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Environmental Security Through Alleviating Thermal Energy Poverty in Poland: Assessing the Dual Effectiveness of Air Quality Programmes

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Abstract:

Purpose: *To examine whether Polish air-quality support programmes address environmental objectives and thermal energy poverty simultaneously, and to identify the gap between formal access to assistance and households' reported participation. The study considers why improvements perceived at municipal level need not translate into comparable improvements in heating affordability.* ***Design/Methodology/Approach:*** *A critical review of policy and research literature, comparative analysis and descriptive statistics are combined with paper-and-pencil interviews with 1,222 households and computer-assisted personal interviews with 50 local-government representatives in ten purposively selected Polish towns and cities (January–March 2025). The two respondent groups provide complementary, rather than statistically representative, perspectives on programme implementation and outcomes.*
Findings: *Reduced emissions or air pollution were identified by 36 of 42 municipal respondents assessing this outcome, whereas 20 of 44 reported a reduction in thermal energy poverty. Only 39 of 1,222 surveyed households (3.2%) reported receiving support over the preceding five years. The contrast points to a potential disconnect between perceived environmental achievements and households' ability to benefit from support. The descriptive evidence cannot establish causal programme impacts or be generalised to all Polish municipalities.*
Practical Implications: *Evaluation should assess environmental outcomes alongside heating affordability, thermal comfort and actual access to support. Better targeting, pre-financing and locally accessible advice may help address the barriers faced by vulnerable households. Municipal reporting should distinguish programme delivery from changes in household welfare.*
Originality/Value: *The article advances a dual-effectiveness analytical framework that treats environmental improvement and the alleviation of thermal energy poverty as distinct but interconnected criteria of public-policy performance. By bringing together municipal assessments and household experiences, it exposes an evaluation blind spot: programmes may be judged successful on environmental grounds even when their distributional reach remains limited. This approach contributes to environmental-security research by linking programme assessment to social vulnerability without overstating causal inference.*

Keywords: *Household vulnerability, subsidy uptake, local governance, heating affordability, distributional equity.*

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1. Introduction

Air quality is one of the most directly experienced dimensions of environmental security. Air pollution increases morbidity, reduces life expectancy, exacerbates territorial inequalities, and weakens the capacity of the state and local communities to safeguard living conditions (European Environment Agency (EEA), 2025b). According to the EEA, the combustion of solid fuels in household heating appliances remains the principal source of particulate pollution in Poland (EEA, 2025a).

Across Europe, the residential sector continues to make a substantial contribution to PM2.5 emissions; improvements to building insulation and heating systems, together with the transition to cleaner energy carriers, should therefore be pursued in an integrated manner (EEA, 2026). Evidence from the Kraków metropolitan area links particulate pollution patterns to heating technologies, household income and heating behaviour (Węglińska *et al.,* 2026).

The way in which a dwelling is heated is not solely the result of unrestricted choice. It is shaped by household income, building standard, energy prices, tenure status, access to energy networks, and the capacity to finance investment. Energy poverty therefore requires the combined use of income-based, expenditure-based, technical, and subjective indicators (Bouzarovski and Petrova, 2015; Kajoskoski *et al.,* 2025).

In 2024, 9.2% of the EU population and 3.3% of Poland's population reported being unable to keep their homes adequately warm (Eurostat, 2026). However, this indicator does not capture all strategies of underheating or the need to forgo other essential needs.

This article adopts the concept of thermal energy poverty as a specific form of energy poverty, defined as a persistent difficulty in providing adequate space heating and hot water without sacrificing other basic needs. This distinction is analytically necessary because, under Polish conditions, heating constitutes a central component

of household energy demand, while the heating method used remains closely associated with area-source emissions. Studies concerning Poland and the wider Central and Eastern European region demonstrate relationships between energy poverty and housing costs, building type, health status, and regional disparities (Karpinska and Śmiech, 2023; Przywojska *et al.,* 2025; Sokołowski *et al.,* 2020, 2024; Świerszcz, 2021).

The research gap concerns how the effects of policy instruments are assessed. Programmes are typically evaluated in terms of the number of agreements concluded, expenditure incurred, heating sources replaced, energy savings achieved, or modelled emission reductions. Less frequently examined is whether support reaches the households most at risk, durably reduces heating costs, and ensures an adequate and safe level of thermal comfort. A policy instrument may deliver an environmental benefit while increasing the operating costs of a new heating source; it may also temporarily lower energy bills without improving the energy performance of the building.

The literature indicates that energy-efficiency and social policies do not constitute a fully integrated framework in the European Union, with the result that the benefits of the energy transition do not always reach vulnerable groups (Świerszcz, 2022b; Bouzarovski *et al.,* 2021; Nordensvärd *et al.,* 2025; Shortall and Mengolini, 2025; Simionescu and Cifuentes-Faura, 2024; Śmiech and Karpińska, 2025; Vandyck *et al.,* 2023).

The aim of this article is to assess the dual effectiveness of air quality programmes and related policy instruments in Poland, understood as their capacity to alleviate thermal energy poverty and, through this mechanism, contribute to emission reductions and improved air quality, thereby strengthening environmental security.

