PUBLISHED BY
VOPROSY EKONOMIKI
N. P.

Russian Journal of Economics 8 (2022) 1–27
DOI 10.32609/j.ruje.8.XXXX
Publication date: XX June 2022

Russian Journal of Economics

www.rujec.org

Oil markets between Scylla of recovery and Charybdis of climate policy☆

Leonid M. Grigoryev[a,*], Ekaterina A. Kheifets[a,b]

[a] *HSE University, Moscow, Russia*
[b] *Center for Strategic Research, Moscow, Russia*

Abstract

In 2020 the energy transition path was distorted by the COVID-19 pandemic which caused a sharp economic decline and a fast global recovery in 2021. Unlike that period, the years between 2001 and 2019 illustrated a different type of energy evolution for developed and developing countries regarding primary energy consumption. During this period the composition of energy balances of these two major groups demonstrated dramatic disparity, notably marked by the high share of coal in developing countries. The shock of 2020 led to a belief in expediting the transition to green energy, but in 2021 the economic recovery revived demand for oil and coal, dashing hopes for the growing renewable energy sources sector in the European Union that year. The return of coal, however, to the EU energy sector and stable demand for motor fuel globally led to the restoration of the GHG emission growth against the backdrop of the practical implementation of the climate policy setback. The current energy transition is denoted by features such as the flat oil demand in developed countries, the flat global demand for motor gasoline and the growing demand for diesel. The econometrics of demand for two motor oil products are quite opposite. For gasoline we have almost all hypotheses met: the negative influence of climate policy and oil prices, strong effect of dummies for shock of 2020 and 2021, and naturally 0.3 coefficient at GDP growth rate. Nevertheless, for diesel everything is exactly the opposite — only 0,4 coefficient at GDP and practically nothing else. This effect shows the strong role and trend for cargo use of diesel fueled trucks in the global economy. The high income of oil and gas majors in 2021 did not secure the investment upturn. A mature oil industry receives substantial profits for its investors, supplying dividends, and buying back debts without enlarging production capacities. At this point climate policy expectations of phasing out fossil fuels in the foreseeable future operated as a braking mechanism against reinvesting oil incomes. Moreover, at this junction we can observe governments' limited capacity to

☆ This work uses the results of the project "Assessing the effects of anti-Russian sanctions on the global economy," implemented as part of the project groups competition at HSE University, Faculty of World Economy and International Affairs, 2022. This is an updated English version of the article published in Russian in *Voprosy Ekonomiki*, 2022, No. 9, pp. 5–33.

* Corresponding author, E-mail address: lgrigor1@yandex.ru

pursue policies toward multiple objectives simultaneously: modest energy prices, energy transition and securing the sufficient capital formation for energy. The continued fusion of the economic upturn and energy transition will be dependent on demand and supply matching in the oil markets. It is also possible that the sanctions policies of 2022 may aggravate the situation, triggering high prices and uncertainties.

Keywords: pandemic, energy markets, climate regulation, oil prices, energy security.
JEL classification: A14, F02, F21, F44, O44, P28.

1. Introduction

Oil occupies pole position in the world's energy balance and plays the most important role in the supply of energy for transportation. Supply and demand in this market are determined by a complex mix of factors, which frequently act ambiguously and generate price shocks (Grigoryev and Kurdin, 2015). In March 2020, the world economy and oil market faced an unprecedented shock that disrupted existing global supply chains and caused lockdowns in almost every country worldwide, triggering a record decline in oil demand. At the same time, OPEC+ deal was failed which resulted in a massive market imbalance and lifting the productions limits. The only way to mitigate the drop in prices and exporter revenues was a massive reduction in supply from OPEC++.

In 2021, global GDP increased by 6.1% after falling by 3.1% in 2020 (IMF, 2022), which indicates economic recovery (another 3.2% increase is expected in 2022). This was partly due to the massive economic stimulus packages offered by governments in developed countries which fueled consumer demand and, therefore, a steady recovery in global oil demand. By the end of 2021, demand for oil had almost recovered to pre-pandemic levels, even though restrictions on air travel had not been fully lifted. If such high demand for motor fuel continues, alongside a corresponding increase in greenhouse gas emissions, then the global energy transition, and progress towards achieving UN's Sustainable Developments Goals (SDGs), will be set back. In that eventuality, most governments and international organizations will be forced to revise their climate policies to sustain living standards after an unprecedented energy price shock. The challenges facing the global oil industry are a prime example of how contradictory public policy can affect the natural process of the next energy transition.

The geopolitical events of 2022 have once again changed the global development landscape in general, and the energy sector in particular. This resurrects the question of balance between the rational economic development of the world, with its liberal markets, the pursuit of efficiency and the improvement of public welfare vs. political decisions that bring additional costs to the economy and increased uncertainty in investments. This has happened before, but today the world economy has innumerable unresolved global issues such as poverty, social and economic inequality, and global warming, among many others. Changing the course of the development of the world economy "top-down" through political decisions will require a major revaluation of assets, a change in investment streams, and a restructuring of industry supply chains and the nature of consumer behavior. The summer of 2022 appears to mark a transitional period, as we are

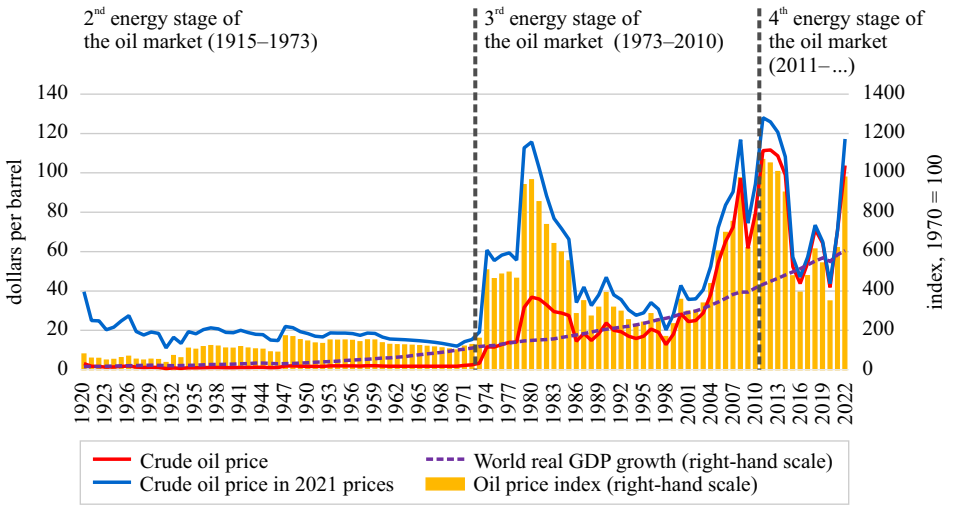

Fig. 1. Oil prices and world real GDP, 1920–2022.

Note: Oil prices in the period 1920–1944 are presented on average in the USA, in the period 1945–1983 — for Arabian light oil (Ras-Tannura), in the period 1984–2022 — for Brent oil.
Source: Compiled by the authors using data from BP (2022), IEA (2020), IMF (2022).

likely to see a shift in paradigm: from strong political influences and climate policies playing a vital role in market processes to the total domination of geopolitics in strategic markets processes.

2. Oil markets before 2020

The global oil market was established in mid-19th — early 20th century. In general, its formation and development are traditionally divided into four phases. During the first energy phase (1868–1915) the global economy had not yet become highly dependent on oil as an energy source. At that time, oil still played a relatively small role in the global energy mix and production costs were low due to ideal competition in the early years, followed by the Standard Oil monopoly (Makarov et al., 2015). The second energy phase (1915–1972) was characterized by extremely low oil import prices (by modern standards) to Europe and North America (OECD). The "Seven Sisters" cartel became the key player in the oil market. A steady $4 per barrel price during such an extended period of time resulted in the heavy dependence of the global economy on oil, which remains to this day.

The third energy phase (1973–2010) was marked by a 1973 price shock (Fig. 1) and is known for large price shifts, aggravation of conflicts, and a gradual decline in the household and industry demand for oil.[1] Finally, the fourth energy phase (2010–present) brought a new important factor to the forefront: the global community's desire to fight climate change.

см. рис.!

Since 1973, OPEC countries have been the driving force of the global oil market, regulating the world's massive share of oil supply with prices occasionally spiking. In addition, as the oil futures market emerged in 1986, the number of players increased and the oil stock market developed vastly with the trading

[1] The boundary between the third and fourth phases is blurred, but in any case it occurred between 2008 and 2015.

volumes significantly exceeding the actual production of oil. During this period, oil remained the backbone of the supply chains, competing with coal, gas, and also, in the 21st century, with renewable energy. We should also note that in the past 50 years there has been a significant growth in the world's GDP along with the increasing road and air transportation, not only in developed countries, but also across the world in general. Improvements in energy efficiency failed to prevent fossil fuel consumption from increasing. At the same time, significant energy price surges, especially oil prices, with substantial fluctuations, failed to curtail economic growth.

Pricing has also changed significantly due to the structural transformation from a regulated market, which existed until 1971, through a transitional period following the first and second oil shocks from 1973–1984, to a commodity-based unregulated market (1986—present). Researchers point out that prices during this period were driven by expectations regarding limited supply and demand (Mitchell, 2002; Yergin, 1992). And supply expectations depend not only on production capacity, but also on the physical availability of energy sources (Fattouh, 2007; Hamilton, 2009; Kilian, 2008). Demand expectations, in turn, are influenced by the business cycle and the uncertainty associated with unforeseen shortages of oil supply relative to expected levels of oil demand (Hamilton, 2013; Kilian, 2009). The prices of both crude oil and refined products were affected by events that could result in actual disruptions in oil supply to the market or create uncertainty regarding the future supply or demand for this resource, causing greater price volatility. The determining factor here is the low oil demand price elasticity (Tsirimokos, 2011) due to the inability to quickly switch to other fuel types for energy production (de facto—the lack of substitute commodity for oil in transportation sector).

