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Selected aspects of low emission management in the Middle Odra Region¹

1. Introduction

The problem of low emission in the Middle Odra Region is so complex that it is difficult to solve it in a short time. A significant reduction of low emission will require a series of activities that will be spread over at least the next few years (Llano-Paz et al. 2018, pp. 123-135). Air pollution in the Middle Odra Region and throughout Poland is mainly caused by the so-called low emission. It is assumed that low emission is generated at a height not exceeding 40 meters (Dzikuć and Adamczyk, 2015, pp. 217-225). Its main sources are household boilers, road transport and small industrial plants.

The reduction of low emission requires effective management of various types of activities, allowing the systematic introduction of a number of solutions (Woźniak and Pactwa 2018, pp. 1184-1200). Due to, among other things, high costs, this process will be spread over the years (Adamczyk et al. 2017, pp. 16316-16327). The aim of the article was

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1 This study was conducted and financed in the framework of the research project "Economic, ecological and social aspects of low emission limitations in the Middle Odra", granted by the National Science Centre in Poland, program SONATA, grant No. 2015/19/D/HS4/00210.

to show the possibilities allowing to reduce low emission in the Middle Odra Region and presentation of selected aspects of low emission management.

2. The problem of low emission in the Middle Odra Region

The air quality in the Middle Odra Region and all over Poland is such a serious problem that it was analysed by the European Court of Justice in Luxembourg. The complaint in this matter was brought by the European Commission in June 2016, due to the failure to meet the EU law requirements regarding airborne particulate matter concentrations. The European Commission accused Poland of exceeding PM10 suspended dust standards and the lack of appropriate measures that had been set out in air protection programs (Burchart-Korol et al. 2018). Moreover, the European Commission pointed to the incorrect implementation of the directive on ambient air quality and cleaner air for Europe. The Court of Justice of the EU recognized in February 2018 that the Polish authorities violated EU regulations relating to air quality standards. It was shown that the limit values for suspended particulate matter concentrations PM10 in the years 2007-2015 were systematically exceeded.

The Polish authorities that responded to the European institutions' remarks on air quality, pointed to social, economic and budgetary difficulties related to the necessary technical investments. In response, the EU Court of Justice pointed out that the conditions presented by the Polish authorities are not exceptional. In the opinion of the EU Court of Justice, none of the adopted air protection programs accepted by Poland at the national and regional level clearly indicated that these programs should allow for the reduction of exceedances of limit values in the shortest possible time, as required by EU law (Dzikuć et al. 2017b, pp. 1107-1112).

It should be emphasized that exceeding the permissible concentrations of pollutants in the air was not a one-off, because the Court based on data provided by Poland showed that in the years 2007-2015 the daily limit values for PM10 suspended particular matter in the air were constantly exceeded in the majority of designated quality zones air in Poland (35 out of 46). In the opinion of the Court of Justice of the EU, the breaches are to be considered as permanent. It should be noted that the problem of poor air quality has not been solved after 2015. Also later, exceedances of permissible concentrations in PM10 dust were recorded (fig. 1). However, an even worse situation occurred in the case of B(a)P (fig. 2 and 3), whose elevated concentrations also did not bypass non-industrialized and low-population areas, such as the Middle Odra Region.

