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RENEWABLE ENERGY SOURCES AS A WAY TO PREVENT CLIMATE WARMING IN POLAND

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ABSTRACT: The discussion on renewable energy sources, especially wind and solar energy, conducted in Poland reveals diverse positions among representatives of science, business, local government, and government. It is generally accepted that renewable energy sources are an important factor in limiting global warming. However, it is also emphasised that this energy absorbs high costs related to, e.g. the acquisition of rare metals used in the production of wind turbines, with the disposal of used parts. The article aims to present the opinions of representatives of science, economic practice, and authorities as an expression of behaviour toward the problem of climate warming and renewable energy. An example of expressed opinions is the discussion in the public space, which is created by publications in magazines and non-serial literature. As a result of using the method of analysis of secondary materials, the article shows the diversity of views on the subject under study. Opposing views on the causes of global warming have found; that wind energy can limit global warming, but it can also cause damage to the economy, landscape, and human health. The development of wind energy is determined by legal, organisational, economic, and technological obstacles that are difficult to overcome in Poland. However, the need to develop renewable energy, including wind and solar energy, is supported by 85% of Polish society.

KEYWORDS: climate, wind energy, developmental barriers, fighting global warming

Introduction

Energy independence is a fundamental condition for the security of any country, including Poland. The European Union (EU) closely links energy independence to the fight against global warming. Therefore, efforts concentrate on increasing the share of renewable energy sources in the so-called energy mix. In parallel, great efforts are being made to decarbonise economies, thus moving away from coal, considered the main source of CO_2 emissions. It is a nuisance for the atmosphere and exacerbates global warming with all the related catastrophic visions. There are projects developed in the EU to fight against global warming called the European Green Deal and 'Fit for 55'. However, due to the war in Ukraine, an adjustment in the discussions on global warming, renewable energy sources, and energy policy proved necessary.

The purpose of this study is to learn the opinions and positions on the ongoing discussion on the role of renewable energy sources, especially wind energy, in ensuring energy independence, limiting climate warming, and identifying the barriers of these sources. The opinions expressed in the public discussion and presented in the literature and magazines are an example of the social awareness of Poles about renewable energy sources and their importance in global warming. The article answers the following questions:

- What are the positions in the discussion of representatives of science and practice on climate warming?
- What is the importance of renewable energy sources in counteracting climate warming?
- What barriers limit the development of wind and solar energy in Poland?

While developing the topic, the authors used primarily the method of analysing reports from secondary empirical research, the method of analysing selected items of non-fiction and periodical literature, which is a forum for public discussion regarding the problem under study.

An overview of the literature

It follows from observations that the climate is warming. Poland is experiencing violent winds, torrential rains, and other calamities, causing significant material damage. Catastrophic descriptions (Gates, 2021), for example, rapidly melting glaciers and rising sea levels, boost uncertainty in readers, leading them to believe that this is the truth. Over time, it gets accepted and labelled political correctness. This belief is further strengthened by the hypothesis that human activity is the cause of the warming. This is accompanied

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by aggressive propaganda from environmental organisations known as eco-warriors (Mastalerz, 2005).

Advocates of the hypothesis of anthropocentric sources of global warming very often cite the findings of scientists working for the Intergovernmental Panel on Climate Change (IPCC). These pieces of research are interesting and inspiring, but they do not come close to scientific truth. The aforementioned Gates (2021) noted that scientists still need a lot to learn about how and why the climate is changing. The reports from the Intergovernmental Panel on Climate Change show that some things, for example, how fast temperatures will rise and the exact effects of the projected temperature rises, are still uncertain. Further, the same author raises his doubts as to whether the many aspects of climate change 'that we still do not understand' (Gates, 2021) can be explained using mathematical models.

Let us add another quote. In 2014, Kleiber (2014), President of the Polish Academy of Sciences, wrote as follows when outlining the future of climate policy: "In the last century, the Earth has warmed by almost 1 deg. C, and there is virtually no doubt today that this is due to increased carbon dioxide emissions from fossil fuels. The temperature is extremely likely to rise by at least 2 degrees Celsius by the end of this century. Possibly even twice as much. The impact of such changes on people's lives would be enormous..." (Kleiber, 2014).

