share is over 34%, while in OECD economies, its share is

only 14% (Figure 1). In our opinion, it means that these two groups of countries are at different stages of energy transition (Medzhidova, 2022): advanced economies are shifting from fossil fuels to renewable energy sources (RES), while developing countries still rely on coal, and only the richest begin to switch to natural gas and invest in RES. Even OECD countries find it hard to reach goals on economic growth, development, inequality, poverty, and climate — all at the same time; for the developing world this is much more difficult (Grigoryev & Medzhidova, 2020). According to the UN, 9% of the global population does not have access to electricity and 31% — to clean cooking, mostly in Africa. For these countries, the energy agenda might be very different from the one prevalent in other parts of the world.

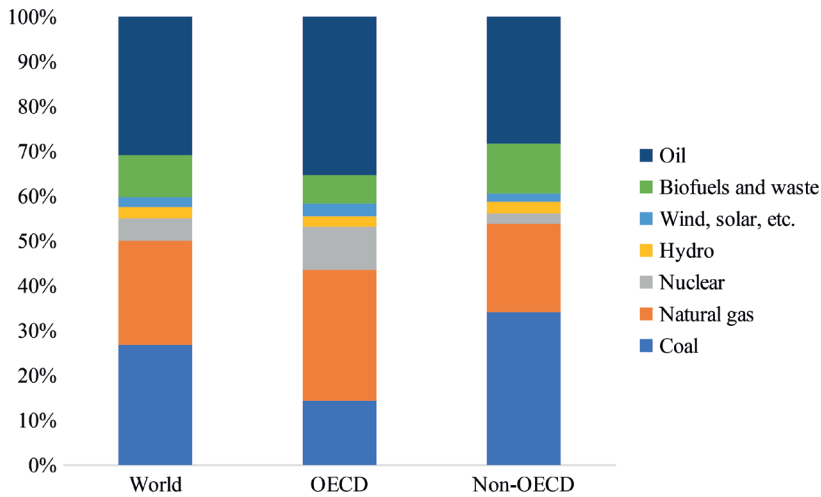


Figure 1. Energy balance structure by type of fuel: world, OECD, non-OECD countries, 2019. *Source:* IEA data. <https://www.iea.org/data-and-statistics/data-browser?country=OECDTOT&fuel=Energy%20supply&indicator=TESbySource>

For the coal industry, 2021 was an important year, as coal consumption grew both in developed and developing countries, exceeding the 2019 level. Current forecasts assume that in 2022 the growth rate might again reach 0,7% (IEA, 2022a). Many coal stations in the EU, which had been closed in earlier years, were reopened during the energy crises, despite anti-coal policies and declarations. While the turbulence and market uncertainty are growing, coal is again considered a possible backup fuel, and the assets that used to be stranded (out of use and conserved) are again in operation.

Natural gas was previously considered a backup and a transition fuel, used as a bridge from coal to renewable energy and as a reserve energy source. However, RES remain unstable and intermittent (even hydro energy is at risk during droughts) and the geopolitical tensions in Europe may lead to a substitution of natural gas for coal. Natural gas price spikes in 2021-2022 added to coal consumption growth and global

reverse shift from gas back to coal as natural gas remains key competitor to coal. According to the recent scenarios (IEA, 2022c), the demand for the natural gas will slow down owing to high prices in the short- and medium-term, as gas infrastructure construction depends on stable and affordable supply and long-term contracts. This trend might be beneficial for the rapid transition to RES in the advanced economies; however, while the need for investments is enormous, their amounts in developing economies (except for China) remain flat.

The gap between stated policies and commitments concerning the mitigation of climate change is growing, along with financial needs; this is happening when the world has faced a slowdown in economic growth and several crises in commodity markets (IMF, 2022b). The most urgent problems include the rising inflation and interest rates, growing number of conflicts and mounting instability across the globe, the risk of debt distress in low and middle-income economies, and low probability of fulfilling the SDGs by 2030. This challenging environment has already reversed the trends for the reduction of poverty and inequality (World Bank Group, 2022b). Domestic resources in low and middle-income countries might not be sufficient to adequately tackle the aggravating problems, including climate change mitigation and coal phaseout.

This paper attempts to examine the role of coal in the current dynamic conditions that include macroeconomic instability, volatility in energy markets, supply disruptions, trade restrictions, sanctions, and global problems.

2. Methods

Research literature related to coal could be divided into groups or blocks, depending on the main research question. While some authors focus on the coal industry in particular countries (Oei et al., 2020; Palyanova et al., 2017; Zhang et al., 2017), others have a regional (Anke et al., 2020) or a global approach (Steckel et al., 2015). In both cases the prospects for coal do not look bright as the authors proceed from the assumption of inevitable energy transition and their analysis is focused on issues connected with this transition.

