CEESEN-BENDER

Building intErventions in vulNerable Districts against Energy poveRty

Deliverable 2.2

Report on building energy performance in pilot sites

Dissemination Level: Public

WP2 Reinforcing and adapting the governance and decision-making of building management actors to support the energy renovation of private multi-apartment buildings

Čakovec, 2025

Co-funded by the European Union

CENTRAL & EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK
CEESEN-BENDER

Call: LIFE-2022-CET

Topic: Addressing building related interventions in vulnerable districts (LIFE-2022-CET-ENERPOV)

Funding Scheme: European Union's Programme for the Environment and Climate Action (LIFE 2021-2027)

Grant Agreement No.: LIFE 101120994

Contractual Submission Date: 28-02-2025

Actual Submission Date: 28-02-2025

Responsible partner: Medjimurje Energy Agency Ltd. (MENEA)

Grant Agreement No.	LIFE 101120994
Project's full title	Building intErventions in vulNerable Districts against Energy poveRty
Deliverable number and title	D2.2 Report on building energy performance in pilot sites
Type	R – Document, report
Dissemination level	PU – Public
Work Package number	WP2
Work Package Leader	MAE (PP7)
Authors	Ema Novak (MENEA)
Keywords	Unrenovated multiapartment buildings (MABs), renovation measures, financial instruments, CEESEN-BENDER

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union.

Neither the European Union nor the granting authority can be held responsible for them.

Document history

Version	Date	Description
V1	30.12.2024	First version of the content created by MENEA (PP6).
V1	10.02.2025	Document created and sent to the project consortium for review.
V2	18.02.2025	Accepted comments and suggestions provided by the project consortium and finalization of the document.
V2	18.02.2025	Final document sent to the project consortium for translation.

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.

- Also, a support system for homeowners, municipalities, and other large owners of multiapartment 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.

Table of Contents

Executive Summary 8
1. Introduction and relevance of the Deliverable 9
2. Overview of the selected pilot sites within the project CEESEN-BENDER 12
2.1. Analysis of unrenovated MABs in the pilot sites 14
2.1.1. Medjimurje County, Croatia 14
2.1.2. City of Tartu, Estonia 20
2.1.3. Mazovia Voivodeship, Poland 25
2.1.4. Alba County, Romania 30
2.1.5. Spodnje Podravje, Slovenia 35
2.2. Financial instruments for energy renovation of MABs 40
3. Recommendations and future steps 49
4. Conclusion 51
References 52

List of Figures

Figure 1: Unrenovated MABs in the pilot site Medjimurje County (Croatia) 17
Figure 2: Unrenovated MABs in the pilot site City of Tartu (Estonia) 22
Figure 3: Unrenovated MABs in the pilot site Mazovia Voivodeship (Poland) 27
Figure 4: Unrenovated MABs in the pilot site Alba County (Romania) 32
Figure 5: Unrenovated MABs in the pilot site Spodnje Podravje (Slovenia) 37
Figure 6: Financial instruments for energy renovation of MABs 40

List of Tables

Table 1: Territorial distribution of the pilot sites within the project CEESEN-BENDER 12
Table 2: Characteristics of unrenovated MABs in the pilot site Medjimurje County (Croatia) 18
Table 3: Characteristics of unrenovated MABs in the pilot site City of Tartu (Estonia) ... 23
Table 4: Characteristics of unrenovated MABs in the pilot site Mazovia Voivodeship (Poland) 28
Table 5: Characteristics of unrenovated MABs in the pilot site Alba County (Romania) 33
Table 6: Characteristics of unrenovated MABs in the pilot site Spodnje Podravje (Slovenia) 38

Executive Summary

This Deliverable is the output of the Task 2.1 Analysing the overall context of the selected buildings in pilot sites, implemented within the project CEESEN-BENDER. The main aim of the task was to gather empirical data from the 5 (out of 6) project countries regarding the current states of the unrenovated multiapartment buildings (MABs) in their selected pilot sites. The analysis has been conducted via an Excel document, collecting, thereby, data about the construction characteristics, technical information and requirements of the selected MABs, as well as available financial instruments for energy renovation on country level.

The main findings and collected data are summarized through 4 chapters, whereby special focus is on the, aforementioned, general and technical data of the selected unrenovated MABs, as well as their technical requirements for renovation and financial instruments that can foster a more efficient and better renovation process. Within the document a recommendation chapter summarizes additional data and changes on the buildings before and during the implementation of the project CEESEN-BENDER and gives perspectives on the future steps in the energy renovation of the observed MABs. Finally, in order to get a more detailed overview, the collected data are presented in a textual way and supported by corresponding Figures of the pilot sites and Tables, as well as divided per partner countries and their pilot sites.

This document is the starting point of the project CEESEN-BENDER and the basis for a smooth implementation of the upcoming activities and creation of the planned Deliverables.

1. Introduction and relevance of the Deliverable

Unrenovated buildings (including multiapartment buildings (MABs)) are one of the most significant polluters in the world (together with the transport and industry sectors). Their old and inefficient construction, carpentry and technical systems cause high losses of energy, increases of living, energy and maintenance costs, health issues, GHG emissions, decrease in real estate value and leave long-term negative footprints on human lives and the environment. In the regions where the unrenovated building stock has the most critical and irreparable consequences, many countries started to implement green projects with the aim of encouraging their public and private sectors to accept the idea and importance of renovating worn-out and energy inefficient buildings and turning them into sustainable and energy neutral places to work and live.

When taking into consideration the energy properties of the building stock, it is important to mention MABs, which count as the biggest emitters of CO_2 and polluters of air, soil, water and health. The issue of their impact on various aspects of human lives and environment are getting more addressed through renovation projects, whose main aim is to better the performances and increase the energy efficiency of the MABs themselves. One of the current projects promoting the idea of energy renovation of MABs is **CEESEN-BENDER - Building intErventions in vulNerable Districts against Energy poveRty**, where a project consortium consisting of 10 partner organizations from 6 Central and Eastern European countries (Croatia, Estonia, Germany, Poland, Romania and Slovenia) provide their knowledge, expertise and experiences in the topics of renovated and unrenovated buildings, motivation and advisory of the residents and energy poverty, as well as create documents and tools for a better acceptance of the energy renovation process. Thereby, the aim of the project focuses on empowering and supporting vulnerable homeowners and tenants from unrenovated MABs, assisting them through the renovation process and maintaining the results of various activities long after the project's ending.

The activities of the project **CEESEN-BENDER** are carried out through theoretical overviews of the regulatory, market and technical barriers in the partner countries, extensive analyses of the existing buildings stock, awareness raising activities for management authorities, homeowners and tenants, surveys and air quality measurements in unrenovated and renovated MABs, practical tools for building prioritization and return on investment (ROI) calculation, as well as tailormade roadmaps customized for the specific needs of each region and MAB. One of the core activities of the project is the analysis of the features of the unrenovated MABs in 5 (out of 6) partner countries (Croatia, Estonia, Poland, Romania and Slovenia) and their selected pilot sites. This activity aims to take into account all the general and technical data, as well as needs of the unrenovated MABs and serve as a comparison of the current states in the mentioned partner countries. Apart from the mentioned, it gives an overview of the potential financial instruments that can be used to accelerate the energy renovation process and lead to a more energy efficient building stock.

To complete the analysis and present the results, the project **CEESEN-BENDER** foresees the creation of the **Report on building energy performance in pilot sites**, a document that will combine the main information and data about the unrenovated MABs in the selected pilot sites. It serves as a basis for further activities and aims to:

- Present the selected pilot sites with focus on the unrenovated MABs, their general information, technical characteristics and requirements (divided per partner country)
- Highlight the potential financial instruments (programs, calls, tenders, other) for accelerating the energy renovation process
- Indicate the implemented changes and recommendations for the unrenovated MABs in terms of addressing their needs and tackling their main disadvantages.

