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ECOLOGICAL THREATS AS A CONTEMPORARY SOCIO-HEALTH PROBLEM RELATED TO SMOG

***Abstract**: Air pollution, or smog, is the term for solid, liquid and gaseous substances in quantities that have a negative impact on human health and the environment in which we live. The effects of smog can be very different, and the magnitude of their negative effects depends on the degree of their amount. It is worth noting that Poland is one of those countries that exceed the permitted level of pollutant emissions that get into the environment. The intention of this publication is to normalize existing theories and definitions, and to gather and systematizing knowledge about the issue of ecological threats as a modern socio-health problem related to smog that affects human health and directions of threats in the modern world. Scientific publication is focused on the social and economic consequences of smog and its consequences for the life of a social unit.*

***Key words:** environment, smog, pollution, health, human.*

Introduction

Air pollution are the main causes of global environmental threats in Poland and in the world. The International Labor Organization defines them as any air pollution by substances that are harmful to health or dangerous for other reasons, regardless of their physical form. The consequences of exposure to air pollution are mainly assessed in epidemiological studies - cross-sectional or long-term. Smog as a social problem and impact on human health.

One of the types of pollution mentioned is London smog. It consists of sulfur (IV) oxide, nitrogen oxides, carbon oxides, soot and the already mentioned difficult falling dust. It occurs during the heating season - usually from October to March, when the energy demand resulting from low temperatures is the highest. During these months there is a temperature inversion, i.e. an atmospheric phenomenon consisting in an increase in air temperature with altitude. If there is no temperature inversion in the lowest atmosphere (troposphere), the air closer to the earth's surface has a higher temperature than the air above. The air is then heated by a heated earth surface. Then the heated air is carried into the upper atmosphere by convection. In the situation of inversion, we deal with an inverse temperature system. It affects the coexistence of effects such as fog accumulation or smog formation in the atmosphere [1][52].

Health effects incurred as a result of being in polluted air concern primarily the respiratory and cardiovascular systems, are also associated with an increase in hospitalization and a decrease in life expectancy. Extremely poor (compared to other countries in our region) air quality in Poland and enormous health, social and economic costs related to our country with exposure to common air pollution justify this interest [2][53].

1. Smog as ecological threats in Poland and in European Union countries

An effective solution to the problem of air pollution requires decisive action from all sectors contributing to emissions (households, transport, energy production, industry) but also the general

[52] https://airly.eu/pl/wszystko-co-powinienes-wiedziec-o-zanieczyszczeniu-powietrza, [data dostępu: 16.06.2020].
[53] Wpływ zanieczyszczeń powietrza na zdrowie, file:///C:/Users/I919E~1.MAL/AppData/Local/Temp/_Wp%C5%82yw_zanieczyszcze%C5%84_powietrza_na_zdrowie.pdf, [data dostępu: 16.06.2020].

public, whose attitude and awareness are essential to the success of these actions. Data on emissions from individual sectors are inventoried and reported in accordance with the requirements of the Geneva Convention (United Nations Convention on Long-Range Transboundary Transport of Air Pollutants from November 13, 1979). Data is collected on the above-mentioned basic pollutants, as well as several other substances, including in particular additional polycyclic aromatic hydrocarbons and metals, as well as persistent organic compounds (polychlorinated biphenyls [PCB], hexachlorobenzene [HCB] or dioxins and furans) [s. 141][54].

The transport sector, in particular road transport, is an important and in some cases even the dominant source of air emissions. It is of fundamental importance for shaping air quality in large urban centers, as well as for major communication arteries, characterized by high traffic volumes and a significant share of heavy transport (motorways, expressways, city beltways). In the European Union, road transport is the main source of emissions of nitrogen oxides (almost 39% share in the total emission balance) and carbon monoxide (share at almost 21%). The share of this sector in the emission of volatile organic compounds (less than 10%) and particulate pollutants (about 11% in both PM10 and PM2.5 dusts) is also visible. In Poland, the share of the transport sector in the emission of most of these pollutants is lower, although dominant in the case of even nitrogen oxides (30% of the total NOx emission). Is an important source of carbon monoxide emissions (almost 21%) and NMVOC (almost 14%) [3, s. 92][55].

