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Energy Market in Contemporary International Relations: Main Threats and Challenges

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Abstract

The main objective of the present study is to analyze the main challenges and threats to the international energy market in the context of transformations in international relations. It will be possible thanks to a comprehensive explanatory and predictive analysis. The study verifies the research hypothesis that the evolution of energy security and the prospects for its development largely result from the relations on the global energy market. Analyses of energy security issues take into account long-term development trends as well as unpredictable events related to the functioning of international economic relations. Thus, the phenomena resulting from the dynamics of the international environment are gaining in importance. New energy systems and new technologies can lead the world towards new challenges and threats. The methodological framework of the conducted research includes research methods appropriate to the science of international relations. The factor method was useful in identifying the determinants of energy security market transformation in the contemporary world. The predictive analysis turned out to be helpful in the part of the thesis on the prospects for the development of the energy market. The research techniques used in the article include the analysis of literature, documents and statistical data.

Keywords: energy security, energy market, energy market transformation

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Introduction

Energy security results not only from objective economic premises but also from the balance of political power. States often use their resource potential as a foreign policy tool (Mouraviev and Koulouri 2019, 19). In terms of energy security, special attention is paid to oil, which is a very universal raw material, being a basis in the energy mixes of most countries in the world. It is estimated that oil will remain the primary energy carrier for at least two more decades. The main aspect of oil security was the continuous increase in demand for energy and oil products. On the other hand, this demand should be satisfied, which is associated with various types of threats (Dublaga 2014, 61). Michael T. Klare divided them into three groups:

- global oil depletion and doubts about the possibility to increase oil supply to meet the growing demand;
- shifting the center of gravity of global oil production and extraction towards politically unstable states, which may lead to more and more armed conflicts; and
- threats related to the functioning of oil infrastructure and oil transport (attacks on oil facilities and tankers, accidents and disasters) (Klare 2008).

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Table 1. Main threats to energy security

Short-term	Long-term
• Related to the functioning of industrial transport infrastructure — supply shortages caused by accidents, weather conditions or network failures. • Increasing threats of terrorism and maritime piracy — a serious risk to the land and sea transport of raw materials. • Threats in cyberspace.	• Geological — related to depletion of resources. • Technical — problems with extraction and transmission systems due to underinvestment and poor technical condition. • Economic — the difference between supply and demand. • Geopolitical — Suspension of supplies for political reasons. It is also about competing for influence in resource-rich regions and absence of rules for extraction in disputed territories. • Environmental — related to environmental pollution caused by activities in the energy sector.

Source: own elaboration based on Kaczmarski (2010, 18) and Młynarski (2011, 28).

The "oil shock" of the 1970s began a new era in which the oil market became an instrument of political struggle between states (Pronińska 2006, 395). It was at that time that a serious debate on national energy security began. International energy interdependence is determined by the policy of raw material transport. Pipeline routes are determined by economic conditions and political activities of states. According to the U.S. National Energy Policy guidelines quoted earlier, "concentration of world oil production in any region is a major cause of energy market instability, therefore production must be diversified to bring profits for each actor."[1]

Serious challenges to energy security include technological and economic barriers in the mining industry and the slow but inevitable process of resource depletion. As global demand for hydrocarbons is rising, raw materials producers are forced to invest more in exploration of new deposits while consumers are trying to diversify supply. In this context, Marek Pietraś's words deserve special attention: "There are many threats to the extraction and security of energy resources supply. These can be technical reasons related to the failure of transmission or transportation equipment. Political instability in the areas where the raw materials are extracted or transported may be another threat, as can the activities of non-state actors such as terrorist organizations or sea pirates. One must not forget about natural disasters such as earthquakes or floods" (Pietraś 2017). It is also hazardous for the volatility of energy resources prices and the failure of global management of these resources to overlap (Pietraś 2017). In the author's opinion, the variety of threats to energy security should be treated "as another manifestation of the autonomy of this security, which is a dynamic process conditioned by various economic, technical, political, social factors, operating at different levels of social life, including global, regional and national levels" (Pietraś 2017). According to Daniel Yergin, international energy security is conditioned by threats posed by the activities of terrorist groups, political instability in mining regions, and weather anomalies, such as hurricanes Katrina or Rita, which disrupted energy supplies in the international market (Yergin 2006, 70). The aim of this part of the study is therefore to analyze the major threats to international energy security and trends in the development of the global energy market (Misiągiewicz 2017). It takes into account the issues of energy demand, its production, as well as political, economic, and ecological conditions, significantly determining the state of energy security on a global scale.

1 Demand for energy

Satisfying the needs of producers and consumers is an enormous challenge for the global energy market due to the fact that global demand for energy has risen since the 1970s (figure 1). It was estimated that this tendency would continue in the coming years in connection with urbanization and industrialization processes as well as the increase in consumption in the automotive industry