Development methodology

This document is a result of the joint knowledge, expertise and experiences of the project partner organizations from 5 Central and Eastern European countries (Croatia, Estonia, Poland, Romania and Slovenia) included into the project **CEESEN-BENDER**. Each mentioned partner country chose a pilot site which serves as a basis for the implementation of the planned activities and, in the future, as a "role model" when talking about the energy renovation of MABs in these regions.

The starting point for the development of this document was the selection of 30 unrenovated MABs (6 per pilot site, whereby there are 5 pilot sites) and the analysis of their general information, technical and staff requirements, as well as various financial instruments for their renovation through a created Excel document. In addition to the general knowledge included into the analysis, the core task that collected the necessary data for the document is the following:

- T2.1 Analysing the overall context of the selected buildings in pilot sites.

As mentioned, the result of the filled Excel document is this **Report on building energy performance in pilot sites**, which combines all collected data on one place, presents the main characteristics of the unrenovated MABs in the selected pilot sites, indicates various financial instruments for accelerating energy renovation projects and, in the end, provides insights in the already implemented activities and future recommendations regarding energy efficiency increases of the selected MABs. The overall aim of the **Report** is to provide a comparison of the current states of the buildings stock in 5 Central and Eastern European countries included into the project and to highlight the main disadvantages and critical points of the MABs which need to be addressed first.

Furthermore, this **Report** is the starting point on which the other activities are built, whereby the following will benefit the most:

- T2.4 Air quality monitoring in pilot buildings
- T4.1 Design and testing of a digital tool to prioritize buildings for renovation

- T4.2 Desing and testing of a digital tool for the calculation of the return on investment (ROI)
- T5.1 Development of pilot area roadmaps
- T5.2 Development and implementation of building-level roadmaps and investment strategies.

Finally, the **Report on building energy performance in pilot sites** presents the overall state of the unrenovated MABs in Central and Eastern European countries that are in great need of energy renovation. It will contribute to the project through an overview of the current situation in the selected pilot sites in Croatia, Estonia, Poland, Romania and Slovenia and help to understand the needs and requirements of unrenovated MABs in these regions. Also, this document is the main carrier of other activities, since it defines the buildings that are the most affected by energy inefficiency and poverty and will set the basis for further analyses, creation of planned tools and documents, as well as contribute to an easier planning of energy renovation projects in the pilot sites in the 5 Central and Eastern European countries included into the project.

2. Overview of the selected pilot sites within the project CEESEN-BENDER

The project CEESEN-BENDER is carried out by a project consortium of 10 partner organizations from 6 Central and European countries, out of which 5 have provided pilot locations for the implementation of the planned activities. The mentioned pilot sites are located in the regions and counties of Croatia, Estonia, Poland, Romania and Slovenia and represent the current situation of the renovated and unrenovated MABs in the respective countries, as well as a sample on which the activities will be carried out. Related to the mentioned, the selected pilot sites are located as shown in Table 1.

Table 1: Territorial distribution of the pilot sites within the project CEESEN-BENDER

Country	Regional territorial unit	Local territorial unit	Map
Croatia	Medjimurje County	Town of Čakovec	
Estonia	Tartu County	City of Tartu (Annelinn, Karlova)	
Poland	Mazovia Voivodeship	City of Warsaw	
Romania	Alba County	Municipality of Alba Iulia	

Slovenia	Spodnje Podravje	Municipality of Ptuj, Municipality of Kidričevo	

Source: Project CEESEN-BENDER, 2025
Source of images: Wikipedia.org
(https://en.wikipedia.org/wiki/Me%C4%91imurje_County#/media/File:Me%C4%91imurska_%C5%BEupanija_in_Croatia.svg ;
https://en.wikipedia.org/wiki/Tartu_County#/media/File:Tartu_County_in_Estonia.svg;
https://en.wikipedia.org/wiki/Masovian_Voivodeship#/media/File:Masovian_in_Poland_(+rivers).svg ;
https://en.wikipedia.org/wiki/Alba_County#/media/File:Alba_in_Romania.svg ;
https://sh.wikipedia.org/wiki/Podravska_%28regija%29#/media/Datoteka:Drava_Statistical_Region_in_Slovenia.svg)

In order to start the analysis, the first task was to select 6 unrenovated MABs in the mentioned 5 pilot sites (30 in total) with the following characteristics:

- Year of construction after the Second World War and before the 1990's
- Energy efficiency class D, E, F or G (in some cases energy class C is, also, acceptable)
- In need for energy renovation measures on different elements (mostly building envelope, technical systems and lightning).

The selected MABs are located in different parts of the regions, counties or cities/towns, they differ in size, number of floors, apartments and their areas, types of energy carriers and consumption. Also, the selected MABs use different types of heating systems and are in need of significant technical improvements.

After the selection, the partner organizations provided data about the MABs in their pilot sites through a prepared Excel document. The requested data needed for the creation of this Report were classified into 3 main categories:

1. **General information about the buildings:**
    - Micro-location (address, cadastral unit) and photo
    - Homeowner structure (private and public ownership)
    - Energy poverty data (number and types of residents at risk of energy poverty)
    - Role of the management authority
    - Communication with the residents
    - Technical characteristics (year of construction, gross building area (GBA), number of floors and apartments, average apartment area, type of heating system and energy carrier(s), energy consumption, energy efficiency class, information about the previous renovations)

2. **Technical requirements for the renovation:**
    - Construction measures (insulation of the envelope, replacement of external carpentry)
    - Mechanical engineering measures (installation of heat pumps, domestic hot water (DHW) collectors, wood chip/pellet or other types of boilers)
    - Electrotechnical measures (replacement of indoor lightning, installation of PV plants)
    - Technical staff included in the renovation process
3. **Available financial instruments:**
    - Programs, calls, tenders and other financing opportunities available for the energy renovation of MABs on transnational, national, regional and local level.

As mentioned, the collected data will be used for the comparison of the current states in 5 partner countries and their pilot sites, as well as the basis for further activities planned within the project CEESEN-BENDER. The collected data on country and pilot site level are summarized in the following chapters and subchapters.

2.1. Analysis of unrenovated MABs in the pilot sites

The main part of this document is the presentation of the collected data per pilot site, provided by the responsible partner organizations. To have a better insight into the geographical, construction and technical characteristics of the selected unrenovated MABs, as well as their similarities and differences, the following subchapters give an overview of the collected data on country and pilot site level.

2.1.1. Medjimurje County, Croatia

The pilot site in Croatia lies in the northern part of the country, has an area of around 730 km^2 and counts around 106.000 inhabitants (according to the last population census from 2021) (City Population, 2024). Medjimurje County is surrounded by two rivers, Mura and Drava, and is the smallest county in Croatia. Additionally, the micro-pilot site is concentrated in the, so called, capital town Čakovec, where the selected unrenovated MABs are operated and managed by the local building managers, GP Stanorad Ltd. and Euroland Ltd.

For the purposes of this analysis, both building managers provided data for 3 unrenovated MABs (6 in total), which are in the biggest need for energy renovation (taking their general and technical characteristics into account). Thereby the selected addresses are the following:

- Vladimira Nazora 32, Čakovec
- Travnik 12, Čakovec
- Istarska 16, Čakovec
- Josipa Jurja Strossmayera 7b, Čakovec
- Janka Slogara 4, Čakovec
- Istarska 14, Čakovec.

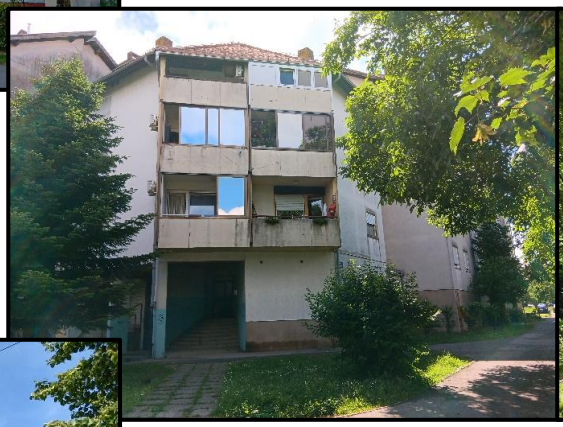
Each selected address includes 1 unrenovated MAB, built between 1959 and 1985 and with 10 to 48 apartments. All MABs are under 100% private ownership and have very few registered data regarding energy poverty (mainly concerning the number of vulnerable residents, where it is stated that only 1 to 2% of the reserves are non-collectible, while data on the types of vulnerable residents are not available in all 6 MABs).