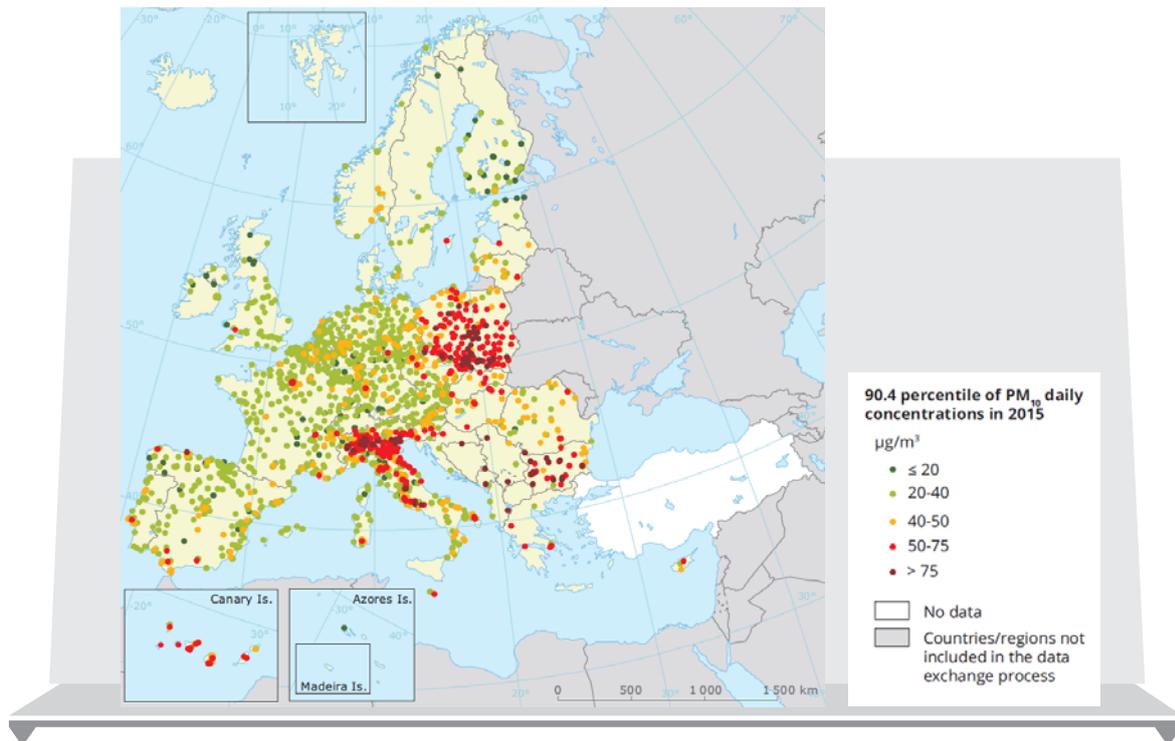


Figure 1. Concentrations of PM₁₀, 2015 - daily limit value

Source: Air quality in Europe - 2017 report, European Environment Agency, Luxembourg: Publications Office of the European Union, 2017

Analysing the problem of air quality in the Middle Odra Region, attention should be paid to substances particularly hazardous to human health, including benzo(a)pyrene, which is found in suspended PM₁₀ (Dzikuć et al. 2017a, pp. 1-8; Awasthi et al. 2017, pp. 32-37). Due to the fact that statistical data for the area of Middle Odra are not collected, the authors of the publication used data on the level of emissions in the Lubuskie voivodship. The results of the tests of benzo(a)pyrene concentration in suspended PM₁₀ in air, which were obtained in 2017, indicate the occurrence of exceedances of the target level (1 ng/m³) specified for benzo(a)pyrene in all three zones designated for the Lubuskie voivodship. This means that all zones are included in the so-called class C, which requires the development of air protection programs. It should be emphasized that in the Lubuskie voivodship, elevated B(a)P concentrations above the acceptable norms were also noted in previous years. Nevertheless, no effective measures have been implemented that would significantly reduce B(a)P in the air (Krauze-Biernaczyk et al. 2018, pp. 47-48). It should be emphasized that Lubuskie is one