The energy-and-social outcome comprises reduced heat demand, lower heating costs, and improved thermal comfort, whereas the environmental outcome comprises reduced emissions and improved air quality. The main research question is: To what extent can these programmes be regarded as dually effective, and how do their design and local implementation shape this effectiveness? The hypothesis is that dual effectiveness is constrained by an implementation gap: financial, procedural, informational, and organisational barriers impede access for the most vulnerable households, while environmental outcomes are identified more readily than durable energy-and-social outcomes (Shortall and Mengolini, 2025).

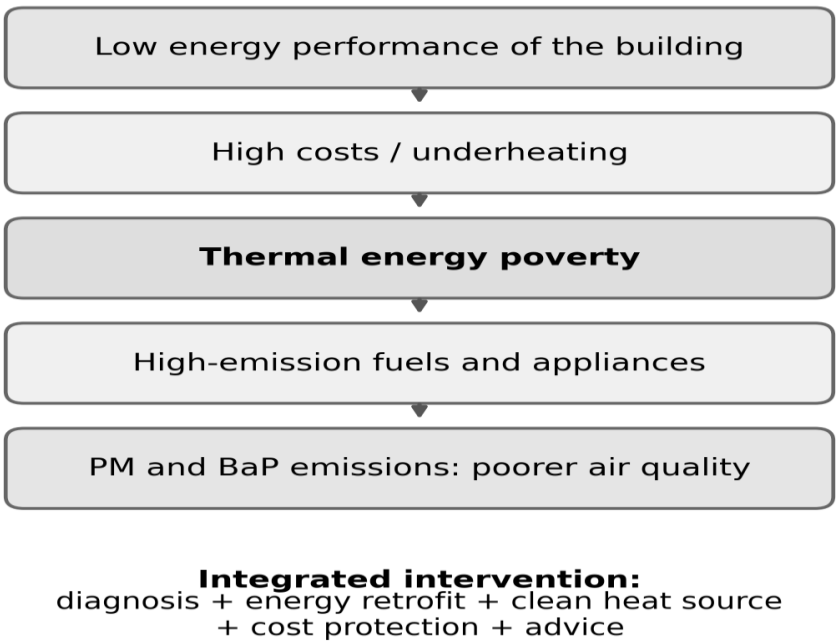
2. Literature Review: Thermal Energy Poverty and Environmental Security

Environmental security denotes the capacity of the public system to maintain environmental quality at a level that does not threaten health, living conditions, or the continuity of socio-economic processes (Pietraś, 2000; Świerszcz, 2022a). Air

quality is therefore simultaneously an environmental condition, a public good, and an outcome of governance. Emissions from individual heating are dispersed, but their costs are borne collectively. Public intervention is justified, yet its legitimacy depends on a fair distribution of the costs of transition.

Under the Energy Law, energy poverty is an inability to secure sufficient heating, cooling, and electricity when low income, high energy expenditure, and poor dwelling or building performance co-occur (Energy Law Act of 10 April 1997, 2026). The definition aids targeting but not identification: certificates, income, arrears, heat-source records, and comfort data are held separately or not collected. Thermal energy poverty is also dynamic, emerging after price rises, illness, income loss, or a retrofit that raises operating costs.

Figure 1. *Mechanism Linking Thermal Energy Poverty to Environmental Security in the Air-Quality Dimension*



Source: *Author's own conceptual elaboration.*

The relationship is non-linear. A household may heat one room or maintain an unsafe temperature, so low consumption signifies deprivation rather than efficiency. After renovation, part of the potential saving may be used to obtain adequate comfort (the rebound effect)—a desirable conversion of technical savings into improved living conditions. Energy use must therefore be interpreted with indoor temperature, heated floor area, damp, arrears, and self-assessed thermal security (Świerszcz, 2020; Śmiech *et al.,* 2025).

The energy-and-social outcome has technical, economic, and social dimensions: lower heat demand, losses, and fuel use; lower bills and expenditure shares; and the ability to maintain an adequate temperature, reduce arrears and damp, and potentially improve health. In Poland, housing conditions mediate the link between energy deprivation and self-assessed health (Sokołowski *et al.,* 2024). A 10% expenditure threshold may therefore misclassify households that economise by underheating.

The environmental outcome must be distinguished from the climate outcome. Air-quality indicators include emissions and concentrations of PM2.5, PM10, benzo[a]pyrene, NOx, SO2, and CO, high-emission appliances, and exceedance days; CO2 reduction cannot substitute for local-exposure measures. From 2030, Directive (EU) 2024/2881 tightens annual limits to 10 μg/m³ for PM2.5 and 20 μg/m³ for PM10, intensifying action in the residential and municipal sector (Directive [EU] 2024/2881, 2024).

Durability depends on sequencing and complementarity. Boiler replacement without building improvement may lower emissions but raise bills and induce a return to solid fuel; renovation without source replacement reduces consumption but not all emissions.

A potentially complementary package combines an audit, envelope and installation upgrades, a correctly sized clean source, controls, connection support, and follow-up advice; its effectiveness requires assessment rather than assumption. For district heating and geothermal systems, social results depend on tariffs, while environmental results depend on the generation mix and closure of local furnaces.

