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THE EUROPEAN GREEN DEAL IN ENERGY SECTOR: CHALLENGES AND POSSIBILITIES FOR POLAND AND POST-WAR UKRAINE

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Introduction

According to the IPCC Sixth Assessment Report, having the present level of CO2 emissions, humanity will burn its carbon budget as early as 2030, beyond which the target of 1.5°C will be impossible to reach[1]. Therefore, countries are to take urgent measures to decrease their carbon emissions by all means, especially bearing in mind that reducing the emissions may require significant investments in energy, industry, transport, and agriculture, as well as changes in consumer choices of people in their everyday life. Global climate change has become essential for the EU to review all regulatory policies related to greenhouse gas (GHG) emissions. The EU has set itself the goal of becoming the first carbon-neutral continent by 2050[2]. Over the

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1 IPCC (2022). Climate Change 2022: Mitigation of Climate Change, https://www.ipcc.ch/report/ar6/wg3/ (access: 07.07.2022).

2 Orsted (2020). European Green Deal. How offshore wind can help decarbonise Europe, https://orstedcdn.azureedge.net/-/media/www/docs/corp/com/about-us/whitepaper/orsted-paper-green-deal-for-europe-web.ashx?la=en&rev=1e6257083f004039839d62aed6b4b8cc&hash=9EA78AC30C5BC12DF6402029E43C5CD3 (access: 07.07.2022).

last fifteen years, the EU's framework climate policy has been revised several times, mainly to tighten the latter. The number of programmes and packages aimed at significant CO2 reduction, coupled with innovative development of economy increases, is aggravated in the light of the Russia-Ukraine war of 2022, when Russia, being a major fossil fuels supplier to the EU, resorts to reducing natural gas supplies as leverage to ease sanctions.

This article aims to consider the evolution of the EU energy policies that evolved into the European Green Deal (EGD), the impact of the Russia-Ukraine war on the EU energy policies, and review the challenges for Poland, as well as the potential role of post-war Ukraine in the EGD.

1. Evolution of the EU energy legislation

The EGD's main regulatory precondition for introducing changes in the energy sector was the Fourth Energy Package – the "Winter Package: Clean Energy for All Europeans" (2016). It provides several proposals to reform the European energy market. They are aimed at amending the legislation on the energy market and climate legislation, as well as proposing new measures. New directives on integrating climate goals into a new market design were introduced. In particular, the Renewable Energy Directive 2009/28 (RED), repealed by RED II Directive (2018/2001/EU)[3], the Energy Efficiency Directive 2012/27 (EED), and the 2018/1999 Governance Regulation have been completely revised. The new RED II Directive entered into force for the EU countries in December 2018. The European Commission estimates that implementing the Fourth Energy Package provisions will create 900,000 new jobs in the EU, mainly in small and medium-sized enterprises[4].

Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action was the first basis for implementing the Fourth Energy Package. The Regulation sets out the political process in which the Member States and the European Commission must work together to achieve the objectives set. The idea is to create a management system that would ensure

[3] EC (2018). Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC (access: 07.07.2022).

[4] EC (2019). European Commission, Directorate-General for Energy, *Clean energy for all Europeans*, Publications Office, https://data.europa.eu/doi/10.2833/9937 (access: 07.07.2022).

the convergence of national and European goals while providing flexibility to adapt to specific national circumstances and needs. Each Member State must develop a national energy and climate plan for 2021–2030. These plans should cover five dimensions of the European Union's strategy: energy security; research, innovation, and competitiveness; domestic energy market; energy efficiency; and carbon-free energy. The Member States must also ensure the effective contribution of all actors (investors, citizens, and local and regional organisations) to the process. The implementation of the plans will be the subject of a biennial progress report prepared by the Member States under the supervision of the European Commission.

In 2016, the EU announced that it aims to increase energy efficiency by 20% by 2020. Revised Energy Efficiency Directive (Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency) introduced a new energy efficiency target for the Member States: energy efficiency in the EU should increase by at least 32.5% by 2030. The Directive strengthened the rules on metering for individual energy consumption and billing for thermal energy (energy consumers in apartment buildings have the right to receive information on their energy consumption more regularly.

The RED II Directive's overall EU target for renewable energy consumption by 2030 should be 32%. Progress towards national targets is measured every two years when the EU countries publish national progress reports on renewable energy. This Directive sets a specific target for the transport sector: at least 14% of the energy consumed by road and rail by 2030 must come from renewable sources. RED II defines several criteria for the sustainability of raw materials and greenhouse gas emissions, which must be met by liquids used in transport to be included in the overall target of 14% and be eligible for financial support from the state. RED II introduces sustainability criteria for wood biomass and GHG emission criteria for solid and gaseous fuels from biomass. The European Commission may review and update GHG emissions as technology improves.

Requirements are also set for the consumption of advanced biofuels, i.e. biofuels made from non-food raw materials. Within 14% of this transport target, there is a specific target for advanced biofuels: at least 0.2% in 2022, at least 1% in 2025, and at least 3.5% in 2030. It is not easy for motor biofuels from food and feed crops (first generation) to reduce greenhouse gas emissions significantly. Hence, the RED II Directive imposes a 7% cap on such biofuels and must be withdrawn from the market by 2030. To avoid indirect land-use change (ILUC), which is accompanied by the release of

CO2 caused by the need to produce biofuels, criteria for the sustainability of raw materials are set, as well as limit values for biofuels from different types of raw materials. In this case, biofuels that do not reduce CO2 emissions (generation I) can be imported and used. Still, it will not be taken into account for the purpose of energy consumption from renewable sources in transport. Raw materials for biofuels are divided into high and low-risk ILUC fuels. The share of biofuels and bioliquids for transport, if produced from food and feed crops, should be no more than one percentage point higher than the share of such fuels in final energy consumption in the transport sector in 2020 in an EU Member State, with a maximum of 7% of final energy consumption in the road and rail transport sectors in this State. Fuels produced from high-risk raw materials ILUC are subject to restrictions. From 2024 to the end of 2030, this limit will gradually decrease to 0%. Electricity on transport will be credited with a factor of 4 (energy content) if used in cars and 1.5 on the railway. Biofuels can also be used in aviation and water transport but are not required. Second-generation biofuels will be credited with a factor of 1.2. According to the RED Directive, Poland's target for the share of renewable energy in gross final energy consumption is 15% in 2030[5].

The European Commission has decided to achieve a carbon-neutral economy by 2050, which means that net carbon emissions should be zero. The European Green Deal (EGD) was adopted to achieve carbon neutrality. The provisions of the EGD are embodied in the European Climate Law[6], which entered into force on 29 July 2021. The law sets a legally binding target of 2050 net-zero greenhouse gas emissions. The EU institutions and the Member States are obliged to take the necessary measures at the EU and national levels to achieve this goal. The law includes measures to monitor progress and adjust our actions in line with existing systems, such as the management process of Member States' national energy and climate plans, regular reports from the European Environment Agency, and the latest scientific data on the effects of climate change. Progress will be reviewed every five years according

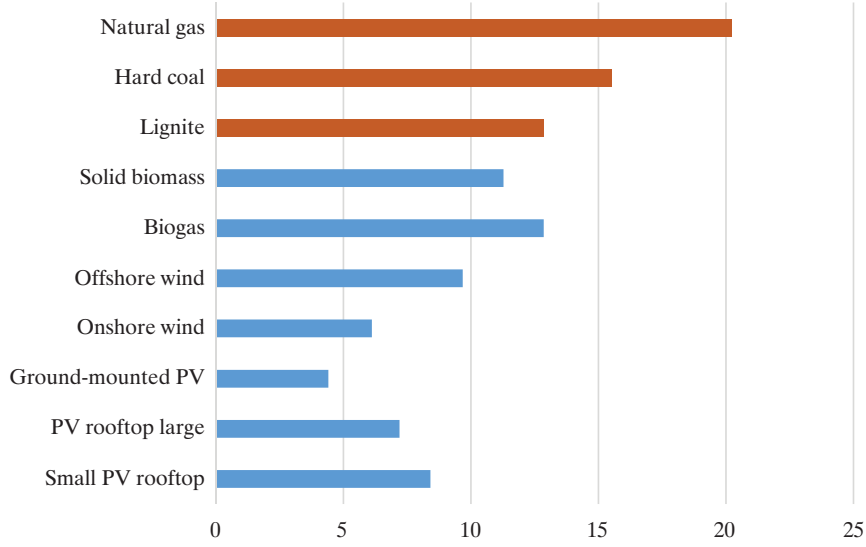
[5] EEA (2021). Technical background document. Accompanying the report. Trends and projections in Europe 2021. European Environment Agency, https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2021/technical-background-document/view (access: 07.07.2022).

[6] EC (2021a). Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119 (access: 07.07.2022).

to a global analysis under the Paris Agreement. The Climate Act also sets out the steps needed to achieve the 2050 target: a new 2030 target to reduce net greenhouse gas emissions by at least 55% compared to 1990 levels. It is expected that economic growth will be achieved, inter alia, by introducing new technologies such as renewable energy, hydrogen, and fuel cells and using sustainable development principles in industrial production and services. To make the energy transition in the EU, electricity consumption must increase by 150% compared to 2017. Increased energy from RES is economically feasible because, due to relatively inexpensive borrowed capital and the high cost of CO2 emissions, the Levelized Cost of electricity from RES in the EU is lower than energy from fossil fuels (Fig. 1).

Figure 1

Levelized Cost of electricity from different sources of energy in Germany in 2021, EURcent/kWh



Source: Fraunhofer ISE (2021) Levelized cost of electricity renewable energy technologies, https://www.ise.fraunhofer.de/en/press-media/press-releases/2021/levelized-cost-of-electricity-renewables-clearly-superior-to-conventional-power-plants-due-to-rising-co2-prices.html#:~:text=Forecasts%20show%20that%20in%202021,€100%2Ft%20in%202030 (access: 07.07.2022).

The proposed budget of the European Commission is EUR 1.8 trillion, and the private sector should invest another EUR 1 trillion. Of these EUR 1.8 trillion, EUR 750 billion will be provided as an incentive package to

address the negative economic consequences of the COVID-19 pandemic, and EUR 1.05 trillion will be provided during 2021–2027[7].