Referring to the comments of both these authors, one may ask how the members of the Intergovernmental Panel know that if global warming exceeds 1.5-2.0 deg. C, an unimaginable catastrophe will occur (Warren et al., 2018). Gates (2021) argues 'no absolute certainty' whereas Kleiber (2014) writes of enormous probability. What conclusions can be drawn from these? Perhaps only such one that thanks to the achievements of social science, psychology, and neuroscience, it is known that with long-term exposure to propaganda, people start recognising propaganda as truth (Stodolak, 2022).

In his work entitled "Social Theory and Social Structure" Merton (1982) noted that scepticism is one of the necessary conditions for science. It presumes that judgements, especially final judgements, cannot be made until the research has been completed on a sound empirical and logical basis. Scepticism is a virtue and, at the same time, a necessary condition for doing science.

Now, going back to the comments of Gates (2021), Kleiber (2014) and Merton (1982), quite numerous doubts can emerge as to the intentions of the proponents of the hypothesis of the anthropogenic genesis of climate change. Reading the views of members of various environmental organisations is certainly worth the trouble. Mastalerz (2005), already mentioned above, has spoken extensively on this subject. Observations of Klaus (2007) from his

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book entitled "Blue Planet in Green Shrouds" are equally interesting. According to him, humanity should first and foremost separate reality from fantasy and truth from propaganda (...). Future generations will probably discuss with a hint of amusement that at the beginning of the 21st century, the whole developed world panicked about average temperatures rising by a few tenths of a degree and considered a return to pre-industrial times. The same author further stresses that global warming is increasingly becoming the field for a fundamental ideological and political clash of our modern age. Environmentalism, an advocate of this theme, has become the dominant alternative to ideologies that are consistently and *a priori* based on human rights and freedoms. This is the world-leading view that radically and without regard to the drastic costs, intends to change people, their behaviour, their social make-up and their system of values. Absolutely everything (Klaus, 2007; Missirian & Schlenker, 2017).

The ongoing public debate on global warming makes it apparent that the promotion of the thesis on anthropogenic sources of this phenomenon is coming to the foreground (Filipiak, 2022). On the contrary, arguments in favour of global warming being a natural phenomenon are rare. They are found in earth sciences and historical records alike. If this man is the biggest 'pest", any further narrative is self-explanatory as greenhouse gases can only be eliminated or reduced through decarbonisation and the widespread use of renewable energy sources (Betakova et al., 2015; Bolwing et al., 2020).

Regardless of the presented remarks, two distinct attitudes are observed in the discussion on stopping climate change and protecting the natural environment. The first opposes climate change and does not support the rapid development of renewable energy sources. There are economic and social reasons for this, including the loss of many jobs (Palmer, 2018). The second position points to the necessity of rapidly shifting away from fossil fuels to renewable energy sources, including wind and solar energy. It is not easy to unequivocally advocate one extreme or the other. It should be emphasised that the development of renewable energy sources is imperative, both for now and in the future (Jasiński et al., 2022). However, the discussion of this topic often overlooks the issue of the raw materials needed to manufacture photovoltaic panels, wind turbines and batteries for electric cars (Bennet et al., 2021). It is, therefore, necessary to include in the discussion rare metals, such as, for example, vanadium, cerium, gallium, indium, iridium, platinum, niobium, and cobalt. As the very name suggests, these are rare and do not occur independently. They are bound with other elements, and their mining entails the destruction of the Earth's crust, often combined with environmental contamination, the use of strong chemicals, and the cost of transport over long distances. Deposits of rare metals, their extraction and

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technological sourcing create several environmental, economic and geopolitical problems (Zarzecka, 2021; Pitron, 2020; van Kamp & van den Berg, 2021).