Research on financing residential energy-efficiency improvements in Poland has shown that access to renovation support requires differentiated financial and institutional arrangements for different groups of homeowners, particularly those exposed to energy poverty (Napiórkowska-Baryła *et al.,* 2022). This reinforces the need to distinguish the availability of a subsidy from a household's effective ability to use it. These studies provide complementary context rather than direct evidence of reduced thermal energy poverty.

The mechanism also raises questions of distributive, procedural, and recognition justice. A high subsidy rate does not ensure justice when pre-financing, home ownership, or acceptance of uncertain future bills is required (Shortall and Mengolini, 2025). Civic anti-smog mobilisation has also been examined in relation to fuel poverty in Poland (Frankowski, 2020).

2.1 European and Polish Policy Instruments

EU energy-poverty policy has evolved from disconnection protection towards integrating energy efficiency, renovation, justice, and air quality. Directive (EU)

2023/1791 requires measures to prioritise people affected by energy poverty, low-income households, and social-housing residents.

Table 1. *Criteria for Assessing the Dual Effectiveness of Programmes and Policy Instruments*

Criterion	Evaluative question	Illustrative indicators
Targeting accuracy	Does support reach households genuinely at risk?	income; energy burden; building standard; heat source; tenure status
Effective accessibility	Can an eligible household complete the entire pathway?	awareness; pre-financing; own contribution; processing time; operator support
Structural effectiveness	Does the instrument address causes or merely mitigate consequences?	scope of retrofit; heat-source replacement; phasing; durability
Energy and social outcome	Does it improve household thermal energy security?	heat demand; bill; expenditure-to-income ratio; comfort; arrears
Environmental outcome	Does it reduce emissions and exposure?	PM2.5; PM10; BaP; NOx; number of obsolete high-emission boilers; concentrations and exceedances

Source: *Author's own conceptual elaboration.*

Commission Recommendation (EU) 2023/2407 calls for multidimensional indicators, local data, and measures addressing causes rather than merely compensating for prices (Directive [EU] 2023/1791, 2023; European Commission, 2023).

The recast Energy Performance of Buildings Directive focuses on the worst-performing buildings and recognises renovation as both remedy and prevention (Directive [EU] 2024/1275, 2024). National renovation plans should link building-stock decarbonisation with instruments for vulnerable households.

Commission Recommendation (EU) 2026/536 provides practical guidance on one-stop shops offering integrated technical, financial, and administrative support for energy renovation. Such services are intended to help households navigate procedural and informational barriers, although their effects require empirical evaluation (European Commission, 2026a; Sequeira *et al.,* 2024).

The Social Climate Fund, established for 2026–2032, supports households vulnerable to ETS2 costs through renovation, clean heating, renewables, advice, and temporary income support (Regulation [EU] 2023/955, 2023). Poland's draft Social Climate Plan envisages approximately PLN 65 billion from EU and national funding

(Ministry of Development Funds and Regional Policy, 2025).

As of 12 August 2026, its implementing framework remained under development. The main risk is a parallel system rather than integration with local diagnosis, renovation, municipal housing, and air-quality policy.

In Poland, the strategic framework is provided by the National Energy and Climate Plan to 2030 with an Outlook to 2040 (NECP), adopted by the Council of Ministers on 8 June 2026. It covers buildings and the heating sector and is intended, inter alia, to underpin the national building renovation plan (Ministry of Energy, 2026).

Its relevance to the problem examined here will depend not on sectoral targets alone, but on how emission reduction, heat affordability, housing policy, and municipal implementation capacity are linked.

The 'Czyste Powietrze' ('Clean Air') programme remains the main instrument for single-family homeowners. The 2025 reform strengthened audits, post-completion energy certificates, operators, and cost controls. Changes from 20 July 2026 added exemptions from the three-year ownership rule, support for selected retrofit measures, and longer implementation periods for advance-payment projects (National Fund for Environmental Protection and Water Management [NFOŚiGW], 2026a).

Because pre-financing depends on an operator, beneficiary protection increasingly rests on local administrative capacity: without an operator, formal eligibility is ineffective.

The 'Ciepłe Mieszkanie' ('Warm Apartment') programme partly addresses multi-family dwellings and small homeowners' associations; 886 municipalities joined, and local calls remain open through 2026 (NFOŚiGW, 2026b).

It includes municipal dwellings, but access depends on municipal participation and capacity. 'Stop Smog' most directly targets the poorest households because the LGU organises investment, although its scale is limited and implementation intensive. The Thermomodernisation and Renovation Fund can support multi-family and municipal housing, but credit or investment requirements may exclude weak associations. Regional anti-smog resolutions complete the framework (EEA, 2025a).

The support architecture is broad but fragmented. Income, ownership, and technical criteria differ, while social, building, heating, and environmental data remain dispersed. Despite the growing number of programmes, the household most in need must still identify the appropriate instrument, prove eligibility, coordinate contractors, and bear investment risk.

Protective transfers alleviate short-term deprivation but cannot substitute for

renovation; tax relief, meanwhile, favours households with taxable income and capital (Świerszcz, 2024; Barrella et al., 2021; Papantonis *et al.,* 2022; Schleich, 2019).