A practical financial element in the EU has been the Investment Plan for Europe (the so-called Juncker Plan), consisting of the European Fund for Strategic Investments. Public funds are used as leverage to secure private investment. Energy (energy efficiency, renewable energy, and infrastructure) received the most significant expenditures. Of the total EUR 371.2 billion investment approved since its inception in 2014/15, approximately 19% went to energy projects. That allowed more than 8.2 million Europeans to receive energy from RES and to install smart electricity and gas meters in 28 million homes. During the financial period 2014–2020, 20% of spending in the EU was on climate-related activities. In the EU budget for 2021–2027, the European Commission proposed a target of at least 25% of the total EU spending on climate change, including the transition to clean. The R&D budget will increase to almost EUR 100 billion under Horizon Europe, of which around EUR 15 billion will be spent on energy, mobility, and climate research[8].

To achieve climate neutrality by 2050, there is a kind of intermediate goal, mainly to reduce greenhouse gas (GHG) emissions by 55% by 2030. This is a very ambitious goal, as the latest climate plans of the Member States provide for a reduction in emissions by only 40%. Emissions will be reduced mainly due to the energy sector, including using energy from renewable sources and ceasing coal use. Even more significant growth of intermittent energy sources, such as wind and solar power, in the electricity balance highlights the problems of energy system flexibility and the need for energy storage technologies. To achieve this goal (reduction of GHG emissions by 55% by 2030), a plan to achieve it, called the Fit for 55 package, was presented in July 2021. The latter is a set of proposals to revise and update the EU legislation and implement new initiatives to ensure that the EU policies align with the climate goals agreed by the Council and the European Parliament. The proposed Fit for 55 package aims to bring the EU legislation in line with the 2030 emission reduction target. The package primarily concerns energy, transport, the environment, and the financial system[9].

The European Commission has proposed a comprehensive set of changes to the existing EU ETS, which should lead to an overall reduction in emissions in the relevant sectors by 61% by 2030 compared to 2005. This will include

7 EC (2019) European Commission, Directorate-General for Energy…, *op. cit.*

8 *Ibidem*.

9 *Ibidem*.

emissions from maritime transport; emission permits for aviation and the sectors covered by the Carbon Border Adjustment Mechanism (CBAM) will be paid; a global compensation and emission reduction scheme will be introduced; funding for the modernization fund and the innovation fund will be increased.

The European Commission is also proposing to create a new autonomous emissions trading system for the buildings and road transport sector to support Member States in achieving their national targets according to the distribution of countries' contributions cost-effectively. This proposal will reduce GHG emissions by 43% in these sectors by 2030 compared to 2005[10].

For non-ETS sectors, as well as LULUCF regulation (land use, land-use change, and forestry), it is proposed to achieve GHG emission reductions at the EU level from 29% to 40% compared to 2005 and to update national targets. EU members. The RED II will be revised. The proposal is to increase the current target by 32% to at least 40% in the energy balance by 2030. The introduction or improvement of sectoral sub-objectives and measures in different sectors is envisaged, focusing on sectors where progress on integrating renewable sources is insufficient (transport, buildings, and industry). The Energy Efficiency Directive will also be revised to increase the current energy efficiency target from 32.5% to 36% for final energy consumption and up to 39% for primary energy consumption. Particular attention will be paid to increasing annual energy-saving commitments in public sector buildings, and measures will be taken to protect vulnerable consumers (i.e. addressing energy poverty).

Significant changes are envisaged in the transport sector; in particular, legislation will be revised to accelerate the development of charging infrastructure for refueling or refueling vehicles with alternative fuels and to provide alternative energy supply for ships in ports and aircraft. The proposal applies to all modes of transport and includes objectives for infrastructure development aimed at improving user comfort. Standards for CO2 emissions from cars and trucks need to change. Compared to the 2021 target, from 2030, they should be reduced by 50% for passenger cars and 50% for minibusses, and from 2035 they should be reduced by 100% for both passenger cars and minibusses. It means that from 2035, production of vehicles with internal combustion engines will not be possible.

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[10] CEU (2021) Fit for 55 package. Brussels, 6 December 2021 (OR. en) 14585/21. Council of the European Union, https://data.consilium.europa.eu/doc/document/ST-14585-2021-INIT/en/pdf (access: 07.07.2022).

In this case, cars with biomethane will be at a disadvantage, but the relevant European associations are currently working to improve the legislation. Renewable and low-carbon fuels should be used in maritime transport so that the carbon content of fuels should be reduced by 75% by 2050. Despite progress in recent years, the maritime sector is still almost entirely dependent on fossil fuels and is a significant source of greenhouse gases.

The creation of a Social Climate Fund is planned, which would provide for the allocation of EUR 72.2 billion for 2025–2032 to address the uneven impact of the emissions trading system for the transport sector and buildings. The EU Member States will develop Social Climate Plans. The Fund will support vulnerable groups such as households, micro-enterprises, and transport users, as well as increase the energy efficiency of buildings, decarbonization of heating and cooling systems in buildings, greater integration of energy from renewable sources, mobility and access to zero-emission and low-emission transport[11].

The individual EU Member States may set even more ambitious climate targets. For example, Germany has pledged to achieve carbon neutrality by 2045. The new law strengthens the intermediate goal of reducing greenhouse gas emissions from 55% to 65% by 2030 compared to 1990. By 2040, a new intermediate target is applied – to reduce greenhouse gas emissions by 88%. The lion's share of the additional reduction will fall on energy and industry. The law also sets specific climate targets for each year after 2030. The law also includes natural carbon sinks (forests and peatlands), which are already essential and whose importance will increase even more after 2050, as Germany plans to achieve negative emissions with the help of these absorbers. It should be noted that the share of energy from RES was not revised[12].

In July 2022, the EU officially recognized natural gas and nuclear energy as those compliant with the EU Green Taxonomy (introduced in 2020[13]),

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11 EC (2021b) Proposal for a Regulation of the European Parliament and of the Council establishing a Social Climate Fund. COM (2021) 568 final 2021/0206 (COD), https://ec.europa.eu/info/sites/default/files/social-climate-fund_with-annex_en.pdf (access: 07.07.2022).

12 LOC (2021) Germany: Amendment of Climate Change Act Codifies Climate Neutrality Goal by 2045. Library of Congress, https://www.loc.gov/item/global-legal-monitor/2021-09-28/germany-amendment-of-climate-change-act-codifies-climate-neutrality-goal-by-2045/ (access: 07.07.2022).

13 EC (2020c). Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable

provided that nuclear energy will have its waste processing. The respective provision will be enacted in 2023. Still, it will have long-term consequences for the development of nuclear energy globally with its pros and cons, as well as will jeopardize the ambitions to decrease the EU's attempts to reduce its dependence on imported Russian natural gas, as well as on nuclear energy through Russian "Rosatom"[14]. In our opinion, this decision will also change the entire economics of hydrogen output, postponing the wide-scale deployment of green hydrogen, but this question requires further studies.

2. Impact of the Russia-Ukraine war on the EU energy policy

The EU Commissioner for Energy, K. Simson, pointed out: "Russia's *invasion of Ukraine has aggravated the security of supply situation and driven energy prices to unprecedented levels*"[15], meaning that the Russia-Ukraine war has affected not only Ukrainians but many other countries as well, at least through growing energy prices, which, in turn, were mitigated by the "Energy Prices Toolbox" since October 2021, partially lowering the energy bills of 70 million households across Europe[16]. As of late June 2022, many OECD countries have refused to use Russian natural gas and oil or impose an embargo on it as a part of punishing sanctions. Until July 2022, the EU, as a whole, was the primary buyer of Russian fossil fuels, whereas Russia was one of the major suppliers of fossil fuels to the EU (Fig. 2).

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investment, and amending Regulation (EU) 2019/2088, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0852&from=EN (access: 11.07.2022).

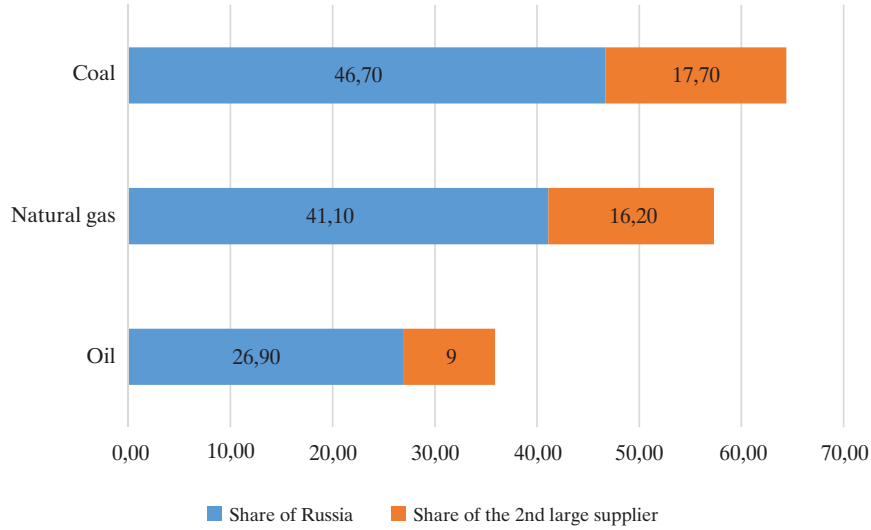
14 Greenpeace (2022). How Russian Companies Lobbied for the EU Taxonomy to Include Fossil Gas and Nuclear Energy, https://cdn.greenpeace.fr/site/uploads/2022/05/How-Russian-Companies-Lobbied-For-the-EU-Taxonomy-To-Include-Fossil-Gas-Nuclear-Energy-1.pdf (access: 11.07.2022).

15 EC (2022). REPowerEU: Joint European Action for more affordable, secure and sustainable energy. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. COM/2022/108 final, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A108%3AFIN (access: 07.07.2022).

16 *Ibidem*.

Figure 2

Imports of the fossil fuels to the EU from Russia in 2020, %



Source: Eurostat (2022). Imports of oil and petroleum products by partner country, https://ec.europa.eu/eurostat/databrowser/view/nrg_ti_oil/default/table?lang=en (access: 11.07.2022).

Together with the USA and Canada's Russian oil ban, by 5 February 2023, 43% of Russian oil exports will be banned. The impact of these restrictions will be assessed based on the results of 2023 and will be long-lasting. IEA[17] indicates that the reliance of the EU on natural gas from Russia was only increasing during the last decade (Fig. 3).

