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Analysis of the impact of the extension of the Turów mine and power plant on Poland's climate protection obligations

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Contents

Executive Summary

The climate, and especially its stability, is a common good. This means that no one can be excluded from the right to use this good. At the same time, it places particular responsibility on all users to preserve the stable climate - so that all people, both from present and future generations, can use it safely. This is particularly important in view of the ongoing climate change. The threat posed by this change and the extremely wide range of negative effects that will affect all spheres of life make climate protection one of the most important global challenges and priorities. These impacts will apply equally to the economic, social and natural environment. This means that public authorities of all countries are under a special obligation to care for climate stability.

Therefore, decisions concerning investment projects that may affect climate stability should be guided by the precautionary and prevention principles. This means that an investor taking actions which may have adverse impact on the natural environment (in this case, on climate stability) is obliged to implement all possible measures in order to mitigate this negative impact. If it is not possible, he must seek another way (different technology or location) to implement the intended project. The low-carbon transformation of the energy sector is particularly important, as is the conversion of the economy to renewable energy sources and the implementation of programmes leading to significant improvement of energy efficiency.

Climate protection has not only a political and ethical dimension, but also a legal one. Poland is a Contracting Party to the United Nations Framework Convention on Climate Change (UN FCCC) and has ratified the Paris Agreement to this Convention. By ratifying the Convention in 1994, Poland has undertaken to stabilise the concentration of greenhouse gases in the atmosphere at a level that will prevent dangerous, anthropogenic interference with the climate system (UN FCCC Article 2). By signing and ratifying the Paris Agreement, the government of Poland has accepted more far-reaching quantitative commitments regarding greenhouse gas emissions by 2030 compared to 1990 levels.

Legal obligations concerning climate protection and reduction of greenhouse gas emissions arise also from Poland's membership in the European Union. The current commitments under the Paris Agreement entail a 40% reduction of emissions by 2030 compared to 1990 levels. Nonetheless, in connection with the adoption by the EU, in the autumn of 2019, of the goal to achieve climate neutrality by 2050, an increase of the current reduction target to 50 - 55% is currently contemplated. Some proposals indicate the need to achieve at least 65% reduction by 2030. Although Poland - as the only EU member state - has not endorsed the climate neutrality goal, it should be expected that the new reduction target, if adopted by the EU, will also apply to our country. Reaching this target will require a significant reduction of greenhouse gas emissions, including - and perhaps primarily - from energy generating installations burning hydrocarbon fuels.

The importance of climate protection in EU policy was confirmed during the last summit of the European Council on 17-21 July 2020. The Conclusions of this meeting stated, inter alia[1], : *Climate action will be mainstreamed in policies and programmes financed under the MFF and NGEU. An overall climate target of 30% will apply to the total amount of*

[1]European Council: Special meeting of the European Council 17-21 07.2020 - Conclusions. Available on: https://www.consilium.europa.eu/media/45109/210720-euco-final-conclusions-en.pdf Access on 27/07/2020

expenditure from the MFF and NGEU and be reflected in appropriate targets in sectoral legislation. They shall comply with the objective of EU climate neutrality by 2050 and contribute to achieving the Union's new 2030 climate targets, which will be updated by the end of the year. As a general principle, all EU expenditure should be consistent with Paris Agreement objectives. The determination of the EU in the pursuit of climate protection is also evidenced by the fact that the amount of support that Poland will receive under the Just Transition Fund depends on the adoption of the climate neutrality objective.

Lignite mining around Zittau, Bogatynia and Hirschfelde began as early as the end of the 18th century. Poland started mining for lignite in this area in 1947, when the existing mine became part of the territory of the Republic of Poland. Until 1961, the lignite extracted there was exported exclusively to the Hirschfelde power plant located on the German side of the border, the volume of lignite extraction in that period ranged from 3.6 to 6.4 million Mg/year. In 1959, a decision was made to build the Polish Turów Power Plant, which since 1963 has become the main consumer of the lignite extracted from the Turów mine. The peak of brown coal extraction came in the years 1975 - 1988, when 22 to 25 million Mg were extracted annually. In the 1990s and in the first decade of the 21st century, the output decreased to about 12 - 15 million Mg/year. In recent years, due to the reduction in the electricity production at the Turów power plant, the output fell below 10 million Mg/year.

The Turów power plant is a thermal, condensing power plant. It operates six generating units and the construction of unit No. 7 is soon to be completed, which will allow to achieve a total electrical power output of 1984.1 MW_e, i.e. approx. 5% of the total capacity of conventional thermal power plants in Poland. The basic fuel used is lignite, but forest and agricultural biomass is also burned. Diesel oil and technical propane are also used during start-ups and to stabilise the operation of power units. Although there is no detailed data available on the volume of greenhouse gas emissions caused by the operation of the Turów mine and power plant, on the basis of the lignite extraction and electricity generation volumes, it can be estimated that since Poland took over the control of the mine in 1947 and commissioned the power plant in 1963, 950 - 1,300 million Mg CO_{2eq} have been emitted into the atmosphere. Only after Poland's accession to the EU and subjecting the power plant to the requirements of the European Emissions Trading System (EU ETS), i.e. between 2005 and 2019, the Turów power plant emitted nearly 148 million Mg of CO_2. This demonstrates how significant is the impact of the analysed facilities on the climate.

The planned exploitation of lignite in the area and the related expansion of the power plant will mean that this significant impact on climate stability will not decrease. It is assumed that annual lignite production between 2020 and 2038 will reach between 9.0 million and 11.5 million Mg, and will then decrease in the years 2039 - 2044 to 3.5 - 7.0 million Mg annually. This means that emissions from the Turów power plant will range from 171 to 218.5 million Mg CO_2 in 2020-2038 and from 16.5 to 35 million Mg CO_2 in 2039-2044. The expansion and operation of the Turów mine will result in emissions at the level of 7.1 to 7.9 million Mg CO_{2eq}. In the period in question, the total emissions from both the mine and the power plant may reach 194.6 to 261.4 million Mg CO_{2eq}, which translates into average emissions of 8.1 to 10.9 million Mg CO_{2eq} per year.

When we refer these figures to the carbon budget available to Poland, based on the need to achieve the Paris Agreement targets, it must be stated that the continued operation of the Turów mine and power plant will have significant impact on that budget. Assuming

that the budget amounts to a maximum of 570 million Mg CO_{2eq} (with the temperature increase target of > 1.5 ^{o}C), up to 3.46 billion Mg CO_{2eq} (with the target of > 2 ^{o}C), the emissions from Turów account for 5 - 7% of this budget (with the target of > 2 ^{o}C) or up to 34 - 45% (with the target of > 1.5 ^{o}C). Assuming, also following the Stanford University estimates, that the social cost of greenhouse gas emissions amounts to about USD220/Mg CO_{2eq}, it can be concluded that the expansion of the lignite mine and the extension of the operation of the Turów power plant to 2044 could contribute to the global social losses due to climate change at the level of USD 41.25 to 55.66 billion.

When assessing the volume of emissions that the proposed investment will cause, its share in the carbon budget available to Poland and the potential social losses it will cause, it should be concluded that the precautionary and prevention principles have not been taken into account when the decision to expand the Turów power plant and continue the extraction of lignite was made. This venture should also be deemed incompatible with the provisions of Article 2 of the UN FCCC and the Paris Agreement.

1. Introduction

1.1 Purpose, basis and scope of the analysis

The purpose of the analysis is to assess how the decision to expand the Turów lignite mine and to use the extracted lignite to generate electricity in the local power plant will impact Poland's ability to meet the climate policy commitments and goals.

The analysis has been commissioned by the organisation Client Earth. In accordance with the terms of reference the analysis contains the following elements:

a) an analysis of the Polish climate policy – its goals and commitments resulting from domestic, EU and international arrangements and an assessment how they may change in future;
b) an assessment of the current impact of the Turów mine and power plant on climate protection and on Poland's climate objectives and an assessment of the impact of the planned extension of the mine;
c) preliminary assessment of the effects of climate change on other elements of the environment (human health and safety, agriculture, biodiversity, water conditions etc.)

The report has been divided into three main parts:

1. The first part analyses Polish climate policy - its objectives and obligations resulting from domestic, EU and international agreements, and assesses how they may change in the future. This chapter also points out that climate stability should be treated as a public good and discusses the prevention and precautionary principles that should be applied in relation to climate protection and ensuring climate stability.
2. The second part presents an assessment of the impact of the Turów mine and power plant and their planned expansion on the climate, Poland's climate objectives and the CO_2 budget.
3. Part three discusses in general terms the anticipated impact of climate change on human health and safety and on selected components and processes of the natural environment.

1.2 Scientific background

Climate change has been acknowledged by the scientific world for many years. As a result of the increasing concentration of greenhouse gases, the level of CO_2 has increased by 50% compared to the pre-industrial period (1750), reaching 415 ppm. Such a significant change in the content of greenhouse gases in the atmosphere could not be neutral for the Earth's climate. There has been an increase in the amount of solar energy accumulated in the dynamic system of the Earth's atmosphere (the so-called radiative forcing). This contributes to an increase in the average annual global temperature by over 1°C, which means a change in the Earth's thermal and humidity parameters.

We have been seeing the consequences of these changes for years on the entire planet, they include in particular[2]:

- rising sea and ocean levels as a result of the melting of glaciers and ice sheets, as well as warming of water, floods and erosion of coastal and lowland regions;
- heavy rainfall and other extreme weather events which are becoming increasingly prevalent - floods, deterioration of water quality or dwindling of water resources in certain regions;
- heat waves with the formation of urban heat islands, forest fires and droughts are becoming increasingly frequent.

Because of these effects, climate change has impact primarily on the following[3]:

- increased death rate as a result of heat waves,
- changes in the incidence of certain water-borne and vector-borne diseases (vectors are organisms transmitting parasites or infectious micro-organisms),
- damage to property and infrastructure and deterioration of human health, which entails high costs for the society and the economy,
- various sectors, especially agriculture, forestry, energy and tourism, as they are highly dependent on climatic factors, including specific temperature and precipitation,
- many plant and animal species that will not be able to adapt to the new climate conditions,
- many land-based, freshwater and marine species that have had to move to new habitats and may subsequently be threatened with extinction.