Disruptions in oil supply deplete oil reserves, which are then restored once supply exceeds demand (Killian and Murphy, 2014). Since reserves can be used towards both current and future demand (for some period), their level is sensitive to the relationship between the current oil price and expected future prices. If the market expects a relatively high demand or low supply in future, prices for futures will tend to rise, stimulating a build-up of reserves. At the same time, a sharp decline in current production, or an unexpected increase of current consumption, tends to increase the role of spot prices relative to futures prices and leads to a reduction in reserves (Considine and Aldayel, 2020).

During the third and fourth phases, a number of shocks occurred that significantly affected the price of energy resources. While price changes were caused by supply-side shocks during the latter half of the 20th century, the market has been dominated by demand-side shocks since 2000. The shifts in favor of renewables and liquefied natural gas (LNG) from 2015 to 2019 were not as great as the climate activists would like (Fig. 2). Both OECD member countries (average weighted GDP per capita PPP—$54,800) and the rest of the world (average GDP per capita PPP—$19,900) are currently still far from reaching net zero greenhouse gases (GHG) emissions. OECD countries are characterized by highly developed transportation systems and greater share of oil in the fuel energy balance, as well as a growing share of LNG. Meanwhile, developing countries gradually built up their energy infrastructure using cheaper and more affordable coal. In both parts of the world, increasing vehicle efficiency and the share of electric vehicles are shift-

ing the balance from oil to natural gas. The global economy has also experienced significant shifts in the fuel and energy balance over the 21st century; yet, they are still far from the levels demanded by the most radical climate change scenarios.

The fourth energy phase is characterized by the sharp rise of decarbonization policies. However, Fig. 2 shows the complexity of the interaction between industrialization in developing countries, global development and energy policy: the share of oil in the global energy balance is slowly decreasing, but the share of coal in developing countries is growing. Since the adoption of the Paris Agreement in 2015, the climate agenda has largely shaped the actions of governments and oil producers worldwide. At the same time, the energy transition was driven by active technological development, the introduction of renewables and the replacement of fossil fuels. Ensuring energy security, achieving high levels of energy efficiency, decarbonizing economic growth, and combating climate change have become the new energy policy priorities (Makarov et al., 2019).

This rapid economic development over the past 30 years has led to a number of negative consequences, including climate change. In this regard, the United Nations adopted its SDGs in 2015 to respond to today's economic, environmental and social development challenges. Among the 17 Goals, Goal 13 (Climate Action) is particularly widely discussed. Together with Goal 7 (Affordable and clean energy), it has come to the forefront of the UN SDGs and, in our opinion, is crowding out the other SDGs (Grigoryev and Medzhidova, 2020).

The Paris Agreement, which was adopted as part of the UN Framework Convention on Climate Change and replaced the Kyoto Protocol, has become the major tool shaping national efforts to prevent climate change. A distinctive feature of this agreement is the bottom-up approach, whereby each participating country determines its own "equitable" contribution to combatting climate change, with efforts to reduce GHG emissions (not necessarily being equal for developed and developing countries). Achieving the Paris Agreement's goal of keeping global average temperatures from rising more than 2°C requires a rapid reduction in greenhouse gas emissions from all participating countries to zero by 2050–2060.

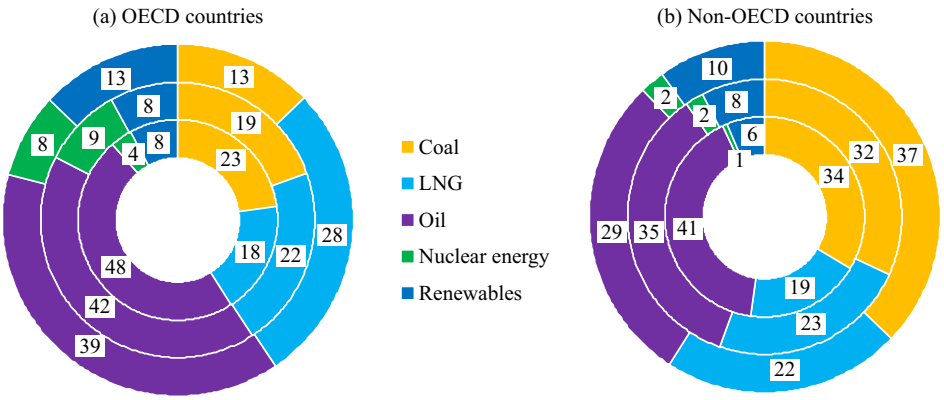

Fig. 2. Fuel and energy balances of the countries (a) included and (b) not included in the OECD, 1980–2019 (%).

Note: Inner circle — 1980, middle circle — 2000, outer circle — 2019.
Source: Compiled by the authors based on EIA (2022a).

Critics of the Paris Agreement point out that even if all national GHG goals were met, the annual change in global temperature would remain at a level corresponding to a 2.7–3.5°C increase by 2100, almost twice as high as agreed upon. We can already conclude that not only stronger commitments, but also more decisive actions at the country level to reduce emissions, will be required. So, it will be necessary to reduce oil consumption even further, sending a clear a signal to the oil industry.

In its latest assessment report (IPCC, 2021), the UN Intergovernmental Panel on Climate Change estimated that the world's remaining carbon budget[2] is 460 billion tons of CO_2, which will be exhausted by the world economy within 11.5 years. However, given the rapid economic recovery during 2021–2022, and the resulting increase in fossil fuel consumption after the pandemic restrictions were lifted, the remaining carbon budget might be depleted even faster.

Evidently, the carbon budget can be increased by reducing annual emissions in three ways: by decarbonizing economic growth (reducing emissions per unit of GDP) through massive investments in new renewable technologies; by reducing global economic growth and slowing down industrialization in developing countries; or even by population of developed countries abandoning their usual lifestyles. Either option implies a very different future path for carbon emissions and, therefore, global fuel consumption. Failing to reduce current levels of oil, coal, and natural gas consumption could lead to an increase in average temperatures up to +6°C and correspondingly more severe changes in global climate and sea levels. On the other hand, it should be noted that preventing environmental consequences by limiting CO_2 growth through deep decarbonization has significant short-term and long-term implications for the oil industry.

Energy transition, which has been on top of the global agenda, has changed perception not only of the oil sector, but of the world economy as well. A serious issue connected with the energy transition is the intention to eliminate fossil fuel consumption faster, announced as part of the 2015 Paris Agreement and supported by crucial EU decisions. Sharp reductions in emissions are scheduled as early as 2030 (reiterated in Glasgow in November 2021), with an attempt to reach net zero by 2050 (by 2060 in China and Russian Federation). It makes sense to address this problem gradually: reduce the world's coal consumption while simultaneously addressing energy poverty and development, since a great share of the livelihood of the world's population depends on energy produced from coal (Grigoryev and Medzhidova, 2020).

The recovery of oil consumption after the COVID-19 pandemic was mainly driven by the transportation sector in 2021, especially with the increase in personal car travel which may have resulted as a response to enduring lockdowns. OPEC expects the petrochemical sector to become a driver of oil demand in the medium term (OPEC, 2021). United States, China, India, Russia and Saudi Arabia are expected to become key players in the market. Various development trends in the petrochemicals sector indicate an upcoming gradual compression of demand and changes in the breakdown of consumption by economic sectors.

[2] The carbon budget is the total amount of CO_2 emissions allowed during a particular period of time to maintain a certain temperature threshold. The carbon budget given here is calculated to keep the global average temperature increase under 2°C by 2100.

However, due to the oil market peculiarities, demand and price fluctuations during 2020–2022 would have been stronger than in the gas and coal markets, had they not been limited by the OPEC+Russia+US agreements.

3. Shocks of 2020–2021

Oil plays a vital role in the global context as a fuel with a strong impact on standard of living, transportation and industry sectors of the economy, as well as on revenues across companies and countries. The relationship between oil market trends, supply and demand, and technological shifts has remained complex (Grigoryev and Kurdin, 2015) and has sparked extensive scientific and political debate. The rebound during 2018–2019 was largely due to stable and predictable oil prices under the OPEC+ agreement, the macroeconomic benefits of which remain largely underestimated by researchers.

The OPEC+ deal was derailed on March 6, 2020, leading to the lifting of oil production limits and a price war between Russia and Saudi Arabia. Nevertheless, this war was swept away by the unprecedented shock of the pandemic. The lockdowns disrupted the conventional global supply chains. Lockdowns were put in action in almost every country, causing an unprecedented drop in oil demand. Many countries imposed widespread travel bans, drastically reducing air travel. COVID-19 restrictions and switching to remote work caused a sharp drop in passenger travel. Container shipments also fell as a result of the decline in global trade, further aggravating decrease in fuel consumption. Brent crude oil price in 2020 averaged $41.84/barrel, the lowest since 2004, while oil consumption dropped by 9.2% reaching 2011 levels.

This market imbalance called for production cuts, and by April 2020 OPEC++, a consortium of leading oil exporters, agreed to reduce supply by 9.7 million barrel per day. The decision was aimed at maintaining market stability, including restoring the price of oil and reducing reserves, which had reached a record high. In 2020, global oil production decreased by 6.4 million barrel per day. It should also be noted that oil accounted for 72% of the total reduction in primary energy consumption in 2020. Shifts in the global energy balance suddenly became aligned with the “green dream” of a climate action movement towards decarbonization, but that did not last long. The OPEC++ agreement was able to stabilize prices at levels that helped lift the world economy out of a severe economic crisis.

The 2021 rebound was marked by a significant feature: a shift from services to goods in personal consumption (Grigoryev et al., 2021). This triggered an early boom in demand for commodities and energy, which in the normal business cycle would have been more likely to occur in the third or fourth year of economic growth (Grigoryev and Medzhidova, 2020). As a result of the extraordinary course of demand recovery and the first-ever decline of the renewables supply, the world faced an upsurge in energy prices as early as mid-2021, sustained by various factors until the fall of 2021.

During this period OECD countries experienced economic growth with a flat oil demand, while developing countries experienced economic growth with a moderate increase (Table 1). This gradually changed the energy balance of the OECD countries and the rest of the world (which had not yet completely

Table 1
Consumption of primary energy, oil, gas, coal and renewables 1991–2021 (%).