Russia's fossil fuel industries make 40% of its federal budget and 60% of its exports[18]. In the EU, Russian natural gas is used mainly in the residential sector (to heat homes). The latter demand could be covered by heat pumps[19],

[17] IEA (2022a). Gas Market Report, Q3-2022 including Gas 2022 medium-term forecast to 2025. International Energy Agency, https://iea.blob.core.windows.net/assets/c7e74868-30fd-440c-a616-488215894356/GasMarketReport%2CQ3-2022.pdf (access: 09.07.2022).

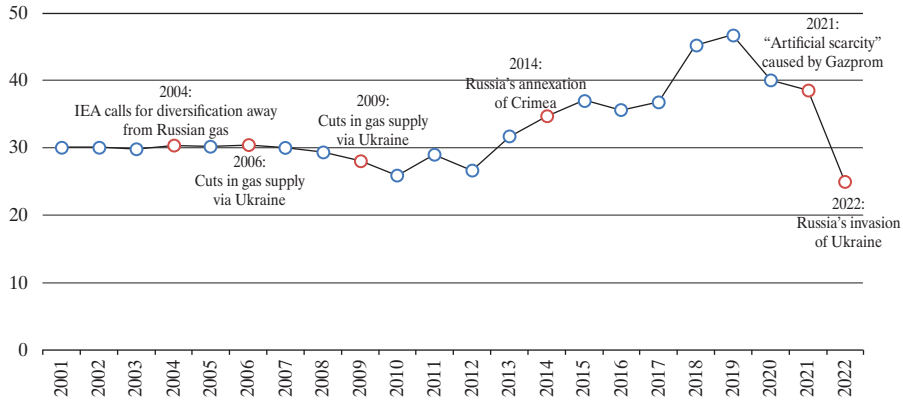
[18] Ecoaction (2022). Ukrainian CSO statement to world leaders: Implement Fossil Fuel Non-Proliferation Treaty. Ecoaction, https://en.ecoaction.org.ua/ukrainian-cso-statement-to-world.html (access: 07.07.2022).

[19] J. Murray (2020). Heat pumps, not hydrogen, key to decarbonise UK heating. Energy Monitor, https://www.energymonitor.ai/sectors/heating-cooling/heat-pumps-not-hydrogen-key-to-decarbonise-uk-heating (access: 07.07.2022).

which would require about 1 TWh of electricity per year[20]. The EU has decided to cut Russian natural gas imports by two-thirds starting in 2022[21]. As a result, in June 2022, the liquified natural gas from the US overtook Russian piped gas in the EU imports, according to IEA 2022a.

Figure 3

Share of gas supply to the EU from Russia in 2001–2022, %



Source: IEA (2022a). Gas Market Report, Q3-2022 including Gas 2022 medium-term forecast to 2025. International Energy Agency, https://iea.blob.core.windows.net/assets/c7e74868-30fd-440c-a616-488215894356/GasMarketReport%2CQ3-2022.pdf (access: 09.07.2022).

Russian natural gas imports to the EU could be cut to as much as 2/3 of the volume, equivalent to 101 billion m3 per year[22]. The study indicates that the EU could stop importing natural gas from Russia in 2025, which is two years earlier than anticipated before, by fulfilling the Fit for 55 package provisions aimed at enhanced energy efficiency and increased use of renewables so that annual gas consumption in the EU would decrease by 100 billion m3 per year by 2030[23]. New natural gas infrastructure is not required (including the Nord Stream-2 pipeline). More than that, coal use decline would gradually

20 Bellona (2022a). Using REPowerEU to its full potential, https://bellona.org/publication/using-repowereu-to-its-full-potential (access: 07.07.2022).

21 EC (2022). REPowerEU: Joint European Action for more affordable…, *op. cit.*

22 Bellona (2022b). EU can stop Russian gas imports by 2025: Accelerating clean energy avoids fossil lock-in. Bellona, Ember, E3G, Regulatory Assistance Project, https://9tj4025ol53byww26jdkao0x-wpengine.netdna-ssl.com/wp-content/uploads/Briefing_EU-can-stop-Russian-gas-imports-by-2025.pdf (access: 07.07.2022).

23 EC (2022). REPowerEU: Joint European Action for more affordable…, *op. cit.*

reduce, as the Fit for 55 package anticipated, without compromising the EU Green Deal even in the short run. To reach it, a special plan, REPowerEU, was developed[24]. It anticipates the increased use of renewables and a way to use renewables for hydrogen output. Should the plan's provisions be fulfilled, it would allow for avoiding up to 170 billion m3 of natural gas a year. REPowerEU anticipates the installation of 80 GW of wind and solar facilities for green hydrogen output, as 20 million tons of hydrogen substitute 50 billion m3 of natural gas. Having that done, the cumulative installed capacities of solar and wind energy will reach 980 GW combined (280 GW of solar, 260 GW of wind, and 80 GW of dedicated wind and solar for hydrogen output)[25]. It also addresses the growing energy prices by establishing retail prices for households and micro-enterprises. TheEU State Aid rules will be adopted in countries to support the companies affected by growing prices. The plan also tackles the issue of gas supply reliability, demanding to have the EU gas storage 90% full by the first of October of each year[26].In the EU, more than others, some countries were reluctant to introduce the Russian fossil fuels embargo. Apart from political reasons, one of the main rationales for the continuation of the purchase of Russian fossil fuels is the attempt to avoid the devastating impact on the economy of the EU through spiked prices for energy carriers and inflation. However, Chepeliev et al. 2022 show that after the Russian fossil fuels ban, the real income of households may drop by 1.7%, and energy prices may grow by 11%. The impact on households will not be homogenous; thus, subsidies and other forms of support are needed for the most vulnerable groups. Should energy efficiency measures be applied, coupled with increased renewables use, the EU will be entirely on track with its Green Deal agenda due to CO2 emissions reduction and lowering the carbon price to EUR 40/t CO2. The impacts of the fossil fuels ban on Russia will be devastating: by 2030, real income loss for Russia will reach USD 1.1 trillion, and real revenue loss will reach USD 1.4 trillion.

Political reasons and the inclusion of nuclear energy in the EU Green taxonomy will lead to the renaissance of nuclear energy globally and may spur the development of small nuclear reactors technology. For instance, Belgium is considering extending its nuclear power plant lifetime. In 2003, the country passed a law to end nuclear generation by 2025. However, with

[24] *Ibidem*.

[25] Bellona (2022a). Using REPowerEU…, *op. cit.*

[26] M.L. Lagana (2022). REPOWER: A European Plan for a More Affordable, Secure and Sustainable Energy, https://www.bridgeeurope.org/blog/2022/3/30/repower-a-european-plan-for-a-more-affordable-secure-and-sustainable-energy (access: 07.07.2022).

the Russia-Ukraine war, Belgium intends to minimise its dependence on Russian fossil fuels.

In the meantime, the security and reliability of gas supply issues from other countries will emerge even earlier than the heating season 2022/2023. For instance, after Gazprom ceased natural gas supply to Poland and Bulgaria, natural gas prices spiked up by 24% in Europe, reaching USD 1,200/1,000 m3. The alternative sources of natural gas for the EU countries will be natural gas (in the form of LNG) supplies from Norway, the US, Azerbaijan, Qatar, and Japan. In the coming decade, new gas supplies may come from Africa (Algeria, Niger, Nigeria)[27]. As of 2022, there are 37 operating LNG terminals in Europe; other five are under construction, and 27 are proposed[28]. Some of the large European natural gas consumers do not have the facilities to store it (LNG terminals), such as Germany[29].

The attempts to rapidly build the new infrastructure for LNG, which might take about five years and be above USD 1 billion worth of investments[30], endanger the low-carbon intentions of the EU. Given the carbon divestment trends, these terminals would take many more years to pay back.

The era of fossil fuels has to end, as there are limited options to hit the climate targets. In the meantime, fossil fuel deposits in many countries require new infrastructure and significant investments to deploy the available fossil fuel resources. So, now it is not a matter of changing fossil fuels supply countries; rather, it is a matter of changing the technological paradigms. Thus, the developed world is at the crossroad now: many countries already have established climate targets, and the world is already living in a climate emergency. Thus, more demand reduction (energy saving) coupled with clean energy solutions must be deployed. Currently, climate finance in mitigation and adaptation efforts remains lower than in fossil fuels[31]. Nonetheless, in the view of unreliability of fossil fuels supply globally, some countries may resort to using their phased-out energy facilities. For instance, in July

27 B. Fox (2022). Where is the cash for Europe's dash for gas? 6.04.2022, https://www.euractiv.com/section/politics/short_news/where-is-the-cash-for-europes-dash-for-gas/ (access: 07.07.2022).

28 D. Keane (2022). Europe's rush for energy security through LNG risks fossil fuel lock-in, https://www.energymonitor.ai/tech/decarbonising-gas/europes-rush-for-energy-security-through-lng-risks-fossil-fuel-lock-in (access: 07.07.2022).

29 V. Caon (2022). How did Germany come to be so dependent on Russian gas?, https://www.energymonitor.ai/policy/germany-dependent-russian-gas (access: 07.07.2022).

30 D. Keane (2022). Europe's rush for energy security…, *op. cit.*

31 IPCC (2022). Climate Change 2022: Mitigation of Climate Change, https://www.ipcc.ch/report/ar6/wg3/ (access: 07.07.2022).

2022, Germany claimed its intentions to put back into operation its phased-out coal-fired CHPs, stating that it is a short-term solution, which should not compromise its intention of becoming the first carbon-neutral country by 2045.

The EU and the USA claimed a new plan to reduce the reliance on fossil fuels from Russia and to become on track with climatic goals. It anticipates that the USA's supplies of the LNG to the EU will increase by at least 15 billion m3 in 2022; the supplies are anticipated to take place at least until 2030, which is not welcomed by climate activists, as it does not solve climate problems. Higher imports from the US require new infrastructure (pipelines etc.). The EU intended to phase out fossil fuels anyway, but the Russia-Ukraine war forced the EU to make it faster. Besides, funds obtained from exporting its fossil fuels also fuel the war. To halt it, it is expected that a Fossil Fuel Non-Proliferation Treaty will be expended from nuclear energy to fossil fuels. So far, over 50 cities and 153 thousand people have endorsed it.