The differences in the estimates of the social cost of greenhouse gas emissions are significant, and generally range from USD 177 to USD 805 per Mg CO_2.[4] According to an estimate made at Stanford University in the US, the social cost of greenhouse gas emissions was put at USD 220 per Mg CO_2[5] and this value, as relatively balanced, has been adopted for the purpose of this analysis. Since global greenhouse gas emissions in 2019 were around 50 billion Mg CO_{2eq}, the annual social costs it caused amounted to USD 11 trillion or PLN 44 trillion, which is close to Poland's 20-year gross domestic product.

In 1988, UN agencies established the Intergovernmental Panel on Climate Change (IPCC), a team of scientists and experts, especially climatologists, working on climate change. IPCC experts prepare reports on the basis of which governments and international organisations can initiate actions and set policy frameworks for tackling climate change. As

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[2] https://ec.europa.eu/clima/change/consequences_pl

[3] As above.

[4] https://www.nature.com/articles/s41558-018-0282-y.epdf?sharing_token=c8xmYjTnWsRryrTu3zH9ZdRgN0jAjWel9jnR3ZoTv0Ms70oz073vBeHQkQJXsJbet9ktyjsQdPqCCla29L3j_XV4pjpmNwNNihHWHcxB8RYvP7lWc6wnYhYiFwud2x_wMvWfwQKPuM8yE2fHPUSE-cW6BAsXgGZ4kMybiht5EVNKB03YjA1wHXaw96zz1Ux1dJKrBqRtmnIeLVokP-uj-A%3D%3D&tracking_referrer=www.vox.com; https://www.rff.org/publications/explainers/social-cost-carbon-101/; https://policyintegrity.org/files/publications/SCC_State_Guidance.pdf; https://www.vox.com/2018/9/26/17897614/climate-change-social-cost-carbon; https://www.vox.com/2018/9/26/17897614/climate-change-social-cost-carbon; https://www.yaleclimateconnections.org/2015/02/understanding-the-social-cost-of-carbon-and-connecting-it-to-our-lives/; http://www.cobham-erc.eu/wp-content/uploads/2019/04/preprint_Ricke2018_country_level_scc.pdf

[5] https://news.stanford.edu/2015/01/12/emissions-social-costs-011215/

part of the Panel's work, four scenarios of climate change by the end of the 21st century have been prepared, depending on the amount of greenhouse gas emissions that result in changes in GHG concentration in the atmosphere. According to today's scientific knowledge, only the scenario leading to climate neutrality in the middle of the 21st century would stabilise climate change and significantly reduce the negative effects, bringing about an increase in temperature by the end of the century of 0.9-2.3°C compared to the pre-industrial period.

Only the scenario where climate neutrality is achieved in 2050 guarantees our security. If we follow the path set by the 'business as usual' scenario and the temperature increases by 4°C, then, according to the World Bank's report, climate change of this magnitude and speed will lead to serious economic, social and geopolitical tensions, deeply transforming our world and making it virtually impossible to predict what will happen. Water shortages, heat waves and food crises can be expected to coincide and intertwine with other tensions.

2. Analysis of Polish climate policy - its objectives and obligations resulting from national, EU and international arrangements, as well as an assessment of how they may change in the future

2.1 Climate as a public good

The category of public good is controversial. Economists, analysing this concept from the point of view of demand, supply, ownership and competitiveness, distinguish three types of goods: public, mixed and private[6]. From this point of view, public goods are non-rival and non-excludable. It means that if a unit of a good has been delivered, no one can be excluded from its use, and it also means that the same unit of a good can be used by many users at the same time without any loss to its value.

Wilkin[7] has presented a simplified classification of public goods, which includes environmental goods (e.g. biodiversity, climate stability, soil conservation, proper water conditions), economic (e.g. food and energy security) and socio-cultural (e.g. economic and social viability of rural areas, enrichment of national culture, shaping local, regional and cultural identity).

Another possible distinction is between global and local public goods. The former are goods that are universal for all countries, population groups and generations. These include oxygen production, climate stability and biodiversity. Local public goods, on the other hand, are goods which are consumed at the local level. Examples of such goods include the landscape or the cultural heritage of rural areas.[8]

[6] Brown C., Jackson P.M., 1990: *Public Sector Economics*. Oxford Press. Oxford

[7] Wilkin J., 2010: *Dobra dostarczane przez rolnictwo w świetle teorii dóbr* [*Goods provided by agriculture in the light of the theory of goods*] [w:] Wielofunkcyjność rolnictwa. Kierunki badań, podstawy metodologiczne i implikacje praktyczne (pod red. Wilkin J.) Wyd. Instytut Rozwoju Wsi i Rolnictwa Polskiej Akademii Nauk. Warszawa: 41 – 52

[8] Fundacja Programów Pomocy dla Rolnictwa, 2009: *Koncepcja dóbr publicznych w dyskusji o przyszłości Wspólnej Polityki Rolne* [*The concept of public goods in the discussion on the future of the Common Agricultural Policy*]j, Wyd. FAPA. Warszawa.

In the context of the impact of economic activity on the natural environment analysed here, it is important to take account of the results of an OECD study.[9] It shows that different types of human economic activity can (and should) create public goods. We can therefore argue that the exploitation of lignite in the Turów mine and its combustion in the local power plant serve the purpose of creating public goods. These goods should include the energy security of the state, but also the environmental security of the country's population. Both energy security and environmental security meet the criteria of public goods, as they are non-rival and non-excludable in nature. It is also important to create these goods in such a way that the production of one does not impair the others. This means that by strengthening energy security, we must not compromise ecological and health security nor any other types of public goods, whether global or local.

In this case, we can also invoke the category of common goods as part of the concept of sustainable development. As Prandecki[10] writes, the use of natural resources (including public goods such as landscape, biodiversity, air or climate and its stability) may make it difficult for another entity (other users) to use them. In this situation, the common good ceases to be a public good and is subject to privatisation (only a selected group uses it). It is therefore necessary to introduce mechanisms for managing the common goods, so that they do not lose their public good character. It is worth noting that such management based on the common good principles is particularly relevant where there is competition over the way in which the environment is used. And it may lead to a conclusion that a loss of part of the short-term benefits obtained by a selected group of stakeholders (e.g. the use of local energy resources) should be accepted if obtaining those benefits will jeopardise the ability of the entire community to use a public good (e.g. climate stability).

Referring to the legal classification of the concept of public good, Haładyj and Trzewik state: *"...it is, however, undeniable that the lack of a uniform and structured conceptual structure, in particular the establishment of complete and complementary scopes of the terms that constitute this structure, precludes the final conclusion of the doctrinal discussion on the essence of public things (goods). Although the lack of legal definitions of these terms makes research into these issues significantly more difficult, using the existing body of knowledge, it is possible to identify certain objective characteristics that indirectly make it possible to classify individual goods sensu largo as public goods or things. Given the above assumptions, it can be presumed that the environment and, in any case, some of its resources, including those perceived as strategic by the legislator, have the characteristics of public things (goods). Whereas recognising this category of resources as public goods, because of the legal consequences that this entails in terms of meeting the requirements for their management and protection, has not only practical but also legal implications ...".*[11]

On the basis of the above analyses, it has been concluded that the climate and its stability, being affected by the Turów Lignite Mine and Power Plant complex, fulfil the

[9] OECD, 2001: *Multifunctionality. Towards an analytical framework*. Agriculture and Food. OECD Publications Service. Paris

[10] Prandecki K., 2016: Dobro wspólne a zrównoważony rozwój. [*Common good and sustainable development*] Optimum. Studia ekonomiczne 4 (82): 55 – 68

[11] Haładyj A., Trzewik J., 2014: *„Strategiczne zasoby naturalne" jako dobra publiczne ["Strategic natural resources" as public goods*] [w:] Prawne aspekty gospodarowania zasobami środowiska (pod red. Rakoczy B., Szalewska M., Karpus K.). Wyd. Towarzystwo Naukowe Organizacji i Kierownictwa DOM ORGANIZATORA. Toruń.

function of public goods and that the activities of these entities may have adverse impact on these resources, restricting the ability of other users to use these public goods. Therefore, in this case, the principle of precaution in environmental protection, expressed in the law as the precautionary and prevention principles, may apply.

2.2 Precautionary and prevention principles

The precautionary and prevention principles should play an important role in the approach to the protection of the climate (its stability). Their primary role in environmental protection is to prevent environmental pollution and degradation of its resources[12]. They constitute general principles of environmental protection, which means that anyone who intends to undertake or pursues activities that may affect the environment is obliged to respect them. With regard to the prevention principle, it is sufficient that there is a possibility of a negative effect on the environment and appropriate measures should be taken to ensure that these effects do not occur. According to legal scholars, the prevention principle consist of two elements: an assumption that potential environmental damage may occur and a link between the activity (for example, operation of a mine or a power plant) and the occurrence of that damage[13]. If these conditions are met, preventive measures should be implemented.

In the domestic law these principles have been embedded in the legal norm set out as Art. 6 of the Act - Environmental Protection Law[14]. The prevention principle is described in Art. 6.1: *Whoever undertakes activities that may have adverse effects on the environment is obliged to prevent such effects,* whereas the precautionary principle is contained in Art. 6.2: *Whoever engages in activities whose negative impact on the environment is not yet fully recognised shall be obliged, acting out of caution, to take all possible preventive measures.*

The European Union takes these principles extremely seriously. The principle of prevention has its origin in the Single European Act of 1986, while the precautionary principle was introduced into the law of the European Communities by the Maastricht Treaty, which entered into force in 1993.[15] At present, the source of both principles in the EU law is Article 191.2 of the Treaty on the Functioning of the European Union (TFEU), which reads: *Union policy on the environment shall be based on the precautionary principle and on the principles of preventive action*.

