

## THE ROLE OF ENVIRONMENTAL FUNDS IN SPENDING ON AIR PROTECTION IN POLAND

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**Purpose:** In the context of the climate crisis, one of the most pressing challenges the international community faces consists in actions aimed at reducing air pollutant emissions in the world. The objective of the study was to determine the role of voivodeship funds in disbursing funding for air protection in Poland.

**Design/methodology/approach:** The study used statistical methods and the desk research method, which involves analyzing and processing data from existing sources. The analyzed data concerned the number of applications and signed contracts, the value of signed contracts and transferred funds under programs implemented by voivodeship environmental protection funds and water management. The study pertained to the 2018-2020 period. As for the Clean Air Programme, the study surveyed 2018-2021.

**Findings:** The study confirmed a significant role the voivodship funds perform in the disbursement of funding on air protection initiatives. Since 2018, voivodeship funds for environmental protection and water management have been increasingly performing the distributive function. By executing own actions concerning air protection between 2018-2020, they faced fewer challenges than the one posed by the joint delivery of such an extensive programme as the Clean Air Programme with the National Fund.

**Research limitations/implications:** A limitation of the study is the inclusion of data on the programmes implemented only by 12 voivodship funds. Therefore, future studies should be extended to include data from all funds and cover further periods of implementation of air quality programmes by these institutions. However, with regard to the evaluation of factors influencing environmental efficiency, future studies may take into account other variables in the analysis of correlations, both in terms of environmental effects and socio-economic variables.

**Originality/value:** The present study contributes to broadening the knowledge of aspects related to the operation of the voivodship funds, and their role in and responsibility for the implementation of air protection programmes. In addition, the study contributed to the expansion of empirical research with the analysis of environmental effects of the Clean Air Programme.

**Keywords:** climate funds, air protection, funds for environmental protection and water management.

**Category of the paper:** Research paper.

## 1. Introduction

Climate change is a prominent phenomenon observable in all parts of the world. Hazards it brings about do not exclusively pertain to the natural environment. They also affect social, territorial and even economic domains. In recognition of the need to counteract the negative consequences of climate change, various financial mechanisms are established to support activities and projects concerning the mitigation of and adaptation to climate change. In the context of the current climate crisis, one of the most pressing challenges the international community faces in connection with climate protection consists in the delivery of actions aimed at reducing air pollutant emissions in the world. Air pollution encompasses all gaseous, liquid and solid (particulate matter) fractions which are not natural components of air, or whose content in the air is higher than the natural one. Air pollution and climate change are closely interrelated. Greenhouse gases retain heat in the atmosphere and translate into global warming. An example of efforts made concerning the reduction of air pollutant emissions is the strategy adopted by the European Commission – climate neutrality by 2050, which assumes that the European Union's economy will be the first in the world to achieve climate neutrality by 2050 (Climate neutrality, 2019), becoming a kind of beacon for others. The implementation of commitments made by individual member states concerning the establishment of a zero-emission economy will not be an easy task. According to a report by IQAir (2021 World Air Quality Report, 2021), a global air quality monitoring company, out of 6,475 cities surveyed in 117 countries, merely 222 met the standards for the volume of PM<sub>2.5</sub> in the air set by the World Health Organization. The results of the report are therefore very alarming, especially with regard to health issues and human life. In connection with the foregoing, it is crucial that the international community intensifies actions aimed at the mitigation of and adaptation to rapidly progressing climate change.

One of the most vital components of actions regarding climate change is to provide the necessary financial support originating from both public and private sources. With this purpose in mind, funds dedicated to environmental protection are established in order to finance programmes and projects aimed at combating climate change. In this article, climate funds financing activities and "air protection programs" implemented by voivodeship environmental protection and water management funds were examined.

Among the most significant functions of climate funds are the redistributive and fiscal functions. The functions performed by climate funds therefore consist, on the one hand, in the collection of funds and, on the other hand, in their distribution (Zdanukiewicz, 2012). In the literature of the subject, merely a narrow field of research is devoted to climate funds. Among the main streams of research, the following can be enumerated: legal and institutional dimension of climate funds (Kalinowski, 2020; Caldwell, Larsen, 2021; Bowman, Minas, 2018), effectiveness of their operation (Omukuti et al., 2022; Bhandary et al., 2021; Cianbiao

et al., 2019) as well as their social perception (Hugel, Davies, 2020; Bhandary, 2021a; Begum, Mahanta, 2017).

According to Carfora and Scandurra (2019), climate funds enable countries to enter the path of sustainable energy development. However, in order for this to actually happen, it is necessary to enhance the effectiveness of mobilization and administration of public and private funds for climate protection purposes (Bhandary et al., 2021).

Research on public, national climate funds is rare (Prasad, Sud, 2019). In Poland, studies on climate funds are available (Rabiega et al., 2022) which discuss priority programmes and actions related to climate protection. As far as air protection is concerned, reports of non-governmental and monitoring organizations are drafted (Adamkiewicz et al., 2021) which assess anti-smog activities implemented in the framework of priority programmes and projects, and which form recommendations for prospective actions. In Poland, there is a lack of research on the role of public climate funds in disbursing funding under climate protection programmes and projects<sup>1</sup>.

The objective of the article is to determine the role of voivodeship funds in disbursing funding for air protection in Poland. Therefore, the following research questions were posed: Has the pool of finances at the disposal of the voivodship funds earmarked for public actions concerning air protection increased? What is the outlook upon the voivodship funds' disbursement of public funding on tasks executed jointly with the National Fund for Environmental Protection and Water Management (NFEP&WM) regarding air protection in Poland? What are the environmental effects of the Clean Air Priority Programme? In order to establish answers to the above questions, the desk research method and statistical methods were employed. The data analysis was conducted on the basis of information made available by the NFEP&WM and the VFEP&WM.

The present study contributes to broadening the knowledge of aspects related to the operation of the voivodship funds, and their role in and responsibility for the implementation of air protection programmes. In addition, the study contributed to the expansion of empirical research with the analysis of environmental effects of the Clean Air Programme.

The present article is organized as follows: Section 1 introduces the issue of climate change and its impacts. The matters discussed therein are related to global air pollution and international community commitments; Section 2 presents climate funds as a source of financing of climate protection actions; Section 3 outlines research methodology; Section 4 analyzes empirical research results; Section 5 presents the interpretation of results and conclusions emerging from the study.

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<sup>1</sup> The following works constitute exceptions: Swianiewicz, Lackowska, 2017, 55-80; Gradziuk, Gradziuk, 2017, 95-105; Wajda, 2022, 51-65; Gręda, Kania, Skomorowska, Wiśniewski, 2020, 51-61.

## 2. Literature review

### 2.1. From financing climate protection to climate funds

Significant financial resources are required to deliver climate protection actions. According to the Adaptation Gap Report "The Gathering Storm", fiscal stimuli amounting to USD 16.7 trillion have been made available worldwide (UNEP, 2021). However, merely a small part of the money has been allocated to adaptation to climate change. The report points out that the delivery of adaptation-related activities has been growing slowly. Moreover, further initiatives towards funding and implementation are required (Adaptation and mitigation..., 2021). It is therefore necessary to ensure financial support for climate-oriented actions, both from public and private sources. For this purpose, funds dedicated to environmental protection must be established, whose task is to finance programmes and projects aimed at combating climate change.

