Dariusz **RAJCHEL** • Anna **RAJCHEL**

THE IMPLEMENTATION OF THE "CLEAR AIR" PROGRAMME IN POLAND INCLUDING VOIVODESHIPS

Dariusz **RAJCHEL** (ORCID: 0000-0001-9858-6334) – *Faculty of Economics and Management, Opole University of Technology*

Anna **RAJCHEL** (ORCID: 0000-0002-9354-1927) – *Faculty of Economics and Management, Opole University of Technology*

Correspondence address:
Prószkowska Street 76, 45-758 Opole, Poland
e-mail: d.rajchel@po.edu.pl

ABSTRACT: Air pollution is a global problem affecting millions of people worldwide. Climate warming, increasingly difficult access to drinking water resources, and desertification of areas have all resulted in population migrations in search of better areas to live and work. High mortality rates due to smog and crop, soil, and water pollution are just some of the problems facing the whole civilised world. In 2019, in response to these and other climate challenges, the EU adopted the Green Deal, a strategy whereby the EU member states have committed to an energy transition. Climate neutrality, according to the document, should be achieved by 2050. From 2018 to 2029, the government program "Clean Air" will be implemented in Poland with the aim of reducing environmentally damaging emissions from heating single-family houses with harmful fuel in old and polluting stoves. The article presents the program's assumptions in relation to the priorities of the European Green Deal and statistical data concerning the replacement of boilers under the "Clean Air" program by province, the use of various heat sources in Poland, as well as the demand for each heat source based on the number of applications submitted. The paper highlights two aspects related to the functioning of the "Clean Air" program, the first of which is economic in character and pertains to heat source replacement costs, whilst the second concerns the management of renewable energy sources. Statistical data referred to in this article were finalised as of December 2022.

KEYWORDS: alternative heat sources, energy management, energy transition costs, green investments in energy, sustainable development

Introduction

Air quality and protection against airborne pollutants is one of the many challenges which need to be tackled in Europe and worldwide. Environmental pollution causes premature mortality and contributes to various diseases. Air quality determines human health and life expectancy (Gładysz et al., 2010). Thus, it is extremely important to address the problem in a comprehensive manner. Greenhouse gases precipitate climate change, whereas environmental pollution affects food production and plant and animal well-being, causes soil degradation and deteriorates water quality.

Published by the European Environment Agency, the report "Air quality in Europe – 2020" estimates that human exposure to airborne pollutants led to the following numbers of premature deaths in Poland in 2018 (EEA, 2020):

- PM2.5 exposure – 46,300 premature deaths: 3200 more than in 2016,
- NO_2 exposure – 1,900 premature deaths: 400 more than in 2016,
- O_3 exposure – 1,500 premature deaths: 400 more than in 2016.

In the same year, Poland was ranked 4th among the six EU countries, which exceeded the EU annual limit value for fine PM2.5, i.e., 25 μg/m^3 (Majewska, 2020; EEA, 2020).

Poles are dying from cardiovascular diseases, cancer, hypertension, respiratory conditions, and diabetes. According to the Greenpeace report "Toxic air: the price of air pollution", the number of premature deaths caused by air pollution in 2018 in Poland was estimated at 30,000 to 51,000 per year, with a total estimated cost of USD 21,000 to 38,000 million (Farrow et al., 2020). The problem is not unique to Poland since polluted air is not constrained by national borders, legislation or sanctions and affects all people. The struggle against smog is a two-pronged effort. On the one hand, the aim is to protect human life and health; on the other hand, it involves an analysis of the costs associated with air protection in the broadest sense. According to a report by Deloitte, the fight against smog and its effects costs Poland PLN 111 billion per year, and the annual cost for the European Union will amount to EUR 475 billion between 2018 and 2025, which corresponds to 2.9 per cent of the average annual GDP (Rzeczpospolita, 2019; Laskowska, 2019).

The European Green Deal is a strategy launched in 2019 in response to these challenges, which intends to align the EU countries' environmental, transport, and energy legislation with the EU's climate goals. This endeavor has several key areas such as increased climate action, clean energy, sustainable buildings/renovations, elimination of pollution, and sustainable finance. By 2030, the EU member states are obliged to reduce emissions by at least 55% from 1990 levels so as to achieve climate neutrality by 2050 (Komisja Europejska, 2022a; EY, 2022).

In Poland, the "Clean Air" government program, which sets out to improve air quality and reduce greenhouse gas emissions by replacing heat sources and improving the energy efficiency of single-family residential buildings, has been implemented since 2018 (Program „Czyste Powietrze"). Actions within the program primarily include the replacement of old stoves and solid fuel boilers and the improvement of the thermal efficiency of single-family buildings in order to enable efficient energy management (Bodalska, 2019).

The program is local in scope and aimed at the inhabitants of Polish cities and villages. It does not cover other energy sources such as biogas plants, CHP (combined heat and power), wind farms, etc. Nevertheless, it is the first climate protection undertaking on such a large scale in Poland, which is consistent with the EU's climate policy. Secondly, the scheme is also aimed at raising Poles' awareness in areas like environmental protection, sustainable development or health protection.