Our study is based on the existing research, the regional and country analysis of the coal industry; it considers the challenges and obstacles the industry faces and possible outcomes of the ongoing processes. It employs a qualitative retrospective analysis of the statistical data on commodity markets (natural gas and coal) and energy balances. Although we are aware of significant differences between the countries, we distinguish developed and developing economies (mainly BRICS member states) to describe the attitude towards coal production and consumption as dependent on the level of economic development. We refer to the concept of 'stranded assets' that is widely used in environmental and transition studies and identify political and economic grounds for dealing with this type of assets. This theoretical framework allows us to analyze the process of reopening and restructuring coal plants and mines.

Finally, we examine the rapidly changing conditions in energy markets in 2020-2022 and assess the possibility of rethinking the place of coal in maintaining energy security and its future as a backup fuel.

3. Results

Our study seeks to define the place in the global economy, outline the prospects and challenges for the use of this fuel and analyze the influence of the most recent events (2020-2022) on the coal market.

Coal is seen as the fuel of the first energy transition but these transitions do not happen simultaneously across the globe: different countries remain at different stages, largely determined by the level of economic development, availability of resources and political will. Figures in Table 1 indicate that developed countries, particularly the EU, had made their first transition long before the 1990s, so coal consumption in these countries has been declining for over 30 years. The highest average annual growth rates in the developing world were recorded in the 2000s, driven primarily by Chinese rapid economic growth; however, even in the 2010s, the rate remained high – 2,2%. On the global level, we can see steady growth in coal consumption, as its decrease in OECD countries is not enough to compensate for the increase in emerging economies.

Table 1. Long-term trends of coal consumption, average annual growth rates, %

	1991-2000	2001-2010	2011-2021	1991-2021	2001-2021
World	0,6	4,4	0,6	1,8	2,3
OECD	0,2	-0,1	-4,3	-1,4	-2,1
Non-OECD	0,9	7,2	2,2	3,3	4,4
EU	-3,2	-1,3	-4,3	-2,8	-2,7

Source: author's calculations based on BP SR 2022.

Figure 2 gives a better understanding of the structure of coal consumption and its patterns in different countries. While consumption in OECD countries remains flat (Japan) or gradually decreases, except for 2021, China remains the sole biggest consumer of coal, accounting for over 56% of global consumption, and India the second one. In emerging countries (excluding China and India), consumption is slowly increasing, in conditions of uneven economic growth. Some researchers believe that in future decades coal consumption will only grow in African countries and might even become critical to these economies (Jakob et al., 2020). Despite the pressure to reduce its consumption, there is a potential for coal use in the region: less expensive infrastructure without the need for sophisticated technologies can provide a stable source of energy (Steckel et al.,

2020). Its realization, however, will largely depend on availability of coal and the prices of this energy resource.

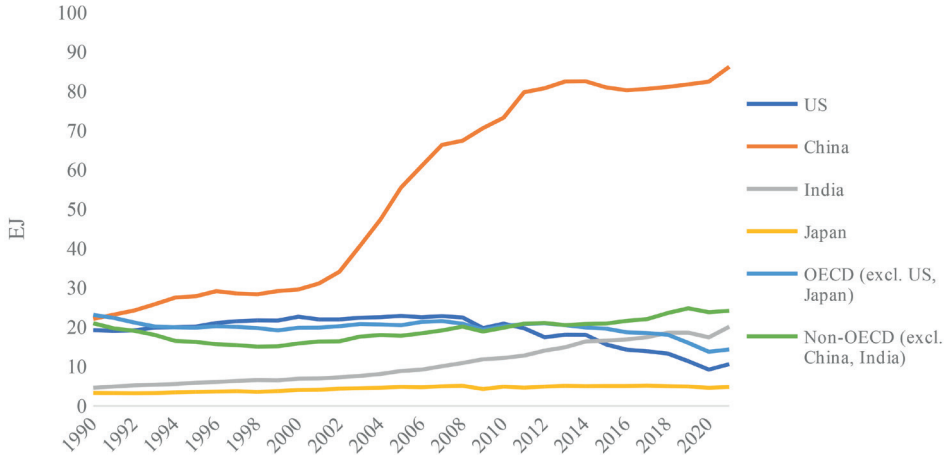


Figure 2. Coal consumption, exajoules (EJ). *Source:* author's calculations based on BP SR 2022.

Considering the existing geographical and economic differences, we believe it is rational to analyze the prospects of using coal from the viewpoint of the key mining regions (labour and output dependence), major consumers (developing economies) and developed economies that are on the fourth stage of the energy transition. Dependence on coal and its relation to economic growth is not uniform in the two groups of countries, and energy balances vary greatly within the groups (Li et al., 2009). It follows that our conclusions are not country-specific but this approach enables us to outline the global trends and see a broader picture of the processes involved.

The Inner Mongolia region in China, Upper Silesian Basin in Poland, New South Wales and Queensland in Australia, Vaal Triangle in South Africa, and Kemerovskaya oblast' in Russia are some of the examples of the regions highly dependent on coal mining. Transition from coal to other energy sources in these regions is a complex and multi-dimensional process as the industry determines the whole economy of the regions.