1. See: Foundation for Energy Security and Innovation (Sec. 2528 of USICA and Sec. 10751 of America COMPETES).

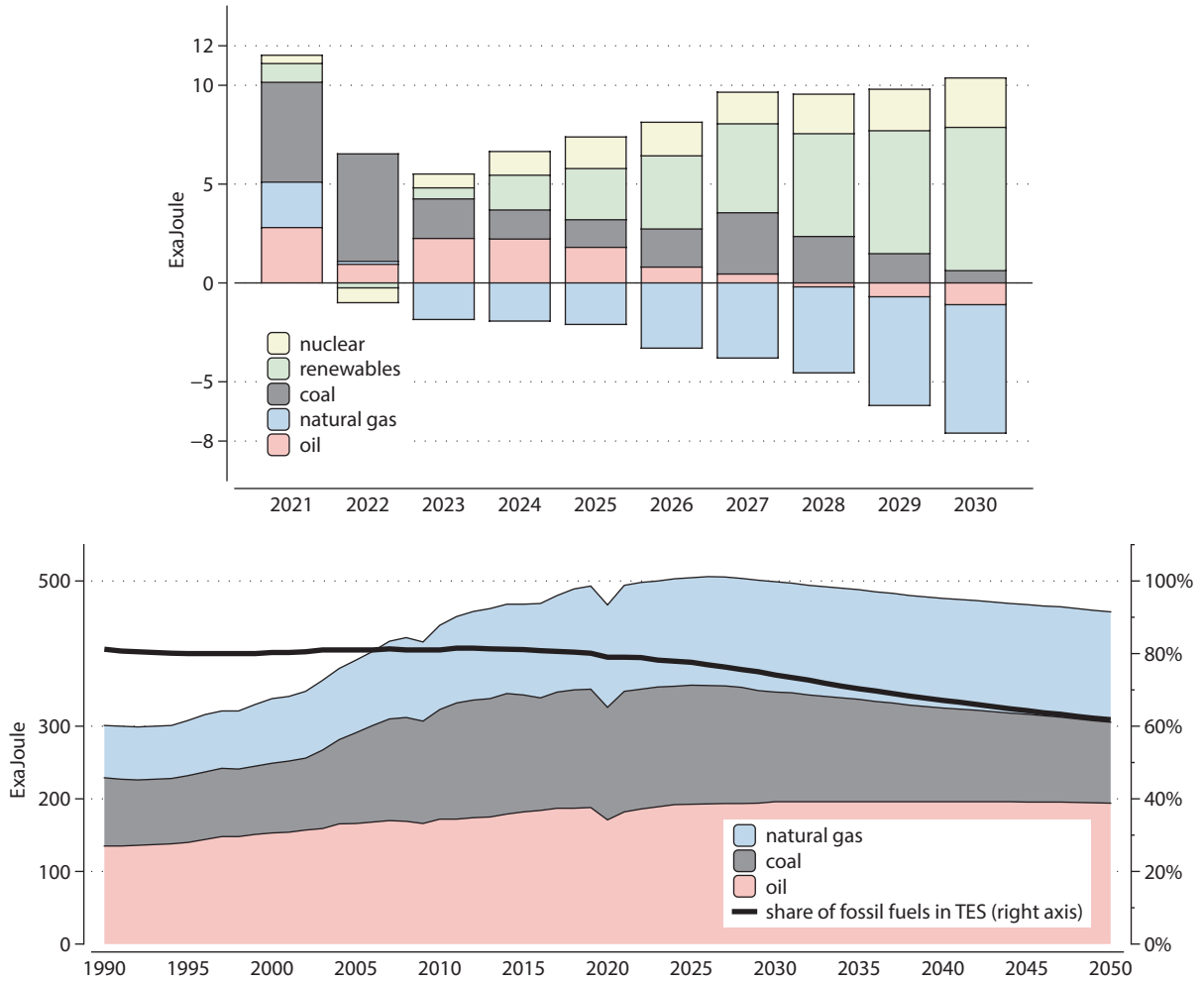

Figure 1. Difference in total energy supply

Data source: "World Energy Outlook 2022." International Energy Agency, https://iea.blob.core.windows.net/assets/c282400e-00b0-4edf-9a8e-6f2ca6536ec8/WorldEnergyOutlook2022.pdf.

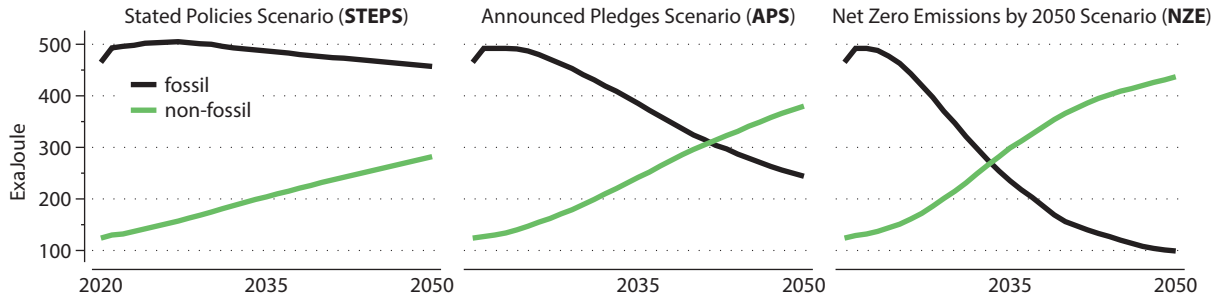

Figure 2. Diagram 2. Fossil and non-fossil energy supply by scenario, 2020–2050

Data source: "World Energy Outlook 2022." op. cit.

(Klare 2008). However, in the context of the global COVID-19 pandemic, the situation changed drastically due to the lockdown of the economy on a global scale. In this situation, energy demand declined steadily, especially for oil and coal. Global energy demand in the first quarter of 2020 fell by 150 million tons of oil equivalent (mtoe) compared to the first quarter of 2019.[2] However, the dynamics of the change in energy demand will largely depend on the pandemic control policies in individual countries and the pace of the recovery of their economies. The International Energy

2. See: "Global Energy Review 2020. The Impacts of the Covid-19 Crisis on Global Energy Demand and CO_2 Emissions." International Energy Agency, https://www.iea.org/reports/global-energy-review-2020.