The aim of this article is to demonstrate the effectiveness of the implementation and management of the "Clean Air" program in statistical and economic terms with regard to individual provinces. The statistical approach focuses on heat sources, their popularity, structure, and indicator analysis, while the economic approach includes the aspect of subsidising heat exchange sources, including the number of applications submitted, agreements signed, and subsidies paid out.

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An overview of the literature

Air protection and the related issue of renewable energy sources are reflected both in European legislation and in the laws of the EU countries (Table 1).

Table 1. Selected Polish and European legislation on renewable energy sources

European legislation	Polish legislation
Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on promoting the use of energy from renewable sources	Act of 20 February 2015 on renewable energy sources, Journal of Laws 2015, item 478, as amended
Commission Delegated Regulation (EU) 2021/2003 of 6 August 2021 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing an EU platform for the development of renewable energy sources	Act of 21 November 2008 on support for thermal efficiency improvement, renovation, and central emission register of buildings, Journal of Laws 2008 no. 223, item 1459, as amended
Commission Delegated Regulation (EU) 2021/2003 of 6 August 2021 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing an EU platform for the development of renewable energy sources	Act of 28 October 2020 amending the Act on support for thermal efficiency improvement and renovation, and certain other acts, Journal of Laws 2020, item 2127, as amended
Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance)	Regulation of the Minister of Climate and Environment of 31 October 2022 on the reference price of electricity from renewable energy sources and periods applicable to generators who have won auctions each year, Journal of Laws 2022, item 2247
Directive of the European Parliament and of the Council amending Directive 2018/2001 of the European Parliament and of the Council, Regulation 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources and repealing Council Directive (EU) 2015/652	Regulation of the Council of Ministers of 27 September 2022 on the maximum volumes and values of electricity from renewable energy sources that may be auctioned in individual consecutive calendar years 2022-2027, Journal of Laws 2022, item 2085
Commission Implementing Regulation (EU) 2020/1294 of 15 September 2020 on the EU Renewable Energy Financing Mechanism	Regulation of the Minister of Climate and Environment of 13 July 2022 on the change of the volume share of the sum of electricity from redeemed certificates of origin confirming energy generated from renewable sources in 2023, Journal of Laws 2022, item 1566

The literature on the subject can be divided into several areas, the most important of which include:

1. Reduction in CO_2 emissions, e.g. (Hou et al., 2022; Radelczuk, 2017; Petruška et al., 2022; Soliński et al., 2008). The use of coal for heating flats, houses, and public utility buildings generates air pollution. Air quality will be improved if industry, especially heavy industry, is modernised, nuclear energy is employed, and investments in renewable energy sources are made, which in Poland also means investing in wind farms. This requires changes in national energy policy and taking pro-quality actions aimed at making greater and more effective use of green energy.
2. Renewable energy sources and their use, e.g. (Matos et al., 2022; Thomaidis & Moukas, 2022; Sowa, 2018; Tomaszewski & Sekściński, 2020). A low-emission economy and the use of renewable energy sources will enable Poland to meet the relevant EU guidelines. Water, solar, wind, and other types of energy are associated with reduced pollution, faster renewal rate linked to cost reduction; they are also accessible to households and businesses alike. Admittedly, renewable energy sources have certain drawbacks. However, an analysis of potential benefits, EU requirements and their significance for sustainable development allows us to conclude that their benefits surpass the advantages of conventional, coal-based energy sources.

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3. Costs associated with renewable energy sources, e.g. (Osman et al., 2023; Sowiński, 2014; Succetti et al., 2023). Conventional, coal-based energy sources are costly and create environmental hazards and health risks. The widespread use of renewable energy sources means, on the one hand, considerable expenditure generally associated with this type of investment but, on the other hand, leads to lower operating expenses and civilisational progress.
4. Air pollution protection and the impact of pollutants on human health and the environment, e.g. (Syrtsova et al., 2023; Manisalidis et al., 2020; Vandyck et al., 2018; Taghizadeh-Hesary & Taghizadeh-Hesary, 2020). Air pollution is directly linked to the incidence of cardiovascular diseases, cancer, diabetes and other conditions. When air quality standards are not met, this translates into a high mortality rate, premature deaths, and increased treatment costs. The problem is global in scale, making it necessary for nations worldwide to take some pro-environmental steps as well as to introduce relevant changes in legislation.

Materials and methods

This article refers primarily to statistical data pertaining to the implementation of the objectives of the Polish "Clean Air" government program. The data relates to the following aspects:
1. Boiler replacements in each Polish province.
2. Popularity of individual heat sources on a regional basis.
3. Heat sources are applied in each Polish province.

The assumptions, objectives, priorities and financing of the program were presented. The assumptions of the Polish program and the document "Poland's Energy Policy up to 2040" were compared to the goals of the European Green Deal. The paper refers to information available on the Ministry of Climate and Environment website, government documents, and EU documents.

