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Rural Energy Efficiency Roadmap - REER

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About RENOVERTY

RENOVERTY will foster energy efficiency building upgrades in the Central and Eastern European (CEE), South-eastern Europe (SEE) countries, as well as Southern European (SE) countries, by setting the methodological and practical framework to build renovation roadmaps of vulnerable rural districts in a financially viable and socially just manner.

Specifically, the project aims to deliver tools and resources to support local and regional actors to build and execute operational single or multi-household roadmaps for rural areas. A scalable model will also be created to ensure the wide geographical replicability and implementation of the roadmaps by different actors at the EU level. Strategically, the project will contribute to minimising logistical, financial, administrative, and legal burdens caused by a complex and multi-stakeholder home renovation process. Additionally, RENOVERTY will ensure that building retrofits consider the social dimension by incorporating security, comfort, and improved accessibility in the roadmaps to further improve the quality of life of vulnerable populations.

Over the project's three years, seven pilots located in Sveta Nedelja (Croatia), Tartu (Estonia), Bükk-Mak & Somló-Marcalmente-Bakonyalja Leader (Hungary), Zasavje (Slovenia), Parma (Italy), Coimbra (Portugal), and Osona (Spain) will implement the roadmaps, while wider integration of rural and peri-urban development is foreseen in the long run.

Table of Contents

List of figures

List of tables

Background to the Area of Study and the purpose of the REER

The Rural Energy Efficiency Roadmap (REER) involves 7 European countries and 17 selected rural areas, with the goal of creating actionable roadmaps to renovate residential buildings in rural regions. The primary objective of the roadmaps is to provide citizens with practical guidance for improving the energy efficiency of their homes, reducing energy costs and addressing energy poverty. The roadmaps are also intended for stakeholders working to combat energy poverty, offering adaptable tools that can be tailored to specific regional needs. In Italy, the province of Parma was chosen as the reference area due to its aging and energy-inefficient building stock.

Parma, located in the heart of the Po Valley – a region that accounts for approximately 40% of Italy's population (around 23 million people) and generates close to 50% of the national GDP – is part of one of Italy's most densely populated and productive areas. However, the region's orographic and anthropogenic features make it particularly vulnerable to air pollution. Air quality in the province frequently exceeds legal thresholds (Directive 2008/50/EC, transposed with Legislative Decree 155/2010), prompting the EU to initiate an infringement procedure (n°2014/2147 and subsequent actions). This area includes 24 municipalities in the province of Parma among the total 195 involved.

The province is divided into three main areas: the fertile Po Valley to the north, which is well-suited for agriculture; the central hilly belt and the Apennines to the south, characterized by small villages and vast agricultural and forested districts. Major rivers, such as the Taro and Parma, enhance the area's suitability for agricultural development and water resource management. The climate is continental, with hot, humid summers and cold winters, with peak rainfall occurring in autumn and spring. In 2024, Parma, Italy, experienced an average annual temperature of approximately 13.7 °C, while the highest temperature recorded during the year was 34.4 °C and the lowest was -1.1 °C

The population of approximately 450,000 residents is predominantly concentrated in the provincial capital, Parma, which serves as the economic, cultural and administrative centre of the province. The plains are densely populated, while the hilly and mountainous areas exhibit a more sparse and scattered population. Over recent decades, an increase in the immigrant population has contributed to the local social and cultural diversity.

From a socio-economic perspective, Parma is a leader in the agri-food sector. Iconic products like Parmigiano Reggiano and Prosciutto di Parma make agriculture and food processing key pillars of the local economy. Additionally, the province is home to international companies in the mechanical, chemical and pharmaceutical sectors, including Chiesi and Lilly, and the capital is a major hub for services, commerce and tourism.

Despite this robust economic foundation, rural and mountainous areas of the province face significant challenges, including an outdated building stock and widespread energy poverty. An analysis of the residential building stock reveals that much of it is obsolete, having been constructed before 1976, the year energy efficiency regulation the law 373/76 were introduced.

Currently, around 90% of homes are equipped with heating and/or domestic hot water systems, with 77% relying on methane as the primary fuel. However, rural areas, which are only partially served by the methane network, often use alternative fuels such as Liquefied petroleum gas (LPG), diesel and wood. Furthermore, 75% of Energy Performance Certificates (EPCs) issued in the province fall into the least efficient energy classes - E, F and G - highlighting particularly poor performance in terms of energy loss through opaque and transparent surfaces. Renovating these elements is challenging due to high costs and technical complexity, resulting in a low renovation rate for buildings.

The RENOVERTY project emphasizes the need for long-term, structural interventions to improve air quality and reduce energy consumption and emissions in the residential sector. Additionally, challenges arising during the COVID-19 pandemic underscored the importance of improving domestic environments - not only to reduce consumption and costs but also to enhance the quality of life of households, particularly for the most vulnerable sections of the population.

The document is divided into two parts. The first part details the work carried out in collaboration with the Territorial Agency for Energy and Sustainability of Parma (Agenzia Territoriale per l'Energia e la Sostenibilità - ATES) and the Local Action Group (LAG) "GAL del Ducato". It covers the types of buildings selected, the inspections and energy audits conducted, and the meetings held with property owners. Additionally, it outlines the main obstacles encountered during the process, the solutions developed to overcome them, the energy efficiency measures proposed, and their projected impact on energy consumption and emissions.

The second part provides a broader overview of renovation objectives, potential barriers, and challenges, which may vary by area, along with suggestions on how to address them. This section also identifies key stakeholders, from local to national levels, who should be involved in the co-creation of solutions. Finally, it outlines strategies for promoting scalability, replicability and dissemination of the roadmaps.

As the two parts share some overlapping sections, it is recommended to consult the first part for a detailed, predominantly technical analysis supported by data, graphs and models. Conversely, those seeking general guidelines for constructing REERs and solutions to common challenges can refer directly to the second part for practical insights.

1. Technical Considerations for Renovating Homes Affected by Energy Poverty

In Italy, the definition of energy poverty corresponds to that found in Directive (EU) 2023/1791, which states that it is the

"inability of a household to access essential energy services that provide basic levels and decent standards of living and health, including an adequate supply of heating, hot water, cooling lighting, and energy to power appliances, within the respective national context of existing national social policy and other relevant national policies, due to a combination of factors, including at least economic inaccessibility, insufficient disposable income, high energy expenditures, and poor household energy efficiency."

This definition has also been included within the National Integrated Energy and Climate Plan (PNIEC), and in its latest version, the "share of the total population unable to adequately heat their homes" is taken as an indicator.

1.1. Energy Audits

The energy certification of buildings evaluates the energy quality of a property to promote efficiency through a detailed analysis of its performance. This process culminates in the issuance of an Energy Performance Certificate (EPC), prepared by a qualified technician after a comprehensive building inspection. The EPC, mandatory for the sale or rental of entire buildings, provides essential information such as the building's overall energy performance, energy class, energy demand, CO_2 emissions, and recommendations for improvements. The energy class is determined by the global non-renewable energy performance index (EPgl,nr), with higher classes indicating lower consumption and greater efficiency. In addition to enhancing transparency in the real estate market, the EPC identifies measures to improve energy efficiency, thereby reducing costs and emissions.

To prepare the EPC, certified technicians gather documentation, including the cadastral survey, floor plans, and the system's booklet. They conduct an inspection to evaluate the building's energy-related features, such as wall stratigraphy, construction details, and system specifications. Using software certified by the Italian Thermotechnical Committee (CTI), they calculate the global energy performance index and assign the energy class. The technician also proposes interventions to improve the property's energy efficiency. The EPC must be registered in the regional energy certification system and remains valid for up to 10 years, unless updates are required due to renovation works.

To represent the diversity of building types in the province, an analysis was conducted considering construction periods, building types (single or multi-family), envelope characteristics, heating systems (autonomous or centralized), and historical-testimonial value. Five main building categories were identified:

1. Single-storey detached buildings (two-family) constructed before 1980, featuring reinforced concrete load-bearing structures with brick infills.
2. Multi-storey detached buildings built before 1945, characterized by exposed stone structures (of historical value) and autonomous heating systems.
3. Multi-storey detached buildings (condominiums) with at least six apartments, built before 1960, with solid brick or stone structures and autonomous heating systems.
4. Multi-storey detached buildings (condominiums) with at least six apartments, built before 1980 featuring reinforced concrete structures, brick infills and centralised heating.
5. Multi-storey row buildings constructed before 1945, with load-bearing structures and autonomous heating systems.

The selection of buildings for auditing was carried out in collaboration with the Local Action Group "GAL del Ducato", agricultural trade associations like Coldiretti and Confagricoltura (for single/two-family buildings), and the Territorial Agency for Energy and Sustainability of Parma (ATES) for condominium buildings in rural areas. The selected buildings are located in the municipalities of Fornovo, Solignano, Berceto, Bedonia, Tornolo and Albareto.

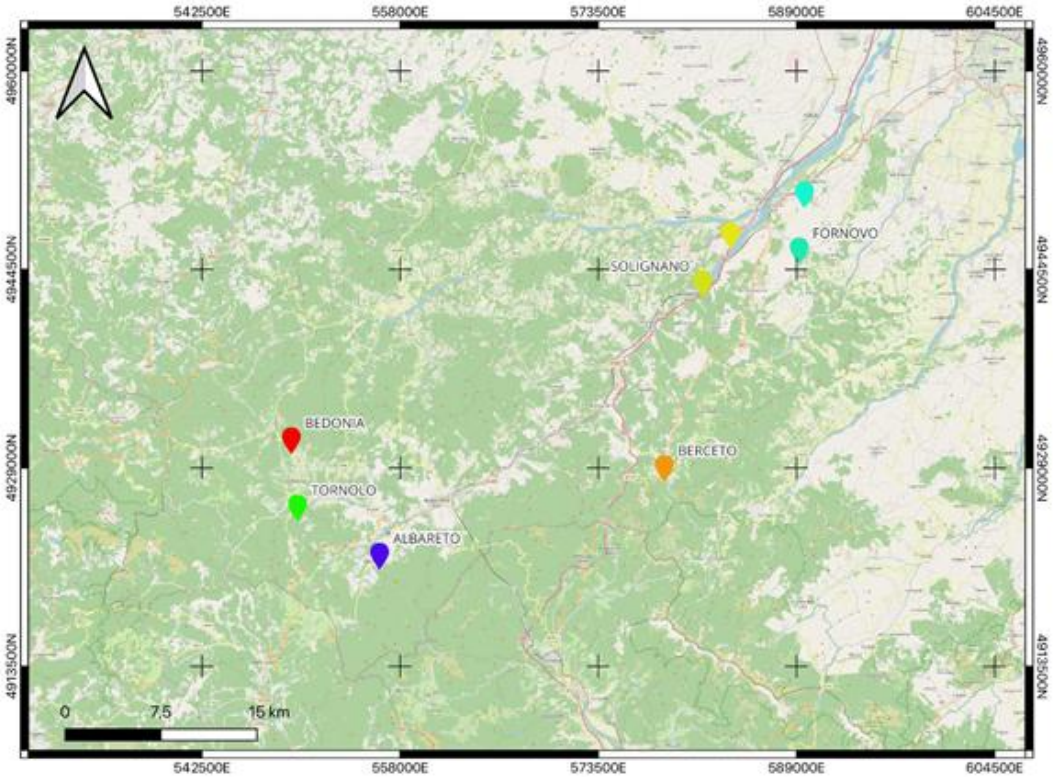


Figure 1: Map of municipalities

A total of 24 inspections were conducted, one for each apartment. These inspections collected data essential for developing a building-system model, which is fundamental for drafting the EPC. Local climatic conditions, specifications of opaque and transparent envelope elements (e.g., type, thickness and energy performance of walls, floors and windows), and air conditioning systems were analysed.