	Primary energy consumption						Oil consumption						Gas consumption					
	1991–2002	2003–2008	2009	2010–2019	2020	2021	1991–2002	2003–2008	2009	2010–2019	2020	2021	1991–2002	2003–2008	2009	2010–2019	2020	2021
World	1.5	3.1	–1.5	1.9	–4.0	5.8	1.4	1.4	–1.4	1.6	–9.2	6	2.1	3.1	–2.1	2.9	–1.6	5.3
OECD	1.3	0.5	–4.8	0.4	–7.3	4.7	1.2	–0.4	–4.4	0.2	–12.4	6.4	2.7	1.6	–3.1	2.2	–2.5	2.3
USA	1.3	0.1	–4.9	0.6	–7.4	5.3	1.2	–0.6	–4.3	0.8	–11.5	8.7	1.6	0.3	–1.8	3.3	–2.2	–0.4
EU	0.4	0.4	–5.9	–0.2	–7.6	5.6	0.5	–0.3	–5.3	–0.6	–12.9	5.8	2.2	1.9	–6.1	0.1	–2.9	4.6
Japan	1.5	–0.3	–8.8	–0.7	–7.4	3.8	0.4	–2.2	–9.4	–1.6	–11.5	2.2	3.5	4.6	–6.7	1.7	–3.7	–0.2
Germany	–0.4	–0.3	–6.2	0	–7.1	2.6	0	–1.5	–3.9	–0.3	–9.7	–0.2	2.8	0.4	–5.7	0.8	–2.4	4.2
Non-OECD	1.7	6.1	1.6	3.1	–1.8	6.5	1.8	4.0	2.4	3.1	–6.4	5.7	1.5	4.7	–1.1	3.6	–0.8	7.8
Brazil	3.5	3.7	–0.6	2.1	–4.4	5.0	3.5	2.1	–0.8	1.2	–7.4	5.5	13.8	10.1	–19.5	6.4	–12.1	29.1
Russia	–2.6	1.4	–5.0	1.1	–3.8	8.7	–5.3	2.1	–3.0	2.0	–4.9	6.1	–0.7	2.0	–5.9	1.2	–4.7	12.4
India	4.4	6.3	7.8	4.7	–5.7	10.4	5.8	4.5	5.2	4.8	–8.7	3.8	7.2	7.1	22.8	2.2	2.1	3.1
China	4.6	11.5	4.4	4	2.5	7.1	7.4	7.4	4.4	5.8	0.6	7.2	5.6	18.7	10.1	13.2	9.2	12.8

	Coal consumption						Renewables consumption					
	1991–2002	2003–2008	2009	2010–2019	2020	2021	1991–2002	2003–2008	2009	2010–2019	2020	2021
World	0.9	5.9	–1.5	0.9	–4.0	6.3	6.0	14.8	14.8	13.5	9.7	15.0
OECD	0.2	0.7	–10.5	–2.8	–14.7	8.3	6.4	14.9	12.7	10.6	8.1	7.9
USA	1.1	0.4	–12.0	–5.2	–18.9	15.2	3.4	12.8	13.3	9.5	7.2	12.8
EU	–2.6	–0.9	–11.3	–2.8	–18.2	13.2	13.5	19.6	12.7	9.4	7.4	2.9
Japan	2.5	2.7	–16.1	1.5	–6.7	5.2	4.0	6.9	–0.9	14.3	10.0	9.9
Germany	–3.4	–1.0	–10.5	–2.5	–19.6	17.5	26.0	23.2	3.5	9.7	5.5	–6.2
Non-OECD	1.6	9.4	3.0	2.2	–1.2	5.8	5.0	14.5	21.5	19.7	11.8	24.2
Brazil	2.3	1.8	–19.3	3.8	–9.1	21.6	2.1	12.9	11.4	10.5	1.2	9.5
Russia	–4.5	–0.4	–8.5	–0.7	–7.7	4.0	9.8	22.4	1.2	18.4	70.9	53.9
India	3.9	7.0	8.7	4.7	–6.4	15.8	54.0	25.2	13.7	16.3	6.8	13.2
China	3.7	12.2	4.8	1.5	0.8	4.9	70.1	43.6	62.1	29.0	15.5	33.1

Source: Compiled by the authors based on BP (2022).

developed their transportation and energy infrastructure). In addition, it should be stated that in developed countries, the role of energy efficiency in slowing the growth of primary energy consumption and moving away from oil consumption is more pronounced.

Due to the rapid growth in demand for goods in 2021, primary energy consumption has almost returned to pre-pandemic levels (as did the emissions). What's more, oil consumption has not yet returned to 2019 levels in all countries by the first half of 2022, thus seller's market conditions are being created.

However, current primary energy and oil markets conditions are not as atrocious as a sudden return to rising coal demand (+6.3% worldwide in 2021). The cheapest fossil fuel is "back on the market" for developed countries, showing an 8.3% increase, including the US. Such growth is particularly unusual for Germany and the EU (+17.5 and +13.2%) after years of cutting back on coal. The sharp rise in demand for coal in Brazil, India and especially China is not surprising. In the year of the 26th UN Climate Change Conference in Glasgow, the world took a noticeable step back in its climate change mitigation efforts. Correspondingly, the overall emissions accelerated, especially in China, which accounts for about half of global coal consumption (Fig. 3).

Countries are implementing various strategies to achieve a "clean" recovery and transition to renewable energy after the pandemic. Despite the growing demand for green stimulus plans around the world, investments in fossil fuels still dominate half of the world's announced strategies for economic recovery.

The pandemic resulted in budget redistribution as governments were forced to postpone costly climate policies in favor of restoring economic growth and the welfare of citizens after the unprecedented economic shock. According to Energy Policy Tracker (2020), in 2020 most developed countries increased gov-

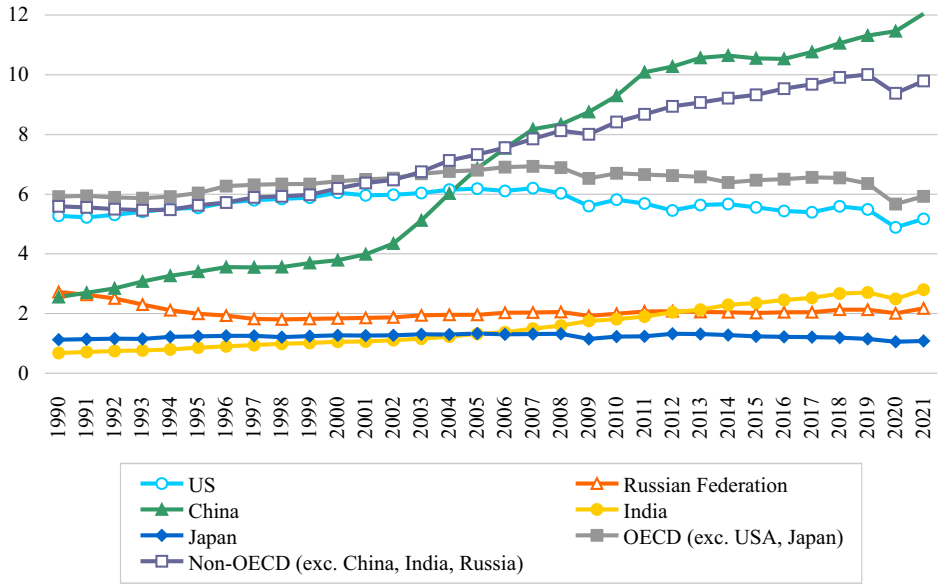

Fig. 3. CO_2 emissions from energy, process emissions, methane, and flaring (billion tonnes of CO2e).

Source: BP (2022).

ernment spending on fossil fuel production, while cutting spending on climate strategies. To support business, governments also had to suspend a number of environmental regulations and requirements, lower taxes, and provide preferential financing to mining companies.

4. Motor oil demand econometrics

We assessed the effects of the pandemic and decarbonization on oil demand in the top-30 oil-consuming countries. Based on the statistics, forecasts by major energy agencies, and the literature which served as the methodological basis for this study, three hypotheses were formed. By testing them, we aim to clarify the effects of the pandemic and decarbonization on the global energy market. Our focus was on the most volatile part of the oil market — motor fuel, which accounts for about 64% of global oil consumption (not including aviation kerosene).

Hypothesis H1. There is a negative sensitivity in total oil demand to rising oil prices — confirmed for automotive gasoline, but not for diesel.

Hypothesis H2. The recovery of motor fuel demand in 2021 was influenced by a set of cyclical and price factors as well as climate policy — confirmed.

Hypothesis H3. Countries with strong climate policies experienced less considerable growth in motor fuel demand in 2021 compared to countries without a climate agenda — the opposite was confirmed.

Total oil demand and motor fuel consumption were used as dependent variables. In our analysis we used data for the top-30 oil-consuming countries between 2000 and 2021. The main explicative variable is the Brent oil spot price. The behavior of the average motor fuel consumption indicator correlates strongly with the aggregate oil consumption and describes fuel consumption in the economy. All climate strategies are based on measures to reduce motor fuel consumption. Several dummy variables were also used in the models:

– dummy availability of a climate agenda *(Climate)* (1:0);

– dummy variable for 2020 *(Covid_2020)* — 1 for 2020, 0 for other years;

– dummy variable for 2021 *(PostCovid_2021)* — 1 for 2021, 0 for other years.

The dummy variables for 2020 and 2021 had to be introduced, because the recession trigger (lockdowns) was not a normal cyclical event and we cannot expect that GDP declines in the countries tested adequately reflect this factor. The dummy variable for 2020 is needed to account for that year's structural shift and declining demand for fuel and petroleum products amid the pandemic restrictions. The dummy variable for 2021 accounts for specific growth after pandemic restrictions were lifted. The GDP variable was used in the model, which was converted into an incremental scale, and allowed us to separate the demand trend for oil products from general cyclical fluctuations.

The variable reflecting the presence of a climate agenda was set to 1 for countries with strong climate policies and 0 for those with weak policies (Appendix A). It was created based on an assessment by the independent Climate Action Tracker (CAT) of governmental climate actions and their compliance with the global goals of the Paris Agreement.