It should be noted that the principles in question have acquired the status of legal norms enshrined in the Treaty (TFEU), i.e. the primary law of the EU. This means that all Member States are obliged to comply with them and that these rules can (and should) be

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[12] *Communication from the Commission on the precautionary principle.* 02.02.2000. http://eur-lex.europa.eu/LexUriServ/site/en/com/2000/com2000_0001en01.pdf

[13] Korzeniowski P., 2000: *Zasady ogólne prawa i polityki ochrony środowiska Unii Europejskiej w procesie dostosowania ustawodawstwa polskiego do prawa Wspólnot Europejskich*. [*General principles of the European Union's environmental law and policy in the process of adapting Polish legislation to the law of the European Communities*] Przegląd Legislacyjny 3 (25): 6 - 28.

[14] Act of 27 April 2001, *Environmental Protection Law*, D.U. [Journal of Laws] of 2019 item 1396 as amended

[15] Lew-Gliniecka K., 2011: *Zasada przezorności i zasada prewencji w unijnym prawie ochrony środowiska. Analiza przypadku na tle uwag ogólnych.* [*The precautionary principle and the principle of prevention in the EU environmental protection law. Case study against general remarks*] Studia Gdańskie. Wizje i rzeczywistość. 8:207–218

directly applicable. Acknowledging the principle of primacy of the international law over the national law, adopted in Polish legislative practice, means that in case of conflicting legal norms - national and EU - the latter should be applied.

In conclusion, given that the precautionary principle applies to the operation of the Turów mine and power plant, it can be argued that if it is shown that the activities of these entities may have negative impact on climate stability, appropriate measures should be taken to ensure that this impact does not occur.

This analysis shows that climate stability is a public good that requires special protection. An effective way to counteract anthropogenic climate change is to ensure that the precautionary and prevention principles are respected in the planning and implementation of projects that may have a negative impact on climate stability.

2.3 International regulations on the protection of climate stability

2.3.1 United Nations Framework Convention on Climate Change

The key international legal instrument for protecting climate stability is the United Nations Framework Convention on Climate Change (UN FCCC). It was signed during the Conference in Rio de Janeiro on 9 May 1992 and came into force on 21 March 1994 after it had been ratified by 50 countries - Parties to the Convention. It is a framework agreement whose provisions may be further developed in additional agreements adopted under the UNFCCC. Poland ratified the Convention on 16 June 1994, and the legal norm included in the Convention entered the national legal system in 1996 after its publication in the Polish Journal of Laws.[16]

The purpose of this legal instrument is described by the provision of Art. 2: *The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt* ***is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system****. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change*.

This provision can be interpreted to mean that the States - Parties to the UNFCCC, by ratifying this agreement, have decided to implement all measures that will ensure stabilisation of greenhouse gas concentrations in the atmosphere. Since the most effective way to achieve this objective is to reduce greenhouse gas emissions, this means that the Parties to the Convention, by ratifying it, have agreed to do so. Nevertheless, the Convention itself does not impose reduction obligations on the Parties, but merely points to the commitment of the developed countries - Parties to the Convention - to reduce it to such an extent that by the year 2000 their emissions are no greater than in the base year, i.e. 1990. Poland, which has obtained the status of a country 'with the economy in transition' under

[16] Dziennik Ustaw [Journal of Laws] No. 53 of 1996 item 238.

the UNFCCC, has adopted a different base year for this purpose than most other developed countries. The base year adopted for Poland at that time was 1988.

Whereas Art. 3.3, describing the principles of the Convention, refers to the need to apply the precautionary principle: *The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects.* ***Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures****, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties*.

This Article contains an extremely important provision that when the possibility of damage (understood as a disturbance of climate stability) is identified, it creates an obligation to take effective preventive action even if there is scientific uncertainty as to whether such damage will indeed occur. It can therefore be concluded that a mere assertion that activity of an entity may have an adverse effect on the concentration of greenhouse gases in the atmosphere should result in taking effective and efficient preventive measures - that is, making sure that these emissions are avoided.

2.3.2 Kyoto Protocol and Paris Agreement

As mentioned before, the UN Convention on Climate Change is a framework agreement. As such it contains provisions for the future adoption of further agreements and commitments within its framework, if the objective of the Convention (set out in Article 2) so requires. To date, the international community has adopted two such amendments: the Kyoto Protocol and the Paris Agreement.

The Kyoto Protocol was adopted at the 3rd Conference of the Parties to the UNFCCC on 11 December 1997. Poland ratified the Protocol on 2 December 2002, and the legal norm contained in it entered into force after the publication of the Protocol in the Polish Journal of Laws.[17] The legal norm stipulated in the Protocol required Poland to ensure that the average annual emissions in the years 2008 - 2012 were 6% lower than in the base year (1988). As those commitments covered only the period from 2008 to 2012, at present, the provisions of this legal instrument have no effect on our country's international legal obligations.

However, the legal norm laid down in the Paris Agreement does have such an effect. It was adopted on 12 December 2015 during the 21st Conference of the Parties to the Climate Convention. Poland ratified it on 7 October 2016, and it became part of the national legal system in 2017.[18] The Agreement was adopted because the Parties to the Convention had recognized the need for an effective and progressive response to the urgent threat of climate change on the basis of the best available science.[19] They therefore decided to enhance the implementation of the Climate Convention by strengthening the global

[17] Dziennik Ustaw [Journal of Laws] No. 203 of 2005 item 1684
[18] Dziennik Ustaw [Journal of Laws] of 2017 item 36.
[19] Preamble to the Paris Agreement.

response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, in particular by holding the increase in the average global temperature well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this will significantly reduce the risks and impacts of climate change.[20]

The specific commitments that should lead to achieving this goal have been laid down in Art. 4 of the Paris Agreement:

4.1 *In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.*

4.2 *Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions*.

In conclusion, it should be stated that, by deciding to accede to the United Nations Framework Convention on Climate Change and the Paris Agreement, the Polish government has decided about the need to take action to protect climate stability - to ensure that the concentration of greenhouse gases in the atmosphere is stabilised at a level where the average temperature increase is no greater than 2°C. By acceding to the Climate Convention, the Polish government considered it appropriate to apply the precautionary principle to environmental protection. In this case, it means that if the actions and decisions taken are likely to jeopardise climate stability, the government will take appropriate measures to make sure that the effects of those actions do not have an adverse effect on climate stability.

2.4 Climate policy - international, in the EU and in Poland

As mentioned above, the UN Framework Convention on Climate Change is the reference point for the international climate policy. By ratifying this agreement, Poland has undertaken not only to seek climate stability, but also to fulfil a number of specific obligations. The most important one was to achieve reduction of greenhouse gas emissions, while the other commitments included:

- to develop and implement a national strategy for the reduction of greenhouse gas emissions based on economic mechanisms and administrative measures and to monitor its implementation;

[20] Paris Agreement Art. 2

- to submit to the UNFCCC Secretariat in Bonn an annual inventory of greenhouse gas emissions and removals in accordance with the IPCC guidelines;
- to develop long-term emission reduction scenarios for all economic sectors, separately for each gas;
- to conduct climate change research and monitoring;
- to prepare periodic government reports (every two years) for the Conference of the Parties containing detailed information on the fulfilment of the above mentioned obligations.

Poland fulfils the above obligations, however, the document adopted in 2003, *Polish Climate Policy. Strategy for the reduction of greenhouse gas emissions by 2020* (which assumed 40% reduction in greenhouse gas emissions by 2020, as compared to 1988) has never actually been implemented and has not had any impact on other strategic documents adopted by the Polish government.

Since the beginning of the negotiations on the Climate Convention, climate policy has been one of the European Union's priorities, and its objectives for reducing emissions have been incorporated into many sectoral policies: concerning energy, industry, science. Following the Paris Agreement, the EU undertook intensive work on the transformation towards a no-carbon economy, and the European Parliament and the European Council obliged the European Commission (EC) to prepare a strategic vision for building a climate neutral economy by 2050. In November 2018, the European Commission presented a long-term strategic vision for the reduction of greenhouse gas emissions, demonstrating how Europe could pave the way to climate neutrality, by creating an economy with almost zero greenhouse gas emissions.[21] (Fig. 1).

During the meeting of the European Council on 12.12.2019 the Conclusions were adopted, which stated, "*In the light of the latest available science and of the need to step up global climate action, the European Council endorses the objective of achieving a climate-neutral EU by 2050, in line with the objectives of the Paris Agreement.*" In December 2018, when adopting the new long-term development strategy, the so called European Green Deal, the European Union declared that it would seek to achieve climate neutrality by the middle of this century. This goal shall be legally binding.[22] The European Commission has announced that between 2020 and 2021 it will present a number of legislative proposals designed to implement the new climate targets. These will include a European climate law with a legally binding objective of climate neutrality by 2050 and a proposal to extend the emissions trading system.