Methodology

The article presents the theoretical and empirical aspects of climate warming, the importance of renewable energy sources, mainly wind and solar energy, in limiting this warming, and the difficulties in this area. The basis for interest in a selected topic is the public discussion conducted in Poland in the circles of science, economy, and government. Examples of this discussion are articles in journals, the Internet, published research reports, and compact publications. To recognise the problem, following the research methodology in the social sciences, the article adopts an appropriate research process consisting of several stages. In the first stage of the research procedure, attention was drawn to the need to recognise the positions expressed in the public discussion on climate warming and the role of renewable energy sources in limiting this warming. The second stage of the research procedure concerns the specification of the research problem. At this stage, attention was paid to the differences in the views of representatives of science, economic practice, and authorities regarding the selected problem. They particularly referred to wind and solar energy, difficulties in developing these sources, and the opinion of the Polish society on wind farms. The next research step was the selection of appropriate research methods useful to verify the identified problems and conduct research. The article uses the method of analysing secondary materials in the form of a critical analysis of the literature on the subject, analysis of publications in journals, the Internet, and published reports on empirical research. The article uses the results of nationwide empirical research commissioned by various institutions. The results from the report on the awareness and environmental behaviour of Polish residents regarding wind energy were taken into account. These studies were carried out as the sixth edition in 2020 at the request of the Ministry of Climate and Environment. The study used the CATI (Computer Assisted Telephone Interview) technique, i.e. computer-assisted telephone interviews. A random representative sample of the total population of Poland aged over 15 was 1015 people. The maximum estimation error of this sample was +/- 3.1% (Ministerstwo Klimatu i Środowiska, 2022).

The article also uses the results of research conducted by the Center for Public Opinion Research (CBOS) in February 2023. This study used the mixed-mode procedure on a representative named sample of 982 adult residents of Poland. People for the study were drawn from the PESEL register

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(WNP, 2023). Research reports were also used: Social Changes (PSEW, 2022); Polish Alternative Fuels Association (PSPA, 2022); Staszic Institute (Jasiński et al., 2022); Kantor Public (ClientEarth, 2022). After collecting quantitative and qualitative data using the adopted research methods, an important research step was their presentation and discussion. This stage is presented in the part of the article entitled «Research results: Analysis and discussion». At the final stage of the research procedure, theoretical-cognitive and practical conclusions were formulated. Therefore, following the research methodology in the social sciences, the principle of knowledge of the literature on the subject and the research procedure was followed (Babbie, 2001).

It should be emphasised that in modern science, more and more researchers use secondary data collected by other researchers. These data are included in empirical reports, magazines, and statistical yearbooks. The analysis of secondary empirical data is an established research method in the social sciences (Frankfort-Nachmias & Nachmias, 1996). This approach results primarily from economic and methodological reasons. Because the collection of primary data is expensive and not always in line with the methodological requirements, especially when it concerns one researcher or a small research team with limited financial resources. The adopted research methodology used in the article includes, among others, the above methodological premises.

Research results: analysis and discussion

The general benefits of using renewable energy sources have economic and social fields (reducing the use of foreign energy sources, creating new workplaces, developing wasteland to provide agricultural energy for the source), ecological (reduction of air pollution, global warming, and the total amount of waste); health (reduction of diseases affecting the environment). Indicators of energy consumption from daily sources in gross final energy consumption per year in Poland in 2010-2021 are presented in a detailed summary. In 2010 – 6.1%, 2015 – 13.7%, 2018 – 11.1%, 2019 – 12.2%, 2020 – 16.1%, 2021 – 16.1% (Rynekelektryczny, 2022). These data indicate that the share in obtaining energy sources in total energy production in Poland is still insignificant. Since 2016, the source of development of energy sources, especially wind energy, has been inhibited by the Act on Wind Farms, known as Act 10H.

The generation of electrical power in Poland is dominated by hard coal (46.4%) and lignite power plants (27.4%). When it comes to green energy, other power plants contributed 8.6% to the total energy yield, wind installations 9.7% and hydroelectric plants 1.6%. Gas power plants accounted for

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6.3% of the electricity generation mix. These figures refer to May 2022 (Rynekelektryczny, 2022). When renewables are analysed alone, wind farms accounted for 38.3% of the mix, solar PV 50.6%, hydro 5.1%, biomass 4.7% and biogas 1.3% of renewable electricity generation (Rynekelektryczny, 2023). Thus, it follows that wind and solar energy are the most popular renewables. Both sources are clean in the sense that they do not emit carbon dioxide into the atmosphere. The fact that once erected, it generates only low operating costs is also an advantage. The same is true for photovoltaic cells. Disadvantages of both of these energy sources include the fact that they disfigure the landscape, contribute to the death of birds and bats (wind farms) (Pawlas, 2009; Gamboa & Munda, 2007; Krug & Lewke, 2009), and the low concentration of generated energy produced in need for storage (photovoltaic farms).

