CEESEN-BENDER

Building intErventions in vulNerable Districts against Energy poveRty

Deliverable 5.1

Building renovation roadmaps in 5 pilot areas

Pilot area roadmap for the town of Warsaw

WP 5 - Creating roadmaps and support services for building energy renovations for vulnerable districts

Dissemination Level: Public

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Contents

1.Introduction

Mazovia has one of Poland's largest and oldest concentrations of multi-apartment buildings (MABs). According to the 2021 National Census, the voivodeship contains approximately 2.4 million dwellings in 956 thousand buildings, representing 15.9% and 14.0% of national totals, respectively[1], underscoring the region's strategic importance for large-scale renovation.

A significant portion of Mazovia's urban building stock, particularly in Warsaw and its surrounding municipalities, was constructed in the 1960s–1980s using large-panel prefabrication systems (e.g., WUF-T). These buildings were designed for rapid housing delivery, not long-term energy performance. As a result, they now suffer from high heat losses, inefficient heating and ventilation systems, and poor thermal comfort, contributing to high energy bills and low living standards[2].

Energy poverty is a pressing social dimension of renovation in Mazovia. The Mazovia Centre for Social Policy (MCPS) found that 7.1% of residents cannot meet basic energy needs, while 38.1% are "energy-frugal" (meeting needs but spending >10% of income on energy)[3], highlighting the urgency of upgrades in MABs with vulnerable households.

Policy and funding conditions are favourable for deep retrofits. Regionally, European Funds for Mazovia 2021–2027 finance energy-efficiency projects in public and residential buildings (typical requirement: ≥30% efficiency improvement vs. baseline, confirmed by audit)[4]. These instruments sit alongside national/EU frameworks (EPBD recast; National Building Renovation Plan) that steer the stock toward decarbonization by 2050.

This roadmap therefore focuses on multi-apartment buildings—the backbone of Mazovia's housing sector and a key lever for achieving regional energy, climate, and social goals. Targeted, staged renovations combining building-envelope upgrades, heating system modernization, and renewable energy integration can significantly reduce energy demand and CO_2 emissions, improve comfort, and alleviate energy poverty.

2.Vision of the roadmap

The roadmap envisions a climate-resilient, energy-efficient, and socially inclusive Mazovia, where multi-apartment buildings provide affordable, comfortable, and low-carbon housing for all residents, especially those most vulnerable to energy poverty.

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[1] Główny Urząd Statystyczny (GUS), Narodowy Spis Powszechny Ludności i Mieszkań 2021 – Raport województwo mazowieckie, https://warszawa.stat.gov.pl/opracowania-biezace/opracowania-sygnalne/narodowy-spis-powszechny-ludnosci-i-mieszkan-2021/

[2] Orbi ULiège, Energy efficiency in the Polish residential building stock, https://orbi.uliege.be/bitstream/2268/264395/1/Energy%20efficiency%20in%20the%20polish%20residential%20building%20stock.pdf

[3] Kalinowski, S., Łuczak, A., Zwęglińska-Gałecka, D., Paczek, B., Szczygieł, O., & Wojciechowska, A. (2023). Diagnoza przyczyn ubóstwa energetycznego w województwie mazowieckim. Raport końcowy z badań. Mazowieckie Centrum Polityki Społecznej

[4] Fundusze Europejskie dla Mazowsza 2021-2027, https://www.funduszedlamazowsza.eu/

By 2040, the region seeks a comprehensive transformation of its MAB sector in line with EPP2040 and the EU's Renovation Wave under the Green Deal and Fit for 55 initiatives. This transformation will ensure that most MABs in Mazovia:

- meet modern energy-performance standards,
- integrate renewable energy sources (RES) such as solar PV and heat pumps,
- provide healthy, comfortable indoor environments, and
- deliver measurable reductions in CO_2 emissions and energy demand.

The roadmap promotes an ecosystem of cooperation among housing cooperatives, building managers, municipalities, regional authorities, financial institutions, and residents—supported by data-driven decision tools such as the Return on Investment Calculator and Digital Building Ranking Platform. These instruments will help prioritize renovations, guide investment, and ensure transparent allocation of funds.

In the long term, the roadmap aspires to embed renovation planning within local energy and climate strategies, transforming each upgraded MAB into both an energy-efficient dwelling and a model of community resilience. Lower energy bills, improved comfort, and decentralized renewable generation will enhance quality of life while driving Mazovia's contribution to Poland's climate neutrality by 2050.

3.Objectives of the roadmap

The roadmap provides a structured, evidence-based framework for planning and implementing energy renovations of multi-apartment buildings in Mazovia. Its objectives are to:

- Assess the renovation needs by identifying the number, typology, and energy condition of MABs, particularly those occupied by low-income or vulnerable households.
- Quantify financial requirements, including total investment needs, funding sources, and projected returns using the CEESEN-BENDER ROI Tool developed by Mazovian Energy Agency (MAE).
- Evaluate technical outcomes, such as expected energy savings, CO_2-emission reductions, and improved indoor comfort.
- Support decision-making for building owners, managers, and municipalities through clear, data-driven renovation pathways and prioritization methods.
- Encourage replication and capacity-building via training, advisory services, and stakeholder engagement to scale best practices region-wide.
- Promote renewable-energy integration within renovation plans to ensure measurable progress toward EU and national decarbonization and energy-efficiency targets.

4.The status of legislative and regulatory frameworks for building renovation

4.1 EU directives (other policy instruments) that set the ground:

- → Directive 2010/31/EU – Energy Performance of Buildings Directive (EPBD)
  - Defines nearly-zero energy buildings (nZEB) and sets standards for new and renovated buildings.
  - Enforced via the Building Law and Technical Conditions.
- → Directive (EU) 2024/1275 – Energy Performance of Buildings Directive (EPBD) (Recast)
  - Requires national integration of decarbonization in building stock.
- → EU Green Deal & Renovation Wave Strategy
  - Targets energy-efficient renovations and decarbonization of building stock by 2030.
  - National focus on increasing the pace of building renovations.
  - Regional renovation efforts, benefiting from EU funding.
- → Directive (EU) 2012/27/EU – Energy Efficiency Directive (EED) (Revised in 2023)
  - Establishes binding energy-saving targets.
  - Supports programs like Czyste Powietrze[5], FEnIKS[6], Moje Ciepło[7], for energy-efficient upgrades.
  - Increased retrofit projects in Poland, including Mazovia, to meet savings targets.
- → Directive (EU) 2018/2001 – Renewable Energy Directive (RED II)
  - Sets targets for renewable energy integration in buildings.
  - Promotes renewable solutions like solar and geothermal.