Table 2. *Principal Components of Poland's Contemporary Intervention Architecture*

Instrument	Dominant mechanism	Potential for a dual outcome	Principal risk
'Czyste Powietrze' ('Clean Air')	grant, pre-financing, and operator support for single-family houses	high with comprehensive renovation	complexity, funding gap, and dependence on operator availability
'Ciepłe Mieszkanie' ('Warm Apartment')	support for dwellings and small homeowners' associations through municipalities	medium–high	unequal territorial accessibility
'Stop Smog'	investment organised by an LGU for the least affluent households	high	limited scale and heavy organisational burden
Thermomodernisation and Renovation Fund	premiums and grants for owners, managers, and LGUs	high within the housing stock covered	credit or investment threshold for entry
Thermomodernisation tax relief	tax deduction	medium	limited usefulness for people with low tax liabilities and little capital
Protective transfers	allowance, benefit, or price protection	short-term social outcome	no lasting reduction in demand or emissions
SCF, FEnIKS, NRRP, and regional programmes	renovation, district heating, renewables, and infrastructure	high systemic potential	fragmentation and weak links to household identification
Operators and one-stop shops	support from diagnosis through final settlement	strengthen both outcomes	unstable funding and staff shortages

Source: *Author's own elaboration based on programme documents and legislation.*

3. Research Methodology

The study employed a critical review of the literature, the comparative method, and descriptive statistical analysis. These methods were used to examine the state of

research and relevant legal and policy documents; to compare EU and national arrangements, the selected cities, and the perspectives of local government units and households; and to analyse frequencies and percentages descriptively.

Empirical data were collected between January and March 2025 using Paper-and-Pencil Interviewing (PAPI) for households and Computer-Assisted Personal Interviewing (CAPI) for LGU representatives, in Barlinek, Biała Rawska, Gniezno, Gorlice, Kłodawa, Mszczonów, Pyrzyce, Stargard, Uniejów, and Zakopane. The study involved 50 representatives of local government units (LGUs)—five in each city, representing five functional areas—and 1,222 household respondents.

The questionnaire administered to LGU representatives comprised 33 closed- and open-ended questions. Households were purposively selected according to income level and household size to ensure that the city-level samples were as comparable as possible with regard to both characteristics. The cities were also selected purposively, taking into account the use of conventional and geothermal heat sources.

The data obtained from the two groups were analysed separately and subsequently brought together at the interpretive stage. The sampling strategy enhances comparability across the selected cities but does not ensure national representativeness. The responses provided by LGU representatives concern perceived rather than causally established outcomes. Since only 39 surveyed households had received financial support, the empirical material permits an assessment of access to support but does not provide a basis for ranking individual programmes. The design is cross-sectional and observational.

The two respondent groups are distinct and their answers are not matched at household level; consequently, differences between local-government assessments and household experiences should be interpreted as a triangulation of perspectives, not as estimates of individual-level programme effects. Percentages use the number of valid responses to each question, which can vary across measures. Multiple-response questions are not expected to sum to 100%.

The 3.2% uptake estimate (39/1,222) refers to reported receipt of funding within the preceding five years in this purposively selected sample; it is neither a national participation rate nor a programme-specific take-up rate.

The data do not contain verified pre- and post-intervention measurements of household energy bills, indoor temperatures, pollutant concentrations or emissions.

Accordingly, the dual-effectiveness framework is used as an evaluative lens, rather than as a validated causal impact estimator. Policy documents and programme changes introduced in 2026 are discussed as subsequent policy context, not as conditions prevailing during the January–March 2025 fieldwork.

4. Research Results and Discussion: Programme Accessibility and Uptake

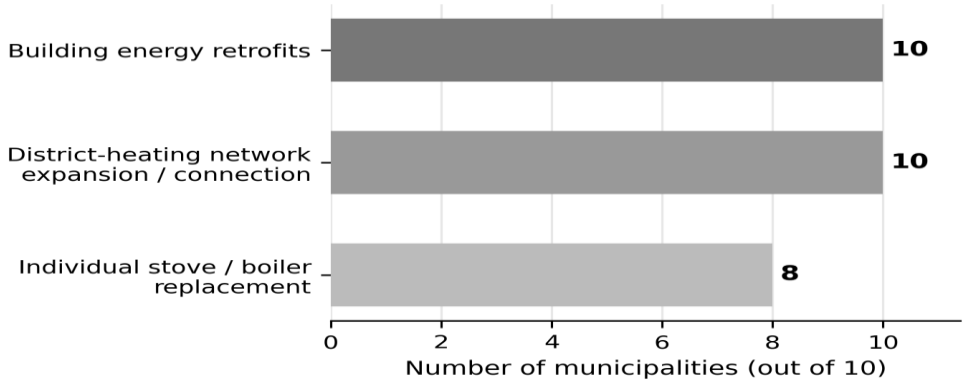
4.1 LGUs as Local Actors in Public-Policy Implementation: Diagnosis, Institutional Capacity, and Implementation Barriers

The responses indicate uncertainty among surveyed LGU representatives about whether thermal energy poverty had been formally identified in their localities. Only 20 of the 50 LGU representatives believed that thermal energy poverty had been identified in their locality; nine answered no and 21 were unable to say.