In response to EU Climate Commissioner F. Timmermans' call to reduce dependence on traditional energy carriers such as natural gas, oil and coal, Bielewicz (2022) wrote: "Sound simple? However, the reality does not necessarily conform to this politician's wishful thinking because (...), to put it simply, the sun does not shine every time and everywhere, and neither does the wind always blow (...). For this simple reason, until we learn how to efficiently store the generated energy produced and how to efficiently transmit just when shortages occur, renewable sources will remain impractical and, in that sense (...), 'non-renewable'" (Bielewicz, 2022).

In late 2021 and early 2022, there was some confusion in the RES discussion. In particular, as a result of the war in Ukraine, some fuels, previously considered detrimental to the climate, have been given a friendly, usable status. This applies, for example, to gas, coal and the atom (Sommer, 2022b). It is interesting that when revising the renewable energy proposals, the EU allowed the use of wood (Sommer, 2022a).

It thus becomes clear that the economic interests of some European countries are more important than the slogans on the commitment to climate protection. Economic, political and electoral considerations came to the fore and climate concerns were pushed to the background. An attentive observer would surely ask whether this is about protecting the climate or rather about protecting own interests (Landeta-Manzano et al., 2018).

Despite such a pessimistic conclusion, based on past experience, the conviction might be justified that new possibilities for energy storage, safe and inexpensive use of hydrogen, generation of electricity from plastic film and many other inventions related to renewable energy sources will soon emerge. Therefore, the 2015 Paris Agreement calls for a complete phase-out of fossil fuels in the European Union by 2050 (Sobieraj, 2017).

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To say that concern for access to energy sources is a fundamental duty of every state is just a truism. These are what determine energy security, the competitiveness of the economy and the standard of living of citizens. They are not only a commodity but also a common good. Thus, energy policy focuses on issues such as the access to and volume of energy sources (both renewable and non-renewable), ways of allocating (distributing) energy, and energy consumption patterns in society (Gryz et al., 2018).

As already mentioned, the war in Ukraine questioned certain dogmas about the pros and cons of renewable energy sources and their place in Poland's energy policy. For example, the significance of RES for military purposes was pointed out due to their geographical dispersion, which is somewhat new. The need to strengthen RES was emphasised, as such decisions allow for independence from Russian gas, oil and coal supplies. An additional argument in favour of supporting renewable energy sources includes the lower installation and operating costs (compared to conventional sources) coupled with the economic and social benefits. According to the Polish Wind Energy Association (PWEA), in an optimistic scenario, the construction of wind farms could yield an increase in GDP (by 2030) of PLN 70-133 billion, whereas orders for products and services would translate into around 57-97,000 new jobs.

However, the development of the renewable energy sector and the determination of its importance in the country's energy policy, fighting global warming face various barriers (Hajto et al., 2017). These can be divided into: – technical and technological, – legal and organisational, – economic, and – social barriers. Technical and technological barriers mainly relate to mass refusals for conditions for connecting new investments to the power grid. According to the Polish Confederation Lewiatan, in 2019-2020, the field offices of the Energy Regulatory Office (ERO) received refusals to connect 1209 installations to the grid (Ciepiela, 2022). Outdated transmission and distribution networks were the reason. The storage of energy generated in the RES network used for the consumers' consumption is also problematic. Bartłomiej Pawlak, vice-president of the Polish Development Fund (PFR), draws attention to another technical and technological barrier to RES development. He stresses that while we do produce masts and blades in Poland, we do not manufacture turbines for wind farms. "Even if an assembly plant for such turbines were established in Poland, it would still increase the chances that the contractors would come from the immediate neighbourhood and not from the other side of the globe" [translated from Polish]. Moreover, the vice president emphasises that Poland does not have engines for biogas plants (Ciepiela, 2022).