4.2 National laws/regulation that set the ground linking their influence on pilot regional level

- → Energy Law[8]
  - The law creates the regulatory framework and financial mechanisms (such as "white certificates" - energy efficiency certificates), and obligations for energy suppliers, that encourage thermo-modernization projects.
  - It mandates the development of the National Energy Policy and energy efficiency action plans, which prioritize thermo-modernization as a key tool to reduce energy consumption and meet EU climate goals.
- → Act of Supporting Thermo-modernization and Renovations and on the Central Register of Building Emissions[9]

[5] Czyste Powietrze, https://czystepowietrze.gov.pl/ accessed on June 12th 2025
[6] FEnIKS, https://www.feniks.gov.pl/ accessed on June 12th 2025
[7] Moje Ciepło, https://mojecieplo.gov.pl/ accessed on June 12th 2025
[8] Ustawa z dnia 10 kwietnia 1997 r. – Prawo energetyczne (Dz. U. z 2024 r. poz. 266, z późn. zm.)
[9] Ustawa z dnia 21 listopada 2008 r. o wspieraniu termomodernizacji i remontów oraz o centralnej ewidencji emisyjności budynków (Dz. U. z 2024 r., poz. 1446, z późn. zm.)

- The act supports thermo-modernization projects by providing financial aid (e.g. bonuses, subsidies) for improvements that reduce energy use in buildings—such as insulation, window replacement, and heating system upgrades.
- Its goal is to lower energy consumption and heating costs, reduce emissions, and improve energy efficiency in residential and public buildings across Poland.

→ Regulations[10] on the methodology for determining the energy performance of a building or part of a building and energy performance certificates

- Those regulations define the technical conditions that buildings must meet, including those related to energy performance. It implements EU standards like EPBD and sets out the requirements for thermal insulation, ventilation, and energy-saving technologies.
- They primarily concern the energy performance of buildings and the methodology for determining energy performance certificates (EPCs), reflecting updated goals set by the EU Energy Efficiency Directive (EED) and Poland’s own Energy Policy.

→ Energy Efficiency Act[11]

- This act outlines measures for improving energy efficiency across sectors, including buildings. It mandates energy audits, efficiency improvements, and sets energy-saving targets for different sectors.
- In Mazovia, this law supports the implementation of energy-efficient retrofits in public and private buildings, including those funded under programs like Czyste Powietrze (Clean Air Program)
- A law focusing on financial support for improving energy efficiency in buildings, including grants and subsidies for renovation projects.
- This law helps fund energy efficiency upgrades in Mazovia-, where energy-efficient retrofits are critical to achieving climate-neutral goals.

→ Energy Policy of Poland until 2040 (EPP2040)[12]

- The policy emphasises the thermal modernisation of buildings (insulation of building partitions, replacement, modernisation of central heating / hot water systems), heat recovery from ventilation (recuperation), smart energy management and application of energy-efficient lighting and household appliances.
- The EPP2040 calls for increasing the adoption of renewable energy systems in buildings, such as solar panels, geothermal, and heat pumps, aligning with EU directives like the Renewable Energy Directive (RED II).

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[10] Rozporządzenie Ministra Infrastruktury z dnia 27 lutego 2015 r. w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie; Rozporządzenie Ministra Rozwoju i Technologii z dnia 28 marca 2023 r. zmieniające rozporządzenie w sprawie metodologii wyznaczania charakterystyki energetycznej budynku lub części budynku oraz świadectw charakterystyki energetycznej

[11] Ustawa z dnia 20 maja 2016 r. o efektywności energetycznej (Dz. U. Z 2025 r. poz. 711)

[12] Obwieszczenie Ministra Klimatu i Środowiska z dnia 2 marca 2021 r. w sprawie polityki energetycznej państwa do 2040 r.

   - The Energy Policy of Poland is aligned with EU Green Deal and Fit for 55 objectives, including the need to reduce energy demand in buildings and improve their energy efficiency to contribute to the EU's decarbonization goals by 2050.

→ Draft of National Energy and Climate Plan for 2030[13]
   - Area 2.2 of the plan highlights the importance of improving energy efficiency in the building sector, with a strong emphasis on thermo-modernization—especially insulation, modernisation of heating systems, and the integration of smart technologies to manage energy consumption.

→ The Building Law[14]
   - This law establishes the general framework for the construction and renovation of buildings in Poland. It covers building permits, construction standards, safety, and technical regulations.
   - The law ensures that building projects (including renovations) adhere to national standards, including those for energy efficiency and sustainability.

→ Renewable Energy Sources Act[15]
   - The Act provides mechanisms for integrating renewable energy sources, such as solar panels or heat pumps, into buildings. This integration can enhance building energy performance and contribute to thermal modernization efforts.
   - It includes provisions for the modernization of existing renewable energy installations. This can involve upgrading or replacing systems to improve efficiency, aligning with broader thermal modernization goals.
   - It defines a collective prosumer as a group (e.g. residents of a multifamily building) that generates renewable electricity (usually solar PV) for their own use.
   - In the context of thermal modernization, buildings are upgraded to reduce energy demand. Integrating RES (like photovoltaics or heat pumps) reduces reliance on external energy sources, complementing insulation or window upgrades. Collective prosumers reduce operating costs and energy losses in common areas (e.g. lighting, elevators, heating systems), which supports thermal efficiency goals.
   - The energy settlement system (net-billing) allows prosumers to receive monetary credit for excess electricity fed into the grid. These savings can be reinvested into thermal modernization efforts, making renewable integration both an economic and energy-efficiency advantage.

[13] Krajowy Plan w dziedzinie Energii i Klimatu do 2030 r. (aKPEiK)
[14]Ustawa z dnia 7 lipca 1994 r. - Prawo budowlane (Dz. U. z 2025 r. poz. 418, z późn. zm.)
[15] Ustawa z dnia 20 lutego 2015 r. o odnawialnych źródłach energii (Dz. U. z 2024 r. poz. 1361)

4.3 Accreditation / certification of construction professional

→ Professionals in Mazovia, including engineers, architects, and energy auditors, must be accredited by national bodies like the Polish Chamber of Civil Engineers (PIBP) and Chamber of Architects of the Republic of Poland (IARP).

→ Energy auditors play a key role in assessing the energy performance of buildings and ensuring compliance with nZEB standards.

→ Passive House or EnerPHit certified professionals are also in demand for high-performance renovation projects (accredited by PIBP[16]).

4.5 Labelling of construction materials (related to building renovation and energy efficiency)

→ Environmental Product Declarations (EPD)

- Provide verified, transparent data on the environmental impact of construction materials throughout their lifecycle.
- EPD is a Type III environmental declaration according to ISO 14025.
- Based on standards ISO 14040/14044 (life cycle assessment), ISO 14025 (environmental labels and declarations), PN-EN 15804 or ISO 21930 (construction product-specific rules).

→ Relevant standards:

- PN-EN ISO 14021: Governs self-declared environmental claims and labelling.
- EN 15804: Specifies core rules for environmental product declarations for construction products.

5.Energy poverty in the pilot region

5.1 National context regarding energy poverty and specifically MABs

→ Definition of energy poverty in Polish Energy Law:

“1. Energy poverty means a situation in which a household run by one person or by several persons jointly in a self-contained dwelling or in a single-family residential building in which an economic activity is not carried out, it shall not provide itself with a sufficient level of heat, cold and electricity to power the equipment and lighting, where the household together fulfils the following conditions:

1) achieves low income;
2) incurs high expenditure on energy purposes;
3) it resides in a premises or a building with low energy efficiency.