In the current EU climate and energy policy the following targets have been set by 2030:

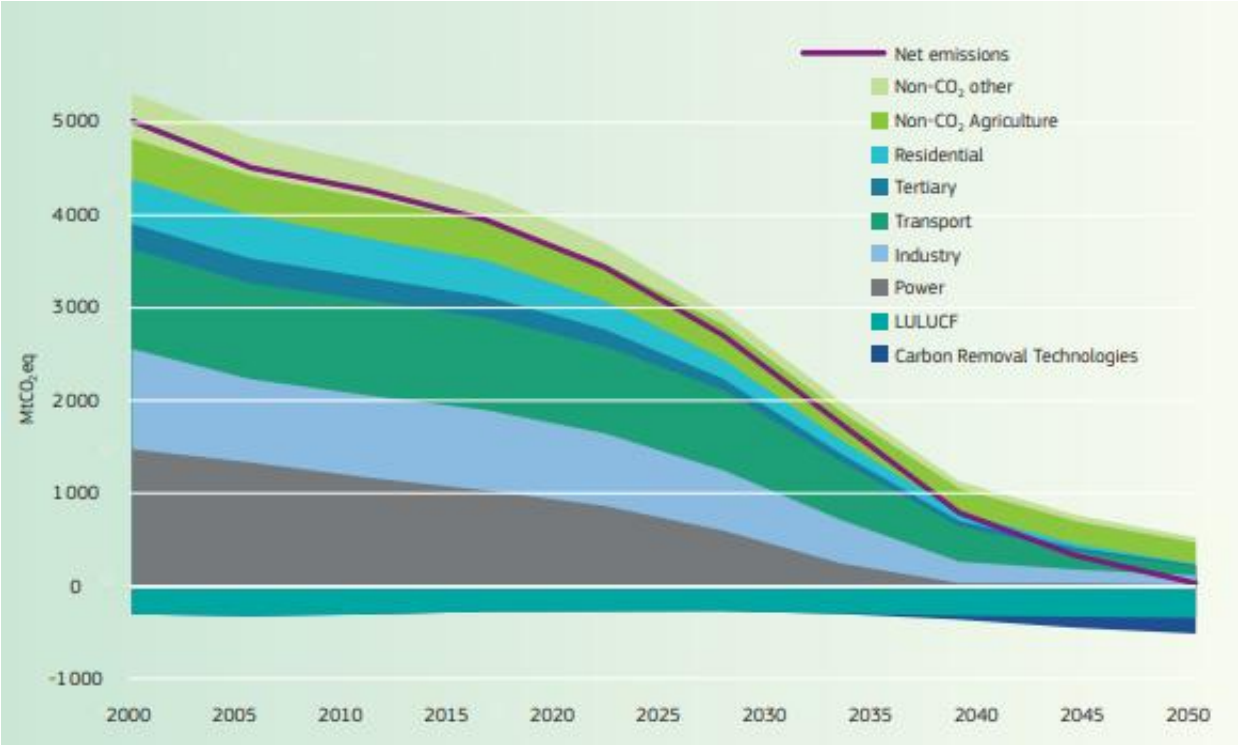
- to reduce greenhouse gas emission by at least 40% (compared to the 1990 level);

[21] Communication from the European Commission. *A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by2050* [COM (2018) 773 final].

[22] 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: *European Green Deal*, COM (2019) 640 final, https://ec.europa.eu/transparency/regdoc/rep/1/2019/PL/COM-2019-640-F1-PL-MAIN-PART-1.PDF, accessed, 05.07.2020.

- to increase the share of renewable energy in final energy consumption to at least 32%;
- to increase energy efficiency by at least 32.5%.

Fig. 1 GHG emissions trajectory in a 1.5°C scenario in the EU in million Mg CO_{2eq}



Source: *Climate neutrality by 2050. A European strategic long-term vision for a prosperous, modern competitive and climate neutral economy*. The European Commission

However, in the light of the climate neutrality goal set for the middle of the 21st century, the target of 40% GHG emissions reduction adopted for 2030 is insufficient and it has become necessary to raise it to at least 50-55% compared to 1990. In the course of the ongoing work in the European Parliament, proposals are being put forward to increase this target even to 65%.

Currently, Poland does not have a separate long-term climate policy document. The objectives and the strategy in this respect are partly expressed in the National Energy and Climate Plan 2021-2030 (NECP) submitted to the EC on 30.12.2019. In addition, EU Member States are required to develop national long-term strategies on how they plan to achieve the reduction of greenhouse gas emissions necessary to meet their obligations under the Paris Agreement and the EU targets. According to the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, "*By 1 January 2020, and subsequently by 1 January 2029 and every 10 years thereafter, each Member State shall prepare and submit to the Commission its long-term strategy with a perspective of at least 30 years. Member States should, where*

necessary, update those strategies every five years."[23] In accordance with an annex to this Regulation, the strategies should include information about:

a) total GHG emission reductions and enhancements of removals by sinks that the country commits to achieve by the given time;

b) volume of energy produced from renewable sources;

c) planned level of energy efficiency improvement;

d) measures to reduce emissions in individual sectors – energy, industry, transport, agriculture and land use, land use change and forestry with links to agricultural and rural development policies;

e) financing of the activities planned;

f) impact of the implementation of climate policy and the related socio-economic aspects.

As at 01.07.2020 Poland is one of 12 countries that have not submitted their strategies yet, in spite of the fact that the time limit for the submission has passed.[24]

Given the provisions of the NECP, Poland plans to reduce GHG emissions by only 29.1% by 2030 compared with 1990 levels, and by the year 2040 -- to reach 42.8% reduction. To date, the Polish government has only declared that it will take action which may result in a reduction of around 50% by 2050 in relation to 1990 levels. Such a level of reduction is far below the EU targets for 2030 and the objective to achieve climate neutrality in 2050. (Fig. 2).

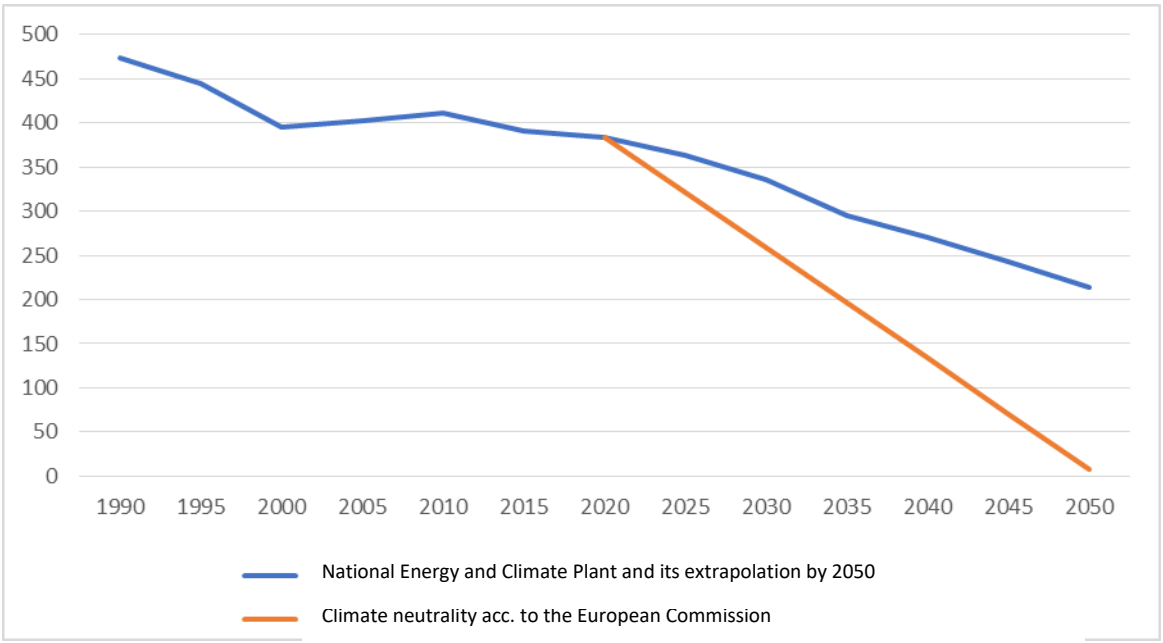
There is therefore a distinct discrepancy between the declarations made by Poland in the international forum when it ratified the Paris Agreement and the position of the Polish government at the European Council of 12 December 2019, where it was the only Member State not to endorse the goal of climate neutrality in 2050.

It seems, however, that it will be increasingly difficult for Poland to block the objectives of EU climate policy and attempt to maintain the status quo in terms of the dominance of coal in the energy sector. The next EU budget will provide significant support for the development of a low-carbon economy, and a considerable part of the funds (under the Common Agricultural Policy, for example, 40% of the total budget is to be assigned to this purpose) will be allocated to climate protection and climate change adaptation programmes. Another constraint will be the need to purchase greenhouse gas emission allowances under the European Emissions Trading Scheme. The increase in the price of these allowances will undermine, in particular, the profitability and efficiency of energy production based on fossil fuels (especially lignite).

[23] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council.

[24] https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/long-term-strategies_en#strategies

Fig. 2 Change in the volume of GHG emissions in the years 1990 -2017 and an emission forecast by 2050 in million Mg CO_{2eq}



Sources: *National Inventory Report 2019. Greenhouse gases inventory for the years 1988–2017*, Synthetic report prepared for the UNFCCC and the Kyoto Protocol, National Centre for Emissions Management (KOBiZE) at the Institute of Environmental Protection – National Research Institute, Warsaw 2019. *Energy and climate policy scenario* (PEK), Impact assessment of the planned policies and measures. Annex 2 to the National Plan for Energy and Climate for the years 2021–2030. Version 5.2 z 18.12.2019 r. + authors' own calculations

Poland is the only EU Member State which has not yet declared its willingness to achieve climate neutrality by 2050. The Polish government has also failed to prepare a long-term strategy for achieving climate neutrality, and there is no document defining national climate policy objectives. Therefore, the only document which specifies the targets that the Polish government intends to achieve in this respect by 2040 is the *National Energy and Climate Plan for 2021-2030* submitted to the European Commission on 30.12.2019.

According to the provisions of this document, by 2030 Poland intends to reduce (in relation to 1990 levels) its GHG emissions by only 29.1%, and by the year 2040 -- by 42.8%. Such a level of reduction is far below not only the EU targets, but also below Poland's commitments under the Paris Agreement.

3. Assessment of the impact of the Turów mine and power plant together with their extension on Poland's climate, climate objectives and the CO_2 budget

3.1 Current climate impact of the mine and the power plant

Lignite mining around Zittau, Bogatynia and Hirschfelde began as early as the end of the 18th century. Poland started mining for lignite in this area in 1947, when the existing mine became part of the territory of the Republic of Poland. Until 1961, the lignite extracted

there was exported exclusively to the Hirschfelde power plant located on the German side of the border, the volume of lignite extraction in that period ranged from 3.6 to 6.4 million Mg/year. In 1959, a decision was made to build the Polish Turów power plant, which since 1963 has become the main consumer of the lignite extracted from the Turów mine. The peak of brown coal extraction was reached in the years 1975 - 1988, when 22 to 25 million Mg were extracted annually. In the 1990s and in the first decade of the 21st century, the output decreased to about 12 - 15 million Mg/year. In recent years, due to the reduction in the electricity production at the Turów power plant, the output fell below 10 million Mg/year.