This data enabled the creation of 24 EPCs and the development of "expeditious audits" – streamlined reports that combine energy audits and EPC insights. These audits describe the current state of buildings and identify cost-effective measures to improve energy efficiency and performance.

1.1.1 Expeditious Audit of the 1st Building

The building is located in the Municipality of Albareto, in the southernmost part of the Province of Parma, in the locality of Case Mirani, north of the town of Albareto. The area is classified as climate zone F, with over 3,001 Degree Days and no restrictions on the hours or period of operation for air conditioning systems. Built in the early 1900s, the building consists of a basement and one above-ground floor intended as a residence. The load-bearing structure is made of stone and solid bricks, partially plastered, while the base and roof floors adjoin unheated spaces (cellar and attic). The building components lack thermal insulation. During the inspection, the building was found to have no windows, air conditioning systems, or lighting systems, resulting in an energy class G classification.

1.1.2 Expeditious Audit 2nd Building

The building is located in the Municipality of Bedonia, in the southwestern part of the Province of Parma. It falls within climate zone E (2,100-3,000 Degree Days), with air conditioning systems allowed to operate between October 15 and April 15 for a maximum of 14 hours per day. The building is located in Prato, north of the town of Bedonia, and was built at the beginning of the 1900s. It includes two above-ground floors intended as residential space. The load-bearing structure consists of stone and solid bricks, with a concrete slab for the ground floor and a wooden slab for the roof. The building elements lack thermal insulation. Windows are wooden, fitted with traditional double glazing. A recently installed air conditioning system consists of a 7.5 kW biomass stove. Domestic hot water is provided by an electric boiler, while lighting is supplied by LED lamps (approximately 20 W each). A 4.8 kW photovoltaic system is installed on the roof. The building is classified as energy class G.

1.1.3 Expeditious Audit of the 3rd Building

The building is located in the Municipality of Berceto, in a predominantly mountainous area classified as climate zone F, with over 3,001 Degree Days and no restrictions on the operation of

air conditioning systems. Built in 1960, the building is situated in the town of Berceto and consists of three above-ground floors with a total of six apartments (two per floor). The load-bearing structure is made of reinforced concrete, with plastered perforated brick infills. The base and roof floors are constructed of brick and concrete, adjoining unheated spaces (cellar and attic). The building components lack thermal insulation. The windows, made with aluminium frames, have either single glazing or traditional double glazing. The autonomous air conditioning system includes a dated methane gas boiler (less than 35 kW) used for heating and domestic hot water. The lighting system uses traditional lamps (40-60 W). The building is classified as energy class G.

1.1.4 Expeditious Audit of the 4th Building

The building is located in the Municipality of Fornovo, in a hilly area at the confluence of the Taro and Ceno rivers, classified as climate zone E (2,100-3,000 Degree Days). Air conditioning systems operate from October 15 to April 15 for a maximum of 14 hours per day. The building, located in Riccò, east of the town of Fornovo, was constructed in 1960. It consists of a basement, used as cellars and garages, and three above-ground floors with a total of 12 apartments (four per floor). The load-bearing structure is made of reinforced concrete, with perforated brick infills. The base and roof floors are made of brick and concrete and adjoin unheated areas (cellar/garage and attic). The building lacks thermal insulation. Windows, made of wood, are equipped with single glazing. The centralized air conditioning system is powered by an outdated methane gas boiler (greater than 35 kW). The lighting system primarily consists of traditional lamps (40-60 W). The building is classified as energy class G.

1.1.5 Expeditious Audit of the 5th Building

The building is located in the Municipality of Fornovo, on the slopes of the Parma Apennines at the confluence of the Taro and Ceno rivers, in the locality of Vizzola, east of Riccò. It is classified as climate zone E (2,100-3,000 Degree Days), with air conditioning systems operating from October 15 to April 15 for a maximum of 14 hours per day. Built in 1900, the building consists of three above-ground floors intended as residences. The load-bearing structure is solid masonry, with base and roof slabs constructed of brick and cement adjoining unheated spaces (ground floor and attic). The building components lack thermal insulation. Windows, with wooden frames, are fitted with single glazing or traditional double glazing. The air conditioning system includes three condensing methane gas boilers installed in 2020. The lighting system uses traditional lamps (40-60 W). A 5.4 kW photovoltaic system was also installed in 2020. The building is classified as energy class G.

1.1.6 Expeditious Audit of the 6th and 7th Buildings

The building is located in the Municipality of Solignano, in the locality of Ravagnina, a hilly area between the Taro and Ceno rivers on the slopes of the Parma Apennines. It is classified as climate zone E (2,100-3,000 Degree Days), with air conditioning systems operating from October 15 to April 15 for a maximum of 14 hours per day. Built in 1975, the building is adjacent to an identical and symmetrical structure and consists of a single above-ground floor intended for housing. The load-bearing structure is made of reinforced concrete, with perforated block infills. The base and roof floors, made of brick and concrete, adjoin unheated spaces (cellar and attic). The building components lack thermal insulation. Windows, made with wooden frames, are equipped with single glazing. The autonomous air conditioning system is powered by a traditional LPG boiler (less than 35 kW), installed in 2010, for combined heating and domestic hot water production. The lighting system primarily uses traditional lamps (40-60 W). The building is classified as energy class G.

1.1.7 Expeditious Audit of the 8th Building

The building is located in the Municipality of Tornolo, a predominantly mountainous area classified as climate zone F, with over 3,001 Degree Days and no restrictions on the operation of air conditioning systems. Built in 1960 in the town of Tornolo, the building consists of a single above-ground floor intended for housing. The load-bearing structure is made of reinforced concrete, with perforated block infills in the original section and wooden infills in the extended section. The base and roof floors, made of brick and concrete, adjoin unheated spaces (cellar and attic). Windows, with wooden frames, are fitted with traditional double glazing. The autonomous air conditioning system includes a traditional methane gas boiler (less than 35kW) installed in 2021, for combined heating and domestic hot water production. Domestic hot water is supplemented by a solar thermal system with panels of approximately 2 square meters. The lighting system primarily uses traditional lamps (40W). The building is classified as energy class G.

1.2. Renovation Expectations and Indicators for Rural Households

The objectives and indicators for energy renovation of buildings serve as an essential guide to improving energy efficiency, reducing consumption, and lowering CO_2 emissions. Below, the primary objectives and associated indicators for monitoring the results of renovations are described. The use of these indicators allows for the monitoring of progress and outcomes of renovation efforts, ensuring measurable improvements in the energy efficiency of buildings.

Objectives of Energy Renovation	
Reduced Energy Consumption:	- Minimize the energy required for heating, cooling and lighting buildings. - Replace or optimize heating, ventilation, and air conditioning (HVAC) systems.
Reduction of CO_2 Emissions:	- Lower the environmental impact of buildings through improved energy efficiency and integration of renewable energy sources.
Improved Living Comfort:	- Achieve optimal indoor temperatures, enhanced air quality, and better sound insulation. - Reduce heat loss to ensure greater indoor climate stability. - Improve health and well-being by reducing presence of damp and mould.
Increased Share of Renewable Energy:	- Incorporate solar panels, photovoltaic systems, or geothermal systems to decrease reliance on traditional, non-renewable energy sources.
Economic Enhancement of Buildings:	- Elevate the energy class of buildings (e.g., A+, A), and the increasing of the value of the property for the owners. - Reduce long-term energy management costs. - Allow households to become prosumers.
Cost Savings for Users:	- Lower energy expenses through targeted efficiency improvements. - Opportunity for households to not be exposed to the effects of poverty or energy poverty.

Compliance with Energy Regulations:	- Adhere to European, national, and local energy efficiency directives, such as the Energy Performance of Buildings Directive (EPBD).

Table 1: Objectives of Energy Renovation

Indicators to Monitor the Success of Energy Renovation	
Energy Class:	- Measures the improvement in the building's energy classification (e.g., A+, A, B, C, etc.). - Reflects the overall efficiency of the building in terms of primary energy consumption. - **An ideal improvement corresponds to a jump of at least two energy classes (e.g., from G to E).**
Energy Consumption per Square Meter (kWh/m²/year):	- Indicates the annual energy consumption for heating, cooling, domestic hot water, and lighting per m^2·**Optimal values range between 50 and 90 kWh/m²/year.**
Reduction of CO_2 Emissions ($kgCO_2$/year):	- Quantifies the decrease in CO_2 emissions achieved through renovations. - **An optimal reduction falls between 30% and 50%.**
Thermal Insulation (Thermal Transmittance U - W/m²K):	- Assesses the quality of thermal insulation in walls, roofs and windows. Lower values indicate greater efficiency in reducing heat loss. - **Optimal values for thermal transmittance range between 0.20 and 0.30 W/m²K for walls and roofs.**
Share of Renewable Energy (%):	- Monitors the proportion of renewable energy in the building's total energy needs. - **The goal is to achieve a renewable energy share of 30% to 50%.**
Efficiency of Heating and Cooling Systems (COP/EER):	- The Coefficient of Performance (**COP**) for heating and the Energy Efficiency Ratio (**EER**) for cooling measure system efficiency. Higher values represent greater efficiency. - **Recommended benchmarks are COP ≥ 4.0 and EER ≥ 3.5.**
Return on Investment (ROI):	- Evaluates the time required to recoup renovation costs through energy savings. - **An ideal ROI ranges between 5 and 10 years, depending on the energy-saving measure implemented.**
Economic Savings on Energy Bills (%):	- Compares pre- and post-renovation energy expenses to quantify actual savings. - The goal is a 20% to 50% reduction in energy bills.