It also indicates its presence in primary dust emissions - just over 5% share in PM10 emissions and almost 8% in PM2.5 emissions. However, in the case of cities, especially large urban centers, road transport can be an important and sometimes dominant source of emissions of air pollution, including dust. The road transport sector is also an important source of emissions of certain metals, although the average share in emissions throughout the European Union is much higher than in the case of Poland (where metal emissions are dominated by the municipal and domestic sector). The share of transport in metal emissions remains primarily associated with the processes of abrasion of tires and road surfaces as well as brake system components. This mainly concerns copper emissions (over 80% share in emissions in the EU-28 and less than 22% in Poland), zinc (41% in the EU-28 and just over 4% in Poland), chromium (almost 18% in the EU -28 and less than 10% in Poland) and lead (just over 16% in EU-28 and 2% in Poland).The last 25 years have been a period of intensive reduction of emissions of most air pollutants emitted from the majority of sectors of the national economy. This trend is observed despite the growing number of emission sources in some areas of the economy, which is particularly evident in the road transport sector, for example. Greater awareness of the risks arising from exposure to environmental pollution, technological progress or the systematic introduction of numerous legal and administrative tools in the field of air protection since the 1990s contribute to reducing total emissions. On the other hand, the constantly growing percentage of urban residents (in 2010, the number of people living in cities globally exceeded the number of people living in non-urban areas, and in the European Union already 75% of the population lives in cities) is not conducive to improving the quality of the environment in urban conditions. Nevertheless, a strong increase in air pollution can be seen in many developing countries. There is also a disturbance in the radiation balance due to increased levels of ozone and particulate matter, which on shorter than before time scales has an impact on climate change [3, s. 151][56].

To sum up, it is worth noting that generally in the European Union, both emissions and concentrations in the air of many substances harmful to human health and life and the natural environment (such as PAHs, dioxins and furans, sulfur dioxide or carbon monoxide) have been significantly reduced. However, these changes did not contribute to resolving all the nuisances associated with maintaining adequate air quality. Currently, the main problem of air quality in

[54] Juda Rezler K., *Oddziaływanie zanieczyszczeń powietrza na środowisko*. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2015, s. 141.
[55] Ibidem, s. 92.
[56] Ibidem, s. 151.

Europe, requiring an urgent solution, especially in the health context, is high exposure to dust pollution and ozone, although in many regions significant levels of nitrogen oxides or, as in Poland, also benzopyrene [4, s. 281][57].

2. Air monitoring as a source about the environment

In Poland, the source of information on the environment, including air quality, is primarily state environmental monitoring (SEM). It is a system of measuring, assessing and forecasting the state of the environment, as well as collecting, processing and disseminating information about the environment, the scope of which has been defined in the Act - Environmental Protection Law. Information provided to public administration bodies and the public includes, among others current situation and the state of compliance with air quality standards and data on the areas where they are exceeded. An important role of the SEM is the information and warning function for society, especially important in situations of elevated and high concentrations of pollutants and in relation to sensitive groups (e.g. children, the elderly or the sick, especially chronic respiratory and cardiovascular diseases).

Data on air quality, collected under the SEM, are also subject to reporting to various bodies, including the European Commission and the European Environment Agency, under Poland's international obligations. Among other things, for this reason, it is necessary to maintain comparability of research results both within the country (which allows, for example, to refer them to applicable standards) and within the European community. The provisions related to fulfilling the reporting obligations under Community law are set out in Decision EC 2011/850 / EU of 12 December 2011 laying down the rules for the application of Directives 2004/107 / EC and 2008/50 / EC of the European Parliament and of the Council with regard to the system of mutual exchange of information and reports on ambient air quality.

In accordance with art. 89 paragraph 1 of the Environmental Protection Act, provincial inspectors for environmental protection, by 30 April each year, assess the air pollution in a given zone for the previous year. The methods used for the purposes of air quality assessments carried out by the Environmental Protection Inspection authorities include [5, s.81][58]: measurements (intensive and indicator); calculations using mathematical models of atmospheric dispersion and emission data; objective estimation based on the analysis of information on emissions and its sources, land development, topographic and climatic conditions of the areas under consideration. Estimation also includes, for example, the use of modeling results carried out for a period other than the one being assessed. Objective estimation methods are used, among others for the purpose of identifying areas where normative values of air pollution concentrations are exceeded and estimating the number of people exposed to these exceedances. Requirements as to the methods used, including the minimum number of measuring stations in the zone, result from the recorded concentrations of a given pollutant in the zone, the number of inhabitants living there and its nature (higher requirements for agglomerations).

