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ALEKSANDRA GAWLIKOWSKA-FYK
Forum Energii
aleksandra.gawlikowska-fyk@forum-energii.eu
BOGUMIŁA MUCHA-LESZKO
Akademia Nauk Stosowanych Wincentego Pola w Lublinie
ORCID: 0000-0002-1288-4662
mucha@hektor.umcs.lublin.pl

Major energy producers, exporters and importers–transition to renewables sources and diversification of suppliers in 2000–2019

Główni producenci, eksporterzy i importerzy energii – przejście na źródła odnawialne i dywersyfikacja dostawców w latach 2000–2019

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Artykuł składa się z dwóch zasadniczych części: teoretycznej i empirycznej. W pierwszej z nich przedstawiono opinie autorów reprezentujących Międzynarodową Ekonomię Polityczną, którzy poddają w wątpliwość założenie, że transformacja sektora energetycznego może opierać się tylko na mechanizmie rynkowym. Uzasadniają, że najkorzystniejsze warunki do przeprowadzania zmian strukturalnych idących w kierunku stopniowego ograniczania paliw kopalnych i zwiększania udziału źródeł alternatywnych w produkcji energii istnieją w krajach demokratycznych, w których państwo realizuje funkcje społeczno-ekonomiczne i zaangażuje się w promowanie czystych technologii w sektorze energii. Analiza empiryczna zawiera ocenę zaawansowania zmian strukturalnych w produkcji energii wymiarze globalnym i w grupie 15 największych producentów według udziału wykorzystywanych surowców w latach 2000–2019. Badaniem zostały objęte również zmiany w strukturze podmiotowej i przedmiotowej eksportu i importu surowców energetycznych. Z analizy wynika, że dywersyfikacja źródeł energii postępowała, ale dotyczyła głównie udziału w jej produkcji węgla, ropy i gazu. Negatywnym zjawiskiem był wzrost udziału węgla w produkcji energii w gospodarce globalnej z 22,8 do 27,1%. Przyczyniły się do tego: Chiny, Australia, Indonezja, Indie i Rosja. W UE wyniki transformacji sektora energii, na tle innych krajów, były wyjątkowo dobre. Udział surowców odnawialnych w produkcji energii wzrósł z 11,0 do 33,4%.

Autorki odnosząc się do wpływu transformacji sektora energii i zmian na rynkach energii na globalny układ sił gospodarczych uznały, że kopalne zasoby surowcowe, które są skoncentrowane w niewielkiej grupie krajów dają im duże możliwości bezpośredniego oddziaływania na kształtowanie ich cen światowych, na sytuację na innych rynkach i ogólną sytuację w gospodarce globalnej w skutek transmisji inflacji, wahań kursów walutowych i nierównowagi w bilansach płatniczych. W latach 2000–2019 swoją dominację na globalnych rynkach surowców energetycznych umocniła Rosja zwiększając udział w światowym eksporcie z 10 do 12,7%, wobec 9,1% USA, 8,8% UE-28, 7,5% Arabii Saudyjskiej i 6,05% Australii. Ważnymi atutami Rosji jako *energy power* są: dobrze rozwinięta infrastruktura przesyłowa ropy i gazu obejmująca Europę i Azję, mocna monopolistyczna pozycja Gazpromu i innych spółek na rynkach paliw kopalnych i duża zależność UE od importu surowców energetycznych z Rosji. Nowa sytuacja geopolityczna ma zasadniczy wpływ na zmianę priorytetów polityki energetycznej UE i USA oraz krajów uzależnionych od importu surowców z Rosji. Proces transformacji sektora energetycznego może być zdynamizowany, co osłabi pozycję Rosji.

Major energy producers, exporters and importers–transition to renewables sources and diversification of suppliers in 2000–2019

The article consists of two main parts: theoretical and empirical. The first presents the opinions of authors representing International Political Economy who question the assumption that the transformation of the energy sector can be based only on the market mechanism. They justify that the most favourable conditions for carrying out structural changes going in the direction of gradual reduction of fossil fuels and increasing the share of alternative sources in energy production exist in democratic countries where the state performs social-economic functions and engages in the promotion of clean technologies in the energy sector. The empirical analysis assesses the advancement of structural changes in energy production globally and in the group of the 15 largest producers by the share of raw materials used in 2000–2019. The study also includes changes in the subject and object structure of exports and imports of energy raw materials. The analysis shows that diversification of energy sources was progressing, but mainly concerned the share of coal, oil and gas in its production. A negative phenomenon was the increase in the share of coal in energy production in the global economy from 22.8 to 27.1%. Contributing to this were: China, Australia, Indonesia, India and Russia. In the EU, the results of the transformation of the energy sector, compared to other countries, were exceptionally good. The share of renewable raw materials in energy production increased from 11.0 to 33.4%.

Referring to the impact of the energy sector transformation and changes in energy markets on the global balance of economic power, the authors concluded that fossil raw material resources, which are concentrated in a small group of countries, give them great opportunities to directly influence the formation of their world prices, the situation in other markets and the overall situation in the global economy through the transmission of inflation, exchange rate fluctuations and imbalances in the balance of payments. In 2000–2019, Russia strengthened its dominance in global energy commodity markets by increasing its share in world exports from 10 to 12.7%, against 9.1% of the USA, 8.8% of the EU-28, 7.5% of Saudi Arabia and 6.05% of Australia. Russia's important assets as an energy power are its well-developed oil and gas transport infrastructure covering Europe and Asia, the strong monopolistic position of Gazprom and other companies on the fossil fuel markets and the EU's high dependence on imports of energy resources from Russia. The new geopolitical situation has a major impact on changing the priorities of the energy policy of the EU and the US, as well as of the countries dependent on raw material imports from Russia. The process of transformation of the energy sector may be dynamised, which will weaken Russia's position.

Introduction

Energy is the driving force behind economic growth and development. The primary source of energy from the turn of the 20th century to the contemporary economic stage has remained oil. Since the mid-20th century, diversification of energy sources has progressed due to the increasing share of hydro and nuclear power plants in energy production. It should also be noted that energy demand at that time was growing as a result of the development of the private automotive industry and business transport. A new source of growth in energy demand was the increasing demand from households for electric equipment. Energy security and low oil prices were important factors in the dynamic and stable economic growth of the 1950s and 1960s, and the increase in energy production was driven by growing demand from both the production and consumption spheres. The literature highlights the impact of low oil prices on high global economic dynamism until the 1970s.[1] The energy crisis of the 1970s made economists, including economic analysts, political scientists, but also market participants, power elites and the population aware of the possible consequences of rising prices of basic energy commodities (then oil) and a decline in energy security. It took about ten years for a sustained economic recovery and the containment of inflation in Europe and the United States. Studies have shown the danger of high dependence on the dominant energy source and the concentration of its resources in a small number of countries and the price policy of oil monopolies.[2]

The energy shocks, covering two phases of 1973/1974 and 1979, demonstrated the powerful impact of the oil market on the global economy. It provided many examples of the need to diversify energy sources and suppliers. The importance of nuclear power (in France, the US, United Kingdom or Russia) and investment in energy-saving technologies increased substantially. Periodically, oil prices stabilised at a low level from the mid-1980s and did not rise until the mid-1990s, with the exception of 1990, and

1 S. Newton, *The Global Economy 1944–2000: The Limits of Ideology,* Arnold Publishers, London 2004, p. 107.

2 T. Rynarzewski, *Wpływ strategii cenowych wielkich korporacji i krajów OPEC na powstanie kryzysu naftowego,* „Ruch Prawniczy, Ekonomiczny i Socjologiczny" 1982, vol. 44, issue 3, pp. 305–318.

Persian Gulf War. (Cf. figure 1 and description in the text.) Since the late 1990s, oil prices have been rising with a marked deceleration of this trend during the 2001–2003 decline in GDP growth and a sharp decline in 2009, 2015 and 2020 (recession, unconventional production, COVID-19).

In assessing the situation in the energy raw materials market, one cannot ignore the revolutionary structural changes which were initiated at global level in the 1990s in connection with increased energy production and consumption and greenhouse gas emissions resulting in climate change and ecological threats. The scale of these problems increased with the high GDP dynamics in the countries that embarked on the path of intensive industrialisation in the mid-1990s. This group includes: China, India, Indonesia, Iran, Brazil and Nigeria. The largest energy producers and CO_2 emitters are the countries with the largest economies, but those making up the group of highly developed economies have, for the most part, in the last two decades pursued a policy of transforming the energy sector towards decarbonisation and switching to renewable sources. They are also undertaking investments ensuring lower energy consumption in production processes and transport and reducing CO_2 emissions. The European Union has the greatest achievements in this respect. On the other hand, China, India, Indonesia and Iran are posing increasing climate and environmental threats on a global scale.

The aim of the article is to assess structural changes in the energy sector in the global, regional and country dimensions (largest energy producers) on the basis of indicators of share in energy production: traditional raw materials (coal, oil, gas) and nuclear sources, hydro, wind, solar etc. biofuels and waste. The subject of analysis and evaluation is a group of 15 entities, the largest energy producers in 2000, 2018 and 2019. This is a method to illustrate the reduction of the share of coal, oil and gas in favour of the increase in the share of renewables and to present the progress in the diversification of energy sources in the last twenty years before the decline in economic dynamics caused by COVID-19. The authors examined indicators illustrating the share of energy commodities in energy production in the last two years of the adopted time frame (2018 and 2019) to assess the extent to which the marked slowdown in economic growth in 2019 among the top 15 energy producers (excluding Nigeria and the UAE) caused changes in the share of individual commodities in energy production and the share of the largest producers in global energy production.