Descriptive statistics for these variables are presented in Table 2 and Appendix B. It is crucial that, in our sample, countries with strong climate poli-

Table 2
Descriptive statistics for dependent variables taking into account the impact of climate policy.

Country group	Variable	Arithmetic mean	Standard deviation	Min.	Max.
Countries with strong climate policy ($N = 11$)	Total oil consumption	–0.0034	0.0549	–0.2301	0.3472
	Motor oil consumption	–0.0124	0.0730	–0.4198	0.3472
Countries with weak climate policy ($N = 19$)	Total oil consumption	0.0223	0.0565	–0.2787	0.2348
	Motor oil consumption	0.0319	0.0755	–0.2734	0.4741

Note. The presence or absence of a strong climate policy is considered in the period from 2015 to 2019, considering CAT estimates. The list of countries and their estimates are given in Appendix A.
Source: Authors' calculations.

cies have much higher GDP per capita than countries without a climate agenda: the average PPP-weighted GDP per capita in the first group is 41,500 international dollars, as opposed to just 26,400 in the second group.

Total oil demand over the period of our study (2020–2021) increased globally by an average of 1.28% a year, with slightly faster growth in motor fuel demand — 1.56% a year. The variation in motor oil demand by country is much greater than the corresponding total oil demand. Indeed, given the global geopolitical conflicts and the pandemic, transportation was the first to suffer.

The average price growth rate between 2001 and 2021 was 8.6 percent, while the average from 2001 to 2019 was just 7.7%. The oil price variable has the highest volatility among all variables. Under the influence of external shocks, the price varied within a wide range: from a 47% decline in 2015 to a 68% increase in 2021. The largest declines prior to the COVID-19 pandemic were in 2009 and 2015. At the same time, the maximum increase in oil prices in 2021 can be associated with economic recovery after the lifting of coronavirus restrictions.

The overall change in fuel consumption does appear to be more volatile than that of motor fuel (Figs. 4–5). Moreover, in 2009, countries with strong climate policies significantly reduced their overall consumption of oil products as a result of the crisis, and from 2012 to 2014, in both cases we can see the inverse trend for countries with strong and weak climate policies. Nevertheless, despite the first group's stated desire to gradually reduce fuel consumption, it has actually kept growing since 2014. In addition, during the recovery from the COVID-19 pandemic crisis, automotive gasoline consumption in these countries exceeded the average for all countries. The rapid demand rebound in developed countries in 2021 was caused by large economic stimulus packages for households and businesses, the removal of restrictions on personal transportation, the resumption of domestic and international air travel, and the recovery of industry and petrochemical production. As a result, many countries, especially developed ones, de facto shelved their plans to reduce GHG emissions. Increased budgetary constraints in support of both the poor and financial markets also had an impact on the situation (Grigoryev et al., 2021). Fig. 4–5 show that shock factors prevailed in 2020 and 2021, with demand falling deeper in countries with strong climate policies, but also recovering more strongly afterwards.

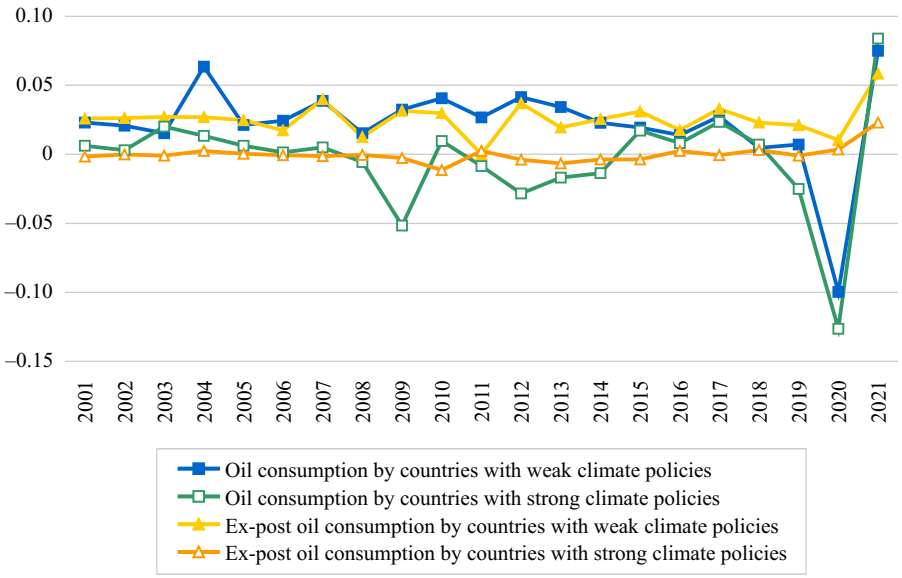

Fig. 4. Factual data and predicted ex-post "no dummy 2020 and 2021" values of oil consumption for countries with weak and strong climate policies (ARIMA model).

Source: Authors' calculations.

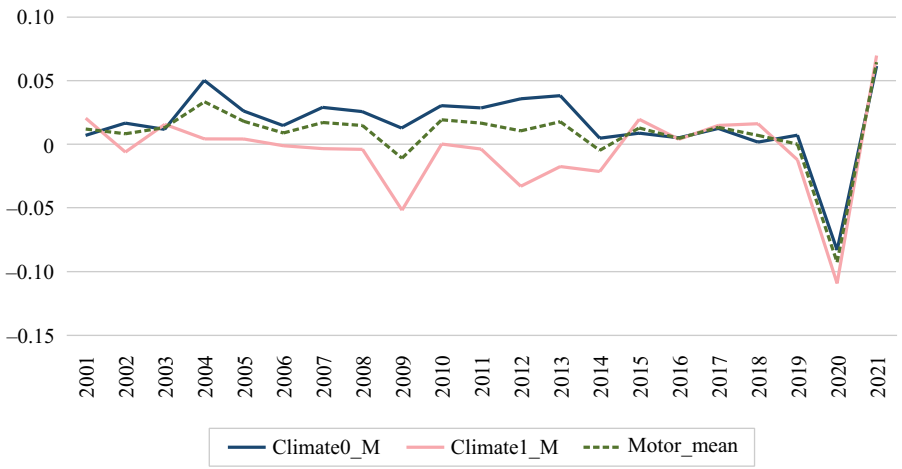

Fig. 5. Change in motor fuel consumption (motor gasoline and diesel fuel), 2000–2020 (average by country).

Source: Authors' calculations.

Figs. 4–5 show both the actual trends in oil and fuel demand and the estimates (based on equations) for 2020–2021 of how the demand for oil and motor fuel would have developed had there not been a pandemic shock and the ensuing recovery. We use the GDP variable in the equations both to reflect trends over a 20-year period and to offset the effect of business cycles. It should be noted that GDP trends are strongly correlated with the consumption of oil products and change in a very similar pattern. We can see a drop in GDP in 2008, and recovery growth after that, as well as a drop during the acute phase of the pandemic in 2020. There is a notable correlation between average GDP and the increasing role of

Table 3
Correlation matrix of variables, 2001–2021 (growth rate, $N = 30$).

	Total oil consumption	Motor oil consumption	Brent oil prices	GDP	Dummy variable 2020	Dummy variable 2021	Dummy variable "Climate policy"
Total oil consumption	1						
Motor oil consumption	0.6383	1					
Brent oil prices	0.3161	0.2164	1				
GDP	0.471	0.3379	0.3111	1			
Dummy variable 2020	–0.4788	–0.3657	–0.3366	–0.3194	1		
Dummy variable 2021	0.2557	0.2749	0.4685	0.1391	–0.05	1	
Dummy variable "Climate policy"	–0.2166	–0.2755	0	–0.1458	0	0	1

Source: Authors' calculations.

climate policy in a country. GDP growth is often lower in countries with an active climate agenda, but GDP volatility is also lower. This may be due to the lack of direct influence of oil market changes on the country's economy, which is usually observed in resource-exporting countries (Taghizadeh-Hesary et al., 2019).

As follows from the correlation matrix (Table 3), the 2020 dummy variable has the greatest influence on the dependent variables because of the decrease in fuel demand due to lockdowns during the pandemic. We can observe a significant influence of the GDP variable on total fuel consumption, which justifies its use in the model and points to the dependency of oil product consumption on business cycles. At the same time, the independent variables are also interrelated. For example, the price variable is dependent on the GDP variable, since inflation is often accompanied by an increase in business activity. Moreover, the 2021 dummy variable has the most significant impact on the price. This may be due to the specific (not quite normal for the business cycle) growth of the economy, as well as the fact that many developed countries have extensively used monetary stimuli to support the economy and population (Grigoryev et al., 2021).

Given the characteristics of the data, the dynamics of the variables used, and the hypotheses posed, two models must be constructed to explain the trends in a) aggregate oil consumption and b) motor fuel consumption. The model to explain the trend in motor fuel consumption (separately for gasoline and diesel) and to test the second and third hypotheses looks as follows:

$$\begin{aligned} Motor\ Oil\ Consuption_{it} &= \alpha_i + \beta_0 + \\ &+ \beta_1 \cdot D.Price_{it} + \beta_2 \cdot Covid\_2020 + \beta_3 \cdot PostCovid\_2021 + \\ &+ \beta_4 \cdot Climate + \beta_5 \cdot Climate \times PostCovid\_2021 + \beta_6 \cdot GDP + \varepsilon_{it}. \end{aligned}$$

Fig. 6 shows the consumption patterns for the two types of fuel globally and by the two key consumers: the U.S. and EU. During the 2000–2021 period, there

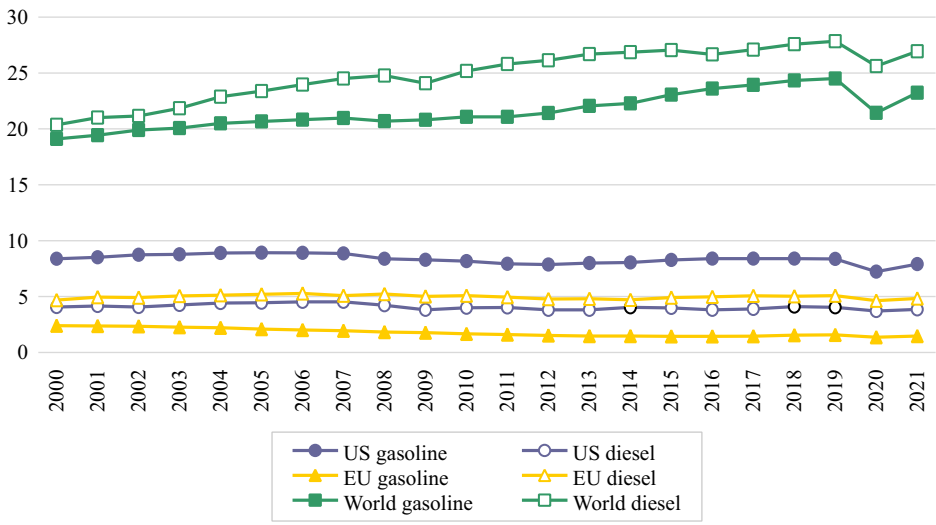

Fig. 6. Consumption of gasoline and diesel fuel, 2000–2021 (million barrels per day).
Source: BP (2022).

were huge changes in pricing, demand and the policies of various countries in the oil market, but the most significant ones occurred between 2020 and 2022. Demand for diesel has gradually overtaken demand for gasoline, and the volatility of the latter has been a little higher. Diesel fuel is used to a large extent in trucks and is subject to different laws. Econometric calculations show major differences in the models between these two sectors, which should be taken into account while forecasting market development, especially in the context of the climate agenda.