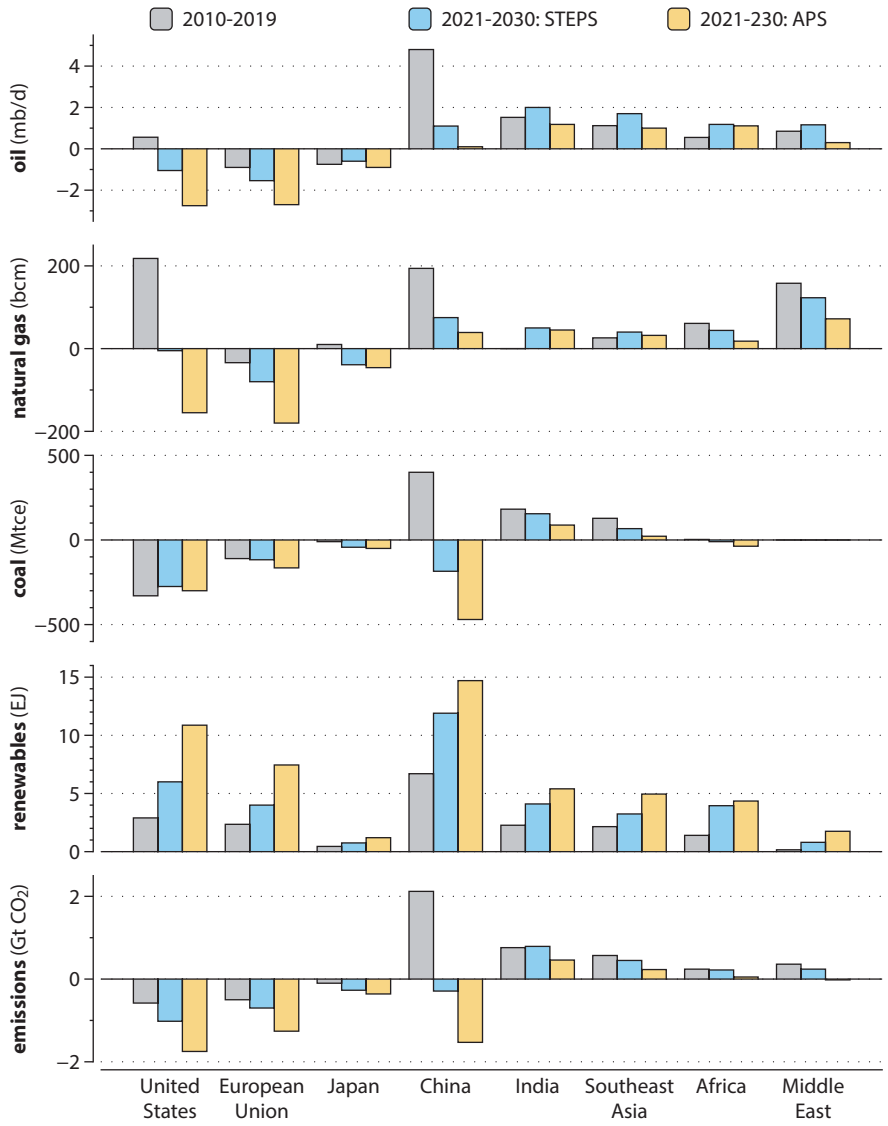

Figure 3. Energy demand by region

Data source: "World Energy Outlook 2022." op. cit.

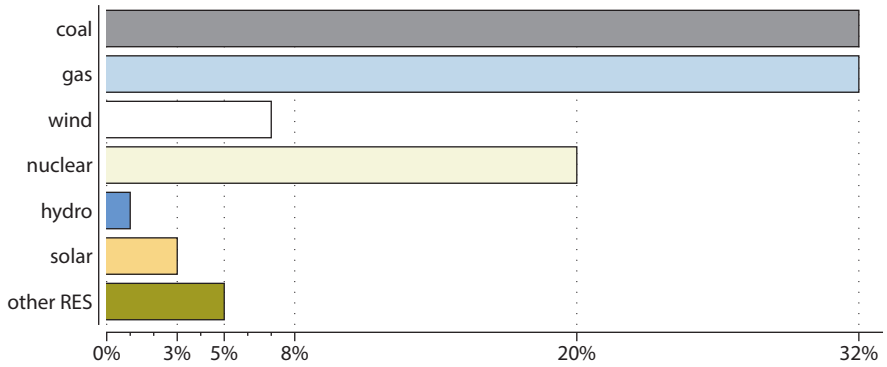

Figure 4. Electricity production in OECD countries

Data source: Own work based on data published in "World Energy Balances 2018," International Energy Agency, Statistics, OECD Publishing, doi: 10.1787/world_energy_bal-2018-en, https://www.oecd-ilibrary.org/energy/world-energy-balances-2018_world_energy_bal-2018-en.

Agency even estimated that the impact of the pandemic on energy demand in 2020 will be more than seven times greater than the impact of the 2008 financial crisis in that dimension.[3]

Today, we see two primary energy sectors along with challenges related to energy security. The first sector is electricity generated from coal (41.0%), gas (20.5%), renewable resources such as water, biomass, sun, wind and geothermal energy (18.5%), and nuclear energy (15.0%) (for comparison in the OECD see figure 4).

The second sector is transport. In this sector, the contribution of oil is essential. According to the U.S. Department of Energy, oil account for 38% of the world's energy supply and it is estimated that this share will not change substantially by 2030. Despite the increase in the share of low-carbon energy sources, the global energy balance remains dominated by fossil fuels supported by subsidies. While the world's largest consumers are able to exploit oil reserves to meet their basic needs, most states depend on imports. Their position in the energy market is very weak, as they are susceptible to external pressure, not only in the economic but also in the political dimension. Dependence on a single producer threatens to undermine the liquidity of imports.

The biggest problem for world energy markets is the concern over whether global production of resources will keep up with the growing demand. By 2030, the world's population will likely need 45% more energy than in the 1990s. However, it is unclear whether the production of energy resources will be large enough to meet the demand, especially for oil. This creates a necessity for increased production in the next two decades. Global energy markets are currently undergoing structural changes following the increase in the number of producers (in the regions of Persian Gulf, Central Asia, and Africa) and the emergence of new major consumers (countries of Southeast Asia). Cambridge Energy Research Associates states that "the global order is transforming: new alliances are emerging, reflecting interests that may fundamentally differ from those dominant in international politics over the past few decades" (Pronińska 2006, 406). Thus, the transformation of the energy market has a direct impact on the relations between producers and consumers of raw materials.

The imbalance in the world energy market may occur as a result of fewer discoveries of new sources of raw materials. The fact that the world's major oil fields are slowly depleting should be taken into account. Fewer and fewer new sources of oil are being discovered. Energy market analysts estimate that the current global production has already peaked and will decline steadily. More and more often they refer to the 1950s thesis of the geophysicist Marion King Hubbert that after a period of growth, global production of fossil fuels will peak (*peak-oil*) and then decline until the reserves are completely exhausted (Pronińska 2011, 262). Colin Campbell wrote in 2001: "Reality shows that there is no adjournment. Gradually, the market — not just for oil — will have to realize that the Organization of Petroleum Exporting Countries (OPEC) is not enough to deal with resource depletion. This will be a difficult experience as it means that there is no longer any barrier to price increases other than that resulting from a decline in supply. These events will result in a global recession and stock market crash" (Campbell 2001).

The peak of discovering new oil fields occurred in the 1960s when newly discovered reserves totaled 480 billion barrels (Klare 2008). Since then, fewer and fewer new reserves have been discovered, while the consumption of the exploited resources has risen in recent years. The international crisis related to the coronavirus pandemic caused an imbalance in the energy market but once the situation normalizes, energy consumption will likely increase further. On the basis of an analysis of 800 key oil fields worldwide, the IEA estimated that the average annual decline in production would be 5.1%, reaching as much as 8.6% in 2030. The largest decline in oil production occurred between 2000 and 2008 in Mexico, China, Norway, Australia, and the United Kingdom. North Sea oil production fell from 6.4 mb/d in 2000 to 2.1 mb/d in 2005. Production declines also occurred in Venezuela, Indonesia, and the Middle East.