Regarding the construction and technical characteristics, the gross construction areas (GCA) range approximately from 800 to 3.900 m^2, whereby approximately 600 to 2.400 m^2 is used as housing area (HA). The selected MABs have, in average, 3 to 4 floors (including ground floors and basements) with an average apartment area of 48 m^2. The heating systems are mostly individual and natural gas based and the data about energy consumption refer only to the used types of energy (electrical, heating and DHW), but not to actual consumption figures and rates. Also, the energy classes range from D to F (whereby, the data is available for 5 out of 6 MABs) and previous renovation activities were not implemented, since these buildings were not a priority for renovation until now.

As for the technical requirements, all 6 MABs are in need of a thermal insulation of the envelope (outside walls, roofs, floors, ceilings) and replacement of the external carpentry (whereby 3 MABs already partially replaced it). Also, technical systems and measures such as heat pumps, DWH collectors and wood chip/pellet boilers were not replaced or installed and the need of replacing indoor lightning is significant. Here it is important to highlight that in most MABs individual (meaning on apartment level) rapid water heaters are, currently, used. Regarding the installation of PV plants, none of the observed MABs have or plan to install such systems in the near future. Finally, in order to carry out the necessary improvements, qualified technical staff is more than needed, whereby architects, construction engineers and contractors are the demanded the most.

To have a clearer overview of the indicated data, photos of the 6 selected unrenovated MABs and their characteristics are presented below.

V. Nazora 32,
Čakovec



Travnik 12,
Čakovec

Istarska 16,
Čakovec

J. J. Strossmayera 7b, Čakovec

J. Slogara 4, Čakovec

Istarska 14, Čakovec

Figure 1: Unrenovated MABs in the pilot site Medjimurje County (Croatia)

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

Table 2: Characteristics of unrenovated MABs in the pilot site Medjimurje County (Croatia)

General information						
Location (address, cadastral unit)	V. Nazora 32, Čakovec	Travnik 12, Čakovec	Istarska 16, Čakovec	J. J. Strossmayera 7b, Čakovec	J. Slogara 4, Čakovec	Istarska 14, Čakovec
	2401	3433/11	1456/4	2098	927/4	1461/2
Ownership structure	100% private, 0 public					
Energy poverty data	Not available			1% non-collectible reserves	2% non-collectible reserves	1% non-collectible reserves
Role/involvement of the building managers	• Project management • Communication with the contractors • Submission of projects to co-financing calls/tenders			• Protection of the interests of all co-owners • Following instructions of the majority in the performance of regular management tasks • Undertaking extraordinary tasks on the basis of the consent of all co-owners or a court decision		
Communication	• Regular meetings with the co-owners			• Choosing the co-owner representative and communication with the building managers		
Technical characteristics						
Year of construction	1966	1985	1967	1962	1959	1964
Gross building area (m^2)	GCA = 2.975,14 m^2 HA = 2.288,57 m^2	GCA = 862,39 m^2 HA = 663,38 m^2	GCA = 1.573,20 m^2 HA = 1.194,78 m^2	GCA = 3.849,70 m^2 HA = 2.354,00 m^2	GCA = 1.136,06 m^2 HA = 562,38 m^2	GCA = 1.680,00 m^2 HA = 1.062,08 m^2
Number of floors	4	4	3	Basement + ground floor + 5 floors	Basement + ground floor + 2 floors	Basement + ground floor + 2 floors
Number and average apartment area	45 50,86 m^2	10 66,34 m^2	34 35,14 m^2	48 Approx. 50 m^2	12 Approx. 47 m^2	28 Approx. 38 m^2
Heating system(s)	Individual heating			Gas floor heating		

Energy carrier(s)	Natural gas			Natural gas and electricity		
Energy consumption	Electrical, heating and DHW			Not available		
Energy efficiency class	D	E	E	E	F	Not available
Previous renovation activities	No previous renovation activities were implemented					

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

From all presented data it is evident that the MABs in the pilot site Medjimurje County are in great need of energy renovation measures that have to be carried out on various elements of the buildings themselves. The current priority is the thermal insulation of the envelopes (outside walls, roofs, floors, ceilings) and the replacement of external carpentry, what will lead to a significant increase of the MABs' energy efficiency. Other desirable measures are related to the improvement of current or installation of new technical systems for heating (possibly cooling) and lightning. Thereby, PV plants are not planned since the residents are, usually, not interested in installing such systems and the main priority is the increase of the energy efficiency of the buildings. As for the previous renovation activities, only 3 MABs have already partly replaced their carpentry (meaning, external windows and doors), but a deeper renovation process has not been carried out.

2.1.2. City of Tartu, Estonia

The Estonian pilot site is located in the City of Tartu, which lies in the eastern part of the country along the banks of the Emajõgi River. Tartu is the second largest city in Estonia, a major educational and research hub and home to the University of Tartu. With a population of approximately 98.000 inhabitants, Tartu is known for its vibrant student community, innovative initiatives and focus on sustainable urban development.

The pilot areas selected for the purposes of the analysis, are the Annelinn and Karlova districts (2 of Tartu's 18 districts), where MABs are managed by homeowner (apartment) associations, comprising all apartment owners (as required for all MABs in Estonia), but in many cases, a management company is hired to provide various services. In these districts, 6 unrenovated MABs were selected from the following addresses:

- Uus tn 63a, Tartu
- Pikk tn 84, Tartu
- Pikk tn 94, Tartu
- Jamma tn 77, Tartu
- Anee tn 45, Tartu
- Väike-Tähe 7/9, Tartu.

The construction years for the MABs range from 1967 to 1986 and they are in 100% private ownership. The average number of apartments is 50 with and area of 52 m^2, whereby data on energy poverty (specifically number and type of vulnerable residents) are not available. Furthermore, the average gross building area (GBA) is 3.500 m^2 and the buildings have around 5 floors.

Regarding the technical systems and energy use, 5 (out of 6) MABs are connected to the local district heating system and 1 building has its own individual heating system. Related to the mentioned, the energy carrier (in most cases) is the one provided through the district heating system, while natural gas is used for cooking, firewood for heating and electricity for running the heat pump. The data on energy consumption are provided for 4 (out of 6) MABs and are recorded as follows:

- District heating (DH) – 156 to 204 kWh/m^2*a
- Electricity (E) – 21 to 53 kWh/m^2*a
- Natural gas (NG) – 4 kWh/m^2*a
- Firewood (FW) – 219 kWh/m^2*a.

These figures indicate that the energy classes of the observed MABs range from D to F and that no previous renovation measures have been undertaken.

As for the technical requirements for the renovation, all 6 MABs need a modernization of the outer shell, meaning the insulation of the envelope (outside walls, roofs, floors, ceilings), with partial of complete replacement of the carpentry. Also, the buildings are in need of new central ventilation systems with heat recovery and modernized heating systems (meaning heating unit and pipe lines). Although some improvements have been made, additional replacement of the water pipes and sewage is recommended, as well as the installation of heat pumps or connection to the district heating system. In addition, all 6 MABs are in need of replacement of indoor lightning and for 2 (out of 6)

of them the installation of PV plants is considered. Finally, all mentioned works and modernizations need the hand of quality technical staff, whereby the most requested are technical consultants, designers, construction contractors, supervisors, engineers and experts on special parts of the buildings.

Apart from the necessary construction and technical improvements, the management authorities of the selected MABs plan to construct bicycle and waste houses, as well systems for rainwater drainage to further increase the outer appearance of the buildings.

The 6 selected unrenovated MABs and their main data are presented in the Figures and Table below.