The inclusion of interaction effects in the second model is driven by the hypothesis of recovery growth in 2021 for countries with strong climate policies. Based on general theoretical considerations, we can expect the following signs for the variables in the equations: plus for GDP, minus for prices, minus for "climate policy," minus for the 2020 dummy variable, and plus for the 2021 post-COVID dummy variable.

The data is presented in panel form (30 countries for 2001–2021) and includes both temporal and spatial components; one might assume the need to apply individual effects for each country when using the FE or RE panel data model. Based on the test results, the final specification of both models is RE estimation with robust errors (Tables 4–5). The estimation in Model 1 (automotive gasoline, which accounts for 24.7% of oil consumption) showed the influence of almost all factors and the climate agenda on the total oil consumption variable. The model also considers the 2020 and 2021 structural shift variables; however, the equation does not contain a pronounced (and expectedly negative) impact of the oil price on consumption.

Large fluctuations in oil prices do not lead to sharp immediate changes in demand — crises and shocks dominate here. This may be due to the low elasticity of oil consumption in the transportation industry. Thus, oil price and consumption are essentially unrelated, which can be expected, although this may be influenced by the sharp increase in the price of oil in 2021, which is not fully accounted

Table 4
Results of the model for gasoline demand (1).

Variable	Coefficient	Standard deviation	*t*-statistics	*p*-value
Price	–0.0199327	0.0132871	–1.5	0.134
Covid_2020	–0.1155104	0.0168388	–6.9	0
PostCovid_2021	0.0624563	0.0209840	3.0	0.003
Climate	–0.0444437	0.0081145	–5.5	0
Climate · PostCovid_2021	0.0952376	0.0392816	2.4	0.015
GDP	0.3113198	0.0757283	4.1	0
_cons	0.0286862	0.0080014	3.6	0
R^2	0.3201			

Source: Authors' calculations.

Table 5
Evaluation results of model (2) RE for diesel fuel.

Variable	Coefficient	Standard deviation	t-statistics	p-value
Price	0.0249536	0.0113051	2.21	0.027
Covid_2020	–0.049418	0.0132756	–3.72	0
PostCovid_2021	0.0259834	0.0209254	1.24	0.214
Climate	–0.005513	0.0081026	–0.68	0.496
Climate · PostCovid_2021	–0.0103279	0.021995	–0.47	0.639
GDP	0.4162149	0.0695369	5.99	0
_cons	–0.0005744	0.0063095	–0.09	0.927
R^2	0.1938			

Source: Authors' calculations.

for by the 2021 post-COVID dummy variable. The oil price is determined by a geopolitical battle, and domestic oil consumption is close to inelastic due to the intensive introduction of petroleum products in all areas of the economy, especially in developing countries.

The significance of the GDP variable indicates the direct dependency of fuel consumption on business cycles. Thus, this variable clears the model from the influence of business activity within the country, which could have distorted the estimates. Other variables are significant and their signs are as expected. This confirms the existence of a structural shift in 2020, and recovery growth in 2021. In 2020, average consumption fell by 9 p. p. compared with the pre-COVID period, while growth in 2021 was 5 p. p. higher. In countries with strong climate policies, oil consumption is indeed regulated and significantly reduced relative to other countries. On average, consumption in the first group increased by 2 p. p. less than in countries without a strong climate agenda.

The price variable turns out to be less significant ($T = 1.5$), but has the "right" negative sign (see Table 4). This brings optimism to the proponents of a rapid energy transition: rising prices are pushing consumers to use more fuel-efficient cars and better fuels, more so in countries with strong climate policies.

The significance of the dummy variables "Covid_2020" and "PostCovid_2021" confirms the existence of a significant structural shift in 2020–2021. When compared with model (1), the quantitative values are higher in absolute terms. Consequently, transportation was the first sector to be hit in 2020, which manifested itself in an accelerated reduction in the use of motor fuel compared to total

consumption. Moreover, economic recovery came at the expense of a sharp increase in the number of car trips, which is again reflected in the high value of the coefficient for the "PostCovid_2021" variable. This confirms our second hypothesis.

Both the climate policy availability variable and the interaction effect are observed to be significant. Thus, the trend in motor fuel consumption in 2020 was 4.9 p. p. lower on average in countries with a strong climate policy than in the other group without these policies. However, during the recovery growth of 2021, motor fuel consumption in the first group grew 10 p. p. faster than in the other group, as evidenced by the interaction effect. This confirms the opposite of our third hypothesis for this study: countries with weaker climate policies saw less significant growth in motor fuel demand in 2021 compared to countries with a strong climate agenda.

The estimation in Model (2) for diesel (another 29% of total oil consumption) showed a very different picture which we retain for contrast with the gasoline situation. Surprisingly, price changes and the presence of a climate agenda had a positive impact on the aggregate oil product consumption variable. The model took into account the structural shock variable in 2020, as well as the effect of the (insignificant) 2021 dummy variable and the insignificant climate policy dummy variables to test the third hypothesis (see Table 5). This indicates huge differences in the demand factors for diesel and gasoline.

In the diesel equation, we are forced to state a few "wrong" signs and insignificant variables, but that was the intention — to test hypotheses that mostly turned out to work for gasoline. We interpret the positive correlation with the "oil price" variable as an incentive to switch from gasoline to diesel, particularly due to the global growth in transportation by large diesel trucks, with a very strong correlation between the use of this type of fuel and GDP growth. The fluctuations in demand for diesel are less pronounced and more correlated to the fluctuations in GDP, while gasoline, which is predominantly used in the private sector, is inherently less stable: the regression coefficient for the "Covid_2020" dummy variable is minus 0.11 for gasoline, and minus 0.04 for diesel. Diesel is overtaking gasoline and dominating freight transport.

The econometric calculations yield several important results:

- climate policy plays a role in reducing gasoline consumption;
- oil prices, although not very reliable in the equations, have the correct (negative) sign in the regression coefficient for gasoline;
- the pandemic shock had a negative effect on the demand for oil, more than in an ordinary crisis;
- countries with relatively strong climate policies experienced a greater reduction in the demand for motor fuel than countries without strong policies in 2020, but they also saw greater growth in consumption during the 2021 recovery;
- there is a big difference in the response to economic factors by the demand for gasoline and diesel.

The GDP per capita in the two groups of countries is radically different, which means that one should not pin excessive hopes on climate policy. Developing countries are still building their transportation and energy systems; it is hard for them to simultaneously pursue a catch-up policy and bear the huge costs of implementing the climate agenda.

5. Investment gloom

To achieve the goals of reducing GHG emissions in the medium term, it is first and foremost necessary to reduce world oil consumption. In terms of the energy transition, the main problem for the oil market is the people who like to drive cars (Table 6): there are 1.4 billion of them, including 16.4 million electric cars (for 2021), or 1.2% of the global car fleet. The consequences of introducing electric vehicles have had a significant effect on the huge existing fuel infrastructure in just a few countries and regions (Norway, California, and beginning to affect China). The habit of comfort in developed countries, demonstration effects and the desire of the middle class in developing countries to live "just like in developed countries" are fundamental factors in the development of the car industry, as evidenced by the sharp increase in demand for fuel in 2021.

According to the IEA, the transportation sector accounts for more than 65% of total oil consumption (with 16% of all GHG emissions). Its future depends on two divergent factors: the motorization of developing Asian countries (primarily India) and the electrification of vehicles in developed countries and China. In addition, despite the EU decision in June 2022 to ban the sale of cars with internal combustion engines after 2035, OPEC expects that the transportation sector will continue to grow under the influence of demographic factors, and due to the economic growth of developing countries, the expansion of global trade and the introduction of new technologies. The growing middle class in developing countries, with the respective consumption model, seems to play an important role in the process.

Improvements in energy efficiency in industries such as power generation and manufacturing, as well as a shift from petrochemicals to gas chemistry, will help reduce GHG emissions. However, judging by the current policies and plans for oil extraction and production, climate change mitigation initiatives will likely have less impact on oil demand in the short to medium term than previously expected.

Table 6 цифры заменила по верстке ВЭ
Oil demand by sector, 2019–2020 (million barrels per day).

Sector	OECD countries		Non-OECD countries		World	
	2019	2020	2019	2020	2019	2020
Transportation					57.4	49.2
Road	23.5	20.5	21.1	19.5	44.6	40.0
Aviation	3.8	1.9	2.9	1.6	6.7	3.5
Marine bunkers	1.6	1.5	2.6	2.4	4.2	3.9
Rail/waterways	0.8	0.8	1.1	1.1	1.9	1.8
Industry					26.6	25.7
Petrochemicals	7.4	6.8	6.3	6.2	13.7	13.0
Other industry	5.3	5.3	7.6	7.4	12.9	12.7
Other uses sectors?					16.0	15.8
Electricity generation	1.2	1.3	3.8	3.6	4.9	4.9
Residential / Commercial / Agriculture	4.1	4.1	7.0	6.8	11.1	10.9
World - Total?					100.1	90.7

Source: OPEC (2021).