Oil is the most important hydrocarbon for industrialized nations. It is an essential raw material for the production of fuels, lubricants, and other organic compounds (Dublaga 2014, 63). Lack of access to oil is not the only threat to energy security. It is worth noting the issue of the so-called *peak oil* production, after which production begins to decline and never returns to its highest level.

3. See: "Global Energy Review 2020. The Impacts of...," op. cit.

Oil market analysts disagree as to when this peak of production occurred. Geologist K.S. Deffeys determined it to be around 2009, J. Laharrere, also a geologist, set the range 2010–2020, the American Energy Information Agency set it at 2016, and the Shell Corporation presented the most optimistic forecast — i.e., beyond 2025 (Gryz 2018, 66). Analysts are not predicting a complete depletion of oil but a situation where oil that is cheap and easy to extract will run out. Thus, the main problem is not the lack of oil but the increasing difficulties with its extraction and refining (Gryz 2018, 67). Most oil-producing countries and most global oil fields have already passed their peak production or are at the so-called flat peak, lasting several years (it is estimated to affect 54 out of 65 oil-producing states). As a result, a significant number of deposits have been depleted, and replacing the production capacity that is lost every year is becoming more and more expensive and difficult. What is more, much less oil is being discovered than a few decades ago. In this respect, last significant discoveries were made in the 1960s. Additionally, since the 1980s we have extracted more than we have discovered. Another problem is the difficulty of producing oil from newly discovered deposits. For example, oil sands in Canada or heavy oil in Venezuela are very abundant deposits but their exploitation is problematic (Gryz 2018, 67). The most significant oil reserves are found in the OPEC cartel states. Many of them are politically unstable areas with high rates of poverty among the population. Rebel movements, terrorist organizations, and corrupt, largely authoritarian governments are present there. Profits from oil trade exacerbate corruption and increase arms spending. Oil transport comes with numerous threats, such as terrorism and maritime piracy.

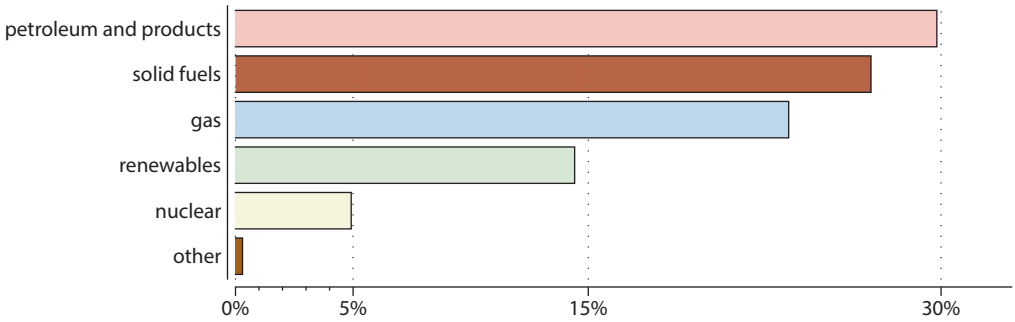

Figure 5. Production of energy resources

Data source: (*EU Energy in Figures. Statistical...* 2022).

There is a growing competition among consumers for supply sources and competition among producers for export routes (Fettweis 2009, 67). One condition that fosters competition between the main consumption centers is the change in the structure of the global demand for energy and fossil fuels, and the loss of leadership in this field by highly developed countries from the Organization for Economic Cooperation and Development (OECD) (Pronińska 2011, 264). According to the EIA, global energy consumption will have increased by 44%, while the share of OECD countries in global consumption will have fallen from 51% to 41% by 2030.The growth in demand for energy and hydrocarbon fuels is primarily driven by China and India, which are becoming major global importers. The population of these countries accounts for one-third of the world's population, and their dynamic economic development has created a new and very large middle class, which generates a rapid growth in energy demand. Thus, more than 80% of the rise in total oil consumption is attributed to Asian countries, which are among the fastest growing economies (Młynarski 2011, 25). Strengthening the position of new global consumption regions increases competition in the market and improves the situation of exporters, who gain more freedom in their choice of markets (Pronińska 2011, 264).

For the world's largest consumers of raw materials, the depletion of resources and the actions of exporters limiting access to these raw materials are a serious problem that may become a threat to their energy security. The consequences of the global deficit in natural resources will have significant geopolitical implications. Importers will look for new sources of supply, which may increase the interest in energy resources in Africa, Asia, South America, and the Arctic. The goal of the competition is to gain access to sources of raw materials and transmission infrastructure.

Simultaneously, the spatial and subjective scope of the competition has significantly expanded. It may take place in various regions of the world and between various actors, not only state actors. M.T. Klare considered three countries in the rivalry for resources on a global scale: the U.S., China, and Russia. The three superpowers, which constitute the so-called strategic triangle, determine the dynamics of the global energy market.

2 Geographical conditions

The main problem for the global energy market is that the deposits which are being currently exploited are located in regions that are difficult to operate due to geographic, environmental or political conditions, which limits the global extraction of energy resources.

Until the 1950s, two-thirds of the production was located in the U.S., Canada and Europe. However, as the demand grew, the search for new sources began. U.S. Department of Energy data show that in 1990 the production of crude oil in the north accounted for 39% of global production only to decline later on (Klare 2008). At the same time, exploitation of resources in the south of the globe increased — i.e., in Africa, the Persian Gulf and the Caspian region. Such a shift in oil production increases the liquidity and security risk of the supply of energy resources. It is greater given the political, social and economic instability in those regions, whose young inhabitants experience high unemployment, ethnic conflicts, instability of government, corruption, and the militarization of social life, all of them being the legacy of the colonial and totalitarian systems. Thus, the prospects for oil production are associated with rising risk, which drives the price growth of this resource. Along with the price growth, the number of conflicts in regions rich in this commodity will probably increase (Ross 2008).