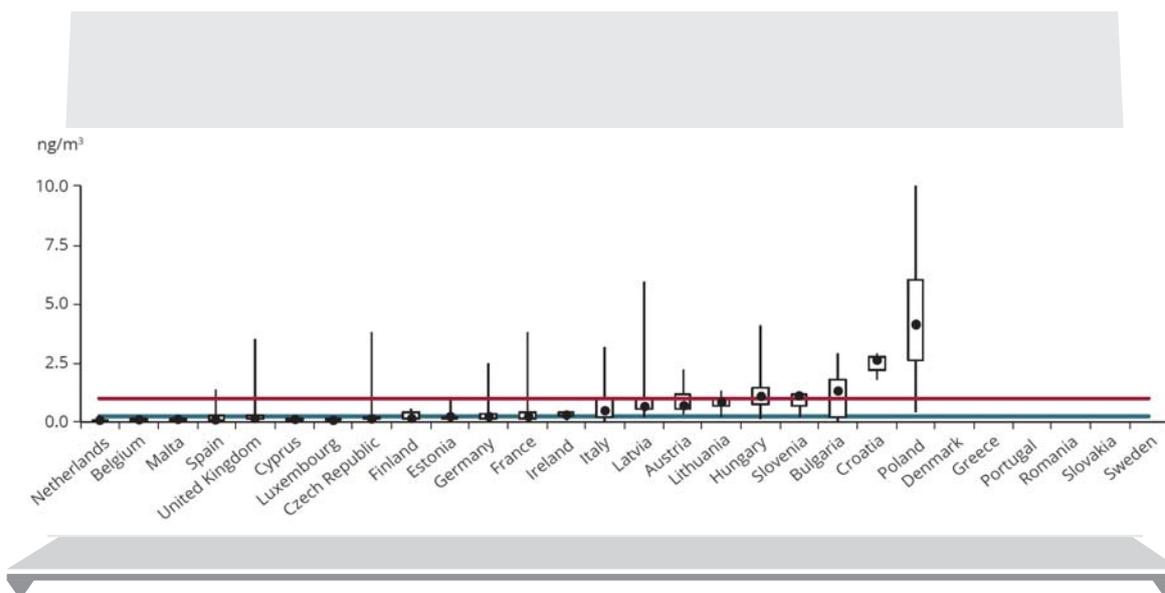


Figure 2. B(a)P concentrations in 2015 in the EU-28

Source: Air quality in Europe - 2017 report, European Environment Agency, Luxembourg: Publications Office of the European Union, 2017

of the smallest voivodships in Poland. It is characterized by a relatively low level of industrialization and the largest afforestation in Poland. Lubuskie voivodeship is inhabited by slightly over 1 million people. The area of the voivodeship is 14,000 km², which means that the Lubuskie voivodeship occupies 4.5% of the area of Poland (Central Statistical Office of Poland, 2018).

Benzo(a)pyrene is particularly important in the analyses of the problem of air quality, because a very large amount of this substance enters the air at great heights from the ground level. Therefore, it is not the industry that is the main source of PM₁₀ (Zarębska and Dzikuć 2013, pp. 97-102) dust emissions, only low emission (table 1).

Table 1. Emission of PM₁₀ fraction in Poland in 2015-2016

Emission source	Emission of PM ₁₀ [Mg]	
	2015	2016
Combustion processes outside the industry	110 409.00	117 406.40
Combustion processes in the industry	31 056.20	30 774.80

Production processes	17 719.00	17 643.00
Extraction and distribution of fossil fuels	6 790.70	6 551.50
The use of solvents and other products	1 065.00	1 373.60
Road transport	11 063.90	12 825.40
Other vehicles and equipment	9 101.20	9 621.30
Waste management	7 178.10	7 323.20
Agriculture	35 452.30	35 753.90
Total	248 654.50	259 165.20

Source: Dębski, B., Olecka, A., Bebkiewicz, Chłopek, Z., Kargulewicz, I., Rutkowski, J., Waśniewska, S., Zasina, D., Zimakowska-Laskowska, M., Żaczek, M., 2018. *Krajowy bilans emisji SO₂, NO_x, CO, NH₃, NMLZO, pyłów, metali ciężkich i TZO za lata 2015 - 2016 w układzie klasyfikacji SNAP. Raport syntetyczny*. Krajowy Ośrodek Bilansowania i Zarządzania Emisjami (KOBiZE), Instytut Ochrony Środowiska – Państwowy Instytut Badawczy, Warszawa, p. 14