Living Comfort Indices (PMV, PPD):	- The Predicted Mean Vote (**PMV**) and the Predicted Percentage of Dissatisfied (**PPD**) measure thermal comfort as perceived by occupants. - **Optimal ranges for PMV are between -0.5 and +0.5, while PPD should be below 10%.**

Table 2: Indicators to Monitor the Success of Energy Renovation

1.3. Planning the Renovation

To identify the energy efficiency measures to be implemented and establish priorities for action, a strategy combining two complementary approaches was adopted: the development of energy audits and the use of the DREEM (**Dynamic high-Resolution dE-mand-sidE Management**) model. This software enables the simulation of consumption scenarios and proposes optimized energy efficiency interventions based on potential savings and technical-economic feasibility.

Seven Energy Efficiency Measures (EEMs) were identified for the application of the DREEM model, applicable to all pilots:

- EEM1 - Insulation of External Walls: External insulation of the main walls of the building (typically solid walls without cavities).
- EEM2 - Double-Glazed Windows: Replacement of single-glazed windows with energy-efficient double-glazed windows to reduce heat loss.
- EEM3 - Roof Insulation: Insulation between and beneath roof beams to reduce the overall heat transfer coefficient, utilizing materials with low thermal conductivity (applicable only to single-family buildings).
- EEM4 – Energy-Efficient Heating System (Gas Boiler): Replacement of an outdated heating system with a high-efficiency gas boiler.
- EEM5 – Energy-Efficient Heating System (Biomass Boiler): Replacement of an outdated heating system with a high-efficiency biomass boiler.
- EEM6 - Energy-Efficient Heating System (Heat Pump): Replacement of an outdated heating system with the installation of a high-efficiency heat pump.
- EEM7 - Energy-Efficient Lighting: Replacement of traditional lamps (fluorescent lamps) with highly efficient LED systems.

Effects of Selected Energy Efficiency Measures

For single-family buildings, the simulation indicates that replacing the existing heating system with a heat pump is the most effective measure. It reduces cumulative annual energy consumption to 10,172.8 kWh, achieving a saving of 17,758.9kWh (a 63.6% reduction compared to the baseline scenario). In terms of effectiveness, this is followed by roof insulation, which reduces consumption to 17,114.4 kWh, with annual savings of 10,816.4 kWh (a 38.7% reduction), and external wall insulation, which reduces consumption to 23,219.7 kWh, with annual savings of 4,711.1 kWh (a 16.9% reduction).

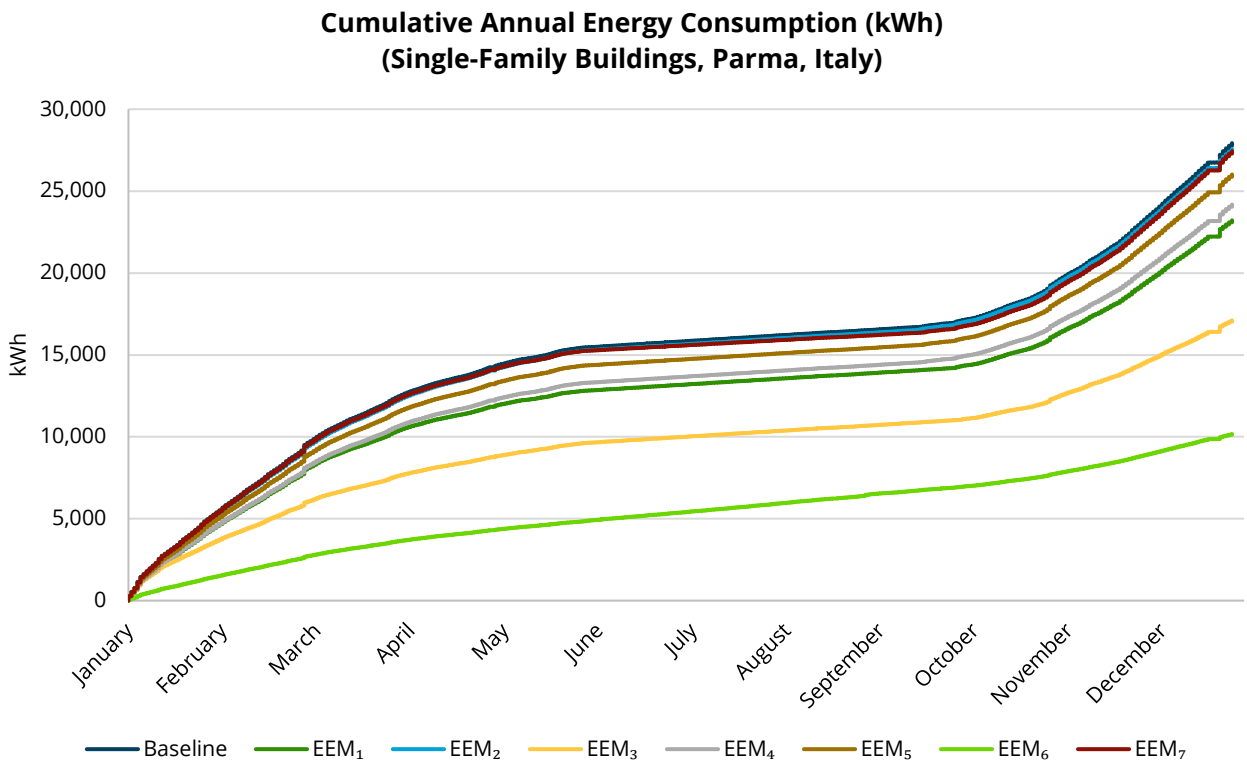


Figure 2: Cumulative Annual Energy Consumption in Parma for Single-family buildings

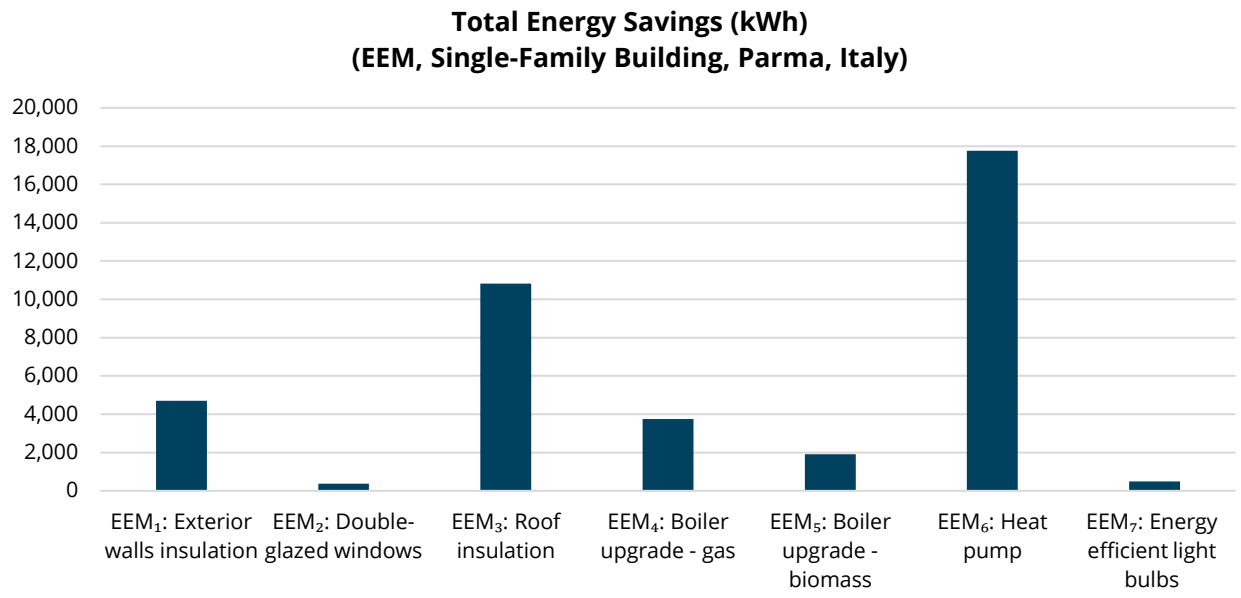


Figure 3: Total Energy Savings in Parma for Single-family buildings and each energy efficiency measures

For multi-family buildings, the simulation shows that replacing the heating system with a heat pump also yields the greatest energy savings, reducing cumulative annual consumption to 10,159.1 kWh, with a saving of 15,696.7 kWh (a 60.7% reduction). This is followed, in terms of effectiveness, by the insulation of external walls, which reduces annual consumption to 17,432.6 kWh, with a saving of 8,426.2 kWh (a 32.6% reduction), and the installation of an enhanced gas boiler, which reduces annual consumption to 22,179.9 kWh, with a saving of 3,675.8 kWh (a 14.2% reduction).

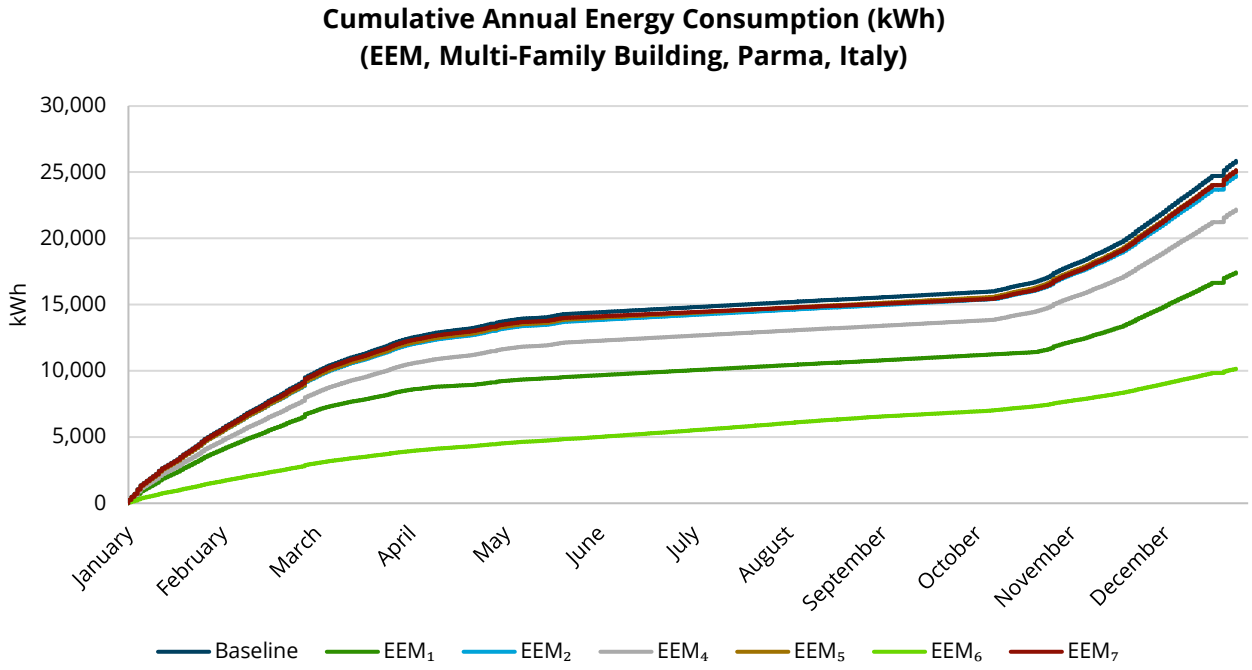


Figure 4: Cumulative Annual Energy Consumption in Parma for Multi-family buildings