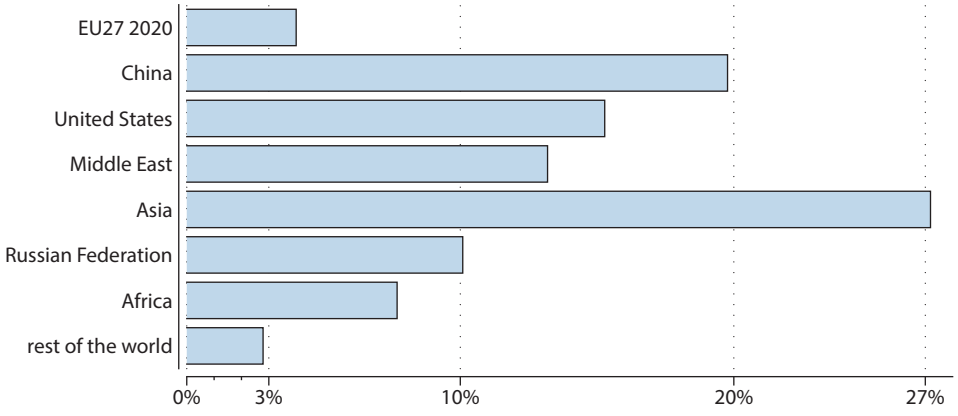

Figure 6. Global energy production

Data source: (*EU Energy in Figures. Statistical...* 2022).

In addition, the profits from the sale of oil corrupt and strengthen the authoritarian rule, and do not translate into the wealth of societies. In this context, attention should be paid to increasing oil and natural gas production in the U.S., caused by the use of extraction technologies that allow for the release of these resources from shale deposits. In the U.S., new shale gas extraction and upscaling technologies have been developed since 2001. Thanks to them, gas molecules trapped in rock formations can now also be extracted (Criekemans 2021). This will boost business activity, giving the industry an additional competitive advantage in the form of cheaper electricity and natural gas, and gradually changing the role of the U.S. in the global energy trade. In 2020, the U.S. became one of the world's largest producers of hydrocarbons. Currently, 30% of the country's energy comes from shale gas, and the U.S. is becoming nearly energy self-sufficient, which is unprecedented compared to most other energy-importing states. The geopolitical consequence is that the U.S. is trying to become a competitor for the Russian Federation in the European natural gas market. This explains why the former U.S. president Donald J. Trump pressured Germany over the Nord Stream II pipeline, which is being built in the Baltic Sea (Criekemans 2021).

3. Supply system

The global supply system presents a challenge for the energy market. According to Jakub Dyczka, the functioning of the critical infrastructure within the following sectors is key to maintaining national energy security:

- gas, oil, and liquid fuels;
- extraction equipment, processing and storage of gas, oil, and liquid fuels;
- power plants; and
- energy transmission and distribution networks that supply electricity, gas, oil, and liquid fuels (Dyczka 2014, 73).

All these sectors can become the target of a wide variety of criminal groups. In the 21st century, terrorists most often attacked infrastructure used for the extraction, processing and storage of gas, oil, and liquid fuels, as well as waterborne transport: maritime, ocean, and energy transmission and distribution networks that supply electricity, gas, oil, and liquid fuels. Terrorist activities that threaten energy security can be divided into two groups: sea-related and land-related (Dyczka 2014, 74).

Transport infrastructure — i.e., pipelines or seaways — is a vulnerable part of the energy market, being an easy target for terrorist attacks, making it increasingly problematic and costly to meet global energy needs. Transport routes very often pass through politically unstable territories, which increases the risk to the supply of resources. Energy security is thus linked to the military aspect of the activities of states (Klare 2008). They are forced to protect energy resources and their transmission routes. Robert Ebel of the Center for Strategic and International Studies (CSIS) stated that "pipelines are very vulnerable targets . . . you don't need sophisticated weapons or great effort to cause physical and psychological damage" (Klare 2008).

The intensification of the threats of terrorism and maritime piracy is a serious risk for land and sea transport of resources, as two-thirds of the world oil trade is conducted by sea, and one-fourth of the world's oil and gas resources is located in the coastal zone of states. The areas of the highest production and highest consumption are separated by enormous distances, which means that energy resources transporting units are exposed to attacks of terrorists to a very significant degree (Dyczka 2014, 74). Energy security is closely connected with shipping security. The major threats include piracy, terrorism, and border conflicts between states. As for shipping, terrorist attacks can take diverse forms:

- bomb attacks in ports or at sea using explosives delivered onto ships,
- hijacking of commercial vessels,
- fire from the shore at vessels maneuvering in coastal areas, or
- actions using mines (Dyczka 2014, 75).

After September 11, 2001, these threats became more common. In 2002, the U.S. Congress passed the Maritime Transportation Security Act of 2002, and the International Maritime Organization issued the International Ship and Port Facility Security Code in the same year. Both documents deal with the problem of maritime terrorism, piracy and other forms of maritime conflicts. In this context, it is very important to secure transport routes for energy resources (Nincic 2009, 31). The so-called bottlenecks through which oil is transported (the Strait of Malacca, the Hormuz, the Bab el-Mandeb, the Suez Canal, the Bosphorus, the Panama Canal) are being attacked by terrorist groups, which for them are the most effective means of jeopardizing Western interests.

Another category is waterways along the coasts of politically unstable states. The territorial waters of Indonesia, Nigeria and Somalia experience the greatest number of piracy acts, very often targeting tankers. Terrorists use various methods to disrupt the maritime oil and gas transport system:

- operations using high-speed units filled with explosives;
- use of onboard armaments: fast motor boats, commercial vessels adopted ad hoc, aircraft, submarines;
- seizure of vessels: criminals can demand a ransom for the return of the cargo or make political demands;

- use of sea mines; or
- use of combat divers (Dyczka 2014, 80).

The consequences of such attacks include the following:

- increase in raw material prices in the world market (economic costs — increase in transport costs)
- environmental disaster — social impact: oil contamination
- costs of providing security to individuals
- fulfillment of terrorist objectives: political destabilization, meeting specific demands

Piracy is an illegal act of rape, detention, or looting committed for private ends by the crew or passengers of a private ship or aircraft (Dyczka 2014, 80).[4] Any act of piracy is also an act of terrorism, but terrorists can use methods characteristic of pirates to achieve their political aims. What distinguishes pirates from terrorists is that the former are motivated by profit. Also, pirates often want to remain anonymous and avoid publicity.