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Advocates of renewable electricity point to legal and organisational barriers that do quite well in hindering its development. The six-year dispute on the 10H distance law was one of the most significant obstacles. It stipulated that the distance between a wind turbine and residential buildings could not be less than 10 times the height of the latter. It means that a windmill 150 m cannot stand closer than one and a half kilometres (1.5 km) from any house. Such a provision prevented wind investment over a significant part of Polish territory. As estimated by the Ember think-tank, the 10H rule excluded around 99% of Polish land from wind investment and limited the total installed capacity for this technology to a maximum of around 10 GW (Dyląg, 2022). It was not until 5 July 2022 that the government adopted a bill liberalising the so-called Distance Law of 2016, which restricted the possibility of locating onshore windmills in Poland so dramatically. The amended 10H Distance Law, among other things, stipulates the conditions and procedures for the locating, construction and reconstruction of onshore windmills, the principles and procedures for social consultations with the local community, and the rules for new residential developments in the vicinity of wind turbines. It has been accepted that a different distance of windmills from a residential building, but not less than 700 metres, could be specified in the Local Development Plan Identical. The amended act assumes that the investor of wind farms will offer at least 10% of the installed capacity of the wind farm to the inhabitants of the commune. The amended act retains the 10H rule in the case of national parks and in the case of nature reserves – the 500m limit. It maintains the ban on building windmills in national parks, landscape parks, nature reserves, and Natura 2000 areas. According to government estimates, the entry into force of the amended Distance Law will enable the construction of onshore windmills of total power between 6 GW and 10 GW by 2033 (Chojnacki, 2022).

Another difficulty for RES development is that small companies investing in renewable energy are not professionals in this industry and lack professional staff capable of preparing such investments in organisational terms. Therefore, they need legal and organisational assistance to implement these projects from start to finish. The implementation of onshore and offshore wind development plans necessitates streamlining the permit-issue system. Connecting renewable energy sources to the grid is also an issue. Janusz Gajowiecki, president of the Polish Wind Energy Association (PWEA), proposes a solution. He believes that energy trading companies and distribution system operators should be separated from the existing energy groups. He claims that as a result, conditions for the connection of new RES sources would be issued quickly, as the CEOs of these companies count on additional revenues (Ciepiela, 2022).

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Investors in the RES industry face significant economic barriers, such as the EUR to PLN exchange rate and rising costs of fuels, services and materials, especially steel products and rare metals. These difficulties are combined with the need to cooperate with entities with enough international experience and foreign capital. The participation of Polish companies in such investments would contribute to their development in the global RES markets. Moreover, small entrepreneurs find it difficult to finance clean energy investments and cannot always count on the support of banks that target larger investors.

Generally, social barriers are not a major impediment to the development of renewable energy sources. (Sikora & Wartecka-Ważyńska, 2015). Please note that the energy sector, and especially the renewables sector, mostly lacks young employees with adequate vocational training. This problem has been presented in Olsztyn at a conference entitled "The energy sector in Poland as a challenge for the young generation", during which Marzena Machałek, Deputy Minister of Education and Science, stressed these are especially young people that the Polish energy sector lacks. The existing generation gap thus poses a challenge for the education system at secondary and tertiary levels, for cooperation between businesses, schools, and universities, and for the transfer of knowledge and technology to education and vice versa (PulsHR, 2022).

The positive effect of social conditions for the support of renewable energy merits a mention (Cohen et al., 2014). The 2020 nationwide empirical study on environmental awareness and behaviours of Polish residents towards wind energy commissioned by the Ministry of Climate and Environment shows that Poles are very positive about the development of wind energy. It found that 85% of respondents support the development of onshore wind farms, and 76% of respondents would like to use electricity from offshore wind farms (Ministerstwo Klimatu i Środowiska, 2020; Ministerstwo Klimatu i Środowiska, 2021; Ministerstwo Klimatu i Środowiska, 2022).

Another nationwide survey conducted in 2022 by the Social Changes studio indicated that 81% of respondents support the development of onshore wind farms, and 85% believe that the Polish law should support the development and use of RES. 75% of the survey respondents believe that onshore windmills contribute to energy security and reduce dependence on fossil fuels. Among the biggest benefits of onshore wind investments, 66% of respondents cited clean air and cheaper electricity, whereas 59% mentioned energy independence. 25% of respondents thought that onshore windmills contribute to the creation of new jobs and security, whereas 22% they boosted the development of Polish companies and revenue to municipal budgets (WNP, 2022b; PSEW, 2022).

