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## **ACTION UNDERTAKEN BY PUBLIC FINANCIAL INSTITUTIONS TO IMPROVE AIR QUALITY**

Key words: air quality, reducing pollutant emissions, West Pomeranian Voivodship

**ABSTRACT.** The goal of this paper is to indicate the role of public institutions in the field of financing investment tasks within the area of air quality preservation on the example of the Provincial Environmental Protection and Water Management Fund in Szczecin. The analytical-description method based on available secondary data was used. Both from a national and regional perspective, problems with air quality, connected with exceeding pollutant emissions levels, are observed. In the study, only emissions of SO<sub>2</sub>, NO<sub>x</sub> and ash, in the years 2015-2018, were addressed. The importance of surface and linear emissions in generating excess was indicated. Spending statutory assets of the Provincial Environmental Protection and Water Management Fund in Szczecin on air protection in the studied area was analyzed. The need to carry out intense action aimed at fulfilling significant environmental goals and the proper use of public funds was indicated. The significance of carrying out joint support programmes aimed mainly at individual benefactors of Provincial Funds together with the National Fund, in order to achieve cohesion of action, efficiency and accumulation of public funds, was emphasized.

## **INTRODUCTION**

Activities connected with air quality protection are of special importance in the common policy of EU countries. Poland belongs to the group of countries of the community characterized by regions of high air pollution. It is a result of development lags. Periods of system transformation, and later EU membership resulted in an increase of awareness and importance of the quality of social life. The necessity to take action within the field of environmental protection came with these periods.

The National Fund for Environmental Protection and Water Management is the basis for the Polish system of funding projects, mainly of investment nature, within the field of widely understood environmental protection on a national scale. Provincial Environmental Protection and Water Management Funds operate on a regional scale. The characteristics of this system consist of directional disbursement of funds coming from fees and penalties paid by industry for using the environment. As part of statutory activity, the funds carry out tasks within the field of preserving and restoring natural resources as well as improving the quality of the environment in accordance with the policy of national and regional government.

## MATERIAL AND METHODS OF RESEARCH

The purpose of the paper is to present the role of public institutions in the field of financing investment tasks in the area of air quality protection on the example of the Provincial Fund Environmental Protection and Water Management Fund in Szczecin (WFOŚiGW). The analytical-description method was used by referring to data published in publications of the National Center of Emission Balancing and Management, reports of the Regional Inspectorate for Environmental Protection and internal papers and studies of the fund. In this paper, reference was made to selected substances influencing air quality in Poland and the West Pomeranian region: nitrogen oxide, sulphur dioxide and dust. The activity of WFOŚiGW, in the scope of expenditure of statutory resources and air pollution reduction achievements, was presented as well. The basic analysis period covers the years 2015-2018.

## RESULTS OF RESEARCH

Over the last decades, in Europe, a decline in the levels of air pollutant emissions have been observed, however, this does not change the fact that still significant excess of norms are reported. Nearly 90% of citizens of European cities are subject to pollutants which have a significant influence on their health. The greatest exceedances of air quality standards are reported in the northern regions of Italy, the Czech Republic, Slovakia, Hungary and Poland. The most important goal is air quality improvement in order to meet EU and national standards regulated by law, specified in Directive 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain kinds of air pollutants [KOBiZE 2019].

In Poland, with regard to air quality, the south-west regions and huge urban centers are problematic. This applies both to greenhouse gasses and other pollutants, mainly sulphur and nitrogen oxide, PM<sub>2.5</sub> and PM<sub>10</sub> particulates, including benzo(a)pyrene. These substances have a very negative impact on the quality of life of citizens and the condition of the environment. In regions where significant exceedances occur, there has been a steady increase in the incidence of cancer, respiratory and circulation system diseases as well as allergies. A report of the European Commission shows that 440 thousand people, including 45 thousand people in Poland die annually due to air pollution in Europe [EEA 2018]. Anthropogenic sources of air pollution are energetics, industry (industrial processes), transport and municipal emissions. In most cases, these toxins are emitted as a result of organic fuel combustion. With regard to data provided by authorities constantly monitoring air quality in selected zones in Poland (WIOŚ and GIOŚ), so called “low emission” (emitters below 40 meters of height), sourced by individual households, transport, local boiler houses, trade, services and public utility buildings, has a significant impact on the emission of dust. However, the household sector is responsible for the emission of approximately 50% of dust, including carcinogenic benzo(a)pyrene. In a report of the European Environmental Agency (Air quality in Europe – 2016), it was indicated that Poland is now at the top when it comes to excess emissions of benzo(a)pyrene and second, after Bulgaria, in exceedances of PM<sub>10</sub> [EEA 2016].