Coal mines had been closed even prior to the climate agenda. Crucial factors were purely economic as the mines were no longer competitive due to the following reasons (Strambo et al., 2018):

- Removal of subsidies.
- Market liberalization.
- International competition.

Phasing-out coal production has consequences for the labor markets. A striking example is the Vaal Triangle in South Africa. In this region cheap coal provides heavy industries with energy, so the phaseout will have consequences not only for the

miners but also for people employed in the steel industry. The World Bank Study on Just Transition takes account of such effects referring to specific considerations in the process of phasing out. Considerable expenses are therefore necessary to cushion the consequences for the labor markets, to reclaim the environment and mitigate spillovers for the whole economy. Consequently, the process of mine closure should involve discussions with several parties: society, business, and state (World Bank Group, 2018). Policy measures are to include support for the local economy, the creation of new jobs and new industries, vocational programs, and human capital development to promote restructuring and avoid devastating effects. In sum, the government's policy requires broad support from the local communities, it needs to remain well-balanced over a long time, as an immediate phaseout will have severe consequences. Social and economic consequences for a just transition in a mining region are hard to predict; but they suggest costs in the short-term period, while the benefits will come in the long-term perspective.

Many of the mining regions are located in developing economies, which means that this group of countries faces greater difficulties during the energy transition. In 2021 non-OECD countries accounted for 81.5% of global coal consumption and 81.1% of the production, shaping the current state of the coal market and its future. As noted, energy transition is not the only issue on the agenda in emerging economies. Poverty, hunger, inequality, job creation, health care and education are matters of permanent public concern. Moreover, the current pace will not allow the world achieve SDG7 — affordable and clean energy. The number of people without electricity access in 2020 shrank to 733 million; however, the regional breakdown reveals a profound disparity between the average share of the population without access to electricity globally and that in low-income economies (especially in Sub-Saharan Africa). The progress is slowing down (UN, 2022), which implies that although African countries are highly vulnerable to climate change, adaptation efforts could be more beneficial in the short-term.

In our opinion, the crucial argument against reducing coal consumption is the possibility of economic growth, a vital part of any agenda in the developing world. The decoupling effect illustrates the difference between the growth rates of GDP and other indicators (Table 2). According to our calculations, there was no decoupling effect on the global scale in the first decade of the XXI century, as economic growth in the emerging markets was fueled by coal consumption. Furthermore, during the crisis of 2009 in some developing countries energy consumption declined less than GDP, which might indicate a high level of energy intensity. Advanced economies, however, show a different dynamics. Although there is a sound decoupling effect for this group over the whole period of recovery in 2021 (GDP growth rate is higher than that of coal consumption), the difference between GDP and energy consumption narrowed and the rate of coal consumption growth exceeded the GDP growth rate. For large coal-consuming advanced economies, like Germany and the United States, this difference was significantly higher than for India while other developing countries had a negative result.

Table 2. Decoupling effect, GDP, energy consumption, coal consumption, pp.

Difference between GDP growth and energy consumption growth, pp.						
	2001-2008	2009	2011-2019	2020	2021	2011-2021
World	-1,50	-1,44	-1,91	-0,92	-0,59	-1,70
Advanced economies	-1,77	-1,48	-1,83	-2,76	-0,79	-1,83
Emerging market and developing economies	-0,98	-1,23	-1,98	0,24	-0,54	-1,64
China	-0,28	-5,06	-3,73	0,30	-1,26	-3,13
Germany	-1,46	-0,47	-2,17	-2,55	-0,48	-2,05
India	-1,94	-0,72	-1,85	0,86	1,11	-1,32
Russia	-5,41	2,86	-1,10	-1,11	3,67	-0,69
South Africa	-1,52	1,09	-1,37	-1,22	-4,40	-1,63
United States	-2,27	-2,32	-1,94	-4,04	-0,67	-2,03
Difference between GDP growth and coal consumption growth, pp.						
World	0,85	-1,38	-3,08	-0,91	-0,13	-2,61
Advanced economies	-1,65	-7,15	-5,75	-10,24	2,79	-5,48
Emerging market and developing economies	1,74	0,15	-2,87	0,82	-1,24	-2,37
China	0,17	-4,70	-6,11	-1,41	-3,47	-5,44
Germany	-2,08	-4,77	-5,66	-15,07	14,35	-4,99
India	-1,20	0,27	-1,72	0,20	6,50	-0,82
Russia	-7,18	-0,68	-2,50	-5,02	-1,03	-2,62
South Africa	-1,33	2,06	-1,94	1,07	-5,71	-1,98
United States	-2,31	-9,44	-8,76	-15,46	9,20	-7,99

Source: author's calculations based on IMF and BP data.

Differences between the periods of 2011-2019 and 2011-2021 are significant as they show the effect of the post-pandemic recovery on the coal market when, globally, the average rates of economic growth and coal consumption became closer. This observation is valid for both types economies due to increases in coal consumption.