The transformation of the energy sector directly affects the market of energy raw materials–the subject and geographical structure of exports and imports. In order to show the changes in the studied period 2000–2019, we present indicators of the share of the 15 largest exporters and importers of energy by raw material structure in 2000, 2018 and 2019. We treat the obtained results as a basis for answering the following questions: 1) Is the diversification of energy sources, the decarbonisation process and the increase in the share of renewables in energy production progressing in line with the Kyoto Protocol (1997) and the Paris Agreement (2015) and can they be considered significant? 2) Which countries have the greatest achievements in energy sector transformation and do these results support the hypotheses formulated by International Political Economy theorists regarding the role of the state in this process? 3) Do the transformation of the energy sector and changes in the markets for energy raw materials indicate the possibility of a new balance of power in the global economy? 4) What chances does Russia have to maintain its dominant position in the global energy market in the light of the recent military actions and the policy of aggression?

The paper consists of two main parts: theoretical and empirical. The first part has been prepared on the basis of the theoretical literature, in which the subject is the analysis of the system characteristics of market economies in the aspect of their influence on accelerating or slowing down the transformation process in the energy sector. The second one is the author's evaluation of structural changes in energy production by sources of energy and by countries forming the group of 15 largest energy producers. The basis for the empirical analysis is primary data from the OECD/IEA database, which was used to calculate indicators characterising changes in the share of individual raw materials in energy production and changes in global market shares in the studied group of the largest exporters and importers of raw materials.

1. The main drivers of structural change in the energy sector at the contemporary stage of the global economy

Each technological revolution led to structural changes in national economies and in a broader spatial dimension, depending on the impact of technological progress on the growth of factor mobility on an international

and global scale and depending on the extent of market openness. In this sense, a crucial stage was the 1980s, distinguished by the dynamic internationalization of business activities, which was a direct consequence of the liberalization of economies and the decline in transport costs. The glut of oil in the world market coupled with low oil price policy pursued by Saudi Arabia had a great impact on the development of transport costs in the 1980s. In 1986, the country increased oil production and caused oil prices to fall around $10 per barrel[3]. This was a strategy of eliminating competitors from the market.[4] From the mid-1980s crude oil prices remained at low level with the exception of 1990, when due to the Persian Gulf War oil prices went up again.[5] In the crisis years 1991–1993 oil prices declined; then–in the mid-90s–they rose again, and in 1998 dropped dramatically to $12.7 per barrel.[6]

The rise in oil prices since the second half of the 1990s was a consequence of the increasing demand in dynamically developing Asian countries. Consistently, the drop at the end of the decade was an effect of the financial and economic crisis in Asia (1997–1998) when the countries of this region limited purchases of energy resources.

In the course of a first decade of the 21st century oil prices gradually increased, reaching a level of nearly $100 in 2008. This was driven by the US invasion of Iraq and its consequences. 2009 saw a short-term decline (to $60 per barrel) caused by the economic slowdown, but in 2011 prices surpassed $110. For three years in a raw (2011–2013) they were surprisingly stable.[7] This happened despite supply disruptions of Libya, Nigeria, Venezuela, Iran. The drop in prices which took place in 2013–2016

3 BP, *Statistical Review of World Energy July 2021*, Workbook [online], [accessed: March 2022]: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/xlsx/energy-economics/statistical-review/bp-stats-review-2021-all-data.xlsx>.

4 A. Pach-Gurgul, *Główne determinanty wahań cen ropy naftowej na świecie na przełomie lat 2014/2015*, „Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego", 2016, vol. 30, issue 3, pp. 185–198.

5 BP, *Statistical Review of World Energy July 2021*; S. Kowalik, J. Herczakowska, *Analiza i prognoza cen ropy naftowej na .rynkach międzynarodowych*, „Polityka energetyczna" 2010, vol. 13, issue 2, pp. 1429–6675.

6 BP, *Statistical Review of World Energy July 2021.*

7 D. Yergin, *The New Map: Energy, Climate, and the Clash*, Penguin Press, New York 2020.

was possible because the shortage in the world market was cover with supply of unconventional oil from the United States. The era of BRIC, meaning high demands of rapidly growing economies, began to give way to the era of shale–rapidly increasing supply.[8] In the following years, global economic growth, especially in China, was weaker than expected, which slowed down oil demand. In 2016 prices decreased to $43,7. The price increase that followed was only possible thanks to the "OPEC plus" agreement, i.e. with Russia, to limit production. But in 2020, due to Covid-19 pandemic and resulting economic slowdown, prices dropped to $41,8 per barrel.

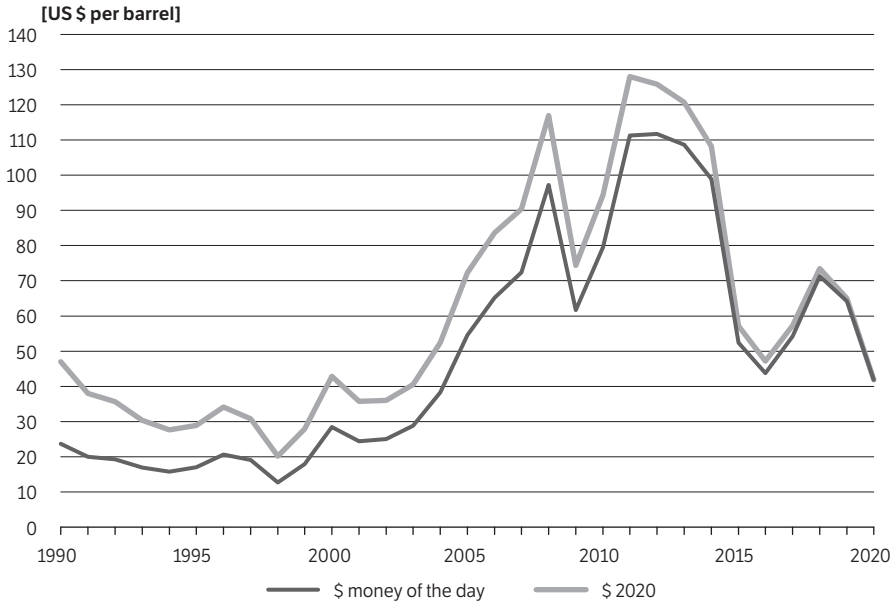

Figure 1. Crude oil prices 1990–2020

Note: Brent data; $2020 (deflated using the Consumer Price Index for the US).

Source: own calculation based on Workbook [online], [accessed: March 2022]: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/xlsx/energy-economics/statistical-review/bp-stats-review-2021-all-data.xlsx>.

If the 1980s created new opportunities for the internationalization of business through the deregulation of economies, the next decade and the following ones in the new century were a period of profound structural changes which were induced by multiple factors. Firstly, technological

8 Ibidem.

progress gave access to new gas and oil reserves, but especially new technologies facilitated a broader use of renewable energy sources, which led to their diversification. Secondly, the industrialization of developing countries and the growth in population contributed to a high increase in the requirement for energy, and countries having the greatest influence on expanding consumption of energy–especially in the 21st century–are: China, India, South Korea and Brazil. Thirdly, the increase in demand, production and consumption of energy does have an impact on the natural environment and it is not only manifested by pollution, but by the more dangerous climate change. Counteracting this process requires cooperation and actions at the global level. In particular greenhouse gas emissions should be limited. Two important documents regarding this issue were signed. The first binding agreement was the Kyoto Protocol (1997), which is signed by 192 countries. However, only the most developed ones (40 countries and the European Union) were committed to reducing emissions.[9] The Paris Agreement (COP21) adopted in December 2015 by 194 states and the European Union is much more important. Its signatories committed to reduce greenhouse gas emissions and achieve carbon neutrality "in the second half of this century".[10] These goals will not be easy to accomplish because respective countries attach different priority to environment security policy and to mitigating climate change. Transformation of the energy sector towards an increase use of renewable energy sources involves reconciling the economic growth objectives with energy security, and environment and climate protection. Generally, more developed countries display more responsibility for the impact of economic activity on the environment, and more efficiently implement the plans of transition to low carbon energy sources. The leader is the European Union promoting green economy, and the country that, among the most developed ones, is the least involved in adapting energy policy to climate challenges is Canada. The country withdrew from the Kyoto Protocol in 2011.

9 United Nations, *A Kyoto Protocol to the United Nations Framework Convention on Climate Change*, Kyoto, 11 December 1997, Entry into force: 16 Feb 2005, No. 30822.

10 Article 4 of the Paris Agreement. *Paris Agreement*, United Nations Framework Convention on Climate Change, [online], 2015 [accessed: March 2022]: <https://unfccc.int/sites/default/files/english_paris_agreement.pdf>.

The largest responsibility for disrupting the Earth's natural balance rests on the main economic centres such as China, the United States and the European Union as well as India, Russia and Japan.

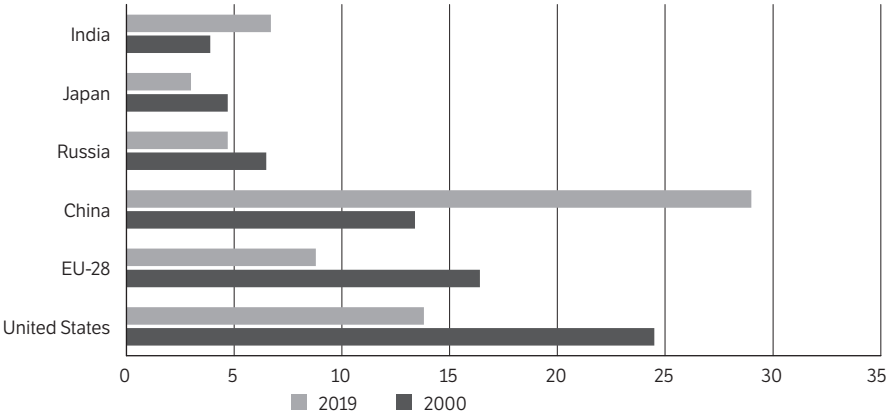

Figure 2. Largest CO_2 emitters in 2000 and 2019 (%)

Note: CO_2 Emissions from fuel combustion only.

