SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 216

THE IMPORTANCE OF THE ENERGY SECTOR IN BUILDING SOCIAL WELL-BEING: CHALLENGES OF SUSTAINABLE DEVELOPMENT AND THE POLISH PERSPECTIVE

Grażyna WOLSKA[1], Joanna KIZIELEWICZ[2*]

[1] Faculty of Economic Sciences and Management, Nicolaus Copernicus University in Toruń; grazyna.wolska@umk.pl, ORCID: 0000-0002-7289-5179
[2] Faculty of Management and Quality Science, Gdynia Maritime University; j.kizielewicz@wznj.umg.edu.pl, ORCID: 0000-0001-7415-9928
* Correspondence author

Purpose: The main objective of the article is to demonstrate that the currently adopted path of economic development in the Polish energy sector is accelerating ecological crisis and failing to ensure the ecological and economic security essential for long-term sustainability. By highlighting the negative consequences of present-day energy policies, it emphasizes the need for a more holistic approach that incorporates economic, social, and environmental considerations.
Design/methodology/approach: This article employs a triangulation of methods, including a critical literature review, hermeneutic analysis, logical-semantic analysis, and conceptualization of key terms, guided by the principle of Occam's razor for clarity and precision. It examines the implications of Poland's energy sector policies on ecological sustainability, economic security, and social well-being. The approach provides a multifaceted perspective on energy transition within the framework of sustainable development.
Findings: A crucial focus has been placed on the energy sector, given its substantial contribution to CO_2 emissions. The argument presented here is that only by integrating environmental objectives with economic and social goals could Poland—and indeed other nations—achieve relevant level of the sustainable development. The key point is that such integration requires rethinking current policy and energy strategies, prioritizing investments in low-carbon technologies, and strengthening public participation mechanisms to foster greater awareness and engagement.
Research limitations/implications: The Polish energy sector operates within a unique socio-political and economic context, influenced by historical dependence on coal, current policy structures, and public sentiment. These factors may reduce the generalizability of research findings to other countries with different energy mixes and policy frameworks. While this research emphasizes the importance of public participation, it does not extensively analyze the perspectives of all stakeholder groups e.g., local communities, private sector, or non-governmental organizations. A broader range of viewpoints could further enrich the findings.
Practical implications: The findings of this research could serve as a valuable resource for researchers and experts in sustainable development, energy policy, and environmental studies, as well as policymakers and local government representatives responsible for implementing environmental and energy strategies.

Social implications: Additionally, non-governmental organizations, scientific research institutions who are engaged in the future of the energy sector should also find the results of the study valuable for the public debate and policy decisions.
Originality/value: The study calls for policy changes, investments in low-carbon technologies, and greater public involvement to support sustainable energy transitions. These recommendations are tailored to Poland's specific social and economic context, offering practical insights for improving sustainability.
Keywords: natural environment, sustainable development, energy policy.
Category of the paper: Case study, literature review.

1. Introduction

The concept of sustainable development is based on the correlation of the economy, natural environment, and society, forming its three fundamental systems. The environment is one of the important pillars of sustainable development, as it provides the economy and society with information on external costs, the standing of institutions, social capital, and the level of social participation. Therefore, it is so important to recognise the role of the natural environment in building social wellness and well-being. The issues covered in this article include primarily issues related to the energy sector, which is one of the largest emitters of CO_2. The study aims to prove that the currently adopted path of economic development in the energy sector in Poland leads to the ecological catastrophe, and that the current activities within the energy policy do not ensure the ecological and economic security.

The socio-economic development and growing environmental problems related thereto, as well as the growing interest in the quality of natural environment in the 1970s, have become particularly important in recent years. In addition to the concept of "nature conservation", the term "environmental protection" emerged and became dominant. Nowadays, the environmental protection is defined as a set of activities including the protection and rational management of natural resources in accordance with the principle of sustainable development, protection of particularly treasured values of the natural environment (Knoepfel, Nahrath, 2005), restoration of natural elements, prevention of pollution, protection of the human living environment against any burdens and nuisances (CSO 1993, p. 41). The environmental protection can also be defined as protection against the wrong directions of civilization development, which contributes to the degradation of environment and disruption of the conditions of human existence on Earth.

From the economic point of view, it is worth quoting the opinion of H. Rogall (2010), who believes that many representatives of the ecological economics want to maintain the traditional neoclassical economics as a foundation, reforming only some of its aspects. Some economists, however, propose to develop a "theory of modern economy", which would be a creative development of classical thought (Rogall, 2010, p. 8). Upon examining these issues, A.T. Kowalewski (2006) proposes to verify these attitudes for at least two reasons:

- obsolescence of many theories that were developed in a decidedly different reality than the current one,
- necessity of confronting the economic theories with the ideas of balancing the development and the areas of natural and social sciences (Kowalewski, 2006, p. 154, as cited in: Pondel, 2013).