[16] Polski Instytut Budownictwa Pasywnego, https://www.pibp.pl/certyfikacja/ accessed on June 12th 2025

2. The energy poverty criteria qualifying for energy poverty reduction programmes are set out in the programmes introducing energy poverty reduction instruments."[17]

→ National data regarding energy poverty

The Polish Institute of Economics in the report "Four dimensions of energy poverty in Polish households during the crisis of 2021-2023"[18] highlighted 4 key groups of energy poverty in Poland:
1) Fuel poverty – when energy bills make up a big portion of the household spendings (16-30% of households in 2022)
2) Structural poverty – relative impoverishment caused by high energy bills compared to incomes (8-12% of Polish households)
3) Municipal poverty - lack of access to adequate infrastructure (3-5% of households)
4) Hidden energy poverty – limitation of own energy consumption due to financial challenges (13-16% of households)

→ Causes and consequences of energy poverty in MABs

Energy poverty in Poland, particularly in multi-apartment buildings (MABs), is a growing concern. According to recent reports, households living in such buildings are often trapped in a vicious cycle of energy inefficiency and high energy costs, exacerbating their economic difficulties. This situation is particularly acute for low-income families who are unable to afford the necessary investments in energy-saving solutions, leading to further social exclusion and worsening health outcomes.

Furthermore, the report highlights that the lack of individualized control over energy consumption and outdated building infrastructure significantly contribute to higher heating costs in MABs. These buildings often rely on centralized heating systems that are inefficient, and low-income tenants, who typically cannot invest in energy efficiency measures, are disproportionally affected.

5.2 EP situation at regional level based on the "Diagnosis of the Causes of Energy Poverty in Mazovia"[19]

→ Definition and indicators of energy poverty

The document defines energy poverty as: "a situation in which households (individuals or families) are unable to provide an adequate, acceptable level of thermal comfort in their place of residence, lack access to basic energy services and products (such as hot water, heating,

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[17] Definition of energy poverty under the Polish Energy Law (Art. 5gb – Ustawa – Prawo energetyczne, Dz.U.2024.266 t.j.), as referenced in Poland's Energy Policy until 2040 (EPP2040), adopted by the Council of Ministers
[18] Polski Instytut Ekonomiczny. (2023). Cztery oblicza ubóstwa energetycznego: Polskie gospodarstwa domowe w czasie kryzysu 2021–2023. Warszawa. ISBN 978-83-67575-74-4
[19] Kalinowski, S., Łuczak, A., Zwęglińska-Gałecka, D., Paczek, B., Szczygieł, O., & Wojciechowska, A. (2023). Diagnoza przyczyn ubóstwa energetycznego w województwie mazowieckim. Raport końcowy z badań. Mazowieckie Centrum Polityki Społecznej

cooling, lighting, and energy to power devices), or their access is severely limited due to infrastructural or income constraints."

Energy poverty is measured using several quantitative indicators that describe its various dimensions:

- *Low Income, High Cost (LIHC)*: This indicator defines energy poverty based on two criteria:
  1. Households incur high energy costs that exceed the median energy expenditure in the country.
  2. Households have low income, which, after subtracting housing costs (below the official poverty line), places them in the energy poverty category.
- *Double Median of Actual Energy Expenditures in Income (2M)*: This measure is based on the share of actual energy expenditures in a household's disposable income. A household is considered energy poor if it spends more than twice the median energy expenditure in the population, meaning energy costs constitute a significant burden relative to available income.
- *Energy Poverty Severity Indicators*: These are subjective measures evaluating household experiences of energy poverty, including:
  1. Inability to pay energy bills on time, leading to arrears and financial difficulties.
  2. Living in a building with structural defects, such as leaking roofs, damp walls, decaying windows or floors, affecting heating efficiency.
  3. Insufficient thermal comfort during winter, related to lack of heating or poor insulation.

These severity indicators help understand the impact of energy poverty on household living conditions and are used to assess the situation of individuals and families in terms of access to energy and housing, as well as to inform policy and assistance programs.

→ Energy poverty criteria

The most vulnerable to energy poverty can be divided into two groups based on:

1) Infrastructure and Technical Factors – Related to the technical condition of the building, heating system, and location of the dwelling.
2) Socio-Economic Factors – Related to household income sources, household structure, and the age of household members.

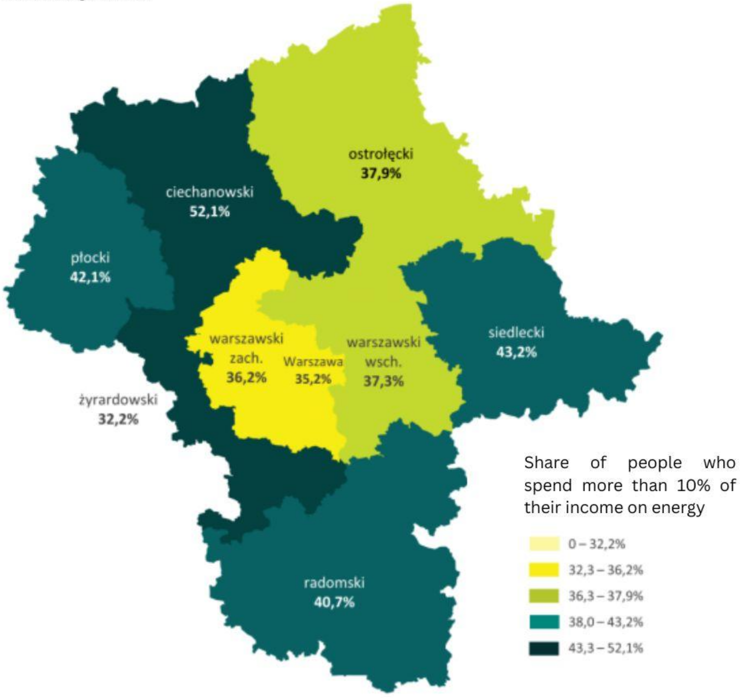
→ Local data regarding energy poverty

In 2023, the number of people affected by energy poverty in Mazovia ranges from 7.1% to 38.1% of the total population, depending on the adopted energy poverty measurement indicator:

- 7.1% of Mazovia's residents were unable to meet basic energy needs (heating, lighting, etc.).
- 38.1% were considered “energy frugal,” meaning they meet their energy needs but spend more than 10% of household income on energy, which is a common energy poverty threshold.

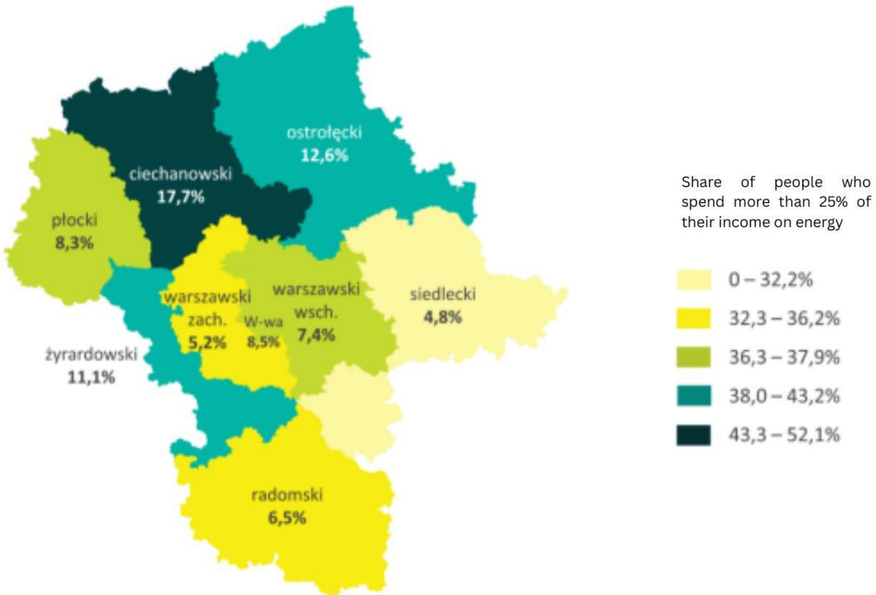
About 25% of residents live in buildings with no insulation, leaky windows, poor lighting, or damaged construction (e.g., rotting or leaking roofs). Among households with at least four members, this applies to 80% of them.