Air pollution in Poland – selected rankings

With regard to Poland's air pollution ranking:
- NO2 air pollution ranking as of March 2022 – the Polish city of Katowice was ranked 18th with a level of 29.1 (116%),
- PM10 air pollution ranking (March 2022) – among Polish cities, Katowice was ranked 4th – 40.5 (90%), Kraków was 7th – 36.8 (82%), Wrocław 10th – 34.7 (77%), Łódź 14th – 33.8 (75%), and Poznań was in the 15th position – 33.7 (75%) (Airly, 2022).

Based on the results of air measurements made by the Chief Inspectorate of Environmental Protection and published by the Polish Antismog Alert in 2021, the most polluted city in Poland was Nowa Ruda (Table 2), followed by Nowy Targ, and Sucha Beskidzka. Other smog-affected towns included Rabka Zdrój, Szczawno-Zdrój, and Goczałkowice-Zdrój. Of concern is the fact that the last three locations have a spa status (Polski alarm smogowy, 2022b). The Chief Inspectorate for Environmental Protection examined air quality according to the following criteria: the highest PM10 dust concentration, the highest benzo(a)pyrene concentration and the number of days with smog in Poland.

Table 2. Air pollution indicators in Nowa Ruda

Type of pollutant	WHO standard	Levels in Nowa Ruda
carcinogenic benzo[a]pyrene	0.12 ng/m^3	15 ng/m^3
PM10	15 ug/m^3	41 ug/m^3
95 days with smog		

Source: authors' work based on Kwinta (2022).

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The "Clean Air" government program

The implementation of the "Clean Air" program is one of the priority tasks set by the Polish government. This undertaking will be implemented between 2018 and 2029 and aims to improve air quality and reduce greenhouse gas emissions by replacing heat sources and improving the energy efficiency of single-family residential buildings.

The beneficiary under the program is a natural person who is the owner/co-owner of a single-family residential building or a separate dwelling in a single-family building with a separate land and mortgage register; the person's annual income must not exceed PLN 100 000 (Ministerstwo Klimatu i Środowiska, 2022a).

The "Clean Air" program involves primarily undertakings aimed at upgrading inefficient heat sources (Table 3).

Table 3. Selected undertakings under the "Clean Air" program

Project scope	Project does not include a photovoltaic micro-installation	Project includes a photovoltaic micro-installation
	Maximum amount of subsidy	
The project involves the removal of an inefficient solid fuel heat source and the purchase and installation of an air-to-water or ground source heat pump, or a heat pump for heating or both heating and domestic hot water (DHW).	PLN 25,000	PLN 30,000
The project involves the removal of an inefficient solid fuel heat source	PLN 20,000	PLN 25,000
An undertaking which does not involve the replacement of a heat source for solid fuel with a new heat source but involves (multiple item selection is permitted): – purchase and installation of mechanical ventilation with heat recovery, – purchase and installation of insulation of building partitions, windows, external doors, garage doors/gates (also includes dismantling), – preparation of documentation regarding the above: energy audit (if thermal insulation of building partitions is performed), design documentation, expert opinion.	PLN 10,000	Non-applicable

Source: authors' work based on Ministerstwo Klimatu i Środowiska (2022a).

In accordance with the program guidelines, two forms of funding are foreseen, namely:

A. a subsidy,
B. a subsidy in the form of a grant:
   - the subsidy is awarded by the Provincial Fund for Environmental Protection and Water Management (WFOŚIGW) covering the area of the province in which the building/flat covered by the application is located,
   - the subsidy will be paid by WFOŚIGW in full or in a maximum of three instalments on the basis of a payment application submitted by the beneficiary together with the documents indicated in the grant agreement, confirming the completion of the project in full or in part, to the contractor's/seller's bank account or to the beneficiary's bank account within 30 days from the date of the receipt of a complete and correctly completed payment application together with the required documents,
   - a subsidy for partial repayment of the bank loan principal.

In the case of a grant for partial repayment of the loan principal, co-financing amount is determined in relation to the actually incurred eligible costs of the project covered from own funds and from the bank loan principal, with the proviso that the amount of the grant paid out must be lower than the loan principal used for the eligible costs of the project (Ministerstwo Klimatu i Środowiska, 2022a). Program progress from the beginning of its implementation until the end of November 2022 is shown in Table 4.

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Table 4. Replacement of boilers under the "Clean Air" program from the beginning of the program to the end of November 2022, by the province

Province	Number of applications submitted	Number of agreements signed	Number of subsidies paid	Efficiency / Effectiveness of boiler replacement (in %)		
				Number of agreements signed / number of agreements submitted	Number of subsidies paid / number of applications submitted	Number of subsidies paid / number of agreements signed
Dolnośląskie	22322	15186	11309	68	51	74
Kujawsko-Pomorskie	29211	24817	21981	85	75	89
Lubelskie	24185	20737	16985	86	70	82
Lubuskie	9027	8588	5992	95	66	70
Łódzkie	33227	27712	14036	83	42	51
Małopolskie	46614	42203	24347	91	52	58
Mazowieckie	44806	39865	23896	89	53	60
Opolskie	13788	12104	9508	88	69	79
Podkarpackie	20767	20458	18216	99	88	89
Podlaskie	14142	11707	8807	83	62	75
Pomorskie	23499	23362	15219	99	65	65
Śląskie	72557	59764	33895	82	47	57
Świętokrzyskie	23439	21197	18882	90	81	89
Warmińsko-Mazurskie	14795	13083	10728	88	73	82
Wielkopolskie	37499	31612	20028	84	53	63
Zachodniopomorskie	9698	8025	6041	83	62	75
Poland	439576	380417	259870	87	59	68

Source: authors' work based on Polski alarm smogowy (2022a).