In-depth research in the field of climate protection allows to distinguish several main dimensions related to climate funds, namely the legal and institutional dimension of climate funds (Kalinowski, 2020; Caldwell, Larsen, 2021; Bowman, Minas, 2018), their effectiveness (Omukuti et al., 2022; Bhandary et al., 2021; Cianbiao et al., 2019) and their social perception (Hugel, Davies, 2020; Bhandary, 2021a; Begum, Mahanta, 2017).

In the literature of the subject, one can find articles on the establishment and operation of international climate funds (Caldwell, Larsen, 2021; Bowman, Minas, 2018), as well as their structure and portfolio strategy (Amighini et al., 2022; Fonta et al., 2018). Such an approach to viewing the funds can be described as legal and institutional. The same applies to national climate funds where the analysis indicates their attributes, including the legal form, the scope of their activities and sources of financing (Bhandary, 2022). As far as the analysis of legal and institutional solutions of climate funds is concerned, studies discussing the role of intermediaries in shaping the financing of climate change actions are also available. Chaudhury (2020) notes a certain dominance of international intermediaries in the development and implementation of projects under climate funds. National intermediaries, on the other hand, have a poor capacity to create and scale projects.

The second area of research concerns the effectiveness of climate funds. Bhandary et al. (2021) point out that in addition to minimizing public costs, while taking fairness aspects into consideration, it is important to achieve climate-related goals, i.e. in addition to economic efficiency, achieving environmental efficiency as well. The basis for studying the effectiveness of climate funds is reporting and monitoring the effects of project implementation. However, as indicated by Weikmans and Roberts (2019), the lack of internationally agreed methods of tracking climate protection activities may cause discrepancies in statements and reports. Such a situation may lead to the inability to conduct a fair comparison of the effects of project implementation and outcomes of activities financed under climate funds.

Climate funds are also examined in the context of their social perception. As Hügel and Davies (2020) point out, it is important to engage society in problems pertaining to climate-related financing. At the same time, it is vital to ensure appropriate access to information as well as the possibility of public participation in decision-making processes. While examining the issue of mainstreaming climate change, Bhandary (2021a) noted that climate funds can engage local communities and be a kind of relay of expertise in climate programming.

The analysis of literature concerning climate-related financing conducted by Jayaram and Singh (2021) indicated an insufficient level of research in certain aspects such as the weakness of local funding institutions and issues connected with the allocation model. These may serve as future research areas concerning climate-related financing. Therefore, a research gap exists in this domain which requires further examination.

## **2.2. Climate protection funds in Poland**

In Poland, institutions that drive activities related to financial support for environmental protection are, *inter alia*, the National Fund for Environmental Protection and Water Management and 16 voivodship funds for environmental protection and water management. These institutions, based on the Environmental Protection Act, implement the environmental policy of the state and the policies of individual voivodships in terms of environmental protection specified in regional strategies and programmes. Additionally, once every four years they establish a common strategy of action which indicates the critical substantive objectives and priorities of cooperation (Common Strategy, 2020). Voivodeship funds for environmental protection and water management are public institutions offering subsidies, loans and other forms of funding for environmental protection programmes. Beneficiaries of the support offered by the funds encompass local governments, public entities, enterprises, social organizations and natural persons. In the past five years, the voivodship funds commenced a large-scale implementation of joint priority programmes for environmental protection, including air protection. Jointly implemented programmes provide the financing of projects from both the National Fund and the individual voivodship funds. Regarding air protection, joint activities of the institutions are aimed not only at improving air quality and transitioning towards a low-carbon economy, but also at achieving the objectives of the climate and energy package for Poland (Common Strategy, 2020).

In 2018, cooperation in the implementation of joint environmental protection programmes between the National Fund and the individual voivodship funds began to gradually increase, mainly concerning financial redistribution. In the aspect of air protection, these institutions began to implement the largest to date Clean Air Priority Programme, whose main objective is to enhance energy efficiency and reduce particulate matter and pollutant emissions into the atmosphere. In 2018, the value of funds made available by the National Fund under contracts concluded with the individual voivodship funds for payments to final beneficiaries of the programme amounted to PLN 1,004,000 thousand of which PLN 830,000 thousand was in the

form of grants and PLN 174,000 thousand in the form of loans (Common Strategy, 2020). The most vital tasks related to the implementation of the programme were assigned to the voivodship funds, which deal with the processing of applications, concluding and settling contracts with beneficiaries, monitoring and reporting activities. The implementation of the Clean Air Priority Programme is scheduled for 2018-2029. The budget of the programme is over PLN 103 billion (Clean Air Priority Programme..., 2022). The second joint programme concerning air protection implemented since 2018 by the voivodship funds was the Air Quality Improvement Programme dedicated to reducing energy consumption in the construction sector. As part of the cooperation in 2018-2020, the National Fund concluded 15 contracts providing grant-based funding to final beneficiaries via the voivodship funds for a total amount of over PLN 250 million. As part of the cooperation, the voivodship funds funded 301 grant-based co-financing applications and 52 loan-based ones (Common Strategy..., 2020). It should be noted that in addition to this, the funds also spend their finances on the basis of the Environmental Protection Act in the framework of the so-called "fields". In their annual operational plans, the funds specify environmental protection financing avenues scheduled to be funded during the particular year. For example, regarding air protection, individual funds allocate their own resources to the delivery of various tasks aimed at reducing emissions of air pollutants and tasks associated with thermo-modernization, and develop and implement their own air protection programmes<sup>2</sup>. Actions eligible under air protection programmes delivered by the voivodeship funds include, e.g. replacement of inefficient solid fuel heat sources, insulation of building partitions or replacement of window and door joinery.

Research on the role of the funds in financing the implementation of air protection programmes and projects is carried out to a limited extent by the Supreme Audit Office as part of the auditing operation of the institution (Post-inspection report – Opole..., 2020). Fura (2017) researched the effectiveness of air protection and climate actions in voivodeships in Poland. Mesjasz-Lech (2014) studied regional air protection actions. However, these studies do not directly pertain to the voivodship funds for environmental protection and water management. The change in the role of the funds is reflected in the content of subsequent Common Strategies of the National Fund and the voivodship funds for environmental protection. However, there is a lack of up-to-date<sup>3</sup> research on the operation of the voivodship funds, their role in and increasing responsibility for the implementation of air protection programmes.

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<sup>2</sup> The Voivodeship Fund for Environmental Protection and Water Management in Warsaw executed, e.g., OA-1 programme entitled "Reduction of air pollutant emissions, reduction of heating consumption, and exploitation of renewable energy sources" and OA-2 entitled "Modernization of electrical lighting", Report on the activities of the Voivodeship Fund for Environmental Protection and Water Management in Warsaw for 2019.

<sup>3</sup> Works on the role of the voivodship funds date back to several years ago, e.g. Górka, Rosiek, 2007, 51-74, i.e. they predate the amendment of the Environmental Protection Act of 2009, which resulted in the funds operating as local government legal entities since 2010. The operation of voivodship funds for environmental protection was also examined by the Supreme Audit Office. However, the audit concerned the 2014-2017 period, <https://www.nik.gov.pl/plik/id,16844,vp,19402.pdf>, 10 September 2022.