Share of energy poor people, according to the threshold of 10% of income spent on energy (Jenks natural ranges used)



Source: Kalinowski et al. (2023), Diagnoza przyczyn ubóstwa energetycznego w województwie mazowieckim, Mazowieckie Centrum Polityki Społecznej

Share of energy poor people, according to the threshold of 25% of income spent on energy (Jenks natural ranges used)



Source: Kalinowski et al. (2023), Diagnoza przyczyn ubóstwa energetycznego w województwie mazowieckim, Mazowieckie Centrum Polityki Społecznej

6.MAB renovation in the pilot region

6.1 National/regional/local programmes

→ National level

- Long-Term Renovation Strategy[20] - a strategic framework outlining Poland's approach to building renovation, aiming to improve energy efficiency and reduce emissions
- Program TERMO[21] - Thermal Modernisation and Renovation Fund (FTiR) and the National Reconstruction and Resilience Plan (KPO) - financial support for implementation of thermal modernisation and renovation projects
- Clean Air Program (Czyste Powietrze) - financing of comprehensive thermal modernization of the building and replacement of old and inefficient heat sources
- My Heat (Moje Ciepło) programme implemented from the Modernisation Fund - supporting the purchase and installation of heat pumps for new single-family buildings in order to reduce emissions resulting from heating single-family houses with inefficient heat sources using fossil fuels, and to increase the share of RES in final energy consumption and promote renewable energy sources.
- My Electricity[22] (Mój Prąd) - subsidies for the thermal modernisation and installation of micro-scale renewable energy installations, such as photovoltaic panels
- Warm Apartment Programme[23] (Program „Ciepłe Mieszkanie") - aimed at improving the energy performance of apartments in multi-family buildings through modernisation and replacement of inefficient heat sources

→ Regional level (Masovia region)

- The Stop Smog program - supports families in energy poverty living in single-family or small multi-family buildings in Warsaw by providing full funding for deep thermal renovation and replacement of inefficient solid fuel heating systems ("kopciuchy") with clean, high-efficiency heat sources. The program aims to reduce energy demand and emissions by upgrading insulation, windows, heating systems, and installing renewable energy solutions, all managed and financed by the city.
- Mazovia for Clean Air[24] (Mazowsze dla Czystego Powietrza) – a regional program supporting the improvement of air quality in Mazovia by financing the

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[20] Ustawa z dnia 26 stycznia 2024 r. – Charakterystyka energetyczna budynków (Dz.U.2024.101 t.j.), art. 39a [Strategia renowacji budynków]
[21] Government of Poland, "Termomodernizacja." Mieszkanie dla Ciebie, https://www.gov.pl/web/mieszkanie-dla-ciebie/termomodernizacja accessed June 16th 2025
[22] Mój Prąd, https://mojprad.gov.pl/ accessed June 16th 2025
[23] Program Ciepłe Mieszkanie, Czyste Powietrze, https://www.czystepowietrze.eu/program-cieple-mieszkanie accessed June 16th 2025
[24] Program „Mazowsze dla czystego powietrza," European Committee of the Regions, https://cor.europa.eu/pl/node/63/program-mazowsze-dla-czystego-powietrza accessed June 16th 2025

replacement of polluting heating systems with clean, energy-efficient solutions like heat pumps and solar panels, along with thermal modernization of buildings. The program aims to reduce emissions and promote sustainable energy use across the region.

- European Funds for Mazovia[25] (Fundusze Europejskie dla Mazowsza 2021-2027) - Priority II: European Funds for Green Development of Mazovia - supports projects aimed at climate adaptation and energy modernization of buildings. It specifically funds thermo-modernization efforts, such as improving building energy efficiency, upgrading heating systems, and integrating renewable energy sources. These actions reduce emissions, improve air quality, and help Mazovia transition to a low-carbon economy.
- Mazovia Without Smog[26] (Mazowsze bez Smogu) - under Priority II: "European Funds for Green Development of Mazovia," Action 2.1: "Energy Efficiency" of the European Funds for Mazovia 2021-2027 program - its goal is to improve air quality by creating a network of experts in air protection and energy, facilitating information exchange among municipalities and stakeholders, enforcing regulations, and supporting energy-poor households. Key activities include:
  1) Energy and ecological consulting and enforcement of anti-smog regulations by employing eco-advisors.
  2) An online service supporting air quality management across the region.
  3) Environmental education at local and regional levels.

6.2 MAB context

The pilot region covers multi-apartment buildings in urban areas of Warsaw and surrounding municipalities. Most of these buildings were constructed between the 1960s and 1980s using prefabricated concrete technology. They are characterised by poor insulation, outdated heating systems, and high heat loss, which significantly affects energy costs and residents' comfort.

→ homeowner structure
most buildings are managed by housing cooperatives or homeowner associations, often representing several dozen individual owners. Decision-making on renovation projects requires a majority vote, which can slow down the process;

→ building managers' role
managers play a key part in coordinating audits, technical documentation, and funding applications. Their level of awareness and competence in energy efficiency projects varies widely;

→ residents' vulnerability

[25] Fundusze dla Mazowsza, https://funduszeuedlamazowsza.eu/ accessed on June 12th 2025
[26] Mazowsze Bez Smogu, https://www.powietrze.mazovia.pl/public/mazowsze-bez-smogu/ accessed on June 12th 2025

many residents are elderly or low-income households, making them particularly exposed to energy poverty. They often lack resources or knowledge to initiate or co-finance renovations,

→ technical characteristics
common deficiencies include insufficient insulation, obsolete single-glazed windows, inefficient heating systems (district heating without control), and ventilation losses;

→ renovation requirements
key technical interventions include external wall and roof insulation, replacement of windows and doors, modernization of heating substations, installation of heat pumps or PV panels, and improvements in indoor air quality;

→ digital and monitoring aspects
within CEESEN Bender, MAE is piloting air quality monitoring and ROI calculation tools in selected buildings to quantify benefits and optimize future investments.