At the same time, 45 were convinced that the problem existed. Divergent responses from people working within the same local-government community point not only to missing data but also to fragmented knowledge across social assistance, housing, environmental protection, energy, and municipal councils.

LGUs drew on data concerning applications for heating fuel, allowances, arrears, energy consumption, heat sources, subsidies, and smog episodes. The survey does not establish whether these sources were integrated into a unified household vulnerability profile. Local government more often diagnosed the visible consequence—low-stack emissions—than the mechanism of thermal energy poverty. The same household might be known to the social assistance centre because of arrears, to the environmental department because of its boiler, and to the property manager because of damp, yet no institution had the full picture.

Figure 2. *Model LGU Investments for Reducing Low-Stack Emissions: Number of Municipalities Reporting Each Measure*

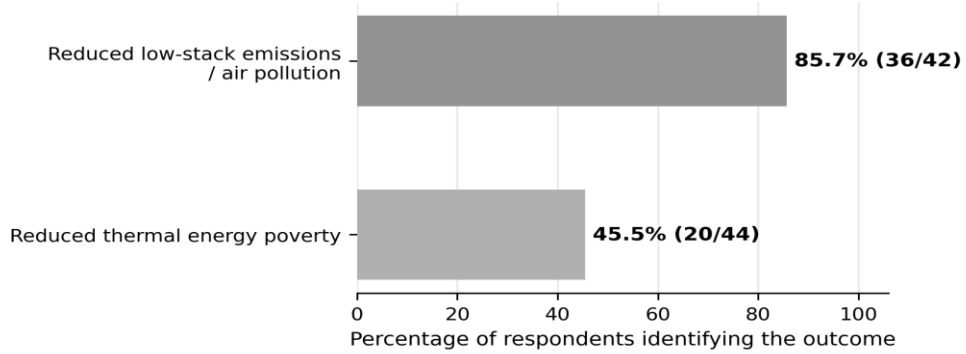


Source: *Author's compilation of the LGU survey report, Table 6; 10 municipalities.*

Categories are not mutually exclusive. Values count municipalities, not individual respondents. Of the 42 participants who assessed the outcomes of LGU measures, 36 identified a reduction in low-stack emissions or air pollution. By contrast, 20 of 44 respondents believed that thermal energy poverty had declined, and eight of them considered the change minimal.

This difference in respondents' assessments may reflect differences in programme objectives, visibility and reporting; it cannot establish a stronger measured environmental impact. The number of appliances replaced is easier to document than a lasting improvement in household circumstances, which requires data on bills, comfort, and income over several heating seasons.

Figure 3. *Comparison of Perceived Environmental and Energy-and-Social Outcomes of LGU Measures*



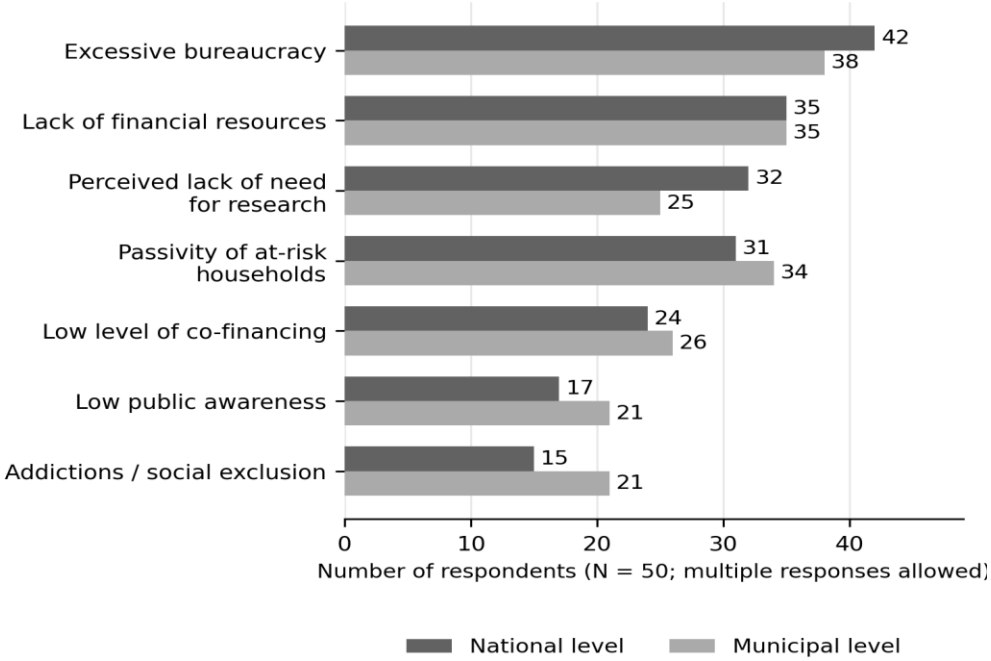
Source: *Author's elaboration based on LGU interview data; n = 42 for perceived environmental outcomes and n = 44 for perceived thermal-energy-poverty outcomes.*

The results reflect respondents' assessments, not measured programme impacts. Building energy retrofits were most frequently associated by respondents with the three reported outcomes: 39 of 45 respondents identified their impact on reduced heat consumption, 34 on reduced low-stack emissions, and 32 on a lower number of households in thermal energy poverty.