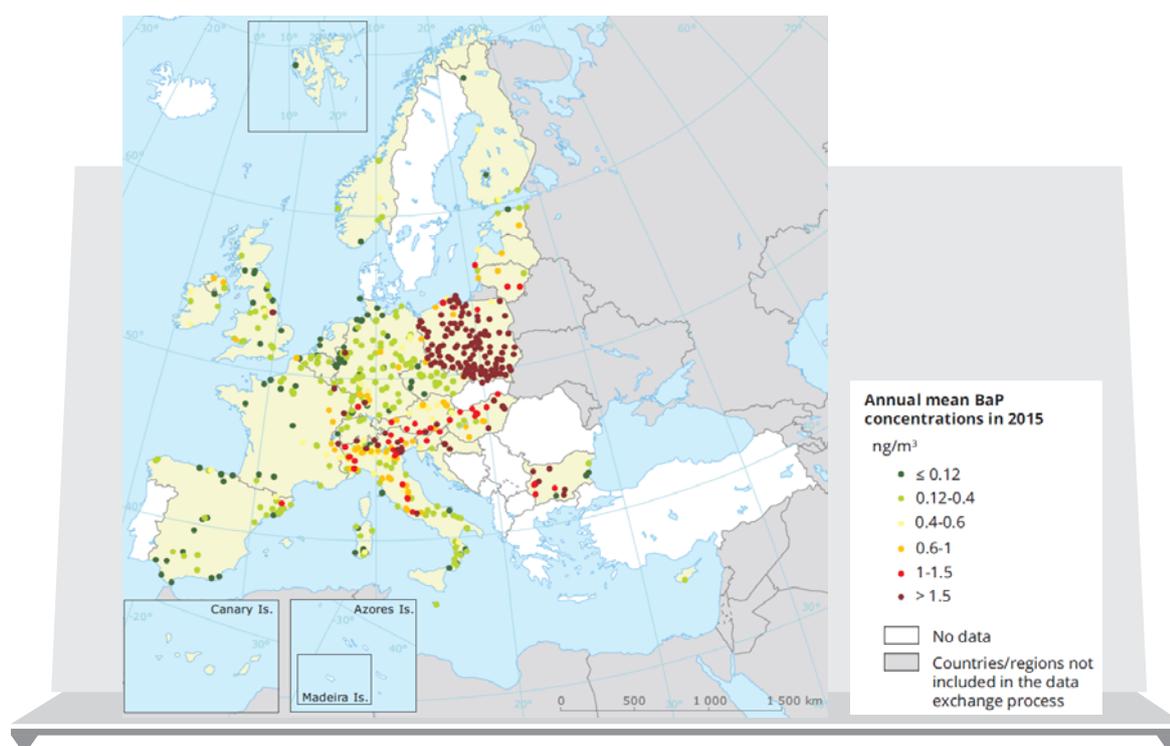


Figure 3. Concentrations of B(a)P, 2015

Source: Air quality in Europe - 2017 report, European Environment Agency, Luxembourg: Publications Office of the European Union, 2017