The Chief Inspector of Environmental Protection supervises the determination by the voivodship environmental protection inspector of the method of air quality assessment and its implementation. One of the elements of fulfilling the obligations regarding the implementation in the Member State of the quality assurance and control system (QA/QC) in air monitoring, enshrined in Directive 2008/50/EC, was the creation of the National Reference and Calibration Laboratory at the Chief Inspectorate for Environmental Protection (CIEP) (KLRiW) in the field of atmospheric air testing. Its basic task is to ensure a high level and consistency of measurement for voivodeship air quality monitoring networks, including by maintaining reference standards, including their certification against higher order standards, and checking working standards, performing analyzer calibration, conducting audits at monitoring stations, preparing and performing national inter-

[57] Ginsbert-Gebert A. (red.): *Ekonomiczne i socjologiczne problemy ochrony środowiska*. Ossolineum, Wrocław 2015, s. 281.

[58] Kassenberg A., Rolewicz Cz.: *Przestrzenna diagnoza ochrony środowiska w Polsce. Obszary ekologicznego zagrożenia*. Studia KPZK PAN, t. LXXXIX. PWE, Warszawa 2016, s. 81

laboratory comparisons, organizing training for air quality monitoring networks, and implementing new measurement methods and research.

Measurements, the results of which can be used to assess air quality, should be carried out using reference methodologies or having demonstrated equivalence with the reference ones. They were specified in EU directives, as well as in the Regulation of the Minister of the Environment of June 8, 2018 regarding the assessment of levels of substances in the air. In practice, the general division of methods for measuring air pollution concentrations is often used into: manual (laboratory) - sampling takes place at the measuring station, followed by analysis in laboratory conditions; automatic (continuous) - sampling and analysis occurs automatically at the measuring station. An example of a method belonging to the first of these groups is the gravimetric method for determining mass concentrations of PM10 and PM2.5 fractions, which is the reference method for these pollutants. Its advantage is high accuracy and the ability to determine the concentration of dust components, including standardized heavy metals and benzo (a) pyrene. However, the results are available after some time, usually after a few weeks, after providing the laboratory with a set of filters after exposure and making appropriate determinations. It is also acceptable for the SEM needs to use measurements by automatic methods, provided that it is demonstrated by appropriate procedures that they are equivalent to the reference method and that correlation coefficients are determined. Automatic methods allow obtaining and making available to decision-makers and the public current information about one-hour as well as daily concentrations of suspended dust, which is particularly important during periods of high concentration episodes. Current, reliable and precise information, combined with forecasts, can then be used when making decisions on actions to reduce exposure to pollution (e.g. avoiding physical activity outdoors), as well as implementing measures to prevent emissions (e.g. reducing traffic) in cities) [6, s. 178][59].

There are many factors that contribute to ensuring high quality measurements as part of air quality monitoring, necessary for adequate reliability of the information provided. One of them is the proper design of the measurement network and location of the station, including determination of the purpose of measurements, identification of undesirable local impacts and ensuring the required spatial and population representativeness of the sites. It is related to the type of positions, among which can be distinguished: background positions (urban, suburban and extra-urban), communication and oriented to assess the impact of a particular plant or industrial area. It is also important to control the possible variability of station location conditions over time. It is important to ensure proper supervision over the functioning of the measuring network and the stability of equipment operation [6, s. 179][60].

Reports from the European Environment Agency indicate Poland's position at the forefront of European countries in terms of particulate matter concentrations. In the list of PM10 dust indicators in the European Union countries, in 2015 higher values were recorded only in Bulgaria (in the case of PM2.5 dust in Poland the highest concentrations were recorded). In all the countries included in the report, the exceedance occurred in 19% of positions for daily averages and at 3% for annual average concentrations. Measurements also indicate a significant problem of PM2.5 dust pollution in Poland relative to other European countries [6, s. 185][61].