For boiler replacement, the corresponding figures were 27, 33, and 27; for geothermal energy, 17, 19, and 17. Moreover, 47 of 50 respondents regarded geothermal investments as counteracting low-stack emissions, and 42 as counteracting thermal energy poverty. These are self-reported assessments; the social outcome of geothermal energy ultimately depends on the tariff, connection cost, network coverage, and building standard.

In the surveyed LGU representatives' assessments, administrative complexity and insufficient funding were prominent barriers at both national and municipal levels. Respondents also frequently cited a perceived lack of need for research, low subsidy levels, and the 'passivity' of people at risk. The last category requires critical interpretation. Apparently passive behaviour may be a rational response to uncertain prices, lack of trust, poor health, unresolved ownership, distance from the municipal office, or fear of penalties. Administrative labelling of the beneficiary may obscure the fact that the programme transfers the costs of information, documentation, and risk to the household.

Figure 4. *Barriers to Addressing Thermal Energy Poverty at National and Municipal Levels, as Perceived by LGU Respondents*



Source: *Author's elaboration from LGU responses to questions 31-32 (N = 50).*

Respondents selected up to five barriers separately for the national and municipal levels; seven categories are shown. The values are respondents' perceptions, not objective measurements of barriers.

The LGU representatives' recommendations form a coherent model of a local public operator. They call for cooperation among universities, central government, local authorities, and civil-society organisations; specialist staffing; greater autonomy in the use of funds; full financing for energy-poor households; expansion of networks, geothermal energy, and renewables; simpler procedures; education; and proactive information.

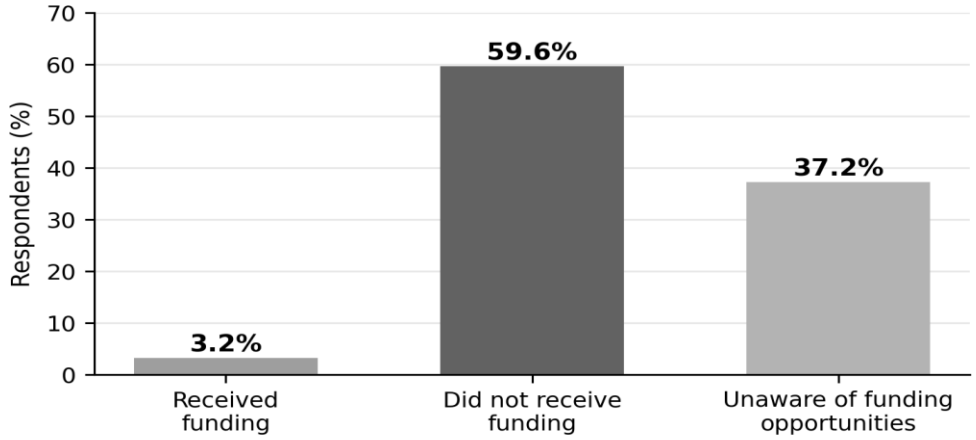
A municipality should not merely announce a call for applications; it should identify the household, organise the audit, select the appropriate option, bridge the funding gap, and verify the outcome.

4.2 Households as End Beneficiaries: Awareness, Financial Accessibility, and Uptake of Support

Over the preceding five years, 39 of the 1,222 respondents—3.2%—had received funding for heat-source replacement or an energy retrofit. A negative response was

given by 59.6%, while 37.2% did not know whether such support was available.

Figure 5. *Use of Funding for Heat-Source Replacement or Energy Retrofitting*



Source: *Author's elaboration based on PAPI survey data collected in January–March 2025; N = 1,222 (39 recipients, 728 non-recipients and 455 respondents unaware of funding availability).*

The profile of the 39 surveyed beneficiaries suggests possible barriers to equitable access, but does not by itself establish social selectivity. Nineteen lived in buildings constructed after 2005; 72% of the buildings were fully insulated, 36 respondents reported thermal comfort, and none received social assistance.

Most assessed their financial situation positively, and 82% spent no more than 20% of their income on heating. This does not mean that the investments were unnecessary. Because only 39 beneficiaries were identified in a purposive, cross-sectional sample, their profile is descriptive and cannot establish which household characteristics increase the probability of participation.

Among the 39 support recipients, three reported an energy retrofit and 38 reported heat-source replacement. These categories may overlap; therefore, their counts must not be added to estimate the number of distinct beneficiaries. The most frequently reported choices were renewable energy sources (16 cases) and gas (11).

Four respondents selected 'eco-pea coal', four pellets, one heating oil, and two did not specify the solution. Fifteen beneficiaries could name the 'Czyste Powietrze' programme, four 'Mój Prąd' ('My Electricity'), and two 'Kawka'; 12 did not know the programme's name. Beneficiaries may therefore perceive support as a one-off grant without understanding its objective or expected outcome. A lack of technology advice can lead to investments that are inconsistent with air-quality improvement.