6.3 Stakeholder involvement in the renovation of MAB sector in the pilot regions

The renovation of multi-apartment buildings (MABs) in Mazovia involves a wide range of stakeholders:

→ housing cooperatives and homeowner associations:
primary decision-makers responsible for approving renovation projects, coordinating with contractors, and managing budgets,

→ building managers:
provide technical documentation, supervise audits, and communicate with residents. MAE supports them through targeted training and advisory services,

→ residents and energy-poor households:
key beneficiaries of the project; their engagement is promoted through informational meetings, surveys, and door-to-door outreach within pilot buildings,

→ local authorities (City of Warsaw, municipalities):
facilitate permitting, promote financing programmes, and act as multipliers of good practices across the region,

→ energy advisors and experts (MAE):
offer technical and financial guidance, conduct ROI calculations, and help communities prepare grant applications,

→ financial institutions and programmes:
Fund of Funds Mazovia, Thermo-modernization Fund, Bank Gospodarstwa Krajowego (BGK), and the National Recovery and Resilience Plan (KPO) enable access to grants and preferential loans for energy efficiency and renewable energy investments.

Engagement methods:

- workshops, technical consultations, training sessions coordinated by MAE and local partners,
- dissemination through the CEESEN network, newsletters, and social media,
- use of success stories and demonstration visits to renovated buildings.

6.4 Main drivers of the MAB renovation process

- → Financial instruments:
  - Thermo-modernization Fund
  - Fond of Funds Mazovia
  - National Recovery and Resilience Plan (KPO)
- → Energy advisory service - provides expert guidance and support to individuals and businesses on various energy-related matters (audits, planning, etc.)
- → In addition to financial instruments already listed, several other key drivers stimulate the renovation process in the pilot region:
  - growing awareness of energy poverty and the need for improved living standards among residents,
  - availability of regional advisory services, such as those provided by MAE, supporting technical, financial, and legal aspects,
  - access to EU and national funds, including grants under Clean Air, Warm Apartment, and European Funds for Mazovia 2021–2027,
  - positive perception of pilot projects – demonstration buildings showing measurable savings in energy costs and comfort improvements encourage replication,
  - local policy alignment – actions consistent with Mazovia's Regional Energy Strategy and EPP2040 priorities foster long-term integration of RES and efficiency upgrades.

6.5 Main difficulties of the MAB renovation process

- → Financial barriers:
  - Lack of sufficient funding;
  - Limited access to upfront capital - to cover initial costs;
  - Complexity of funding mechanisms - application processes can be bureaucratic and time-consuming, especially for small-scale administrators.
- → Legal and administrative obstacles:
  - Ownership and decision-making challenges;
  - Permitting and regulatory delays.
- → Lack of technical expertise
- → Building-specific constraints – some buildings (e.g. large panel prefabricated buildings) present structural difficulties for deep renovation or insulation
- → Inadequate baseline data - many buildings lack comprehensive technical documentation or recent energy audits, complicating planning.
- → Homeowner/tenant resistance and coordination difficulties.

6.6 MABs in need for renovation works

The analysis carried out within the CEESEN Bender project identified several multi-apartment buildings (MABs) in the Mazovia region requiring renovation and energy efficiency improvements. The assessment focused on technical, financial, and social indicators, including the presence of energy poverty, the technical condition of buildings, and the potential for renewable energy integration.

→ Tools supporting the renovation process

To support the evaluation and planning of renovation works, MAE contributed to the development and testing of two complementary tools under the CEESEN Bender project:

- the ROI calculator, developed and led by MAE, used to estimate the financial performance of renovation projects, including investment costs, payback periods, and energy cost savings,
- the digital building ranking tool, developed by the University of Tartu (UTARTU) with input from partners, which helps classify MABs based on their energy performance, retrofit potential, and socio-economic vulnerability.

These tools are used both at the pilot and regional levels to prioritize interventions and to provide data-driven support for decision-making among cooperatives, building managers, and municipalities.

→ Estimation and ranking of MABs

Based on preliminary analyses conducted by MAE, a set of eight pilot buildings in the Mazovia region were assessed. The ranking considered the technical condition of building envelopes, existing or planned renewable energy installations, and residents' economic vulnerability.

Buildings with outdated insulation, obsolete heating systems, and limited access to renewable energy were identified as highest priority for renovation.

The results are being used to develop a scalable methodology for identifying and prioritizing similar MABs in other municipalities.

→ Estimation of financing needs

Preliminary estimations indicate that renovation projects for typical multi-apartment buildings in Mazovia require combined investments from multiple funding sources — including national grants (e.g., the Clean Air and Warm Apartment programmes), regional instruments under the European Funds for Mazovia, and co-financing opportunities through BGK and the Thermo-modernization Fund.

MAE's ROI analyses show that such combinations of grants, loans, and self-financing mechanisms are essential to ensure financial feasibility, especially for buildings inhabited by lower-income households.

→ Expected results

The use of the ROI calculator and ranking methodology allows for a more precise estimation of expected benefits:

- significant reductions in energy demand and heating costs,
- measurable CO_2 emission reductions,

- improved comfort and indoor air quality for residents.

The pilot results will inform regional policy recommendations and serve as a practical example of how data-driven tools can enhance the planning and execution of large-scale renovation programmes across Mazovia.

6.7 MAB renovation role in achieving national targets

Renovating multi-apartment buildings is crucial for Poland to meet its national and EU climate and energy targets. In the Mazovia region, where a significant portion of Poland's urban population resides, MABs constitute a substantial part of the residential building stock, much of which was constructed before modern energy standards.

Key impacts of MAB renovation include:

→ Improved energy efficiency
  - MABs, particularly pre-1989 blocks, are typically energy inefficient. Renovations (insulation, windows, HVAC upgrades) drastically reduce energy use.
  - Thermal modernization contributes directly to meeting the energy savings target and reduces dependency on imported energy.

→ Energy consumption reduction
  - Renovation substantially decreases heating energy demand, especially critical in older buildings with high heat loss.
  - Energy-saving measures like improved insulation, airtight windows, and modern heating systems reduce the primary energy consumption of the residential sector- contributing to Poland's national energy efficiency goals.

→ CO_2 emissions mitigation
  - By improving energy performance and transitioning to cleaner heating systems, MAB renovations play a vital role in reducing CO_2 emissions—particularly in the residential sector, which accounts for over 30% of Poland's emissions.
  - Renovating MABs helps reduce fossil fuel use for heating, especially in cities like Warsaw where district heating can be optimized.
  - This contributes to the 55% emissions reduction target by 2030 and supports longer-term decarbonization.

→ Tackling energy poverty
  - MABs are often home to low- and middle-income households that face disproportionately high energy bills. Renovation lowers energy demand and heating costs, helping to alleviate energy poverty and improve living conditions.
  - This directly supports social inclusion and aligns with Poland's just transition objectives.

→ Contribution to climate policy

MAB modernization supports Poland's commitments under the EU Green Deal and Fit for 55 package, including the Renovation Wave initiative, which prioritizes deep retrofits in residential buildings to reach climate neutrality by 2050.

6.8 Financial solutions

→ European Investment Bank (EIB) Support:

The EIB has signed operational agreements totalling PLN 273 million (approx. EUR 64 million) with Getin Noble Bank to provide loans for thermo-modernization projects in multi-family residential buildings across Mazovia and other two regions[27]. This funding aims to reduce heat losses and modernize heating systems.

→ Mazovia Clean Air Programme:

This initiative provides grants to local authorities for activities aimed at improving air quality, such as monitoring compliance with anti-smog resolutions, educational campaigns, and the installation of electric vehicle charging stations.