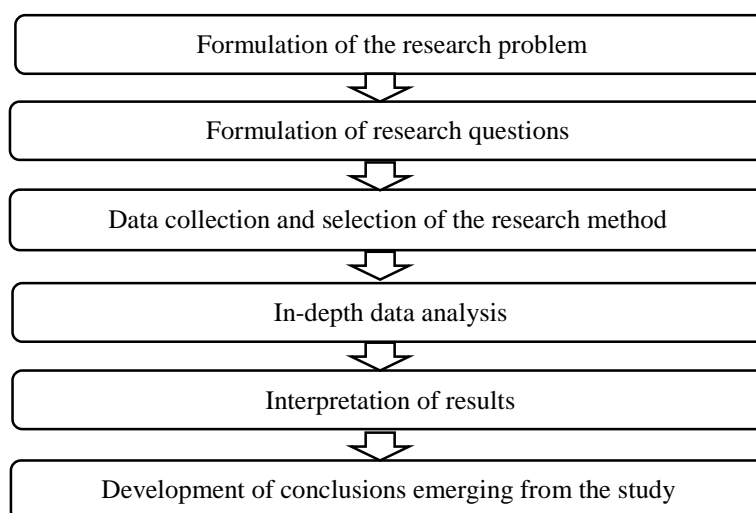
### 3. Methodology

In order to establish answers to the research questions, the desk research method and statistical methods were employed. The data analysis was made on the basis of information made available by the National Fund for Environmental Protection and Water Management and voivodship funds for environmental protection and water management (NFEP&WM and the VFEP&WM). Data on two programmes implemented jointly by the funds were analyzed, i.e. Clean Air Priority Programme and Air Quality Improvement Programme for the reduction of energy consumption in the construction sector. In addition, data on the delivery of air protection tasks financed from own resources of individual voivodship funds in 2018-2020 were also analyzed. The present study employed statistical methods and the desk research method, consisting in analyzing and processing data from existing sources, the so-called legacy data and, based on them, formulating conclusions on the surveyed issue (Encyclopedia..., 2022). As part of the applied method, the analysis of programming documents and the analysis of reporting data were carried out. The Clean Air Programme, as well as the Air Quality Improvement Programme for the reduction of energy consumption in the construction sector, were delivered by the voivodship funds since 2018. Therefore, the research covers the 2018-2020 period, and in relation to the Clean Air Programme, the 2018-2021 period. In 2018-2021, the voivodship funds for environmental protection, jointly with the National Fund, also implemented other air quality improvement programmes, which will be disregarded in this article<sup>4</sup>. This is due to the fact that they were not implemented by all voivodship funds, only concerned selected ones or were implemented by few funds as pilot projects (National Fund report..., 2021).

The analyzed data encompassed the number of applications and signed contracts, the value of signed contracts and funding transferred under programmes implemented from own resources and under the Clean Air Priority Programme and Air Quality Improvement Programme for the reduction of energy consumption in the construction sector. In the case of the Clean Air Priority Programme, data on the obtained environmental effects were also collected. The research process is outlined in Figure 1.

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<sup>4</sup> Excluding the Air Quality Improvement Programme, which was discussed in the article because it was not implemented exclusively by the Voivodship Fund for Environmental Protection and Water Management in Zielona Góra.



**Figure 1.** Research process.

Source: own elaboration.

## 4. Research results

### 4.1. Analysis of the Clean Air Priority Programme

Table 1 presents the number of applications submitted to the individual voivodship funds for environmental protection and the value of the requested co-financing under the Clean Air Priority Programme.

**Table 1.**

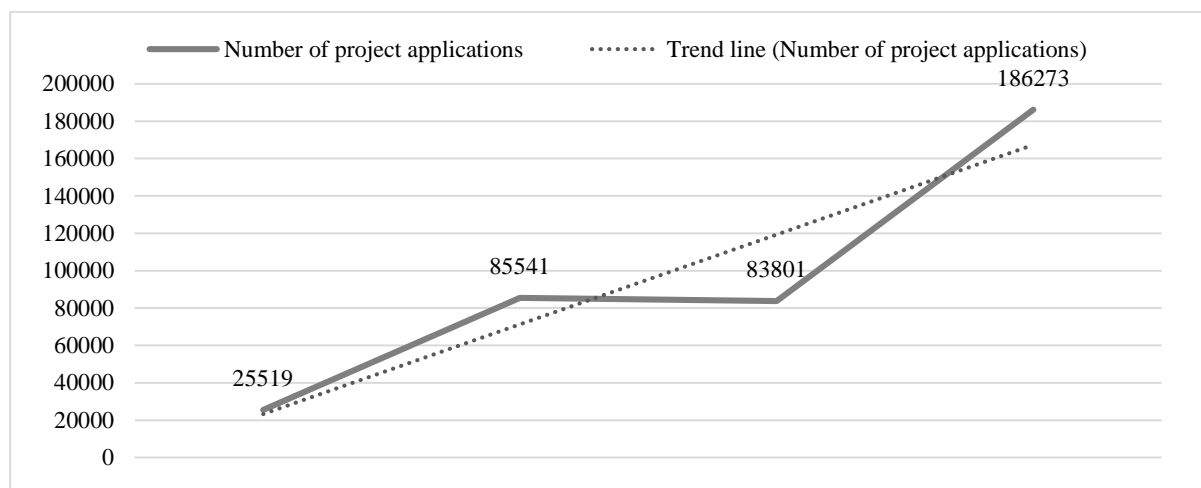
*Applications submitted under the Clean Air Priority Programme in 2018-2021*

No.	VFEP&WM	Number of project applications (pcs.)				Value of the requested co-financing (PLN thousand)			
		2018	2019	2020	2021	2018	2019	2020	2021
1.	Białystok	1182	3731	2904	4989	29 465	89 339	54 567	89 200
2.	Gdańsk	1908	5635	4160	8504	36 453	109 659	63 107	129 253
3.	Katowice	3722	10040	12413	37990	79 022	168 837	155 775	491 179
4.	Kielce	1640	5122	4634	9228	34 248	117 296	86 721	169 364
5.	Kraków	2364	8925	10056	19973	62 825	223 857	171 931	344 910
6.	Lublin	2042	5791	4203	9265	51 233	137 585	78 829	153 028
7.	Łódź	1094	6116	6103	12469	25 243	121 149	88 182	180 890
8.	Olsztyn	697	3183	3238	5949	16 005	70 259	59 102	96 874
9.	Opole	864	1904	2234	5843	16 434	33 705	29 154	83 121
10.	Poznań	1999	6696	6805	15682	46 782	131 246	101 481	224 330
11.	Rzeszów	1318	4999	4798	10128	32 084	109 806	91 435	177 744
12.	Szczecin	816	2416	1984	4134	18 687	47 672	29 293	60 992
13.	Toruń	1479	5580	5982	10746	22 808	98 049	86 226	162 339
14.	Warszawa	2699	9546	8755	18642	48 084	184 027	135 563	278 231
15.	Wrocław	1131	4069	3586	9107	20 088	74 067	49 638	124 273
16.	Zielona Góra	564	1788	1946	3624	9 576	30 074	27 259	52 795
17.	<b>Total</b>	<b>25519</b>	<b>85541</b>	<b>83801</b>	<b>186273</b>	<b>549 037</b>	<b>1 746 627</b>	<b>1 308 263</b>	<b>2 818 523</b>

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.