In the opinion of S. Czaja and B. Fiedor (2010), the necessity to verify the neoclassical economics results from its failure to take into account the laws of nature, which are very important for the sustainable development. Therefore, these authors present two approaches (paradigms) related to the review of economic theories: ecological paradigm of economics (greening of economics and economic activity) and paradigm of economization of the natural environment (in terms of its protection and economic use) (Czaja, Fiedor, 2010, pp. 30-50).

The complexities between the economics and sustainable development, presented in a concise way, indicate that the evolution of traditional economics towards the sustainable economics is underway. Nowadays, the assumptions supporting the sustainable development are defined by the economics of sustainable development. According to H. Rogall (2010), this is "an economic theory that takes into account transdisciplinary foundations (...), pursuing to define such conditions of management that would ensure sufficiently high economic, socio-cultural and ecological standards within the nature tolerance limits, implementing the principle of intra- and intergenerational justice" (Kowalewski, 2006, p. 154; Pondel, 2013, p. 24). In the theory of sustainable development economics, the implementation of its assumptions in the economic practice is particularly important (by virtue of the importance of practical consequences) (Barnett, 2019).

As emphasized above, the concept of sustainable development is based on the correlation of the economy, natural environment, and society, forming its three fundamental systems and it’s associated also with environmental management systems (ISO, 2020). Therefore, the environment is one of the important pillars of sustainable development. While the economic and social issues have long been of interest to theoreticians, economic practitioners and politicians, the ecological considerations have struggled to make their way into the decision-making processes (Wolska, 2021).

A low level of environmental awareness has led to disastrous climate consequences, and the environmental crisis has become a fact. It should be emphasised that in the public awareness the concepts of climate and weather are often considered equivalent. Meanwhile, weather is a short current system of atmospheric and temperature conditions, i.e., a temporary atmospheric

situation in a given place, usually within a small area of the Earth. Whereas long-term, usually thirty-year-old observations of these weather conditions, carried out regularly with the use of objectively verifiable and correct methods, allow us to determine the process of climate creation. Human research on climate is conducted on a large scale by means of instrumental studies, e.g., precipitation, temperature level and wind velocity, and through the paleoclimatic reconstructions, i.e., the possibility to study temperatures that existed on Earth a very long time ago within several hundred thousand years. These studies indicate that the current change in the Earth's atmosphere over a period of approximately 150 years is unprecedented in the geological history of the Earth known to us. It mainly refers to the speed and intensity of changes in the geological history of the Earth, studied quite thoroughly over a period of five hundred million years. The furthest reconstructions of temperature and atmospheric components on the Earth indicate that apart from natural climate processes, people added to them the aspect of economic activity related to the emission of carbon dioxide, methane and nitrogen compounds. When these substances enter our atmosphere, they destabilize the climate. The loss of climate equilibrium is obvious all over the world. The record levels regarding the latest measurements include, for example, the first days of January 2023, when the temperature in many places in Poland reached 19 degrees C. According to the indications of the Institute of Meteorology and Water Management (IMGW Obserwator, 2023), in many places in Poland we observed the thermal summer. Whereas on the other side of the Atlantic Ocean, in the USA and Canada, we observed a very strong and violent hit of winter. Paradoxically, this is also a consequence of climate change, involving e.g., global warming, i.e., an increase in average global temperatures, and the accumulation of more energy in our atmosphere, caused by the effects of greenhouse gases (CEN, 2012).

The accumulation of energy slowly disturbs the climate system and causes, e.g., the disruption of the so-called polar vortex, i.e., cold air masses circulating over the North Pole. As a result, they get out in the southern areas and enter the areas where harsh winter did not occur. In recent years, we observed this phenomenon e.g., in Texas and New Mexico (Attack of Winter in the USA, 2023). In 2021, winter hit Canada with a great force and then the southern regions, covering a large area of the United States. Snowfall and cold temperatures were also observed in the state of Texas. There have been numerous collisions and accidents, and many sections of the road were impassable. The temperature was lower than the long-term standard for this time of year, even by 14-17 degrees Celsius. Snowfall, frost, and stronger wind gusts forced Americans to close many stores and cancel thousands of flights. There have been many failures of power grids. In addition, the frost with snowfall from Canada also reached the Gulf of Mexico and Florida. Most of the problems occurred on the roads in the state of Texas near the border with Mexico, where people are not prepared for extreme winter weather.

Climate change is a process that has been observed over decades. The Organization of United Nations issued a document ”Transforming our world: the 2030 Agenda for Sustainable Development” (UN, 2015, pp. 5-38).” where 17 Sustainable Development Goals (SDGS) were established and the European Commission developed the program called the European Green Deal (EC, 2019) **which also set out the main goals that should be achieved by 2030, i.e. a reduction in net greenhouse gas emissions by at least 55% and** the second target set by 2050, i.e. net-zero greenhouse gas emissions (Kizielewicz, 2022). However, this is now becoming more and more dangerous as gradually more greenhouse gases are emitted. The annual global emissions reach approximately 35-36 billion tonnes of gases. These gases decompose in the atmosphere and over 150 years have caused a 40% increase in the concentration of carbon dioxide (IMGW Obserwator, 2023). The process of increasing the carbon dioxide concentration has been ongoing ever since. Such a rapid increase in the amount of gas in the atmosphere has never occurred in the geological history of the Earth.