The actions taken by oil companies, given the trend towards stabilizing consumption in OECD countries, reveal a well-known phenomenon: a mature industry has become "profitable" for shareholders and investors, its funds are invested in other sectors of the economy as part of the "capital spillover." Oil and gas companies have accumulated immense free resources during 2021–2022, but they did not rush to invest those funds in increasing production, which should be reduced in the medium term according to the logic of energy transition. It is a sort of a "philosophical and financial stalemate": high oil prices provide enormous revenues, but the climate agenda implies that this trend will not be possible in the future. Therefore, many oil and gas producers have started restructuring their portfolios and shifting their priorities toward diversification, sustainability and decarbonization, with only a few (state-owned) companies reacting to the 2021 oil price spike by securing additional production volume. Even shale oil producers are not rushing to provide additional supplies due to infrastructure and financial constraints (in the U.S.) as well as supply chain disruptions.

New oil price cycles affect investments. In the current cycle, the Brent crude oil price exceeded $100/barrel in early 2022, and remains above $90 as of the beginning of September. Despite the surge in oil prices and steady cash inflow, upstream investment shows little growth, with no sign of recovering to 2019 levels (Fig. 7). This indicates a fundamental change in the approach by oil and gas producers to allocate financial resources between dividends, investments and the repurchase of debt and shares.

According to the IEA, capital investment by oil producers during 2020 dropped to its lowest level since 2006. Spending decreased in all areas of the world, with U.S. companies accounting for more than 50 percent of the decline. In the U.S., the IEA cost index for shale oil production fell by more than 10%. However, the downward capital investment trend in oil exploration and produc-

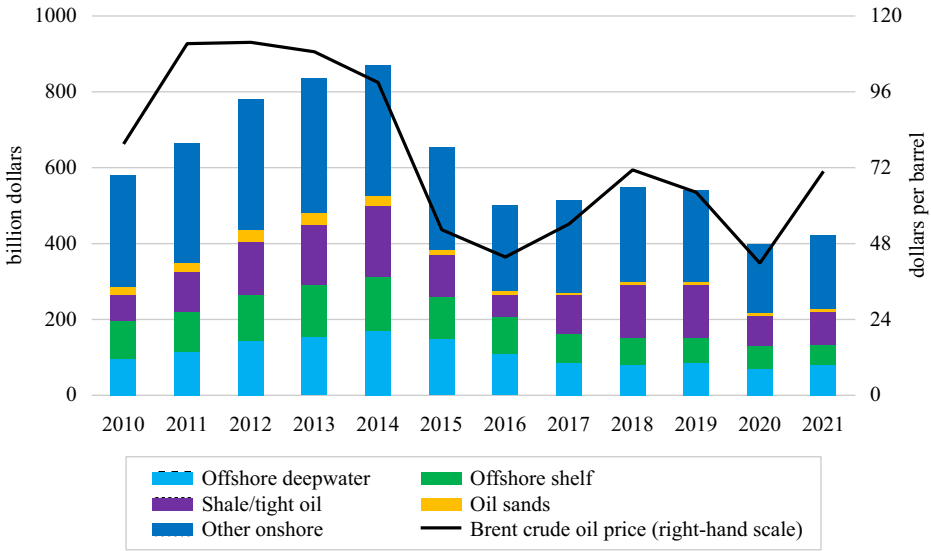

Fig. 7. Investments in oil exploration and production and Brent crude oil prices, 2010–2021.

Source: Rystad Energy (2022, p. 3).

tion has been observed globally since 2014. In fact, we can state that the industry "believed in its own imminent end" and began to transfer excess revenues into dividends, the financial sector and other shareholder interests, rather than into extra capacity.

Therefore, one of the key reasons for the reduced sensitivity of investments to oil price fluctuations is a change in the distribution of cash flows by large industrial companies. Against the economic downturn fueled by reduced demand due to the COVID-19 pandemic, returning cash to shareholders became a top priority, and companies had to change their business models. Thus, despite the recovery in oil prices last year and record high cash flows, the investment ratio fell from 60% in 2020, to about 34% in 2021. This means that only 34% of the total cash flow from oil operations was reinvested, the lowest level since 1990.

According to Rystad Energy (2022, p. 6), free cash flow from mining operations among large companies increased to $121 billion in 2021, 3.5 times that recorded in 2020 ($35 billion). Last year, all major companies significantly increased their production profitability with the greatest growth in absolute terms demonstrated by ExxonMobil, Shell, Chevron and Equinor.

U.S. President Joe Biden's policies also contributed to limiting new drilling and access to financing for the oil business; that is, it built regulatory "brakes" into the oil industry's investment plans and reduced its ability to quickly adapt to the changing situation. Note also tightening regulations on new production projects and the redistribution of investment towards renewable energy or low-carbon projects.

Although some producers are looking to increase oil and gas investment back to 2019 levels (Saudi Aramco, for one, has pledged to increase capital investment in its oil and gas capacity expansion program in 2022), most companies are reallocating capital spending towards renewables: for example, BP and Total have pledged to allocate more than 15% of their investments to renewable energy development and power generation. Overall, Rystad Energy predicts that 15% of the industry's total investment this year will be in renewable resources and low-carbon development schemes.

Under the influence of the pandemic and the desire to maintain the goals of the 2015 Paris Agreement, global investment in oil and gas has declined significantly during 2020-2021. While oil business revenues are expected to be even higher in 2022, these funds will go towards paying dividends and buying out debt (see above). We can declare a change in the investment function for the oil industry in the context of structural shifts and long-term climate policy. One should also remember that the cost of newly created energy infrastructure and its replacement is estimated at tens of trillions of dollars, while not all new technologies have been fully mastered to become profitable (Medzhidova, 2022). Here, another classical theorem about the "irreversibility of physical assets" appears (Bernanke, 1983; Pindyck 1991). It will limit energy supply as a byproduct of a successful energy transition stimulus policy.

6. Fatal implications

The economic downturn and decline in oil prices during the late 1990s caused the West to temporarily expect a buyer's market to form, with developed

countries being able to impose sanctions against oil exporters.[3] 20 years later, these sanctions came at a time of accelerated energy transition policies within the developed world, as well as stagnant investment with a significant increase in global energy demand. The post-pandemic economic recovery, the aspirations of developing countries to achieve higher levels of development, and the return of hedonism in the OECD represent a challenging background for energy sanctions. Attempting to rebuild the market geography with growing demand and a lack of significant spare capacity (reduced investment, etc.) means a textbook seller's market, which threatens to stifle growth and increase prices, regardless of the political reasoning of the process. The radical reorientation of oil flows in any case causes an increase in costs due to the zugzwangs on both sides of the market: the lengthening of the "delivery shoulder," changing oil grades for refineries, the shortage of tankers, the rising cost of insurance and risks, and so on. Sanctions against a major fossil fuel exporter reduce financial resources available to countries for implementing a climate policy. They have already caused stagflationary effects and, in fact, are hampering established energy and economic policies at several levels — for countries, companies, families, and while affecting global energy trends.

The way out of recession and for global oil consumption to recover to 97.5 million barrels per day provoked growth in prices by late 2021, further intensifying at the end of February 2022 due to the restrictions on trade with Russian energy companies. Replacing Russian oil and gas supplies will require significantly higher investment in the oil and gas industry, which may prove difficult given the entrenched pattern of shifts in the energy sector. At the same time, the increase in oil and gas production by exporters, particularly in the Gulf countries, is constrained by technological, economic and political (Venezuela, Iran) factors.

Since mid-2021, a climate of crisis has arisen due to surging prices for all types of energy, especially in Europe, although physical supplies have not been interrupted. Since the start of Russia's special military operation in Ukraine on February 24, 2022, many countries have imposed sanctions on RF, including the halting or freezing of investments in joint projects and oil refining equipment supplies; full or partial embargoes on coal, gas, and oil imports to the EU are planned in August–December 2022 (Analytical Center, 2022). The restrictive measures immediately led to a further rise in energy prices in light of the expected shortage in market supply (global oil production was 98.5 million barrels per day in Q2 2022) instead of the usual spring price decline (Fig. 8).

The impact of sanctions on the global economy is not entirely clear in scope, although stagflation has already emerged as a threat. The IMF's April forecast of global GDP growth this year was estimated at 3.6%, with consumer inflation at 5.0% in developed countries and at 6.1% in developing countries (IMF, 2022). This year, oil quotations crossed the $100/barrel mark. Such price spikes slow economic growth in developed oil-importing countries. At the same time, these countries (along with China) can offset rising energy costs by increasing exports in value terms.

[3] "It is exporting countries that now need to be concerned about sanctions aimed at their domestic and foreign policies by governments and public opinion in developed countries" (Mitchell et al., 2001, p. ???).

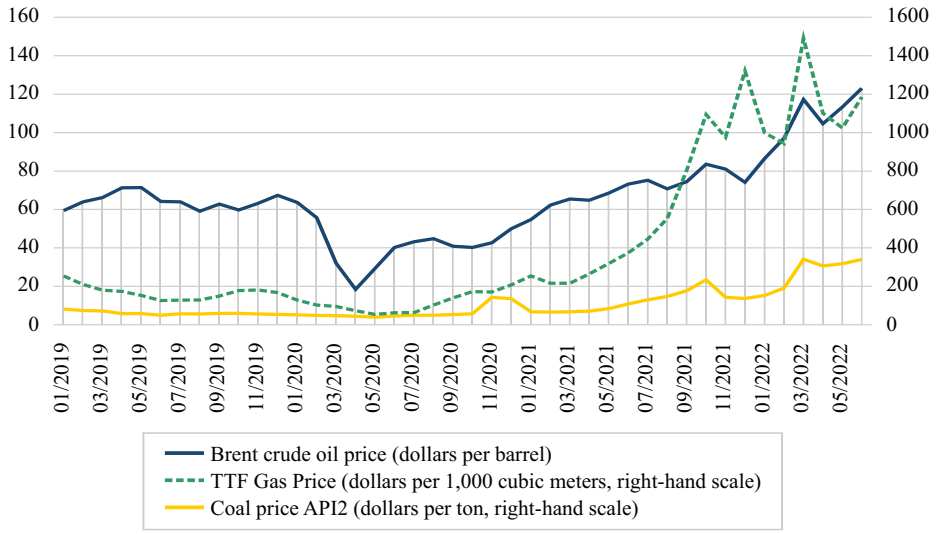

Fig. 8. Spot prices for Brent crude oil, TTF gas and API 2 coal, 2019–2022.