Table 1 shows that energy production and industry, constituting 73% in 2015 and 67% in 2016 and 2017 are mainly responsible for SO<sub>2</sub> emissions. However, combustion outside industry, that is of household nature, generates 23-29% of sulphur dioxide emission. In this case, transport is of marginal importance, however, this does not change the fact that the size of emissions, in the studied period, from this source is getting bigger and bigger each year and shows dynamics of 128% in 2017 in relation to 2015.

Over the period of 2015-2017, the main source of nitrogen oxide emission was road transport and energy production. In 2015, the share of transport in nitrogen oxide emission stood at 30% and systematically increased to 33% in 2016 and 37% in 2017. In that period, dynamics constituted 137%. Figures in the table show that, since 2015, a permanent increase in NO<sub>x</sub> emissions were observed, dynamics till 2017 amounting to 111%. Simultaneously, the share of energy production in nitrogen oxide emissions decreased,

Table 1. Emissions of selected annual air pollution in Poland during the period from 2015-2017

Air pollution	Emission [t]		
	2015	2016	2017
SO <sub>2</sub>			
Total, including:	711,489	590,664	582,656
- energy production	370,191	261,181	251,299
- industry	152,897	133,269	138,851
- combustion outside industry	165,581	173,244	170,871
- road transport	427	471	546
NO <sub>x</sub> :			
Total, including:	725,257	742,168	803,661
- energy production	198,935	178,266	168,903
- industry	73,500	70,844	73,354
- combustion outside industry	82,585	87,682	85,723
- road transport	216,966	245,725	297,356
PM 2.5:			
Total, including:	136,010	141,875	147,281
- energy production	6,051	6,127	6,028
- industry	28,461	28,522	31,020
- combustion outside industry	66,295	69,547	68,503
- road transport	10,988	12,565	14,993
PM 10:			
Total, including:	231,625	240,632	246,310
- energy production	11,219	11,353	11,223
- industry	30,562	30,561	33,229
- combustion outside industry	110,480	116,444	114,649
- road transport	14,139	16,090	19,198

Source: own study based on [KOBiZE 2019]

both in nominal and percentage terms. Each year, a decrease in emissions in the sector were observed, in 2017 there was a decrease of over 30 thousand tons compared with 2015, dynamics of 84%. However, in 2015, emissions from energy production represented 27% and decreased each year, i.e. 2016 – 24% and in 2017 – 21%. Emissions of ash in Poland, both PM10 and PM2.5 pose a major problem. It is connected with the need to take more radical action to lower it and adjust emission levels to both national and EU norms. Over the period of 2015-2017, we have a steady increase in the emissions of these hazardous substances were observed. In 2017, emissions of PM2.5 were 10 thousand tons higher in comparison with 2015, however emissions of PM10 was nearly 15 thousand tons greater. The figures in the table show that combustion outside industry has the largest share in dust emissions and, in both cases, represents nearly 50% of total emissions in the studied period. However, industry constitutes approximately 21% of total emissions of PM2.5 dust and on average 13% of PM10 dust in the period of 2015-2017. It is significant that in 2017 a slight decrease in the emissions of dust from the industry were observed, which is connected with the modernization and implementation of modern low-emission industrial technologies.

Improvement in air quality in subsequent years is a result of carrying out investment projects within the scope of external and national resources, mainly the Infrastructure and Environment Operational Programme and regional programmes in subsequent years of programming and financing in the form of subsidized loans and outright grants of the system of environmental protection funds.

## AIR QUALITY IN THE WEST POMERANIAN VOIVODSHIP

The Voivodship Inspectorate for Environmental Protection carries out an annual evaluation of air quality based on data obtained from measuring stations. In accordance with the provisions of the Environmental Protection Law Act, three zones were created in the West Pomeranian Voivodship, for which annual reports and programmes designed to improve air quality are prepared. They are: the Szczecin agglomeration, the city of Koszalin, the West Pomeranian zone (the area remaining upon excluding the Szczecin agglomeration and the city of Koszalin). In accordance with administrative provisions, reflecting EU law on monitoring and evaluating air quality, set out in the Regulation of the Minister of the Environment of 2 August 2012.

According to daily air quality measurements in the West Pomeranian Voivodship, no drastic exceedances in gas and dust emissions into the air have been observed. In 2018, the share of West Pomeranian emissions in national emission was approximately 3.9% of sulphur dioxide, 3.8% of nitrogen dioxide and 3.6% of PM10 dust (Table 2).