The study indicated that in 2019 and 2020, the number of applications submitted under all voivodship funds was at a similar level. In 2018, the number of applications was lower due to the fact that the programme was launched in Q3. The programme noticeably accelerated only in 2021. The largest number of applications was submitted to the Fund in Katowice – 64,165, and the lowest in Zielona Góra – 7,922. The requested value of co-financing in 2018-2021 for all applications submitted to the funds amounted to over PLN 6.4 billion.



**Figure 2.** Number of applications submitted under the Clean Air Priority Programme plotted with the trend line.

Source: own elaboration.

Similar results were obtained in relation to the number and value of co-financing contracts concluded in 2018-2021 under the Clean Air Programme (Table 2).

**Table 2.**

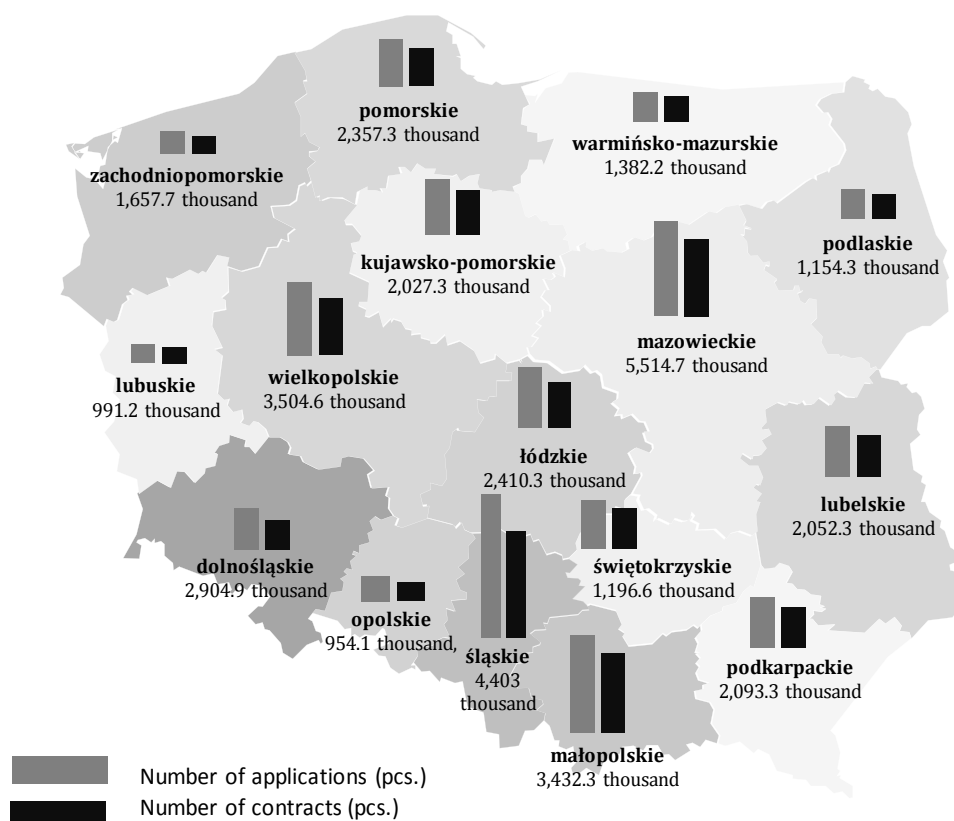
*Co-financing contracts concluded under the Clean Air Priority Programme with final beneficiaries in 2018-2021*

No.	VFEP&WM	Number of concluded co-financing contracts in individual years (pcs.)				Value of contracts (PLN thousand)			
		2018	2019	2020	2021	2018	2019	2020	2021
1.	Białystok	0	2969	3362	4151	0	66 674	67 238	75 375
2.	Gdańsk	16	4965	5115	6434	165	16 445	151 812	97 463
3.	Katowice	0	5536	15675	26333	0	87 902	217 999	338 536
4.	Kielce	0	3480	5662	8364	0	69 197	113 769	149 725
5.	Kraków	0	5402	11463	16743	0	123 920	221 996	286 952
6.	Lublin	0	2990	7111	7651	0	62 557	143 955	127 877
7.	Łódź	0	2937	7639	8838	0	56 664	121 561	129 091
8.	Olsztyn	9	3321	3097	4888	104	65 329	56 431	81 820
9.	Opole	0	1182	2820	4383	0	18 279	37 809	61 958
10.	Poznań	0	3112	9117	11784	0	57 517	150 765	170 403
11.	Rzeszów	0	3227	5218	8294	0	71 564	102 218	145 857
12.	Szczecin	0	2665	2004	2390	0	44 866	30 720	35 855
13.	Toruń	0	4966	5839	8281	0	80 442	86 585	123 966
14.	Warszawa	29	7039	11088	14211	318	123 616	186 157	213 191
15.	Wrocław	0	2513	3761	6129	0	40 434	53 569	77 099
16.	Zielona Góra	5	1671	2075	3254	49	24 805	29 839	46 468
17.	<b>Total</b>	<b>59</b>	<b>57975</b>	<b>101046</b>	<b>142128</b>	<b>636</b>	<b>1 010 211</b>	<b>1 772 423</b>	<b>2 161 636</b>

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

The study indicated that despite the launch of the programme on 19 September 2018, only 59 contracts were signed by the end of that year. In the following years, the situation regarding the number of signed contracts began to change gradually. Therefore, certain acceleration in the implementation of the Clean Air Programme can be observed. At the same time, there are differences in the number of submitted applications and signed co-financing contracts between individual voivodship funds. The largest number of co-financing contracts was concluded by the Fund in Katowice – 47,544, and the lowest in Zielona Góra – 7,005. The value of signed co-financing contracts in 2018-2021 for all applications submitted to the funds amounted to approx. PLN 5 billion.

One of the factors affecting this situation is certainly the number of inhabitants in individual voivodships, which translates into the number of applications submitted and contracts signed under the programme (Figure 3). In view of the foregoing, the largest number of applications for co-financing under the Clean Air Programme was submitted in śląskie, małopolskie and mazowieckie voivodships, respectively 64,165, 41,318 and 39,642. Similarly, in the case of co-financing contracts, the largest number of contracts was signed in the same voivodships, respectively in the śląskie voivodship – 47,544, małopolskie voivodship – 33,608 and mazowieckie voivodship – 32,367.



**Figure 3.** Number of applications (pcs.) and signed co-financing contracts (pcs.) under the Clean Air Programme in 2018-2021 in relation to the number of inhabitants in the individual voivodships.

Source: own study based on <https://excelraport.pl>, CSO (National Census, 2021) data and reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

Taking into account the per capita subsidization of projects, the most funding in 2018-2021 went to a resident of the świętokrzyskie voivodeship 278 PLN, and the least to a resident of the dolnośląskie voivodeship: 59 PLN (Table 3).