The largest number of applications was submitted in Śląskie province (72,557), and the smallest in Lubuskie province (9,027).

As can be seen from the data in Table 4, the efficiency/effectiveness of boiler replacement was the highest in Podkarpackie (99%) and Pomorskie (99%) province, and least auspicious in Dolnośląskie (68%) province.

Since 23 April 2018, Podkarpackie province has applied the so-called anti-smog resolution, imposing restrictions on the introduction of fuel-burning installationsin the said province. As for Pomorskie province, three anti-smog resolutions have been in effect since 2020 (BIP, 2023):

1. Resolution 310/XXIV/20 of the Assembly of Pomorskie Province of 28 September 2020 imposing restrictions and bans on the use of fuel-burning installations in Pomorskie province with the exception of the commune of the City of Sopot and city areas,
2. Resolution 309/XXIV/20 of the Assembly of Pomorskie Province of 28 September 2020 imposing restrictions and bans on the use of fuel-burning installations in the cities of Pomorskie province with the exception of the commune of the City of Sopot,
3. Resolution 236/XIX/20 of the Assembly of Pomorskie Province of 24 February 2020 imposing restrictions and bans on the use of fuel-burning installations in the commune of the City of Sopot.

On 30 November 2017, the Assembly of Dolnośląskie Province passed a resolution imposing restrictions and bans on the use of fuel-burning installations in Dolnośląskie Province with the exception of the commune of Wrocław and spas. From 1 July 2024, the province will prohibit the use of

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non-compliant installations which fail to meet the requirements of PN-EN 303-5:2012 – the ban on the use of "black-smoke stoves", i.e. installations which do not meet minimum class 3 requirements (Gmina Góra, 2023).

Analysing the three indicators simultaneously, the highest share in the effectiveness/effectiveness of the "Clean Air" program implementation was reported for Podkarpackie province. In the period from 19/09/2018 to 23/12/2022, the "Clean Air" program in Poland was implemented as follows (Table 5).

Table 5. Implementation of the "Clean Air" program in the period from 19/09/2018 to 23/12/2022*

Applications submitted	Subsidies from applications	Of which applications through gov.pl	Agreements signed	Subsidies from agreements	Subsidies paid out
535,547 each	PLN 10,025,980,376	61,232 each	468,996 each	PLN 8,535,980,396	PLN 4,139,226,977

* Data updated on a weekly basis.

Source: authors' work based on Ministerstwo Klimatu i Środowiska (2022c).

Table 6 shows the popularity of various heat sources in Poland.

Table 6. Popularity of heat sources by region of the "Clean Air" program from the start of the program to the end of November 2022 by province

Province	Heat pumps extracting heat from ground or water	Air heat pumps	Natural gas boilers	Electric heating systems	Thermal heat exchangers	Coal-fired boilers	Biomass-fired boilers
Dolnośląskie	163	9595	5082	845	42	1641	4731
Kujawsko-Pomorskie	1241	9594	7982	634	164	5912	4806
Lubelskie	1138	5130	9835	442	104	2703	4800
Lubuskie	457	2187	2338	255	27	641	3111
Łódzkie	1423	9612	10612	461	132	5161	5532
Małopolskie	712	7744	28840	593	60	1612	6945
Mazowieckie	1810	7925	19420	667	106	5045	9389
Opolskie	510	4464	3047	365	20	1626	3609
Podkarpackie	335	3150	14591	261	15	516	1811
Podlaskie	1010	2639	3305	331	108	1095	5595
Pomorskie	1044	5465	8008	259	93	2452	5961
Śląskie	1944	13482	31860	1117	175	14863	8550
Świętokrzyskie	1179	5225	6803	319	39	2592	7330
Warmińsko-Mazurskie	474	3091	3444	258	69	1441	5954
Wielkopolskie	547	10411	11067	556	101	7665	6752
Zachodniopomorskie	254	3231	2636	313	18	470	2731
Poland	14241	102945	168870	7676	1273	55435	87607

Source: authors' work based on Polski alarm smogowy (2022c).

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Figure 1 contains a graphical representation of the popularity of each heat source by region from the launch of the "Clean Air" program to the end of November 2022 by province.