Sources: BP (2022); World Bank (2022); authors' calculations.

As a result of rising prices, the nature of competition between different fuels has changed, which explains the shifts in demand (See Table 1). In 2019, European TTF natural gas traded at $4.45 per one million British thermal units (MMBtu); European API2 coal at $2.43 per MMBtu, and Brent crude oil was at $11.1 per MMBtu. Oil was expensive. Coal was cheap but "dirty." And gas was cheap and clean, but politically "dangerous." As early as June 2022, MMBtu of TTF natural gas was selling for $33.10 (a sevenfold increase) in the European market, while API2 coal sold for USD 13.50 (also a 7-fold increase), and oil sold for USD 21.20 (price doubled). Coal became more expensive but was still much cheaper for heating than gas. Oil became relatively cheap over 18 months (only doubled in price)—thanks to the OPEC++ agreement.

Russia has about 12% of the world oil market and is also one of the largest suppliers of gas. The main importers of Russian energy products are European countries and China. According to JP Morgan, the U.S. imported about 600–800 thousand barrels of Russian oil daily, which includes mainly fuel oil and some crude. According to the U.S. Energy Information Administration, the share of Russian oil made up a record high 10% of total U.S. oil imports in May 2021, up from 4% in 2008. This coincided with U.S. sanctions on Venezuela in 2019, as U.S. refiners sought to replenish some of their heavy oil reserves.

The 2020–2021 period was a time of great uncertainty for the global oil market, and that uncertainty only intensified in 2022, due to the simultaneous impact of Russian sanctions, the ongoing pandemic, climate regulation and the global economic recovery. The effect of sanctions on the scale of Russia's oil supply effectively forms a tug-of-war situation, in which both sides find themselves in a stalemate, or without "good lines of play" as they say in chess.

The "post-sanctions" world will once again face more fragile supply chains and increased polarization. European importers, who decided half a century ago to reduce their dependence on Middle Eastern oil supplies and increase

imports from Russia, are now forced to refocus on the Middle East region again. The Asian region, primarily India and China, will benefit from low oil prices. But Western markets will likely turn against these countries, prompting them to seek alternative supply chains, likely in their own region. The Middle East could become the only major supplier of oil and gas to both the West and the East.

For this paper, we identified six main actors in the oil market: Russia, the United States, the EU, China, India, and Saudi Arabia (Table 7). These countries are characterized by a high level of uncertainty about their future behavior in the oil market.

Another outbreak of the new coronavirus infection was reported in China in the spring of 2022, which resulted in severe quarantine restrictions and, consequently, suspended operations at key facilities including oil refineries. According to the National Bureau of Statistics, China's crude oil imports were 14% lower in March 2022, than the same period the previous year (Aizhu and Xu, 2022). China's economic slowdown has led to a decrease in demand for energy commodities and worsened supply chain problems, which are likely to continue supporting inflationary pressures in China's trading partners.

On the contrary, the EU countries are experiencing a rapid recovery in oil demand, primarily from the transportation sector. According to OPEC, oil demand in Europe remained relatively high before the geopolitical conflict within the region: it exceeded 7.9 million barrels per day in Q1 2022 (OPEC, 2022). Demand during Q2 this year is also above last year's figures (98.5 million bpd, compared with 95.5 million bpd in Q2 2021).

According to preliminary OPEC estimates, Saudi Arabia's real GDP grew at an annualized rate of 9.6% during Q1 2022, the highest rate since 2011. Saudi Arabia's economy is expected to continue to expand in the short term, supported by higher fossil fuel prices and stronger domestic demand originating from

Table 7
Oil production and consumption, 2019–2021 (million barrels per day).

		China	EU, Norway, UK	India	Russia	Saudi Arabia	USA
Production	2019	3.8	3.3	0.8	10.9	11.8	17.1
	2020	3.9	3.4	0.8	10.1	11.0	16.5
	2021	4.0	3.3	0.7	10.4	11.0	16.6
Consumption	2019	14.3	13.0	5.1	3.4	3.7	19.4
	2020	14.4	11.2	4.7	3.2	3.6	17.2
	2021	15.4	11.9	4.9	3.4	3.6	18.7
Import	2019	10.2	10.9	4.5	0	0	6.8
	2020	11.2	10.4	3.9	0.0	0	5.9
	2021	10.6	9.4 [a)]	4.3	0.0	0	6.1
Export [b)]	2019	0	2.7	0.0	8.3	7.4	2.9
	2020	0	2.8	0.0	7.7	7.0	3.2
	2021	0	0.7 [a)]	0.0	7.6	6.5	2.8

[a)] Imports and exports for 2021 are indicated only for the EU.
[b)] Including heavy oil.
Source: Compiled by authors based on Bank of Russia (2022), Rosstat (2022), EIA (2022b), BP (2022).

the transportation sector. In any case, neither KSA nor OPEC in general are interested in another oil war and the resulting decline in revenues.

Sanctions have led to a new shock to both the global economy and extractive industries in Russia. The refusal to buy Russian oil is a serious problem for the European Union, due to the high proportion of Russian imports within its energy balance. Pressured by the sanctions, Russia has already started to redirect its export flows to the east. In the period before the embargo was imposed, oil exports from Russia, of course, continued growing, and oil extraction increased in July this year. By the end of 2021, Russia exported 4.7 million bpd of oil and 2.9 million bpd of petroleum products. In the medium term, it is expected to be able to increase its share of oil imports to the Asia-Pacific region. However, excessive supply may be a problem in the short run, especially for petroleum products in the context of restructuring business processes within Russia.

In the U.S., President Biden's oil policy has been at the center of a conflict of interest: the climate component limits funding for oil and infrastructure projects, while there is a strong interest in lowering motor fuel prices in the short run. Tapping into strategic reserves to increase supply when an import embargo has been imposed is an action with many unknowns and an uncertain chance of success for the domestic market. By early July, there were proposals to abandon the ban on exploratory drilling on federal lands.

U.S. energy companies and investors remain uncertain that prices will stay high long enough to profit from drilling large numbers of new wells. Over the past 20 years, oil companies have almost always responded to higher prices by investing and increasing production, but market conditions have changed significantly in the past two years. In addition to the current geopolitical crisis, there is pressure from the climate lobby and ongoing risks of repeated lockdowns. The contradiction between the strategic advantages of local oil and gas production and the environmental costs of using fossil fuels is unlikely to be overcome any time soon. The U.S. is concerned that issuing large numbers of permits for oil drilling on federal lands and building new terminals to export natural gas to Europe will increase the world's dependence on fossil fuels and the goals of the Paris Agreement will not be met. As it turns out, in attempting to increase oil production "outside of Russia," the world, including the leading Arab exporters, does not have significant reserves enough to bridge the gap in the short run.

Reducing and maintaining moderate energy prices under these conditions becomes a serious problem that could only be solved by a major oil consumption crisis or a new pandemic. With low investment and rising demand in developing countries (and OPEC+ stability), even attempts to limit household energy consumption in Europe may not be enough. Calls to limit the price of oil exports from Russia look like a hope to return to conditions during the Second Energy Transition, when the Western "Seven Sisters" ensured a consistently low oil price. So far, the "balkanization" of the oil market with its multiple barriers — oil sources, tankers, ports, and insurance (Rystad Energy, 2022) creates enormous uncertainty in balancing supply and demand. In all likelihood, we are dealing with a price shock reminiscent of the 1973–1974 period. This time, it is a "reverse political embargo" of developed importers against a large moderately-developed exporter of a huge set of commodities, particularly energy of all kinds.

7. Conclusions

As can be seen from the example of oil, there are two classifications related to its consumption and dealing with GHG emissions: developed vs. developing countries and countries with and without a strong climate agenda. Developed countries (but not only them) usually have a strong climate policy and are attempting to address the problem of growing GHG emissions. Developing countries maintain demand for energy, particularly coal and oil, because they are still going through the industrialization processes that developed countries had completed before World War I. Even though the pandemic sparked discussions on the long awaited energy transition to green energy, recovery in 2021 witnessed post-COVID effects which included free movement of people and a significant increase in motor fuel consumption in 2021 across the world, especially in the U.S. and China. At the same time, growth accelerated in aviation and petrochemicals. A marked increase in GHG emissions followed.

The 2021 recovery has not only brought back demand for oil, but for coal as well. What is more surprising is a substantial growth in demand for coal in developed countries, particularly in Germany and European countries which were reputed to be climate activists on the international arena. The continuation of such a trend, especially in rich developed countries, will jeopardize their own climate change goals. The lack of necessary climate policy and the failure to implement stated strategies, combined with the increase in energy consumption caused by the economic recovery after the pandemic, could lead to significant negative consequences for the environmental situation worldwide. On the contrary, the lack of support for the energy sector may expose not only the incomes of energy companies and resource-exporting countries, but also energy-consuming households and therefore the world economy, especially given the current economic uncertainty.

Green climate policy and propaganda, along with the 2020 oil crisis, have suspended capital investment in the oil sector. Major investments are not expected to return soon, despite high prices: a mature industry with a threatening outlook for the foreseeable future logically diverts its profits to paying dividends and maintaining stock prices through debt buybacks, etc. Investments are more focused on refurbishment rather than capacity expansion: under these conditions, the past cheap loans and even large profits do not stimulate capital investment. Low investment is supported by market uncertainty, recessionary expectations and climate agenda. At this point climate policy expectations of phasing out fossil fuels in the foreseeable future operate as a braking mechanism against reinvesting oil incomes. High oil product prices (and therefore producer and exporter revenues) deter consumer countries from investing in costly climate change mitigation strategies. Apparently, we are dealing with a price shock reminiscent of the 1973–1974 period, but not because of a political embargo by Arab exporters, but rather because of a political embargo by developed importers.