2. Energy in the Context of Natural Environment – Literature Review

The energy sector is one of the largest CO_2 emitters. At the same time, it allows to maintain and develop the civilizational progress. Nevertheless, it is difficult to refute the argument (put forward by scientists and the enlightened part of society) that it is necessary to reduce CO_2 emissions from the energy sector and other areas of human economic activity. This does not mean that they demand to abandon energy production, on the contrary, they recommend a wider use of the latest technologies that allow for the production of green energy (turbines, photovoltaics, biomass, nuclear power), which, despite many imperfections, is safer for people than coal-based energy.

Despite numerous measures taken and noticeable downward trends (EEA Report, 2023), CO_2 emission rates are too high in most EU countries. This points to the need for more effective measures to protect the environment. In accordance with the Energy and Climate Package, called the 3x20 Package, which is a collection of documents concerning the areas of energy, climate and synergies between them, the EU has committed to reducing the emissions of hot gases by 20% as early as in 2020, increasing the share of energy from renewable energy sources (RES) to 20% and increasing energy efficiency by 20%. Moreover, the increase in the share of biofuels in transport to 10% was planned as well as the increase in the EU energy security and independence. (Ziębik, Gładysz, 2015). The EU detailed targets and objectives are presented in Figure 1.

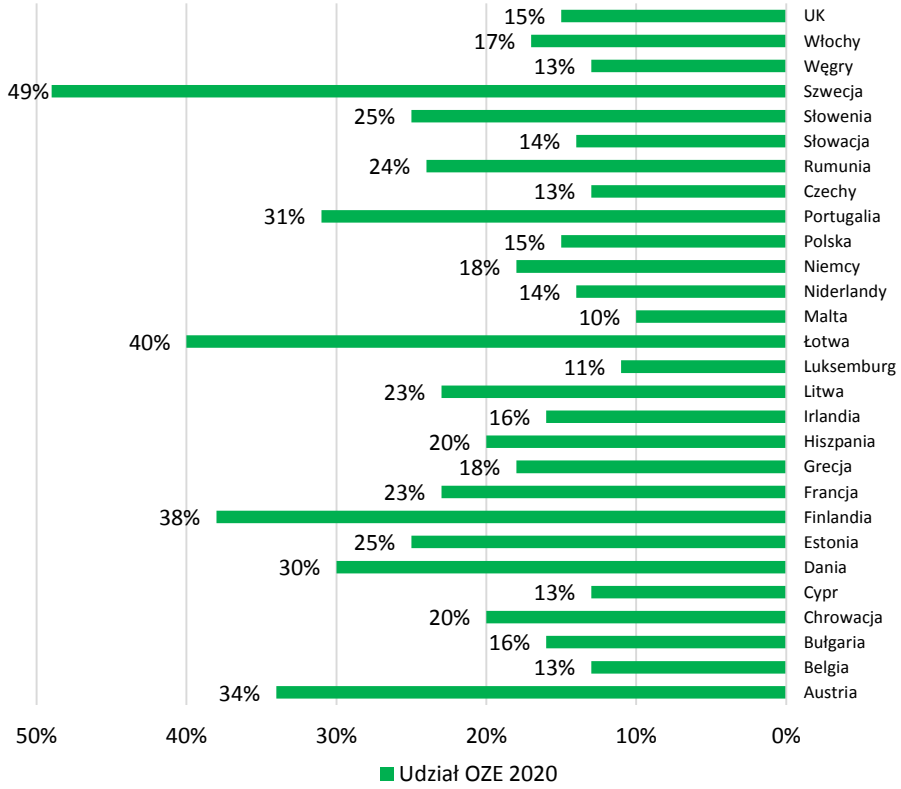

Figure 1. The share of RES in the structure of energy generation in a given country in 2020 compared to 2005 in the EU according to PEK.

Source: own elaboration on the base of (EEA Report, 2019; EEA Report, 2020).

The objectives presented in Figure 1 and Figure 2 were divided amongst Member States. Each of them was given an individual goal, conditioned by historical factors, raw material deposits and the level of the country development. One of the key tools for achieving the above-mentioned objectives referred to the Emissions Trading Scheme (ETS) (Bednorz, 2010, p. 47; Directive 2003/87/EC, 2023). The system introduces predetermined, total limits of CO_2 emissions into the atmosphere each year. Over the years, this limit is reduced by 1.74% per year, which is designed to reduce the emissions in the EU in proportion to the decrease in the number of allowances. Moreover, this ETS trading system covers countries outside the Community, such as: Iceland, Liechtenstein, and Norway.