Looking for more new climate-friendly technologies to substitute Russian natural gas may spur the development of green hydrogen globally. Considering the potential economy of scale, one may anticipate a significant price decline. Ukraine had to take part in the EU Hydrogen Strategy[32] as one of the priority partners of the Eastern Neighborhood, and to make it possible, the research and pilot projects are to start as fast as the war ends, as nearly half of the hydrogen and hydrogen products are to be imported by the EU in 2050[33].

The already available sanctions, coupled with a clear understanding of the risks and scopes of war, make technological giants leave the Russian market for political reasons, as did Vestas (one of the global leaders in wind turbine manufacturing). Vestas left the Russian market in early March 2022, which means they have ceased two production plants and service of the available turbines in Russia.

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32 EC (2020a). A hydrogen strategy for a climate-neutral Europe. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 8.7.2020 COM (2020) 301 final, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0301&from=EN (access: 07.07.2022).

33 WEC (2021). Decarbonised hydrogen imports into the European Union: challenges and opportunities. World Energy Council, https://www.weltenergierat.de/wp-content/uploads/2021/10/WEC-Europe_Hydrogen-Import-Study.pdf (access: 07.07.2022).

3. Challenges of the EGD for Poland

Poland is a country with a significant reliance on fossil fuels, especially coal (Fig. 3) and oil. In 2021, Poland was the second-largest importer of oil in the EU, having paid Russia over EUR 14 billion for oil imports. Energy imports from other countries reached 47% in 2019, which is a significant indicator, though being nearly 10% p. smaller than the EU average. In 2018, coal comprised 77% of electricity production[34]. It imposes a significant risk to climate neutrality. Fig. 4 below indicates that the primary energy production in Poland has declined. The share of energy from renewables in the energy mix is growing (in 2020, it reached 15% of gross final energy consumption compared to 9% in 2010). Poland has quite limited potential for hydro and solar energy (its annual insolation reaches 1400–1900 hours a year).

In contrast, the Baltic Sea offers good potential for offshore wind energy[35], and the country enjoys abundant biomass resources. The large-scale energy consumers are located mainly in the country's south and not in the north, where large offshore wind power plants could be located. To ensure the development of onshore wind capacities, Poland intends to abolish the law of 2016, providing that a minimum distance of 10 times the height of the onshore wind farm between the station and residential buildings was established, which in reality stopped the development of new projects. According to the new rules, should they be supported by the Parliament, the minimum distance between a wind farm and a residential building is to be 500 meters. Such a legislation amendment will allow the construction of new wind power plants on 7.08% of Poland's territory, 25 times more than now[36].

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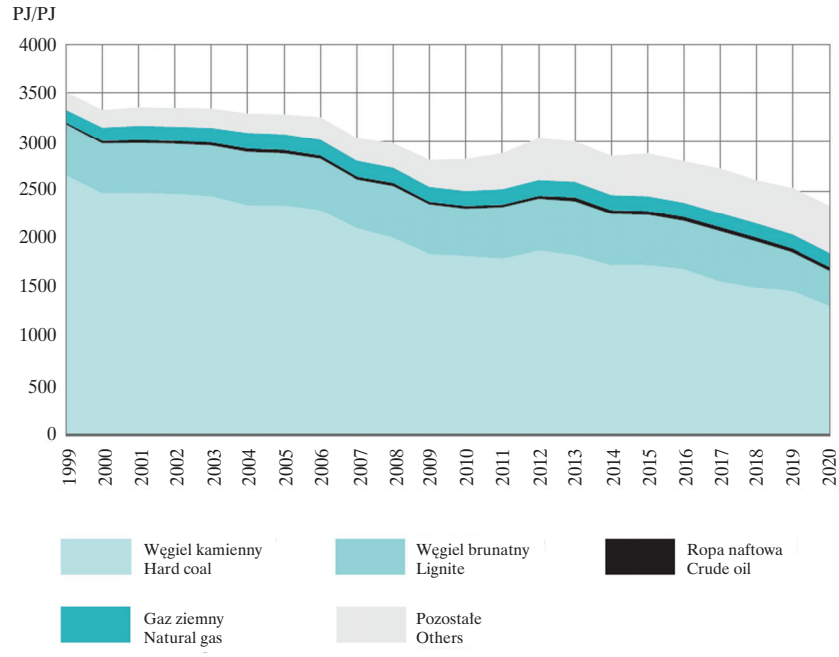
[34] McKinsey & Company (2020). Carbon-neutral Poland 2050, https://www.mckinsey.com/~/media/mckinsey/industries/electric%20power%20and%20natural%20gas/our%20insights/carbon%20neutral%20poland%202050%20turning%20a%20challenge%20into%20an%20opportunity/carbon-neutral-poland-2050.pdf (access: 07.07.2022).

[35] *Ibidem*.

[36] P. Czyżak, M. Sikorski, A. Wrona (2021). *Wiatr w żagle. Zasada 10H a potencjał lądowej energetyki wiatrowej w Polsce*. Instrat Policy Note 01/2021, https://instrat.pl/wp-content/uploads/2021/05/Instrat-Wiatr-w-żagle.pdf (access: 08.07.2022).

Figure 4

Primary energy production in Poland, PJ



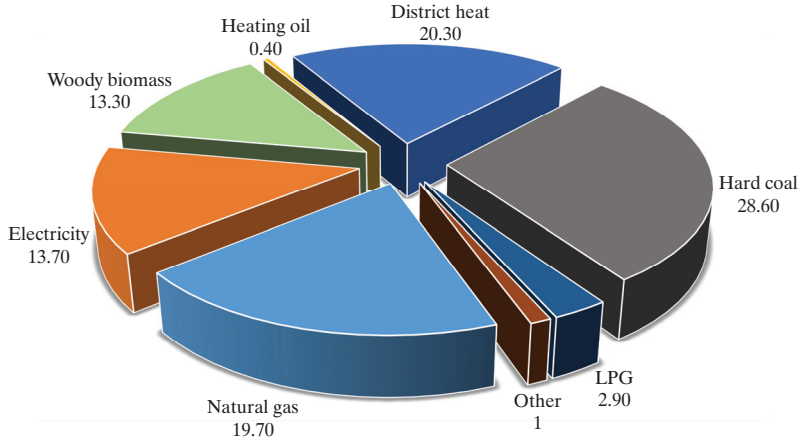
Source: GUS (2021). Energy. Statistics Poland, https://stat.gov.pl/en/topics/environment-energy/energy/energy-2021,1,9.html (access: 11.07.2022).

Figure 4 also indicates the decrease in primary energy output, which occurred due to the enhancing energy efficiency and transition towards a service-based economy (as opposed to the industrial planned economy). As a result, Poland's economy's energy intensity (total final consumption) decreased from 79 toe/million USD in 2010 to 61 toe/million in 2019. Additionally, the COVID-19 pandemic dropped the TFC from 77.3 Mtoe to 75.8 Mtoe in 2020[37]. In the structure of household energy consumption, the share of fossil fuels and their derivatives in 2019 exceeded 95% (Fig. 5).

[37] IEA (2022b). Poland 2022 Energy Policy Review. International Energy Agency, https://iea.blob.core.windows.net/assets/b9ea5a7d-3e41-4318-a69e-f7d456ebb118/Poland2022.pdf (access: 07.07.2022).

Figure 5

Structure of household energy consumption per 1 inhabitant in 2019 in Poland, %



Source: GUS (2021). Energy. Statistics Poland, https://stat.gov.pl/en/topics/environment-energy/energy/energy-2021,1,9.html (access: 11.07.2022).

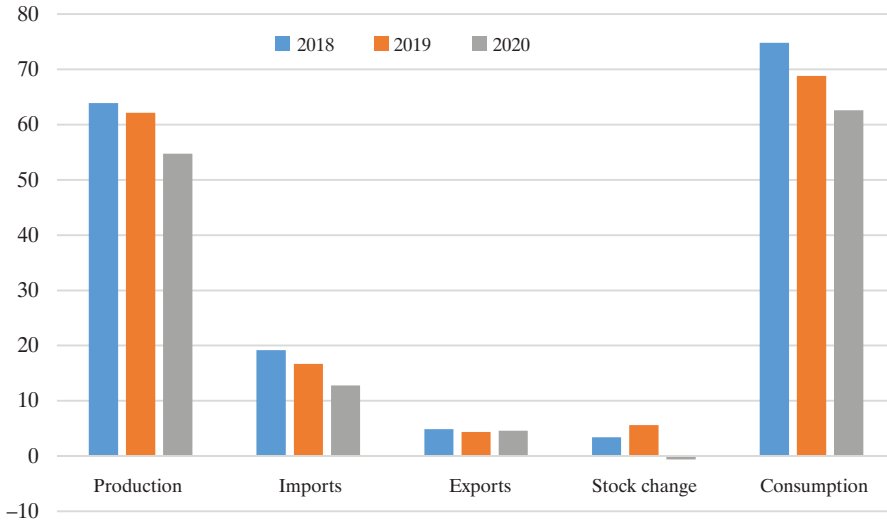
Poland doesn't have nuclear power plants yet. Still, the construction of them is anticipated by the National Energy and Climate Plan until 2040, so that Poland could have the first reactor in 2033 (1–1.6 GW) and the remaining six with a total capacity of 6–9 GW would be commissioned by 2043, which would enable Poland to have up to 16% of nuclear energy in its generation.

Poland has reserves of coal and uses coal intensively. The coal used in Poland is mainly domestically mined (Fig. 6a and 6b). It is an essential consideration from the point of view of employment and just energy transition, as laid-off miners need to be employed elsewhere. As of late 2021, about thirty thousand people were employed in coal mining in Poland[38].

[38] A. Wolska (2022). Fit for 55: What challenges for Poland?, https://www.euractiv.pl/section/energia-i-srodowisko/news/fit-for-55-eu-ets-ets-cbam-european-commission-poland-coalexit-von-der-leyen-timmermans-european-green-deal/ (access: 07.07.2022).