The funding question distinguished three mutually exclusive responses across all

1,222 households: 39 beneficiaries (3.2%), 728 respondents who had not used support (59.6%), and 455 respondents who did not know whether such funding was available (37.2%). Thus, the 37.2% information deficit refers to the entire sample, not to the 728 respondents reporting non-use.

Other reported barriers, including perceived lack of need, housing arrangements, administrative complexity and co-financing requirements, should be interpreted separately and only with the denominator applicable to the relevant follow-up question. These findings indicate an information and implementation gap but do not establish a causal effect of any particular barrier on programme uptake.

4.3 The Implementation Gap: Discrepancies between the Programme Offer and Beneficiaries' Experience

The two respondent groups suggest a possible gap between municipal activity and household access, not a measured implementation effect. LGUs can identify investments and their environmental outcomes, whereas households exhibit low participation, a substantial information deficit, and a beneficiary profile that warrants closer investigation of equity in access.

A programme is formally available when it has rules, a budget, and a defined category of eligible recipients. It becomes effectively accessible only when a person in the target group can complete the entire pathway without disproportionate cost, risk, or cognitive burden.

Three mechanisms may help explain this gap. First, financial constraints: percentage-based grants may be harder to use for people without savings, creditworthiness, or the ability to wait for reimbursement. Second, procedural and information-related constraints: forms, audits, contractor agreements, and financial settlement require time and skills. Third, territorial and institutional constraints: the actual offer depends on whether the municipality has joined the programme, appointed an operator, can integrate departments, and conducts proactive outreach.

Identical legal entitlements therefore have different practical value depending on place of residence (Carrere *et al.,* 2022; Schleich, 2019; Szpak and Ostrowski, 2025).

As a policy proposal, LGUs could mediate between programme rules and households by explaining criteria, coordinating services, building trust and reducing delivery risk. This role accords with the concept of intermediary organisations in local energy support (Sequeira *et al.,* 2024) and with multilevel governance of building energy performance (Björklund *et al.,* 2023).

This proposed model was not tested in the survey and would require dedicated funding and capacity.

Table 3. *Distinction between Formal and Effective Programme Accessibility*

Dimension	Formal availability	Effective accessibility
Information	call for applications and a website	clear information reaches the household through an appropriate channel
Eligibility	income, ownership, and technology criteria	criteria capture actual poverty, tenants, and atypical circumstances
Financing	subsidy percentage and maximum amount	pre-financing and coverage of the necessary own contribution and documentation
Procedure	form, guidance, and list of attachments	an operator supports the household from diagnosis through settlement and appeal
Technology	the appliance appears in the approved catalogue	the solution is matched to the building, tariff, and future bills
Outcome	number of contracts, expenditure, and appliances	lasting exit from poverty and measurable emission reduction

Source: Author's own conceptual elaboration.

5. Discussion: Dual Effectiveness and Policy Recommendations

Within the limits of the research design, the findings are consistent with the proposed interpretation but do not constitute a causal test of programme effectiveness. Formal availability does not ensure that support reaches those most in need, and LGUs identify the environmental outcome more clearly than the energy-and-social outcome. This does not prove that programmes have no effect on poverty; rather, the available survey data do not establish how many beneficiaries have durably escaped deprivation.

European research reaches similar conclusions: transition can reduce or reproduce poverty depending on cost redistribution, the accuracy of targeting, and access to renovation (Śmiech and Karpińska, 2025; Śmiech *et al.,* 2025).

Dual effectiveness does not require identical indicators. The energy-and-social outcome should be measured at household level, while the environmental outcome should also be assessed at building, air-quality-zone, and municipal levels.

Connecting them requires tracing an outcome pathway: who received support, what work was completed, how demand and the heat source changed, what the post-retrofit bill is, and whether emissions fell and air quality improved. Without such a chain, programme outputs can be documented, but the dual effectiveness of air quality programmes cannot be credibly assessed.

The first recommendation for central government is to establish an operational

diagnostic standard that combines the Energy Law definition with social-assistance data, the Central Register of Emissions of Buildings (CEEB), energy-performance information, energy costs, and self-assessed comfort. The absence of an energy performance certificate should not exclude a household; obtaining one should be financed as the first step.

Because different indicators identify different populations, a basket of indicators is needed, together with the possibility of eligibility based on documented vulnerability rather than a single threshold (Kajoskoski *et al.,* 2025; Maier and Dreoni, 2026).

The second recommendation is genuine pre-financing or an operator-managed investment for households with the least financial capacity. The highest support tier should cover 100% of the reasonable costs required to attain the standard, including the audit, documentation, connection, and supervision. Controls on cost ceilings and contractors should protect public funds, but responsibility for misconduct by a professional contractor should not be transferred to a vulnerable beneficiary.

The third recommendation is the principle 'building and bill before appliance'. Heat-source replacement should be preceded by an assessment of demand and a simulation of operating costs. Where full renovation is not feasible, the programme should finance a staged renovation passport, but the first stage must not lock in incorrect sizing. Particular caution is required for gas and biomass because of price, emission, and regulatory risks. Commission Recommendation (EU) 2026/1001 also emphasises the protection of vulnerable consumers when gas is phased out and networks are reorganised (Barrella and Romero, 2025; European Commission, 2026b).