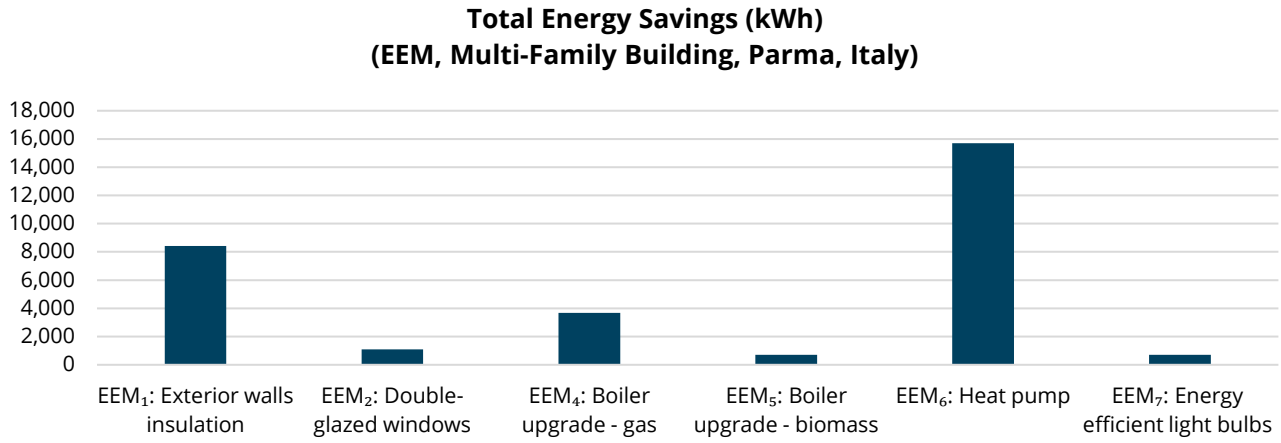


Figure 5: Total Energy Savings in Parma for Multi-family buildings and each energy efficiency measures

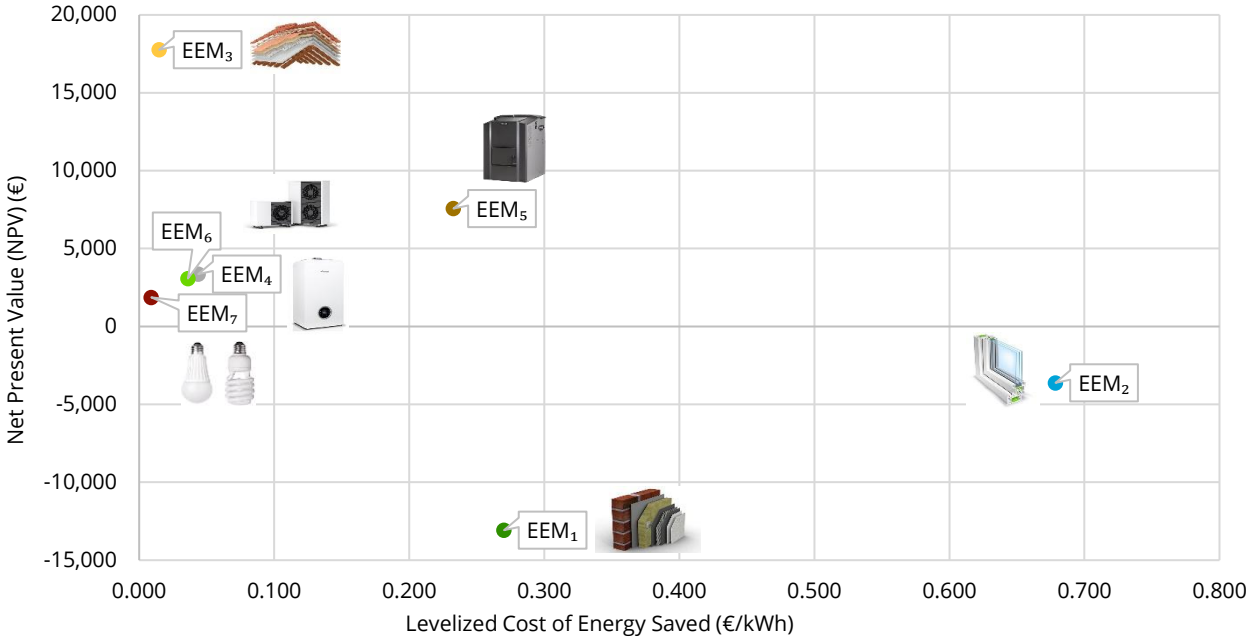
Economic Benefits and Return on Investment

This section outlines the indicators used to highlight the economic benefits of each energy efficiency measure. The key indicators considered are:

1) Investment Costs (€): Represents the total expenditure required to implement a specific project or intervention, including initial costs for materials, labour, installation, and other related expenses.
2) Useful Life (Years): Estimates the period during which the investment or installation (e.g., heating or thermal insulation system) remains effective and functional before requiring significant repairs or replacements.
3) Discount Rate (%): The percentage used to discount future cash flows, calculating the present value of anticipated savings or earnings while accounting for inflation and the cost of capital or expected return rate.
4) Net Present Value (NPV) (€): The difference between the present value of future cash flows generated by the investment and its initial cost. A positive NPV indicates a profitable investment, serving as a critical indicator for evaluating a project's cost-effectiveness.
5) Payback Period (Years): The time required to recover the initial investment through the savings or benefits generated. This reflects how many years it takes for economic returns to offset costs.
6) Levelized Cost of Energy Saved (LCSE): Measures the cost per kWh of energy saved, calculated by dividing the total investment cost by the energy saved over the useful life of the intervention. This facilitates comparison of the economic efficiency of different measures.

Single-Family Buildings

According to the DREEM model, developed by the University of Piraeus Research Centre (UPRC), the measures with the best NPV performance for single-family buildings are roof insulation and biomass boiler upgrades, with NPVs of €17,765.9 and €7,568.6, respectively. Conversely, external wall insulation and replacing windows with double-glazed alternatives yield negative NPVs, making these interventions unprofitable without subsidies. The most cost-effective measures, in terms of LCSE, are energy-efficient light bulbs and roof insulation, with LCSEs of €0.009/kWh and €0.015/kWh, respectively. These measures also have the shortest payback periods, at 0.4 and 2.4 years, respectively.



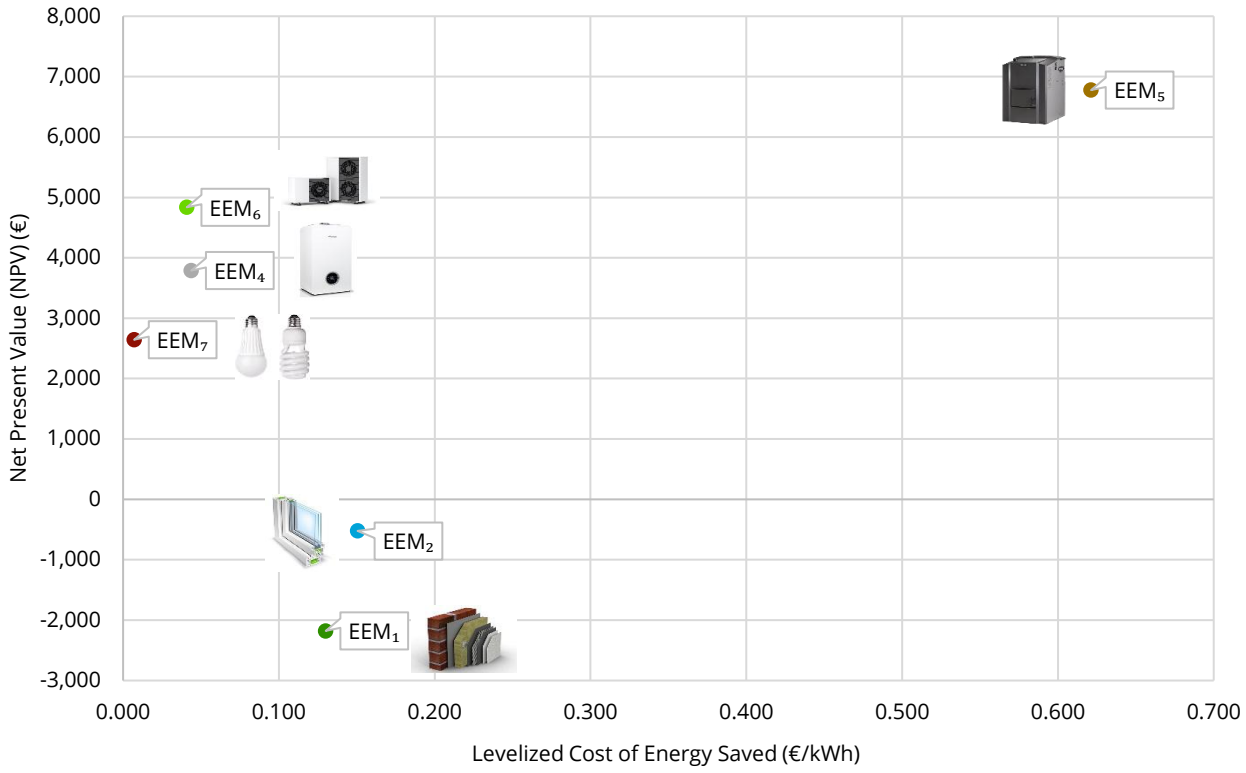
The table below outlines investment costs, useful life, discount rate, NPV, payback period and levelized cost of energy saved (LCSE) for single-family buildings, in the absence of subsidies.