**Table 3.**

*Per capita subsidy in 2018-2021 by voivodeship*

No.	Voivodeship	Value of contracts 2018-2021 (PLN thousand)	Population of voivodships (pcs. thousand)	Subsidies per capita (PLN)
1.	podlaskie	209287	1154	181
2.	pomorskie	265885	2357	113
3.	śląskie	644437	4403	146
4.	świętokrzyskie	332691	1197	278
5.	małopolskie	632868	3432	184
6.	lubelskie	334389	2052	163
7.	łódzkie	307316	2410	128
8.	warmińsko-mazurskie	203684	1382	147
9.	opolskie	118046	954	124
10.	wielkopolskie	378685	3505	108
11.	podkarpackie	319639	2093	153
12.	zachodniopomorskie	111441	1658	67
13.	kujawsko-pomorskie	290993	2027	144
14.	mazowieckie	523282	5515	95
15.	dolnośląskie	171102	2905	59
16.	lubuskie	101161	991	102

Source: own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

In the analysis of the implemented programme, the speed and amount of co-financing made available by the institutions are also crucial.

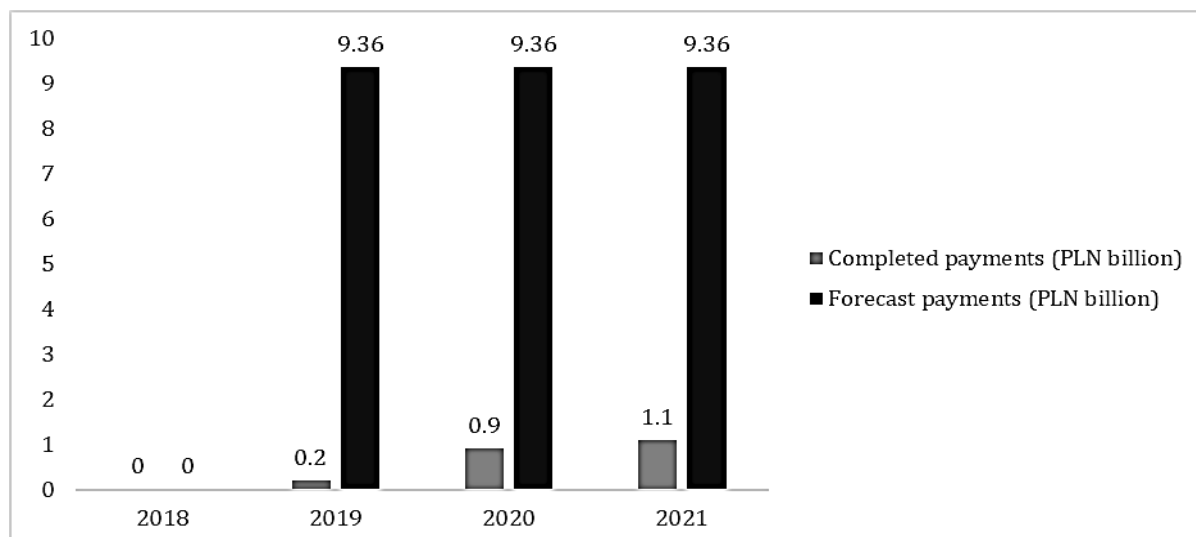
**Table 4.**

*Disbursements under the Clean Air Priority Programme*

No.	VFEP&WM	Disbursement of funds from the NFEP&WM to the VFEP&WM - transfer of funding (PLN thousand)				Disbursements to final beneficiaries (PLN thousand)			
		2018	2019	2020	2021	2018	2019	2020	2021
1.	Białystok	0	39 676	43 936	35 742	0	9 927	49 925	52 841
2.	Gdańsk	0	62 000	27 500	53 852	0	2 988	76 364	59 191
3.	Katowice	0	20 208	70 385	153 195	0	13 746	86 718	121 519
4.	Kielce	0	30 000	76 800	74 893	0	21 717	72 570	79 212
5.	Kraków	0	41 533	44 375	95 998	0	6 806	57 771	113 596
6.	Lublin	0	66 599	64 700	108 305	0	16 066	79 677	94 337
7.	Łódź	0	12 900	56 275	96 200	0	8 324	52 444	87 096
8.	Olsztyn	0	15 000	66 400	60 857	0	20 679	53 671	45 554
9.	Opole	0	14 000	17 500	56 500	0	7 300	23 199	37 386
10.	Poznań	0	86 000	0	104 153	0	19 828	60 195	86 622
11.	Rzeszów	0	50 000	64 000	75 000	0	21 343	70 562	77 190
12.	Szczecin	0	13 409	22 071	24 794	0	15 735	28 179	23 413
13.	Toruń	0	50 000	49 800	67 234	0	29 564	62 271	63 550
14.	Warszawa	0	100 000	51 000	130 190	0	25 161	122 996	99 478
15.	Wrocław	0	62 000	0	65 420	0	17 293	35 057	40 629
16.	Zielona Góra	0	12 066	26 000	21 000	0	8 018	22 052	25 402
17.	<b>Total</b>	<b>0</b>	<b>675 391</b>	<b>680 742</b>	<b>1 223 333</b>	<b>0</b>	<b>244 495</b>	<b>953 651</b>	<b>1 107 016</b>

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

The budget of PLN 103 billion was set for the implementation of the Clean Air Programme. The first allocation of finances to the funds to be disbursed among final beneficiaries was made in the second year of the programme. Despite the transfer of over PLN 675 million by the National Fund, by the end of 2019 the voivodship funds disbursed merely just over PLN 244 million among final beneficiaries. The situation improved in two following years when the funds made disbursements to final beneficiaries at a level exceeding PLN 2 billion (Figure 4).



**Figure 4.** Payments made to the beneficiaries of the Clean Air Priority Programme in 2018-2021 in relation to forecast payments.

Source: own elaboration based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021<sup>5</sup>.

Taking into account the disbursement of funding to beneficiaries, the study showed that despite the acceleration of the implementation of the Clean Air Programme in 2021, it may turn out that by the end of September 2029 the budget of the programme will not be expended<sup>6</sup>. The level of payments made to beneficiaries by the end of 2021 is merely over PLN 2 billion, which is slightly over 2% of the total budget of the programme. This may result in a lack of effective use of available funding and affect the achievement of the environmental and material effects assumed under the programme. Taking into account that environmental effects are determined by the number of delivered projects, it is necessary to monitor the speed and effectiveness of the implementation of the programme so that the achievement of the effects is not threatened. This is also confirmed by the report (Stefańczyk et al., 2022) according to which it is necessary to maintain certain dynamics of introducing changes in the programme, as well as to draw attention to key issues such as reducing energy demand. In this report, the Clean Air

<sup>5</sup> As part of the disbursement forecast, it was taken into account that the Clean Air Programme has been implemented since 19 September 2018, and in accordance with the provisions of the programme, disbursements may be made by the voivodship funds until 30 September 2029. Due to the fact that the Clean Air Programme has been implemented since Q2 2018 and no disbursements were made in the first year, no disbursements were forecast in 2018.

<sup>6</sup> According to the provisions of the programme, this is the deadline for the disbursement of funding by the voivodship funds for environmental protection.

Programme is referred to as a two-speed programme due to the fact that more than half of the projects funded under it have not scheduled energy efficiency (Stefańczyk et al., 2022) improvement measures. Conclusions emerging from the present study indicate that if the programme does not implement comprehensive thermo-modernization activities to a greater extent, the achievement of air quality improvement in the short-term will not be possible, especially in connection with the rise of gas and electricity prices in Poland (Stefańczyk et al., 2022).