Uus tn 63a, Tartu

Pikk tn 84, Tartu

Pikk tn 94, Tartu

Jamma tn 77, Tartu

Anee tn 45, Tartu

Väike-Tähe 7/9, Tartu

Figure 2: Unrenovated MABs in the pilot site City of Tartu (Estonia)

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

Table 3: Characteristics of unrenovated MABs in the pilot site City of Tartu (Estonia)

General information						
Location (address, cadastral unit)	Uus tn 63a, Tartu	Pikk tn 84, Tartu	Pikk tn 94, Tartu	Jaama tn 77, Tartu	Anne tn 45, Tartu	Väike-Tähe 7/9, Tartu
	Cadastral unit not available					
Ownership structure	100% private, 0 public					
Energy poverty data	Not available					
Role/involvement of the building managers	• Service contract with the management company • Maintenance and management		• Management from the board of homeowners (apartment) association	• Service contract with the management company • Maintenance and management		• Management from the board of homeowners (apartment) association
Communication	Not available					
Technical characteristics						
Year of construction	1969	1977	1986	1967	1973	1977
Gross building area (m^2)	GBA = 5.411,20 m^2	GBA = 5.323,30 m^2	GBA = 3.386,50 m^2	GBA = 3.577,20 m^2	GBA = 2.790,70 m^2	GBA = 385,90 m^2
Number of floors	5	5	5	5	9	2
Number and average apartment area	85 45,60 m^2	80 47,50 m^2	60 43,60 m^2	45 56,90 m^2	45 56,50 m^2	5 63,60 m^2
Heating system(s)	District heating					Individual heating
Energy carrier(s)	District heating			District heating and natural gas	District heating	Firewood and electricity

Energy consumption	Not available		DH = 156 kWh/m²*a E = 25 kWh/m²*a	DH = 204 kWh/m²*a E = 21 kWh/m²*a NG = 4 kWh/m²*a	DH = 164 kWh/m²*a E = 32 kWh/m²*a	FW = 219 kWh/m²*a E = 53 kWh/m²*a
Energy efficiency class	E	E	D	E	E	F
Previous renovation activities	No previous renovation activities were implemented					

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

Following the data presented in the Table above, the energy renovation in the pilot site City of Tartu implies interventions that are not strictly related to the common measures on the buildings' envelopes and technical systems. Here it is important to highlight that measures such as removal of old balconies and installation of prefabricated facade panels can further increase the energy efficiency of the buildings and improve their safety, as well as the living comfort of the residents. Although most buildings in the City of Tartu are connected to the local district heating systems, energy renovation measures need to be implemented in order to decrease the current energy consumption. Finally, the thoughts of installing PV plants and heat pumps (mostly air-water based) indicate that the interest for and awareness of the benefits of RES is getting more and more visible among the MABs in the observed pilot site.

2.1.3. Mazovia Voivodeship, Poland

Mazovia Voivodeship is the largest pilot site identified within the project CEESEN-BENDER, located in the central part of Poland. It counts around 5.500.000 inhabitants, lies on an area of 35.500 km^2 and is the "home region" of the capital city, Warsaw (City Population, 2025). Apart from being the political, economic, cultural and science center of the country, Warsaw is, also, the "home city" of numerous renovated and unrenovated MABs, whereby the latter present a good opportunity for the implementation of modern energy renovation measures.

Due to its large population, Mazovia Voivodeship and its capital city Warsaw have been selected as the Polish pilot site where, again, 6 unrenovated MABs were identified as the most suitable for the implementation of the planned activities, starting with the current analysis of the general and technical characteristics, as well as the technical requirements for renovation of the buildings. The selected samples include 1 unrenovated MAB located at the following addresses:

- Sokratesa 2B, Warsaw
- Wolumen 6, Warsaw
- Wolumen 4, Warsaw
- Szekspira 4, Warsaw
- Aleja Władysława Reymonta 23, Warsaw
- Sándora Petöfiego 1, Warsaw.

Built between 1966 and 1987, all 6 MABs are in 100% private ownership and have no registered data on the number and type of vulnerable residents. Furthermore, the gross building areas (GBA) are in average 4.000 m^2 (in the case of 4 (out of 6) MABs), whereby 2 MABs stand out with a much larger gross building area (GBA) of around 21.600 m^2. The observed buildings count around 10 floors with an average of 66 apartments (in the case of 4 (out of 6) MABs) and an average of 476 apartments in the 2 remaining larger buildings. The average apartment area is around 58 m^2.

Regarding the technical characteristics, all 6 unrenovated MABs are connected to a local district heating system and the energy carrier is the one provided within the heating service. The last available data on energy consumption are from 2022 and recorded for 3 (out of 6) MABs as follows:

- Heating (H) – 2.178,90 to 9.409,00 GJ
- Electricity (E) – 61.136,51 to 79.179,65 kWh.

The energy efficiency class is not available for all 6 buildings and previous renovation activities have not been undertaken in 3 (out or 6) MABs. As for the remaining 3 buildings, they did undergo several renovation activities in the past years in the forms of thermo-modernization (insulation of the external walls, balconies/loggias and roofs, replacement of the external doors and window frames in common areas, basements and administrative rooms) and modernization of the technical systems (replacement of the central heating and DHW system).

The technical requirements for the observed buildings are similar to the ones described in the previous pilot sites. All 6 MABs are in need of insulations of the envelopes (outside

walls, roofs, floors, ceilings), whereby the already renovated buildings require only further improvements of the current insulation of the walls, roofs (with thicker Styrofoam or mineral wool), plinths and reveals, as well as foundations. Regarding the technical systems, mechanical ventilation systems with heat recovery, DHW tanks and thermostatic radiator valves are the most desired and all buildings consider the installation of PV plants. Finally, the technical staff needed for the implementation of the mentioned measures are energy auditors, designers and architects, technical systems specialists, cost estimators, supervisors and renewable energy (RES) experts.

The mentioned data are supported and presented by the Figures and Table below.

Sokratesa 2B, Warsaw

Wolumen 6, Warsaw

Wolumen 4, Warsaw

Szekspira 4, Warsaw

Aleja W. Reymonta 23, Warsaw

S. Petöfiego 1, Warsaw

Figure 3: Unrenovated MABs in the pilot site Mazovia Voivodeship (Poland)

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

Table 4: Characteristics of unrenovated MABs in the pilot site Mazovia Voivodeship (Poland)

General information						
Location (address, cadastral unit)	Sokratesa 2B, Warsaw	Wolumen 6, Warsaw	Wolumen 4, Warsaw	Szekspira 4, Warsaw	Aleja W. Reymonta 23, Warsaw	S. Petöfiego 1, Warsaw
	146504_8.0805.24/2	146504_8.0803.72/2	146504_8.0802.15	146504_8.0803.94/6	146504_8.0803.94/6	146504_8.0805.16
Ownership structure	100% private, 0 public					
Energy poverty data	Not available					
Role/involvement of the building managers	• Safe housing, maintenance of residential properties, managing local infrastructure, fostering community engagement through cultural and social initiatives (housing cooperative) • Managing the buildings' resources, ensuring quality service to residents, following the financial and economic plan, coordinating and controlling the activities of employees, coordinating the administration with the buildings' council, cooperating with other organizational units of the housing cooperative (building managers)					
Communication	• Regular meetings with the buildings' councils (every 3 months) • Informal technical meetings with residents (several times a month) • Printed notices posted in the buildings or letters delivered to mailboxes			• Meetings with residents (once a year) • Printed notices posted in the buildings or letters delivered to mailboxes		
Technical characteristics						
Year of construction	1985	1987	1987	1975	1974	1966
Gross building area (m^2)	GBA = 3.258,30 m^2	GBA = 5.826,90 m^2	GBA = 1.828,26 m^2	GBA = 23.102,08 m^2	GBA = 20.150,68 m^2	GBA = 5.087,89 m^2
Number of floors	6	7	7	12	12	16
Number and average apartment area	59 55,00 m^2	90 65,00 m^2	22 83,00 m^2	510 45,00 m^2	443 45,00 m^2	95 54,00 m^2