Source: own elaboration based on International Energy Agency (IEA), Data and statistics [online, accessed: February 2022]: <https://www.iea.org>.

In 2000 the US ranked as the biggest emitter of CO_2, being responsible for a quarter of global emissions, European Union (EU-28) emitted 16% of CO_2. China ranked at that time as the third emitter. Three other countries with visible share in emissions where Russia (6.5%), Japan (4.7%) and India (3.9%). However, in 2019, while the group of major emitters did not change, their order did. China was the biggest World's emitter of CO_2, accounting for 29% of global emissions. The US ranked second (14%), EU-18 third (9%). India (6.7%) overtook Russia (4.7%) and Japan (3.0%). The increase in emissions, and thus share of global ones, in China and India was due to rapid economic growth and high energy demand. At the same time, the EU and the United States were able to use more and more less emissions fuels.

Fourthly, transformation of energy systems is a key global problem of contemporary development which will have a decisive influence on the economic foundations and safe living conditions of future generations. Fifthly, changes in demand and supply on energy commodities markets, and in particular an increased significance of renewable energy sources, growing competition and diversification of supply markets are highly challenging to all

major producers of crude oil. Thus, the question arises of how the transformation of the energy sector affects the new configuration of powers on the European and global energy markets and what will be the position of Russia in this game. The previous question leads to another one: how can the transformation of the energy sector and diversification of fuel supply markets affect the European Union's trade relations with Russia under the conditions of EU's strong dependence on oil and gas imports from that trade partner? Here, it should be emphasized that despite being very interested in increasing exports of oil and gas to China, Japan and South Korea, Russia cannot afford to regard the EU market less important.[11]

Exporters of conventional energy resources, including Russia, will strive to retain their share in the most important selling markets. The European Union is the largest oil and gas selling market for Russia. A strong position of Russia on the global fuel market is not possible without maintaining acquired shares in regional markets, encompassing European one. Until recently, the European Union was regarded a safe demand area for Russia and keeping hold on a large share is a prerequisite for stable income and revenues to the state budget.[12] The basis of Russia's economic strength are its resources, including–in the first place–energy fuel resources. Russia employs energy policy to accomplish its geopolitical goals[13] and has the largest reserves of crude oil in the world, comparable to those in Saudi Arabia.[14] However, resting on structural features–low level of innovativeness and competitiveness–Russian economy cannot be classified among great economic powers. Yet, it is worth noting

11 H. Simola, *Limited Interdependence in EU-Russia-Trade*, [in:] *Post-Crimea Shift in EU-Russia Relation: From Fostering Interdependence to Managing Vulnerabilities*, eds. K. Raik, A. Racz, International Centre for Defence and Security, Tallin 2018, pp. 138–139.

12 M. Siddi, *The Role of power in EU-Russia Energy relations: The interplay between markets and geopolitics*, „Europe – Asia Studies" 2018, vol. 70, issue 10, pp. 1552–1571.

13 B. Mucha-Leszko, T. Białowąs, *EU-Russia Trade Relations: Interdependence and Geopolitics*, [in:] *The Growth-Oriented Economic Policy of the EU*, eds A. Santagostino, B. M. Vural, Cambridge Scholars Publishing, Newcastle 2020; p. 271.

14 S. Laffaye, F. Lavopa, C. P. Llana, *Changes in the global economic power structure: towards a multipolar world?*, „CEI Argentine Journal of International Economy" 2013, issue 1, pp. 1–21: <http://www.cei.gov.ar/en/changes-global-economic-power-structure-towards-multipolar-world>: [accessed: January 2022].

that–considering this issue in the context of international political economy–realists attach great importance to military power and this criterion allows them to see Russia as a strong power of international relations. The European Union (according to realists) is not a strong actor because it has no military potential of its own.[15] In dealings with external energy suppliers it has exploited so far mainly its normative power.[16]

In contrast to realists/neorealists, liberals/neoliberals prefer economic and regulatory soft power criteria. In the first case, the size and strength of the market and the country's share of global exports and imports are recognized as the basis for a country's position in the global economy.[17] Regulatory influence consists in promoting the idea of economic openness and development of the legal and institutional system that creates the principles of global economic order.[18] Growing global economic interdependence makes the argumentation justifying the strengthening of the global economic system based on multilateral law and institutions grow in importance[19]. Such direction of evolution of international economic order is proposed by representatives of interdependence theory. In this context a question about energy power arises. The answer is simple–Russia has sufficient oil and gas resources to maintain its position as global energy super power. To this end, it invests in in oil and gas pipelines in Europe and Asia aiming to consolidate the energy sector through the development of infrastructure to achieve a dominant position[20]. The pipelines run

15 M. Siddi, *The Role of power in EU-Russia Energy relations.*

16 A. Gawlikowska-Fyk, L. Puka, Z. Nowak, *The EU gas game: Time to redefine the rules? Case studies of Russia and Norway and lessons for the EU, Norway and Poland*, PISM Report, Warsaw 2015.

17 C. Damro, *Market power Europe,* „Journal of European Public Policy" 2012, vol. 19, no. 5, pp. 682–699; S. Meunier, K. Nicolaïdis, *The European Union as a conflicted trade power*, „Journal of European Public Policy" 2006, vol. 13, no. 6, pp. 906–925.

18 I. Manners, *Normative power Europe reconsidered: beyond the crossroads*, „Journal of European Public Policy" 2006, vol. 13, issue 2, pp. 182–199; I. Manners, *Normative power Europe: a contradiction in terms?*, „Journal of Common Market Studies" 2002, vol. 40, issue 2, pp. 235–258.

19 R. O. Keohane, J. S. Nye, *Power and interdependence: World politics in transition*; Little Brown, Boston 1977.

20 A. Hadfield, *EU-Russia energy relations: Aggregation and aggravation*, „Journal of Contemporary European Studies" 2008, vol. 16, issue 2, pp. 231–248.

through transit countries and Russia intends to expand the reach of its exports farther and father. A monopolist in pipeline gas export to Europe is Gazprom. State-controlled energy companies are active on the international arena and gain increasing influence on global markets of energy commodities and, as a result, on international relations[21].

2. The role of the state in the process of transformation of the energy sector in the light of the international political economy theory– literature analysis

As early as the end of the 1980s S. Strange (1988) and Gill and Law (1988) pointed to a need for focusing more on the energy sector in scientific analyses. S. Strange went down in history of International Political Economy (IPE) as the author who underlined the effect of high mobility of oil as a production factor (in comparison to coal) on economic processes. The interest of IPE theoreticians in the role of energy and enormous profits achieved by producers and exporters, especially of crude oil, increased in successive decades. Energy commodities more and more often became strategic resources and the markets showed high sensitivity to changes in demand and supply, what particularly regards oil and gas. The development of the transmission infrastructure not only improved the organisation of commodities supply but also led to an increased dependence of their importers on suppliers. The situation in energy markets had a strong impact on other markets and on the global economy. Energy prices drive the transmission of inflation, fluctuation in exchange rates and the imbalance of payments. From the beginning of the new century problems related to the energy sector have been giving rise to social unrest and require decisive tackling at a global level. However, the existing balance of market and capital forces will not foster the desirable transformation of energy sources. The task of the theoreticians is to present a new conceptualisation for both the expected and already occurring transition in the energy sector. But also to describe roles assigned in such processes to countries, multinational corporations and international institutions,

21 T. Romanowa, *Is Russian Energy Policy Towards the EU Only About Geopolitics? The Case of the Third Liberalisation Package*, „Geopolitics" 2016, vol. 16, no. 4, pp. 857–879.

including to the group of the most developed countries, that is, the G-20. The global dimension of environmental damage and climate change determines the need for global change management.

Energy sector transition entails the creation of a new, sustainable global economic order ensuring the maintenance of ecological and climate security, energy security and fair use and management of global, regional and local common goods.[22] Changes in the energy sphere reach beyond ensuring the generation of electricity from low or zero-carbon sources. They include: shifts in the position of exporters and importers on global and regional energy markets, modifications in the structures of national economies, geopolitical changes, as well as in global and regional interdependence. Globally renowned energy expert, D. Yergin, claims that the existing system of actors and stakeholders deriving profits from an economy based on fossil fuels (states and energy market participants) will not give up their benefits easily.[23] Difficulties in transition to a low-carbon economy do not preclude cooperation between state authorities and energy sector actors. The aim is to establish compromises which will allow them to preserve at least part of the existing structures and adapt the energy system to the new challenges. Mutual links between political authorities, economic actors and capital owners determine the scope of opportunities for the system transition of the energy sector, and in particular its rate. Furthermore, the course of such transformation can differ from country to country due to various pace replacing fossil fuels with other energy sources.

What can the state do? At the current stage of development, the role of the state is primarily to support sustainable development, promote research and innovation activities to accelerate the development of low-carbon technologies, prepare restructuring plans for the energy sector, organise cooperation to help implement such plans, and obtain financing for the development of clean technologies and increase in the share

22 P. Newell, *Transformismo or transformation? The global political economy of energy transitions*, „Review of International Political Economy" 2019, vol. 26, issue 1, pp. 25–48; Heinrich Böll Foundation, *Research for and on the "Great Transformation"*, Heinrich Böll Foundation, Berlin 2013.