For emerging markets, however, the decoupling effect is less visible than for advanced economies in terms of coal and energy consumption. Studies have also revealed a considerable suppressive impact of economic growth on emissions, at least for some of the developing countries (Kanat et al., 2022).

Although energy transition takes time and developing economies have set their carbon-neutrality pledges for 2060-2070, they are already taking steps to reduce emissions without an immediate restructuring of their energy balances. In this regard, carbon capture, utilization and storage (CCUS) facilities have certain potential, especially in large industrial economies, like China. However, they still need more advanced technologies, research and investment, as well as the implementation of the projects at scale (Yu et al., 2019). Although short-term coal phaseout does not seem to be possible globally, the options to cut the emissions from the fuel are also limited by available funds and technologies. The linkages between coal consumption and industrial development are still strong in non-OECD economies. For now, there is no possibility of relying solely on RES, so developing countries will continue to be the key coal consumers at least in the medium-term.

In the XXI century, the climate agenda has become a priority for the international community whose efforts are concentrated on inventing mechanisms to cut emissions on the global scale and cease carbon leakage. The existing institutional environment in advanced countries is essentially ill-disposed to coal consumption and energy-intensive industries, forcing them to move to emerging economies, which often place economic growth above climate targets. The gap between production and consumption-based emissions is alarming; it undermines the efforts to reach the Paris Agreement goal of 1.5-2°C temperature rise.

In order to decrease consumption-based emissions, the EU introduced the carbon border adjustment mechanism (CBAM). New regulations endanger Russian, Turkish, Chinese and Ukrainian producers, who rely on old technologies and cheap fuel, including coal, especially in steel and chemical industries (Holovko, Marian, Aperi, 2021). Still, it is not at all clear if CBAM will help reduce global emissions. (Zhong & Pei, 2022). In other words, although CBAM might affect carbon leakage and EU imports, these mechanisms do not significantly influence industrial coal consumption per se. Other possible mechanisms include debt-for climate and debt-for-environment swaps, concessional and external finance and a variety of others, but their impact and efficiency are yet to be examined.

Although coal consumption and production are driven by developing economies, strong opposition to coal phaseout is observed in the developed ones, too, in particular in Poland and Australia. Both countries remain heavily dependent on coal: in Poland coal accounts for over 40% of the energy balance; in Australia its share is around 30% and besides, the country is the largest exporter of coal in the world (29%). Important cases of Poland, Germany, Australia and the United States show that even advanced economies find it hard to completely shut down their coal industries. At the same time, they have sufficient resources to phase out coal and promote this policy at the global level.

Since 2019, the energy markets, including that of coal, have faced a number of crises. The direct effect of COVID-19 on climate change was positive: due to massive lockdowns and decreased demand for energy products (by 4%) global energy-related emissions dropped by 5.9% (IEA, 2021). However, in 2021 the emissions were at an

all-time high, reaching 36.3 Gt (IEA, 2022b). The revival of 2021 was hugely driven by energy-intensive industrial growth, accompanied by a record level of coal consumption. It should be noted that the drop in GDP experienced by emerging economies in 2020 was smaller than that in the advanced economies (-2.0% vs -4.5%) and its growth in 2021 was more robust (6.8% vs 5.2%) (IMF, 2022a). In other words, the countries with the largest share of global emissions developed more rapidly.

Price spikes and supply chain disruptions affected all energy markets (Zakeri et al., 2022). The period of instability in commodity markets continued with the increased production in OPEC+ countries, accompanied by shrinking oil prices in March 2020, the energy crisis in Europe in 2021 and geopolitical tensions in 2022. The authors of the present paper have identified the implications of these occurrences for coal markets.

Firstly, 2021 proved that specific economic logic still influences coal consumption. Almost 82% of coal is consumed by industry; in this context, natural gas and coal appear to be substitute goods. Tightness in the gas markets and price spikes contributed to a higher demand for coal.

Secondly, the debate on the impact of the 2021 coal revival on the long-term climate policy continues. Although advanced economies have not changed their plans to reduce emissions, the actual retreat from the policy of coal phaseout could be regarded as a wrong policy signal to the developing world, showing that the climate agenda appears to become less important during economic and geopolitical crises. Following this logic, the efforts to mitigate climate change could be overshadowed by more urgent problems related to economic growth, like food security, rising inequality, debt and poverty.

Finally, trade restrictions such as sanctions and changed supply routes have caused shifts and changes in the commodity markets. In the spring and summer of 2022, some of the developed economies (EU, USA, Japan) introduced trade embargoes on Russian coal. In 2021 China was the largest single importer of Russian coal (24.4%), followed by Japan (8.6%) and South Korea (9.9%). Despite the EU efforts towards energy transition, the share of the European countries in Russian coal exports in 2021 exceeded 35%. Sanctions on Russian coal (total share in the global exports — 18%) and other restrictions will affect the global market in the future. Although production increase in 2021 was lower than the increase in consumption, reshuffling of trade will elevate transportation costs (World Bank Group, 2022a), and increases in final consumer prices are expected to be significant both for coal and natural gas markets.