Heating system(s)	District heating			
Energy carrier(s)	District heating			
Energy consumption	Not available	H = 9.409 GJ E = 70.110,68 kWh	H = 8.998,70 GJ E = 79.179,65 kWh	H = 2.178,90 GJ E = 61.136,51 kWh
Energy efficiency class	Not available			
Previous renovation activities	No previous renovation activities were implemented	• Insulation of external walls and roof • Replacement of external doors, window frames in the common areas, basement and administrative rooms • Replacement and modernization of the central heating system • Replacement of the DHW system		

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

As visible in the Figures and Table above, the presented data implicate that certain renovation measures need to be implemented in the observed MABs of the Polish pilot site. Since the buildings were built between the 1960's and 1990's, data about the previous renovations are available for 3 (out of 6) MABs, whereby the modernization was carried out between 1996 and 2012. The implemented measures include the applying of insulation (from 2 to 20 cm thickness, depending on the part of the building) and replacement of the wooden and metal window frames with PVC ones (with heat transfer coefficient of from 1,1 to 1,6 W/m^2K). Also, although it is not strictly mentioned, the current state of the buildings implicates high electricity costs, which would be decreased with the installation of PV plants and production of own energy.

2.1.4. Alba County, Romania

Together with Mazovia Voivodeship in Poland, Alba County is one of the largest pilot sites with approximately 300.000 inhabitants and an area of 6.200 km^2 (City Population, 2025). As part of the region Transylvania, it has a significant cultural and historical significance for the country. The micro-pilot site within the region selected for the activities of the project CEESEN-BENDER is the Municipality of Alba Iulia, which is also the capital city of the County.

For the purposes of this analysis, again 6 unrenovated MABs have been selected. Unlike the previous examples, the Romanian pilot site provided deeper and more detailed data regarding the observed characteristics of the selected MABs. Thus, the addresses and buildings selected for the purposes of the project CEESEN-BENDER are the following:

- Alexandru Ioan Cuza 16, Alba Iulia (Bl. G5-G6)
- Closca 10, Alba Iulia (Bl. 2 C, D, E, F)
- Transilvaniei 8-10, Alba Iulia (Bl. 26-27)
- Gheorghe Sincai 27-31, Alba Iulia (Bl. 71-72-73)
- Orizontului 8-16, Alba Iulia (Bl. B1-B5)
- Livezii 46, Alba Iulia (Bl. 46 Camin).

The selected MABs were built from 1971 until 1986 and are in 100% private ownership. From the total number of residents, 30 to 60% are considered energy poor or at risk of energy poverty, whereby the most vulnerable residents are the ones with low income, elderly, single living, as well as persons with chronic diseases and disabilities.

The gross building area (GBA) ranks from 2.720 m^2 to 6.112 m^2, out of which the conditioned floor area takes up from 2.272 m^2 to 5.073 m^2. Regarding the data about the number of floors, all 6 MABs have 4, with around 63 apartments and an average apartment area of 57 m^2. The heating system is individual and natural gas based and the most used energy carriers are natural gas and electricity. Considering the consumption of certain energy types, the last available yearly data were:

- Heating (H) – 171,74 to 292,17 kWh/m^2
- Hot water (HW) – 52,45 to 71,75 kWh/m^2
- Electricity (E) – 9,59 to 16,37 kWh/m^2.

Finally, the assigned energy efficiency classes are C and D and the energy renovation activities have, already, been partially implemented by the apartment owners.

As for the technical requirements, for all 6 selected MABs similar renovation measures are planned. Thereby, the insulation of the envelope (outside walls, roofs) and replacement of the external carpentry (exterior windows, balcony and entrance doors), as well as waterproofing of the foundation and facade painting are the priority measures. Regarding the technical systems, neither the installation of new nor the replacement of the current heating and lightning systems are planned to be carried out within the energy renovation process. Finally, all renovation works, necessary technical staff and materials will be subcontracted and selected within a public procurement procedure and in compliance to the national laws and regulations.

The following Figures and Table present the mentioned data in more detail.

A. I. Cuza 16,
Alba Iulia

Closca 10,
Alba Iulia

Transilvaniei 8-10,
Alba Iulia

G. Sincai 27-31,
Alba Iulia

Orizontului 8-16,
Alba Iulia

Livezii 46,
Alba Iulia

Figure 4: Unrenovated MABs in the pilot site Alba County (Romania)

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

Table 5: Characteristics of unrenovated MABs in the pilot site Alba County (Romania)

General information						
Location (address, cadastral unit)	A. I. Cuza 16, Alba Iulia (Bl. G5-G6)	Closca 10, Alba Iulia (Bl. 2 C, D, E, F)	Transilvaniei 8-10, Alba Iulia (Bl. 26-27)	G. Sincai 27-31, Alba Iulia (Bl. 71-72-73)	Orizontului 8-16, Alba Iulia (Bl. B1-B5)	Livezii 46, Alba Iulia (Bl. 46 Camin)
	Cadastral unit not available					
Ownership structure	100% private, 0 public					
Energy poverty data	≃40%	≃40%	≃30%	≃40%	≃40%	≃60%
	• Low-income residents • Elderly • Single living residents • Persons with chronic diseases • Persons with disabilities					
Role/involvement of the building managers	• Creation of posters and announcements • Facilitation of the tax collection for utilities from the residents • Representation of the building in front of the utilities' companies and the public administration • Collection of suggestions and complaints from the residents • Supervision of maintenance works in the building					
Communication	• Posters/printed sheets at MABs' entrance doors and homeowner's association cash desk • Meetings with the homeowners (in the building or the City hall) • Phone/email/utilities payment application					
Technical characteristics						
Year of construction	1975	1983	1971	1986	1983	1979
Gross building area (m^2)	GBA = 2.720,00 m^2	GBA = 4.670,00 m^2	GBA = 5.100,00 m^2	GBA = 5.255,00 m^2	GBA = 6.112,00 m^2	GBA = 2.973,00 m^2
Number of floors	4					

Number and average apartment area	40 60,00 m^2	38 80,00 m^2	59 60,00 m^2	53 60,00 m^2	93 60,00 m^2	92 21,00 m^2
Heating system(s)	Individual and natural gas					Individual
Energy carrier(s)	Natural gas and electricity					
Energy consumption	H = 171, 74 kWh/m^2 HW = 71,75 kWh/m^2 E = 9,59 kWh/m^2	H = 245,14 kWh/m^2 HW = 52,45 kWh/m^2 E = 11,64 kWh/m^2	H = 213,30 kWh/m^2 HW = 63,18 kWh/m^2 E = 11,51 kWh/m^2	H = 156,20 kWh/m^2 HW = 55,77 kWh/m^2 E = 9,82 kWh/m^2	H = 292,17 kWh/m^2 HW = 67,20 kWh/m^2 E = 11,95 kWh/m^2	H = 259,56 kWh/m^2 HW = 63,77 kWh/m^2 E = 16,37 kWh/m^2
Energy efficiency class	C	D	C	C	D	D
Previous renovation activities	Partial renovation activities implemented by the apartment owners					

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

The presented data show some differences between the MABs in Romania and the rest of the pilot sites in terms of the technical requirements for renovation, meaning that only the buildings' envelopes are planned to be renovated, while the technical systems will remain the same. During the analysis it was calculated that the eventual energy renovation measures will generate yearly energy savings in average of 252.312 kWh (per building) and 4.459 kWh (per apartment). Also, the estimated yearly cost reduction would be 15.643 EUR (per building) and 276,00 EUR (per apartment).

2.1.5. Spodnje Podravje, Slovenia

The last pilot site of the project CEESEN-BENDER is located in Spodnje Podravje in Slovenia. This area is a part of a bigger statistical region called Podravje which counts 2.000 km^2 in size and has approximately 300.000 inhabitants (City Population, 2025). Thereby, Spodnje Podravje lies on the northeastern part of the mentioned statistical region, along the river Drava and borders, partly, with Medjimurje County in Croatia.