23 D. Yergin, *The prize: The epic quest for oil, money and power*, Simon & Schuster, London 2008; P. Newell, M. Paterson, *Climate for business: Global warming, the State and capital*, „Review of International Political Economy" 1998, vol. 5, issue 4, pp. 679–704.

of RES (renewable energy sources). This promoting and supporting role of the state is incorporated in the broader interpretation of the functions of the state as underlined by theoreticians: creating a climate to foster business development, selective industrialisation, diffusion of knowledge, structural transformations, organising and coordinating public-private partnerships, especially in the area of joint research as a prerequisite for knowledge spill over.[24] "The role of the state is also enabling the creation and diffusion of knowledge, because the markets on their own are not effective enough in that function".[25] After presenting areas and forms of activity that states can undertake at the current stage of development, another question appears: what determines the activity of the state and what guides its priority choices in social and economic policy? There are many factors behind it, the most important being: system models defining the ideological foundations and the method of exercising power, the role of the state in the economy, including the share of public property, the state-market relationship, the scope and level of welfare state policy, the role of social dialogue, and an efficient institutional and regulatory system. All the features are important for effective transformation of the energy sector. With reference to the responsibility of the state for putting the economy on the path of development based on clean and climate-friendly technologies attention should be paid to the need for choosing between companies and technologies and gaining social acceptance of the transformation concept that also compensates and rewards potential losers.[26] Highly developed countries with a solid regulatory and institutional framework of governance and operation of the state and capital resources are more efficient in implementing RES than emerging economies.

L. Lapachelle and M. Paterson claim that differences in political systems and characteristics of socio-economic systems have an influence on the scope and effects of the environment and climate policy.

24 B. Greenwald, J. E. Stiglitz, *Industrial policies, the creation of a learning society, and economic development*, [in:] *The Industrial Policy Revolution I*, eds. J. E. Stiglitz, J. Y. Lin, International Economic Association Series, Palgrave Macmillan, London 2013; pp. 43–71.

25 B. Mucha-Leszko, *Causes and consequences of deindustrialization in the Euro area*, „Problems of World Agriculture" 2016, vol. 16, issue 4, pp. 240–252.

26 P. Newell, *Transformismo or transformation?*.

Nevertheless, researchers are not unanimous whether this policy is more efficient under democratic or authoritarian regimes. It seems, however, that the prevailing belief favours democratic governance. Yet, the higher capacity of the parliamentary regime to transform the energy sector through decarbonisation in comparison to the presidential regime is not deemed fully verified.[27] On the whole, the comparative-institutional literature suggests that climate policy performance should be greatest in democratic regimes where policy makers have the necessary incentives (e.g. where they represent a broader set of interests, or are under PR rules) and capabilities (e.g. under parliamentary regimes) to implement stricter mitigation policies.[28] The contemporary market economies can differ in terms of a greater or lesser number of features; hence, it is difficult to determine without ambiguity which of them have the biggest impact on the rate of transformation in the energy sector. The above-mentioned authors employed the following scheme in their analysis: identifying differences between countries in terms of the state–business–civil society relationship and investigating options for implementing the "ecological modernisation" strategy. This analysis made use of a new system typology in the group of OECD countries introduced by P. A. Hall and D. Soskice.[29] They distinguished two types of economies: the liberal market economy and the coordinated market economy–leaving six countries out due to their specific system and structural characteristics (France, Italy, Spain, Portugal, Greece and Turkey). Countries such as: Australia, Ireland, Canada, New Zealand, the United States and United Kingdom are classified as liberal economies. On the other hand, the largest group consists of market economies engaging a certain scope of intervention, that is, coordinated market economies, including: Austria, Belgium, Denmark, Finland, the Netherlands, Iceland, Japan, Germany, Norway, Switzerland and Sweden. Surveys show that liberal regulated economies have more options to prepare and implement constructive transformation strategies for the energy sector as they have better developed communication and

27 L. Lapachelle, M. Paterson, *Drivers of national climate policy*, „Climate Policy" 2013, vol. 13, issue 5, pp. 547–571.

28 Ibidem.

29 *Varieties of capitalism*, eds. P. A. Hall, D. Soskice, Oxford University Press, Oxford 2001, pp. 19–68.

collaboration with business and attach more importance to social dialogue. To reduce GHG (greenhouse gas) emissions and increase the significance of renewable energy sources they employ mainly the following instruments: regulations and standards, economic incentives, carbon pricing, voluntary agreements and research and development (R&D).[30] Germany and Sweden have the most ambitious plans to achieve environmental and climate sustainability and differ in this respect from the USA and Canada (LMEs–liberal economies) in which, like in other countries from that group, energy policy is based on market mechanisms. There are also other countries whose policies focus on stimulating economic growth and– to a lesser extent–mitigating the consequences of the greenhouse effect (the emerging economies).

Local government authorities are also involved in the discussion on the role of the state in the transformation of the energy sector through reducing greenhouse gas emissions, decreasing energy consumption, giving up coal as an energy source and substituting it with renewable sources. Their role is to a large extent related to the scope of powers delegated to local authorities according to the Constitution. Countries differ in this regard, because if some of them are federations, regions enjoy a lot of autonomy. In the EU this type of regime is can be found in: Germany, Austria, Belgium and Spain, where power and public finance are decentralised through regions and within regions to lower levels. In states other than federations a trend of decentralising power and increasing the importance of local governments can be observed. In terms of the possibility of engaging local authorities in improving the efficiency and cleanliness of the energy sector, funds at their disposal will be of great significance. The debate developed by representatives of international economic policy puts emphasis on multiple factors determining the position and impact of local governments on changes in energy policy and development of local energy supply systems. Firstly, the mindset, political debate and approach to sustainable energy policy and its strategy are substantially influenced by: neoliberal institutionalism and the centralised nature of energy systems, including materials factors,

30 L. Lapachelle, M. Paterson, *Drivers of national climate policy*.

ideas and interests.[31] Secondly, revolutionary changes lead to resistance from the existing coal and oil organisations. Thirdly, the activity of local authorities increased in the 1990s[32] in response to intensive economic globalisation[33]. Fourthly, in the first decade of the 21st century the subject of discussion in literature was multi-level governance and – in practice – initiatives were taken up in regions and cities which testified to the involvement of local authorities in implementing national and local projects to mitigate climate change and reduce carbon dioxide emissions (Germany, Spain, Sweden, Slovenia, and China). Fifthly, sustainable energy policy comprises: objective setting, production policy and energy utilisation and demand. Thousands of regions, cities and smaller localities all over the world have already set objectives leading towards sustainable energy through developing low-carbon production and using renewable sources. Renewable energy (mainly, solar and wind power) offers a wide range of options to supply clean and cost-effective energy to towns and villages and to small and medium-sized businesses[34]. Local authorities can play a significant role in the electrification of the energy system. Sixthly, neoliberal reforms, including reforms of municipal services, weakened the municipal energy sector and strengthened the market position of national and international energy corporations. New technologies, and the local nature of RES, can contribute to changes on the local service markets and return of the municipal service providers.

The conceptualisation of energy and energy policy at the stage of sector transition towards RES along with discussion in literature set an empirical analysis framework defined by different schools of thought. Considering an issue in terms of IPE theory it is noticeable that neoliberal institutionalism and neorealism are the most useful approaches

31 P. A. Hall, *Policy paradigms, social learning, and the state: The case of economic policymaking in Britain*, „Comparative Politics" 1993, vol. 25, no. 3, pp. 275–296.

32 H. Bulkeley, *Cities and the governing of climate change*, „Annual Review of Environment and Resources" 2010, vol. 35, no. 1, pp. 229–253.

33 J. N., Pieterse, *Globalisation and emancipation: From local empowerment to global reform*, „New Political Economy", 1997, vol. 2, no. 1, pp. 79–92.

34 C. Kuzemko, *Re-scaling IPE: local government, sustainable energy and change*, „Review of International Political Economy" 2019, vol. 26, no. 1, pp. 80–103.

to solving international problems and achieving compromises[35]. The first prefers open energy markets legitimised by the existence of international institutions and global governance. Liberals defend the view that markets are always efficient. By contrast, realists assume that energy resources are limited and states must compete for them. Thus, they rely on policies oriented at ensuring energy security and markets control by state-owned energy enterprises. The authors find the recent recommendations of theoreticians very interesting and constructive, namely that – given the high dynamics of global energy markets – the mindsets of both neoliberals and neorealists can constitute valuable contributions to the analysis of global energy transition[36].

3. Major producers, exporters and importers of energy commodities in 2000–2019

The most important factors influencing the increase in energy production include: economic growth, introduction of energy-saving technologies, population growth and structural changes in economies, including those relating to energy sources. In the first two decades of the 21st century, the increase in energy demand and production was mainly influenced by high economic growth in the group of developing countries that pursued a policy of intensive industrialisation (emerging economies). In contrast, highly developed countries have introduced energy-saving technologies, decarbonised their economies and supported projects aimed at increasing the importance of renewable energy sources. New energy technologies introduced in the European Union affect the structure of demand for fuels and lead to structural changes in the energy sector and in the structure of fuel exports and imports both in regional and global dimension.

In Table 1, we present figures illustrating changes in the structure of energy production by source globally and in the group of the 15 largest energy producers in 2000, 2018 and 2019.

35 T. Młynarski, *Bezpieczeństwo energetyczne i ochrona klimatu w drugiej dekadzie XXI wieku*, Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków 2017, pp. 19–30.

36 A. Goldthau, N. Sitter, *Horses for courses. The roles of IPE and Global Public Policy is global energy research*, „Policy and Society" 2020, pp. 1–17.

Table 1. Largest energy producers in 2000, 2018 and 2019: energy production structure by countries and by sources.