3. Analysis of potential actions to reduce low emissions in the Middle Odra Region

Despite the implementation of low-emission economy plans for individual cities and municipalities by a significant part of local government authorities, the low emission problem has not been solved. The task of the Low Carbon Economy Plan document is to analyse the activities that are feasible to implement, which will contribute to changes in the structure of energy carriers used and the reduction of energy consumption of high-emission fossil fuels, which have the greatest negative impact on the environment (Adamczyk and Dzikuć 2014, pp. 42-50). The main task of the indicated activities is to reduce the emission of harmful substances into the air. The data presented in this publication shows that solving the low emission problem in the Middle Odra Region is proceeding at an unsatisfactory pace, as exceedances of permissible concentrations of certain harmful substances into the air are still noted. The authorities of individual municipalities in the Middle Odra Region, despite being obliged by national and Community regulations, have taken a number of actions aimed at reducing the emission of harmful substances into the air. It should be emphasized that in the Middle Odra Region the two largest cities (Gorzów Wielkopolski and Zielona Góra) have natural gas-fired combined heat and power plants. This means that in the analysed area in the two largest cities, a significant proportion of residents have the option of using district heat. As a result, there are fewer local boiler houses, which are the main source of low emission in the Middle Odra Region. Combined heat and power plants in selected cities use high-efficiency cogeneration and natural gas is the basic fuel used to produce energy (Usubharatana and Phungrassami 2018, pp. 1781-1793; Urban and Dzikuć 2013, pp. 84-92). However, mainly in the suburbs, where the district heating network does not reach, a large part of the buildings is equipped with boiler rooms that do not have exhaust gas cleaning systems (Adamczyk and Dylewski 2017, pp. 856-864). An additional negative factor is the fact that the fuel used to heat the flats is often of low quality. Moreover, the efficiency of burning low-quality solid fuels in old type boilers leads to a significant amount of emissions of harmful substances. The biggest problem concerns the suburbs of the indicated cities and whole towns where there is not one heat and power plant (Dzikuć 2017a, pp. 81-87). This situation means that basically every larger town in the Lubuskie voivodship is characterized by elevated concentrations of harmful substances in the air (Kułyk and Michałowska 2016, pp. 239-255). One of them is carcinogenic B(a)

P, whose elevated concentrations in the air are recorded especially during the heating season (fig. 4).