In this pilot site 2 micro-locations have been selected as representative areas for this analysis and those are Ptuj (1 of the 2 major towns in Podravje) and Kidričevo (a small municipality near Ptuj). Here, also, have 6 unrenovated MABs been selected to form the sample on which this analysis and further activities will be implemented, whereby 2 MABs are located in Ptuj and the remaining 4 are in Kidričevo. The specific addresses of the observed MABs are:

- Kajuhova 11, Kidričevo
- Čučkova 7, Kidričevo
- Borisa Kraigherja 7, 9, 11, Kidričevo
- Borisa Kraigherja 20, 22, 24, 26, Kidričevo
- 25. Maja 7, 9, Ptuj
- Arbajterjeva ulica 3, Ptuj.

The average age of the selected MABs is 70 years, while the construction years vary from 1950 to 1985. The ownership is dispersed between the private and public type, whereby only 1 building is in 100% private ownership. Data regarding the energy poverty (meaning number and type of vulnerable households) are not available.

As for the size, data are provided for the net and usable area, whereby the average net area (NA) is 2.552,18 m^2 and the average usable area (UA) is 1.710,08 m^2. The buildings flooring is rounded to 6 floors, with approximately 25 apartments and 64,47 m^2 average apartment area. Furthermore, all 6 buildings are connected to the district heating system and use mostly natural gas and wooden biomass. Data on the energy consumption and energy classes were not available for this analysis and regarding the implemented renovation activities 5 (out of 6 MABs) have in the previous years renovated their roofs.

Regarding the technical requirements, for all 6 buildings the insulation of the envelope (mainly outside walls) and for 4 (out of 6) MABs the replacement of the carpentry are recommended. Also, 4 (out of 6) buildings require the installation of a district heating substation. Finally, technical experts needed for the implementation of the proposed measures are in all cases architects and contractors.

For a better visualization of the collected data, the same are presented in the Figures and Table below.

**Kajuhova 11,
Kidričevo**

**Čučkova 7,
Kidričevo**

**B. Kraigherja 7, 9, 11,
Kidričevo**

B. Kraigherja 20, 22, 24, 26, Kidričevo

25. Maja 7, 9, Ptuj

Arbajterjeva ulica 3, Ptuj

Figure 5: Unrenovated MABs in the pilot site Spodnje Podravje (Slovenia)

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

Table 6: Characteristics of unrenovated MABs in the pilot site Spodnje Podravje (Slovenia)

General information						
Location (address, cadastral unit)	Kajuhova 11, Kidričevo	Čučkova 7, Kidričevo	B. Kraigherja 7, 9, 11, Kidričevo	B. Kraigherja 20, 22, 24, 26, Kidričevo	25. Maja 7, 9, Ptuj	Arbajterjeva ulica 3, Ptuj
	Cadastral unit not available					
Ownership structure	45% private 55% public	100% private	72% private 28% public	37,50% private 62,50% public	95% private 5% public	85% private 15% public
Energy poverty data	Not available					
Role/involvement of the building managers	• Management of residential and commercial buildings • Development and implementation of a maintenance plan • Routine and emergency maintenance works • Accounting and bookkeeping services • Legal and technical advisory services • Management of the reserves funds • Mediation and ensuring transparency in billing and cost sharing among the residents					
Communication	• Annual meetings • Web portal • Email and phone					
Technical characteristics						
Year of construction	1953	1954	1950	1952	1985	1954
Gross building area (m^2)	NA = 5.109,60 m2 UA = 2.519,50 m2	NA = 683,70 m2 UA = 280,20 m2	NA = 3.095,40 m2 UA = 2.603,90 m2	NA = 1.956,20 m2 UA = 1.761,60 m2	NA = 3.181,80 m2 UA = 2.189,40 m2	NA = 1.286,40 m2 UA = 905,90 m2
Number of floors	6	4	5	5	7	7
Number and average apartment area	51 49,40 m^2	4 70,00 m^2	18 76,00 m^2	24 73,40 m^2	38 57,60 m^2	15 60,40 m^2
Heating system(s)	District heating					

Energy carrier(s)	District heating system on natural gas and wooden biomass	
Energy consumption	Not available	
Energy efficiency class	Not available	
Previous renovation activities	Not available	Renovation of the roof

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

From the mentioned data it is visible that, although the selected MABs have already partly been renovated, there is still need for further improvement of the buildings' envelopes. Regarding the technical systems, there are no specific data that would indicate the need for modernization of the same, but considering the ages of the buildings, it can be assumed that the heating and lightning systems are in need for renovation. As in the case of the other pilot sites, the energy measures would foster the energy efficiency of the buildings, decrease the energy costs and ensure a higher real estate value.

In order to start the energy renovation process in the presented pilot sites, the necessary financial programs, tenders, calls and other options need to be ensured. Therefore, the next chapter deals with different financial instruments (transnational, national, regional, local and other) used on country level for a better, faster and direct implementation of the planned and desired energy renovation measures.

2.2. Financial instruments for energy renovation of MABs

While analysing the current energy features of the selected pilot sites, apart from the technical characteristic and requirements, it is important to highlight, also, the financing opportunities for funding energy renovation projects. Within the data collection, the 5 partner countries with selected and described pilot sites provided insights into the, currently, available financial instruments used for encouraging the energy renovation process and increase the energy efficiency of MABs. These are divided into transnational, national, regional and local levels, as well as include various financing instruments such as programs, calls and tenders, grants, subsidies and incentives either for building management authorities or building residents.

In order to get a better overview of the available financial instruments, the following Figure presents a summary of the most used ones provided by the respective countries of the project CEESEN-BENDER.

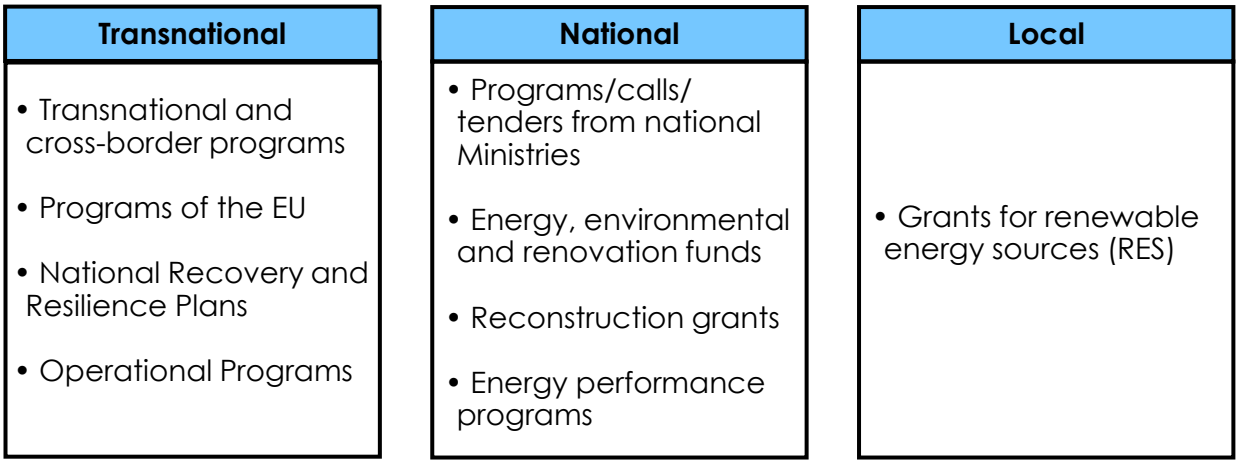


Figure 6: Financial instruments for energy renovation of MABs

Source: Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites, 2025

Related to the Figure above, a brief explanation of the presented financial instruments with descriptions, eligible measures and co-financing rates is provided below. Thereby, it is evident that 4 (out of 5) countries rely mostly on transnational and national financing sources, while local financing opportunities are available only in Poland and regional are not offered in any of the 5 observed countries.