Energy production structure by countries/ groups of countries (in %)		Energy production structure by sources (in %)							Total energy production (in PJ)
		Coal	Crude oil	Natural gas	Nuclear	Hydro	Wind, solar etc.	Biofuels and waste	
2000									
World	100.0	22.8	37.1	20.6	6.8	2.2	0.6	9.9	418658
US	16.7	32.2	21.9	26.8	12.5	1.3	0.9	4.4	69771
China	11.2	63.5	14.5	2.0	0.4	1.7	0.2	17.6	47045
Russia	9.8	13.1	33.0	48.1	3.5	1.4	0.0	0.7	40952
EU-28	9.5	22.6	18.4	22.1	25.9	3.2	0.8	7.0	39825
Saudi Arabia	4.8	0.0	93.5	6.5	0.0	0.0	0.0	0.0	19922
Canada	3.7	9.2	34.3	39.6	5.1	8.2	0.0	3.7	15696
India	3.3	39.9	11.4	7.0	1.3	2.0	0.1	38.4	13721
United Kingdom	2.7	6.8	48.3	35.8	8.1	0.2	0.0	0.7	11409
Iran	2.5	0.3	79.9	19.7	0.0	0.1	0.0	0.1	10620
Indonesia	2.4	19.1	30.1	25.8	0.0	0.4	3.5	21.1	9944
Australia	2.3	70.5	14.5	12.2	0.0	0.6	0.0	2.2	9779
Mexico	2.3	2.5	74.7	14.6	0.9	1.2	2.2	3.9	9601
Norway	2.3	0.2	73.6	20.3	0.0	5.3	0.0	0.6	9547
Venezuela	2.2	2.6	84.6	10.0	0.0	2.5	0.0	0.3	9182
Nigeria	2.0	0.0	59.4	5.1	0.0	0.2	0.0	35.2	8287
UAE	1.6	0.0	80.4	19.6	0.0	0.0	0.0	0.0	6582
2018									
World	100.0	27.1	31.6	22.7	4.9	2.5	2.0	9.2	605149
China	17.9	72.7	7.3	5.2	3.0	4.0	3.3	4.6	108604
USA	14.9	17.1	31.8	32.6	10.2	1.2	2.0	5.1	90346
Russia	10.3	16.2	37.6	40.9	3.6	1.1	0.0	0.6	62138
EU-28	5.2	16.8	10.3	12.5	28.7	4.0	7.3	20.2	31440
Saudi Arabia	4.6	0.0	88.1	11.9	0.0	0.0	0.0	0.0	27858
India	4.0	49.8	6.9	4.7	1.7	2.3	1.7	32.9	24154

Energy production structure by countries/ groups of countries (in %)		Energy production structure by sources (in %)							Total energy production (in PJ)
		Coal	Crude oil	Natural gas	Nuclear	Hydro	Wind, solar etc.	Biofuels and waste	
Canada	3.7	5.4	49.7	30.7	4.9	6.2	0.6	2.5	22514
Indonesia	3.1	63.8	8.7	13.9	0.0	0.4	5.3	7.8	18887
Australia	2.9	69.7	3.5	24.5	0.0	0.3	0.6	1.3	17266
Iran	2.8	0.3	51.6	47.1	0.5	0.3	0.0	0.1	17123
Brazil	2.1	0.7	46.5	7.5	1.4	11.3	1.8	30.8	12418
Nigeria	1.7	0.0	38.8	14.8	0.0	0.2	0.0	46.2	10536
Iraq	1.7	0.0	95.9	4.0	0.0	0.1	0.0	0.0	10109
UAE	1.6	0.0	82.9	17.0	0.0	0.0	0.1	0.0	9549
Qatar	1.5	0.0	33.9	66.1	0.0	0.0	0.0	0.0	9339
Norway	1.4	0.0	41.4	51.8	0.0	5.8	0.2	07	8634
2019									
World	100,0	27.1	30.8	23.3	4.9	2.5	2.2	9.2	617338
China	18,4	72.0	7.0	5.4	3.3	4.0	3.5	4.7	113848
US	15,7	15.0	33.0	34.6	9.5	1.1	2.0	4.8	96706
Russia	10,4	16.5	36.8	41.3	3.6	1.1	0.0	0.7	64056
EU-28	4,9	14.7	10.5	11.8	29.4	3.8	8.3	21.3	30543
Saudi Arabia	4,3	0.0	87.5	12.5	0.0	0.0	0.0	0.0	26796
India	3,9	49.6	6.5	4.4	2.1	2.6	2.0	32.9	24290
Canada	3,6	5.4	50.9	29.6	4.9	6.1	0.6	2.6	22424
Indonesia	3,2	66.8	8.3	12.4	0.0	0.4	5.2	7.1	19695
Australia	3,0	67.6	3.7	26.5	0.0	0.3	0.7	1.1	18623
Iran	2,4	0.3	42.6	56.0	0.5	0.4	0.0	0.1	14718
Brazil	2,1	0.7	47.5	7.4	1.3	11.0	2.0	30.0	13059
Nigeria	1,8	0.0	39.7	14.6	0.0	0.2	0.0	45.5	10830
Iraq	1,7	0.0	95.9	4.0	0.0	0.1	0.0	0.0	10428
UAE	1,6	0.0	81.1	18.8	0.0	0.0	0.2	0.0	9945
Qatar	1,5	0.0	33.6	66.4	0.0	0.0	0.0	0.0	9406
Norway	1,3	0.0	41.4	51.9	0.0	5.6	0.2	0.8	8142

Note: heat–insignificant values.

Source: own compilation based on: International Energy Agency, Data and statistics [online, accessed: February 2022]: <https://www.iea.org>.

The global energy production volume increased by 44.5% in 2000–2018 and by 47.5% in 2000–2019. The highest rise was recorded in China–amounting to 130.8% (2000–2018) and to 142% (2000–2019). Within the group of major energy producers, high production growth between 2000 and 2019 was also achieved by Indonesia 98.1%, India 77.0% and Russia 56.4%. It should be noted, however, that if globally the increase in energy production in 2019 compared to 2018 was significant, several countries saw their production decline or it remained almost unchanged. However, the large reduction in the volume of energy production in the EU-28 should be noted first, in 2018 it represented 78.9% of the 2000 production level and in 2019 76.7%. The group of countries where energy production in 2019 was lower than 2018 was formed by: Iran, Saudi Arabia, Norway and Canada. The output of these countries is mainly impacted by the external demand. A slight increase in 2019 over the previous year was recorded in India 0.5%. An important factor influencing the level of energy production is GDP dynamics. There was a marked slow down in 2019 compared to 2018. While global GDP grew by 2.8% year-on-year in 2019, in 2018 growth was 3.6%. For the entire preceding decade, the rate had not fallen below the 3% level.[37]

The data presented in Table 1 shows that there have been significant changes in the top 15 global energy producers between 2000 and 2019. Although the top 5 energy producers remained unchanged, the US dropped to the second position after China, thus swapping places. In 2019 top 5 energy producers were as follows: China, the US, Russia, EU-28 and Saudi Arabia. China's share of global energy production increased from 11.2 (2000) to 17.9 (2018) and 18.4% (2019). The US share decreased by 1.8 percentage points in 2018, but increased to 15.7% in 2019. Russia maintained its third position in the top 5 with a slight increase in share from 9.8 (2000) to 10.4% (2019). The major changes in the top 15 energy producers in the first two decades of the 21st century were the large reduction in the EU-28's share of world energy production from 9.5 (2000) to 4.9% (2019) and the promotion to the top 10 of Brazil and the top 15 of Iraq and Qatar. Eliminated from top 15 were: United Kingdom, Mexico

37 International Monetary Fund (IMF), Datamapper [online], 2022, [accessed: March 2022]: <https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD?year=2022>.

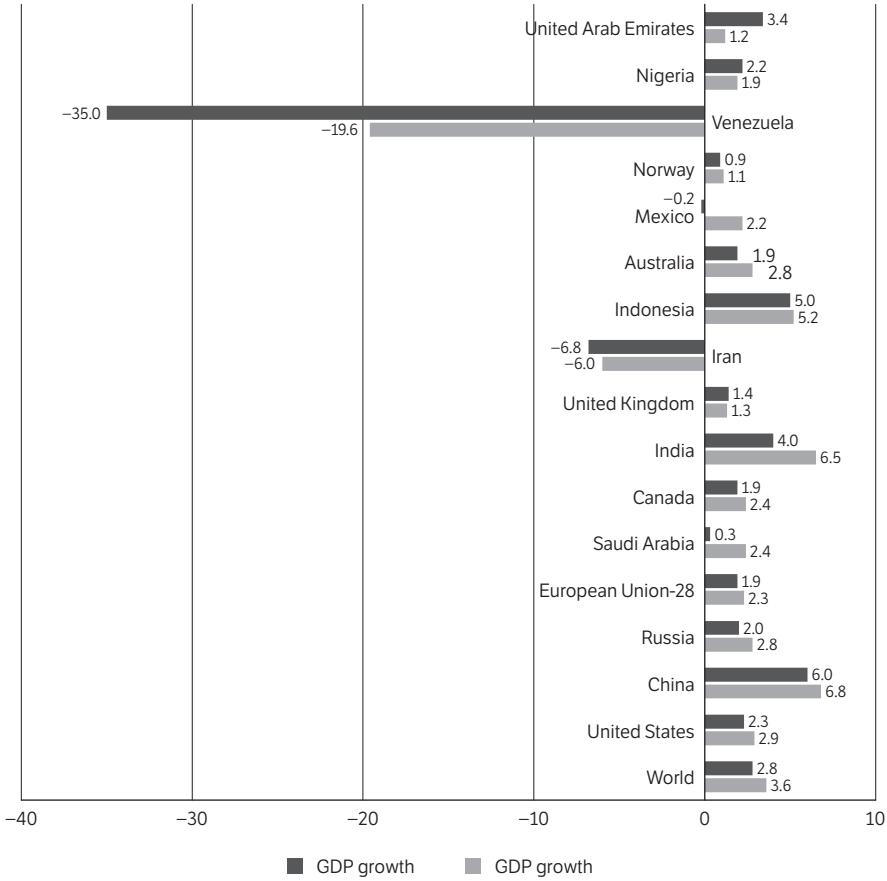

Figure 3. Annual average growth of real GDP of major energy producers in 2018–2019 (in %)

Note: the largest energy produces ranked according to the size of their energy production in 2019.