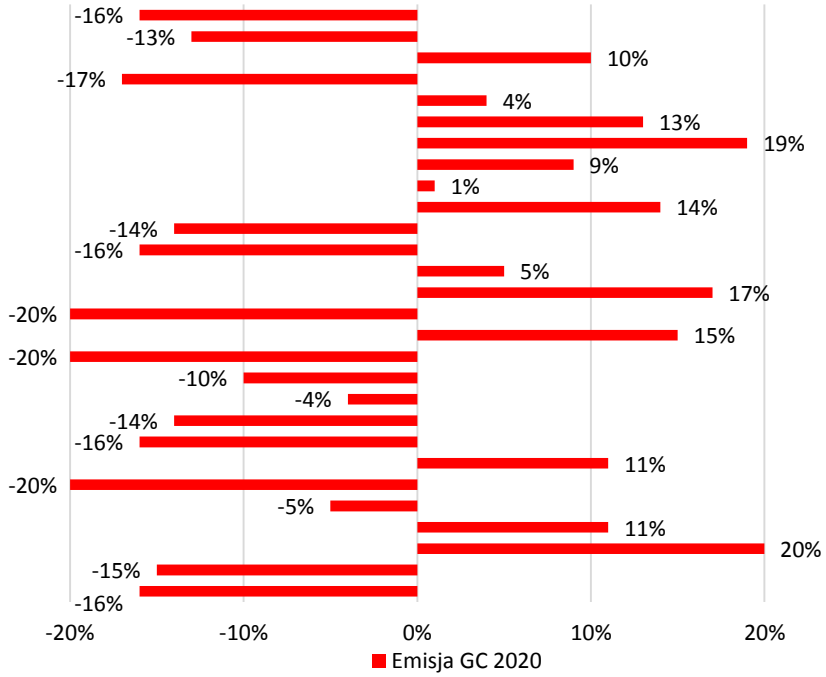

Figure 2. Change in the amount of GC (Greenhouse Gases) emissions in a given country in 2020 compared to 2005 in the EU according to PEK.

Source: own elaboration on the base of (EEA Report, 2019; EEA Report 2020).

A single allowance means that the holder can emit one tonne of CO_2. Allowances are allocated amongst Member States according to their needs. Each country distributes them as per the national plan throughout installations and appraises the volume thereof at the end of the year. If not all allowances are used, it is possible to sell them in auction or leave them for the next term. Otherwise, it is necessary to incur the cost of purchasing an additional number of allowances. This system covered only approx. 45% of all gas emissions, did not apply to all facilities and sectors (non-ETS). It excluded small entities with a capacity not exceeding 3 MW or emitting no more than 25 thousand tonnes per year. The remaining 55% (e.g., transport, aviation, agriculture) has been covered by another document, which assumes a 10% emission reduction in this period at the Community level (Decision 2009/406/E, 2009).

When considering the issue of greenhouse gas emissions into the atmosphere, it is worth noting that in 2020 there were 276 coal-fired power plants operating in the EU, including 110 lignite-fired and 166 coal-fired power plants. 63% of all facilities were located in three countries: Germany, Poland, and the Czech Republic. The largest power plants in terms of installed capacity include: lignite-fired plant in Bełchatów (5030 MW), Grevenbroich-Neutrach (Germany, 4424 MW), Niederaussem (Germany, 3676 MW), and Jaenschwalde (Germany, 3210 MW), coal-fired plant in Kozienice (3994 MW) and lignite- and coal-fired plant in Opole (3332 MW). Among the twenty largest installations, there were also another six in Germany and one in Poland (Bąk et al., 2022).

In 2020, under construction or in the commissioning process there were three facilities, including two coal-fired facilities in Poland and Germany and one lignite-fired plant in Greece. This state of affairs is very unsatisfactory; therefore, we have high hopes of modern coal-based technologies. In the EU, the NER300 programme has been established, involving the selection, by the European Investment Bank, of several dozen projects implementing innovative technologies, e.g., CCS (Carbon Capture and Storage), involves capturing carbon dioxide and financing half of the cost. In the first phase of this programme, none of the CCS projects was granted support from the national government, and no CCS facility was built (Hinc, 2011, p. 53). Such an approach raised concerns, especially since both the EU and independent organizations perceive in their analyses the use of CCS technology as one of the most important activities aimed to reduce greenhouse gas emissions (International Energy Agency, 2013; COM, 2011). Europe is lagging behind other regions of the world as regards this technology, as in 2015, in Europe there were only two advanced facilities (both in Norway, i.e., outside the EU) (Global CCS Institute, 2019). In 2019, the situation improved slightly, and eight facilities began to operate within the EU: six in the UK (then part of the EU) and one in Ireland and in the Netherlands (table 1).

Table 1.
Carbon Capture and Storage Technology in Europe

Name of the state	Carbon Capture and Storage Technology
Norway	2
Ireland	1
The Netherlands	1
United Kingdom	6

Source: (International Energy Agency, 2013; Global CCS Institute, 2019).

However, the European Commission and the European Court of Auditors have independently concluded that the pace of investment is not satisfactory, both technically and economically, and that the EU's actions unfortunately failed to deploy the CCS technology on a larger scale (Strzępka, 2018; Directive 2009/31/EC, 2009). In order to speed up this process, the European Commission has established a fund for "economically weaker" countries, i.e., those with GDP below 60% of the average level in the EU. The resources from this fund are used for investments in the energy sector. Funds from the sale of ETS allowances from the reserve pool are indicated as a source of financing. According to the existing algorithm, in 2019 approx. 90% of the auction pool, the remaining 10% was distributed to countries with a GDP per capita up to 90% of the EU average. The EU has also approved the possibility to allocate free allowances to the energy sector, up to 40% of the auction pool, in countries with a GDP per capita up to 60% of the EU average. The allocation process is controlled by the EU institutions. Restrictions regarding energy markets have also been introduced (EUCO 169/14, 2014; COM, 2019).