In addition to Bulgaria and Poland, high concentrations of dust occur in significant areas of Italy (mainly northern, in the region of the Padanska Valley), the Balkan countries, as well as in Turkey. Figure 2.1 presents an example of the 90.41 percentile value from a series of average daily PM10 concentrations recorded in Europe in 2016. This parameter is often treated as an indicator of compliance with the standard established for 24-hour averages, and exceeding it indicates a value above 50 µg / m3 .

[59] Kostrowicki A.S.: *Straty ekonomiczne wynikające z degradacji środowiska. W: Ekonomiczne problemy ochrony środowiska*. Liga Ochrony Przyrody, Warszawa 2013, s. 178.
[60] Ibidem, s. 179.
[61] Ibidem, s. 185.

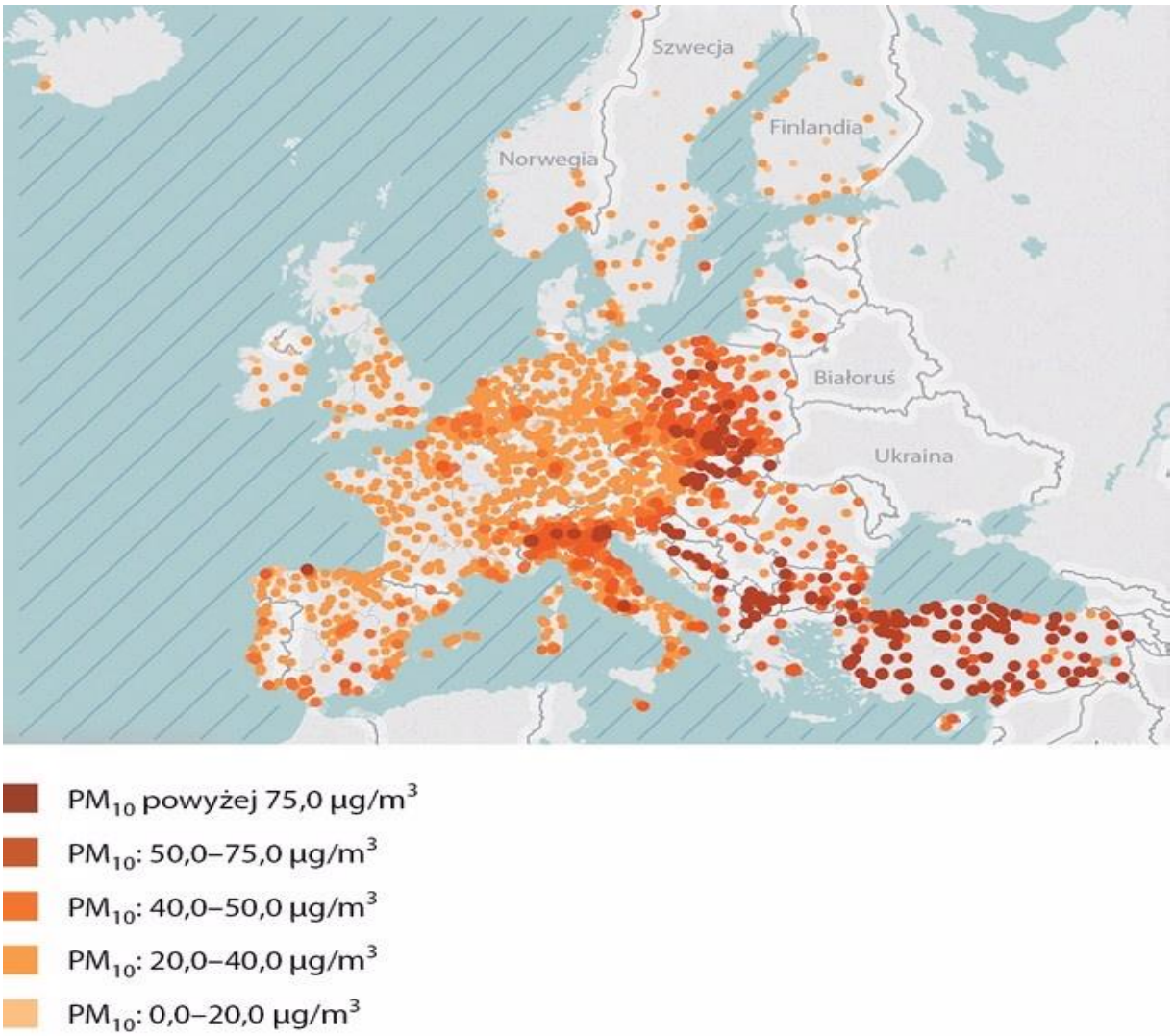

Figure 1 The 90.41 percentile values registered in Europe from the series of average daily PM10 concentrations in 2016

*Source:*European Air Quality Portal [7].