Energy terrorism is not only related to armed attacks on energy infrastructure. This phenomenon also involves the theft of resources and the threat of an attack on infrastructure if a company or state does not financially support a given criminal group. Regardless of the definition of energy terrorism that we adopt, it is undoubtedly an activity that causes enormous financial losses. The protection of energy infrastructure — i.e., refineries, tankers, and pipelines, accounts for a large part of the financial expenditure of both states and corporations (Koknar 2009, 18).

The technical condition of the infrastructure also poses a serious problem. For example, Russian installations leak as much oil every day as during the Exxon Valdez disaster in Alaska in 1989. Thousands of kilometers of rusty and damaged pipelines can also be found in Canada and the U.S. The cause of the 2010 breakdown and disaster in the Gulf of Mexico was a faulty device used for emergency shutdown of a borehole. This is one of the effects of oil exploration in increasingly inaccessible locations (Dublaga 2014, 69). Digital technologies are now being used to control the entire global energy production and distribution sector. One consequence of this is increased susceptibility to cyber attacks. This state of affairs seems to be particularly dangerous in the context of the protection of this strategic sector, which is one of the key elements of the critical infrastructure of the state (Saramak 2014, 147). In the last few years, critical infrastructure has become the prime target of perpetrators of cyber attacks: from government mercenaries, to political hacktivists and cybercriminals, to well-organized cybergangs. The attack on the Ukrainian energy network on December 23, 2015 is considered to have been the first known successful cyber attack on electricity networks. Hackers successfully broke into the computer systems of three Ukrainian distribution companies and temporarily disrupted the electricity supply to consumers. Tens of thousands of people were left without electricity. This attack was a complex operation, elaborated in the smallest detail, with consequences in the physical world as well. It was undertaken by a group of exceptionally talented hackers who spent many months planning their attack: they began by identifying electrical grids and the data of their operators, and finally launched a rehearsed, coordinated offensive. According to many analysts, the incident in Ukraine was only a rehearsal before the real attack. The cyber attack consisted of the following stages: an early breach of the plants' security networks using e-mail messages containing malicious software; taking control of the system and remote disconnection of power substations; blocking infrastructure elements; destruction of files stored on the servers; an attack blocking the operation of the call center; depriving energy consumers of up-to-date information on the situation. Electric grids are closely interconnected, and a breach of their security may have a cascading effect on other sectors of the economy. Single operator problems can have cross-border implications. Cyber security involves the principle of the weakest link, according to which the resilience of interconnected systems is determined by their weakest element.

4. Politics

A serious threat to international energy security is the fact that the resource potential may become an instrument of the foreign policies of producer states. Such a situation took place in the 1970s,

4. See also: United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982, https://treaties.un.org/doc/Publication/MTDSG/Volume%20II/Chapter%20XXI/XXI-6.en.pdf.

when the embargo imposed on oil by Arab states on states supporting Israel caused fluctuations in the energy market and a sharp increase in oil prices (Pronińska 2006, 395). The so-called "oil shock" was a breakthrough in understanding energy security. The Western states reacted by establishing the International Energy Agency in 1974. The subsequent oil crises of the 1980s and 1990s were caused by the turmoil on the fuel market due to the Iranian revolution and the suspension of oil exports from Iran, the war in the Persian Gulf, and the constant fuel consumption growth and uncertainty as to the future supplies of resources. These events resulted in the limitation of oil supplies to global markets (Bielecki 2002, 242).

Russia also treats its energy policy as an instrument of its foreign policy. It perceives the energy-rich Central Asian and Caucasus region as its exclusive sphere of influence, both economically and politically. Russia's activity in this region clearly limits its integration with the global energy market (Cohen 2009, 119). Russia maintains its troops here and influences the decisions of the ruling elite in the newly created post-Soviet states. In 2008, Russia invaded Georgia to defend the autonomous regions of Abkhazia and South Ossetia (Stokes and Raphael 2010, 112). The main reason for the operation in Georgia, however, was Russia's desire to control the routes of the transport of resources from the Caspian and Black Sea regions (Nichol 2014). The background to the current conflict in Ukraine is also related to energy. Russia's goal was to undermine the credibility of Ukraine as a transit state for resources to Europe, cut the country off from Russian gas resources and even from its own coal resources in the Donetsk region.

As stated by M. Pietraś, it is fully justified to "politicize" energy security, because "energy carriers have become an instrument for achieving political goals, exerting influence in international relations, the object of political decisions at the highest level, and not just economic transactions . . . They can change the geopolitical significance of regions in international relations" (Pietraś 2017).

5. Economic conditions

The economic dimension of energy security is primarily identified with the functioning of the market for energy resources. Until 1973, this market was governed by the law of supply and demand. After 1973, for many years, OPEC member states dictated the price of kerosene oil (Pietraś 2017). Regulatory action has also been taken by Western countries. Deregulation of the energy commodity market has contributed to a number of problems, and the fluctuation of energy commodity prices, market failure, and the involvement of states in regulatory activities have become a challenge for many countries (Harris 2003, 158). The energy sector directly influences the efficiency and competitiveness of the state economy. The economic dimension of security energy is mainly connected with the cost of energy and continuity of supplies. Energy is a specific product, as it must be available on a continuous basis, even at times of political or economic crises (Gradziuk et al. 2003, 76). Lack of liquidity in energy supply entails high costs for the entire national economy. Therefore, the energy sector plays a fundamental role in shaping the efficiency and competitiveness of the economy and has a direct as well as an indirect impact on the quality of citizens' lives. Consequently, energy resources are treated as a strategic product.

Contemporary analyses of the international energy market indicate numerous problems resulting from instability in the world economy caused by the crisis. According to a 2008 report by the IEA, the world's energy system is at a crossroads. Today's global energy supply and consumption trends are completely unsustainable in ecological, economic, and social terms. According to the report, these problems had their source in underinvestment in the energy sector with respect to production and transportation. According to a 2010 report, "the global energy industry is facing unprecedented uncertainty. The global economic crisis of 2008–2009 has thrown energy markets around the world into disarray, and the pace at which the global economy recovers will be critical to the development of the energy sector in the coming years" (Pronińska 2011, 261). One consequence of the global crisis was a temporary decline in demand for energy resources. The economic crisis also affected the price of oil, destabilizing it significantly. As a result of falling demand, the energy sector first witnessed a severe drop in oil prices in 2008 (from 145 to 40 dollars per barrel); then the prices of this commodity rose to 110 dollars per barrel in late 2010 (Pronińska 2011, 261). According to data

provided by the IEA, in 2009 investment in the upstream oil and gas sector fell by 19% (Pronińska 2011, 262). Underinvestment in the sector can pose a serious threat to future security of supplies.