3. Research methodology

This article uses a triangulation of research methods, comprising a critical literature review, the hermeneutic approach, logical-semantic analysis, and the conceptualization of key terms. The principle of Occam's razor was also adopted, ensuring conciseness and precision in argumentation. It presents an original analysis of the implications of solutions adopted in the Polish energy sector for ecological policy, economic security, and social well-being. The hermeneutic approach took into account the intentions of the authors of the examined sources, while the critical literature review highlighted both historical conditions and current development trends. Logical-semantic analysis and consistent conceptualization of terms maintained coherence and prevented terminological ambiguities. As a result, a multifaceted perspective on the issue of energy transition in the context of sustainable development was developed, serving as a key to evaluating and designing future solutions.

4. Results and Discussion: Poland's Energy Solutions and Ecological Implications

In Poland, one of the most important current issues involves the slow implementation of the environmental requirements delegated by the EU and the comprehensive stability of the legal environment in terms of sustainable development. This indicates the need to reorient the position and role of the state in the area of sustainable development, which should come down to supervision, mainly arbitration activities towards the economic entities and the EU. Despite the fact that Poland is an EU member state, many EU environmental arrangements are not respected. This was clearly demonstrated by the events at the turn of 2023, related to maintaining the current model of coal use in households. At the time, the government in Poland argued that heating with coal was a good alternative and that the state would take care of the coal-based well-being of its citizens. As a result, 19.4 million tonnes of coal were imported in 2022 (Grzeszczak, 2023, pp. 42-71), compared to 12.9 million tonnes in 2020. In this context, it is worth mentioning that the extraction from the coalmines in Poland will have to gradually decrease, especially after bringing into effect the EU regulations on the reduction of methane emissions, which is a very weak point of the Silesian mines. *Polska Grupa Górnicza S.A.* (PGG) warns that the new standards will threaten its seven mines already in 2027, and two more by 2031. More affluent EU countries, influenced by the war in Ukraine and the need to cut off Russian energy resources, have undertaken austerity programs and energy transition acceleration. Meanwhile, since 2015, the Polish government has been successively blocking wind energy generation. In addition, contrary to the government's frequent praise of coal-fired

energy, a photovoltaic revolution has been initiated on the Polish Renewable Green Energy (RES) market. By installing PV panels, Poles have become the electricity prosumers. In 2022, the number of PV panels was estimated at about 1.26 million, while the installation capacity was estimated at 9.5 thousand MW. The number of solar power plants has also been gradually increasing. In 2022, they provided 55% of renewable energy. Micro-installations, together with larger photovoltaic farms, had a total capacity of 13.5 thousand MW. It should be noted that a PV installation with a capacity of 1 MW produces about 1.1 thousand MWh of energy per year. In a coal-fired power plant, this amount of electricity requires burning 500 tons of coal (Grzeszak, 2023, p. 41). It should be mentioned that power grids operate in two areas: commercial and physical. One area refers to contracts, settlements with producers and consumers, and the other to the laws of physics that determine the flow of energy in the network. This causes serious challenges, especially for distribution grids where the renewable photovoltaic sources are connected. Grids have to operate both directions, transmitting and receiving energy, although they were developed as Energy supplying systems only. At the same time, a large proportion of renewable energy is not produced where it is most needed. As a result, without large investments in power grids, the energy transition will not be possible. The draft Polish Energy Policy PEP2040 assumes that PLN 500 billion will be allocated for grid expansion by 2040. However, experts doubt whether such an amount will be possible to generate and whether there will be contractors able to carry out such large investments.

According to the assumptions of the European Commission, Poland (like other EU Member States) should move away from coal by 2040 in order to achieve climate neutrality in 2050. True climate neutrality means no carbon dioxide emissions into the atmosphere. However, it is difficult to measure the amount of carbon dioxide reaching the atmosphere versus a given entity responsible therefor. There are several types of definitions; the narrowest of them indicate that only emissions caused directly by an entity during the production process matter. Those who apply more broad definitions indicate that the electricity consumed by a company, when it comes from the combustion of coal, oil, or gas, should also be taken into account. The most comprehensive definitions also include the effects of sale, use and recycling of goods launched by a company.