Also, according to data provided by the World Health Organization, averaged dust concentrations place Poland at the forefront of European countries in terms of the occurrence of this pollution. Higher levels occur, among others in Belarus, Turkey, Bulgaria and former Yugoslavia. Much higher PM10 concentrations than in Poland are in turn recorded in selected Asian and African countries (e.g. China, India, Pakistan, Afghanistan, Egypt, Saudi Arabia, Nigeria, Iran, Qatar) [8, s. 116][62].

Particulate matter PM10, whose main source in Poland is the combustion of solid fuels for the needs of heating buildings, and which has high concentrations in the air, often exceeding the applicable target level, is benzo (a) pyrene (BaP). It is treated as an indicator of air pollution with polycyclic aromatic hydrocarbons. Exceedances of 1 ng / m3 are recorded at the vast majority of measuring stations in the country - in 2016 out of 122 out of 129 included in the assessment. At 7%, the norm was exceeded more than ten times, and the highest value recorded (in the Łódź Voivodeship) reached nearly 18 ng / m3.

Poland has been at the forefront of European countries for many years in terms of BaP concentrations. Of the 22 EU Member States that provided results of BaP concentration measurements made in 2015, the highest concentrations, many times higher than in other countries,

[62]A. Badyda, *Zagrożenia środowiskowe ze strony transportu*. Nauka nr 4, Warszawa 2010, s. 115–125.

were recorded in Poland. Figure 2.2 presents the annual average concentrations in individual countries: minimum and maximum, median and 25 and 75 percentiles. The red line indicates the target level for BaP (1 ng / m3), while the green line is the reference level (reference level) according to WHO (0 , 12 ng / m^3) [9, s. 46-48][63].

Another problematic pollutant, whose concentration exceeds the target level in a part of the country (mainly in the south-west belt) is ozone. Exceedances occur more intensively, especially in years characterized by long-lasting high temperatures in the summer, e.g. in 2006 and 2015. In this respect, countries located south and west of Poland have a much bigger problem, e.g. Italy, Austria, Spain, France or southern Germany [9, s. 52-53][64].

3. Socio-economic consequences of smog air pollution

Since the industrial revolution in the nineteenth century, there has been a rapid increase in pollution of the natural environment, especially air, soil and water, causing negative social and economic effects that economists call negative external costs (Marshall 1892). Air pollution, which reaches high concentrations during smog episodes, is particularly dangerous. Judging by the title of the London publication ″The Guardian″ on the 65th anniversary of the so-called the great smog of 1952 that killed more than 12,000 London residents - 65 years on from the Great Smog nothing has changed. We're still choking (65 years after the Great Smog, nothing has changed. We're still choking) - British ″lessons″ have not been done. Admittedly, Great Britain - the cradle of the industrial revolution - has taken decisive action, introducing within a few years after this tragedy quite effective and the world's first legislation on improving air quality and protecting the natural environment, most of the countries, especially those developing (e.g. China or India), has not yet initiated equally intensive activities and their population is still exposed to high levels of pollution to this day [10, s. 26-27][65].

Poland, which has taken radical and effective steps to reduce environmental pollution, especially air from large industrial emissions since the beginning of the 1990s, in terms of reducing emissions from other sources (especially municipal and domestic) is still facing a big challenge. As a result, the concentration of pollutants in Polish cities is extremely high, placing our country among the countries most heavily polluted by suspended dust and polycyclic aromatic hydrocarbons in the European Union, and out of the 50 most polluted dusts by European Union cities, as many as 33 are Polish cities [10, s.28][66].

In order to assess the scope of various effects (including social and economic) resulting from air pollution, it is necessary to conduct reliable interdisciplinary scientific research showing the relationships between concentrations of pollutants and their effects. Such research in a broader dimension began practically only in the 1960s.