In the West Pomeranian Voivodship, in 2018, the concentration of SO<sub>2</sub>, compared to the area of zones, amounted to 8.29 t/km<sup>2</sup> for Szczecin agglomeration, 10.48 t/km<sup>2</sup> for the city of Koszalin and 0.65 t/km<sup>2</sup> for the West Pomeranian zone. The size of NO<sub>2</sub> emissions was at a level of 8.55 t/km<sup>2</sup> for Szczecin, 6.65 t/km<sup>2</sup> for Koszalin, and 1.13 t/km<sup>2</sup> for the remaining area of the region. As far as PM10 is concerned, emissions constituted 2.26 t/km<sup>2</sup> for Szczecin, 5 t/km<sup>2</sup> for Koszalin, and 0.59 t/km<sup>2</sup> for the West Pomeranian zone. National emissions in 2018 of all the above mentioned substances was almost twice

Table 2. Emissions of SO<sub>2</sub>, NO<sub>2</sub>, PM10 in the West Pomeranian Voivodship separated into zones and in Poland in 2018

Zone – area [km <sup>2</sup> ]	Emissions [t]		
	SO <sub>2</sub>	NO <sub>2</sub>	PM10
Szczecin agglomeration – 300	2,487	2,566	679
The city of Koszalin – 84	880	559	420
The West Pomeranian zone – 21,712	14,065	24,487	12,899
The West Pomeranian Voivodship – 22,892	17,431	27,611	13,388
Poland – 312,679	451,367	719,335	373,387

Source: own study based on [GIOŚ 2019, p. 36]

higher than in the West Pomeranian Voivodship and at a level of SO<sub>2</sub> – 1.4 t/km<sup>2</sup>, NO<sub>2</sub> – 2.3 t/km<sup>2</sup>, PM10 – 1.2 t/km<sup>2</sup>.

The main source of air pollution in the West Pomeranian Voivodship is anthropogenic emission, which consists of emissions from industrial activity (point emissions) and emissions from the household sector (area) as well as emissions from means of car transport (linear)

In addressing the data included in Table 3, it should be emphasized that, in the studied period, SO<sub>2</sub> emissions are characterized by a decreasing trend in the case of point emissions, dynamics in 2018 compared with 2014 were 67%. However, area emissions are at a relatively similar level, in spite of the fact that after an increase of emissions in 2017, a decrease of 286 tons of SO<sub>2</sub> in the following year were observed. However, in the case of nitrogen dioxide, in the studied years, a permanent decrease in point emissions were observed; in 2015 compared with 2014 a decrease of 1,686 tons (13%) and in 2018 compared with the previous year of 3,919 tons (40%). In the case of area and linear emissions, data show no tendencies in the studied years. Emissions of dust to the air is of significant importance for the citizens of the West Pomeranian region due to the fact that in this case norms are usually exceeded. In the studied years, a steady decrease of PM10 emissions from all sources were observed. Only in 2017 did a significant increase of point emissions occur, from 1,275 tons in 2015 to 2,852, with a radical decrease to 1,135 in 2018. In the case of area emissions, connected mainly with individual heating systems, substantial improvements were observed. In 2017, emissions dropped by nearly 50% in relation to 2015. Linear emissions were also showing significant changes in the studied period. The biggest decrease occurred in 2017, whereby PM10 emissions constituted 13.5% of emissions in 2015. Area emissions from the household sector and linear emissions from means of car transport were of increasing importance in the region. However, point emissions from the industry sector showed a decreasing tendency. In urbanized areas of the cities, particularly in the Szczecin agglomeration, some threats to air quality occurred. They were connected with PM10 dust. The constant development of car transport observed in recent years poses a threat to people and the environment, mainly due to the fact that it results in a higher concentration of nitrogen dioxide in the air. Apart from the Szczecin agglomeration and bigger towns of the region, the threat connected with car transport emissions

Table 3. Emissions of SO<sub>2</sub>, NO<sub>2</sub>, PM10 in the West Pomeranian Voivodship, divided into types, in 2014, 2015, 2017, 2018

Pollution	Emissions [t]			
	2014	2015	2017	2018
SO <sub>2</sub> :				
- point	14,270	13,697	14,223	9,560
- area	6,092	6,325	8,128	7,842
- linear	1,618	1,998	35	21,370
NO <sub>2</sub> :				
- point	14,597	12,911	13,283	9,364
- area	3,631	6,939	270	2,543
- linear	30,864	26,992	1,639	11,171
PM10:				
- point	1,482	1,275	2,852	1,135
- area	14,569	15,566	8,634	8,340
- linear	8,385	9,864	1,333	734

Source: own study based on [GIOŚ 2014, 2015, 2017, 2018]

may also occur on a local scale in urbanized areas where main highly frequented routes are situated. Therefore, there is a need for urgent systemic action, both in legislature and in the form of financial incentives to purchase and use modern, technologically advanced means of transport (electric, hybrid, low-emission cars).