CROATIA

Transnational financial instruments

Transnational and cross-border programs – Interreg

Source: European Regional Development Fund (ERDF)

Programs: Interreg Central Europe, Interreg Danube Region, IPA Croatia – Bosnia and Herzegovina – Montenegro

Topics/activities: increase of energy efficiency and use of RES in combination with storage and charging systems for e-mobility, improving energy performance of buildings, fostering behavioural changes, reducing energy consumption, testing innovative technologies and solutions for RES and energy efficiency, energy planning at regional and local levels, financing schemes and capacity building, energy poverty

Co-financing rates: 80 – 85% depending on the program

Programs of the European Union

Source: European Commission

Programs: LIFE, HORIZON

Topics/activities: development of business models for large-scale deep renovation projects, innovative technologies and tools for constructions and renovations, installation of heat pumps and solar energy systems, development of One-Stop-Shops (OSS), capacity building, renovation of MABs with energy poor residents, construction approaches and solutions for zero emission buildings, improvement of indoor environment and air quality

Co-financing rates: 95% (LIFE), 100% (HORIZON)

National Recovery and Resilience Plan

Source: Mechanism for Recovery and Resilience

Activities: project documentation (energy audits, reports and certificates, main and other project documentation), energy renovation measures (building's envelope, technical systems, RES systems, automation and management systems, green infrastructure elements, safety measures, mobility and accessibility for people with disabilities), supervision and safety coordination, project administration, management and promotion

Co-financing rates:

- 85 – 100% for creation of the project documentation
- 60 – 80% for energy renovation
- 85 – 100% for project administration and management
- 85% for promotion and visibility of the project

Operational programs

Source: European Regional Development Fund (ERDF) and Cohesion Fund (CF)

Activities: project documentation (energy audits, reports and certificates, main and other project documentation), energy renovation measures (building's envelope, technical systems, RES systems, automation and management systems and accessibility for people with disabilities), supervision and safety coordination, project administration, management and promotion

Co-financing rates: the call has been postponed several times and no further information is available

ESTONIA

National financial instruments

National Reconstruction Grant

Source: National subsidy

Activities: reconstruction of MABs, replacement of gas, stove or electric heating devices with RES based ones, connection to the district heating network

Co-financing rates: 30 – 50% (30% in the City of Tartu)

National Reconstruction Grant for renovation with prefabricated facade panels

Source: National subsidy

Activities: reconstruction of MABs, replacement of gas, stove or electric heating devices with RES based ones, connection to the district heating network

Co-financing rates: 50%

POLAND

Transnational financial instruments

Clean Air Program

Source: National Fund for Environmental Protection and Water Management, European Fund for Infrastructure, Climate and Environment

Topics/activities: replacement of inefficient solid-fuel heat sources with high standard sources, thermal insulation of the envelope, replacement of the carpentry, modernization of the central heating and HW systems, installation of PV plants and mechanical ventilation with heat recovery, preparation of project documentation and energy audits

Co-financing rates:

- Basic (without comprehensive thermo-modernization) – 35.000 PLN (1.200 PLN for energy audit) ; basic (with comprehensive thermo-modernization) – 60.000 PLN (1.200 PLN for energy audit)
- Increased (without comprehensive thermo-modernization) – 50.000 PLN (1.200 PLN for energy audit) ; increased (with comprehensive thermo-modernization) – 90.000 PLN (1.200 PLN for energy audit)
- Highest (without comprehensive thermo-modernization) – 59.000 PLN (1.200 PLN for energy audit) ; highest (with comprehensive thermo-modernization) – 99.000 PLN (1.200 PLN for energy audit)

My Electricity Program

Source: National Fund for Environmental Protection and Water Management

Topics/activities: installation of PV plants, energy storage systems, energy management systems

Co-financing rates:

- 4.000 PLN for PV plants
- 5.000 PLN for PV plants with additional elements
- 7.500 PLN for energy storage systems
- 3.000 PLN for energy management systems
- 20.500 PLN maximum grant per project

European Fund for Infrastructure, Climate and Environment

Source: European and national funds

Topics/activities: insulation of public and residential buildings, installation of renewable energy systems

Co-financing rates: 85% (residential buildings and enterprises), 100% (public buildings)

National Recovery and Resilience Plan

Source: Recovery and Resiliency Facility

Topics/activities: insulation of residential buildings, replacement of high emission heat sources, installation of renewable energy systems

Co-financing rates: 85% (residential buildings (multi-family)), for single-family buildings depending on the eligibility under the "Czyste Powietrze" program

Renewable Energy Grant

Source: Bank Gospodarstwa Krajowego, National Recovery and Resilience Plan

Topics/activities: construction, installation or modernization of renewable energy systems

Co-financing rates: 50%

Renovation with Energy Savings Guarantee Plus (Energy Performance Contract)

Source: National Fund for Environmental Protection and Water Management, Modernization Fund

Topics/activities: insulation of the envelope, replacement of the carpentry, modernization of the heating and lightning systems, upgrading of ventilation systems, integration of renewable energy systems

Co-financing rates: 29% (installation-only improvements or combined with a minimum of insulation works), 39% (optimal energy modernization), 49% (high energy modernization)

National financial instruments

Termo Program – Fund for Energy Renovation and Repairs

Source: state budget (Ministry of Development and Technology)

Topics/activities: insulation of the residential buildings, installation of renewable energy systems, reinforcement of large panel buildings, energy efficiency in municipal residential buildings, compensation for owners of rent controlled apartments

Co-financing rates:

- 26% for insulation of the envelope
- 31% for insulation of the envelope combined with the installation of renewable energy systems
- 50% for reinforcing large panel buildings
- 25% renovation bonus
- 50 – 60% bonus and grant (in case of meeting additional conditions)
- Compensation bonus (product of the project cost index and 2% of the conversion factor for every 1 m² of usable floor space in rent-controlled apartments)

Warm apartment

Source: National Fund for Environmental Protection and Water Management

Topics/activities: replacement of inefficient solid-fuel heat sources with efficient sources, connection to an efficient heat source in the building, replacement of the carpentry

Co-financing rates:

- 41.000 PLN (9.442 EUR) for individuals
- 375.000 PLN (86.362 EUR) for housing associations

Local financial instruments

Renewable Energy Installation

Source: City of Warsaw

Topics/activities: installation of heat pumps, solar collectors, PV plants, wind turbines

Co-financing rates:

- heat pumps (air) 30.000 PLN, but no more than 1.000 PLN/kW ; ground 40.000, but no more than 2.000 PLN/kW
- solar collectors - 15.000 PLN, but no more than 1.000 PLN/m^2
- PV plant - 15.000 PLN, but no more than 1.500 PLN/kW
- wind turbines - 15.000 PLN, but no more than 1.500 PLN/kW

ROMANIA

Transnational financial instruments

Regional Operational Program

Source: Cohesion Fund

Topics/activities: insulation of the envelope, replacement of the carpentry, foundation waterproofing and standard facade paint, installation of renewable energy systems

Co-financing rates: 100%

National Recovery and Resilience Plan

Source: NextGeneration EU

Topics/activities: insulation of the envelope, replacement of the carpentry, foundation waterproofing and standard facade paint

Co-financing rates: 100%

National financial instruments

National Multiannual Program for energy performance improvement of housing blocks

Source: National funds

Topics/activities: insulation of the envelope, replacement of the carpentry, foundation waterproofing and standard facade paint, installation of renewable energy systems

Co-financing rates: 80%

SLOVENIA

National financial instruments

Grants for new joint investments in the Energy Efficiency of older buildings with 3 or more individual parts

Source: Eco Fund of the Republic of Slovenia (Ministry of Natural Resources and Spatial Planning)

Topics/activities: insulation of the envelope (external walls, floor above the external air or external walls towards the ground)

Co-financing rates: 30%

Non-refundable financial incentives for citizens for new investments in higher energy efficiency and the use of renewable energy sources in buildings

Source: Eco Fund of the Republic of Slovenia (Ministry of Natural Resources and Spatial Planning)

Topics/activities: installation of energy efficiency wooden windows, insulation of the facade of one or two-dwelling buildings

Co-financing rates: 30%

Transnational and national financial instruments

Non-refundable financial incentives for reducing energy

Source: European Regional Development Fund (ERDF), European Cohesion Policy Program (partial transnational funding), Energy Poverty Reduction Program (partial national funding)

Topics/activities: installation of energy efficiency windows/exterior entrance doors in one or two-dwelling buildings or in individual apartment, insulation of the facade of one or two-dwelling buildings

Co-financing rates: 100%, but not more than 18.000 EUR (including VAT)

3. Recommendations and future steps

Based on the previously analysed data which provided significant insights into the current states of the 30 unrenovated MABs in the selected pilot sites, it is evident that the first step in all cases is the increase of the energy efficiency of the buildings. Related to that, the most required measures are the insulation of the envelope (outside walls, roofs, floors, ceilings) and replacement of the external carpentry (windows and doors). Also, modernization of the technical systems (mainly heating and lightning) is recommended either through the installation of new, efficient and RES based systems or connection to the district heating systems.