Figure 6a

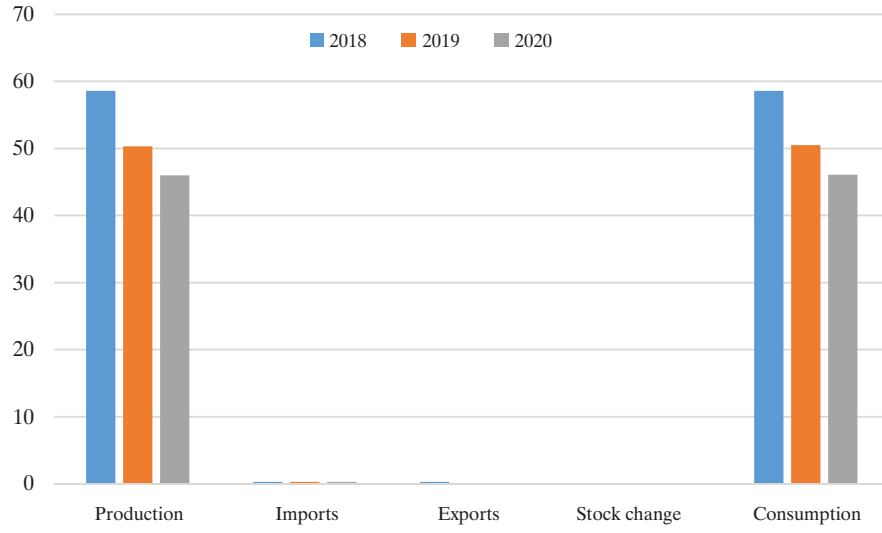
Balance of hard coal in Poland in 2018–2020, million t



Source: GUS (2021). Energy. Statistics Poland, https://stat.gov.pl/en/topics/environment-energy/energy/energy-2021,1,9.html (access: 11.07.2022).

Figure 6b

Balance of lignite in Poland in 2018–2020, million t



Source: GUS (2021). Energy. Statistics Poland, https://stat.gov.pl/en/topics/environment-energy/energy/energy-2021,1,9.html (access: 11.07.2022).

In the case of lignite, imports and exports are negligible, whereas stock change was non-existent. Fig. 6a and 6b indicate that hard coal and lignite consumption decreases over time except for 2021, which is not shown in Fig. 6a and 6b when coal demand increased significantly[39].

Economic recovery after the COVD-19 pandemic resulted in the growing demand for energy covered with fossil fuels, which does not allow Poland to be on track with the needed CO2 emissions reduction. Overall in Poland, EGD has two main cornerstones – the substitution of coal and the development of renewable energy[40]. Overall, coal in Poland is essential from the point of view of both economic and energy security[41]. Still, it is also a massive source of GHG emissions: in 2018, average emissions in Poland reached 682 gCO2eq/kWh compared to the EU average of 296 gCO2eq/kWh[42].

According to McKinsey, Poland has to triple its rate of decarbonization in 2020–2030 compared to 1990–2020, and even faster decarbonization will be needed in 2030–2050 to become a net-zero emissions economy in 2050.

Poland's National Energy and Climate Plan until 2040 anticipates that there will be no new coal-fired power plants, whereas the energy demand is going to grow. Partially, it will be covered by nuclear energy from 2033. Gradual commissioning of new nuclear units will lead to the overall installed capacities of 6-9 GW[43].

In our opinion, in the light of the Russia-Ukraine war, when the potential renaissance of coal is possible in many countries (e.g. in Germany), in the short run, there is a risk of slowing down the coal phase-out in Poland. It is worth noting that such renaissance would be possible only with the use of the domestic coal, as in the EU currently there is an embargo on coal from the Russian Federation. However, even slower phase-out pace is still in line with Poland's commitment to phase out coal by 2049, for which a social contract between the Government and coal trade unions was established in 2021. The agreement presumes that hard coal miners will have employment until retirement, or a severance package will be guaranteed. This is the case only

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39 IEA (2022b). Poland 2022 Energy Policy Review…, *op. cit.*

40 K. Tomaszewski (2020). *The Polish road to the new European Green Deal – challenges and threats to the national energy policy*, Polityka Energetyczna – Energy Policy Journal 2020, nr 23(2), s. 5–18.

41 H. Nyga-Łukaszewska, K. Aruga, K. Stala-Szluga (2020). *Energy Security of Poland and Coal Supply: Price Analysis*, "Sustainability" 2020, vol. 12, pp. 1–18.

42 K. Tomaszewski (2020). *The Polish road to the new European Green Deal…*, *op. cit.*

43 NECP (2019). Krajowy plan na rzecz energii i klimatu na lata 2021–2030. Ministerstwo Aktywów Państwowych, http://surl.li/bzrvp (access: 07.07.2022).

for hard coal, while there are no targets and no intentions to phase out the lignite-based generation[44]. Still, measures are undertaken to ensure the just energy transition, including, but not limited to, the creation of new infrastructure (as in the Silesian Voivodeship, where the IT cluster emerged). To ensure just energy transition, significant subsidies were made for Poland's coal phase-out: according to the EC and the OECD, in 2008–2018, fossil fuel (mostly coal) subsidies in Poland reached EUR 0.5–1.8 billion per year[45].

As in the EU, GHG emissions in Poland are regulated by the EU Emissions Trading Scheme (ETS). In Poland, the EU ETS covered 47% of all CO2 emissions in 2019. In the view of Fit for 55, the EU ETS presumes a drastic reduction of carbon emissions, which requires significant investments in Poland's industry and energy sector, and thus is considered difficult to achieve[46]. In 2021, the national emission fee was only 0.07 EUR/t CO2, compared to the ETS price of 89 EUR/t CO2[47]. According to McKinsey assessments of 2020, decarbonization would require significant investments – EUR 10–13 billion a year, or 1–2% of GDP annually, within the last 30 years[48]. According to the NECP, its measures would require EUR 195 billion during 2021–2030, or 3.5% GDP, whereas the overall cost of energy transition in 2021–2040 would cost EUR 350 billion[49], of which EUR 72 billion by 2030 would come from national funds, while the remainder – from the EU funds and private capital.

4. Role of Ukraine in the EGD and its challenges for post-war Ukraine

Ukraine had announced its intention to join the EGD even before the country gained the status of the EU Candidate country in June 2022, also planning to renew and modernise its important industries (clean energy, industry, mobility, pollution reduction, climate action). In 2021, Ukraine still had its

44 IEA (2022b). Poland 2022 Energy Policy Review…, *op. cit.*

45 EC (2020b). Final Report Energy Subsidies, https://op.europa.eu/en/publication-detail/-/publication/92ae71b0-173a-11eb-b57e-01aa75ed71a1/language-en (access: 07.07.2022).

46 A. Wolska (2022). *Fit for 55: What challenges for Poland…*, *op. cit.*

47 IEA (2022b). Poland 2022 Energy Policy Review…, *op. cit.*

48 McKinsey & Company (2020). Carbon-neutral Poland 2050…, *op. cit.*

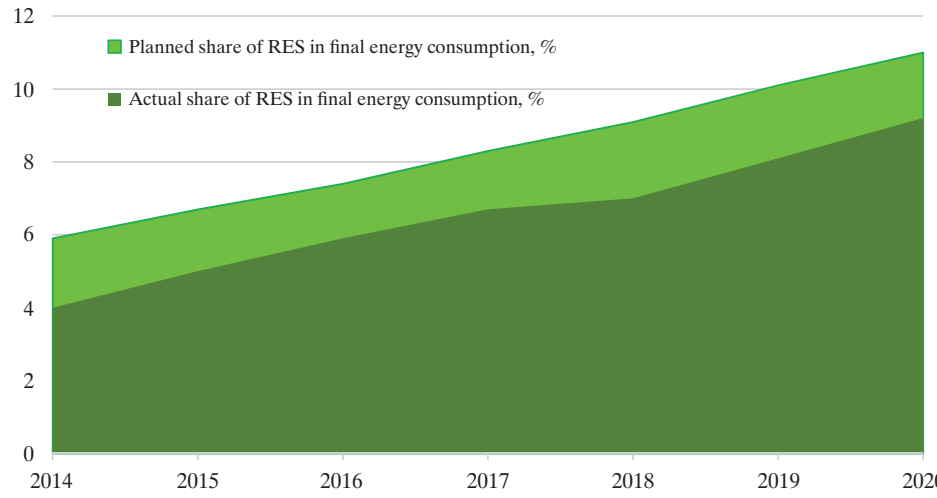
49 NECP (2019). Krajowy plan na rzecz energii i klimatu…, *op. cit.*

carbon emissions at the level of 0.3 kg CO2/EUR GDP compared to the EU-27 average of 0.05 kg CO2/EUR GDP[50].

The carbon border adjustment mechanism (CBAM) is an important issue requiring special attention and preparation. The latter will increase the cost of importing carbon-intensive products; so exporting some products to the EU will be unprofitable. However, as a result of the Russian-Ukrainian war, Ukraine should postpone the entry into force of the CBAM[51]. Before the war, Ukrainian producers tried to use at least part of their electricity from renewable sources. In 2020, the share of energy from renewable sources in the energy balance was 9.2% (including large hydropower plants), which is 1.1% more than in 2019. According to the 2020 National Renewable Energy Action Plan, in 2020, this share was to be 11%, i.e. the gap was 1.8% (Fig. 7).

Figure 7

Share of energy from renewable sources in final energy consumption in Ukraine, %



Source: SAEE (2021). Reaching the targets of 2020 National Renewable Energy Action Plan. State Agency for Energy Efficiency and Energy Saving of Ukraine, https://saee.gov.ua/uk/news/4043 (access: 11.07.2022).