#### THE ACTIVITY OF THE PROVINCIAL ENVIRONMENTAL PROTECTION AND WATER MANAGEMENT FUND IN THE FIELD OF AIR QUALITY PROTECTION

Provincial funds are financial instruments for supporting undertakings in the field of environmental conservation in the region, based on subsidized loans and forms of non-returnable support: grants, loans, additional financial means granted when taking preferential credits, write-offs. Legal and financial grounds for the operations of WFOŚiGW as individual institutions of the public finance sector are specified by the Act of 27 April 2001 – Environmental Protection Law with subsequent amendments and the Public Finance Act.

In addressing the data included in Table 4, it should be emphasized that, in the period of 2015-2018, expenditure on air quality protection constituted a significant part of total expenditure on statutory activities and, in 2015, amounted to nearly 46%. In the following year, a substantial drop in expenditure on air quality protection both in nominal and percentage terms in total expenditure was observed, due to the fact that a separate category of RES (renewable energy sources) was created. In 2016 almost PLN 35 mln was spent on investments in RES constituting 38% of total expenditure and, when connected with the category of air quality protection, 62% of total expenditure. In the following years,



Table 4. Expenditure of statutory resources of WFOŚiGW in Szczecin on activities within the scope of air quality protection in the period of 2015-2018 with a division of forms of financing

Activities	Expenditure [thous. PLN]											
	2015			2016			2017			2018		
	grants (subsidies)	loans	total	grants (subsidies)	loans	total	grants (subsidies)	loans	total	grants (subsidies)	loans	total
Total	27,993 (901)	75,036	103,029	35,054 (1,975)	57,028	92,081	26,054 (538)	63,353	89,407	28,617 (499)	42,112	70,729
Air quality protection	10,134 (12)	36,930	47,064	7,516 (1,298)	14,214	21,731	7,317 (997)	26,693	34,010	10,727 (2)	18,464	29,191
RES	No data	No data	No data	14,292 (0)	20,675	34,967	2,805 (0)	6,449	9,254	203	606	809
Monitoring	1,320	No data	1,320	1,857	No data	1,857	1,000	No data	1,000	1,101	42	1,143

Source: own study based on [WFOŚiGW2015-2018]

the share of air quality protection increased in total expenses on statutory activities of the Fund, in 2017 – 38% and in 2018 – 41%. Simultaneously, a decrease of funding RES investments was noted.

In Table 4, resources mainly transferred in the form of grants for the Regional Inspectorate for Environmental Protection for activities connected with environment monitoring, including measurements of air quality were presented as well. These expenditures were at a level ranging from PLN 1 mln in 2017 to PLN 1.86 mln in 2016.

As a result of statutory activity, tangible environmental effects were created. They were related to limiting emissions of air pollutants. Data in Table 5 show that, due to a diversity of actions supported by financing within the scope of air quality protection, these figures show no tendencies in the studied period.

However, it should be stated that the effects connected with reducing emissions connected with the statutory activities of WFOŚiGW Szczecin constitute a small percentage in emissions in the region. In the period of 2015-2018, emissions of SO<sub>2</sub> were successfully reduced by 298 tons, which constitute a mere 1.33% of emissions in 2017. In the period of 2015-2018, emissions of dust was reduced by 218 tons, which constitutes 1.7% of annual emissions of 2017. However, in 2018 emissions of dust were reduced by 86 tons, constituting 0.84% of annual emissions of West Pomerania in 2018.