Energy Efficiency Measure	Investment Costs (€)	Useful Life (Years)	Discount Rate (%)	NPV (€)	Payback Period (Years)	Levelized Cost of Energy Saved (€/kWh)
EEM1: Insulation of External Walls	22,013	30	4.00%	-13,072.3	>Lifetime	0.270
EEM2: Double-Glazed Windows	4,313	30	4.00%	-3,615.0	>Lifetime	0.679
EEM3: Roof Insulation	2,762	30	4.00%	17,765.9	2.5	0.015
EEM4: Gas Boiler Upgrade	735	20	4.00%	3,364.8	2.6	0.044
EEM5: Biomass Boiler Upgrade	3,500	20	4.00%	7,568.6	4.8	0.233
EEM6: Heat Pump	6,000	20	4.00%	3,078.9	11.4	0.036
EEM7: Energy-Efficient Light Bulbs	60	23	4.00%	1,871.6	0.4	0.009

Table 3: Table reporting energy efficiency measure and respective Investment Costs, Useful Life, Discount Rate, NPV, Payback Period, Levelized Cosy of Energy Saved for Single-family buildings

Multi-Family Buildings

For multi-family buildings, upgrading the biomass boiler and installing a heat pump deliver the highest NPV, with values of €6,777.5 and €4,836.3, respectively. Regarding LCSE, energy-efficient light bulbs and heat pumps provide the best results, at €0.007/kWh and €0.041/kWh, respectively. The shortest payback periods are observed for energy-efficient light bulbs and gas boilers upgrades, at 0.4 and 2.5 years, respectively. However, measures like external wall insulation and replacing windows with double-glazing are not economically viable without subsidies, as they exhibit negative NPVs.



The table below outlines investment costs, useful life, discount rate, NPV, payback period and LCSE for multi-family buildings, in the absence of subsidies.

Energy Efficiency Measure	Investment Costs (€)	Useful Life (Years)	Discount Rate (%)	NPV (€)	Payback Period (Years)	Levelized Cost of Energy Saved (€/kWh)
EEM1: Insulation of External Walls	18,943	30	4.00%	-2,177.8	>Lifetime	0.130
EEM2: Double-Glazed Windows	2,200	30	4.00%	-552.2	>Lifetime	0.151
EEM4: Gas Boiler Upgrade	735	20	4.00%	3,789.5	2.5	0.044
EEM5: Biomass Boiler Upgrade	3,500	20	4.00%	6,777.5	5.2	0.621
EEM6: Heat Pump	6,000	20	4.00%	4,836.3	9.1	0.041
EEM7: Energy-Efficient Light Bulbs	75	23	4.00%	2,643.9	0.4	0.007

Table 4: Table reporting energy efficiency measure and respective Investment Costs, Useful Life, Discount Rate, NPV, Payback Period, Levelized Cosy of Energy Saved for Multi-family buildings

Expeditious Audit Results

The analysis of the most common building types in the rural area of Valtaro and the efficiency measures suggested by the expeditious audits has led to the identification of the following intervention guidelines:

- Insulation of Vertical Opaque Envelopes (Walls): These interventions are often challenging due to high costs, long payback periods, and the aesthetic characteristics of many rural buildings, such as exposed stone walls. In such cases, less invasive and more cost-effective solutions are recommended, such as insulating floors adjoining attics (using insulating mats) or cellars, after verifying regulatory height requirements. These measures, while requiring lower investments, can reduce heat loss and achieve energy savings of 10-20%.

  For condominium buildings constructed between the 1960s and 1980s, characterized by poor thermal insulation, reinforced concrete frames, perforated or semi-solid brick walls, brick and concrete floors, and single-glazed aluminium or wooden windows, external insulation is a preferable solution. These buildings typically have high energy consumption (>180 kWh/m^2) and are generally not subject to landscape or technical constraints. In such cases, external wall insulation can be more cost-effective, as fixed costs (e.g., scaffolding and design) can be divided among multiple owners.
- Replacement of Windows and Doors: While this intervention involves significant initial costs and long payback periods, it offers benefits in terms of energy savings (5-10%) and improvements in safety and living comfort.
- Installation of Renewable Energy Sources and Efficient Heating Systems: The adoption of renewable energy sources, such as heat pumps combined with photovoltaic systems, is

encouraged under the Energy Performance of Buildings Directive (EPBD, called "Green Homes"), approved in March 2024. This directive aims to progressively reduce greenhouse gas emissions and energy consumption in the building sector by 2030 and achieve climate neutrality by 2050. These solutions are applicable even in rural settings but involve significant investments and are most efficient in well-insulated buildings (insulated envelope). Otherwise, hybrid systems, such as gas or LPG condensing boilers integrated with - or entirely replaced by – new-generation biomass systems, are more advantageous. Biomass systems can achieve savings of 15-30% and shorter payback times, especially when combined with local supply chains and incentives such as the Thermal Account ("Conto Termico") or regional subsidies in Emilia-Romagna.

- Building Automation Systems: Advanced technologies can transform buildings into "smart buildings" through the use of sensors, platforms, and integrated control systems. These systems adjust indoor air conditioning based on outdoor temperatures, manage lighting and appliances according to occupant needs, improve living comfort by regulating air quality and adjust shading systems (e.g., blinds or shutters) according to natural light. They also enhance safety by monitoring for fires and alarms. Implementation costs are relatively low, with short payback times and potential energy savings of up to 30% using advanced systems.

Timing of the Works

The time required to complete energy renovation interventions and achieve one or more energy class upgrades depends on the complexity of the work, bureaucratic processes, and the availability of contractors. General timelines are as follows:

- Design and Inspection (*1-3 months*): A qualified technician conducts an inspection to perform the energy diagnosis and develop the renovation project.
- Obtaining Permits and Funding (*1-6 months*): The duration depends on securing the necessary permits (e.g., SCIA or CILA) and, if applicable, on the approval of incentives and financing.
- Execution of the Works (*3-12 months*): Timing varies based on the complexity of the interventions. Simple measures, such as replacing fixtures or installing photovoltaic systems, require only a few months, whereas more extensive projects, such as wall insulation or heating system replacement, may take longer.
- Final Energy Certification (*1-2 weeks*): Once the work is completed, a qualified technician drafts a new Energy Performance Certificate (EPC) to certify the building's improved energy class.

In total, the process may take 6 months to 1.5 years, with potential delays due to bureaucracy, material shortages, and/or labour availability. Based on the audits conducted, the average cost of the efficiency measures included in the certificates is approximately €29,500 per property unit,

with a range between €13,000 and €52,000, depending on the size of the property and the interventions required.

Funding Currently Available

At the time of writing, the main financing options available for energy renovation projects are tax deductions, including:

- **Superbonus**: 70% deduction, valid until December 31, 2024, for condominiums and multi-family buildings.
- **Ecobonus**: Deduction of 50-65%, depending on the type of intervention (e.g., thermal insulation, replacement of fixtures), valid until December 31, 2024.
- **Renovation Bonus**: 50% deduction on a maximum of €96,000, valid until December 31, 2024.
- **Sismabonus**: Deduction of 50-85%, depending on the reduction in seismic risk, valid until December 31, 2024.
- **Furniture and Appliances Bonus**: 50% deduction on the purchase of furniture and large appliances up to €8,000, valid until 2024.
- **Green Bonus**: 36% deduction for garden and terrace interventions, with a maximum of €5,000, valid until December 31, 2024.
- **Bonus for the Removal of Architectural Barriers**: 75% deduction for installing lifts, stairlifts and ramps, valid until December 31, 2025.

The methods for utilizing tax deductions include direct deductions, credit assignment, and invoice discounts. Direct deductions are applied directly to personal taxes, allowing taxpayers to offset a portion of their expenses against their tax liability. Credit assignment involves transferring tax credits to third parties, such as banks or companies, to gain liquidity or immediate discounts on the costs of interventions. Lastly, the invoice discount method allows suppliers to apply an immediate discount on the price of the work, with the supplier subsequently recovering the tax credit. However, these options may not be accessible to low-income households or those experiencing energy poverty due to a lack of initial capital.

Looking ahead, it remains unclear what financing options will be available in 2025. The National Recovery and Resilience Plan (PNRR), supplemented by the RePowerEU chapter, and the Integrated National Energy and Climate Plan (PNIEC) outline initiatives aimed at combating energy poverty, reducing emissions, and promoting energy upgrades to the building stock. New financial measures to support these objectives are anticipated.

At present, European cohesion policy funds do not finance private residential building renovations in the region. However, several Italian banks offer specific financial products, such as loans and mortgages with favourable conditions, to facilitate energy renovation interventions.

These financial products support projects like installing photovoltaic systems, insulating walls, replacing windows, and adopting more efficient heating systems.

Risks and Disturbances Arising from the Work

Renovation projects can present various technical, economic and environmental risks that may jeopardize their success. Technical risks include inadequate initial energy analyses, which may result in interventions that fail to address the actual needs of the building, rendering them ineffective; for example, the analysis assumes that existing windows are in good condition and with efficient seals, which means that significant thermal losses are not taken into account. To mitigate this risk, you must perform a comprehensive energy audit by certified professionals, including thermal imaging, blower door tests, and detailed energy simulations. Compatibility between the interventions and the building structure is another critical factor; for example, thermal insulation solutions may need to be tailored to specific materials or configurations. To be more specific, the application of a thermal insulation system on porous brick walls or on historic buildings with decorative plasterwork can lead to plaster detachment or compromise the transpiration of the structure. To mitigate this risk, you may take in consideration the possibility to conduct a structural assessment and material analysis before finalizing the design. Opt for tailored solutions such as breathable insulation for historical buildings or lightweight panels for fragile structures.
Design or installation errors can further undermine the effectiveness of measures, potentially causing structural damage such as leaks or ventilation issues. The use of poor-quality materials or insufficient integration of energy systems may also reduce the overall effectiveness of the interventions. To mitigate all those risks it's better to engage experienced, certified contractors and require detailed execution plans, and also specify high-quality, certified materials in contracts, by using suppliers with proven track records and request product warranties.

From an economic perspective, unexpected costs can arise during the works, often due to undetected structural problems or bureaucratic delays in securing funding or tax incentives. To mitigate this risk, it's better to include a contingency budget of at least 10-15% in financial planning. Regulatory uncertainty, as demonstrated by the case of the Superbonus, can disrupt financial planning and exert additional pressure on costs. On the environmental front, improper waste management or the presence of hazardous materials such as asbestos can pose significant challenges. To mitigate those risks, it's better to conduct an environmental assessment before starting works, and also hire certified removal specialists if required and follow strict containment and disposal protocols.

The renovation works can also cause physical and psychological discomfort for residents and neighbours. Noise is one of the most common disturbances, but it can be mitigated by scheduling noisier tasks during specific hours, avoiding early mornings or evenings, and temporarily isolating in quieter areas. Earplugs or noise-cancelling headphones can also help.

Dust and dirt generated by the work can be minimized by sealing affected areas with plastic sheeting or panels, using air purifiers to keep adjacent areas clean, and scheduling regular cleaning. Moreover, chemicals from materials used may emit strong smells or toxic fumes, which can be managed through proper ventilation and the use of eco-friendly, solvent-free materials.