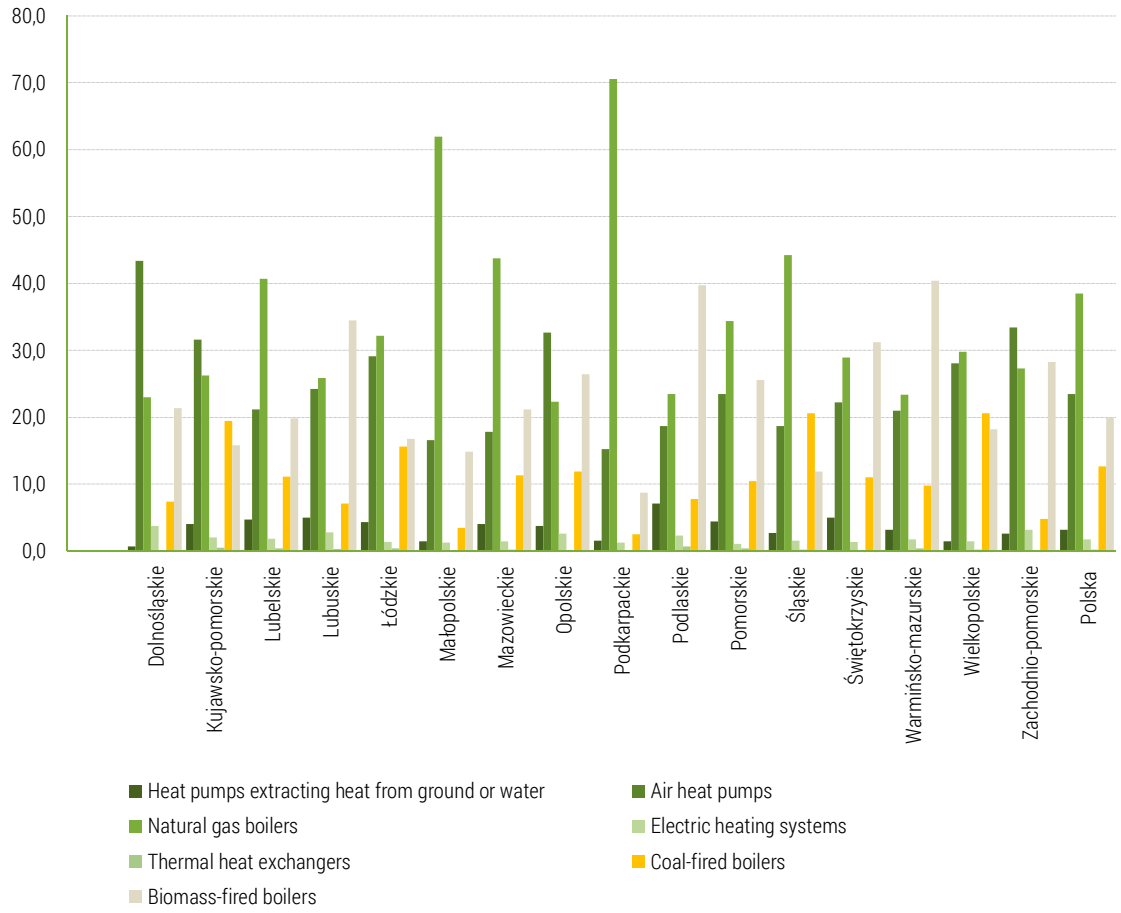

Figure 1. Structure of heat sources at the end of November 2022

Source: authors' work based on the Polski alarm smogowy (2022c).

As can be seen from the data presented above, out of a total of 16 provinces, as many as 8 have the largest share of gas boilers, 4 predominately use biomass boilers, and in 4 provinces, air source heat pumps are most often installed. On a national scale, gas boilers have the largest share, followed by air-source heat pumps and biomass boilers. In line with the primary objective of the "Clean Air" program, i.e., combating smog, each province offers a subsidy for coal boilers, i.e., solid fuel boilers, as confirmed by data on heat sources applied for from 19/09/2018 to 30/11/2022 (Table 7).

Table 7. Heat sources applied for from 19/09/2018 to 30/11/2022

All heat sources (total)	**470,373 100%**
Natural condensing gas boilers	38.76%
Air heat pumps	23.32%
Biomass-fired boilers	19.78%
Coal-fired boilers	12.20%
Ground heat pumps	3.82%
Electric heating systems	1.71%
Thermal heat exchangers	0.28%
Oil boilers	0.13%

Source: authors' work based on Ministerstwo Klimatu i Środowiska (2022b).

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As can be seen from the data, condensing gas boilers account for the largest share and oil boilers for the smallest share in the structure of heat sources applied for.

The European Green Deal strategy

The EU's European Green Deal Strategy comes as a response to the European Commission's commitment to face environmental and climate-related challenges (Kasztelan, 2022).

The main objectives of the strategy European Green Deal include:

- delivering clean and secure energy,
- implementing a circular economy,
- buildings with lower energy demand,
- accelerating the transition to sustainable and intelligent mobility,
- protecting and restoring ecosystems and biodiversity,
- adapting to climate change,
- health protection (Buczkowska et al., 2021).

The main tenets of the European Green Deal are shown in Figure 2.