The Turów power plant is a thermal, condensing power plant with seven generating units and total electrical power output of 1984.1 MW_e (together with unit No. 7 under construction), i.e. approx. 5% of the total capacity of conventional thermal power plants in Poland. The basic fuel used is lignite from the Turów lignite mine and for units No. 1-6 until 16.08.2021 also forest and agricultural biomass. During start-ups, outages and to stabilize the operation of power units No. 1-6 heavy diesel oil is used with technical propane used for start-up while at unit No. 7 light diesel oil will be used.[25]

Although there is no detailed data available on the volume of greenhouse gas emissions caused by the operation of the Turów mine and power plant, on the basis of the lignite extraction and electricity generation volumes, it can be estimated that since Poland took over the control of the mine in 1947 and commissioned the power plant in 1963, 950 - 1,300 million Mg CO2eq have been emitted into the atmosphere. Only after Poland's accession to the EU and subjecting the power plant to the requirements of the European Emissions Trading System (EU ETS), i.e. between 2005 and 2019, the Turów power plant emitted nearly 148 million Mg of CO2. This demonstrates how significant is the impact of the analysed facilities on the climate. Between 2005 and 2019, since the launch of the EU Emissions Trading Scheme, the Turów power lant emitted nearly 148 million Mg of CO_2. Below there is a graph showing changes in emissions (Figure 3). A decrease of over 50% is clearly visible throughout this time. This is mainly due to a reduction, for various reasons, in the production of electricity, which, for instance, between January 2017 and January 2020 fell by nearly 40%.[26]

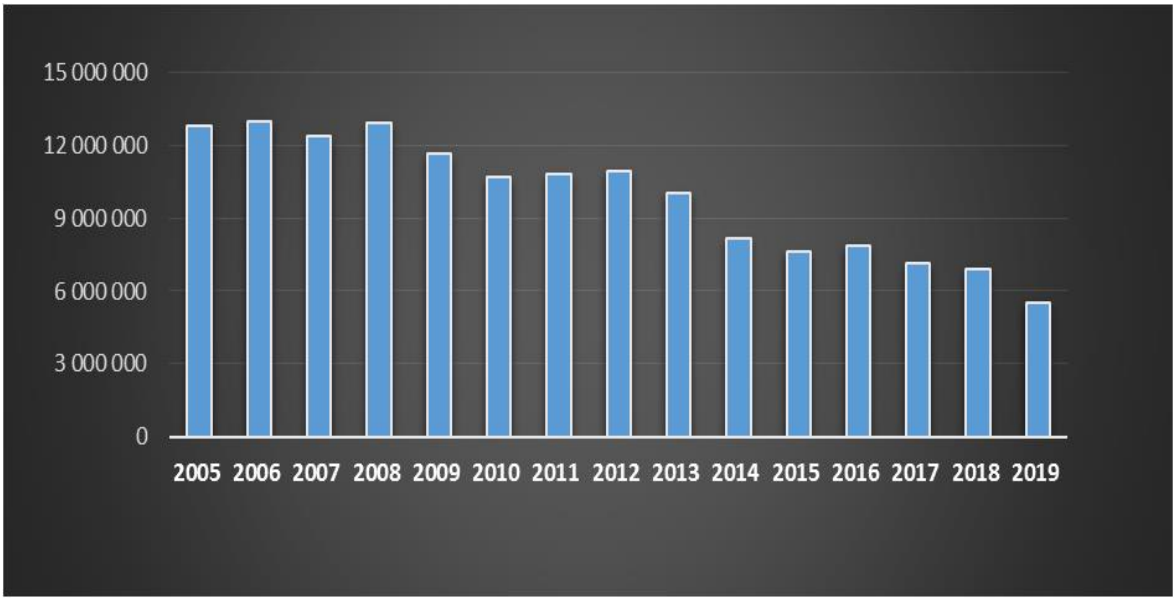
This is a problem for all Polish lignite-fired power plants, whose share in Poland's electricity production fell by 18% in the decade 2009-2019. At the same time, the calorific value of lignite has fallen by 11%. Over the same period, there has been an increase of 12%

[25] Application for change of IPPC in connection with the construction of a new unit.

[26] Derski B. *Elektrownia Turów będzie pracować, ale w coraz trudniejszym otoczeniu*. *[The Turów power plant will operate, but in an increasingly difficult environment]* 30 April 2020. . https://wysokienapiecie.pl/28871-elektrownia-turow-bedzie-pracowac-ale-w-coraz-trudniejszym-otoczeniu/

in the consumption of energy for the plant's own use, which currently accounts for nearly 10% of its total electricity output.[27]

Fig. 3 Turów Power Plant CO_2 emissions in 2005 – 2019 [Mg]



Source:
https://ec.europa.eu/clima/ets/ohaDetails.do?accountID=92927&action=all&languageCode=pl&returnURL=installationName%3D%26accountHolder%3D%26search%3DSearch%26permitIdentifier%3D%26form%3Doha%26searchType%3Doha%26mainActivityType%3D-1%26currentSortSettings%3D%26account.complianceStatusArray%3DA%26installationIdentifier%3D3%26account.registryCodes%3DPL%26languageCode%3Dpl&registryCode=PL

Apart from the Turów power plant, another source of GHG emissions is the Turów ignite mine, technologically linked to the power plant. The analysis carried out as part of the environmental impact assessment report contains complete information about the carbon footprint of this entity.

The table below shows emissions from the mine (Tab. 1)[28]. In total, GHG emissions for the Turów power plant and the mine in 2019 amounted to 5.7 million Mg CO_{2eq} and were lower from the emissions of 2013 by 45%. The current emissions account for 1.4% of total GHG emissions from all types of sources in Poland, while in the category 'energy and buildings' (excluding transport) the share is twice as high[29].

It is worth noting that lignite-fired power plants, both present and future, have the highest emission factor ranging from 900 to 1085 g CO_2/kWh, as shown in Table 2 below.

[27] As above.

[28] Source. Kontynuacja eksploatacji złoża węgla brunatnego Turów. Raport o oddziaływaniu na środowisko (wersja ujednolicona). [Continuing exploitation of the Turów lignite deposit. Environmental impact assessment report. Uniform text] PGE GIEK S.A. Branch KWB Turów. Bogatynia, July 2019

[29] *Set of tables with data on GHG emissions in the Common Reporting Format (CRF)*, it contains detailed data on emissions in the years 1988–2017. The update of data was submitted to the Secretariat on 23.05.2019, National Centre for Emissions Management (KOBiZE) at the Institute of Environmental Protection – National Research Institute.

Tab. 1 Direct and indirect CO_{2eq} emissions of the Turów mine in 2013 – 2019 (Mg)

CO_{2eq} emission – total	**2013**	**2014**	**2015**	**2016**	**2017**	**2019**
Direct emissions	12,738.9	11,190.2	11,009.2	11,391.0	12,556.7	12,507.9
Indirect emissions resulting from energy supply	295,317.0	283,360.8	304,348.5	265,784.2	157,875.8	183,908.8
Indirect emissions related to travel	3,041.0	2,814.5	2,673.2	2,553.6	2,413.8	2,413.8
Total	**311,096.9**	**297,365.5**	**318,030.9**	**279,728.8**	**172,846.3**	**198,830.5**

Source: PGE GIEK S.A. Branch KWB Turów (2019). *Kontynuacja eksploatacji złoża węgla brunatnego Turów. Raport o oddziaływaniu na środowisko (wersja ujednolicona)*. [Continuing exploitation of the Turów lignite deposit. Environmental impact assessment report. Uniform text] Bogatynia, July 2019

Tab. 2 Emissions of Polish conventional power plants by type of fuel

Type of conventional power plant	**Emissions in g of CO_2/kWh**
Hard coal power plants – old	750 – 957
Hard coal power plants – new	687 – 730
Lignite power plant Bełchatów – units No. 1-11	1084
Lignite power plant Bełchatów – unit No. 12	903
Lignite power plant Turów – units No. 1-6	1075
Lignite power plant Turów – unit No.7	900
Natural gas-fired power plants	330 – 360

Source: *Mapa drogowa polskiej energetyki 2030 +.[Road map for Polish energy sector 2030+] Jagiellonian Institute.* https://poczta.nazwa.pl/ajax/mail?action=attachment&session=24b7fa3288a6438b8f467e3b3162e62b&folder=default0%2FINBOX&id=159302&attachment=2&save=0&filter=1

3.2 Expected future emissions from power plants and mines in the context of the situation in Poland

According to the *National Energy and Climate Plan for 2021-2030* (NECP), lignite production is expected to fall by less than 10%, between 2015 and 2030, i.e. to 11,095 ktoe, and then to fall threefold by 2040. As a result, the consumption of lignite will decline. In 2015, electricity production from lignite accounted for 1/3 of total domestic production and it is expected to drop to 1/4 in 2030 and 7.5% in 2040. The reason for this is that lignite-fired power stations are going to lose capacity as a result of the phasing out of existing units. In 2015, their capacity was 8.6 GW, in 2030 it is expected to be 7 GW, and in 2040 only 2.9 GW. The only new lignite investment project is the 496 MW unit in Turów, which is to be commissioned at the end of 2020.[30]

In accordance with the *Programme for the lignite mining sector in Poland*[31] the extractable resources of lignite in Turów amount to 286 million Mg and are planned to be

[30] *Scenariusz polityki energetyczno-klimatycznej* (PEK), Ocena skutków planowanych polityk i środków. Załącznik 2. do Krajowego planu na rzecz energii i klimatu na lata 2021–2030. [*Energy and climate policy scenario.* Impact assessment of the planned policies and measures. Annex 2 to the National Plan for Energy and Climate for the years 2021–2030.] Version 5.2 of 18.12.2019 r.