Reduction of living space is another challenge, particularly if the work involves critical areas of the house like the kitchen or bathroom. In such cases, reorganizing living spaces and using temporary storage for bulky items may help. Planning the work in phases can ensure that not all areas are inaccessible at the same time, while temporary solutions, such as makeshift kitchens or emergency bathrooms, can reduce inconvenience. Interruptions to essential services such as electricity, water, or gas can also be disruptive. These can be mitigated by planning for outages, conserving water, preparing meals in advance, or renting equipment like electric generators or water tanks if necessary.

Stress caused by delays, unforeseen expenses, or challenges in managing timelines should not be underestimated. Detailed planning, a realistic budget, a clear schedule, and regular communication with professionals can help minimize project-related anxiety. Engaging a general contractor to supervise the work is another effective strategy. Additionally, including financial and time buffers can help address unexpected issues. Monitoring expenses regularly and maintaining open communication with suppliers can prevent surprises and ensure effective budget control.

Finally, renovation projects may also strain family or neighbourly relationships. Noise and prolonged inconveniences can create tensions, but transparent communication with neighbours, including advance notice about the work and agreeing on suitable schedules, can help maintain good relations. Listening to complaints and finding shared solutions is essential to avoid conflicts.

In conclusion, undertaking energy renovation projects requires not only careful planning and effective management of spaces, time, and costs but also a strong focus on engaging homeowners. By actively listening to their visions, addressing their concerns, and ensuring they feel genuinely heard throughout the process, disruptions can be minimized. This inclusive approach fosters a sense of collaboration and trust, paving the way for the successful and satisfying completion of the works with greater peace of mind for everyone involved.

1.4. Identify and Overcome Barriers and Challenges

The energy renovation of buildings in Italy faces numerous barriers that require targeted strategies for resolution. Among the primary obstacles are:

Economic Barriers:

The high costs associated with interventions such as thermal insulation, window replacement, or the installation of efficient energy systems often make energy upgrades inaccessible, especially for families with limited financial resources. In these cases, government incentives such as tax deductions or building bonuses are crucial, although they are often difficult for economically disadvantaged families to access. Long-term financial tools, such as subsidized mortgages, can provide a solution by allowing investments to be spread over time, thereby reducing the immediate financial impact. Several financial institutions offer products to support such interventions:

- Banco BPM provides green loans at subsidized rates for interventions like solar panel installation or improving thermal insulation.
- BPER Banca offers the "Green Mortgage" (Mutuo Green), which covers a wide range of energy efficiency interventions.
- Crédit Agricole provides green loans and mortgages to improve home energy efficiency, supporting various interventions aimed at reducing energy consumption.
- UniCredit offers green financing for energy efficiency measures, including efficient heating systems or building insulation, with tailored financial solutions for families and condominiums.
- Intesa Sanpaolo has multiple subsidized-rate products specifically designed for energy renovation interventions.
- BNL promotes green loans and financing under favourable terms for energy efficiency interventions, such as installing low-consumption systems or optimizing thermal insulation.

State guarantee funds, such as the "Guarantee Fund for the Purchase and Renovation of the First Home", represents another valuable resource. This fund guarantees up to 50% of a mortgage (to a maximum of €250,000) for all applicants, regardless of age, while providing reduced rates for specific groups such as young couples (at least one member under 35 years of age), young people under the age of 35 with an atypical employment relationship, single-parent families with minors, and tenants of public housing (owned by IACPs). Applications must be submitted directly to participating banks using official forms available on the websites of CONSAP Spa, the Department of the Treasury, and the banks involved.

For individuals in energy poverty, additional tools exist, such as support from third-sector organizations like Banco Energia and Centoperuno Odv, or microcredit services offered by associations like RICREDITI. Energy Service Companies (ESCos) also present an attractive option, enabling property owners to undertake renovation projects without bearing the full upfront cost, as payments are made using the energy savings achieved (e.g., https://escosolution.it/ Faenza; https://www.escoagroenergetica.it/ Rome).

Information Barriers:

Many property owners lack adequate information about energy-saving opportunities, available technologies, or existing tax incentives. Awareness campaigns highlighting the economic and environmental benefits of energy efficiency are essential. These awareness campaigns can also serve to inform the citizen about where to go for support, such as the ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) website, which offers comprehensive resources on energy-saving technologies, best practices, and current tax incentives. Also, they provide publications, guidelines, and tools to assist property owners in making informed decisions about energy efficiency improvements. Tools such as free training courses, like those offered under the RENOVERTY project via the AISFOR Academy platform, and low-cost energy consultancy or audit services, can provide valuable guidance to property owners during the decision-making process.

Administrative Barriers:

Bureaucratic procedures for obtaining permits, particularly for historic buildings or buildings subject to preservation constraints, are a significant deterrent. Simplifying regulations and establishing one-stop shops for permit management can streamline the authorization process. At present, only one OSS is available in the Parma area, the Sportello Energia&Condomini managed by ATES Parma, which offers free services to citizens such as inspections with a thermal imaging camera to check heat dispersion and support to find out how to finance energy renovation.

Disagreements in Condominiums:

Conflicts among residents and a lack of interest often slow down the decision-making process for initiating renovation projects in apartment buildings. Generally, the majority required for the approval of works is 50% plus one of the votes of the condominiums present at the meeting. In some cases, a qualified majority of 66% or 75% may be required. Informational meetings with experts can help clarify the economic and living benefits of these interventions, fostering consensus.

Return on Investment:

The long payback periods of investments serve as another disincentive. Flexible financing solutions that allow interventions to be covered through energy savings over time, or incentives

that shorten the payback period, could motivate more property owners to undertake these works. Another way is to pool resources with other property owners, to form or join energy communities which can create economies of scale, lowering the costs of installation and maintenance.

Shortage of Technical Skills:

A lack of up-to-date technical expertise among professionals can compromise the quality of interventions. Investing in continuous professional training is essential to ensure the correct implementation of advanced technologies and compliance with current regulations. To rely on thrustworthy and capable companies and professionals, in addition to word of mouth from family and friends, you can consult the dedicated section of the Sportello Energia&Condomini.

All these issues and possible actions to mitigate them were validated during workshops organised within the project. Furthermore, during one of this workshop, property owners who had participated in energy audits shared their direct experiences, highlighting both positive and negative aspects. Among the main challenges reported were the high costs of interventions, the complexity of administrative procedures, and a limited understanding of long-term benefits. In many cases, particularly among elderly owners or when there is disinterest from their children, the focus remains solely on immediate costs, leading to a reluctance to undertake interventions without considering future advantages.

To overcome these challenges, the following measures will be implemented in the pilot area:

1) Public Awareness Campaigns: Efforts will focus on raising awareness among rural residents and farmers, including participation in local festivals, events, and fairs, as well as publishing articles in trade association magazines (e.g., Confedilizia and Confagricoltura). Stakeholders' communication tools, such as newsletters, will also be utilised.
2) Information Desk: A primarily virtual information desk will be established, with the option for in-person consultations with dedicated architects available weekly. This service will be linked to the Energy & Condominium Desk, offering tailored support for condominium projects.
3) Promotion of Renewable Energy Communities (RECs): Public policies and initiatives will encourage the creation of RECs, enabling citizens and small businesses to locally produce, consume, and manage renewable energy, reducing CO_2 emissions and enhancing energy independence.
4) Partnerships with Third-Sector Entities: Collaboration with third sector organizations addressing energy poverty will fund renovation interventions to improve housing conditions of citizens living in energy poverty. The information desk will also provide advice on alternative funding channels, such as microcredit, targeted tax incentives or municipal grants.

2. What to do next? Conceptualize and Implement Actions to Reduce Energy Poverty in Rural Areas

2.1. Definition of Renovation Objectives, Indicators and Possible Interventions

The primary objectives of energy renovation projects in rural areas are to improve the living conditions of families experiencing energy poverty, reduce household energy costs, and promote environmental sustainability. These objectives translate into tangible social, economic and environmental benefits.

Reducing Energy Poverty:

Energy-efficient building renovations help lower energy costs by improving the overall efficiency of buildings and reducing energy consumption. This enables households to more easily access winter heating and summer cooling, alleviating the financial burden of energy expenses.

Improving Living Conditions:

Interventions such as thermal insulation, the replacement of windows and doors or the installation of more efficient heating systems enhance indoor thermal comfort, creating a healthier and more enjoyable living environment for families.

Reducing CO_2 Emissions:

By improving energy efficiency and reducing energy consumption, homes can significantly lower their environmental impact. This contributes to combating climate change and fostering a more sustainable use of natural resources. The integration of renewable energy sources, such as solar panels or heat pumps, further supports the transition away from fossil fuels.

Stimulating Local Economies:

Energy renovation interventions create job opportunities for local companies and professionals in construction and green technology sectors. These projects strengthen the economies of rural areas, which are often disadvantaged compared to urban regions.

Fostering Social Resilience:

Energy-efficient homes help protect families from extreme weather events such as harsh winters and scorching summers. This enhances housing security, reduces health risks, and provides greater stability for households.

Enable a Higher Productivity:

Efficiency drives productivity gains, particularly by reducing maintenance costs and increasing production output per unit of input. Furthermore, improvements in operational performance and process reliability, which can result from efficiency enhancements, lead to fewer instances of equipment downtime, shutdowns, or system failures. Optimizing processes to boost efficiency also helps minimize the time staff spend on operations and scheduling, while decreasing the likelihood of human errors.

Establishing a Long-term Sustainable Model:

The ultimate goal is to develop a long-term sustainable renovation model that requires minimal maintenance while delivering ongoing benefits for communities and the environment. Through such an approach, energy renovation interventions not only enhance the quality of life for economically struggling households but also contributes to building more resilient and cohesive rural communities.

Performance Indicators:

To evaluate the effectiveness of energy renovation interventions, a set of performance indicators covering energy, economic, social, and environmental aspects is required:

Energy Indicators:

- Reduction in energy consumption (kWh saved): Measures how much energy is saved following the interventions.
- Improvement in building energy class: Assesses the efficiency gains of homes compared to their initial state.
- Percentage of renewable energy utilisation: Reflects the level of sustainable energy integration achieved.

Economic Indicators:

- Reduction in household energy costs: Tracks how much energy bills decrease, highlighting the financial impact on household budgets.
- Return on investment (ROI): Evaluates the time required to recover the costs of renovation interventions through the energy savings.
- Local job creation: Measures the number of jobs generated in the local community, contributing to economic growth by involving businesses and professionals in the construction sector.

Social Indicators:

- Percentage of households lifted out of energy poverty: Quantifies how many families are no longer classified as energy-poor due to the renovation interventions.

- Improvement in living comfort (via surveys): Surveys are used to assess perceived improvements in thermal comfort and overall quality of life.
- Number of families benefiting from interventions: Provides insights into the broader social impact of the project.