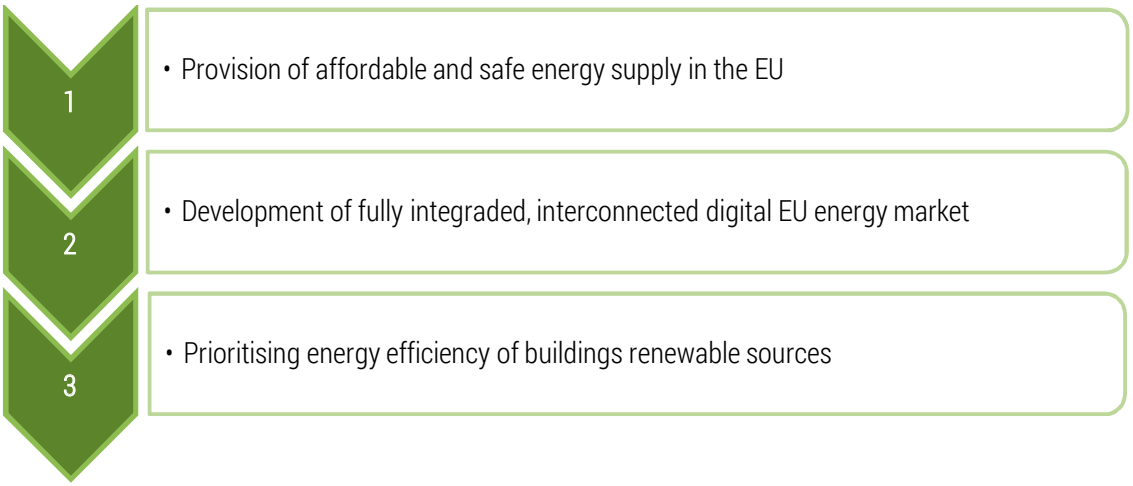

Figure 2. Main principles of the European Green Deal

Source: authors' work based on Komisja Europejska (2022b).

The Polish government's "Clean Air" program is primarily an implementation of priority 3. The assumptions of the EU strategy also correspond to the document "Energy Policy of Poland up to 2040". In light of the document, the energy transformation will be based on three pillars (Figure 3).

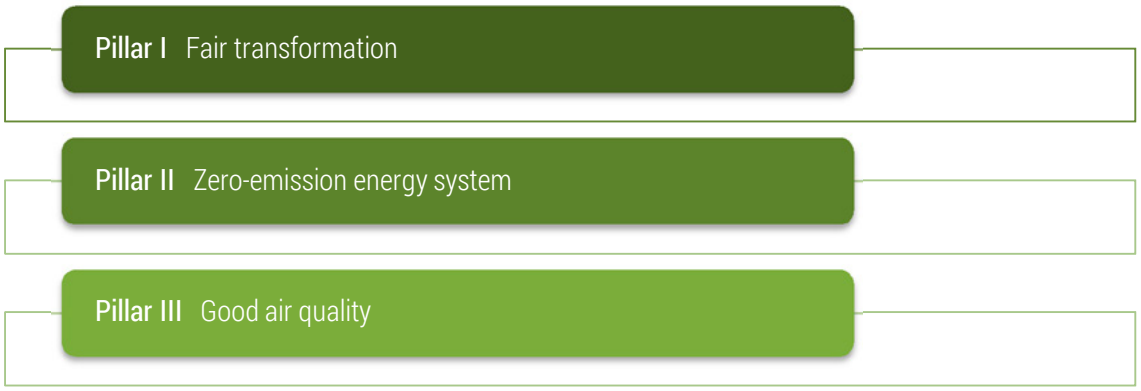

Figure 3. Pillars of energy transformation

Source: authors' work based on Obwieszczenie (2021).

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Good air quality is mainly about:

- the development of district heating (4-fold increase in the number of efficient systemic heating systems by 2030),
- low-carbon transformation of individual sources (heat pumps, electric heating),
- moving away from coal burning in urban households by 2030, in rural areas by 2040, with the possibility of using smokeless fuel by 2040,
- increasing energy efficiency of buildings,
- development of low-carbon transport, in particular aiming for zero-emission public transport by 2030 in cities with more than 100,000 inhabitants (Obwieszczenie, 2021).

Results and discussion

The "Clean Air" program has failed to produce the expected results. According to a report by the Supreme Audit Office, in October 2021, three years into the implementation of the priority program, the number of insulated buildings was less than 73,000 (2.4%), and more than 66,000 old-generation boilers (2.2%) were replaced with low-emission ones. By that point, as shown by an audit conducted by the Supreme Audit Office (NIK), with a budget of PLN 103 billion, agreements for only PLN 4.2 billion (approximately 4%) had been signed (NIK, 2021). On the other hand, the Prime Minister's Plenipotentiary for Clean Air reported in November 2022 that the "Clean Air" program had been implemented only in 25 per cent, bearing in mind the material scope of the expected effect of subsidies for thermal efficiency improvement and replacement of fossil fuels. Furthermore, assuming the actual payments transferred to beneficiaries in the amount of PLN 3.8 billion and adding the thermal efficiency improvement allowance, we may conclude that 12% of the program was completed (Rudziński, 2022). According to data from the Ministry of Climate and Environment, National Environmental Protection and Water Management as of November 2022, the replacement of old heat sources (fossil fuels) in the provinces of Poland was as follows (Table 8).