→ Mazovia for Clean Heat:

A financial support scheme for municipalities to assist residents in purchasing energy carriers or to subsidize the replacement of heat sources and energy renovations of residential buildings.

6.9 Tools supporting estimation and planning of renovation

To support housing associations and cooperatives in estimating renovation costs and financing needs, several tools and schemes are available in Poland:

Investment / payback calculators:

→ CEESEN ROI tool: a simple calculator to estimate investment needs, energy savings and payback time (project tool)[28].

→ PV generation & self-consumption calculators: PV yield and self-consumption can be approximated using PVGIS (EU JRC) and its self-consumption simulation module, which supports early-stage PV sizing for multi-apartment buildings.

Bank loan calculators and loan products:

→ Commercial banks offer loan products dedicated to housing associations/cooperatives; for example, PKO BP provides a specific loan product for

[27] European Investment Bank, "EIB support for energy efficiency projects in the Polish housing sector,", https://www.eib.org/en/press/news/eib-support-for-energy-efficiency-projects-in-the-polish-housing-sector accessed June 12th 2025

[28] https://ceesen.org/renovation-roi-calculator-tool/

housing communities/cooperatives (useful for modelling loan amount, term and affordability alongside grants).

Early-stage PV feasibility / integration into renovation roadmaps:

In Poland, electricity-related emissions in multi-family housing vary by region and heating type, but electricity demand can increase after renovation (e.g., ventilation systems). On-site solar PV (and, where relevant, collective self-consumption arrangements) can be assessed using PV yield and self-consumption calculators (PVGIS) as a first screening step.

Building prioritization and cost estimation:

The T4.1 Energy Poverty Prioritisation Tool, developed within the CEESEN-BENDER framework, was used to rank multi-apartment buildings by renovation priority. It combines socio-economic and building indicators to reflect both vulnerability and technical renovation needs. The methodology applied statistical analyses, including correlation checks and regression models, to identify the most influential factors, which were standardised and weighted to generate a composite score for each building.

For renovation cost estimation and financing planning, indicative unit costs per square metre were applied, reflecting market experience for deep renovations in Poland. National support instruments, including thermo-modernisation and renewable energy schemes, as well as commercial loans for housing associations and cooperatives, were considered when estimating potential grant shares and own contributions.

Integration of PV and collective energy solutions:

There is significant potential for photovoltaic investments in the analysed multi-apartment buildings. Key technical aspects—roof structure, available area, and grid connection—should be assessed at the planning stage, and roof renovation can often be combined with PV installation to improve efficiency.

In most buildings, PV systems primarily cover electricity demand in common areas, such as lighting, elevators, and ventilation. Allocating energy to individual dwellings is more complex, and roof space usually limits the coverage of residents' electricity needs. Reducing consumption in common areas lowers operating costs and service charges.

PV investments also enable collective energy solutions. Following November 2025 legislative changes, urban energy cooperatives can be established, facilitating energy sharing among buildings or residents. Although procedures are not fully finalised, this option should be considered in planning to ensure technical readiness and long-term flexibility.

6.10 Results of energy poverty-based prioritization and renovation cost estimates

The Energy Poverty Prioritisation Tool was applied to multi-apartment buildings included in the Polish pilot area. Based on the calculated composite scores, buildings with the highest combined renovation need and energy poverty risk were identified and ranked.

The results show that the highest-ranked buildings are predominantly multi-storey buildings constructed in the 1970s and 1980s, characterised by large numbers of dwellings, relatively high energy demand, and socio-economic indicators suggesting increased vulnerability of residents.

Table 1 presents the ranking of buildings in the Polish pilot area in the order of renovation priority.

Table 1. Ranking of buildings by renovation priority (Poland)

Rank	Building address
1	Sokratesa 2B, Warsaw
2	Wolumen 6, Warsaw
3	Wolumen 4, Warsaw
4	Szekspira 4, Warsaw
5	Aleja Władysława Reymonta 23, Warsaw
6	Sándora Petöfiego 1, Warsaw
7	Hansa Christiana Andersena 2, Warsaw
8	Hansa Christiana Andersena 3, Warsaw
9	Hansa Christiana Andersena 5, Warsaw
10	Hansa Christiana Andersena 6, Warsaw
11	Balzaka 2, Warsaw
12	Czechowa 2, Warsaw
13	Dantego 1, Warsaw
14	Dantego 1a, Warsaw
15	Dantego 1b, Warsaw
16	Dantego 3, Warsaw
17	Dantego 5, Warsaw
18	Dantego 7, Warsaw

Rank	Building address
19	Sándora Petöfiego 2, Warsaw
20	Sándora Petöfiego 4, Warsaw
21	Sándora Petöfiego 6, Warsaw
22	Sándora Petöfiego 8, Warsaw
23	Aleja Władysława Reymonta 21, Warsaw
24	Szekspira 1, Warsaw
25	Szekspira 2, Warsaw
26	Szekspira 3, Warsaw
27	Tołstoja 1, Warsaw
28	Tołstoja 3, Warsaw
29	Tołstoja 4, Warsaw
30	Hansa Christiana Andersena 8, Warsaw

→ Characteristics of the highest-ranked buildings

Based on the prioritisation results, the three highest-ranked (worst-performing) buildings were selected for further analysis. Their key characteristics are presented in Table 2.

Table 2. Key characteristics of the highest ranked buildings (Poland)

Key building parameters	Building 1: Sokratesa 2B	Building 2: Wolumen 6	Building 3: Wolumen 4
Year of construction	1985	1987	1987
Number of floors	6	7	7
Number of apartments	59	90	22
Gross floor area, m^2	3258,3	5869	1828,26

Key building parameters	Building 1: Sokratesa 2B	Building 2: Wolumen 6	Building 3: Wolumen 4
Construction material	Reinforced concrete (+brick/aerated concrete)	Reinforced concrete (+brick/aerated concrete)	Reinforced concrete (+brick/aerated concrete)
Main heating system	District heating	District heating	District heating

As a common characteristic, all three buildings are located within the same urban district, two of which are located next to each other (Wolumen street), and the third one is located 850m away, which creates potential for coordinated renovation planning and bundled procurement.

Like most multi-apartment buildings constructed before 1990, all three buildings would require deep renovation solutions to achieve significant improvements in energy performance, indoor comfort, and operating cost reduction.

→ Renovation cost assumptions and estimates

While indicative renovation cost levels have become relatively well established on the Polish market, actual investment costs may vary considerably depending on market conditions, procurement timing, and whether several buildings are renovated simultaneously.

For this reason, indicative renovation cost levels were derived from unit cost estimates per square meter of gross floor area, reflecting typical scopes of deep renovation for multi-apartment buildings constructed in the 1970s and 1980s. The applied cost range of 500–600 €/m² is based on expert input used within the CEESEN-BENDER framework and reflects current Polish market conditions for comprehensive energy renovation[29].