After the system transformation, Poland has actively joined the research on the health consequences of environmental pollution into international think tanks organized by the World Health Organization (WHO), the World Bank (WB) or the Organization for Economic Cooperation and Development (OECD), and since 2004 to Eurostat and the European Environment Agency (EEA). He also participates in the largest research network (over 3,000 scientists from 130 countries) organized by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington in Seattle, which in 1990 introduced a useful instrument called decision makers called the Global Burden of Disease (GBD) - global disease burden), which allows quantifying the loss of health caused by diseases and other risk factors. By joining various cooperation networks, Poland can benefit from comparative research at the highest global level of medical knowledge and statistical methods. Current reports of these organizations estimate that in Poland in the years 2005-

[63] Badyda A., Majewski G., Rogula-Kozłowska W. i wsp.: *Zanieczyszczenie powietrza – czym oddychamy w Polsce*. Lekarz Wojskowy nr 95, Warszawa 2017, s. 46–48.
[64] Ibidem, s. 52-53.
[65] Wieczorek J., Wieczorek Z., Mozolewski W., Pomianowski J., *Wielopierścieniowe węglowodory aromatyczne w pyle PM10.* Inżynieria i Aparatura Chemiczna nr 50, Warszawa 2014, s. 26-27.
[66] Ibidem, s. 28.

2014 approx. 48,000-50,000 inhabitants died prematurely (probability of estimation 95%) [11, s. 331][67].

It is worth paying attention to the estimates showing that 250-300 thousand people suffer from various diseases related to air pollution in Poland (GBD) annually. If one considers the other consequences that are associated with it, such as the suffering of their loved ones, reduction of mobility or additional expenses related to treatment, the scale of socio-economic effects increases significantly. When analyzing the social effects of air pollution, it is worth looking at how Poland compares itself to other European countries in terms of the YLL indicator (years of life lost) per 100,000 inhabitants. According to the EEA, in 2014 Poland, with an indicator of 1,455 years lost life, ranks very distant among 41 European countries, leaving only Bulgaria (1873) and the former republics of Yugoslavia - Kosovo (1824), Macedonia (1578) and Serbia (1508), with an average size for this group of 856. However, compared to the EU-28, Poland is on the penultimate place before Bulgaria [11, s. 335][68].

4. Economic and health consequences of smog and air pollution consequences

Air pollution causes multiple economic losses, mainly in three basic groups: losses due to loss of health and premature death; losses caused in agriculture and forestry and in other natural ecosystems; losses caused by corrosion of machinery and equipment, buildings and structures, including logistics infrastructure. Even in the nineteenth century, these losses were noticed by the British economist Alfred Marshall - the initiator of neoclassical economics - and called them negative external costs, which, without entering into the costs of the transaction, are not included in the price of the product or service, but charge third parties - most often the local or national community, but they can also apply to the global community (such as greenhouse gas emissions). Together with another school representative - Arthur Pigou - they paved the way for environmental economics, which appeared in American universities in the 1960s, but as a standard discipline it was not taught until the early 1980s. To understand the reasons for the differences that occur when estimating losses caused by air pollution, it is advisable to approximate the methodology for calculating them. External health costs are largely synonymous with the economic and social effects of exposure to polluted air, and their estimation is based on a five-step algorithm [12, s.10][69]: To understand the reasons for the differences that occur when estimating losses caused by air pollution, it is advisable to approximate the methodology for calculating them. External health costs are largely synonymous with the economic and social effects of exposure to polluted air, and their estimation is based on a five-step algorithm [12, s. 11][70].

Economists also use VSL to examine the effectiveness of investments to prevent premature death by comparing the benefits of avoiding premature deaths to planned outlays. OECD recommends the use of a base VSL of USD 3 million with two necessary corrections for individual countries, taking into account the adjustment to the achieved level of GDP per capita according to purchasing power parity from 2005 and to the increase in income and inflation after 2005. For Poland, the VSL indicator in 2005 amounted to USD 1.61 million, while in 2010 it increased to USD 2.10 million. According to the World Bank, the value of life in Poland is currently USD 2.5 million in accordance with the WTP methodology [12, s. 12][71].