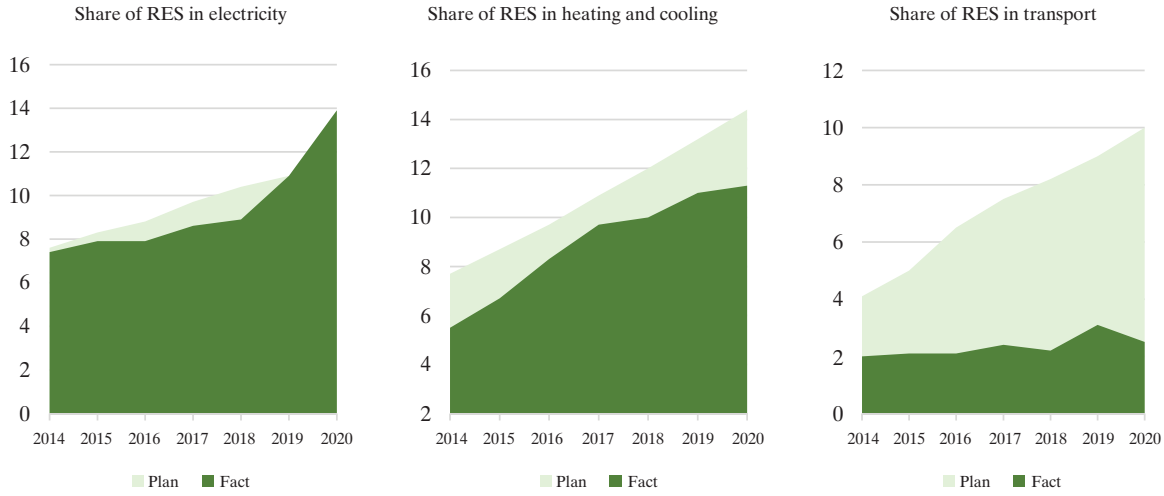
50 EnCom (2022). Energy Community Secretariat's Energy Transition Tracker 07/2022. Energy Community, https://www.energy-community.org/news/Energy-Community-News/2022/07/07.html (access 13.07.2022).

51 UAEnergy (2022). Expert: the energy system needs monthly support of 250 million euros, https://ua-energy.org/uk/posts/ekspert-enerhosystema-potrebuie-shchomisiachnoi-pidtrymky-na-250-mln-ievro (access: 07.07.2022).

The share of RES in electricity generation was a record 13.9%, in the heating and cooling system – 9.3%, and in the transport sector – 2.5% (Fig. 8). In other words, the actual indicators of electricity generation were ahead of the planned ones. According to the results of 2020, this indicator corresponds to the target of 2030, defined by the Energy Strategy of Ukraine for the period up to 2035[52].

Figure 8

Actual and planned energy consumption from RES in Ukraine, %



Source: SAEE (2021). Reaching the targets of 2020 National Renewable Energy Action Plan. State Agency for Energy Efficiency and Energy Saving of Ukraine, https://saee.gov.ua/uk/news/4043 (access: 11.07.2022).

The most significant lag in achieving the NREAP2020 was observed in transport. The reasons for the lag are the lack of blending mandate requirement, over-regulation of the industry, as well as the significant growth of electric vehicles fleet. Despite such a significant lag in reaching the targets in the transport sector, Ukraine was still well ahead with its target compared to other Energy Community Contracting Parties[53]. Due to the destruction of the Kremenchuk oil processing plant and other oil-processing facilities during the war, in 2022, Ukraine turned into a nett-importer of oil products such as

[52] EnCom (2022). Energy Community Secretariat's Energy Transition Tracker 07/2022…, *op. cit.*

[53] *Ibidem*.

petrol and diesel. Given the fact that Ukraine has high amounts of grain that are impossible to export due to the blockade of marine ports by the Russian fleet, as well as bioethanol production facilities (124 thousand tons/year with the possibility of increasing those to more than 300 thousand tons/year), Ukraine could produce its bioethanol.

As of July 2022, there are ongoing active discussions regarding the target of renewable energy for 2030. Before the war, Ukraine developed the draft of the National Renewable Energy Action Plan until 2030 but did not have the possibility to adapt it. NGOs such as Solar Power Europe, and Wind Europe, together with the respective Ukrainian counterparts, encourage the country to set a target of 40% RES in the energy mix, which would be in line with the European targets. In our opinion, the target mentioned above is too ambitious, as the duration of war is not known yet, as well as the structure of the remaining generation capacity.

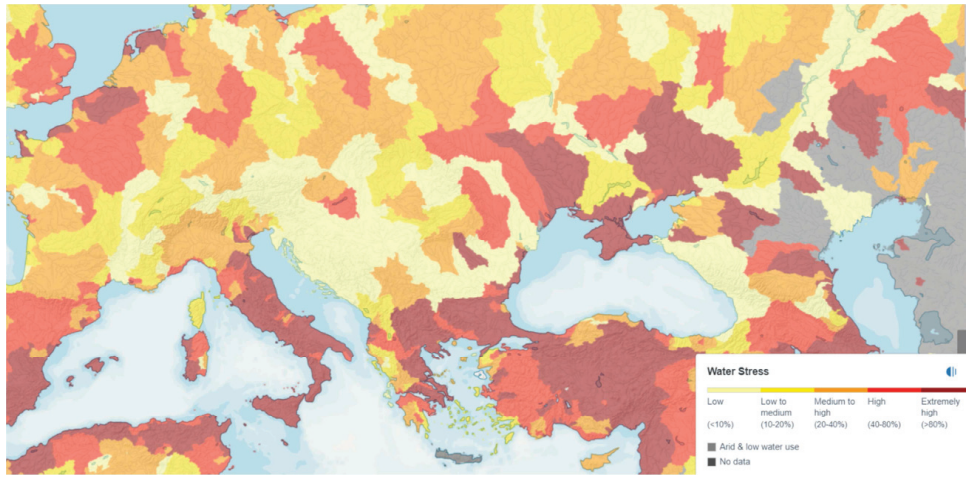
The EU's Hydrogen Strategy has been approved under the EGD. According to the latter, the EU is cooperating with Ukraine; in particular, the production of green hydrogen (i.e. the one produced from renewable energy) and its further export to the EU countries is expected. In 2020, the European Clean Hydrogen Alliance was established. It is projected that green hydrogen will be produced from wind energy in Ukraine. According to estimates by the Institute of Renewable Energy of the National Academy of Sciences of Ukraine and the World Bank, Ukraine has a significant potential for offshore wind energy (250 GW), which can produce up to 19.5 million tons of green hydrogen.

Most offshore wind farms can be located in the south of Ukraine. Since there are almost no large industrial consumers, the electricity of offshore wind farms can be used to produce green hydrogen, and the offshore wind farms themselves do not need to be connected to the United Power System of Ukraine. The primary consumers of green hydrogen can be the transport industry, heavy industry, and district heating. In heavy industry, hydrogen can be used to produce methanol for polymers. Hydrogen can also be a source of ammonia, used as fertilizer, i.e. to replace natural gas. In 2020, the consumption of ammonium nitrate in Ukraine exceeded 2 million tons, and urea-ammonium mixture – by 0.9 million tons. Domestic production of conventional ammonia fertilizers is declining due to increased competition from producer countries in the years of cheap natural gas. Therefore, using green hydrogen to produce ammonia fertilizers in Ukraine should take into account the relevant consequences of fertilizer production costs while improving Ukraine's agricultural and economic security. Ukraine can be

a significant exporter of green hydrogen to the EU countries. As of July 2022, the possibility of creating up to 10 GW of electrolyzers for green hydrogen was considered. However, water availability for green hydrogen production is essential, as Ukraine is a water-deficient country[54]. Water scarcity is expected to persist in the future and even increase due to projected climate change (Fig. 9), so Ukraine will experience even more significant water shortages.

Figure 9

Projected water stress level in 2040



Source: Aqueduct (2022). Water Risk Atlas, http://bit.ly/water-risk-atlas (access: 11.07.2022).

At the current stage of technology development (i.e. at 3–5 USD/kg of green hydrogen), it is expected that hydrogen will be exported mainly to the EU. Therefore, there is a conflict of interest – Ukraine needs to spend water on a product that is not intended for consumption in the domestic market.

The Ukrainian power system has a significant need for balancing, which is further deepened as the share of energy from RES in the electricity balance increases. While wind-based electricity can hypothetically be generated at any time of the day when there is wind, including at night, solar-based electricity is generated a maximum of half the time. Ukraine has a severe shortage of maneuverability, and Ukraine's energy system is one of the least

[54] S. Snizhko, O. Shevchenko, Yu. Didovets (2021). *Analysis of the Climate Change Impact on the Water Resources of Ukraine*. NGO "Ecoaction", https://ecoaction.org.ua/wp-content/uploads/2021/06/analiz-vplyvu-vodni-resursy-full.pdf (access: 07.07.2022).

flexible energy systems in the world[55]. Integration with the ENTSO-E is expected to partially reduce this problem over time, but in 2020 renewable energy, including intermittent energy sources, was even accused by Ukraine of threatening Ukraine's energy security due to destabilization of the energy system due to uncontrolled production of green electricity. It indicates certain unpreparedness not only of the power system to accept a larger share of electricity from RES but also the relative unpreparedness of state institutions for the development of renewable energy. In contrast, plans to increase electricity production from renewable sources were announced in 2014 with the adoption of the National Renewable Energy Action Plan until 2020.

The energy from coal-fired power plants is used to balance the energy system in Ukraine, so the so-called green-coal paradox is observed. Due to the growing share of solar and wind energy, the dependence on thermal generation for balancing the energy system is growing, so the growth of electricity generation from RES leads to an increase in greenhouse gas emissions. To solve the balancing problem, at least 2 GW of highly maneuverable capacity would be needed to integrate RES into the Ukrainian power system in the coming years[56]. The capacity of energy storage devices should reach 500 MW. RES must also provide a load reduction service, i.e. become one of the sources of power system flexibility. Power-to-Gas (P2G) technology must be introduced to convert excess energy into gas, producing electricity to meet peak loads. At the same time, it is necessary to introduce smart grids, as well as measures to manage demand and involve energy consumers in balancing the grid, for example, charging electric vehicles at night, when energy demand is lowest[57]. Household electricity generation also helps increase network flexibility. After the green tariff for domestic installations expires in 2029, incentives for the use of solar energy and storage should be introduced.

In Ukraine, private companies MHP Agro and DTEK build private energy storage systems. MHP implements the technology of the Battery Energy

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55 Wärtsilä (2020). The Optimal Path Forward for Ukraine's Power System. White paper on power system optimization, https://www.finnishenergyhub.com/post/оптимальний-шлях-розвитку-енергетичної-системи-україни (access: 07.07.2022).

56 NCREU (2021). Resolution of the NCREU dated 16.06.2021 No. 975: "On the approval of the Report on the assessment of the adequacy (sufficiency) of generating capacities to cover the forecasted demand for electric energy and ensure the necessary reserve in 2020".

57 K. Krynytsky, O. Aliyeva (2020). *The green-coal paradox*, https://ua.boell.org/uk/2020/06/09/zeleno-vugilniy-paradoks-zupiniti-ne-mozhna-dozvoliti-de-koma (access: 07.07.2022).