One of the key external factors affecting the coal market is the demand for natural gas. During the 2021 crisis, the difference between coal and natural gas prices has been increasing (Figure 3), providing economic rationale for Europe's shift from gas back to coal. As this trend in pricing persists and energy security issue is aggravated by explosions of Nord Stream 1 and Nord Stream 2, coal seems to be an obvious choice for the winter. In addition, there are significant obstacles to full transition to RES. In the absence of natural gas in the medium-term it is unclear what other back-up fuel may be available for Europe.

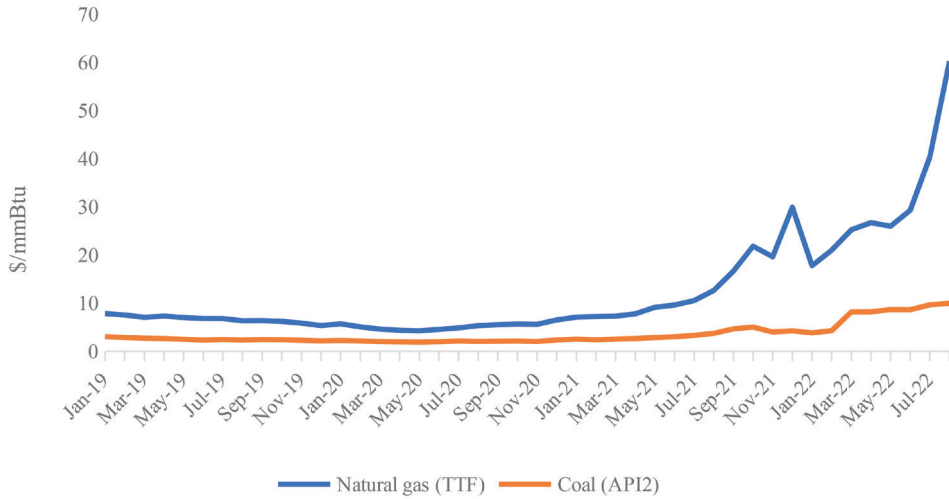


Figure 3. Natural gas and coal prices, 2019-2022, \$/mmBtu. *Source:* author's calculations based on Bloomberg terminal data.

Whether coal is back or not seems to be a rhetorical question because coal had never gone away. Despite the attempts to reduce its consumption in advanced economies, in 2011-2021 the global use of coal grew by 0,5% on average. Nevertheless, we should note that it had fallen from 4.4% in the previous decade. While developing countries are closing the old and economically inefficient coal plants, building the new ones and slowly shifting to RES and natural gas, the advanced countries are putting in operation their previously stranded assets.

IEA defines stranded assets as 'those investments which have already been made but which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return' (IEA, 2013). This description seems excessively broad so for our purposes we will rely on the following: 'stranded assets are assets that have suffered from unanticipated or premature write-downs, devaluations, or conversion to liabilities' (Caldecott, Howarth, McSharry, 2013). Assets may be stranded for either political or economic reasons. In Germany, the courts decided to favour nuclear operators with capacities stranded by a phaseout policy and the state must pay compensations for the non-economically driven losses. One way to avoid financial costs is to repurpose the plant either for natural gas or even for RES. It might be an appealing option in order to retire coal plants cost-effectively; however, the resources needed are significant (Niemann, 2018). Repurposing is accompanied by a long list of associated problems for various stakeholders: employment and revenue losses, grid intermittency, decommissioning costs, loss of industrial facilitation and many more, as identified by Chattopadhyay et al. (2021). Although examples are not numerous, research has shown that there might still be prospects for developing countries to repurpose old inefficient coal plants (Jindal & Shrimali, 2022; Nogaya et al., 2022), but the options and details should be considered using a holistic approach.

Since not all coal plants are repurposed, recent years revealed the opposite trend – to reopen them as an alternative to natural gas in developed economies. If the infrastructure is not repurposed or demolished, there is a chance to use it in times of crisis. In this context, coal’s main competitors are not RES, but natural gas and nuclear energy, which are used to balance the intermittences and stabilize electricity supply, if necessary. From the environmental point of view, coal could be used if carbon capture, utilization and storage facilities are enabled, which might be a lower-cost option if compared to low-carbon gases.

4. Discussion

One of the most apparent reasons for the global intention to phase out coal driven by advanced economies is its effect on climate change and associated emissions. According to Our World In Data, global per capita CO2 emissions vary depending on the fuel used: in 2020 coal emission was 1.79 tonnes per capita, oil – 1.42 tonnes, and natural gas – 0.95 tonnes. In other words, coal is the most polluting fossil fuel.