[31] *Programme for the lignite mining sector in Poland* covers the years 2018 – 2030 with a perspective until 2050 and presents directions for the development of the lignite mining sector in Poland together with targets and measures necessary to achieve them. Ministry of Energy. Warsaw 2018.

extracted until 2044. In 2015, an investment project crucial for the region commenced, i.e. the construction of a new generation unit with the capacity of 496 MW. The unit will have net efficiency of over 43%. Its commissioning will stabilize the level of lignite extraction in the mine at about 11 million Mg per year. The estimated exploitation time is 24 years. This time depends on two basic factors: the country's variable demand for energy produced from lignite and the need to make best use of the capacity of the power units of the main customer, i.e. the Turów power plant.

It is presumed that annual lignite output in the years 2020-2038 will be between 9.0 and 11.5 million Mg. In the following years until 2044, it will be lower, ranging from 3.5 to 7.0 million Mg. Assuming, in simplified terms, that 1 million Mg of lignite represents the emission of 1 million Mg of CO_2 and that the entire output will be used at the Turów power plant, the total emission in 2020-2038 will be between 171 and 218.5 million Mg of CO_2, and in 2039-2044 between 16.5 and 35 million Mg of CO_2. Whereas, depending on the option of exploitation, in the years 2020 -2044, the emissions in the Turów mine will range from 7.1 to 7.9 million Mg of CO_2. In the period in question, the total emissions from the mine and the power plant may range from 194.6 to 261.4 million Mg CO_2, which gives an average of 8.1 to 10.9 million Mg CO_2 per year[32]. If we relate that to the *National Plan*, in 2030 this emission will constitute from 3.0 to 4.0% and in 2040 from 4.0 to 5.3% of the total emissions in the country.

3.4 Carbon budget

The benchmark for taking action to limit climate change is the total amount of carbon that is allowed to enter the atmosphere in order not to exceed the limit for the increase in the Earth's average temperature (i.e. > 2°C and preferably >1.5°C). This is defined as the carbon budget. The 2014 IPCC report estimates the amount of anthropogenic CO_2 emissions that will allow the Paris Agreement target to be met. (Tab. 3).

In view of the global threat posed by climate change, the Paris Agreement requires the countries which are parties to the Agreement to reduce their GHG emissions in order not to exceed the amount of the global carbon budget, i.e. 713 billion Mg CO_2 (the 2.0°C target) or 113 billion Mg CO_2 (the 1.5°C target), with 66% probability. This means that in 2019, with the world population of 7.73 billion people[33], the carbon budget per capita will be, depending on the target, 91-15 Mg CO_2. Taking Poland's population in 2019, 38 million[34], the carbon budget for Poland would be between 3.46 and 0.57 billion Mg CO_2, and if today's emissions of 327 million Mg CO_2[35] are maintained, the budget will be depleted in 2029 or 2022.

Taking the size of the carbon budget for Poland in accordance with the Paris Agreement, estimated in relation to the population and the 2.0 °C objective, the emissions of the Turów mine and power plant will cover from 5.4 to 7.3% of the budget, but if we

[32]

[33] https://www.worldometers.info/pl/

[34] https://stat.gov.pl/obszary-tematyczne/ludnosc/ludnosc/ludnosc-stan-i-struktura-ludnosci-oraz-ruch-naturalny-w-przekroju-terytorialnym-stan-w-dniu-31-12-2019,6,27.html

[35] Global Carbon Atlas 2019 ttp://www.globalcarbonatlas.org/en/CO_2-emissions

adopt the 1.5 °C target, the emissions from the Turów mine and power plant will use its significant portion, 1/3 or even close to 45%.

Tab. 3 Carbon budget by Paris Agreement targets

Paris Agreement target	**2.0 °C**			**1.5°C**		
Probability of reaching the target	66%	50%	33%	66%	50%	33%
Budget size in 2019 in billion Mg CO_2 (year when budget depleted)	713 (2038)	1013 (2046)	1473 (2059)	113 (2022)	263 (2026)	563 (2034)

Sources: IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland; https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions; https://www.globalcarbonproject.org/carbonbudget/index.htm + authors' own calculations

The impact of the Turów lignite mine and power plant in 2019 expressed in terms of GHG emissions amounts to 5.7 million Mg CO_{2eq}, which represents 1.4% of national emissions. As Poland will be reducing its GHG emissions, the expansion of Turów will mean that the contribution of the mine and power plant to GHG emissions in 2030 will be between 3.0 and 4.0% and in 2040 between 4.0 and 5.3% of the Poland's total emissions.

4 Assessment of the impact of climate change on other elements of the environment

The expansion of the Turów lignite mine and power plant will have a wide-ranging, negative impact on almost all elements of the natural environment - both locally, regionally and globally. It will affect local water conditions and increase the radial extent of the cone of depression and thus have adverse impact on agricultural production, forestry and the stability of local natural and semi-natural ecosystems. It will worsen the acoustic climate, increase car traffic and thus affect the safety of the inhabitants. Deteriorating air quality will have negative impact on health security, both for people living in the vicinity of the investment project and on a wider, regional scale, as many of the emitted substances will move over long distances. The intensity of these negative impacts may be exacerbated by the effects of climate change.

4.1 Impact of greenhouse gas emissions from the mine and the power plant on the economy and the society

As shown in Chapter 3, the operation of the Turów mine and power plant results in considerable levels of GHG emissions, and with the planned expansion this impact will increase even further. The activity of these entities has (and will have) a significant impact on the stability of the global climate, accelerating climate change. It is therefore a form of activity that runs counter to the objectives set out in the legal norm of the UN Framework Convention on Climate Change.

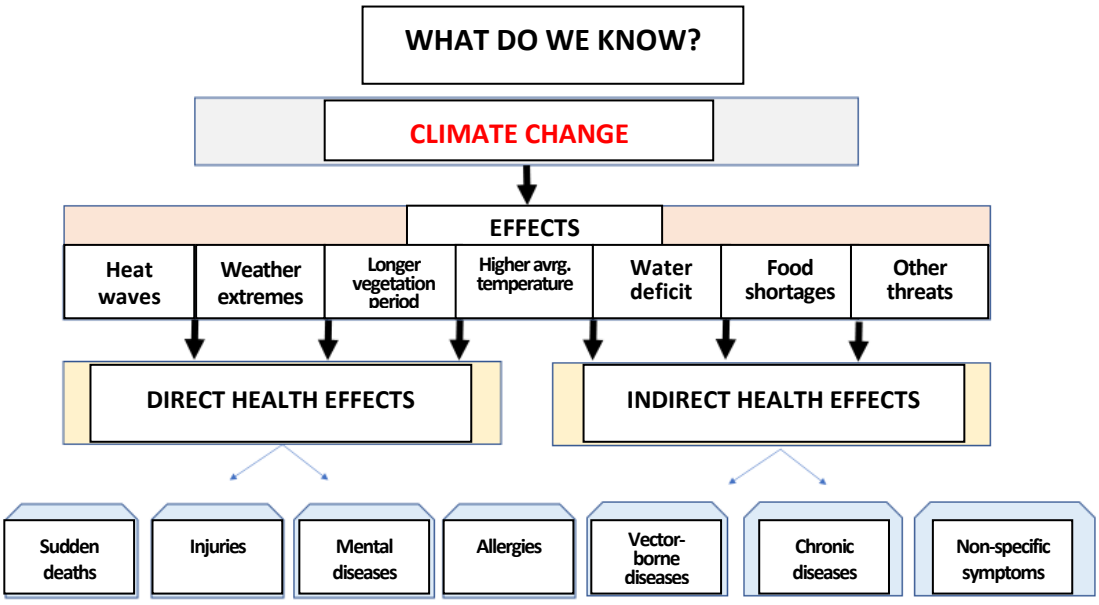
However, it is impossible to show conclusively the proportion of the changes taking place caused by the emissions from this source alone, or which of the negative effects would not have occurred if these emissions had been eliminated. Nonetheless, it can be said with confidence that the GHG emissions generated by Turów accelerate the change, increase the intensity of the negative impacts and make it more difficult to contain anthropogenic climate change.

An example of such impact may be the effect air pollution has on the health of people living in Poland. According to data of the European Environment Agency[36] almost 50,000 people in our country die because of poor air quality, and the number of years of life lost is almost 550,000. Although smog incidents are mainly caused by low-stack emissions (burning coal in household heaters and car traffic), industrial emissions, including those from the Turów power plant, have significant impact on the background level of pollution. On the other hand, the mine and its infrastructure facilities (dumps, workings) are a significant source of secondary dust pollution which directly affects the local air quality.

GHG emissions from the Turów mine and power plant will exacerbate the negative effects of climate change on human health. The way in which this process affects human health is shown in Figure 4.

The World Health Organisation estimates that over 140,000 deaths per year are today directly attributable to climate change. If effective action is not taken to tackle climate change, this figure will rise to at least 250,000 deaths per year by 2040 due to malaria, heat stress, diarrhoea and undernutrition. On a global scale, the direct economic costs of climate change associated with health impairment could be USD 2-4 billion per year.[37]

Fig. 4 Negative effects of climate change on human health.



Source: Karaczun Z.M., Michalak W., 2019: Wpływ zmiany klimatu na zdrowie mieszkańców Warszawy. [Impact of climate change on health of Warsaw residents] Publisher: PKEOM. Warsaw

[36] EEA, 2020: Air quality in Europe — 2019 report. Report 10/2019. Luxembourg: Publications Office of the European Union. Copenhagen.