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In its turn, a study conducted in the Lubelskie Region in 2022 by the Staszic Institute on public awareness of the construction of wind farms indicated that 65% of respondents approved of the expansion of energy potential based on wind energy (PortalSamorządowy, 2022a; Fijak, 2022). These results show a high awareness of the need for energy transition, public acceptance for the construction and development of wind power and of the related benefits.

The results of the latest survey conducted by the Public Opinion Research Center (CBOS) in February 2023 entitled «Opinie o energetyce wiatrowej» indicated that 83% of Poles support the development of onshore wind energy. 10% of citizens hold the opposite position. It was pointed out that compared to the results from two years ago, the attitude of public opinion on this matter «basically has not changed». The results of these studies have highlighted that obtaining energy from renewable sources is one of the important elements of the strategy to reduce greenhouse gas emissions and strive for climate neutrality (WNP, 2023; Radun et al., 2022; Westerlund, 2020; Onakpoya et al., 2015; Pedersen & Larsman, 2009).

Energy security and fighting global warming is more than just a replacement for current fossil fuel-based energy capacity. It is also about developing many other elements and sources of electricity and electromobility. This situation is linked with, for example, an increased number of RES-powered public charging stations for electric cars. A report by the Polish Alternative Fuels Association (PSPA) shows that Poland is one of the European Union members states with the least developed infrastructure for charging electric cars. As the PSPA estimates, in just three years, thus in 2025, the number of charging points for electric cars should reach 42 000. Now, it is only one-tenth of this number (WNP, 2022a). Meanwhile, with current procedures, the construction of an electricity connection for a car charger takes longer in Poland than in any other EU country and takes one to two, and sometimes even three years. According to Maciej Mazur, PSPA managing director, such a slow increase in the number of charging points will not only result in a slowdown in the rate of production and sales of electric cars but will also lead to queues at the charging stations and cause financial penalties to be imposed on Poland for failing to meet the requirements set by the European Commission (WNP, 2022a; PSPA, 2022).

Given the current geopolitical situation and the ongoing war in Ukraine, many EU countries, including Poland, have announced an intensification of their efforts to reduce imports of fuels from the Russian Federation and replace them with, among others, green energy. At the end of March 2022, the Polish government declared that by 2030, the total installed capacity of RES would increase to around 50 GW, which is almost as much as the entire cur-

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rent energy system in Poland. The installed capacity of green energy sources now exceeds 17 GW, with half of which being photovoltaic projects (Dyląg, 2022). The Kantar Public Survey[1] conducted in June 2022 shows that 66% of the respondents believe that increasing onshore wind generation should be a priority for the government in the coming months, with 30% of them believing it should be a firm priority (PortalSamorządowy, 2022b; ClientEarth, 2022).

The energy security of any country, not just Poland, lies in its energy independence. This, in turn, is fostered by new energy sources, the construction of onshore and offshore wind farms, the development of biogas plants, and the expansion of energy storage and distribution networks. Thus, energy security has no price and cannot be treated as a commodity. It still needs to be borne in mind that the traditional economy needs to generate money, which will then support investments in renewable energy sources. Moreover, public consent and acceptance are the prerequisites for the energy transition (Landeta-Manzano et al., 2018; Pedersen & Larsman, 2009; Sklenicka et al., 2018).

Unfortunately, new modernisation investments requiring large amounts of money are needed in this area (Sobczyk-Grygiel, 2022). Joanna Wis-Bielewicz, market development director in Offshore Orsted Poland, argues that Poland has excellent wind conditions. The Baltic Sea is relatively shallow, which guarantees the high financial viability of offshore wind farm projects. She mentions plans by the Polish government to build 11 GW of offshore wind farms. However, the Wind Europe Association estimates that today's technology would allow for up to 30 GW to be built in the Polish part of the Baltic Sea (Ciepiela, 2022). Offshore windmills could therefore be the basis for the Polish energy system, with Gdynia being an investment port and Władysławowo a service port (Chojnacki, 2021; Kolendow, 2016; Sudra & Bida-Wawryniuk, 2018).