Figure 4 illustrates the fact that different countries are at different stages of energy transition: China and India are shifting from coal to natural gas, Germany and the UK

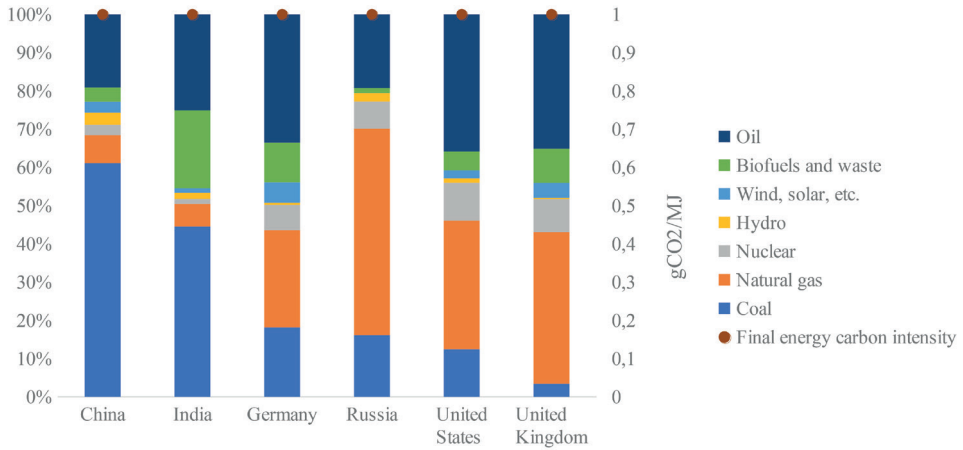


Figure 4. Total energy supply by source, %; final energy carbon intensity¹, gCO2/MJ, 2019. Source: IEA Data & Statistics.

are developing renewable energy. The amount of final energy carbon intensity seems to be at least partly explained by coal’s share in energy consumption. However, the level of energy intensity can further be lowered by additional measures, including energy efficiency and saving. In addition, it is affected by sectoral specialization patterns (Duro et al., 2010).

¹ Carbon intensity is defined by the amount of emitted gCO₂ to produce MJ.

On the one hand, environmental consequences are obviously negative; on the other hand, energy system structural transformation should be analyzed taking into account issues of economic growth and equality, energy availability, affordability and stability, which are particularly pressing in the developing world.

Political decisions often affect energy policy, especially natural gas and coal consumption. The decision to phase out nuclear power in the European Union led to a search for a so-called backup fuel, which could help to minimize the intermittence in electricity production by RES. From the environmental point of view, natural gas seems to be a better option; however, the high level of European dependence on Russian exports is regarded as an obstacle, together with all-time high gas prices. These factors, along with others outlined in our paper, boosted coal consumption in the EU in 2021, leading us to the conclusion that even advanced economies have not yet overcome their dependence on coal and still have to resort to it during energy crises.

We regard affordability, availability and existing infrastructure as the crucial factors determining coal consumption in the developing world that need to be viewed holistically. Availability is defined both by the existing export flows and domestic resources. From this perspective, the re-combination of global trade and rerouting caused by sanctions against Russia reaffirms long-term prospects for coal. However, in the short-term, trade disruptions are possible. Affordability depends on several external factors, including the volatility of gas prices and macroeconomic forecasts. As it is relatively easier to substitute gas with coal (in comparison to renewables, for example), gas price spikes lead to higher coal prices. The latter could be an obstacle for some importers; however, in this regard, coal's prospects are defined by alternative costs of shifting to renewable power.

The issue of infrastructure is among the most widely debated. With the declining popularity of coal and its broad replacement by natural gas, countries decided to close mines and accelerate coal-to-gas conversion in the power sector. Mines are closed when they become inefficient, but low technological intensity of coal infrastructure is an important factor for low-income economies, still lacking energy access.

The role of coal nowadays is largely defined by politics: bilateral relations, sanctions and restrictions, and global efforts on climate mitigation. In the short-term agenda, geopolitics seems to be prioritized. Various trade restrictions in the medium-term will be important factors, influencing coal prices: the reshuffling of flows might increase transportation and transaction costs, but more research is needed to evaluate the consequences.

The European Union is one example of the changing policy toward coal. For a long time, coal phaseout was understood as a necessity, although it was hard to reach a consensus among the members. Studies show that in Poland, coal consumption was mostly driven by socio-political considerations, including energy security, dependency concerns (Brauers, Oie, 2020), and also miners' electoral factor. Some of the economic spillovers and direct consequences of the transition were mitigated by policy measures on the national and the EU levels: creating new job opportunities in coal-mining

regions and investing in infrastructure and human capital could help reorientate the economy and prevent its slowdown (Śniegocki et al., 2022). Europe is the leader in green transition, serving as an example to the rest of the world. However, there are also drawbacks to these dramatic changes for the whole energy sector.