[37] https://www.who.int/globalchange/publications/COP24-report-health-climate-change/en/

Research has shown that the effects of climate change have greater negative impact on the health of children and pregnant women than on other adults[38]. Women and children are particularly vulnerable to adverse effects in low and middle-income countries, especially in those with poor air quality.[39] It is also estimated that almost 88% of all cases related to climate change impacts occur in children under five years of age.[40] Children are particularly susceptible to dehydration. There is also a high risk of kidney disease, mental health problems and emotional disorders in children.[41]

One of the effects of climate change is an increase in the frequency and length of heat waves and the temperature levels that will accompany them. These events cause premature deaths, hospitalisation and reduced labour productivity. Hungarian research studies show that during heat waves, premature death rate increases from 10.1 to as much as 38.2 persons / 1,000,000 inhabitants[42]. For example: the 2003 heat waves in Europe led to the premature death of at least 70,000 people[43]. In 2010, in Russia, 11,000 people died prematurely as a result of a heatwave[44].

Heat waves bring tragic consequences also in our country. In July 1994, they caused an increase in the number of premature deaths in Polish cities from 23% (Szczecin) to 63% (Łódź).[45] Forecasts prepared for Warsaw show how dangerous this phenomenon will be if climate change is not contained. They estimate that between 2041 and 2070 the maximum temperatures in the city may reach about 43°C, and temperatures ranging 30-35°C will occur for about 22-23 days in a year, and heat waves of 35-40°C will occur for up to four days in a year. Over this period, compared to the present time, the frequency of 3-day heat waves with temperatures of over 30°C will increase by about 280 percentage points, and as regards 5-day heat waves by as much as 600 percentage points. In the period 2071-2100, this increase will reach about 370 and 700 percentage points, respectively. This will result in an increase in mortality rate of over 225% and deaths from cardiovascular diseases by over 252%.[46]

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[38] Kelishadi R., Poursafa P., 2014 : *The effect of climate change and air pollution on children and mother's health* [in:] Global Climate Change and Public Health. Bussines Media. New York

[39] Haines A., Kovts R.S., Campbell-Lendrum D., Corvalan C., 2006 : *Climate change and human health : impact , vulnurability and mitigation*. Lancet 367 : 2101 - 2109

[40] Kelishadi R., Poursafa P., 2014 : Ibidem

[41] Mandeville J.A., Nelson C.P. 2009 : *Pediatric urolithiasis*. Current Opinion in Urology 19(4): 419 - 23

[42] Paldy A., Bobvos J., 2010: *Health impacts of heat waves of 2007 in Hungary – background and experiences.* [In:] Dincer, I. et al. [eds.]: Global Warming. Green Energy and Technology. Springer : 629 - 642

Paldy A., Bobvos J., 2012*: Impact of heat waves on excess mortality in 2011 and 2012 in Hungary*. Central European Journal of Occupational and Environmental Medicine, 67(2): 33–39.

[43] Bono A de, Giuliani G, Kluser S, Peduzzi P., 2004*: Impacts of summer 2003 heat wave in Europe.* Environment Alert Bulletin 2. UNEP-GRID Europe.

[44] Shaposhnikov D[1], Revich B, Bellander T, Bedada GB, Bottai M, Kharkova T, Kvasha E, Lezina E, Lind T, Semutnikova E, Pershagen G., 2014: *Mortality related to air pollution with the Moscow heat wave and wildfire of 2010*. Epidemiology 25(3):359-64.

haposhnikov et al., 2014

[45] Błażejczyk K., Baranowski J., Błażejczyk A., 2015: *Wpływ klimatu na stan zdrowia w Polsce: stan aktualny oraz prognoza do 2100 roku.* [Impact of climate on health condition in Poland: current situation and forecast by 2100] Institute of Gepgraphy and Spatial Organisation, Polish Academy of Sciences, Warsaw 2015. pp. 226

[46] Kuchcik M., 2013, *The Attempt to Validate the Applicability of Two Climate Models for the Evaluation of Heat Wave Related Mortality in Warsaw in the 21st Century*. Geographia Polonica 86 (4): 295–311

It should be remembered that these negative social effects will have measurable economic consequences - associated, among other things, with higher costs of health care, lost working days or premature death of top-class specialists.

An increase in the frequency and intensity of extreme weather events will have similar negative implications. According to the 2018 Global Risks Report published by the World Economic Forum, extreme weather events will pose the greatest threat to the global order and stability over the next decade. Every year, not only does their frequency increase dangerously, but so does the severity of the damage they cause.[47]

This phenomenon is already present in Poland as can be seen, for instance, from the broadening of the area where hurricane winds occur.[48] Since 2005, several hurricanes have occurred in Poland, with wind velocity periodically exceeding 30-35 m/s. The regions most exposed to hurricane winds are the central and eastern part of Pobrzeże Słowińskie [Słowiński coastal region], from Koszalin to Rozewie and Hel, and a wide belt of northern Poland up to the Suwałki region, the region of Beskid Śląski, Beskid Żywiecki, Pogórze Śląskie [Silesian Foothills] and Podhale, and Pogórze Dynowskie [Dynowskie Foothils], the central part of Poland with Mazovia and the eastern part of Wielkopolska.[49]

For a few years now, there has also been a systematic increase in the frequency of whirlwinds, in which the wind velocity ranges from 30 to 120 m/s. While in the 1990s these phenomena occurred 1 to 2 times a year, at the beginning of the 21st century they were already occurring around 6 times a year on average, and at the beginning of the second decade of the 21st century, their frequency has increased to 7-20 a year. In Poland, we can already identify a specific belt along which whirlwinds are most likely to occur. It runs in the north-south direction: from the western part of the Podkarpacie region, through the Silesian-Cracow Upland, the Małopolska Upland, the central part of the Central Poland Lowlands, up to the eastern part of the South Baltic Lake District.[50]

The precipitation structure is also changing. The amount and frequency of low and medium precipitation decreases, while the number of days with heavy daily rainfall increases. This is also true about the occurrence of dangerous and catastrophic rains (with more than 100 mm of rainfall per day). Currently in Poland there are at least 5 days a year with rainfall ≥70 mm/day and 4 days a year with rainfall ≥100 mm/day.[51] Such rainfall causes local flooding and the so-called flash floods. They not only bring economic losses, but often lead to loss of human health and even lives. As the concentration of greenhouse gases in the atmosphere rises, it is predicted that the incidence of heavy rainfall will increase.

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[47] *The Global Risks Report 2018*, World Economic Forum. http://www3.weforum.org/docs/WEF_GRR18_Report.pdf. Accessed: 5/13/2018

[48] Kossin J. P., Emanuel K.A., SUZANA J. Camargo S.J., 2016: *Past and Projected Changes in Western North Pacific Tropical Cyclone Exposure.* Journal of Climate 29(16): 5725 - 5738

[49] http://klimada.mos.gov.pl/zmiany-klimatu-w-polsce/tendencje-zmian-klimatu/

[50] Wieczorek L., 2016: *Zmienność czasowo-przestrzenna występowania trąb powietrznych w Europie i w Polsce w latach 1998-2013. [Temporal and spatial variability of the whirlwind occurrence in Europe and Poland in the years 1998-2013]* Przegląd Geograficzny 88 (3): 353 - 368

[51] IMGW, 2011: *Struktura występowania intensywnych opadów deszczu powodujących zagrożenie dla społeczeństwa, środowiska i gospodarki w Polsce.* Project: Identification and assessment of extreme meteorological and hydrological events in Poland in the second half of the 20th century. Task 4. Natural disasters and internal security (civil and economic) of the country. Available at www.klimat.imgw.pl Accessed on 5.01.2020

These are only some of the negative economic and social consequences of climate change. But even they alone demonstrate how important and urgent it is to take action to prevent them. Without a radical and rapid reduction in greenhouse gas emissions - and this includes the Turów mine and power plant - it will not be possible to reduce these negative, expected effects.

4.2 Cumulative impacts

The effects of climate change already coincide with the negative environmental impacts of the mine and power plant, and it is very likely that, if the increase in the concentration of greenhouse gases in the atmosphere continues, their strength, extent and disruption caused by them will intensify.

An area where negative, cumulative impacts are to be expected is water management and, in particular, water availability. The activity of all opencast mines causes disruption of the hydrological system of neighbouring areas, including: interruption of hydrological connectivity, destruction of existing watercourses and surface reservoirs. Since the exploitation of the resources requires continuous pumping out of water below the extraction line, a cone of depression is formed around such facilities, leading to the loss of surface as well as underground water.

This is also the case of the Turów mine, although its extent is smaller than in many other open-pit mines. It is estimated that currently in the tertiary aquifer on the Polish territory the cone of depression has a surface of about 28 km^2. [52] The monitoring carried out since 1985 indicates that the water table in the tertiary aquifers: between-coal and after coal, is lowered by over 50 m. In the quaternary aquifer, at points along the Lusatian Neisse River, where deficiencies can be compensated by water inflow from the river, the impact of dehydration is not currently observed, but piezometers located on the higher ground show a constant slow lowering of the water table due to water seepage to the dehydrated tertiary layer. It is estimated that the water level there has decreased by about 2.8 metres over 25 years.[53]

The planned expansion of the mine and the exploitation of new lignite seams will have a negative impact on existing water conditions. It will be necessary to drain the deposit and build a sealing wall along the Lusatian Neisse River. This will increase the radial extent of the depression cone in the tertiary level and completely dehydrate the overlying layers. Along a certain section, the Lusatian Neisse River will be enclosed on both sides with cut-off walls and will lose hydraulic connectivity with the surrounding area. The Reichwalde and Nochten mines, situated at the level of the village of Przewóz, are located at a distance from the German-Polish border, and the existing outline of the open pit has not reached the

[52] Dubicki A., Kryza J. 2008: *Zastosowanie metody modelowania numerycznego do oceny wpływu odwodnień górniczych na wody podziemne w rejonie kopalni Jänschwalde*. [Application of the numerical modeling method to assess the impact of mining drainage on groundwater in the area of the Jänschwalde mine.] Meteorologia, Hydrologia, Ochrona Środowiska kierunki badań i problemy. Instytut Meteorologii i Gospodarki Wodnej. Warszawa, p. 98-104.