The disbursement of funding to the beneficiaries aims to aid the achievement of the Clean Air Programme objective, which is to "improve air quality and reduce greenhouse gas emissions by exchanging heat sources and improving the energy efficiency of single-family housing" (Clean Air Priority Programme..., 2022). The framework of the programme assumed the funding of a number of activities aimed at delivering the programme's assumptions, such as dismantling inefficient solid fuel heat sources, insulation of building partitions or replacement of window and door joinery. The achievement of the objective is to be confirmed by the achievement of the following material and environmental effects (Clean Air Priority Programme..., 2022):

- number of buildings/residential premises with improved energy efficiency – 3,030,000 pcs.;
- number of inefficient heat sources replaced by low-carbon ones in buildings/residential premises – 3,000,000 pcs.;
- additional electricity generation capacity from installed photovoltaic micro-installations – 50 MW/year;
- reduction of final energy consumption – 37,500,000 MWh/year;
- reduction of particulate matter emissions with a diameter of less than 10 micrometers (PM10) – 210,000 Mg/year;
- reduction of benzo-alpha-pyrene emissions – 140 Mg/year;
- reduction of CO<sub>2</sub> emissions – 14,000,000 Mg/year.

Table 5 illustrates the selected environmental and material effects after four years of the implementation of the Clean Air Priority Programme.

**Table 5.**

*Environmental and material effects resulting from concluded and completed contracts under the Clean Air Priority Programme between 2018-2021 (for the entire programme)*

No.	Environmental and material effect	2019		2020		2021	
		from signed contracts <sup>7</sup>	from completed projects	from signed contracts	from completed projects	from signed contracts	from completed projects
<b>Environmental effects</b>							
1.	Reduction of electric energy and heating demand (thousand MWh/year)	1 123,6	269,5	1 292,7	597,8	2 535,7	1 141,9
2.	Volume of limited or prevented CO <sub>2</sub> emission (Mg/year)	362 829	87 420	542 262	303 472	1 110 400	518 500
3.	Reduction of PM <sub>2.5</sub> particulate matter emission (Mg/year)	678	191	1 401	745	2 860	1 342
4.	Reduction of PM <sub>10</sub> particulate matter emission (Mg/year)	826	240	1 571	834	3 202	1 503
5.	Reduction of SO <sub>2</sub> emission (Mg/year)	3 296	947	6 164	3 655	12 526	5 889
<b>Material effects</b>							
6.	Number of inefficient heat sources replaced by low-carbon ones in existing buildings (pcs.)	35 442	10 708	62 993	33 704	135 366	62 432
7.	Number of thermo-modernized buildings (pcs.)	42 051	11 569	70 922	38 202	143 558	67 428
8.	Number of low-carbon energy sources installed in newly erected buildings (pcs.)	16 750	5 379	6 498	3 864	1 772	3 133

Source: Own study based on reports on the operation of the National Fund for Environmental Protection and Water Management for 2018-2021.

The actual effects of the programme are spread over time. As a result of the delivery of the Clean Air Programme, 106,844 inefficient heat sources were replaced by low-carbon ones in existing buildings over the period of four years. This represents 3.6% of the number assumed in the programme. In the case of other effects, i.e. volume of limited or prevented carbon dioxide emissions and reduction of PM<sub>10</sub> emissions, they were achieved in 6.5% and 1.2% of the assumed effects of the entire programme, respectively.

<sup>7</sup> The discrepancy between the number of signed contracts and completed projects primarily resulted from the fact that projects were being delivered in certain timeframes determined by regulations pertaining to the delivery of projects under the priority programme. Data concerning the number of signed contracts were based upon a schedule. On the other hand, data on the number of completed projects pertained to the actual number of projects executed in a specific year.

#### **4.2. Analysis of the Air Quality Improvement Programme for the reduction of energy consumption in the construction sector**

The delivery of the Air Quality Improvement Programme for the reduction of energy consumption in the construction sector was different. Much like the Clean Air Programme, the voivodship funds commenced the delivery of this programme in 2018. The call for applications was opened and operated by the National Fund for Environmental Protection and Water Management in Warsaw (Call for applications..., 2017). Subsequently, based upon joint agreements, the applications were evaluated by the voivodship funds and projects were delivered in their respective areas of responsibility. The delivery of the programme was scheduled for 2016-2022. The budget of the programme was set at PLN 1,129,567 thousand (Air Quality Improvement Priority Programme..., 2017). The objective of the Air Quality Improvement Programme is "to improve the quality of air by limiting or preventing CO<sub>2</sub> emission as a result of increasing renewable energy production and decreasing energy consumption in buildings" (Air Quality Improvement Priority Programme..., 2017). The beneficiaries of the programme encompass entities operating medical in-patient 24/7 services, entities operating museums, dormitories, owners of national heritage buildings, as well as churches, church legal entities, and religious associations (Air Quality Improvement Priority Programme..., 2017). The achievement of the programme's objectives is to be confirmed by the achievement of the following effects (Air Quality Improvement Priority Programme..., 2017):

- energy production from renewable sources at least 100 thousand MWh/year;
- reduction of primary energy consumption by at least 157.16 thousand MWh/year
- reduction of CO<sub>2</sub> emission by at least 47.6 thousand Mg/year.

The programme scheduled funding of thermo-modernization of buildings, inter alia, museums, hospitals, dormitories, religious buildings, monuments, and other buildings for the purpose of culture, science and education (Air Quality Improvement Priority Programme..., 2017). The data pertaining to the delivery of the programme by individual voivodship funds in 2018-2022 is outlined in Table 6.

**Table 6.**

*Delivery of the Air Quality Improvement Programme. Part 2) Reduction of energy consumption in the construction sector in 2018-2020<sup>8</sup>*

No.	VFEP& WM	Number of evaluated applications in 2018-2020	Number of signed contracts (pcs.)			Value of signed contracts (PLN)			Value of disbursements to beneficiaries (PLN)		
			2018	2019	2020	2018	2019	2020	2018	2019	2020
1.	Białystok	3	0	0	1	0	0	961 367	0	0	961 367
2.	Gdańsk	6	0	4	0	0	10 258 289	0	0	689 816	7 001 099
3.	Katowice	43	0	27	3	0	24 379 682	2 801 199	0	15 296 914	12 963 010
4.	Kraków	37	0	5	9	0	5 147 522	4 946 206	0	0	8 161 512
5.	Lublin	53	14	16	7	13 420 182	18 388 697	10 533 391	830 131	7 060 678	16 389 433
6.	Łódź	13	1	7	0	516 500	9 852 515	0	0	1 077 519	2 202 608
7.	Olsztyn	10	2	8	0	1 378 599	3 925 137	0	0	3 332 540	1 971 196
8.	Poznań	16	5	1	0	5 073 039	318 585	0	225 412	1 199 633	645 746
9.	Rzeszów	41	0	26	6	0	16 314 832	2 472 613	0	4 057 305	10 162 107
10.	Toruń	8	0	5	2	0	5 206 000	2 888 000	0	6 247 000	1 883 000
11.	Warszawa	24	0	9	12	0	19 932 053	18 322 086	0	3 934 173	11 862 660
12.	Wrocław	8	0	3	3	0	1 161 569	16 740 278	0	679 011	1 308 245
<b>13.</b>	<b>Total</b>	<b>262</b>	<b>22</b>	<b>111</b>	<b>43</b>	<b>20 388 320</b>	<b>114 884 881</b>	<b>59 665 140</b>	<b>1 055 543</b>	<b>43 574 589</b>	<b>75 511 982</b>

Source: Own elaboration based upon data made available by the voivodship funds and data included in the reports of these institutions.