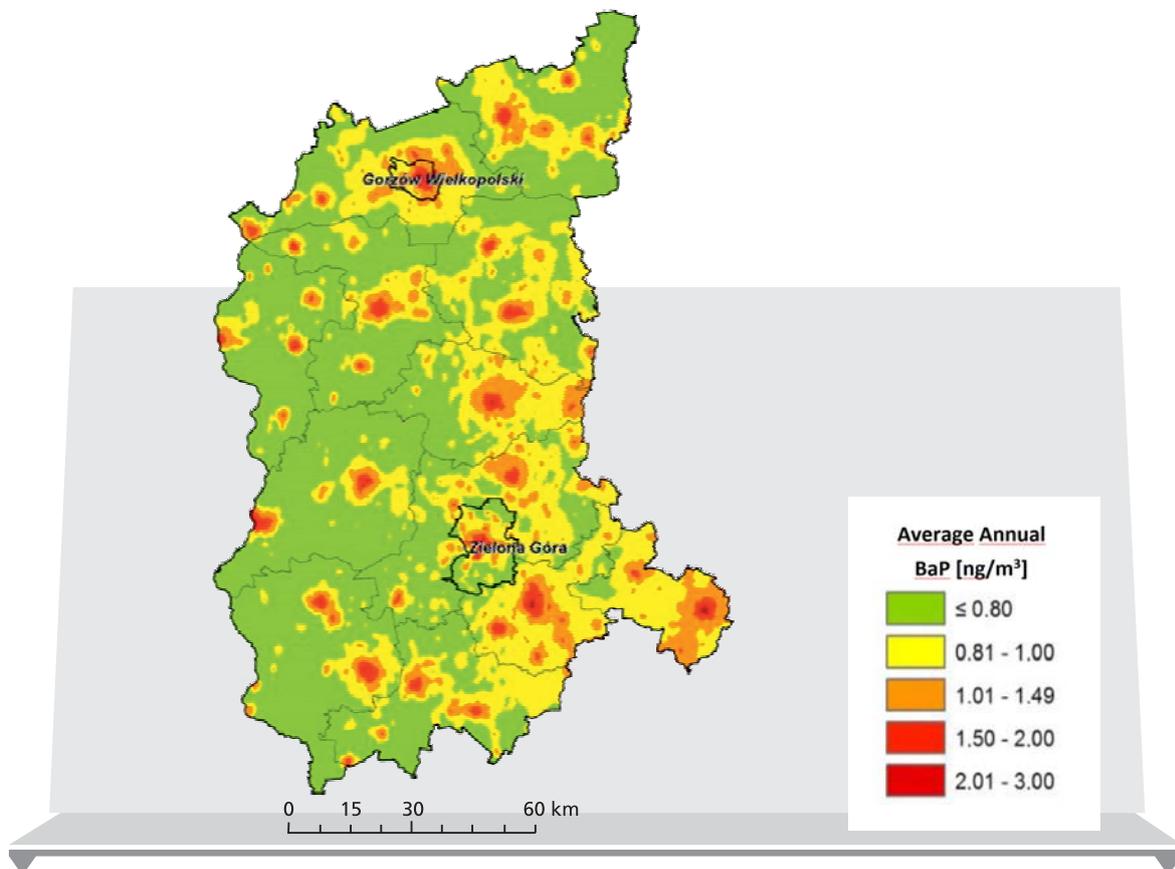


Figure 4. Distribution of the concentration of benzo(a)pyrene contained in particulate matter PM₁₀ in Lubuskie Province in 2015

Source: Krauze-Biernaczyk M., Czarniecka P., Kociołek E. (2016), *Roczna ocena jakości powietrza w województwie lubuskim*, Wojewódzki Inspektorat Ochrony Środowiska w Zielonej Górze, Zielona Góra

Apart from burning fossil fuels in home-grown boiler rooms, road transport is another important component of low emission (Talbi 2017, pp. 232-238). During combustion of fuels in automotive engines, gaseous and dust pollutants enter the air (Singh and Mohapatra 2018, pp. 43-54). In addition to local traffic, transit is an additional problem for the Middle Odra Region in every major city. Road transport contributes to the emission of nitrogen oxides into the air (NO_x). Road

transport is one of the most important sources of NO_x emissions to the air, which confirms the fact that the concentration of this substance is higher in the vicinity of roads characterized by high traffic (fig. 5). The amount of nitrogen oxide emissions is largely dependent on changes in emissions from fuel combustion processes in the energy sector and can be relatively quickly limited by reducing the consumption of solid fuels, as illustrated by the example of a large part of EU countries. However, in the case of road transport, the volume of emission in the Middle Odra Region and throughout Poland is decreasing very slowly. Despite the fact that the share of new cars that meet the current ecological standards, which emit significantly less NO_x is growing, the total number of vehicles traveling on Polish roads is still increasing. The spots in figure 5