The macroeconomic crisis caused by the COVID-19 pandemic represents another watershed moment in terms of energy market stability. It brought a drop of about 6% in global GDP. Demand for energy decreased by 3.8% in the first quarter of 2020.[5] The reduction in demand for oil, caused mainly by the restrictions imposed on people's mobility on the global scale, was the most drastic measure. It caused a drop in oil prices on the global market. The transport industry noted a 50% drop in activity compared to 2019, while activity in the airline industry decreased by up to 60%.[6] The decline in demand for energy observed in the face of the pandemic was the greatest in 70 years (figure 7). The situation remains uncertain and unstable, as there is a prospect of another wave of infections.

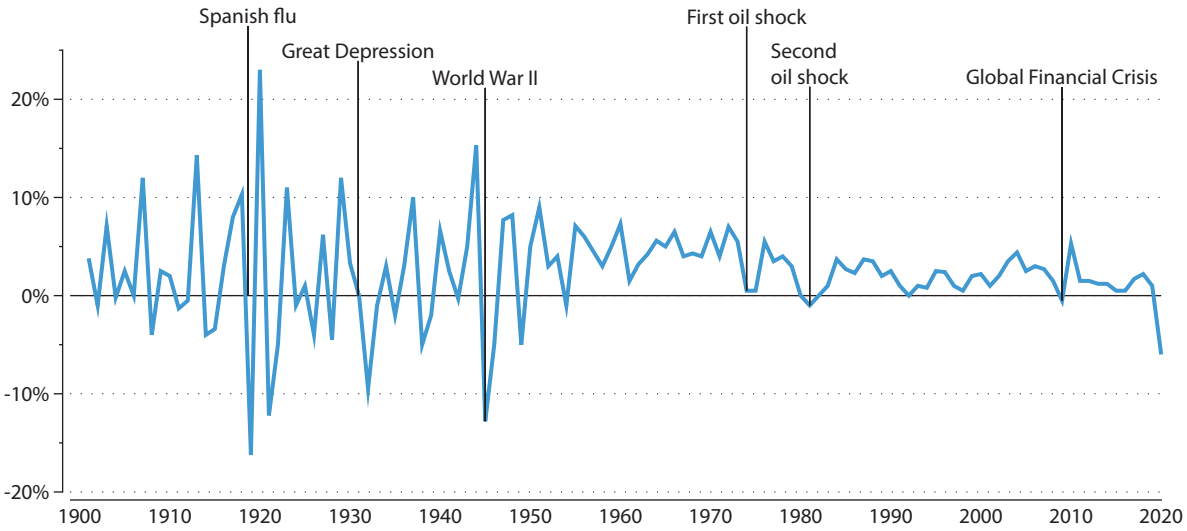

Figure 7. Changes in energy demand (1900–2020)

Data source: "Global Energy Review 2020. The Impacts of the Covid-19 Crisis on Global Energy Demand and CO2 Emissions." International Energy Agency, https://www.iea.org/reports/global-energy-review-2020.

Another turbulence in the international energy market occurred after Russia's invasion of Ukraine on 24 February. In recent months, energy prices have spiked to record highs — most notably in Europe and some major Asian markets — causing potentially significant economic impacts.[7] These include multiple negative effects on energy companies and consumers, in some cases resulting in government interventions to limit the damage. The increases in energy prices have also contributed to broader price inflation that is affecting many economies worldwide.[8] "Nobody is under any illusions anymore. Russia's use of its natural gas resources as an economic and political weapon show Europe needs to act quickly to be ready to face considerable uncertainty over Russian gas supplies next winter," said IEA Executive Director Fatih Birol.[9] Kadri Simson, European Commissioner for Energy, declared that "Reducing our dependence on Russian gas is a strategic imperative for the European Union. . . . But Russia's attack on Ukraine is a watershed moment."[10]

5. See: "Global Energy Review 2020. The Impacts of the Covid-19 Crisis on Global Energy Demand and CO_2 Emissions." International Energy Agency, https://www.iea.org/reports/global-energy-review-2020.

6. Ibid.

7. See: "World Energy Outlook 2022." International Energy Agency, https://iea.blob.core.windows.net/assets/c282400e-00b0-4edf-9a8e-6f2ca6536ec8/WorldEnergyOutlook2022.pdf.

8. Ibid.

9. See: "How Europe Can Cut Natural Gas Imports from Russia Significantly within a Year." IEA Press Release, 2022-03-03, IEA provides 10-Point Plan to European Union for reducing reliance on Russian supplies by over a third while supporting European Green Deal, with emergency options to go further. Accessed 2022-12-28, https://www.iea.org/news/how-europe-can-cut-natural-gas-imports-from-russia-significantly-within-a-year.

10. Ibid.

6 Ecological conditions

Environmental protection under the conditions of a competitive energy market represents another significant challenge for participants in that market. In this context, the exploitation of renewable resources is increasingly becoming an element of energy security strategies developed by countries. It was not until the end of the 20th century that environmental problems emerged as a significant issue in the discourse on energy security. Climate change will be counteracted by reducing greenhouse gas emissions, which, in turn, will be achieved by reducing energy consumption, switching to low-carbon sources, and using energy from renewable sources (Pietraś 2017). This means that there is a feedback loop between environmental security and energy security. The extraction and consumption of energy resources cause environmental pollution. On the other hand, the requirements of environmental security, particularly with regard to combating climate change, stimulate actions supporting energy efficiency, the development of new technologies, and the use of renewable energy (Froggatt and Levi 2009; Pietraś 2017; Sen, Khazanov, and Kishimoto 2011). The main renewable technologies are hydropower, biomass energy, geothermal energy, wind energy, solar energy, wave energy, and ocean thermal energy (Demirbas 2007, 42; Fridleifsson 2001). Renewable resources were the principal sources of energy used by our ancestors. During the last 200 years, industrialized countries have relied mainly on hydrocarbon resources, as industrialization has changed the structure of energy resource consumption in favor of resources such as coal and oil, which generate more energy. The prospect of the abundant availability of these resources was very attractive, while rapid technological advances made their exploitation highly profitable. Meanwhile, renewable technologies could not provide such a rapid productivity growth (Edinger and Kaul 2000).