The study indicates that between 2018 and 2019 the largest number of applications was evaluated by the Fund in Lublin, and the lowest by that in Białystok. The case was similar as far as the number of signed contracts for funding is concerned. The Fund in Lublin concluded 37 contracts and that in Białystok merely one. Therefore, a difference between the funds emerged as regards the number of evaluated applications and delivered projects. The discrepancy stems from a different number of applications transferred to the voivodship funds by the National Fund<sup>9</sup>. In the first year of the programme's delivery, the voivodship funds completed two payments to the beneficiaries totaling over PLN 1 million. In the following years, the payments to the beneficiaries totaled over PLN 120 million.

The study also showed that the requirements for preparing institutions for the implementation of the programmes may result from the specificities of the programmes themselves. The Air Quality Improvement Programme required a slightly different preparation of the implementing institutions than the Clean Air Programme. The number of evaluated applications and signed contracts in 2018-2020 was much lower in this programme than in the Clean Air Programme. Assuming that the National Fund, as part of cooperation in 2018-2020, transferred 353 applications for implementation to the voivodship funds, on average 23.5 applications (Common Strategy, 2020) per institution were evaluated and settled<sup>10</sup>.

<sup>8</sup> The table does not include data from the Funds in Kielce, Opole and Szczecin due to the information not being made available. The fund in Zielona Góra did not deliver the programme.

<sup>9</sup> For example, as part of the contract concluded on 29 May 2018 the Voivodship Fund for Environmental Protection and Water Management in Lublin received 53 applications for evaluation (data from the fund's operational report in 2019, Available online: [https://www.wfos.lublin.pl/materialy/\\_upload/sprawozdanie/Sprawozdanie2019r.pdf](https://www.wfos.lublin.pl/materialy/_upload/sprawozdanie/Sprawozdanie2019r.pdf)) whereas the Voivodship Fund for Environmental Protection and Water Management in Toruń received eight applications (data from the fund's operational report in 2019, Available online: <http://bip.wfosigw.torun.pl/uploads/files/Sprawozdania/SPRAWOZDANIE%202019.pdf>).

<sup>10</sup> Assuming that the Voivodship Fund for Environmental Protection and Water Management in Zielona Góra did not participate in the programme.



The study revealed that the implementation of projects submitted to the voivodship funds for evaluation and delivery proceeded quite slowly. In 2018, merely 22 funding contracts with beneficiaries<sup>11</sup> were signed, which translated into just two of the examined funds disbursing funding.

#### **4.3. Programmes and projects delivered by the voivodship funds in the framework of own resources**

Pursuant to the Environmental Protection Act, by each 30<sup>th</sup> November, voivodship funds for environmental protection and water management must adopt plans for their operation for the consecutive year (Environmental Protection Act..., 2022). Individual funds schedule the execution of own programmes and projects concerning environmental protection within the scope of own funds at their disposal.

As far as air protection is concerned, individual funds allocate own resources for the delivery of initiatives aiming to reduce air pollution and for thermo-modernization purposes. The funds also deliver own programmes. For example, in 2019, the Fund in Warsaw, delivered the OA-1 programme entitled "Reduction of air pollutants emission, reduction of heating consumption, and exploitation of renewable energy sources", as well as OA-2 programme entitled "Modernization of electrical lighting" (Voivodeship Fund report, 2019). In 2017, the Fund in Lublin executed the "EKODOM" programme (Regulations for the call..., 2017). Data pertaining to the delivery of programmes and initiatives regarding air protection by the voivodship funds is outlined in Table 7.

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<sup>11</sup> Considering the data from the studied voivodship funds.

**Table 7.**

Data pertaining to the delivery of programmes and initiatives regarding air protection excluding those executed jointly with the National Fund for Environmental Protection and Water Management (own programmes)<sup>12</sup>

No.	VFEP&WM	Number of applications (pcs.)	Number of contracts (pcs.)	Value of contracts (PLN)	Disbursements (PLN)	Number of applications (pcs.)	Number of contracts (pcs.)	Value of contracts (PLN)	Disbursements (PLN)	Number of applications (pcs.)	Number of contracts (pcs.)	Value of contracts (PLN)	Disbursements (PLN)
		2018				2019				2020			
1.	Białystok	0	14	5 317 198	5 994 070	6	3	143 000	143 000	19	16	1 400 842	1 400 842
2.	Gdańsk	197	69	28 224 604	15 672 711	16	18	45 517 214	4 963 496	26	12	8 362 139	8 393 778
3.	Katowice	518	366	40 695 583	199 913 825	243	338	214 048 149	172 184 527	229	242	221 657 401	223 265 426
4.	Kraków	173	117	28 867 272	26 756 262	82	75	38 733 888	38 713 362	39	38	13 932 512	13 909 596
5.	Lublin	153	114	80 084 508	20 445 830	65	40	95 932 789	19 374 433	46	29	16 098 623	10 101 614
6.	Łódź	172	131	70 840 941	63 706 714	195	125	49 946 494	60 091 751	356	153	65 667 663	38 439 397
7.	Olsztyn	48	21	12 255 115	15 873 196	52	22	577 934	1 132 561	50	35	3 919 572	2 858 539
8.	Poznań	121	38	33 879 568	63 723 702	63	28	34 909 965	21 517 519	133	84	17 253 282	33 517 384
9.	Rzeszów	228	194	30 554 273	28 500 369	51	45	6 583 705	10 543 105	97	41	8 583 252	7 190 558
10.	Szczecin	247	179	5 861 212	8 095 697	45	27	458 760	9 487 053	91	37	1 438 407	479 076
11.	Toruń	272	170	18 158 000	26 747 000	47	44	15 437 000	11 442 000	53	33	1 904 000	3 488 000
12.	Warszawa	66	23	8 701 898	14 343 955	51	22	13 309 793	14 411 277	196	139	19 761 326	30 414 692
13.	Wrocław	115	93	44 131 000	39 758 000	54	57	98 721 000	71 510 000	52	41	116 387 000	113 200 000
14.	<b>Total</b>	<b>2 310</b>	<b>1 529</b>	<b>407 571 172</b>	<b>529 531 332</b>	<b>970</b>	<b>844</b>	<b>614 319 690</b>	<b>435 514 084</b>	<b>1 387</b>	<b>900</b>	<b>496 366 021</b>	<b>486 658 902</b>

Source: Own elaboration based upon data made available by the voivodship funds for environmental protection.

<sup>12</sup> The table does not include data from the funds in Kielce, Opole and Szczecin due to their not being made available.

The study revealed that in 2018-2020, the largest number of applications pertaining to air protection were submitted to the Fund in Katowice - 990, and the fewest to the Fund in Białystok - 25. A similar observation was made concerning signed funding contracts. Between 2018 and 2019, the voivodship funds disbursed over PLN 1.4 billion of their own financial resources to the beneficiaries. Interestingly, in certain cases, the number of signed contracts exceeds the number of applications submitted to the funds in a specific year. This is due to the fact that the evaluation procedure may not have been completed by the end of the specific year. Occasionally, applications go under evaluation in the following year, thus the number of signed contracts may exceed the number of applications, which was the case in e.g. the Fund in Katowice in 2018-2019 (Voivodeship Fund report, 2018).