Using this unit-cost approach, total renovation investment needs were calculated by multiplying the assumed cost range by the gross floor area of each building. Table 3 presents

[29] CEESEN-BENDER (2024). Building Interventions in Vulnerable Districts against Energy Poverty – Poland's report on building renovation technical and economic barriers. Annex 4 to Deliverable 3.2 – Report on Building Renovation Technical and Economic Barriers in Five Pilot Countries and in Central and Eastern Europe. The report indicates indicative deep renovation cost levels for multi-apartment residential buildings in Poland in the range of approximately 500–600 €/m² (planning-level estimates)

the resulting investment ranges for the three highest-priority buildings, together with an indicative potential grant share and the resulting own contribution.

Table 3. Estimated renovation investment and average cost per apartment (Poland)

Parameter	Building 1: Sokratesa 2B	Building 2: Wolumen 6	Building 3: Wolumen 4
Renovation need	Deep renovation	Deep renovation	Deep renovation
Cost, € / m² (expert input)	500-600 €/m²	500-600 €/m²	500-600 €/m²
Renovation cost, M€	1.63–1.95	2.93–3.52	0.91–1.10
Potential grant share, %	30%*	30%*	30%*
Own contribution, M€	1.14–1.37	2.05–2.47	0.64–0.77

*Indicative value reflecting typical national deep renovation support scenarios; actual grant intensity depends on final scope and eligibility.

Where deep renovation projects are supported by national grants and combined with long-term loans, investment costs can be spread over longer periods, typically 20–30 years, helping to reduce the monthly financial burden for residents. Indicative loan maturities and interest assumptions suggest that monthly repayments per apartment remain within a manageable range, although actual values depend on final loan conditions and market developments.

7. Best practice cases

7.1 Low-energy multi-family building of the "Śląska 12" Homeowner Association (pol. Wspólnota Mieszkaniowa "Śląska 12") in Szczytno, Poland[30]

The thermo-modernisation project, initiated by Zbigniew Chrapkiewicz, President of the Homeowner Association, involved a prefabricated residential building constructed in 1974–1975. The goal was to improve energy efficiency, reduce heating costs, eliminate outdated heating systems, and lower greenhouse gas emissions. The investment was implemented in three main stages, using hybrid renewable energy technologies. The project was co-funded by local and regional environmental funds, EU programs, and the community's own contributions, with total cost estimated at PLN 1,8 mln.

Best practice examples:

→ Integrated use of renewable energy sources:

[30] Z. Chrapkiewicz, Niskoenergetyczny budynek wielorodzinny Wspólnoty Mieszkaniowej w Szczytnie, Konferencja „Spółdzielnie i Wspólnoty Mieszkaniowe w obliczu Transformacji Energetycznej", 2025

- Combined geothermal (ground-source) heat pumps, air-source heat pumps, photovoltaic panels, and solar collectors to create a hybrid, energy-efficient system
- Synergy between systems reduced heating and hot water costs significantly
- The community transfers the surplus electricity to the grid and sells it

→ Phased implementation strategy - project divided into three manageable stages:
1) Heating system modernisation
2) Hot water system overhaul
3) Residential comfort upgrades (balconies with PV)
    - Allowed for gradual financing and minimised disruption for residents

→ Smart energy management (e.g. use of digital platforms for remote monitoring and control of heating and PV systems)

→ Effective use of funding mechanisms - successfully combined partnerships with public institutions, loans, EU grants, and community contributions:
- loan from the Voivodeship Environmental Protection and Water Management Fund (PLN 1,200,000)
- EU funding via Regional Operational Programme (PLN 235,000)
- Local municipality involvement (PLN 337,000 community's own contribution)

→ Improved safety and living standards
- Removed individual gas water heaters (safety hazard) and introduced centralised systems
- New balconies and better water infrastructure improved both comfort and property value

→ Environmental impact reduction
- Significant reduction in CO_2 emissions and air pollution
- Use of clean energy sources contributed to local climate goals

7.2 Pre-Heating Domestic Hot Water Using Electricity from Photovoltaic Panels, Housing Association „Wrzeciono", Warsaw

The project concerns a system for the pre-heating of domestic hot water (DHW) using electricity generated by photovoltaic (PV) panels installed on the roof of a building. The aim is to reduce the demand for thermal energy from the municipal district heating system by using solar-generated electricity to raise the temperature of cold mains water before it enters the district heating system's DHW exchanger.

The installation includes rooftop PV panels, a SCADA system, and a custom water heating setup. The PV system is composed of three independent, galvanically isolated strings. A camera was installed a year in advance to monitor rooftop shading throughout all seasons, providing detailed insights into shadow effects—particularly from chimneys—which vary significantly over the year. This allowed for an optimized design and accurate identification of the most productive hours for solar energy generation.

The SCADA system enables real-time data acquisition, visualization, storage, and diagnostic monitoring of the entire installation. For water heating, the system uses pulse water meters (0.25 liters per pulse) to analyse daily and hourly DHW consumption patterns, allowing for a heating system tailored to the building's real-time water flow dynamics.

Cold water from the mains enters through a main water meter and shut-off valve into a custom-designed flow-through heat exchanger. This exchanger is made from a 3-meter steel pipe equipped with approximately 1 kW electric sheath heaters made from Kanthal. These heaters are covered with adiabatic shields for directional heat transfer and encased in microspherical insulation, which both minimizes heat loss and prevents condensation.

An automation system modulates power to the heaters based on flow rate. When water is not being drawn, power to the heaters is instantly cut, preventing energy waste. Pre-heated water is then sent to the building's district heating exchanger, where it is heated to the legally required temperature. The hot water is pumped upward to the top floor distribution system and then routed down through the vertical risers. Return water from the circulation loop is collected in the basement, where its temperature is measured to estimate heat losses. Typically, this returning water is around 3°C cooler than the setpoint and is fed back into the pre-heating system. In winter, this returning water may also be heated using energy recovered from the central heating return line.

7.3 Thermal modernization of a housing block in Zwoleń, Poland[31]

The thermo-modernization project of the residential block at ul. Bogusza 9/11 in Zwoleń involved upgrading a typical PRL-era large-panel apartment building to improve energy efficiency, reduce energy costs, and increase the use of renewable energy sources. The renovation focused on enhancing thermal insulation, modernizing heating, and cooling systems, and integrating photovoltaic technology. The project was executed by Euros Energy Sp. z o.o. and included the following key works:

- → Renewable energy integration:
    - Installation of a containerized heat pump system (180 kW) with a ground heat storage unit, combined with photovoltaic panels (80 kWp) mounted on a reinforced roof designed to support the solar installation.
- → Enhanced building insulation:
    - Insulation of the roof slab, basement ceilings, walls, and a complete façade refurbishment significantly improved the building envelope.
- → Modern climate control systems:
    - Installation of flat wall-mounted fan coil units in all apartments to provide efficient heating and entirely free cooling.
- → Structural adaptations:

[31] Muratorplus.pl, "Budynek wielorodzinny w Zwoleniu nagrodzony w konkursie RenOwacje2024", https://www.muratorplus.pl/galeria/budynek-wielorodzinny-w-zwoleniu-nagrodzony-w-konkursie-renowacje2024/gg-ro2Q-muJG-iEyg/gp-PJ6Y-BVyA-U85E accessed June 16th 2025

- Roof reinforcement to support photovoltaic installation ensured structural safety and long-term durability.

→ Implementation approach:
- The modernization was planned to maximize energy savings and resident comfort while ensuring the building's structural integrity and aesthetic value.