The energy and fuel companies are currently strongly referring to the future climate neutrality. The problem is that they also most frequently use greenwashing, in Polish referred to as "green whitewash", "ecological baloney" or "eco-crap". In Poland, the state-owned energy company Polska Grupa Energetyczna (PGE), producing electricity mainly from coal is an example of greenwashing. The company declares reaching energy neutrality by 2050. However, it is not shutting down coal-fired power plants but wants to sell them. The Council on Foreign Relations (ECFR) best describes these and similar actions, indicating in their report that the existing ignorance towards climate becomes an area for practicing politics and playing interests that are not always headed in the right direction. By protecting their interests related to sectors threatened by transformation, the economic lobby is often resistant, providing

numerous analyses indicating that too rapid a transformation means a loss of competitiveness and is economically dangerous. The economic losses from the transition to greener energy production are probably inevitable, at the national level, in the regions and within companies. However, we should be aware that if the critical point in the climate system is exceeded (the moment thereof is difficult to precisely determine), feedback will be triggered, making human life difficult or even impossible. And it does not matter where the excess CO_2 emission occurs: in China, Africa, the United States, Australia, or Poland.

Another economic issue related to sustainable development and neglected by the Polish government is the thermal modernization of buildings. This is part of the EU's REP Power EU plan, which imposes an obligation on Member States to fight the "energy vampires". This name refers to buildings with the lowest thermal standard, requiring the highest expenditure on heating. There are about a million such residential buildings in Poland. It is estimated that they account for ca. 15% and that they consume about a third of the energy used in residential buildings. The EU's plan aims to introduce energy efficiency classes for buildings, similar to household appliances. According to the EU's proposal, buildings will be assessed as per classes from A+ to G. Class A+ refers to buildings with positive value as for energy efficiency relative to non-renewable primary energy, class A – emission-free buildings, while the worst class G will cover 15 per cent of buildings with the lowest energy performance. The class will also include information on the level of air pollution, including CO_2 emissions. Information on energy demand and emissions will also be provided in advertisements for the sale and rental of real estate. It is estimated that the modernization of the most energy-intensive buildings of class F and G, upgrading them to class B or C, could reduce their final energy consumption by 90 per cent, while upgrading them to class E would reduce the consumption of gas and heating oil by 31 per cent. In the European energy fragmentation, in buildings with the worst energy performance the consumption of energy from gas accounts for 47%, from heating oil 13% and 4% from coal. All countries will be required to identify the 15% most energy-intensive buildings (class G - "energy vampires") and upgrade them to at least class F (Buildings in Poland…, 2023). Unfortunately, Poland is currently the last EU country where energy classes of buildings do not apply.

Another problem to be solved refers to issues related to the ETS-2 system, i.e., the parallel emissions trading system, which the industry and energy sector must now take into account in their calculations (European Emissions Trading System (EU ETS)). It covers buildings and road transport and involves charges for CO_2 emissions caused by residential buildings and cars. In the ETS, emission fees should be transferred to the national budgets and allocated for energy transition, thermal insulation of buildings and moving away from fossil fuels. Currently in Poland, revenues from emission fees are transferred mainly to subsidize coal-fired power generation and imports of coal.

There is also the issue of introducing a deposit for plastic bottles, the improper disposal of which results in the increased CO_2 emissions into the atmosphere. No recycling system involves paying fines (65% of packaging is to be recycled by 2025, 2023, according to the EU targets). In order to prevent establishing new landfills, the EU Directive on Packaging and Packaging Waste has been introduced. It sets targets for particular types of raw materials from packaging by 2025. As much as 50% of plastics, 25% of wood, 70% of ferrous metals are to be recycled; 50% aluminium; 70% glass and 75% paper and cardboard. The Polish government transfers EUR 0.8 per 1 kg of plastic from the national budget to the EU budget for every tonne of new plastic packaging that is not recycled. By 2023, Poland has paid in about PLN 2 billion to the EU budget for insufficiently performer recycling. According to the Statistics Poland (GUS), in 2019 each Pole produced 332 kg of rubbish. In 2020, 334 kg (tabel 2) and in 2021, 360 kg. Meanwhile, about 27% of waste is recycled, and we observe no signs for the rate upward trend in recent years (Kowanda, 2023, p. 43).

Table 2.
Rubbish left by an average Pole in 2019-2021 according to the Central Statistical Office (GUS)

Name of the state	Carbon Capture and Storage Technology
2019	332 kg
2020	334 kg
2021	360 kg
United Kingdom	6

Source: (Kowanda, 2023, p. 43.)

According to the European Commission, the number and significance of negligence is significant, and proves that e.g., the management of Natura 2000 areas in Poland is an example nature protection on paper. In the call, the European Commission also refers to the Biodiversity Strategy 2030 programme. The European Green Deal and the EU Biodiversity Strategy for 2030 underline how important it is for the EU to stop the loss of biodiversity by protecting natural areas and restoring degraded ecosystems to their good ecological condition. The European Commission also indicated that there is also serious negligence in climate policy. Not only does Poland have one of the least ambitious CO_2 emission reduction targets in the EU, but it also has insufficient climate programmes. This proves that the dysfunctions in the Polish economy require developing the economic policy strategy in the area of natural environment. Fundamental importance should refer to the intensification of efforts towards the implementation of common objectives set by the EU.