[53] Dubicki A. Adynkiewicz-Piragas M., Zdralewicz I., 2010: *Monitoring stosunków wodnych w przekształconym krajobrazie strefy przygranicznej.* [Monitoring of water relations in the transformed landscape of the border zone]. Problemy Ekologii Krajobrazu, T. XXVI. 161-169.

catchment area of the Lusatian Neisse River. However, the results of the monitoring carried out since 1997 show a slow drop in the water level in tertiary piezometers on the Polish territory. As a result of the planned investment, the water level fall is likely to intensify, not least because the plans in both mines involve shifting the extraction front towards the German-Polish border. It can be assumed that even stopping the extraction of the deposits will not end the negative impact. The Berzdorf mine, which is located on the German side of the border, may serve as an example: despite the fact that lignite mining ceased in 1997, drainage must continue in order to keep the slopes stable. Filling the excavation pit of this mine with water drawn from the Lusatian Neisse River also affects the water conditions in the area. Current analyses show that it will take up to 100 years to fill the reservoir completely (up to a capacity of 35 million m^3), i.e. significantly longer than planned.[54].

These negative phenomena will be compounded by the already existing and projected effects of climate change: an increased risk of water shortages caused by changes in rainfall distribution. This is currently identified as the most dangerous effect of climate change that will occur in our country. As with the other effects, an increase in the frequency and severity of drought is already being observed. Long-term meteorological observations show that while in the years 1951-1980, in Poland, drought occurred, on average, every five years, in the following thirty years (1981-2010), it was already every two years on average.[55] Whereas, since 2013, we have been actually dealing with regular summer drought, with the years 2018 and 2019 and the spring of 2020 being periods of very severe droughts, including hydrological ones. This has had consequences for the profitability of agricultural production. Between 1957 and 1991, i.e. over a period of 24 years, losses in agricultural production caused by drought were noted only twice (in 1959 and 1964), and in the following 15 years, i.e. between 1992 and 2006, they occurred five times (in 1992, 1994, 2000, 2003 and 2006).[56] This has had very serious social and economic consequences: the losses caused by the drought reduce agricultural income (by approx. 10 - 12% for cereal crops and by approx. 7 - 10% for animal production), affect the volume of agricultural production and thus also food security, both in terms of availability of adequate quantities of food and the impact on food prices.[57] Forestry is a sector affected by drought, just as heavily as agriculture. Drought increases the risk of forest fires and causes decline in timber production. These effects will be exacerbated by the direct negative impact of the expansion of the lignite mine, which entails removal of a layer of biologically active soil from the extraction zone and destruction of all vegetation in this area. Considering these threats and the growing risk of water scarcity resulting from climate change, avoiding the disruption of local water conditions - such as that occurring in the vicinity of the Turów mine - is a priority of Poland's environmental and climate policy.

These are only selected areas in which the direct effects of lignite mining and its combustion on the environment, enhanced by the impact of this activity on the global climate, will affect the environment in Poland. However, even such a brief review shows how

[54] Ibidem.

[55] http://klimada.mos.gov.pl/zmiany-klimatu-w-polsce/tendencje-zmian-klimatu/

[56] T. Górski, J. Kozyra, A. Doroszewski, *Field crop losses in Poland due to extreme weather conditions – case studies* [in:] The Influence of Extreme Phenomena on the Natural Environment and Human Living Conditions, Łódzkie Towarzystwo Naukowe, Łódź 2008.

[57] Karaczun Z.M., Kozyra J., 2020: *Wpływ zmiany klimatu na bezpieczeństwo żywnościowe Polski.* [*Impact of climate change on Poland's food security]*. SGGW. Warszawa

serious adverse effects we are dealing with, on both the natural environment as well as the economy and people. It is extremely important to realise that climate change is not a distant future. Its effects can already be observed in Poland today. For the time being, we can still deal with them and adapt to the changes that are taking place. However, if Poland and the entire international community are unable to take effective measures to stop climate change, we may no longer be able to adapt to future developments.

This reasoning should be applied to the activities of the Turów mine and power plant. Although, on a global scale, the volume of greenhouse gas emissions from this plant seems very small, the impact of this project must be regarded as significant. The only way to avoid these negative effects is to begin the low-carbon transition today and to reduce GHG emissions by at least 65% by 2030. This must be taken into account when decisions are made whether or not to extend the exploitation of local lignite resources.

Climate change will cause widespread negative effects, many of which will also occur in Poland. Among these, the impact on the health and quality of life of Poles is particularly dangerous, with an already increasing number of cases of Lyme disease and other vector-borne diseases, more and more heat waves causing premature deaths, especially in urban areas, and a growing number of Polish women and men who suffer from extreme weather events.

Climate change will have adverse impact on the economy. The sectors that are particularly vulnerable include agriculture and forestry - because climate factors are decisive for the success of production in these sectors, energy sector, which in our country depends heavily on water cooling, and tourism, where success also depends on weather conditions.

The impact of the Turów mine and power plant operation on the global climate will aggravate a number of negative effects that already persist in the vicinity of these facilities: water scarcity and the expansion of the depression cone around the mine, air pollution, reduction of biodiversity.

That is why it is so important to contain anthropogenic climate change. At this stage we are able to adapt to most of the negative events and effects. However, if the Paris Agreement objective is not achieved, it may turn out that the Polish economy, society and the natural environment will not be able to adapt to the new climate conditions.

5. Conclusion

1. For decades, greenhouse gas emissions have been rising year on year and, even though in 2020, they will fall as a result of the COVID-19 pandemic, without fundamental systemic changes during the recovery period following the pandemic, there is a serious risk that the scale of emissions will remain constant. This is all the more dangerous because in order to limit the aggravation of the negative effects of climate change, it is essential to consistently implement the provisions of the Paris Agreement. The Agreement sets out important objectives: not to exceed a 2°C increase in temperature

compared to the pre-industrial period, and preferably not to exceed 1.5°C increase. For this, it is imperative to achieve climate neutrality by the middle of this century. The temperature increase has now exceeded 1°C. Staying on the 'business as usual' path will result in temperature rising by up to 4°C. As the World Bank report states, this will lead to serious economic, social and geopolitical tensions, profoundly changing our world and making it virtually impossible to predict future developments. Water shortages, heat waves and food crises can be expected to coincide and intertwine with other tensions.

2. Both the European Union, as a community of states, and Poland as an independent country, have ratified the Paris Agreement, pledging to implement its provisions. Under the European Green Deal - the EU development strategy for the coming decades - the decarbonisation of the economy and, above all, of the energy sector, is a key task. At the end of 2019, the EU pledged to achieve climate neutrality by 2050 thus delivering on its Paris Agreement commitment. Poland has been the only Member State not to accept this obligation, stating that it is not ready yet to do so.

3. The current EU GHG emission reduction target for 2030 compared to 1990 is 40% and is not enough for the Community to achieve climate neutrality in 2050. Therefore, an increase to 50-55% is being contemplated, with 65% being proposed by some.

4. In accordance with the *National Energy and Climate Plan for 2021-2030*, Poland intends to maintain the significant role of coal in meeting its energy needs until 2040. Lignite is to have an important part in this, despite its declining share in the domestic energy mix. By 2030, the capacity of power plants using lignite as fuel is expected to reach 7 GW, and in 2040 - 2.9 GW, with the current capacity of 8.6 GW (2015). It is worth emphasising that lignite is the most emission-intensive conventional fuel. Consequently, the document provides for the reduction of greenhouse gas emissions in Poland by only 42.8% in 2040, which makes it possible to reduce greenhouse gas emissions by mid-century only by 50% compared to 1990. This means that in the middle of the 21st century Poland will still be far from the climate neutrality target set by the Paris Agreement.

5. The Turów lignite mine and power plant form an important part of Poland's power system, generating about 5% of its electricity. Recently, i.e. between 2013 and 2019, because of the need to reduce the production of electricity for various reasons, GHG emissions from this facility decreased by 45% and in 2019 amounted to a total of 5.7 million Mg CO_{2eq} for the Turów power plant and mine, which represents nearly 3% of the domestic emissions in the category of 'energy and buildings' (excluding transport). Pursuant to the decisions taken by PGE Górnictwo i Energetyka Konwencjonalna S.A., the construction of unit No. 7 is underway along with the expansion of the mine so that the entire complex can operate until 2044. As a result, the total emissions in the years

2020 - 2044 will range from 187.5 to 253.0 million Mg CO_{2eq}. Taking the size of the total carbon budget for Poland in relation to the population and the 1.5°C objective, pursuant to the Paris Agreement, the emissions of the Turów mine and power plant will account for a significant portion of the budget, one third or even nearly 45%.

6. Given that the climate is a common good, and considering the need to be guided by the precautionary and prevention principles, abandonment or a major reduction of lignite mining and limiting the operation of the Turów power plant would contribute significantly to this. At the same time, it would contribute to achieving the climate neutrality required by the Paris Agreement and the EU's commitments. On the other hand, maintaining the operation of the mine and power plant as planned will make it more difficult to meet these commitments. It would put Poland in the position of a country with a low level of global responsibility and no concern for intergenerational justice.

7. As previously stated, climate change is causing and will lead to major negative environmental, economic and social consequences. Above all, it is worth highlighting the following:

    - the number of deaths caused directly by climate change, which amounts to 140,000 per year worldwide, and if no firm action is taken, it could increase by nearly 80% by 2040;
    - the effects of climate change are particularly dangerous for the health of children and pregnant women and for the elderly, especially those living in large cities;
    - climate change will bring tangible economic consequences such as reduced agricultural yields, losses in animal production, losses in forestry, higher health care costs, with working days lost due to sickness;
    - one of the most important effects of climate warming are the risks associated with excess or scarcity of water, such as floods, heavy rainfall, rising sea or ocean levels and increasing frequency and severity of drought;
    - the expansion of the lignite mine and the extension of the operation of the Turów power plant to 2044 could contribute to global social climate change-related losses in the range of USD 41.25 to 55.66 billion.