#### 4.4. Factors determining environmental effectiveness of the Clean Air Programme

In order to verify the relationship between the environmental effect and economic and social variables, an r-Pearson correlation analysis was carried out. Based on the literature on the subject (Pello et al., 2021; Begum & Mahanta, 2017), for the Clean Air Programme, the author selected such variables as the reduction of CO<sub>2</sub> emissions in 2021, the level of urbanization, the amount of financing disbursed under the programme, as well as disposable income per capita. Significance level  $p < 0,05$ .

**Table 8.**

*Correlation between the environmental effect and economic and social variables for the Clean Air Priority Programme*

Voivodship	Reduction of CO <sub>2</sub> emission	Disposable income	Urbanization level	Disbursed funding
podlaskie	19 272,9	415,6	2,808849	52 841
pomorskie	29 409,7	876,2	2,748661	59 191
śląskie	57 475,7	1 847,3	2,686767	121 519
świętokrzyskie	62 610,6	431,7	3,050998	79 212
małopolskie	25 098,0	1 229,7	3,104854	113 596
lubelskie	36 752,1	771,1	3,150392	94 337
łódzkie	42 765,0	972,6	3,443650	87 096
warmińsko-mazurskie	19 639,6	546,1	2,686594	45 554
opolskie	16 019,7	339,4	2,711650	37 386
wielkopolskie	46 828,7	1 273,5	2,399934	86 622
podkarpackie	29 358,3	676,6	3,498706	77 190
zachodniopomorskie	11 766,5	661,6	2,663452	23 413
kujawsko-pomorskie	53 425,6	769,5	3,137206	63 550
mazowieckie	48 268,1	2 222,9	2,849209	99 478
dolnośląskie	23 187,6	1 157,8	2,901037	40 629
lubuskie	13 419,0	385,3	2,427276	25 402
Reduction of CO <sub>2</sub> emission				
Disposable income	0,483836024	1		
Urbanization level	0,265877616	-0,033847719	1	
Disbursed funding	0,701048721	0,672998961	0,372914616	1

Source: Own study based on data made available by the voivodship funds and statistical data – Eurostat.

The results indicate that the strongest correlation occurs between the reduction of CO<sub>2</sub> emissions and disbursed financing. It can be concluded that the increase in the disbursed funding reduces CO<sub>2</sub> emissions. There is also a strong correlation between the disbursed funding and disposable income,  $r = 0.67$ . Therefore, it can be argued that in more affluent regions, more funding was disbursed under the Clean Air Programme.

However, no correlation was found between the amount of funding and the level of urbanization. These variables are therefore not related to each other.

## 5. Conclusions

The objective of the study was to determine the role of voivodeship funds in disbursing funding for air protection in Poland. The study revealed that the voivodship funds, jointly with the National Fund, have started to implement air protection programmes since 2018. Initially, the pace of implementation was slow. In the case of the Clean Air Programme, implementation accelerated significantly only in 2021 when the number of submitted funding applications more than doubled compared to applications submitted in the two previous years. Similar conclusions can be drawn as regards the number of contracts concluded under the programme. The study revealed that there are differences between the individual voivodship funds in the number of submitted applications and signed funding contracts. One of the factors influencing this situation is certainly the population in each voivodeship, which translates into the number of applications submitted and contracts signed under the program and indirectly into the value of per capita funding. Initial problems related to the implementation of the programme were also due to the lack of experience and proper organizational structure of the institutions. In order to implement the Clean Air Programme, the funds had to prepare for dealing with a much larger number of applications and projects to be settled than before. These institutions faced new challenges and needs. Until 2018, the institutions did not implement such an extensive programme designed for natural persons. This is confirmed by the results of the audit by the Supreme Audit Office which indicates that in the period from 19 September 2018 to 19 July 2019, the implementation of the programme in the Fund in Opole was assessed negatively (Post-inspection report – Opole..., 2020). The fund did not establish an appropriate organizational structure that would allow for efficient processing of incoming applications and did not train the staff who were to become responsible for this area of the programme's implementation. At the same time, in the institution that faced the largest number of applications and signed co-financing contracts, i.e. in the Fund in Katowice, the audit showed that the organizational structure was being adapted on an ongoing basis in order to manage tasks emerging from the implementation of the programme (Post-inspection report – Katowice..., 2020).

The results pertaining to an overly slow submission rate concerning project applications at the onset of the Clean Air Programme delivery are reflected in another report (Adamkiewicz et al., 2021). The report argues that between 19 September 2018 and 14 May 2020, the daily submission rate<sup>13</sup> merely amounted to 18% of the expectations (822 applications daily). As a result, the initial version of the programme, valid until 14 May 2020, required reforms in, among others, the improvement of the service for beneficiaries at the level of the voivodship funds for environmental protection. The introduced changes resulted in a 30% increase of the daily submission rate, compared to expectations, in the period from 15 May 2020 to 31 March 2021 (Adamkiewicz et al., 2021). However, despite the observable significant acceleration of the submission rate, the results were still unsatisfactory. Should the trend continue for a longer period, a risk may arise that the budget of the programme may not be fully disbursed. The lack of effective disbursement may affect the delivery of environmental and material outcomes scheduled in the project.

The study indicated that challenges the implementing institutions face may stem from the specific character of programmes themselves. The Air Quality Improvement Programme required a slightly different preparation of the institutions than the Clean Air Programme. The number of evaluated applications and signed contracts in 2018-2020 was much lower in this programme than in the Clean Air Programme. However, as studies show, the delivery of the programme was still relatively slow.

Since 2018, in connection with air protection, the voivodship funds have been performing and increasingly redistributive function, i.e. they disbursed funding to specific entities. Such a conclusion can be drawn when we analyze the data on the implementation of air quality improvement programmes and projects financed exclusively from own resources. In 2018-2020, the voivodship funds implementing their own initiatives and projects on air protection faced fewer challenges than while implementing joint priority programmes with the National Fund, including such an extensive programme as the Clean Air Programme. The number of submitted applications and signed contracts for financing from own funds in 2018-2020 accounted for only over 2% of applications and contracts handled by these institutions under the Clean Air programme during this period<sup>14</sup>.

The study confirmed the significant role of the voivodship funds in financing air quality projects. The present study contributes to broadening the knowledge of aspects related to the operation of the voivodship funds for environmental protection, their role in and responsibility for the implementation of air protection programmes. A limitation of the study is the inclusion of data on the programmes implemented only by 12 voivodship funds. The desk research method applied in the study covered the period between 2018 and 2020, and in the case of the

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<sup>13</sup> The results of the study did not refer to all submitted applications, but only to applications for the replacement of a heat source without applications related exclusively to thermal modernization activities.

<sup>14</sup> The calculation pertains to 13 voivodship funds that enabled access to data on implemented programmes and initiatives funded from own resources in 2018-2020. Therefore, it does not include the funds in Kielce, Opole and Zielona Góra.

Clean Air Programme also 2021. Therefore, future studies should be extended to include data from all funds and cover further periods of implementation of air quality programmes by these institutions. However, with regard to the evaluation of factors influencing environmental efficiency, future studies may take into account other variables in the analysis of correlations, both in terms of environmental effects and socio-economic variables. This would allow for the development of a more complete picture of factors determining the environmental efficiency of the Clean Air Programme.

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