Table 8. Replacement of old heat sources (fossil fuels) by province. Status as of November 2022

Province	Applications for heat source exchange subsidy	Number of agreements signed	Number of payments	Paid amount [PLN m]
Dolnośląskie	642	574	581	8.39
Kujawsko-Pomorskie	644	748	1083	17.94
Lubelskie	493	549	721	12.13
Lubuskie	175	229	9	0.13
Łódzkie	929	1098	787	11.35
Małopolskie	860	1328	2068	23.30
Mazowieckie	1021	1337	771	11.49
Opolskie	319	284	481	7.48
Podkarpackie	345	448	765	11.94
Podlaskie	309	364	301	5.99
Pomorskie	445	550	583	9.04
Śląskie	1273	1934	2153	29.85
Świętokrzyskie	356	474	795	10.97
Warmińsko-Mazurskie	245	209	319	5,72
Wielkopolskie	903	1002	1024	16.09
Zachodniopomorskie	210	321	261	4.25

Source: authors' work based on Ministerstwo Klimatu i Środowiska (2022b).

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Applications for subsidies by heat source are presented in Figure 4.

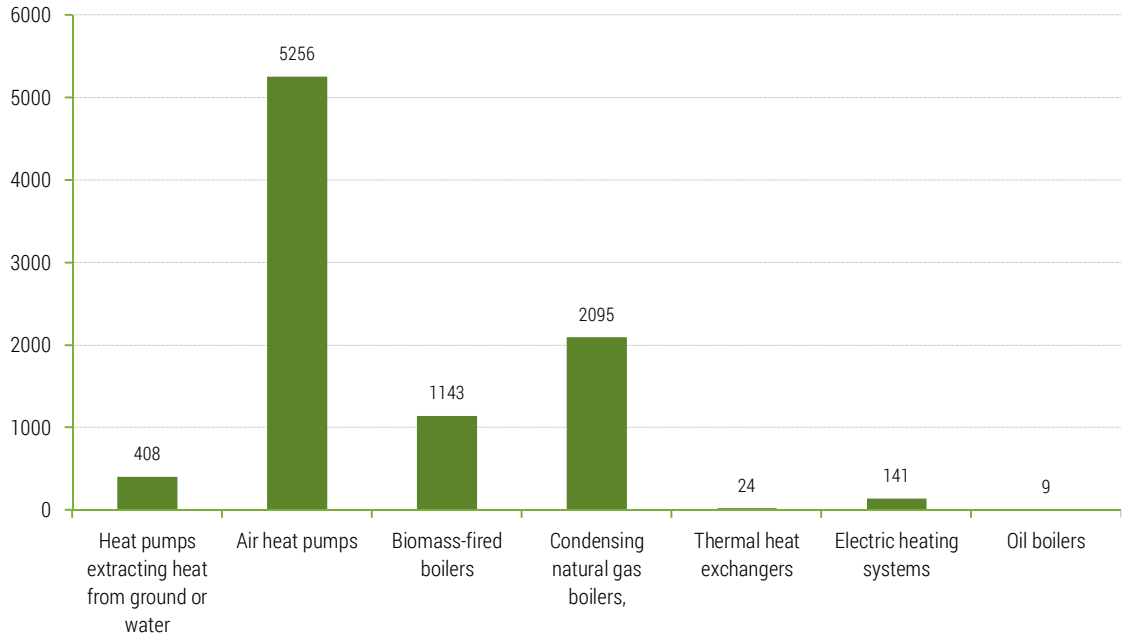

Figure 4. Number of subsidy applications by heat source

Source: authors' work based on Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej (2022).

The most popular heat sources were natural gas boilers, heat pumps, and biomass boilers. In terms of regional popularity of individual heat sources, Śląskie province ranked first (16%), followed by Małopolskie province (11%) and Mazowieckie province (10%). Lubuskie and Zachodniopomorskie performed the worst, with a result of 2%. In order to improve the effectiveness of the implementation of the "Clean Air" program, significant changes have been introduced since 3 January 2023, including:

- higher income thresholds,
- higher co-financing that can be applied for,
- the possibility of extending the application to include thermal residential efficiency improvement if the application previously concerned only the replacement of a stove,
- the bank procedure under the scheme – a bank loan with a partial repayment subsidy will be available for investments commenced up to 6 months before submitting the application to the bank,
- the schedule for replacing old heat sources with ecological ones in individual voivodeships may result from the adopted local legal acts regulating the date of their replacement, and consequently, this process takes place at a different rate in each voivodeship,
- the 'Clean Air' programme includes co-financing for the replacement of heat sources, but it should correspond with the wealth of the inhabitants of the particular voivodeships,
- since January 3rd, 2023 the subsidy for the replacement of furnaces and thermal modernization of buildings has amounted to PLN 135,00 zloty (Infor, 2023a).