In the studied period, besides statutory resources, the fund in Szczecin carried out activities within the scope of financing air quality protection



Table 5. Reduction of emissions of air pollutants obtained as a result of executing contracts of WFOŚiGW Szczecin within the scope of air quality protection in the period of 2015-2018

Type of pollution	Size of reduction (tons/year) in particular years			
	2015	2016	2017	2018
Sulphur dioxide – SO <sub>2</sub>	98	6	40	154
Nitrogen dioxide – NO <sub>x</sub>	28	2	9	19
Carbon dioxide – CO <sub>2</sub>	23,402	5,523	12,916	26,310
Dust	91	6	35	86

Source: own study based on [WFOŚiGW2015-2018]

within the scope of cooperation with the National Fund for Environmental Protection and Water Management as part of contracts. The KAWKA Programme, a response to the provisions of air protection programmes aimed at local governments mainly concerned the financing of overall thermo-modernization and replacing sources of heat. Its continuation is the “Clean Air” (“Czyste Powietrze”) programme with conditions adjusted to the current situation and needs of potential beneficiaries. It assumes co-financing in the form of grants and loans mainly in the field of overall thermo-modernization, replacing heat sources in existing buildings as well as the purchase and installation of heat sources meeting requirements of the programme in new buildings. Implementation of the programme covers a period of 10 years and with plans to spend nearly PLN 1.3 bln in this time from sources of the national fund (875m in the form of grants and 185m in the form of subsidized loans) and also a declared contribution of Provincial Funds enabling attractive financial arrangements at a level of PLN 200 m, including 170 mln in the form of loans. The prosumpt programme was also carried out. It was aimed at legal persons interested in installing household RSE micro-installations. In the programme, almost PLN 75 mln from the national fund was spent in the form of grants and low-interest loans. Access to information, promotion and constant cooperation with all stakeholders is a very important element activating potential beneficiaries of both programmes co-financed from external sources and statutory resources. The fund in Szczecin carried out a series of promotion actions in this area. There is an urgent need to remove barriers to access and apply conditions facilitating the implementation of tasks within the field of atmosphere protection.

## SUMMARY

In Poland, as a result of development lags, there is a problem concerning air quality connected to excessive emissions of pollutants into the atmosphere. Some regions, in particular big cities, are characterized by significant exceedances of norms of particular toxic substances, mainly dust. In the West Pomeranian Voivodship, in comparison with national results of air monitoring, the situation is good, however, monitoring stations often indicate exceedances of norms of emissions, mainly in winter. The system of environmental protection, developed since 1989, functioning on national and provincial funds, has potential to implement tasks connected with supporting environmental investments

in the field of atmosphere protection. It is necessary to take appropriate corrective action, on a large scale, mainly in so called “low emission”.

In the studied period, there was strong involvement of own statutory resources of WFOŚiGW in Szczecin in projects aimed at curbing air pollution emissions and activities intended to obtain national resources as a part of cooperation with the national fund. However, intensification of action and adjusting financial instruments to the needs of beneficiaries in order to improve air quality and maximize ecological effects is needed.

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## DZIAŁANIA PUBLICZNYCH INSTYTUCJI FINANSOWYCH W ZAKRESIE POPRAWY JAKOŚCI POWIETRZA

Słowa kluczowe: jakość powietrza, ograniczenie emisji zanieczyszczeń,  
województwo zachodniopomorskie

### ABSTRAKT

Celem opracowania jest wskazanie roli publicznych instytucji w zakresie finansowania zadań inwestycyjnych z zakresu ochrony powietrza na przykładzie Wojewódzkiego Funduszu Ochrony Środowiska i Gospodarki Wodnej w Szczecinie. Wykorzystano metodę analityczno-opisową na podstawie dostępnych danych wtórnych. W ocenie jakości powietrza wykorzystano publikowane dane Instytutu Ochrony Środowiska z podziałem na źródła emisji oraz dane zawarte w „Rocznych ocenach jakości powietrza w woj. zachodniopomorskim” (GIOŚ). Zarówno w ujęciu krajowym, jak i regionalnym obserwuje się problemy z jakością powietrza, co wiąże się z przekroczeniami emisji zanieczyszczeń. W opracowaniu odniesiono się tylko do emisji  $\text{SO}_2$ ,  $\text{NO}_x$  oraz pyłów w latach 2015-2018, wskazując znaczenie emisji powierzchniowej i liniowej w tworzeniu przekroczeń. Analizie poddano wydatkowanie środków statutowych WFOŚiGW w Szczecinie na działania z zakresu ochrony atmosfery w badanym okresie, wskazując konieczność podjęcia intensywnych działań zmierzających do uzyskania znaczących efektów ekologicznych i efektywnego wykorzystania pieniędzy publicznych. Podkreślono znaczenie prowadzenia wspólnych programów pomocowych, skierowanych głównie do beneficjentów indywidualnych funduszy wojewódzkich z narodowym funduszem w celu spójności działań, efektywności i koncentracji środków publicznych.

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