The fourth recommendation is to reform monitoring. Alongside the number of contracts, reporting should cover changes in heat demand, cost and the expenditure-to-income ratio, temperature and comfort, arrears, fuel, PM emissions, and concentrations in the intervention area. Evaluation after two or three heating seasons should test durability and identify rebound effects. Data should be reported by income group, tenure, age, disability, building type, and municipality, subject to privacy protection.

The fifth recommendation is to integrate the Social Climate Fund with existing programmes. Temporary direct income support is justified as protection on the path to structural investment, particularly in the context of ETS2, but it cannot substitute for renovation.

The NECP, Social Climate Plan, national renovation plan, 'Czyste Powietrze', municipal housing stock, and air-quality programmes should share a common intervention logic. Otherwise, competing calls, definitions, and databases will emerge.

For LGUs, the appropriate solution is a local ‘single-entry’ system. A one-stop shop should integrate environmental protection, energy, housing, and social assistance. Its tasks should include a home visit, diagnosis, choice of financing, assistance with the audit, comparison of future costs, contractor selection, final settlement, and post-investment contact. Central government should finance stable posts and training, not only equipment. This model is consistent with Commission Recommendation (EU) 2026/536, research on instruments targeted at vulnerable households, and the recommendations of the surveyed LGUs (van der Wal *et al.,* 2025).

Heat-planning policy must incorporate thermal energy poverty. Connection to an efficient district-heating or geothermal system may deliver a strong environmental outcome, but its social outcome depends on the tariff, connection charge, and dwelling standard. A municipality can finance connections, renovate its housing stock, aggregate procurement, provide tariff support, and negotiate the sequence of network expansion. Geothermal energy is a local resource, not an automatic guarantee of affordable heat; it requires a full assessment of system and consumer costs.

Table 4. *Dual-Effectiveness Matrix for Public Interventions*

Intervention type	Energy and social outcome	Environmental outcome	Assessment
bill or fuel allowance	positive but short-lived	low or neutral	protective measure, not a structural solution
boiler replacement without building improvement	uncertain; bills may rise	usually positive	risk of deepening poverty
energy retrofit without changing the heat source	positive	moderate	partial solution
deep renovation and a clean heat source	high and durable	high	preferred model
connection to efficient district heating or a geothermal system	potentially high	high locally	depends on the tariff and connection cost
package with pre-financing and operator support	greatest accessibility	high due to scale and durability	dual-effectiveness model

Source: *Author’s own conceptual elaboration.*

5.1 Methodological Limitations and Scope of Inference

The non-probability selection of ten cities and households limits external validity.

The number of supported households (n = 39) is too small for robust programme-specific comparisons, and self-reported receipt of assistance is not independently verified. Municipal respondents assessed perceived outcomes using varying item-specific denominators; their responses are not substitutes for monitored air-quality or household welfare indicators.

The study therefore identifies access barriers, distributional patterns and a discrepancy in reported outcomes, but cannot establish the causal effects of individual interventions or measure their durability. A longitudinal evaluation linking administrative programme records with household energy costs, building characteristics, thermal comfort and local pollutant measurements would be required to test dual effectiveness directly.

6. Conclusions, Proposals and Recommendations

This study examined the proposed dual effectiveness of Polish air-quality programmes, considering environmental and energy-and-social outcomes without claiming a causal link between them. Under the proposed framework, effectiveness requires two interdependent outcomes: an energy-and-social outcome, reflected in lower heat demand, reduced heating-cost burdens, and improved thermal comfort; and an environmental outcome, reflected in lower emissions and improved air quality.

Alleviating thermal energy poverty should therefore be understood not as a policy objective parallel to air quality improvement, but as a mechanism through which environmental security can be strengthened.

Poland has a broad portfolio of programmes and a supportive EU policy framework, including directives on energy efficiency, buildings, and air quality, the Social Climate Fund, the one-stop-shop standard, and the updated NECP. The findings suggest a possible gap between formal support availability and uptake among surveyed households, without establishing its prevalence nationwide.

The low share of beneficiaries within the surveyed sample, information deficits, the characteristics of the 39 surveyed beneficiaries, and uncertainty among LGU respondents about local diagnosis suggest a difference in the visibility of reported outcomes: surveyed LGU representatives more frequently identified reductions in pollution than reductions in thermal energy poverty.

Given the research design, these findings support a diagnostic assessment of programme accessibility and reported outcomes rather than a causal estimate of programme impact.

The central policy implication is the need to move from a fragmented subsidy system to an integrated framework in which alleviating thermal energy poverty

constitutes an explicit pathway to environmental security. Its core should comprise multidimensional diagnosis, pre-financing, a local operator, comprehensive renovation, protection against future energy costs, and post-investment monitoring.

An air quality programme should be regarded as dually effective only when a lasting reduction in thermal deprivation forms part of the pathway to lower emissions and improved air quality, while the costs of transition are not shifted onto vulnerable consumers.

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