Environmental Indicators:

- Reduction in CO_2 emissions: Quantifies the project's contribution to climate change mitigation through reduced energy consumption and renewable energy integration.
- Reduction in the ecological footprint of homes: Assesses the overall environmental benefits achieved by the renovated homes.

The following table shows a number of interventions that can be implemented, subdivided according to the type of redevelopment you are willing or able to undertake based on your economic availability. The first column shows the interventions that can be tackled in steps, with relatively low economic and time costs. In the second column, on the other hand, are shown those interventions that fall under that renovation which is defined as 'deep' and has greater economic and time costs. The last column instead shows those interventions that do not involve direct work on the building or its interior but still have a significant impact on consumption.

Step-Wise Renovation	Deep Renovation	Other Types of Interventions
Installation of fans with air recovery systems	Replacement of doors and windows	Small photovoltaic panels
Elimination of standby electricity usage with a multi-plug	Thermal insulation of the building envelope	Creation of energy communities: Utilizing public rooftops for the production of energy-efficient electricity
Replacement of outdated appliances	Modification or upgrade of heating technology (e.g., heat pumps, etc.)	Outdoor greenery interventions (to address summer energy poverty) - planting trees, creating shaded areas. Façade greening
Replacement of energy-intensive appliances	Basement and roof insulation	Neighbourhood-level measures (not related to a single building but to an area)
Floor insulation	Roof modification with insulation	Energy tips and recommendations
Installation of smart thermostats	Thermal insulation of the ceiling above the basement level	Provision of free administrative assistance to families applying for renovation funds
PV installation		Development of financial support mechanisms (e.g., interest-free loans, grants, etc.).
Provision of curtains		Storage batteries
Use of radiator foils		Installation of a wall box (e.g., for charging electric cars or bicycles)

Table 5: Type of renovations and possible interventions

2.2. Identify Barriers, Challenges and How to Overcome Them

Barriers and Challenges	Description	How to Overcome Them
Community Barriers	The need to obtain unanimous agreement among families to start renovation work.	- Define clear roles and responsibilities to negotiate with all group members. - Engage local and reliable authorities or organizations to “pressure” families. - Appoint a trusted "community leader" or similar figure. In such cases, condominium administrators should mobilise to find impartial third-parties (who do not profit from the renovation) who can facilitate dialogue among tenants and/or owners.
Financial Barriers	Lack of government subsidies or difficulty in accessing financing for families in financial distress.	- Introduce microcredit solutions, contracting solutions, crowdfunding, energy performance contracts and reverse mortgages (a U.S. financial mechanism for the elderly). - Implement low-interest loans (excluding consumer credit), on-bill financing, and government-backed guarantees for defaults. - Promote energy communities (dedicating 10% or similar to addressing energy poverty). - Increase flexibility in financing mechanisms (e.g., adjustments to terms/ durations, legal conditions, or funding opportunities) and establish mechanisms to lock in interest rates for periods of 10 to 15 years. Addressing this issue requires the involvement of multiple actors at various levels: the government should take legislative action to introduce adequate subsidies and act as a guarantor to enable citizens to access necessary financing. Financial institutions, third-sector organizations, energy providers, municipalities and local stakeholders should work collaboratively to implement complementary solutions, such as creating local energy communities, promoting crowdfunding initiatives, or providing microcredit.
Lack of Information	Renovation efforts rely largely on word of mouth, with limited structural or institutional support. OSSs (One-Stop Shops) are essential to provide information and support (especially first-hand	- Organize training sessions, programs, and community awareness events to highlight the benefits of renovations. - Open physical and digital counters to provide personalized advice. Set up a toll-free number or online chat to answer citizens' questions. - Develop web portals and apps that simulate the energy savings and economic benefits of renovations. To implement these initiatives, collaboration between local authorities, consumer associations, professional bodies (engineers, architects, surveyors), and energy companies would be essential. These

	guidance) on how to renovate.	initiatives would require resources such as public funding, private contributions, qualified personnel, and digital tools for appointment management.
Illegally Constructed Buildings	Lack of legal permits for buildings built without permits, which limits access to financing.	- Allow the regularization of buildings constructed before a specific date by verifying their existence through satellite images. - Physical offices in municipalities offering guidance on amnesties, legalization pathways, and urban planning compliance. - Digital support through online platforms, allowing citizens to quickly verify their building's legal status and receive instructions on the next steps. - Public awareness campaigns, including brochures, webinars, and expert-led meetings to clarify which buildings can be regularized and how. In this case, it is the legislator's responsibility to intervene and allow property owners to regularize their situations. However, collaboration would be required between municipalities, regional governments, professional associations (engineers, architects, urban law experts), and the Ministry of Infrastructure and Transport.
Illegal Connections to the Electricity Grid (lack of energy contracts)	Unauthorized connections to the electricity grid or lack of regular energy contracts, preventing efficient management of energy consumption.	- Legalize irregular connections and settle outstanding debts with energy suppliers. - Personalized consultations to guide citizens through the process of securing a legal energy contract and verifying connection conditions. - Financial support and incentives to encourage the transition, including discounted tariffs for low-income families. In the first case, it is difficult to identify who should handle the problem. At present, it is the tenants or owners who must regularize their situation. To implement the other initiatives, collaboration between energy distributors, local authorities, consumer protection associations, and the Ministry of Environment and Energy Security would be crucial.
Administrative Barriers	Complex and lengthy bureaucratic processes.	- Identify the most significant administrative barriers and propose policy changes to overcome them. Legislators at the national, regional and local levels should simplify bureaucratic procedures and regulations, avoiding conflicts with higher-level regulations.
Distrust of Actors	Lack of trust in institutions or operators by households in energy poverty.	- Involve trusted figures such as social workers or local experts. - Organize targeted and personalized meetings with people affected by energy poverty instead of large generic workshops.

		Municipalities, in collaboration with local energy agencies and other actors dedicated to combating energy poverty, should take the initiative and work together to build trust. Additionally, the government must avoid sudden, frequent and complex changes to regulations and funding mechanisms.
Protected Historic Buildings (requiring special permits)	Special authorizations are required for interventions on protected or conservation-regulated buildings.	- Involve restorers and technicians trained in addressing challenges for those affected by energy poverty. - Support a "lightening" of rules and procedures (New European Bauhaus principles). Joint efforts between legislators and local authorities are needed. Training courses on energy poverty and building renovations should also be offered in academies and institutions responsible for training restorers. Additionally, legislators should revise the supervisory powers of the superintendencies.
Landscaping Regulations	Regulations that constrain the execution of specific renovations, such as those involving the building's exterior.	- Engage all stakeholders (homeowners, homeowner associations, landscape architects, urban planners, local governments, etc.) to review existing landscape regulations. - Develop co-creative solutions that balance individual needs while with regulatory goals. Efforts should involve stakeholders at all levels. Initiatives can originate either from the grassroots level (e.g., municipalities or trade associations advocating for regulatory amendments), or from the top (e.g., legislators proactively implementing measures while incorporating stakeholder input).
Knowledge Barriers	Many individuals are unaware of the benefits of renovations.	- Launch direct and targeted awareness campaigns with support from local stakeholders. - Educational programs for schools and universities, fostering a culture of energy efficiency from an early age. - Information desks in municipalities, providing free advice on incentives, regulations, and energy efficiency technologies. - Practical events and workshops to engage the public, showcasing innovative solutions such as solar panels, heat pumps, and advanced insulation systems. To implement these initiatives, collaboration between the Ministry of Environment, educational institutions, industry associations (CNA, ANCE, ENEA), local authorities, and energy companies would be essential.
Families in Rental Properties	Difficulties arise in distributing incentives between owners and renters.	- Inform landlords about the increased property value resulting from renovations. - Prevent rent increases post- renovation. - Utilize shared incentive mechanisms to provide clear and quantifiable benefits to both parties (link).

		In this case, an information campaign carried out at multiple levels by various stakeholders (LAGs, municipalities, ministries) would be useful. Such a campaign should highlight the possibilities for distributing incentives between owners and tenants and provide measures to discourage owners from increasing rents.
Geographical Barriers - Absence of mainstream channels for the commercialisation of renovations	Lack of sufficient personnel for the renovation. Even higher upfront costs.	- Encourage group orders and bulk purchases to reduce costs. Municipalities, provinces and regions should address geographical obstacles by improving transportation and infrastructure. Trade associations and businesses should coordinate to recruit the necessary personnel and facilitate bulk orders, thereby lowering costs.
Resistance in Condominiums	Lack of consensus among owners, with some opposing the renovation efforts.	- Present the benefits, such as increased property value and improved living comfort. - Engage facilitators to mediate negotiations between the parties. - Consider companies or One-Stop Shops offering "solutions from a single source" (consulting, restructuring planning, implementation, management, and financing). - Present the building's CO_2 emissions status annually at owners' meetings and propose measures if key figures (climate protection budget) are too high. Condominium managers or tenants interested in renovating the building should mobilize to involve third parties who can facilitate dialogue and demonstrate the benefits that derive from such works. Legislators should instead promote the implementation of Counters (One-Stop Shops – OSSs) in accordance with European standards.
Regulatory Barriers	Energy efficiency policies often fail to address the specific needs of rural areas.	Local actors, irrespective of their role or political stance, should work to urge the national legislator to implement appropriate measures, respond to grassroots demands, and adopt inclusive policies that address the economic disparities not only in rural areas but also among citizens as a whole.

Financial	The costs of goods and services related to renovations tend to increase following the announcement of public funding or incentives.	- Grants and subsidies for energy retrofits, reducing the initial investment burden. - Low-interest loans or green loans for solar panel installations, heat pumps, and insulation interventions. - Public guarantee funds, which could reduce the risk for financial institutions and encourage offering favorable loans. - Public-private partnerships, where local authorities collaborate with banks and financial institutions to create tailor-made financing products. - Energy performance contracts (EPC), where companies carrying out the work commit to ensuring specific energy savings and transferring a portion of that savings as payment for the services provided. - Financing based on energy savings, allowing repayment through monthly savings on energy bills, reducing the initial financial strain. - Leasing models for solar panels and other technologies, where the customer pays only for the use of the system without owning it directly. To implement these funds, collaboration between local and national governments, banks, financial institutions, research bodies, and renewable energy companies would be essential.

Table 6: Types of barriers and challenges and possible solutions

2.2.1 Possible mitigation measures

Listed below are some actions that may be helpful in mitigating some of these issues, such as lack of public interest, awareness and information or alternative financial solutions.

Rural Energy Efficiency Roadmap (REER) as an Information Service of the Provincial OSS

Objective: To make the roadmaps accessible, providing clear guidance to citizens and stakeholders.