The European gas crisis of 2021 had a complex set of reasons: (1) global recovery, dominated by goods production; (2) demand for gas in Asia and the increase in LNG flows; (3) extreme weather conditions that led to falls in RES energy production both in Europe and in Asia; (4) Russian domestic demand for coal and gas; (5) the influence of the financial market, uncertainty and speculations; (6) European institutional framework, favoring short-term contracts and gas-to-gas prices; (7) low storage levels. Prices have reached record heights which provoked a short-term shift from natural gas to coal. In 2022, however, the prices climbed even higher in response to the decrease in Russian gas supplies that had been considered indispensable for the EU economies (Di Bella et al., 2022), hot weather, and the shutting of nuclear plants for maintenance (mainly in France). Coal is back in advanced economies of the EU as a possible backup fuel now that technologies providing energy storage and producing low-carbon gases are not mature and remain expensive. Production of energy by RES is subject to intermittences, calamities or extreme weather conditions and these risks have to be addressed. A fast and simultaneous phaseout of nuclear energy and fossil fuels without compensating (introducing affordable and available low-carbon backup fuels) will put energy markets at risk and create settings for future crises.

There are substantial differences in coal consumption on a country-level in the EU. In 2020, the share of coal in electricity generation varied from 69% in Poland and 53% in Estonia to around 23% in Germany and less than 1% in France. Despite the trend towards lower consumption, countries that are still dependent on coal, still have the option to reopen the plants and re-introduce coal to their energy systems. We should also note that energy transition in a developed economy is strongly related to drastic changes in the lifestyle, which, presumably, are to be accepted by voters.

According to IEA (2022a), the global coal consumption will reach a new all-time high in 2022, growing by 0.7%, and in the EU its growth rate is expected to be 7%. Today, coal appears to be a relatively affordable substitution for natural gas and the expectations of supply shortages in 2022 are driving the growth of coal reserves in APA terminals (Figure 5).

According to the IPCC report, the coal phaseout and halting investment in fossil fuel infrastructure will be necessary if we are to reach the Paris Agreement target and limit the warming of the planet to 1.5-2°C without CCUS (IPCC, 2022). These measures, however, will endanger the existing plants and mines, which if not repurposed will be stranded, leading to policy-motivated financial losses.

In 2022, the outlook for coal is positive, as its consumption is growing globally. Although it may slightly decrease in some developed economies (EIA, 2022), it is likely to be balanced by growing use of coal in other developed and most developing economies. There is great uncertainty about coal consumption in 2023, caused by highly volatile commodity markets and expected slowdown in global economic growth. Still,

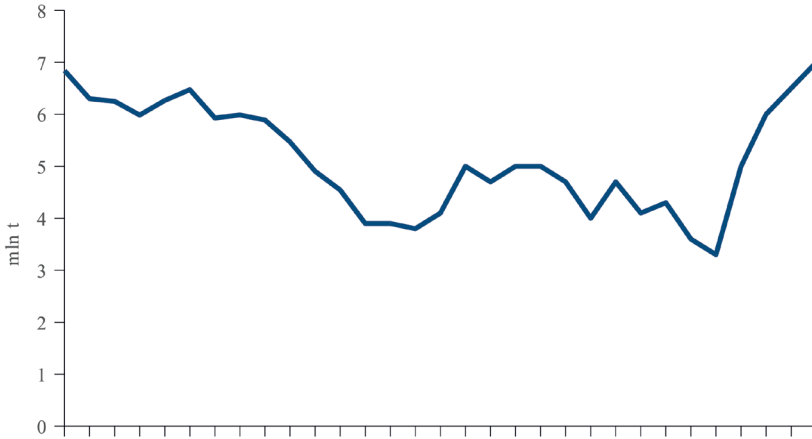


Figure 5. Coal reserves in APA terminals, 2020-2022, mln tons. *Source:* Metall Expert.

if the geopolitical issues remain high on the agenda, coal may see another good year in terms of both consumption and prices. The effects of these years on climate change mitigation are yet to be analyzed, but the sheer inability of developed countries to cope with their energy problems without coal might be an alarming signal for the developing ones. Another bad sign is the growth of global emissions in 2021, which is likely to continue as coal plants are reopening and mining capacities increasing; all this will certainly have long-term consequences.

Huge advantages of coal underlie the massive search for the ways to decarbonize the fuel, reduce the emissions, improve recycling and reuse of methane gas; to reach higher energy efficiency in coal mining; to use CCUS and other technologies that can help reduce emissions (Li, 2021). A phasedown of the industry should accompany these measures; otherwise, no significant progress on the path of climate change mitigation can be achieved.

As concerns coal consumption, developing economies have to choose between long-term climate goals and their need for short-term development. The developed countries have a different trade-off, choosing between climate and geopolitical agendas, as the prolonged coal consumption will require greater effort to reduce emissions. The choice in any case is far from obvious; it may have grave consequences both for the country and for the global environment.

5. Conclusion

Many crucial questions about the future of the coal industry still lack comprehensive answers.