The pace of civilizational changes, the development of production, and, as a result, the growth and pollution of the Earth have made the ecological aspect one of the most frequently discussed issues today. However, it can be noted that in Poland it is very difficult to build real environmental awareness and cause the same ecological attitudes in the household and in the workplace. Meanwhile, management is primarily a dependent system. It is subject not only to economic, but also to non-economic influences in the form of socially sanctioned norms and

rules, defining culturally important goals and permitted ways of achieving them. Social understanding is therefore the main tool for achieving the assumptions of Polish's sustainable development. In fact, there are no areas of the economy in which significant progress is possible without strengthened mechanisms for cooperation between society, institutions and sectors. It is worth noting, however, that in Polish society, climate denialists are a marginal party for the benefit of society as a whole, as only about 2 percent of respondents said that there was no climate change, 9 percent that it was only natural change (Kaczorowska, 2023). It is worth mentioning that greater differences are noticed between age groups than between rural and urban areas. Nevertheless, the countryside is changing more slowly, primarily because it is inhabited by older people who are reluctant to use digital tools and the internet. Lower proficiency in the use of these tools limits access to information, which means that the degree of development of the information society is of great importance in understanding the degradation of the natural environment.

5. Conclusions

In Poland, the principle of sustainable development has been included in the *Constitution of the Republic of Poland on 2 April 1997*. However, despite the fact that in 2003 the Polish government adopted the document ”Obligations of Poland resulting from provisions included in the “Action Plan” of the Earth Summit in Johannesburg – “Implementation Programme”, activities for sustainable development in Poland have been neglected for years. The priority obligations from Johannesburg included: changing the production and consumption models, rational use of natural resources and ensuring the protection of biodiversity, increased use of renewable energy, minimising the chemicals adverse impact on human health, fulfilling obligations to help the poorest countries, and developing the institutional framework for sustainable development.

As it has been repeatedly emphasized, the energy sector is one of the largest emitters of CO_2. Although the energy sector allows to develop the civilizational progress, it is necessary to modernize it as soon as possible for climate security reasons. Increasing the energy efficiency and reducing emissions can be achieved by increasing financial expenditure in the area of R&D and training of modern human resources. The development of a "green" economy is also conditioned by measures taken for the efficient use of resources. This means decoupling the economic growth from the increasing use of resources, especially the primary ones, shifting towards a low-emission, low-carbon economy, increased use of renewable energy sources, promoting energy efficiency (Burchard-Dziubińska et al., 2014, p. 32), and developing and implementing eco-innovation and eco-technology.

To sum up, the technological progress should be perceived primarily as a means applied to reduce the number of resources needed to produce goods and services, greenhouse gas emissions, noise, to stop pollution of seas and oceans, forests, and the process of biodegradation. The effectiveness of technical progress is mainly determined by the synergy of science and business, openness to new ideas, and human capital. A significant importance is attached to a country, which, through its institutions and economic entities, should provide conditions for pro-environmental activities.

6. Limitations and recommendations

The Polish energy sector operates within a unique socio-political and economic context, influenced by historical dependence on coal, current policy structures, and public sentiment. These factors may reduce the generalizability of research findings to other countries with different energy mixes and policy frameworks. While this research emphasizes the importance of public participation, it does not extensively analyze the perspectives of all stakeholder groups e.g., local communities, private sector, or non-governmental organizations. A broader range of viewpoints could further enrich the findings.

Acknowledgements

This work was supported by the Gdynia Maritime University [grant numbers WZNJ/2025/PZ/09] and by the Department of Management and Economics.

References

1. Atak zimy w USA (2023, January 19). *Dobra Pogoda*. Retrieved from: https://dobrapogoda24.pl/artykul/atak-zimy-usa-luty-2021-stan-kleski-zywiolowej-teksas, February 12, 2024.
2. Barnett, M.L. (2019). The business case for corporate social responsibility: A critique and an indirect path forward. *Business & Society, 58*(1), 167-190.
3. Bąk, I., Barwińska-Małajowicz, A., Wolska, G. (2021). Is the European Union making progress on energy decarbonisation while moving towards sustainable development? *Energies, 14*(13), 1-18. https://doi.org/10.3390/en14133792