Source: own elaboration and calculations based on: International Monetary Fund (IMF), Datamapper [online], 2022, [accessed: March 2022]: <https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD?year=2022>.

and Venezuela. Nevertheless, over the past two decades, the world's largest energy producers have invariably been China, the US, Russia, the EU, Saudi Arabia, India and Canada. It is worth remembering, however, that this balance of power is based on the dominance of traditional energy resources. The war in Ukraine is forcing an energy policy that ensures the energy security of countries interested in putting an end to the tragedy in Ukraine as soon as possible, due to their dependence on gas and oil imports from Russia. This entails speeding up the transformation of the energy sector towards a decisive increase in the proportion

of renewable sources, all the more so because, during the period under review, the process of structural change towards renewable energy sources did not bring the expected results.

Averaged global indicators of energy production structure by sources in 2000 and 2019 do not lead to positive conclusions–the share of coal as source of energy increased, the share of crude oil decreased, the share of natural gas insignificantly went up. The role of nuclear energy declined. As for RES, water, wind as well as solar energy rose, but biofuels & waste energy fell. Countries responsible for augmenting the share of coal as a source of energy are China, Australia, Indonesia, India and Russia. Still, positive structural changes are clearly visible in some regions and countries–the European Union and the United States. The share of coal in the energy production dropped: in the US from 32.2 (2000) to 15.0% (2019), and in the EU from 22.6 to 14.7%. Nevertheless, in the US–in the group of other conventional commodities–the share of crude oil rose from 21.9 to 33.0% and that of natural gas from 26.8 to 34.6%, while the share of nuclear power declined from 12.5 to 9.5%. In the EU-28 changes in the group of other conventional commodities were different than in the US: the share of crude oil dropped from 18.4 to 10.5% and that of natural gas from 22.1 to 11.8%, while the share of nuclear power increased from 25.9 to 29.4%.

In the transformation of energy sector the transition to renewable energy sources is deemed the most important. In the period 2000–2019 such changes varied strongly between regions and countries. An unquestionable leader in utilizing renewables to generate energy is the European Union in which their share increased from 11.0 to 33.4%[38] in analyzed period. The United States have a low share of renewables in the energy production structure (6.6–7.9%). Nigeria had the greatest achievements in the use of renewable resources–an increase in the share from 35.4 to 45.7%, however only in biofuels and waste category. Brazil should also be recognized for its renewable and waste share, which amounted to 43.0% in 2019. Also, India had notable results in energy sector transformation. Its share of renewable and waste was 40.5% in 2000. Despite a drop of their share to 37.5% in 2019, in absolute terms RES production went up by 60%.. Unfortunately, China and Indonesia have relatively low

38 The share of RES calculated as the sum of the following columns of table 1: hydro, wind, solar, etc. and biofuels and waste.

shares of renewable sources in energy production of 12.2% and 12.7% (2019), which have fallen compared to 2000. To sum up, changes in the structure of energy sources towards increasing the significance of renewables are noticeable but they are clearly concentrated in Europe and in some countries of the worlds.

What remains to be answered is the impact of the transformation of the energy sector on fuel markets. The table 2 provides data on 15 largest exporters of energy raw materials and electricity.

Table 2. Largest energy exporters in 2000, 2018 and 2019; energy export structure by countries and by sources

Countries/ groups of countries		Energy export structure by sources (in %)						Total energy exports (in PJ)
		Coal	Crude oil	Oil products	Natural gas	Biofuels and waste	Electricity	
2000								
World	100.0	10.8	53.1	20.8	14.1	0.0	1.2	159828
EU-28	11.4	6.4	27.9	49.6	11.2	0,1	4.8	18224
Russia	10.0	6.7	37.9	13.9	40.9	0.0	0.5	16013
Saudi Arabia	9.8	0.0	84.6	15.4	0.0	0.0	0.0	15680
Norway	5.4	0.2	74.0	4.5	20.5	0.0	0.9	8621
Canada	5.2	9.6	39.3	7.5	41.4	0.0	2.2	8364
Venezuela	4.2	3.6	72.3	24.1	0.0	0.0	0.0	6677
Australia	4.0	79.1	12.6	2.3	6.0	0.0	0.0	6428
Iran	3.6	0.0	86.9	13.0	00	0.0	0.1	5693
United Kingdom	3.4	0.6	74.6	16.0	8.7	0.0	0.0	5421
UEA	3.2	0.0	78.0	17.3	4.7	0.0	0.0	5148
Nigeria	3.1	0.0	95.3	0.9	3.8	0.0	0.0	4933
Algeria	3.0	0.0	34.4	19.8	45.8	0.0	0.0	4846
Iraq	2.8	0.0	96.3	3.7	0.0	0.0	0.0	4507
Indonesia	2.8	31.3	28.2	8.0	32.3	0.0	0.0	4480
Mexico	2.6	0.0	95.2	4.5	0.2	0.0	0.0	4105
US	2.5	40.0	6.4	46.4	5.8	0,0	1,3	4006

Countries/ groups of countries		Energy export structure by sources (in %)						Total energy exports (in PJ)
		Coal	Crude oil	Oil products	Natural gas	Biofuels and waste	Electricity	
2018								
World	100.0	14,9	41.3	25.2	17.2	0.4	1.0	248290
Russia	12.3	18,3	36.0	17.8	27.7	0.0	0.2	30490
EU-28	9.1	2,5	11.3	65.7	12.2	2.5	5.8	22666
US	8.5	13,6	24.8	43.8	16.8	0.8	0.2	21152
Saudi Arabia	8.3	0,0	76.0	24.0	0.0	0.0	0.0	20619
Australia	5.6	74.2	3.3	0.7	21.8	0.0	0.0	13929
Canada	5.3	6.2	63.0	7.1	21.6	0.4	1.7	13038
Indonesia	4.6	85.7	3.7	1.3	8.6	0.6	0.0	11527
Iraq	3.3	0.0	98.8	1.2	0.0	0.0	0.0	8223
Norway	3.1	0.0	33.6	11.0	54.4	0.0	0.9	7790
UEA	3.1	0.0	73.9	22.9	3.2	0.0	0.0	7814
Qatar	3.0	0.0	25.9	13.1	61.0	0.0	0.0	7507
Netherlands	2.6	0.1	0.6	72.0	25.4	0.9	1.1	6427
Iran	2.4	0.3	74.0	17.1	8.3	0.0	0.4	5963
Kuwait	2.3	0.0	79.2	20.8	0.0	0.0	0.0	5642
Nigeria	2.0	0.0	80.8	0.2	19.0	0.0	0.0	4931
Kazakhstan	1.9	10.6	63.2	5.0	20.8	0.0	0.4	4635
2019								
World	100.0	15.0	41.3	24.3	17.9	0.4	1.1	247347
Russia	12.7	18.3	35.9	17.2	28.4	0.0	0.0	31526
US	9.1	10.3	31.4	40.7	20.3	0.7	0.3	22578
EU-28	8.8	2.5	11.5	64.3	12.7	2.8	6.1	21802
Saudi Arabia	7.5	0.0	80.3	19.7	0.0	0.0	0.0	18634
Australia	6.0	71.1	3.5	0.7	24.7	0.0	0.0	14943
Canada	5.4	6.5	64.0	7.1	20.3	0.4	1.6	13352
Indonesia	4.7	89.9	1.3	1.4	6.8	0.6	0.0	11658
UEA	3.6	0.0	74.5	22.6	2.9	0.0	0.0	8842

Countries/ groups of countries		Energy export structure by sources (in %)						Total energy exports (in PJ)
		Coal	Crude oil	Oil products	Natural gas	Biofuels and waste	Electricity	
Iraq	3.5	0.0	97.5	2.5	0.0	0.0	0.0	8567
Norway	3.0	0.0	34.6	11.3	53.5	0.0	0.6	7483
Qatar	3,0	0.0	27.2	10.7	62.1	0.0	0.0	7480
Netherlands	2.4	0.1	0.6	73.4	23.7	1.1	1.2	6041
Kuwait	2.2	0.0	80.5	19.5	0.0	0.0	0.0	5403
Nigeria	2.1	0.0	81.8	0.0	18.2	0.0	0.0	5159
Kazakhstan	1.8	10.1	64.2	4.7	20.7	0.0	0.0	4559
Iran	1.4	0.4	53.1	30.4	15.4	0.0	0.7	3508

Note: heat–insignificant values.

Source: own compilation based on International Energy Agency, Data and statistics [online, accessed: February 2022]: <https://www.iea.org>.