Taking into account the previously discussed numbers of premature deaths attributable to particulate air pollution, it can be calculated that the external costs of these deaths amounted to USD 47.121 billion in 2005 and increased to USD 51.870 billion in 2010. In turn, the total external costs of exposure to particulate pollutants (APMP) and household losses (HAP) amounted to USD 90.547 billion in 2005, and increased to USD 101.826 billion in 2010. WHO / OECD (2015) data

[67] Seńczuk W., *Toksykologia*. PZWL, Warszawa 2014, s. 331.
[68] Seńczuk W., *Toksykologia*…, op. cit., s. 335.
[69] Rusin M., Marchwińska-Wyrwał E., *Zagrożenia zdrowotne związane ze środowiskowym narażeniem na wielopierścieniowe węglowodory aromatyczne (WWA).* Medycyna Środowiskowa nr 17, Warszawa 2017, s. 10.
[70] Ibidem, s. 11.
[71] Ibidem, s. 286.

indicate that these losses in 2010 amounted to almost 13% of GDP, ensuring Poland a distant place among 28 EU members - we were ahead of only Bulgaria, Romania and Hungary.Using the assumption regarding financial losses incurred by the society, which are not included in fees for the emission of harmful substances (e.g. costs of purchasing medicines, costs of temporary or permanent inability to work, costs of compensation, pensions, etc.), international studies have been created defining the external health costs of pollution air that includes all sources. In any case, however, exposure to air pollution can exacerbate or cause disease symptoms.

Upper respiratory symptoms in people without previous complaints in acute exposure result from irritation and include a feeling of dry nasal and oral mucosa, impaired nasal flow, throat and larynx irritation, and hoarseness. Prolonged exposure of people without prior upper respiratory tract exposure for several days can lead to the development of local inflammation manifested by damage to the epithelium and the inflow of inflammatory cells to the nasal mucosa, as well as DNA damage. Importantly, the clinical and morphological symptoms of inflammation persist up to several weeks after the exposure has ceased.

In people with chronic diseases of the upper respiratory tract, such as chronic rhinitis or larynx, exposure to air pollution leads to an exacerbation of the symptoms of the underlying disease.

Summary

The social and economic consequences of exposure to air pollution presented above (mostly based on APPM and HAP indicators) indicate a serious threat to the future of a country burdened by record-high external costs of air pollution in the European Union. The situation therefore requires undertaking a serious discussion in which the medical community should take an active part, on the one hand identifying the reasons for this condition, and on the other, co-creating the right prevention strategies. Elements of this strategy can be included as follows: one should not create barriers for numerous social initiatives undertaken by both local government administration and non-governmental organizations working to improve air quality; strong incentives (economic mechanisms) must be created to save energy, whereas each unit saved by it almost 80% reduces carbon emissions; using economic tools and based on the results of estimations of the impact of air pollution on health, one should also shape the pricing policy that would effectively promote low-emission transport and sources of energy production. In relation to high-emission fuels, there is a possibility of creating a similar mechanism that is currently used in the case of even alcohol or tobacco products; it is necessary to institutionally strengthen environmental protection management and environmental policy, based on facts, impartial research and broad social participation for their implementation and monitoring of performance; at national level, restrictions on the development of renewable energy sources should be unblocked, giving opportunities not only to large investors, but also to households by developing prosumer energy. At the same time, it is necessary to implement more effective tools that eliminate the possibility of selling low-quality coal (e.g. coal sludge or fine coal) to individual customers; effective measures need to be taken at both the strategic and operational level in the field of waste management to eliminate the risk of illegal waste storage sites being created, which are conducive not only to the deterioration of air quality (also as a result of fires), but generally to aerosanitary conditions and the quality of the soil and water environment; Bearing in mind the key impact of the municipal and household sector on the emission of particulate pollutants and related emissions of other pollutants (in particular PAHs), it is necessary to conduct intensive educational campaigns explaining the causes and effects of the common use of solid fuels to meet the heating needs of Polish households, but first of all, the introduction of universal education in this field at all levels of education (from kindergartens to higher education); entering ecological education, including in particular issues related to air quality, in medical education curricula; the introduction of an effective energy auditing system for single-family buildings and, based on the audit results, support for thermal insulation actions reducing energy demand, and then the exchange of heat sources for high-efficiency and low-emission devices.

Central and local government administration should support the idea of comprehensive, deep thermomodernization not only of single-family buildings, but also public buildings, in particular educational and health care facilities.