The greatest environmental threat posed by the exploitation of non-renewable energy resources is the emission of carbon dioxide (CO_2). Nearly 29 billion tons of CO_2 enter the atmosphere each year due to human activity, with 23 billion tons of CO_2 coming from hydrocarbon combustion and industrial activities (Demirbas 2007, 45). CO_2 accounts for 50% of gases responsible for the greenhouse effect (Dincer 2001; Speight 1996). The growth in greenhouse gas concentrations in the atmosphere leads to an increase in the earth's surface temperature. It is important to apply the principles of sustainable development—i.e., linking economic growth to social progress, environmental protection, and the popularization of technology (Demirbas 2007, 79). The use of renewable energy sources is one of the ways of ensuring sustainable development. Investing in such sources reduces the risk of supply shortages but requires the construction of expensive infrastructure with a high initial cost and a long payback period. It also involves seasonal problems associated with the exploitation of wind and solar energy. The government's assistance to industry through the creation

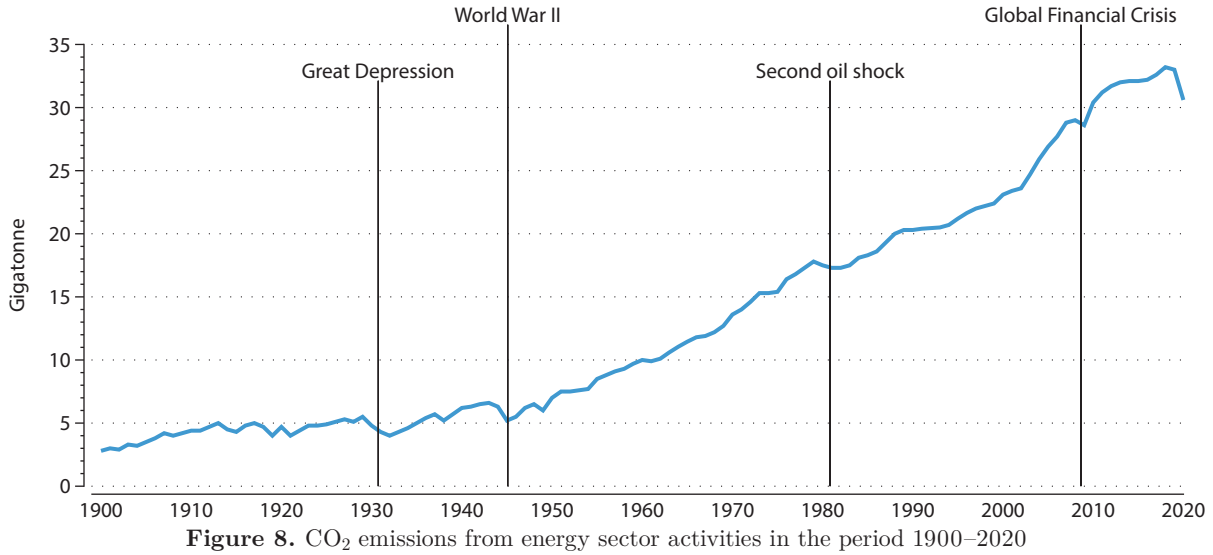

Figure 8. CO_2 emissions from energy sector activities in the period 1900–2020

Data source: "Global Energy Review 2020...", op. cit.

of appropriate legal regulations and supplementation of private investments in research is crucial in this context.

The economic crisis and the reduction in the use of fossil fuels it has caused have resulted in a drop in CO_2 emissions on a global scale. Greenhouse gas emissions in 2020 were 5.0% lower than in the previous year. This was due to an 8.0% decline in emissions from coal mining, 4.5% decline in emissions from oil mining, and 2.3% decline in emissions from gas mining.[11]

Concluding remarks

The above analysis allows us to conclude that the emergence of the issue of energy security at the political level is tantamount to the emergence of the need for new state policy instruments to diagnose and manage the situation in the social sciences. The combination of security and energy creates a new quality for the social sciences. Thus, the science of energy security revolves around energy flow, access to energy, dependencies in the energy market, and the consequences of energy consumption for the climate. We can identify various prerequisites for energy security: the availability of resources, their sufficiency, and the acceptability of particular fuels. The other prerequisites include reserves, output, dependence on imports, political stability, the price of energy, and the sensitivity of particular sectors to changes in the price or supply of raw materials. The analysis allows us to conclude that the combination of security and energy creates a new quality for the social sciences and international relations. Energy security is a dynamic phenomenon. Its definition depends on the specific character of the security policy actors and relations on the international energy market. Access to energy resources is an existential need not only for all states but also for non-sovereign actors, such as multinational corporations.

The study verified the research hypothesis that the evolution of energy security and the prospects for its development largely result from the relations on the global energy market. In this context, we are dealing with high dynamics of the energy market development, which undoubtedly influences the understanding of the concept of energy security. Satisfying the needs of producers and consumers is an enormous challenge for the global energy market due to the fact that the global demand for energy has risen significantly since the 1970s. Thus, under the conditions of the continuous growth in energy consumption on the one hand and the politicization of energy security on the other, it has become an indispensable condition of social life and economic development, as well as an increasingly important factor in national and international security (Flaherty and Filho 2013, 13). Each energy crisis has echoes of the past, and the acute strains on markets today invite comparison with the most severe energy disruptions in modern energy history, but today's global energy crisis is significantly deeper and more complex than those that came before. "The global energy crisis sparked by Russia's invasion of Ukraine is having far-reaching implications for households, businesses and entire economies, prompting short-term responses from governments as well as a deeper debate about the ways to reduce the risk of future disruptions and promote energy security".[12] There is a great deal of uncertainty about how the energy crisis will evolve and for how long fossil fuel prices will remain high, the risks of further energy disruption and geopolitical fragmentation being great. According to the IEA, "The world has not been investing enough in energy in recent years, a fact that left the energy system much more vulnerable to the sort of shocks seen in 2022."[13]

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11. See: "Global Energy Review 2020...," op. cit.
12. See: "World Energy Outlook 2022." op. cit.
13. Ibid.

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