The current situation in Europe, being the consequence of the war in Ukraine with the resulting embargo on Russian gas, is well exploited by Denmark. By 2050, the Danish government plans to increase installed wind capacity in the North Sea and Baltic Sea from the current 2.3 GW to 35 GW. There are also plans to build, among other things, an energy island that will add a further 16 GW of power. Earlier than this, in 2030, Denmark wants to become a net exporter of clean energy. Investments not only in offshore windmills but also in onshore ones and the construction of photovoltaic panel farms are supposed to support these plans (Gurgul, 2021).

In contrast, Turkey presents another example of a country playing the solar energy card while reducing natural gas imports. Europe's largest solar power plant is just being built in Karapinar in the Konya province of south-

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central Turkey. It is expected to reach a capacity of 1,350 megawatts by the end of 2022, providing energy for 2 million households. When completed, the Karapinar plant will feature 3.5 million ground-mounted photovoltaic (PV) modules, will cover an area equivalent to 2,600 football pitches, and employ 3,000 staff members. The plant will contribute to savings of up to $600 million by cutting natural gas imports to Turkey. The investor has signed a financing agreement worth $812 million with eight Turkish banks and international banks. The total investment cost is estimated at one billion dollars (Wolf, 2022).

In conclusion, the importance of renewable energy sources is crucial for preventing global warming and maintaining energy security in Poland. However, wind and solar power cannot be regarded as stable energy sources. They need to be supplemented by nuclear, gas, coal and, in the future, hydrogen. However, the 'other side of the coin' must not be forgotten in renewables. What we mean are issues related to the disposal of windmills and panels, the demand for the location of photovoltaic farms, and the demand for copper and rare elements. These issues require a separate analysis. As an example, let us just mention that a photovoltaic farm from which an annual generation output comparable to that of the Bełchatów Power Plant (28 TWh) could be achieved would have an area of approximately 15,000 ha (Solecki, 2021). The figures for the copper 'equipment' for one windmill of 15 tonnes are equally surprising (Jedlak & Żylińska, 2021). The possession of strategic raw materials, i.e. rare earth metals such as silicon, cobalt, titanium, tungsten and others, will be of key importance, and the need to compete for them in third markets will emerge (Sommer, 2021).

Conclusions

The analysis of the problem of the relationship between climate warming and renewable energy sources presented in the article, presented in the social discussion of representatives of science, economy, and politics, encourages the formulation of appropriate conclusions.

It is hard to keep a fully optimistic take on making renewable energy sources a key part of an energy policy that would put a stop to global warming, given the considerations presented in this paper. As an EU member state, Poland is obliged to develop renewable energy sources. This necessitates financial resources, appropriate legal standards and a longer time frame. Renewable energy sources reduce the state's dependence on fuel imports and contribute to reducing the impact of the energy sector on the environment. Renewable energy sources have a positive impact on the labour mar-

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ket. They contribute to the creation of new jobs. The development of domestic and foreign investments related to the green technology market contributes to increasing the VAT budgets of local authorities and the state budget. Wind energy is associated with fewer negative impacts on human health than other traditional forms of energy generation. It has positive health effects as it reduces pollutant emissions. `There is also no clear evidence of negative impact on human health caused by the noise of wind turbines. It is essential for Poland's energy security and independence to overcome the barriers to RES development. Let us emphasise again that public awareness and approval foster the development of investment in renewable energy sources. Such attitudes should necessarily be used to overcome other existing barriers. It needs to be strongly stressed that in the discussion on renewable energy sources, practitioners and scientists must cooperate. Without such discussion, there is no possibility of scientific development and progress in economic activity. The public discussion conducted by representatives of science, business, local government, and government authorities on climate warming and the development of wind energy shows divergent positions. They are supported by the relevant particular interests of specific professional groups and the political authorities. Representatives of science, economy, and local government have broader support provided by society. The government authorities do not want to fully understand these arguments and public opinion. However, it is responsible for climate warming and the development of renewable energy sources in its decisions.

In the context of the presented discussions and the expressed opinions, we should emphasise that achieving energy independence and fighting global warming based on renewable energy sources, nuclear, hydrogen, and, in the interim period, on its fossil fuels, presents today a significant challenge to economic and scientific practice.

The contribution of the authors

Literature review, J.S. and K.Z.; data collection and analysis, J.S. and K.Z.; interpretation of the results, J.S. and K.Z.

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