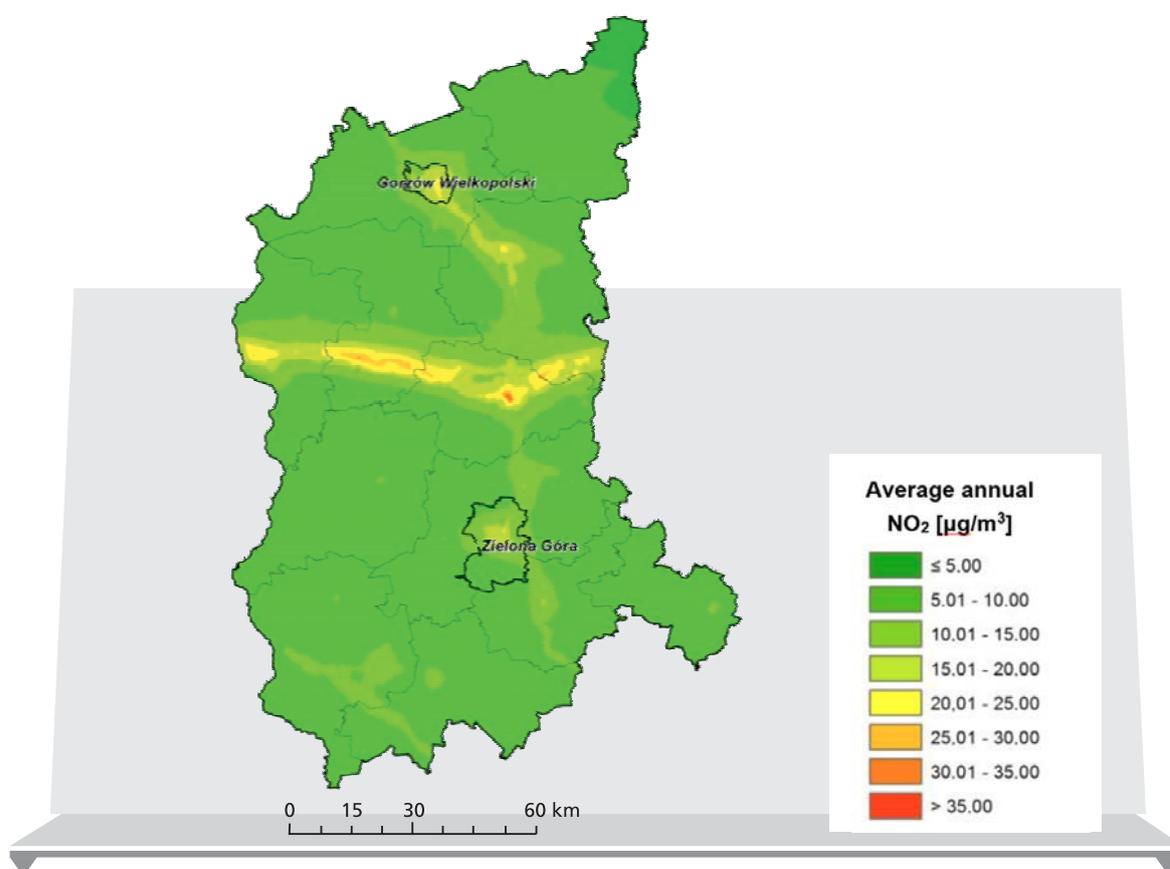


Figure 5. Emissions of nitrogen dioxide in the Lubuskie Province in 2015

Source: Krauze-Biernaczyk M., Czarniecka P., Kociołek E. (2016), *Roczna ocena jakości powietrza w województwie lubuskim*, Wojewódzki Inspektorat Ochrony Środowiska w Zielonej Górze, Zielona Góra

with an increased level of nitrogen dioxide emissions coincide with the course of the S3 road, which an average of about 15,000 vehicles pass on a day. In addition, figure 5 shows the location of national road No. 18, a part of the Berlin-Wrocław route. However, the highest concentrations of nitrogen oxides are noted in the immediate vicinity of the A2 motorway and parallel to it the national road No. 92, which in the Middle Odra Region is used by cars travelling on the Warsaw-Berlin route. It should be emphasized that the Lubuskie section of the A2 motorway and the alternative national road No. 92 passing along the motorway pass are used by 20-30 thousand cars a day (Dzikuć et al. 2017a, pp. 1-8). It is to be expected that in the coming years the traffic volume on transit roads through the Middle Odra Region will increase.

Bearing in mind the limited financial resources, it is first necessary to take actions that will bring the greatest ecological effect. Such activities include replacing old and non-ecological boilers used for heating buildings. It should be emphasized that local boiler houses have a high share in the total low emission in the Middle Odra Region. It is also necessary to strive to promote thermo-modernization of buildings. However, insulation of external walls and building roofs, replacement of window and door joinery requires higher financial expenditures. Therefore, it is important to promote and support such activities by national and local government authorities. So far, despite many announcements from the government, no measures have been implemented whose effects would be visible and would significantly reduce low emission (Dzikuć et al. 2017c, pp. 237-249).