The essential dilemma relates to simultaneously reaching economic growth, prosperity, equality and well-being on the one hand and the pledged climate goals on the other. According to OECD, the current pledges are not sufficient to reach the Paris

Agreement goal of keeping the global temperature rise below 1.5-2°C (OECD, 2021). Moreover, the biggest developing economies (China, India, Brazil and Russia) have set their carbon-neutrality targets beyond 2050 and have not reached their emissions peak yet (except for Russia). The problem of emissions leakage persists, and the existing mechanisms (or the mechanisms that will be introduced soon, like CBAM) still need to prove their efficacy. In contrast, the gap between production and consumption-based emissions at the country level is widening. The growth of coal consumption, driven by economic recovery, is only worsening the situation.

The nuclear disasters of 1986 in Chernobyl and 2011 in Fukushima were game changers that led to the society's consensus on phasing-out nuclear power (Renn, Marshall, 2016), despite the fact that it produces a significantly lesser amount of CO₂ emissions than fossil fuels, which accounted for 75.6% of total energy consumption in 2021. This decision had unexpected consequences: today, natural gas supply shortages and rising prices undermine its role as a transition fuel, while energy storage and grid technologies are still expensive and not fully operational, limiting the possibility to rely solely on renewable energy.

Energy policy is strongly influenced by the geopolitical agenda, according to which the use of coal as a backup fuel will be allowed in the medium-term. However, this shift will further widen the gap between commitments and plans regarding the climate agenda and stated policies.

There is no international consensus on the coal phaseout. During COP26, countries formed three groups: first, those who pledged to end the use of coal power by the 2030s/ the 2040s; second, those who accepted the obligation to end the overseas investment in fossil fuels, and third, those who refrained from signing any statements (Australia, China, Japan, India). Negative consequences of COVID-19 for SDGs and divergence between the developed and developing world in economic terms are counter-productive for the global agreement on coal, which has opponents even among wealthy states. As a result, the Glasgow climate pact accepted the recommendation introduced by India on behalf of the developing world to 'phasedown' coal instead of phasing it out (UNFCCC, 2021)².

We believe that global coal phaseout becomes almost impossible in the current macroeconomic conditions, possible recession or an economic slowdown. The economic rationale, determined by the availability and affordability of resources, affects consumption patterns in both developed and developing countries. However, in the context of international agreements (in particular, the Paris Agreement) and the necessity to achieve the SDGs, this problem in its various aspects might become even more urgent for the international community.

The necessity to provide financial and technological resources to emerging economies can have different explanations. Some argue that advanced economies

² Glasgow climate pact: leaders welcome Cop26 deal despite coal compromise. *The Guardian*. 14.11.2021. <https://www.theguardian.com/environment/2021/nov/14/glasgow-climate-pact-leaders-welcome-cop26-deal-despite-coal-compromise>

have benefited from energy-intensive industries and fossil fuels in the XX century and reached their current wealth and position in the global arena (Ram et al., 2022), so they have to take the main burden of climate change mitigation. As concerns the reduction of global emissions, it is worth noting that financial resources invested in non-OECD countries bring more significant results, i.e. on average, each additional solar panel or wind turbine installed in a developing country with large volumes of emissions has a more positive effect than if installed in a developed country.

Developed and developing countries face different types of problems related to coal consumption. Advanced economies, including coal exporters, look for another back-up fuel, and focus on mitigation measures. Developing economies have to tackle a vast range of problems of structural nature; at the same time they need to find financial resources to phase down coal consumption as they will have to cover social costs for the mining regions when markets are tightening. In such context compromise is hard to achieve, even for a greater good of saving the environment.

Sanctions of 2022 may be another game-changer preventing the phaseout of coal due to politically motivated energy security, cost considerations and back-up necessities. The change in coal consumption and its revival in developed countries lead to the following conclusions: firstly, we are witnessing growth in greenhouse gas emissions so in order to achieve the goals on their reduction it is necessary to strengthen the efforts on the global level; secondly, investment gap in climate finance keeps growing, and the necessity to choose between increased investment in RES and reopening of coal mines and plants adds to this problem. Thirdly, the current path of development makes both Paris Agreement and SDGs impossible to reach; the new transition strategies may require more finance and different instruments. The recent revival of coal may not be an indicator of structural transformation, but certain results 'achieved' are irreversible.

Whether coal is here to stay remains an open question, and the answer depends on the readiness of the developed countries to help the developing ones. According to the estimates, the first phase of the 'Just Transition' process in South Africa will require help from the international community of up to \$8.5 bn (European Commission, 2021), which should help the country overcome dependency on the coal industry (including readaptation of people who live in mining regions). Without global effort and financial support from advanced economies, it will be impossible to go through the fourth phase of energy transition at scale. The short-term or medium-term revival of coal will have consequences both in terms of rising emissions and prolonged transition, as the choice in favor of the geopolitical and economic needs over the climate agenda becomes acceptable.

Disclaimer

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