Investment uncertainty and the economic recovery in 2021, created a seller's oil market (but not just for oil), which caused runaway price increases or physical supply shortages. Supply has been decoupled from prices; physical supply is stable but limited, other than the complex effects of import embargoes on Russian exports.

Demand growth for motor fuels in developed countries after the long lockdown is due to both pent-up demand and a shift in the type of consumption in favor of cars. A new pandemic or a severe global crisis with a sharp decline in oil demand is unlikely. However, even in this case, OPEC++ will be interested in maintaining price stability and market balance.

The sanctions can fix high prices for energy products in the short and medium term if importing countries have no alternative and the exporting countries have insufficient capacity to replace Russian oil in the market. The reconfiguration of the oil market due to sanctions itself fuels uncertainty and drives oil prices higher. As a result, rapid global GHG reduction programs (UN, 2015) and decisions made at the 2021 UN Climate Change Conference in Glasgow 2021, were severely affected during the 2021–2022 (COP26) period, and it is likely that their implementation pace will slow down significantly, threatening the planet's climate in the long run. In this regard, now there is a stark choice between achieving the long-term goal of reducing emissions and the short-term task of maintaining economic growth. Demand and supply equilibrium in the oil markets will be necessary for both the economic recovery and the energy transition to continue. However, sanctions enacted in 2022 may exacerbate the situation with high prices and uncertainty.

References

Aizhu, C., & Xu, M. (2022). China imports 13% less crude oil from Saudi in March, 14% less from Russia. *Reuters,* April 20. https://www.reuters.com/world/china/china-imports-13-less-crude-oil-saudi-march-14-less-russia-customs-2022-04-20/

Analytical Center (2022). Fuel and energy complex of Russia in the conditions of sanctions restrictions. *Energy Trends*, No. 106, Analytical Center for the Government of the Russian Federation (in Russian).

Bank of Russia (2022). *Energy exports of the Russian Federation*. https://www.cbr.ru/eng/statistics/macro_itm/svs/

Bernanke, B. S. (1983). Irreversibility, uncertainty, and cyclical investment. *Quarterly Journal of Economics, 98*, 85–106. https://doi.org/10.2307/1885568

BP (2022). *BP statistical review of world energy 2022*.

Considine, J., & Aldayel, A. (2020). Balancing world oil markets and understanding contango and inventories: The changing nature of world oil markets. *KAPSARC Discussion Paper*, No. KS--2020-DP15. https://doi.org/10.30573/KS--2020-DP15

EIA (2022a). *Primary energy consumption*. U.S. Energy Information Administration. https://www.eia.gov/international/data/world/total-energy/total-energy-consumption

EIA (2022b). *Petroleum and other liquids consumption*. U.S. Energy Information Administration. https://www.eia.gov/international/data/world/petroleum-and-other-liquids/annual-refined-petroleum-products-consumption

Energy Policy Tracker (2020). *Public money commitments to fossil fuels, clean and other energy in G20 countries recovery packages since January 2020*. International Institute for Sustainable Development. https://www.energypolicytracker.org

Fattouh, B. (2007). The drivers of oil prices: The usefulness and limitations of non-structural models, supply-demand frameworks, and informal approaches. *EIB Papers, 12*(1), 128–156. Luxembourg: European Investment Bank (EIB).

Hamilton, J. D. (2009). Understanding crude oil prices. *Energy Journal*, *30*, 179–206. https://doi.org/10.3386/w14492

Hamilton, J. D. (2013). Historical oil shocks. *NBER Working Paper*, No. 16790. https://doi.org/10.3386/w16790

Grigoryev, L. M., Elkina, Z. S., Mednikova, P. A., Serova, D. A., Starodubtseva, M. F., & Filippova, E. S. (2021). The perfect storm of personal consumption. *Voprosy Ekonomiki*, *10*, 27–50 (in Russian). https://doi.org/10.32609/0042-8736-2021-10-27-50

Grigoryev, L. M., & Kurdin, A. A. (2015). World oil market disbalance: Technologies, economy, and politics. *Energy Policy*, *24*, 24–33 (in Russian).

Grigoryev, L., & Medzhidova, D. (2020). Global energy trilemma. *Russian Journal of Economics*, *6*, 437–462. https://doi.org/10.32609/j.ruje.6.58683

IEA (2020). *Global annual change in real gross domestic product (GDP), 1900–2020*. International Energy Agency, May 4. https://www.iea.org/data-and-statistics/charts/global-annual-change-in-real-gross-domestic-product-gdp-1900-2020

IMF (2022). *World economic outlook: War sets back the global recovery*. Washington, DC: International Monetary Fund.

IPCC (2021). *Climate change 2021: The physical science basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. https://doi.org/10.1017/9781009157896

Kilian, L. (2008). Exogenous oil supply shocks: How big are they and how much do they matter for the U.S. economy? *Review of Economics and Statistics*, *90*, 216–240. https://doi.org/10.1162/rest.90.2.216

Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review*, *99*, 1053–1069. https://doi.org/10.1257/aer.99.3.1053

Kilian, L., & Murphy, D. (2014). The role of inventories and speculative trading in the global market for crude oil. *Journal of Applied Econometrics*, *29*, 454–478. https://doi.org/10.1002/jae.2322

Makarov, A. A., Grigoryev, L. M., & Mitrova, T. A. (eds.) (2015). *The evolution of global energy markets and its consequences for Russia*. Moscow: INEI RAS; Analytical Center for the Government of the Russian Federation (in Russian).

Makarov, A. A., Mitrova, T. A., & Kulagin, V. A. (eds.) (2019*). World and Russian energy development forecast 2019*. Moscow: INEI RAS; Moscow School of Management Skolkovo (in Russian).

Medzhidova, D. (2022). Changing the role of natural gas due to the energy transition. *Problems of Economics and Management of the Oil and Gas Complex*, *207*, 5–17 (in Russian). https://doi.org/10.33285/1999-6942-2022-3(207)-5-17

Mitchell, J. V., Morita, K., Selley, N., & Stern, J. (2001). *The new economy of oil: Impacts on business, geopolitics and society.* London: Earthscan.

Mitchell, J. V. (2002). A new political economy of oil. *Quarterly Review of Economics and Finance*, *42*, 251–272. https://doi.org/10.1016/S1062-9769(02)00130-8

Rosstat (2022). *Oil produced (including gas condensate) since the beginning of the year* (in Russian). https://www.fedstat.ru/indicator/61403

OPEC (2021). *World oil outlook 2021*. Vienna.

OPEC (2022). *Monthly oil market report*. Vienna.

Pindyck, R. S. (1991). Irreversibility, uncertainty and investment. *Journal of Economic Literature*, *29*, 1110–1148. https://doi.org/10.3386/w3307

Rystad Energy (2022). *Oil & gas investments and key capital allocation strategies in the E&P sector*. Upstream report, May.

Taghizadeh-Hesary, F., Yoshino, N., Rasoulinezhad, E., & Chang, Y. (2019). Trade linkages and transmission of oil price fluctuations. *Energy Policy*, *133*, 110872. https://doi.org/10.1016/j.enpol.2019.07.008

Tsirimokos, C. (2011). *Price and income elasticities of crude oil demand: The case of ten IEA countries*. Master thesis No. 705, Swedish University of Agricultural Sciences.

UN (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations, Department of Economic and Social Affairs.

World Bank (2022). *World Bank commodities price data (The Pink sheet)*. August 2. https://thedocs.worldbank.org/en/doc/5d903e848db1d1b83e0ec8f744e55570-0350012021/related/CMO-Pink-Sheet-August-2022.pdf

Yergin, D. (1992). *The prize: The epic quest for oil, money, and power*. New York: Simon and Schuster.

Appendix A

Table A1
List of countries submitted for the analysis.

Country	CAT evaluation	Climate policy variable	GDP per capita by PPP, thousand international dollars (2017)
UK	Almost sufficient	1	45.9
Belgium	Insufficient	1	51.9
Germany	Insufficient	1	53.1
Spain	Insufficient	1	38.1
Italy	Insufficient	1	42.0
Netherlands	Insufficient	1	57.2
France	Insufficient	1	46.8
Poland	Insufficient	1	34.4
USA	Insufficient	1	63.0
Japan	Insufficient	1	40.7
South Africa	Insufficient	1	13.1
Australia	Highly insufficient	0	51.3
Canada	Highly insufficient	0	48.2
India	Highly insufficient	0	6.7
Indonesia	Highly insufficient	0	11.9
Brazil	Highly insufficient	0	14.7
Egypt	Highly insufficient	0	12.3
Malaysia	Highly insufficient	0	27.0
Taiwan	Highly insufficient	0	56.9
South Korea	Highly insufficient	0	44.2
China	Highly insufficient	0	17.5
Mexico	Highly insufficient	0	18.8
Saudi Arabia	Highly insufficient	0	45.0
UAE	Highly insufficient	0	67.0
Singapore	Critically insufficient	0	106.0
Iran	Critically insufficient	0	15.4
Thailand	Critically insufficient	0	17.5
Russia	Critically insufficient	0	28.1
Turkey	Critically insufficient	0	31.6

Sources: Climate Action Tracker (CAT); IMF; authors' calculations.

Appendix B

Table B1
Descriptive statistics for the 2001–2021 variables.

Variable	Average growth rate	Standard deviation	Min.	Max.
Total oil consumption, %	0.0128935	0.0572173	–0.2787147	0.3472137
Motor oil consumption	0.0156378	0.0775349	–0.4198027	0.4740506
Brent crude oil price	0.0857674	0.2880458	–0.4713550	0.6887512
Dummy climate policy variable	0.3666667	0.4822599	0	1
GDP	0.0186969	0.0465746	–0.4899398	0.4927968

Source: Authors' calculations.