Storage System. The project will be launched in four phases: three phasesof 5 MW/5 MWh each and the fourth one of 10 MW/10 MWh. In February 2022, the Law of Ukraine "On Amendments to Certain Laws of Ukraine on the Development of Energy Storage Plants"[58] was adopted, i.e. the legal framework for developing this technology is being created.

Despite the ongoing war in Ukraine, there are plans for post-war recovery. The complete vision of recovery was presented at Ukraine Recovery Conference in Lugano, Switzerland, in July 2022. As for energy, it anticipates the allocation of USD 130 billion within the next ten years (out of USD 750 billion needed by the entire economy). It is important to note that it is claimed that these funds will be allocated for energy independence and the EGD. It anticipates the reconstruction of damaged energy facilities, including the several thermal power plants; extension of operating terms of existing nuclear power units and construction of 2 new units at the Khmelnytska NPP; localization of the value chain in the nuclear sphere (construction of fuel production plant, waste storage); localization of production of RES equipment and increase of RES capacity to 30 GW, of which 7.1 GW would be used for electricity output, whereas 10 GW would be used for green hydrogen output; 17 GW of renewables would operate to export eletricty to the EU; construction of 3.5 GW hydroelectric power stations and pumping hydroelectric power stations; construction of peak capacities of 1.5–2 GW and batteries with a capacity of 750 MW; expansion of power export capacities up to 7 GW; increase of domestic natural gas mining, which should yield up to 14.2 billion cubic meters of gas per year; creation of reserves of oil and oil products for more than 30 days; recovery of the destroyed Kremenchug Refinery and re/construction of an additional refinery; access to the LNG terminals in Poland, Greece, Croatia, Turkey, Italy, and Germany; construction of 15 GW of electrolysers.

During COP-26 in Glasgow, Ukraine announced the abandonment of coal in the state-owned electricity generation until 2035[59], joining Powering Past Coal Alliance. State-owned generation takes about 30% of the entire country's energy generation. The remaining generation is commenced primarily by vertically integrated energy holding DTEK Group, responsible for 90% of all coal mined in Ukraine and who possesses 75% of heat generation assets

[58] SCU (2022). Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Development of Energy Storage Installations" dated 15 February 2022 No 2046-IX. Supreme Council of Ukraine, https://zakon.rada.gov.ua/laws/show/2046-IX#Text (access: 07.07.2022).

[59] K. Krynytsky, O. Aliyeva (2020). *The green-coal paradox…*, *op. cit.*

in Ukraine, i.e. nine CHPs[60]. It announced its carbon neutrality by 2040[61]. To ensure coal phase-out, companies generating energy must implement the National Plan for Reducing Emissions from Large Combustion Plants[62]. The Plan is designed to reduce emissions of sulfur dioxide, nitrogen oxides, and dust from large combustion plants with a total thermal capacity of at least 50 MW. At the end of the Plan's action period, each incineration plant must comply with Directive 2010/75/EU requirements on emissions of the above pollutants. There is a high probability that the Plan will not be implemented because coal-fired energy-generating CHPs are outdated and require significant modernization. Still, it makes no sense from an economic point of view. Even though the National Plan for Reducing Emissions from Large Combustion Plants was approved in 2017 and enacted in 2018, its full entry into force was partially postponed several times (however, without changing its horizon year). So, there is a legislative framework in place supporting the coal phase-out. However, one of the negative externalities of carbon-neutrality is the need for socially just transformation of coal regions and the need to employ the laid-off coal miners. Should the state-owned coal mines be closed, nearly 55 thousand jobs are expected to be lost in the mining and electricity sectors[63]. The so-called coal regions in Ukraine are those in Volyn, Dnipropetrovsk, Donetsk, Luhansk, and Lviv regions, where about 850 thousand inhabitants reside. Coal-related companies are often city forming (about 65 mono-cities in Ukraine), and coal is often the only available energy carrier[64]. These are partially the reasons for the extremely high subsidies level for the coal industry in Ukraine: in 2015–2017, these subsidies reached EUR 1,185 billion, and in 2018–2019 alone, these subsidies in Ukraine reached EUR 751.5 million, being the highest amongst all the

60 Ecoaction (2022). Ukrainian CSO statement to world leaders…, *op. cit.*

61 DTEK (2022). https://energo.dtek.com/en/ (access: 08.07.2022).

62 CMU (2017). Decree of the CMU dated 8 November 2017 No. 796-r "On the National Plan for Reducing Emissions from Large Combustion Plants". Cabinet of Ministers of Ukraine, https://zakon.rada.gov.ua/laws/show/796-2017-p#Text (access: 08.07.2022).

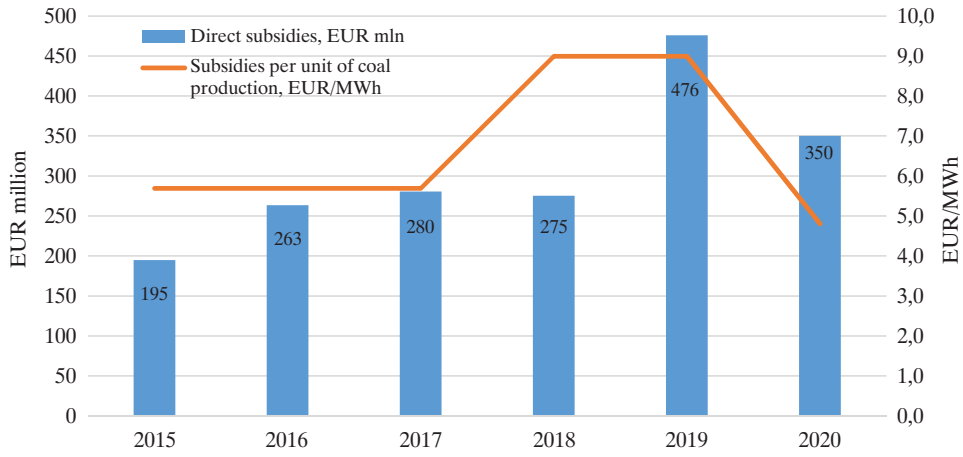
63 M. Preuss, O. Mykhailenko, I. Sabaka, B. Probst, P. Baum, O. Aliieva (2021). *The economic implications of phasing out coal in Ukraine by 2030*, https://ua.boell.org/sites/default/files/2021-08/21-08_03_Economic%20implications%20of%20Ukrainian%20coal%20exit.pdf (access: 08.07.2022).

64 CMU (2021). Resolution of the CMU dated 22 September 2021 No. 1024 "On approval of the Concept of the State target program for the fair transformation of the coal regions of Ukraine for the period until 2030". Cabinet of Ministers of Ukraine, https://zakon.rada.gov.ua/laws/show/1024-2021-n#Text (access: 08.07.2022).

Energy Community Contracting Parties[65] (Fig. 10). In 2020 Ukraine provided the largest coal subsidies amongst all the Energy Community Contracting Parties in both relative and absolute terms[66].

Figure 10

Direct subsidies to coal industry (EUR million) and per MWh produced in Ukraine



Source: D. Miljević (2020). *Investments into the past. An Analysis of Direct Subsidies to Coal and Lignite Electricity Production in the Energy Community Contracting Parties 2018–2019*. Energy Community; EnCom (2022). Energy Community Secretariat's Energy Transition Tracker 07/2022. Energy Community, https://www.energy-community.org/news/Energy-Community-News/2022/07/07.html (access 13.07.2022).

Just energy transition faces numerous challenges; particularly, coal miners in Ukraine have relatively good salaries (even though mining is subsidized), and these salaries are difficult to substitute in other industries. In Ukraine, the debate on just energy transition has already begun, driven chiefly by NGOs (such as H. Boell Foundation, EcoAction, Germanwatch, and others) and by the UNDP and academia. Studies indicate that in Ukraine, the economic costs associated with current coal production could be higher than the cost of new renewable electricity generation capacities. Besides, existing state-owned coal mines in Ukraine are incredibly unprofitable. The losses of

65 D. Miljević (2020). *Investments into the past. An Analysis of Direct Subsidies to Coal and Lignite Electricity Production in the Energy Community Contracting Parties 2018–2019*. Energy Community.

66 EnCom (2022). Energy Community Secretariat's Energy Transition Tracker 07/2022…, *op. cit.*

state-owned mines reach EUR 230/t of mined coal; thus, the closure of these mines will reduce government expenditures by 35%, even considering the costs of decommissioning and compensation for workers[67].

The problem of coal phase-out and just energy transition is extraordinarily complex and long-term. There are no simple one-fits-all solutions for numerous reasons, in particular, because Ukrainians tend to be relatively less socially mobile (taking into consideration internal mobility) compared to people in other countries, such as Germany (during their coal-phase out)[68] or in the USA. Other countries that have already commenced coal phase-out started this process much earlier. E.g., Germany began the process in the 1990s, and the role of coal in the energy balance of the United Kingdom began to decline as early as in the 1980s, allowing the country to claim coal phase-out by 2024/2025[69]. The coal phase-out process is financially supported: e.g., EUR 14 billion is allocated in Germany until 2038 for mining regions. Additionally, EUR 26 billion will be distributed by the Federal Government for infrastructure, research, and expansion of the existing support policies for coal regions. Cumulative adjustment allowance for laid-off miners will reach EUR 5 billion in 2020–2048.

In Ukraine, the first steps towards coal phase-out are already taken, such as creating the Coordination Center for the Transformation of Coal Regions in 2020[70]. It includes the Prime Minister of Ukraine as its Chair, key Ministries, and several coal-mining town-members such as Vugledar, Torestk, and Myrnohrad. In 2019, a Platform for Sustainable development of coal-mining cities in the Donetsk region was formed, comprising six coal towns with three others to join[71]. In 2021, the Parliament approved the Concept of

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67 M. Preuss, O. Mykhailenko, I. Sabaka, B. Probst, P. Baum, O. Aliieva (2021). *The economic implications of phasing out coal in Ukraine by 2030…*, *op. cit.*

68 P-Yu. Oei, H. Brauers, Ph. Herpich (2020). *Lessons from Germany's hard coal mining phase-out: policies and transition from 1950 to 2018*, "Climate Policy" 2020, vol. 20(8), pp. 963-979.

69 H. Brauers, P.-Yu. Oei, P. Walk (2020). *Comparing coal phase-out pathways: The United Kingdom's and Germany's diverging transitions*, "Environmental Innovation and Societal Transitions" 2020, vol. 37, pp. 238–253.