In the area of road transport, it is necessary to increase the effectiveness of compliance with standards (especially emissions standards), which requires the implementation of more effective vehicle diagnostics during e.g. mandatory annual inspections. Following this, mechanisms to encourage the acquisition of low-emission vehicles should be developed. Municipal governments should have the right to designate traffic-free zones that do not meet specific emission standards or to create appropriate payment systems for entering restricted emission zones (this is partly possible thanks to the Act on electromobility discussed below) [13, s. 57][72].

Poland should also prepare for a ban on imports of cars with decommissioned diesel engines in other EU countries (especially in Germany, which at the beginning of 2018 enabled the limitation of this type of vehicle traffic in city road and street networks).

Air pollution is defined as the introduction of solid, liquid and gaseous substances in such quantities that have a negative impact on human health, climate, natural environment, water purity, soil or contribute to other negative changes in nature. The effects that are caused by pollution depend on the degree of their harmfulness and their quantity. The most general division of types of pollution distinguishes dust and gases. The former, like steam, primarily affect the change of physical properties of air. Gases cause mainly chemical changes. It is worth noting that the pollution associated with the emission of dust into the atmosphere has been significantly reduced, however, the amount of gas introduced is still one of the most serious problems [14, s. 34][73].

Small, transient changes (e.g., respiratory markers or inflammatory markers) in healthy individuals that appear after exposure and are not associated with symptoms are interpreted as not clinically relevant. However, even not very large average changes (e.g. functional indicators) are associated with the presence of much larger changes in some people, among whom particularly vulnerable (e.g. low baseline or chronically ill) may cross the threshold leading to clinically significant changes. It is worth noting that the often cited increase in the number of deaths during periods of increased exposure applies almost exclusively to the elderly, with numerous chronic diseases, and is sometimes referred to as "pushing into the casket". For this reason, the final effects of exposure to pollution depend, among others than the structure of the population (probably much less deaths in younger populations = better tolerance of pollutants).The relationship between air pollutant concentrations and lung development disorder, which may be a risk factor for respiratory diseases in adulthood, may cause concern. However, it is worth remembering that the relationship with impaired lung function is also due to, among others genetic factors (including family burden of asthma), pregnant women taking certain medications, frequent infections, season of birth, exposure to indoor pollution (especially tobacco smoke).

Analyzing the role of external pollution, one cannot forget that most people spend no more than 20% of the day outside. Although sick building syndrome is now treated with a distance as an idea of tobacco companies to divert attention from the harmful effects of smoking, there is no doubt that indoor air may also contain numerous harmful substances. Although a drop in the number of smokers is observed in developed countries, tobacco smoke remains the most important of these substances (with the best proven harmfulness). Exposure to tobacco smoke has such a strong effect that often exposure to outdoor air pollution or other substances present in rooms is not able to cause visible additional consequences (which are therefore only noticeable in non-smokers).

Optimism may be caused by the fact that people have been in contact with smog for tens of thousands of years (and maybe even hundreds), as a result of which there may have probably been a selection of people who tolerate exposure better (e.g. to components of pollutant mixtures). Also, catastrophic fears after some environmental pollution (e.g. oil or dioxins) were fortunately not

[72] Ćwiek, K., Majewski, G., *Wpływ elementów*…, op. cit., s. 57.

[73] Sawicka-Kapusta K., Zakrzewska M., Gdula, Argasińska J., Stochmal M., *Ocena narażenia środowiska obszarów chronionych. Zanieczyszczenie metalami i SO2 parków narodowych*. Uniwersytet Jagielloński, Kraków 2005, s. 34.

confirmed. Undoubtedly, improving the air quality (which we expect) should reduce the risks associated with its quality.

An international agreement to combat global warming has required countries with a high level of industrialization to significantly reduce CO2 emissions to the environment. The result of these endeavors are actions taken in particular by the European Union to promote renewable energy. To increase the attractiveness of investments in renewable energy sources (RES), EU institutions undertake a number of actions. These activities include: subsidies for investments related to the construction of renewable energy plants, introduction of the so-called ″Green certificates″ - imposing on energy trading companies the obligation to purchase a part of energy from renewable sources, lowering CO2 emission limits in EU member states. Investing in renewable energy is particularly important for Poland, because it is related to constantly decreasing carbon dioxide emission limits that are allocated to us. Renewable energy is becoming an interesting source of income with low risk due to numerous subsidies and green certificates.

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