→ Outcomes and benefits:
- The building's primary energy demand dropped dramatically from 100 kWh/m²/year before renovation to 21 kWh/m²/year after, substantially lowering energy bills and greenhouse gas emissions.
- Smart energy management maximizes self-consumption of electricity generated by PV panels, reducing reliance on external energy and increasing renewable energy use.
- Improved aesthetics and comfort contributed to a higher quality of life for residents and increased property value.

8. Priority areas and recommendations in the pilot region

8.1 Energy Poverty

→ Identify and prioritise multi-apartment buildings with the highest share of energy-poor households using data from MAE and the Mazovia Centre for Social Policy (MCPS).

→ Provide tailored advisory support for these communities, including technical audits and assistance in applying for renovation funding.

→ Implement targeted awareness campaigns on energy savings, indoor comfort, and available financial tools.

→ Strengthen collaboration between municipalities and cooperatives to facilitate participation in national energy-poverty mitigation schemes.

8.2 Energy Efficiency

→ Promote comprehensive and staged renovation of buildings integrating insulation, heating system upgrades, and RES installation (solar PV, heat pumps).

→ Use the ROI calculator to assess financial and energy performance benefits, supporting data-driven decision-making.

→ Encourage municipalities to integrate renovation priorities into their local energy and climate plans.

→ Facilitate training for regional SMEs and professionals to increase technical capacity in deep renovation projects.

→ Showcase best practices from the pilot buildings (e.g., PV integration, hybrid heating systems) to inspire replication in other regions.

8.3 General recommendations related to the renovation works in the pilot region

→ Target energy-poor households
  - Use regional data (e.g., MCPS Diagnosis of Energy Poverty 2023) to identify and prioritize households dealing with the biggest energy poverty and economic issues

→ Address legal and institutional barriers
  - Facilitate coordination between local governments and housing cooperatives, especially for post-war buildings with complex structures and buildings that are heritage-listed

→ Use pilot demonstrations

→ Improve awareness and engagement
  - Launch regional awareness campaigns showing benefits of renovation (lower bills, better comfort, health);
  - Create knowledge-sharing platforms for housing cooperatives, contractors, and municipalities.

→ Provide training subsidies and certification programs for regional SMEs and professionals focused on building retrofit

→ Promote integrated and phased renovation strategies
  - Encourage the adoption of Building Renovation Passports (as per EPBD Directive 2024/1275)
  - Promote the use of step-by-step (staged) renovation plans, integrating:
    i. Envelope insulation,
    ii. HVAC modernization,
    iii. RES integration (solar PV, heat pumps),
    iv. Ventilation and moisture control.

→ Integrate Circular Economy principles
  - Prioritize use of secondary/recycled construction materials to reduce raw material consumption
  - Apply Material Intensity (MI) indicators to optimize material use
  - Conduct Life Cycle Assessments (LCA) and monitor carbon footprints of renovation materials and processes
  - Minimize environmental impact from transport of building materials by sourcing locally when possible
  - Implement waste reduction and management plans during renovation to maximize recycling and reuse of demolition debris
  - Promote modular and design-for-disassembly solutions enabling easier future renovations or recycling.

→ Optimize energy and resource efficiency beyond buildings
  - Use smart building management systems to monitor and optimize energy consumption
  - Include water-saving technologies and rainwater harvesting where feasible
  - Encourage green infrastructure (e.g., green roofs) to improve urban climate resilience and biodiversity.

Background of the CEESEN-BENDER project

The main goal of the project "Building intErventions in vulNerable Districts against Energy poveRty" (i.e. CEESEN-BENDER), launched on September 1 2023, is to empower and support vulnerable homeowners and tenants living in buildings built after the Second World War and before 1990's in 5 CEE countries: Croatia, Slovenia, Estonia, Poland, and Romania. The project will help them through the renovation process by identifying the main obstacles and creating trustworthy support services that include homeowners, their associations, and building managers. Coordinated by Society for Sustainable Development Design (DOOR), the project CEESEN-BENDER brings together leading European researchers and experts in field from six countries: Croatia (Society for Sustainable Development Design / DOOR, Medjimurje Energy Agency Ltd. / MENEA, EUROLAND Ltd. / Euroland, GP STANORAD Ltd. / GP STANORAD), Estonia (University of Tartu / UTARTU, Tartu Regional Energy Agency / TREA, The Estonian Union of Co-operative Housing Associations / EKYL), Slovenia (Local Energy Agency Spodnje Podravje / LEASP), Romania (Alba Local Energy Agency / ALEA, Municipality of Alba Iulia / ALBA IULIA), Poland (Mazovia Energy Agency / MAE, Housing Cooperative Warszawska Spółdzielnia Mieszkaniowa - The Warsaw Housing Cooperative / WSM), Germany (Climate Alliance) in addition to Central Eastern European Sustainable Energy Network (CEESEN). The project CEESEN-BENDER is carried out from September 2023 until August 2026 and has a total budget of €1,85 million, of which €1,75 million is funded from the European Union's Programme for the Environment and Climate Action (LIFE 2021-2027) under grant agreement n° LIFE 101120994. As stated, the main objective of CEESEN-BENDER is to empower and support vulnerable homeowners and renters living in multiapartment buildings (MABs) through the renovation process by identifying the main obstacles, and creating trustworthy support services that include homeowners, their associations, and building managers.

Therefore, the detailed objectives for CEESEN-BENDER are stated below:

- The project will analyse the ownership structure and physical characteristics of buildings in the pilot sites in targeted regions to comprehensively understand the obstacles that impede or halt homeowner associations, landlords, and property managers from pursuing energy renovations.

- Project partners will identify both legislation and financial, and technical administrative obstacles for the renovation in pilot countries. The identification of obstacles from the homeowners' perspective will help the creation of tailor-made solutions not only for homeowners but also for building managers, landlords, municipalities and other relevant stakeholders involved in the renovation process.

- Through the project, methods and tools that can be used to address different aspects of energy poverty will be developed. This includes:
    - Data gathering on energy poverty in the pilot sites;
    - A digital tool identifying buildings with high levels of energy poor households in the greatest need of renovation;
    - A model of potential savings in buildings undergoing renovation, and a tool for calculating the return on investment for energy renovations.
- 5 Pilot area roadmaps will be developed that prioritize building renovation based on their potential for maximizing emissions reduction via energy savings as well as an increase of quality of life and wellbeing for vulnerable homeowners.
- Within the 5 pilot areas, at least 30 building-level roadmaps will be created that specify the technical details for renovations. These pilot buildings will be supported in the entire pre-construction phase, drawing of plans, applying for permits, audits or other requirements and for financing. Plans will call for the decarbonization of the heating and cooling supply and integration of renewable energy sources (RES), to produce energy to cover its own consumption.
- Furthermore, a support system for homeowners, municipalities, and other large owners of multi apartment buildings (MABs) in targeted regions will be created to speed up the renovation process, by:
    - Advising at least 3.500 homeowners, landlords and building managers on legal, financial, technical and other aspects of energy renovations.
    - Advocating for changes of regulatory requirements and policies to lower the costs and time needed for the preparatory phase of projects.
    - Train at least 30 energy professionals on energy poverty and related topics.

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