There are a number of other solutions that can contribute to reducing low emission in the Middle Odra Region. One of them is the implementation of such activities in other countries, such as the development of heating, continuous education of the public on the risks associated with low emission and measures to reduce low emission in transport (Ghaffar et al. 2018, pp. 3775-3784). The heating development indicated above, despite its limitations, is currently one of the most ecological heat sources based on the combustion of solid fuels. Restrictions related to the development of district heating are related, among others, to the lack of economic efficiency of this type of solutions in areas characterized by dispersed construction. In the Middle Odra Region, old and non-ecological cars are a significant problem. Despite the successive introduction of stricter emission standards for newly produced cars, emissions from road transport remain high (Dzikuć 2017b, pp. 147-152). Air quality in the Middle Odra Region has not improved in recent years despite institutional support for low emission reduction due to insufficient intensity of activities.

In addition to these activities, it is possible to distinguish a number of others, such as RES developments, urban transport investments, and the introduction of legal solutions, for example, limiting the movement of old and non-ecological cars in city centres (Kozłowski et al. 2018, pp. 711-716; Gavurova et al. 2016, pp. 217-228; Kalembkiewicz et al. 2018, pp. 2593-2603; Piwowar et al. 2016, pp. 69-74; Piwowar and Dzikuć 2016, pp. 415-420). However, these activities are much more expensive or can cause social resistance. In order to reduce the problem of low emission, many complementary solutions should be implemented in parallel to achieve the best possible effect in a relatively short time.

4. Conclusions

In the Middle Odra Region there are relatively few industrial plants, especially those that have a negative impact on the environment. The area of the Middle Odra is also not helped by the fact that forests have a large share in the total area of about 50%. Moreover, the Middle Odra Region is characterized by a lower population density than a significant part of Poland. Due to poor air quality, national and local authorities will be forced to consider a number of measures to reduce low emission. Regulations are currently being introduced to improve air quality. However, the possible effects of these activities will be visible only in the coming years. These activities must be restrictive in order to effectively limit the use of ineffective technologies and polluted fuels when heating buildings and in road transport. However, it should not be forgotten that a large part of citizens will not be able to carry out thermo-modernization of buildings from their own financial resources. Therefore, in order to disseminate environment-friendly measures to improve air quality, it is necessary to provide financial support to the poorest inhabitants of the Middle Odra Region.

Summary

Economic determinants of low emission management in the Middle Odra Region

According to the data of the European Environment Agency, due to excessive air pollution about 47 thousand people die prematurely every year in Poland. Although in recent years the level of industrial emissions in Poland has been significantly reduced, it is still a very serious problem of the so-called low emission. The aim of the paper was to determine the most important sources of low emission in the Middle Odra Region and to indicate activities that will optimally

limit this problem. The article points out activities that help reduce low emission in the Middle Odra Region, where the problem is also noticeable, despite the lower population density and the lack of highly industrialized areas. Moreover, it pointed to the possible directions of low emission management, the implementation of which may contribute to a significant reduction of low emission in the Middle Odra Region.

Keywords: *low emissions, economy, ecology, Middle Odra Region.*

Streszczenie

Ekonomiczne determinanty zarządzania niską emisją na obszarze Środkowego Nadodrza

Według danych Europejskiej Agencji Środowiska w Polsce każdego roku z powodu nadmiernego zanieczyszczenia powietrza umiera przedwcześnie około 47 tys. osób. Mimo, że w ostatnich latach poziom emisji przemysłowych w Polsce udało się znacząco zredukować to nadal bardzo poważny problem stanowi tzw. niska emisja. Celem artykułu było określenie najważniejszych źródeł emisji niskiej na terenie Środkowego Nadodrza oraz wskazanie działań, które będą optymalnie ograniczać ten problem. W artykule wskazano na działania pozwalające ograniczyć niską emisję na terenie Środkowego Nadodrza, na którego obszarze problem ten jest również dostrzegalny, mimo mniejszej gęstości zaludnienia i braku wysoko uprzemysłowionych terenów. Wskazano ponadto na możliwe kierunki zarządzania niską emisją, których wdrożenie może przyczynić się do istotnego ograniczenia niskiej emisji na terenie Środkowego Nadodrza.

Słowa

kluczowe: *niska emisja, ekonomia, ekologia, Środkowe Nadodrze.*

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Classification: E000

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