The first seven of major fuel exporters in 2000 comprised the EU-28, Russia, Saudi Arabia, Norway, Canada, Venezuela and Australia, with shares in the world exports ranging from 11.4 to 4.0%. Together, they represented 50.0% of global export of energy commodities. The commodity structure of exports was predominated by crude oil, oil products and natural gas, but with a large advantage of crude oil which accounted for over 70% of fuel exports in: Norway, Venezuela the United Kingdom and UAE, over 80% in: Saudi Arabia and Iran, and over 90% in: Nigeria, Iraq and Mexico. The EU-28 countries, Canada, the US and Russia were distinguished by a more diversified structure of exports of traditional energy resources. The main coal exporters included: Australia (79.1% of its energy export), the US (40.0%) and Indonesia (31.3%). The exports of the EU-28, Canada and USA already covered electricity (4.8%, 2.2% and 1.3%). What changes can be identified in 2018? First, the composition of the top seven exporters changed: Norway and Venezuela dropped out of the group, and the US and Indonesia joined it. The top three were Russia, the EU-28 and the USA, and other countries changed places in the ranking. Second, the combined share of the top seven exporters in world exports rose to 53,7%. Third, Russia enlarged the diversification of exports of traditional raw materials, but the share of gas exports generally decreased and

coal exports increased significantly. Indonesia become the seventh exporter in the world due to coal exports (85.7% of its fuel exports in 2018). Noteworthy is the appearance of biofuels and waste in global energy commodity exports, with an outstanding share of the EU-28, but its share is very low in global scale.

In 2019, the largest increases in the share of global exports were recorded in the US, Russia and Australia. In contrast, decreases in the share of energy commodity exports took place in Iran, Saudi Arabia and the EU-28. However, these substitutions did not exceed 1 p.p. In the structure of energy commodity exports, changes compared to 2018 are insignificant, but the decrease in the share of coal and the increase in the share of oil and gas in the US exports are noteworthy. Moreover, Indonesia's exports were further dominated by coal (89.9%). Summarising the developments in the energy commodity export market, it should be noted that the top 15 energy commodity exporters were joined in 2019 by Kazakhstan with its offer of three valuable conventional raw materials, namely oil, gas and coal. The increase in importance in the export structure of petroleum products during the period under review should also not be overlooked.

If the main exporters of energy raw materials to date have included countries with the largest reserves of oil, gas and coal, the largest importers are countries with great economic potential and distinguished by high GDP growth rates. Therefore, imports of energy commodities are highly concentrated as set out in table 3.

In 2000 the first seven importers of energy raw materials accounted for 84.0% of world imports, and the top three (EU, the US, Japan) for 63.4%. For the top seven importers, the most crucial imported fuel was crude oil, share of which ranged from 44.8% in Germany to 74.7% in the US. In Germany natural gas accounted for 25.9% of imports. France and Italy also had comparable shares of gas in their imports (22.4% and 27.0%). The possibilities of obtaining gas from Russia influenced the structure of fuel imports in the EU countries. In the structure of Japanese imports by energy sources, coal was second (22.5%), similarly in Korea (18.9%). What changes can be noted in 2018–2019? China and India advanced to the top seven importers, while Italy and France fell to the positions of 10th and 11th on the importers' list. The share of seven major fuel importers in the world imports decreased from 84.0% to 74.0%. In 2019 it slightly

Table 3. Largest energy importers in 2000, 2018 and 2019; energy import structure by countries and by sources

Countries/ groups of countries		Energy import structure by sources (in %)						Total energy imports (in PJ)
		Coal	Crude oil	Oil products	Natural gas	Biofuels and waste	Electricity	
				2000				
World	100.0	10.7	54.8	19.1	14.1	0.0	1.2	158375
EU-28	33.3	10.0	50.3	18.6	19.2	0.1	1.8	52779
US	18.6	1.4	74.7	10.8	12.5	0.0	0.6	29394
Japan	11.5	22.5	50.6	12.3	14.6	0.0	0.0	18164
Germany	6.2	9.4	44.8	18.2	25.9	0.0	1.6	9883
South Korea	5.5	18.9	60.9	11.9	8.3	0.0	0.0	8653
Italy	4.6	7.6	51.8	11.1	27.0	0.3	2.2	7301
France	4.3	8.2	52.6	16.5	22.4	0.0	0.2	6812
Netherlands	3.4	6.4	48.3	33.9	9.8	0.0	1.6	5319
China	3.1	4.5	59.3	33.3	2.1	0.0	0.9	4961
Spain	2.9	12.3	54.8	17.6	14.3	0.0	1.0	4535
India	2.6	14.8	75.6	9.6	0.0	0.0	0.1	4197
United Kingdom	2.4	17.1	63.1	16.1	2.3	0.0	1.4	3731
Singapore	2.2	0.0	51.7	46.9	1.4	0.0	0.0	3455
Chinese Taipei	2.1	34.1	48.7	10.6	6.6	0.0	0.0	3336
Belgium	2.0	11.1	49.7	20.2	17.5	0.1	1.3	3170
Canada	1.9	20.9	65.1	10.2	1.8	0.1	1.8	3018
					2018			
World	100.0	14.6	43.0	23.7	17.2	0.5	1.1	242093
EU-28	25.8	7.5	40.1	23.8	24.8	1.5	2.3	62558
China	14.1	19.8	56.6	11.1	12.3	0.0	0.2	34159
US	10.1	0.5	73.9	13.1	11.4	0.2	0.9	24465
India	7.2	30.5	55.4	7.9	6.1	0.0	0.1	17505
Japan	7.1	28.7	37.2	10.7	23.1	0.3	0.0	17155
South Korea	5.6	24.7	47.3	12.7	15.3	0.0	0.0	13542
Germany	4.1	13.2	36.9	17.5	30.1	1.1	1.2	9809
Netherlands	3.6	4.0	30.5	42.8	21.2	0.3	1.1	8627

Countries/ groups of countries		Energy import structure by sources (in %)						Total energy imports (in PJ)
		Coal	Crude oil	Oil products	Natural gas	Biofuels and waste	Electricity	
Singapore	3.0	0.3	32.8	61.7	5.1	0.0	0.0	7293
France	2.7	6.0	35.5	27.9	28.6	1.2	0.8	6421
Italy	2.6	5.8	42.8	10.5	36.3	1.9	2.7	6403
United Kingdom	2.5	5.0	38.0	25.2	28.0	2.6	1.3	5990
Spain	2.3	7.2	53.2	13.9	22.9	1.3	1.6	5547
Chinese Taipei	2.1	31.8	37.3	14.6	16.3	0.0	0.0	5190
Turkey	2.0	21.2	19.3	23.4	35.9	0.0	0.2	4828
Mexico	1.8	5.8	0.7	51.9	41.3s	0.0	0.3	4475
2019								
World	100.0	14.7	42.4	23.5	17.8	0.6	1.1	242089
EU-28	25.8	6.1	39.5	23.6	26.8	1.6	2.3	62528
China	15.1	19.6	58.0	10.0	12.2	0.0	0.2	36476
US	9.3	0.6	71.2	15.1	11.8	0.3	0.9	22578
India	7.6	30.2	53.0	9.9	6.9	0.0	0.1	18335
Japan	6.9	29.2	37.4	10.3	22.6	0.4	0.0	16633
South Korea	5.5	25.3	46.3	13.1	15.2	0.0	0.0	13235
Germany	4.1	11.7	36.4	17.9	31.5	1.0	1.4	10043
Netherlands	3.5	3.3	32.2	42.0	21.2	0.5	0.9	8409
Singapore	3.0	0.3	31.4	63.0	5.3	0.0	0.0	7244
France	2.7	4.7	32.1	29.4	31.6	1.4	0.9	6486
Italy	2.6	4.3	43.3	9.7	38.3	1.8	2.5	6360
United Kingdom	2.4	3.5	38.5	24.4	28.7	3.4	1.5	5849
Spain	2.2	4.3	54.0	14.2	25.0	1.3	1.2	5413
Chinese Taipei	2.1	32.6	38.1	13.1	16.2	0.0	0.0	5122
Turkey	2.0	21.1	28.6	17.9	32.3	0.0	0.2	4829
Mexico	1.8	6.3	0.4	53.2	39.8	0.0	0.3	4316

Note: heat–insignificant values.

Source: own compilation based on International Energy Agency, Data and statistics [online, accessed: February 2022]: <https://www.iea.org>.

rose to 74.3%. The share of the top three decreased to 50.2% (2019). There has been a de-concentration of imports as a result of the increased energy demand of those developing countries that have embarked on a high growth path. The main changes in the top exporters are a rise in the ranking of China and India and a fall in the ranking of Japan, France, Germany, Italy and Spain. A significant change in the structure of imports by energy carrier is the increase in gas imports by European countries and coal imports by Asian ones (tab. 5).

Conclusions

Addressing the research questions formulated in the introduction, we present the main findings.

1. Diversification of energy sources progressed between 2000 and 2019, but mainly concerned the share of coal, oil and gas. In contrast, the share of wind, and solar increased slightly, and biofuels declined slightly. Negatively, the share of renewables in energy production in China, Indonesia and India declined as overall electricity demand went up. From the point of view of the preferred energy policy objective of decarbonising production, the changes in the energy source mix over the period under review did not result in an improvement, but in a deterioration. Globally, the share of coal in energy production increased from 22.8 to 27.1%. This was driven by China, Australia, Indonesia, India and Russia. Positive changes in this respect were recorded in the United States and the European Union. In the former case the share of coal as an energy source decreased from 32.2 to 15.0%, and in the latter from 22.6 to 14.7%. In the United States, the decrease in the share of coal in energy production was compensated by the increase in the share of oil and gas. In the European Union, the results of the transformation of the energy sector were, compared to other countries, exceptionally good. The use of crude oil in energy production fell from 18.4 to 10.5%, natural gas from 22.1 to 11.8% and renewable sources increased from 11.0 to 33.4%.

The second research question concerns the results of verification of the position of the majority of International Political Economy theorists claiming that the market mechanism without state support is not able to ensure the energy sector transformation consisting in moving away from fossil fuels to increasing the share of clean energy sources.