Apart from the common measures, each pilot site requires special and plans future interventions tailored to their needs. Thereby, the most highlighted ones are presented below.

CROATIA

- During the implementation of the project, 1 unrenovated MAB (V. Nazora 32, Čakovec) has been partially renovated in forms of new insulation of the building's envelope and ceiling of the basement, partial replacement of the joint and carpentry per apartment, as well as modernization of the joint lightning. In the future the mentioned building needs further modernization of the heating and other technical systems (possibly by using RES), replacement of the remaining carpentry, installation of ventilation systems and green elements.

ESTONIA

- Apart from the classical measures, some special interventions imply the removal of old balconies and installation of prefabricated facade panels. Also, green elements such as waste houses, rainwater drainage systems and mobility measures (bicycle houses) are planned.

POLAND

- Energy renovation measures have been partially carried before, but, due to the age of the buildings and the length of time since the last renovation, it is necessary to refresh the implemented interventions (mostly, on the buildings' envelopes).

ROMANIA

- Renovation measures are planned only for the buildings' envelopes, while the technical systems are not planned to be modernized
- Partly renovations already made by the apartment owners, but were not officially certified, so the energy classes remain C and D
- A further step forward would be made by including the modernization of the current technical systems of the buildings into the renovation process.

SLOVENIA

- Partial renovation of the roof already done from 2001 until 2010. Now, mostly the buildings' envelopes are planned to be renovated, while the technical systems will remain the same.
- Since the MABs are connected to the district heating systems, substations for the buildings are planned to be installed.

Related to the mentioned, some MABs have already been applied to energy renovation calls and tenders published by the national and local authorities. In some cases, the funds have been received for partial renovation, while in other the renovation projects have not been granted and the managing authorities are waiting for calls and tenders announced for the upcoming periods.

Based on the conducted analysis and presented data, it can be concluded that the 30 unrenovated MABs in the selected pilot sites require significant changes in their construction and technical systems, as well as addition of green elements. The type and depth of the planned interventions depend, mostly, on the age of the buildings, energy carriers and consumption, but, also, on the willingness of the managing authorities and residents to start the energy renovation projects.

In the upcoming periods, either through the project CEESEN-BENDER or other transnational, national and local programs, calls, tenders and financing sources, it is recommended to take all steps and measures in order to start the energy renovation of the observed and presented MABs. These interventions will help in modernizing the buildings, their constructions and technical systems, but, also, foster energy renovation projects on the national, regional and local levels. Finally, energy renovation implies decreased energy consumption and costs, better living conditions for the residents, increased real estate values, modernization of the neighborhoods, and, gradually better environmental protection.

4. Conclusion

Energy renovation is an important step in extending the lifespan of buildings. By strengthening the external construction and modernizing the internal systems, the buildings become more resilient and offer the residents better living conditions. In order to recommend and implement measures which will have the biggest and best impact, it is important to analyse the current state of the construction, technical systems and possible requirements of the buildings themselves.

Such an analysis has been conducted within the project CEESEN-BENDER, where 5 (out of 6) project countries with corresponding pilot sites selected 30 unrenovated MABs (6 per pilot site) and provided information about their current characteristics. By observing the construction details, ownership structure, technical features, energy consumption and energy poverty presence, the project partner organizations could recommend measures and interventions needed for the overall improvement of the MABs.

Related to the mentioned, further common conclusions arose from the analysis:

- 30 MABs were built between the 1950 and 1987
- 24 MABs are in 100% private ownership and 6 MABs keep data on the number and type of vulnerable residents
- 30 MABs are operated by managing authorities (building managers, homeowner associations, managing companies) and have regular meetings and consultations with the same
- 30 MABs use either natural gas, firewood/wooden biomass and electricity
- 17 MABs are connected to the district heating system.

In addition, all 30 selected MABs are in need for the insulation of the envelope and replacement of carpentry (either partial or complete), whereby most of them require modernization of the technical systems (heating and lightning) and some have additional requests on other elements (such as sewage, foundations, balconies, facades, rainwater systems, green and bicycle houses, etc.).

A faster and better implementation of the interventions is accomplished through various transnational, national and local financial instruments, whereby the most used are the transnational programs, calls and tenders provided by the European Union. Related to the mentioned, most observed MABs have already been applied to the available financing sources, out of which some were granted and partially refurbished and others are planned to be applied to the future announced calls and tenders.

Finally, this analysis is the basis point for a deeper and more detailed observation of the selected unrenovated MABs within the planned activities of the project CEESEN-BENDER. The collected data and findings already are and will further be used in the activities of air quality monitoring, testing digital tools and development of pilot area and building level roadmaps and, therefore, present the core information for the implementation of the project CEESEN-BENDER and sustainability of the results beyond its ending.

References

1. City Population.de (2025). Alba. City Population.de (https://citypopulation.de/en/romania/admin/centru/RO121__alba/, accessed in February 2025)
2. City Population. de (2025). Mazowieckie. City Population.de (https://www.citypopulation.de/en/poland/admin/14__mazowieckie/, accessed in February 2025)
3. City Population.de (2024). Međimurje. City Population.de (https://www.citypopulation.de/en/croatia/admin/20__me%C4%91imurje/, accessed in December 2024)
4. City Population.de (2025). Podravska. City Population.de (https://www.citypopulation.de/en/slovenia/admin/POD__podravska/), accessed in February 2025)
5. Project CEESEN-BENDER, WP2: T2.1 Analysing the overall context of the selected buildings in pilot sites
6. Wikipedia.org (2024). Alba County. Wikipedia.org (https://en.wikipedia.org/wiki/Alba_County#/media/File:Alba_in_Romania.svg, accessed in December, 2024)
7. Wikipedia.org (2024). Masovian Voivodeship. Wikipedia.org (https://en.wikipedia.org/wiki/Masovian_Voivodeship#/media/File:Masovian_in_Poland_(+rivers).svg, accessed in December, 2024)
8. Wikipedia.org (2024). Međimurje County. Wikipedia.org (https://en.wikipedia.org/wiki/Me%C4%91imurje_County#/media/File:Me%C4%91imurska_%C5%BEupanija_in_Croatia.svg, accessed in December, 2024)
9. Wikipedia.org (2024). Tartu County. Wikipedia.org (https://en.wikipedia.org/wiki/Tartu_County#/media/File:Tartu_County_in_Estonia.svg, accessed in December, 2024)
10. Wikipedia.org (2024). Podravska (regija). Wikipedia.org (https://sh.wikipedia.org/wiki/Podravska_%28regija%29#/media/Datoteka:Drava_Statistical_Region_in_Slovenia.svg, accessed in December, 2024)

The CEESEN-BENDER project has received funding from the European Union's Programme for the Environment and Climate Action (LIFE 2021-2027) under grant agreement no LIFE 101120994. The information and views set out in this material are those of the author(s) and do not necessarily reflect the official opinion of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.