70 CMU (2020). Resolution of the CMU dated 13 May 2020 "On the establishment of the Coordinating Center for the Transformation of the Coal Regions of Ukraine'. Cabinet of Ministers of Ukraine, https://www.kmu.gov.ua/npas/pro-utvorennya-koordinacijnogo-centr-a391 (access: 08.07.2022).

71 Ecoaction (2019). Memorandum on Partnership and creation of the Platform of sustainable development of coal cities of Donetsk region, https://ecoaction.org.ua/wp-content/uploads/2019/05/memorandum-shahtarskyh-mist.pdf (access: 08.07.2022).

the State Target Program of Just Transformation of Coal Regions of Ukraine until 2030[72].

However, these measures only indicate an intention *to approach* the problems related to the coal phase-out. Particular efforts must be undertaken primarily concentrated in the so-called social dimension. They might include:

1. Defining a Ministry responsible for coal phase-out and social consequences. Currently, the Ministry of Energy is said to be responsible for the actual phase-out in Ukraine. No Ministry or Office is responsible for the employment of laid-off miners or social programmes.
2. Training programmes enabling the laid-off miners to acquire new knowledge and skills in areas offering a perspective during the next decade. The central or regional government should pay for these training programmes (i.e. they should constitute one of the forms of subsidies). In some cases, these can be training enabling miners to work at the renewable energy facilities, as it was in Canada[73]:
   - Stocktaking of jobs and industries available in the coal regions.
   - If applicable, invitation of large employers to the respective regions. They might include large foreign auto manufacturers or international appliance producers after the war's end. Such a job replacement is possible in Lviv and Volyn regions, located close to the EU borders.
   - Financial support for the creation of new jobs (subsidies could be provided to companies employing the former coal miners);
   - Enhanced job-seeking assistance by labour registry offices;
   - Simplification of bureaucratic procedures to obtain severance pay;
   - Allocation of funds by companies that undertake mining to cover the environmental damages and ensure site restoration;
   - Development of programs aimed at switching from coal as an energy carrier to other energy carriers.

Conclusions

Climate change forced the EU to commit to becoming the first carbon-neutral continent by 2050, embodied in the respective legislation. The main regulatory framework includes the European Green Deal, and its provisions are

[72] CMU (2021). Resolution of the CMU dated 22 September 2021 No. 1024…, *op. cit.*

[73] G. Trypolska (2021). *Prospects for employment in renewable energy in Ukraine, 2014–2035*, "Int. J. Global Energy Issues" 2021, vol. 43, pp. 436–457.

incorporated in the European Climate Law, setting a target of net-zero greenhouse gas emissions by 2050. To achieve climate neutrality by 2050, there is an ambitious intermediate goal of GHG emissions reduction by 55% by 2030.

The Russia-Ukraine war underpinned European intention of climate neutrality and seems to force Europe to achieve its targets faster by substituting fossil fuels with more climate-friendly technologies and enhancing energy saving and by means of changing energy strategies of the countries within the EU and beyond. Should the provisions of the particular plan REPowerEU be obeyed, coal use would decline without compromising the EU Green Deal even in the short run. Including nuclear energy in the Green EU taxonomy will lead to the renaissance of nuclear power globally, including the development of small nuclear reactors technology.

Poland significantly relies on fossil fuels, especially coal, and on oil to a smaller extent, being the second largest importer of oil in the EU from the Russian Federation. The share of energy from renewables in the energy mix of Poland was growing and projected to grow, especially at the account of offshore and onshore wind energy and biomass. Still, in the structure of household energy consumption, the share of fossil fuels and their derivatives in 2019 exceeded by 95%. Poland has coal reserves and uses them intensively. The coal used in Poland is mainly domestically mined; thus, phasing out coal requires new employment opportunities for laid-off miners. Poland is not yet on track with the needed CO2 emissions reduction. Poland has to triple its rate of decarbonization in 2020–2030 compared to 1990–2020, and faster decarbonization will be required in 2030–2050 to become a net-zero emissions economy by 2050. In the short run, there is a risk of slowing the coal phase-out in Poland. According to Fit for 55, the EU ETS presumes a reduction of carbon emissions, which requires significant investments in Poland's industry and energy sector, and thus is considered difficult to achieve.

Ukraine has the intention to join the EGD. In 2020, the share of energy from renewable sources in the energy mix was 9.2%. According to the 2020 National Plan for Renewable Energy, in 2020, this share was to be 11%. The target for renewable energy for 2030 is yet to be established. There are several possibilities for Ukraine to join the EGD, particularly using green hydrogen output, including its further export to the EU, electricity exports to the EU due to integration with the ENTSO-E, and coal phase-out. The abandonment of coal in the state-owned electricity generation is announced by 2035. After the war's end, Ukraine plans to renew its outdated energy-generating infrastructure with the help of recovery packages. The new infrastructure will align with the EGD's provisions for energy.

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The European Green Deal in Energy Sector: Challenges and Possibilities for Poland and Post-War Ukraine

Abstract

This paper explores the evolution of EU energy policies leading to the European Green Deal (EGD), highlighting the impact of the Russia-Ukraine war on these policies. The EGD, enshrined in the European Climate Law, commits the EU to achieving carbon neutrality by 2050. It involves reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990. The EU's journey towards carbon neutrality faces multifaceted challenges, with the Russia-Ukraine war introducing geopolitical uncertainties. The paper explores the development of EU energy legislation, notably the Fourth

Energy Package, and its integration with climate goals. It also examines the impact of the Russia-Ukraine war on EU energy policies, which has led to a reassessment of energy supply sources and increased emphasis on renewables and energy efficiency. The article delves into Poland's challenges as it strives to align with the EGD. Poland's transition from coal-dominated energy production to renewables and nuclear energy poses economic and employment challenges and the need for substantial investments. Despite these challenges, the EU's commitment to reducing carbon emissions and geopolitical developments is pushing Poland towards a more sustainable energy future. Ukraine's role in the EGD and its challenges in a post-war context are complex and multifaceted. Ukraine's commitment to join the EGD is a significant step towards aligning its environmental and energy policies with European standards. The country's cooperation with the EU on green hydrogen production is a positive development, even though Ukraine's water scarcity is a concern. Ukraine faces challenges related to energy system flexibility, especially as the share of renewable energy sources increases. The country's commitment to phasing out coal in state-owned electricity generation by 2035 is commendable. Ensuring a just transition for coal miners and coal-dependent regions is a complex and long-term task. Securing adequate financial support for Ukraine's transition to a green economy, including energy independence and EGD compliance, is crucial. Effective planning, international cooperation, and support for a just transition will be essential for Ukraine to achieve its environmental and energy goals while addressing the complexities arising from the war.

Keywords: the European Green Deal, Poland, Ukraine, energy policy, the Russia-Ukraine war, carbon neutrality

Europejski Zielony Ład w energetyce: wyzwania i możliwości dla Polski i powojennej Ukrainy

Streszczenie

W opracowaniu zbadano ewolucję polityk energetycznych UE prowadzącą do Europejskiego Zielonego Ładu (EGD), podkreślając wpływ wojny rosyjsko-ukraińskiej na tę politykę. Dyrektywa EGD, zapisana w europejskim prawie klimatycznym, zobowiązuje UE do osiągnięcia neutralności pod względem emisji dwutlenku węgla do 2050 r. Obejmuje ona redukcję emisji

gazów cieplarnianych netto o co najmniej 55% do 2030 r. w porównaniu z 1990 r. Dążenie UE do neutralności pod względem emisji dwutlenku węgla stoi w obliczu wieloaspektowych wyzwań, przy czym wojna rosyjsko-ukraińska wprowadza niepewność geopolityczną. W artykule zbadano rozwój prawodawstwa energetycznego UE, w szczególności Czwartego Pakietu Energetycznego, i jego integrację z celami klimatycznymi. Dokonano także analizy wpływu wojny rosyjsko-ukraińskiej na politykę energetyczną UE, co skłoniło autorkę do ponownej oceny źródeł dostaw energii i zwiększonego nacisku na odnawialne źródła energii i efektywność energetyczną. Autorka analizuje wyzwania stojące przed Polską w dążeniu do dostosowania się do EGD. Przejście Polski z produkcji energii opartej na węglu na odnawialne źródła energii i energię jądrową stwarza wyzwania gospodarcze i związane z zatrudnieniem oraz potrzebę znacznych inwestycji. Pomimo tych wyzwań zaangażowanie UE w redukcję emisji gazów cieplarnianych oraz rozwój sytuacji geopolitycznej popychają Polskę w kierunku bardziej zrównoważonej przyszłości energetycznej. Rola Ukrainy w EGD i stojące przed nią wyzwania w kontekście powojennym są złożone i wieloaspektowe. Zaangażowanie Ukrainy w przystąpienie do EGD stanowi znaczący krok w kierunku dostosowania jej polityki w aspekcie ochrony środowiska i energii do standardów europejskich. Współpraca tego kraju z UE w zakresie produkcji ekologicznego wodoru jest pozytywnym zjawiskiem, mimo że niedobór wody na Ukrainie stanowi problem. Ukraina stoi przed wyzwaniami związanymi z elastycznością systemu energetycznego, zwłaszcza w związku ze wzrostem udziału odnawialnych źródeł energii. Godne pochwały jest zobowiązanie kraju do wycofywania węgla z państwowej produkcji energii elektrycznej do 2035 r. Zapewnienie sprawiedliwej transformacji górnikom i regionom zależnym od węgla jest zadaniem złożonym i długoterminowym. Kluczowe znaczenie ma zapewnienie odpowiedniego wsparcia finansowego na rzecz przejścia Ukrainy na gospodarkę ekologiczną, w tym niezależności energetycznej i zgodności z dyrektywą EGD. Skuteczne planowanie, współpraca międzynarodowa i wsparcie na rzecz sprawiedliwej transformacji będą miały zasadnicze znaczenie dla osiągnięcia przez Ukrainę celów środowiskowych i energetycznych, przy jednoczesnym uporaniu się ze złożonymi kwestiami wynikającymi z wojny.

Słowa kluczowe: Europejski Zielony Ład, Polska, Ukraina, polityka energetyczna, wojna rosyjsko-ukraińska, neutralność węglowa

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