The involvement of the state in the transformation of the energy sector is understood as creating a solid legal basis and a regulatory system based on efficiently functioning institutions and social dialogue. IPE theorists see greater opportunities for implementing the "ecological modernisation strategy in highly developed countries with democratic regimes than in emerging economies and authoritarian regimes. At the same time, they emphasise that the role of the state at the contemporary stage must go beyond its traditional economic functions. What does the research reveal about this issue? The empirical analysis conducted in this article shows that the best results in the transformation of the energy sector have been achieved by the EU, whose countries are market economies in which the state undertakes and exercises regulatory functions. Their political systems are based on parliamentary democracy, although a detailed analysis of political-economic systems may reveal some differences, the presented results of energy sector transformation in the EU confirm the hypotheses formulated by IPE theorists. Empirical analyses of selected EU countries and local government activity also indicate that they are undertaking ambitious plans to achieve environmental and climate sustainability (e.g. Germany, Sweden, Slovenia, Spain).

In the third question, the authors address the issue of the impact of the transformation of the energy sector and changes in the energy markets on the global balance of economic power and conclude that the resources of energy raw materials since the second half of the 20th century, which are concentrated in a small group of countries, give them great opportunities to directly affect the situation in the markets for energy raw materials. The large share in global exports of the most important energy raw materials and the formation of world prices had a strong impact on: the situation in other markets and the general global economic situation due to the transmission of inflation, exchange rate fluctuations and growing payment deficits of energy raw material importers and surpluses of their exporters. As a result, these phenomena lead to slower economic growth and recession. The balance of power is evolving along with technological progress, changes in the economic efficiency of countries and their economic potential. Structural changes in the energy sector and the growing importance of alternative sources of energy production will reduce the dominance and influence on the global economy of the major exporters of fossil energy resources. The growing importance of local energy systems

based on wind, solar and biofuels can be expected. Given the strong determination of countries dependent on oil and gas imports from Russia to diversify their energy sources (in conditions of current political instability), the process of structural change in the energy sector should gain new momentum.

Question 4 is about Russia's chances of retaining its dominant position on the global energy market. It is not possible to give an unequivocal answer due to the difficult to predict scenarios for the resolution of the war conflict and Russia's policy. Therefore, we focus our attention on the current strengths of Russia's position in the global oil and gas markets and the possible consequences of a reduced role for fossil fuels. An analysis of the rich literature on the subject shows that Russian energy power at the beginning of the second decade of the 21st century is sufficient to maintain its superpower position (c.f. table 2). To a large extent, investments in the development of transmission infrastructure in Europe and Asia, among others, have contributed to this. The second major asset of Russia's power is the monopolistic position of Gazprom and other Russian companies and their influence on the situation on the world's fossil fuel markets and thus on the global economy. However, given the real opportunities for changing the structure of sources in energy production and the growing importance of national and local energy supply options, a raw material revolution is inevitable. This begs the next question: over what period of time is this realistic? Taking into account the technological and capital conditions, we can consider the perspective of the turn of the second and third decades of this century.

In conclusion, the authors would like to point out the research gap that exists in the area of issues that make up the development of an energy policy model adapted to global economic interdependence and the global ecological and climatic effects of growing energy production based on fossil fuels, as well as the dangers resulting from high dependence on an energy superpower such as Russia. This gap is the lack of a regulatory and institutional system underpinning global governance. Conceptualising this problem in an academic discussion is a valuable support and recommendation for initiatives in the G7 and G20.

Bibliography

BP, *Statistical Review of World Energy July 2021*, Workbook [online], [accessed: March 2022]: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/xlsx/energy-economics/statistical-review/bp-stats-review-2021-all-data.xlsx>.

Bulkeley H., *Cities and the governing of climate change*, „Annual Review of Environment and Resources" 2010, vol. 35, no. 1, pp. 229–253.

Damro C., *Market power Europe,* „Journal of European Public Policy" 2012, vol. 19, no. 5, pp. 682–699.

Gawlikowska-Fyk A., Puka L., Nowak Z., *The EU gas game: Time to redefine the rules? Case studies of Russia and Norway and lessons for the EU, Norway and Poland*, PISM Report, Warsaw 2015.

Goldthau A., Sitter N., *Horses for courses. The roles of IPE and Global Public Policy is global energy research,* „Policy and Society" 2020, pp. 1–17.

Greenwald B., Stiglitz J. E., *Industrial policies, the creation of a learning society, and economic development*, [in:] *The Industrial Policy Revolution I*, eds. J. E. Stiglitz, J. Y. Lin, International Economic Association Series, Palgrave Macmillan, London 2013; pp. 43–71.

Hadfield A., *EU-Russia energy relations: Aggregation and aggravation*, „Journal of Contemporary European Studies" 2008, vol. 16, issue 2, pp. 231–248.

Hall P. A., *Policy paradigms, social learning, and the state: The case of economic policy-making in Britain,* „Comparative Politics" 1993, vol. 25, no. 3, pp. 275–296.

Heinrich Böll Foundation, *Research for and on the "Great Transformation"*, Heinrich Böll Foundation, Berlin 2013.

International Energy Agency (IEA), Data and statistics [online, accessed: February 2022]: <https://www.iea.org>.

International Monetary Fund (IMF), Datamapper [online], 2022, [accessed: March 2022]: <https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD?year=2022>.

Keohane R. O., Nye J. S., *Power and Interdependence: World Politics in Transition*; Little Brown, Boston 1977.

Kowalik S., Herczakowska J., *Analiza i prognoza cen ropy naftowej na .rynkach międzynarodowych*, „Polityka energetyczna" 2010, vol. 13, issue 2, pp. 1429–6675.

Kuzemko C., *Re-scaling IPE: local government, sustainable energy and change*, „Review of International Political Economy" 2019, vol. 26, no. 1, pp. 80–103.

Laffaye S., Lavopa F., Llana C. P., *Changes in the global economic power structure: towards a multipolar world?*, „CEI Argentine Journal of International Economy" 2013, issue 1, pp. 1–21: <http://www.cei.gov.ar/en/changes-global-economic-power-structure-towards-multipolar-world>: [accessed: January 2022].

Lapachelle L., Paterson M., *Drivers of national climate policy*, „Climate Policy" 2013, vol. 13, issue 5, pp. 547–571.

Manners I., *Normative power Europe reconsidered: beyond the crossroads*, „Journal of European Public Policy" 2006, vol. 13, issue 2, pp. 182–199;

Manners I., *Normative power Europe: a contradiction in terms?*, „Journal of Common Market Studies" 2002, vol. 40, issue 2, pp. 235–258.

Meunier S., Nicolaïdis K., *The European Union as a conflicted trade power*, „Journal of European Public Policy" 2006, vol. 13, no. 6, pp. 906–925.

Młynarski T., *Bezpieczeństwo energetyczne i ochrona klimatu w drugiej dekadzie XXI wieku*, Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków 2017, pp. 19–30.

Mucha-Leszko B., Białowąs T., *EU-Russia Trade Relations: Interdependence and Geopolitics*, [in:] *The Growth-Oriented Economic Policy of the EU*, eds A. Santagostino, B. M. Vural, Cambridge Scholars Publishing, Newcastle 2020; p. 271.

Mucha-Leszko B., *EU-Russia Trade Relations: Interdependence and Geopolitics*, [in:] *The Growth-Oriented Economic Policy of the EU*, eds A. Santagostino, B. M. Vural, Cambridge Scholars Publishing, Newcastle 2020; p. 271.

Newell P., *Transformismo or transformation? The global political economy of energy transitions*, „Review of International Political Economy" 2019, vol. 26, issue 1, pp. 25–48.

Newell, P., Paterson, M., *Climate for business: Global warming, the State and capital*, „Review of International Political Economy" 1998, vol. 5, issue 4, pp. 679–704.

Newton S., *The Global Economy 1944–2000: The Limits of Ideology*, Arnold Publishers, London, 2004.

Pach-Gurgul A., *Główne determinanty wahań cen ropy naftowej na świecie na przełomie lat 2014/2015*, „Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego", 2016, vol. 30, issue 3, pp. 185–198.

Pieterse J. N., *Globalisation and emancipation: From local empowerment to global reform*, „New Political Economy", 1997, vol. 2, no. 1, pp. 79–92.

Romanowa T., *Is Russian Energy Policy Towards the EU Only About Geopolitics? The Case of the Third Liberalisation Package*, „Geopolitics" 2016, vol. 16, no. 4, pp. 857–879.

Rynarzewski T., *Wpływ strategii cenowych wielkich korporacji i krajów OPEC na powstanie kryzysu naftowego*, „Ruch Prawniczy, Ekonomiczny i Socjologiczny" 1982, vol. 44, issue 3, pp. 305–318.

Siddi M., *The Role of power in EU-Russia Energy relations: The interplay between markets and geopolitics*, „Europe – Asia Studies" 2018, vol. 70, issue 10, pp. 1552–1571.

Simola H., *Limited Interdependence in EU-Russia-Trade*, [in:] *Post-Crimea Shift in EU-Russia Relation: From Fostering Interdependence to Managing Vulnerabilities*, eds. K. Raik, A. Racz, International Centre for Defence and Security, Tallin 2018, pp. 138–139.

United Nations Framework Convention on Climate Change, [online], 2015 [accessed: March 2022]: <https://unfccc.int/sites/default/files/english_paris_agreement.pdf>.

United Nations, *A Kyoto Protocol to the United Nations Framework Convention on Climate Change*, Kyoto, 11 December 1997, Entry into force: 16 Feb 2005, No. 30822.

Varieties of capitalism, eds. P. A. Hall, D. Soskice, Oxford University Press, Oxford 2001, pp. 19–68.

Yergin D., *The New Map: Energy, Climate, and the Clash*, Penguin Press, New York 2020.

Yergin D., *The prize: The epic quest for oil, money and power*, Simon & Schuster, London 2008.