4. Bednorz, J. (2010). Polityka państwa wobec pakietu klimatycznego z uwzględnieniem znaczenia węgla kamiennego w gospodarce Polski. *Polityka Energetyczna, 13*(20), 47-60.
5. Buildings in Poland will be divided into classes from A to G. (n.d.). Retrieved from: https://wysokienapiecie.pl/82483-budynki-w-polsce-zostana-podzielone, February 10, 2024.
6. Burchard-Dziubińska, M., Rzeńca, A., Drzazga, D. (Eds.) (2014). *Zrównoważony rozwój – naturalny wybór*. Wydawnictwo Uniwersytetu Łódzkiego.
7. CEN (2012). *EN 16258: Methodology for calculation and declaration of energy consumption and GHG emissions of transport services (freight and passengers)*. European Committee for Standardization. Retrieved from: https://standards.globalspec.com/std/1562222/EN%2016258#, February 2, 2024.
8. COM (2011). *A roadmap for moving to a competitive low carbon economy in 2050 (COM 112)*. European Environment Agency. Retrieved from: https://www.eea.europa.eu/policy-documents/com-2011-112-a-roadmap, February 10, 2024.
9. COM (2019). *EU Climate Action Progress Report 2019 (Report No. 559)*. Brussels: European Commission. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0550, February 15, 2024.
10. CSO (1993). *Definitions in the field of environmental protection*. Central Statistical Office, Department of Agriculture, Forestry and Environmental Protection.
11. Czaja, S., Fiedor, B. (2010). Ekonomia środowiska i ekologiczna jako filary ekonomii zrównoważonego rozwoju. In: B. Poskrobko (Ed.), *Ekonomia zrównoważonego rozwoju* (pp. 17-38). Wydawnictwo Wyższej Szkoły Ekonomicznej w Białymstoku.
12. Danowska-Prokop, B., Pęciak, R. (Eds.) (2021). *Polska myśl ekonomiczna – wybrane problemy*. Katowice: Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach.
13. Decision No 406/2009/EC (2009). *Decision of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020*. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2009.140.01.0136.01.ENG, February 5, 2024.
14. Directive 2003/87/EC (2003). *Directive of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC.* Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32003L0087, February 12, 2024.
15. Directive 2009/31/EC (2009). *Directive of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009L0031, February 12, 2024.
16. Grzeszczak, A. (2023). Opał z wykopalisk. *Polityka, 11*, 42-71.
17. Grzeszczak, A. (2023). Złapani w sieci. *Polityka, 27*, 41.

18. Hinc, A. (2011). Jak skutecznie wdrożyć CCS w Polsce? Polska Strategia CCS. *Demos EUROPA*.
19. *Ile Polska płaci za importowany węgiel* (n.d.). Retrieved from: http://knurow.solidarnoscgornicza.org.pl/2022/02/21/ile-polska-placi-za-importowany-wegiel/, February 7, 2024.
20. IMGW (2023). *Obserwator*. Retrieved from: https://www.imgw.pl/instytut/imgw-obserwator, January 15, 2023.
21. International Energy Agency (2013). *Technology Roadmap: Carbon Capture and Storage*. Paris: OECD/IEA.
22. ISO (2020). *ISO 14046:2014 Environmental management — Water footprint — Principles, requirements, and guidelines*. Retrieved from: https://www.iso.org/standard/43263.html, February 2, 2024.
23. ISO (2020). *ISO 14046:2014 Environmental management — Water footprint — Principles, requirements, and guidelines*. International Organization for Standardization. Retrieved from: https://www.iso.org/standard/43263.html, February 2, 2024.
24. Kaczorowska, G. (2023). Jacy są Polacy? *Polityka*, *No. 13*.
25. *KE oskarża Polskę o zaniedbania dotyczące ochrony środowiska* (n.d.). Retrieved from: https://zielona.interia.pl/polityka-klimatyczna/news-ke-oskarza-polske-o-zaniedbania-dotyczace-ochrony-srodowiska,nId,5296481, June 3, 2023.
26. Kizielewicz, J. (2022). Monitoring energy efficiency and environmental ship index by cruise seaports in Northern Europe. *Energies, 15*, 4215. https://doi.org/10.3390/en15084215
27. Knoepfel, P., Nahrath, S. (2005). Sustainable management of natural resources: From traditional environmental protection policies towards institutional natural resource regimes. *IDHEAP*.
28. Kowalewski, A.T. (2006). Społeczne, ekonomiczne i przestrzenne bariery rozwoju zrównoważonego. *Instytut Rozwoju Miast*.
29. Kowanda, C. (2023). Gra w butelkę. *Polityka, 11*, 43.
30. Rogall, H. (2010). *Ekonomia zrównoważonego rozwoju. Teoria i praktyka*. Zysk i S-ka.
31. Strzępka, K. (2018). Ambitne cele, ale znikome rezultaty. *Teraz Środowisko*. Retrieved from: https://www.teraz-srodowisko.pl, February 2, 2024.
32. SWD (2019). *Report from the Commission to the European Parliament and the Council: Laying the groundwork for increased long-term ambition, 2019 EU Climate Action Progress Report (SWD 396 final)*. Brussels: European Commission.
33. The Global Status of CCS (2019). *Global CCS Institute*. Retrieved from: https://www.globalccsinstitute.com/resources/publications-reports-research/global-status-of-ccs-report-2019, September 23, 2019.

34. UN (2015). *Transforming our world: The 2030 Agenda for Sustainable Development (A/RES/70/1)*. Retrieved from: https://www.un.org/sustainabledevelopment, February 2, 2024.
35. UN (2015). *Transforming our world: The 2030 Agenda for Sustainable Development (A/RES/70/1)*. United Nations.
36. Wolska, G. (2021). Ocena jakości życia w wybranych krajach UE w latach 2004–2019 na przykładzie wskaźnika rozwoju społecznego HDI. In: B. Danowska-Prokop, R. Pęciak (Eds.), *Polska myśl ekonomiczna – wybrane problemy* (pp. 179-188). Katowice: Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach.
37. Ziębik, A., Gładysz, P. (2015). Uzasadnienie krajowej i unijnej polityki energetycznej – analiza porównawcza. *Energetyka, 9*, 569-577.