Conclusions

The novel approach of the "Clean Air" program combines comprehensive thermal efficiency improvement with heat source upgrades. However, it is not possible to meet the program's objectives without integrating construction with renewable energy sources. The extension of the program assumes the following results:

- improved energy efficiency of buildings,

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- possibility to select the optimum heat source,
- energy consumption reduction,
- increased energy security,
- improved air quality,
- improved living conditions and health of Poles,
- improved environment al quality (Termo Modernizacja, 2022).

The "Clean Air" program is one of key environmental and climate protection initiatives in Poland. It aligned with the EU's postulates concerning environmental protection, clean energy production, and reduced greenhouse gas emissions. So far, it has enjoyed considerable interest on the part of beneficiaries, with 558,124 applications submitted from 19/09/2018 to 17/02/2023 (Ministerstwo Klimatu i Środowiska, 2023a**).**

Still, several aspects should be considered when analysing the development of green energy in Poland:

- to date, the implementation of the "Clean Air" program has been Poland's only large-scale climate protection undertaking targeting various beneficiaries,
- the Act of 9 March 2023 on investments in wind farms and certain other acts defines, among other things, the conditions and methods of siting, construction and conversion of windfarms and the principles of the safe operation of technical components of wind farms (Act, 2023)[1].

  In the light of the issues discussed in this article, the following facts are also worthy of attention: alternative energy sources, such as water energy, biomass, etc., receive very little attention,
- Poland offers no education on the subject of sustainable growth and green energy. This should, in particular, include the advantages and disadvantages of, e.g., the use of renewables or the benefits and costs of heat source upgrade choices,
- the "GreenEvo – Green Tech Accelerator" plan, which was designed for Polish businesses offering environmental technologies (Ministerstwo Klimatu i Środowiska, 2023b).

The "Clean Air" program is a prelude to large-scale activities pertaining to sustainable growth based on renewable energy sources. It is an investment for the future, allowing decision-makers to gradually shut down mines and promote a responsible approach to climate protection, CO_2reduction, and restriction of greenhouse gas emissions. The program covers the heat sources referred to in this article and is intended for households. There are other solutions, such as CHP, but they require adequate infrastructure and funding. Current trends concern biogas plants, photovoltaics, and other technologies, but the "Clean Air" program does not foresee these solutions.

The contribution of the authors

Conceptualization, D.R. and A.R.; literature review, A.R. and D.R.; methodology, D.R. and A.R.; formal analysis, D.R. and A.R.; writing, A.R. and D.R..; conclusions and discussion, A.R. and D.R.

The authors have read and agreed to the published version of the manuscript.

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1 On 28 November 2023, during a session of the lower chamber of the Polish Parliament, MPs from parties 2050-Trzecia Droga (2050-Third Way) and Koalicja Obywatelska (Civic Coalition) submitted a draft amendment to the act, proposing less stringent rules of wind farm and turbine siting in Poland (more details in Infor (2023b)).

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Dariusz RAJCHEL • Anna RAJCHEL

REALIZACJA PROGRAMU „CZYSTE POWIETRZE" W POLSCE Z UWZGLĘDNIENIEM WOJEWÓDZTW

STRESZCZENIE: Zanieczyszczenie powietrza jest problemem globalnym, dotykającym miliony ludzi na całym świecie. Ocieplenie klimatu, coraz trudniejszy dostęp do zasobów wody pitnej i pustynnienie obszarów wpłynęło na migracje ludności w poszukiwaniu lepszych terenów do życia i pracy. Wysoki wskaźnik śmiertelności spowodowany smogiem oraz zanieczyszczenie upraw, gleby i wody to tylko niektóre z problemów, z którymi musi się zmierzyć cały cywilizowany świat. W 2019 r. w odpowiedzi na te i inne wyzwania klimatyczne UE przyjęła Zielony Ład, czyli strategię, w ramach której państwa członkowskie UE zobowiązały się do transformacji energetycznej. Zgodnie z dokumentem neutralność klimatyczna powinna zostać osiągnięta do 2050 r. W latach 2018-2029 w Polsce realizowany będzie rządowy program „Czyste Powietrze", którego celem jest ograniczenie emisji szkodliwych dla środowiska substancji powstających w skutek ogrzewania domów jednorodzinnych szkodliwym paliwem w starych i nieekologicznych piecach. W artykule przedstawiono założenia programu w odniesieniu do priorytetów Europejskiego Zielonego Ładu oraz dane statystyczne dotyczące wymiany kotłów w ramach programu „Czyste Powietrze" z podziałem na województwa, wykorzystania różnych źródeł ciepła w Polsce, zapotrzebowanie na poszczególne źródła ciepła na podstawie złożonych wniosków. W artykule zwrócono uwagę na dwa aspekty związane z funkcjonowaniem programwu „Czyste Powietrze", z których pierwszy ma charakter ekonomiczny i dotyczy kosztów wymiany źródeł ciepła, natomiast drugi dotyczy zarządzania odnawialnymi źródłami energii. Dane statystyczne, na które powołano się w artykule, dotyczyły stanu na grudzień 2022 r.

SŁOWA KLUCZOWE: alternatywne źródła ciepła, zarządzanie energią, koszty transformacji energetycznej, zielone inwestycje w energię, zrównoważony rozwój

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