Activities: The initiative's first phase involves creating a simplified version of the roadmap and uploading it to the platform of the Provincial Energy & Condominiums Desk. This version will be designed to be accessible to all, even those without technical knowledge of energy renovation. The document will include comprehensive guidelines on effective energy renovation measures, providing clear details of the necessary bureaucratic procedures and information on available incentives and support options. Additionally, it will offer useful contacts for assistance and present concrete examples alongside best practices to help guide citizens throughout the renovation process. Once the document is finalized, the project team will collaborate with the managers of the Energy & Condominiums Desk to upload it to the platform and ensure its wide dissemination. Simultaneously, it will be essential to launch a communication campaign to inform citizens and stakeholders about the tool's availability. This campaign may involve information sessions, public meetings, and collaborations with local associations, alongside outreach through newsletters, social media, and institutional websites. To ensure accessibility for individuals without digital access, printing and distributing paper copies at municipal offices and local associations should be considered.

Input: REER document, collaboration with stakeholders from the Energy & Condominiums Desk.

Actors involved: Trade associations, public entities, third-sector organizations, and citizens.

Timeline: 1 month to complete the simplified version, contact the Desk managers, and upload the document to the platform.

Challenges: Creating a simplified and engaging version of the roadmap for citizens will be a primary challenge. It will be crucial to contact the managers of the Energy & Condominiums Desk and ensure the tool is uploaded to the platform. Additionally, effectively communicating the availability of the roadmap to citizens and stakeholders will be essential. A significant obstacle will be making the roadmap clear and appealing to citizens, avoiding the overly technical language that often characterizes this type of document. This will require extensive work to simplify the content and design the layout to enhance readability and accessibility. Another critical issue involves engaging with the Provincial Energy & Condominiums Desk. Establishing

an effective dialogue with platform managers will be vital to ensure the document is published and regularly updated over time. Additionally, a key challenge will be disseminating the initiative in rural areas, where digital literacy and access are often limited. Reaching these communities will require a well-structured communication strategy, incorporating traditional methods such as public meetings, physical information desks and printed materials distributed through local municipalities and associations. Lastly, it will be necessary to ensure that the roadmap is continuously updated, maintaining its relevance as a reliable and useful tool over time. This may result in complex management needs, particularly given the frequent changes in regulations and financial incentives in the energy renovation sector.

Areas Involved:

- **Legal:** Providing general information on regulations for accessing tax incentives.
- **Technical:** Offering guidance on potential energy renovation measures to be implemented.
- **Financial:** Outlining possible costs for implementing energy renovation measures and exploring solutions for securing necessary funding.
- **Local Community:** Raising citizen awareness and engaging stakeholders.

Awareness Campaigns for Citizens

Objective: To raise awareness about energy renovation and sustainability among rural residents and farmers.

Activities: The initiative will involve organizing information events at festivals, fairs, and neighborhood meetings, along with publishing articles in trade magazines such as *Confedilizia* and *Confagricoltura*, and sending newsletters through sector stakeholders.

One of the first actions will be participation in high-profile local events, as the Province of Parma hosts numerous fairs and local gatherings, offering a unique opportunity for direct public engagement. In parallel with in-person events, it is essential to implement a communication strategy using local media. Collaborations with newspapers such as *Gazzetta di Parma* and local radio stations like *Radio Parma* will help reach a wider audience, including those less likely to seek out information independently. Additionally, publishing articles in industry-specific magazines and periodic newsletters will directly engage property owners, farmers, and businesses in the sector. The use of social media platforms, through short informative videos and infographics, will allow the dissemination of clear and concise messages, tailored to different audience segments.

Input: Digital and printed information materials and collaboration with local media.

Actors Involved: Trade associations, public bodies, and local media.

To carry out these initiatives effectively, the involvement of various institutional and private sector stakeholders is necessary: Public bodies such as the Municipality of Parma, the Province

of Parma, and the Emilia-Romagna Region can support the promotion of activities and organization of events. The Chamber of Commerce of Parma can act as a bridge between businesses and institutions, facilitating the dissemination of information among local companies. Trade associations such as Confagricoltura Parma, Coldiretti Parma, and CIA Parma can distribute informational materials to farmers and businesses in the primary sector. Similarly, associations such as Confedilizia Parma, CNA Parma, and ANCE Parma can raise awareness among property owners and construction companies on the importance of investing in energy renovation. Local media play a crucial role in reaching a broader audience through articles, radio, and television broadcasts, while universities and technical institutes can contribute by organizing educational events and producing outreach materials. The contribution of local companies and professionals active in the energy and construction sector is also fundamental. Installers of photovoltaic systems, companies specializing in green building, and suppliers of renewable technologies can participate in events by providing practical demonstrations and case studies. Additionally, local banks and credit institutions can inform citizens and businesses about financing opportunities and available incentives.

Timeline: The preparation phase will take 1–2 months, followed by periodic campaigns.

Challenges: Engaging citizens in less digitalized areas and raising funds for advertising campaigns.

Despite the potential effectiveness of these strategies, several challenges could hinder the success of the campaigns. One significant obstacle is reaching rural areas with low digital access, where digital tools are less widespread. In these areas, it is crucial to prioritize the distribution of printed materials and organize in-person meetings at community hubs. Another challenge is securing funds for advertising campaigns, as producing materials, organizing events, and disseminating information through media outlets require financial resources that may be limited. Lastly, there is the issue of overcoming distrust of new technologies. Some rural property owners and farmers may perceive energy renovation as a costly or unprofitable investment in the short term. To counter this perception, it is essential to showcase local success stories and share testimonials from entrepreneurs and citizens who have already benefited from incentives and experienced tangible improvements in efficiency and cost savings.

Areas Involved:

- **Legal:** Event permits and material distribution authorizations.
- **Technical:** Production of accessible, user-friendly content.
- **Financial:** Budget planning and funding for campaigns.
- **Local Community:** Promoting active participation and engagement.

Information Service for Energy Renovation

Objective: To provide technical, legal, and financial advice to citizens.

Activities: Creation of an information service via email, weekly consultations with architects and technicians, and integration with the Energy & Condominium Desk.

The core of this initiative will be the creation of an online information service, ensuring citizens in the Province of Parma have direct access to guidance and resources while being directed to the Energy & Condominiums Desk. Through the digital platform, users will be able to access practical guides, detailed FAQs, and forms to request personalized consultations. Alongside the digital service, weekly consultations with architects and specialized technicians will be organized. These meetings will offer tailored assistance, focusing on:

- **Building and urban planning regulations** related to energy renovation
- **Available incentives and tax breaks**
- **Technical solutions**, including innovative technologies for improving building energy efficiency.

Input: The initiative will require an online platform with practical guides and a team of experts for consultations.

Actors involved: Architects, engineers, local authorities, and residents' associations.

The success of the information service will depend on the involvement of a broad network of institutional, technical, and professional actors, including the Municipality of Parma, the Order of Architects, and CAN.

Timeline: 2 months for the start-up phase, followed by continuous operation.

Challenges: Ensuring constant regulatory updates and organizing staff for an efficient service. Implementing an information service of this kind presents several significant challenges. One major challenge is the need for constant regulatory updates, as energy renovation laws and incentive programs frequently change. The service must always provide accurate, up-to-date information. To address this, it will be necessary to establish a collaboration network with public bodies and trade associations to ensure prompt receipt of updates. Another critical challenge is the efficient management of professionals involved. Effective coordination between technical experts, legal advisors, and financial consultants will be essential to deliver a complete and effective service. Additionally, it will be crucial to provide flexible access times and ensure that there are enough operators to prevent long waiting times. Finally, there is the challenge of project financing. Ensuring the long-term sustainability of the service will require securing public and private funding. Potential sources include contributions from the Emilia-Romagna Region, European funds dedicated to ecological transition, and sponsorships from companies in the energy and construction sectors.

Areas Involved:

- **Legal:** Building regulations and compliance with user privacy laws.
- **Technical:** Development and maintenance of the digital platform.
- **Financial:** Identification of public and private co-financing opportunities.
- **Local community:** Promotion of the service and encouragement of public engagement.

Energy Mentoring Programs Between Local Families

Objective: To share best practices and stimulate energy renovation interventions.

Activity: Organization of meetings between experienced families and new participants. The first step in launching the program is to select citizens who have already adopted energy-saving solutions and are willing to share their experience with other interested households. This process can be supported by local associations that have direct contact with residents and can identify potential participants. Once the network of mentors has been formed, periodic meetings are organized. These can take the form of face-to-face meetings, home visits to showcase practical interventions, or informative webinars to reach a wider audience. It is important that the meetings are structured according to practical guidelines so that participants can receive concrete information on how to improve the energy efficiency of their homes with accessible and applicable solutions. To encourage participation and ensure continuity, symbolic rewards can be introduced for mentor families. In addition, the creation of a collective purchasing group for small energy technologies (e.g., LED bulbs, smart thermostats, water flow reducers) could be an additional stimulus to participation.

Input: Database of participating families and practical guidelines.

Actors: Local residents and local associations.
The energy mentoring program mainly involves local residents, both as mentors and participants interested in learning new energy-saving strategies. Their involvement is essential for the success of the initiative. Local associations play a key role in promoting the program and creating a strong network between families, acting as a bridge between mentors and new participants. In addition, the support of experts in the field of energy efficiency could enrich the program, providing insights into more advanced solutions or economic incentives available for renovation interventions.

Timing: 1 month for the selection of families and planning of meetings.

Challenges: Initial involvement of mentor citizens.
One of the main barriers to implementing this program is the initial involvement of mentor families. Not everyone may be willing to devote time and energy to sharing their experiences; therefore, it will be necessary to motivate them with incentives and make the process as easy as possible. Another challenge is ensuring that the information provided is reliable and easily applicable. For this reason, it is essential to have clear and accessible support materials, perhaps

in collaboration with experts in the field. Finally, the management of the personal data of the subjects involved must be carefully regulated through membership contracts that protect the privacy of the participants and define the methods of use of the information collected.

More Information: Encourage participation with symbolic prizes.

Areas Involved:

- **Legal:** Membership contracts for the protection of personal data.
- **Technical:** Transfer of knowledge on simple energy interventions.
- **Financial:** Sharing of resources for collective purchases of small technologies.
- **Local Community:** Strengthening social networks and energy awareness.

Practical Workshops for Small Do-It-Yourself Energy Interventions

Objective: Teaching simple do-it-yourself renovation techniques.

Activity: Planning the courses, selecting the participants. The first phase consists of planning the courses, defining a calendar of meetings, and selecting the topics to be covered, such as light insulation, the installation of solar shading, the sealing of fixtures, and the optimization of natural lighting. Next, it will be necessary to select participants, giving priority to those who intend to apply the knowledge they have acquired to their homes. The involvement of expert trainers, such as local artisans, engineers, and sustainable building experts, will be fundamental. These trainers will guide the workshops with theoretical explanations and practical demonstrations. The initiative must be promoted through local associations, public bodies, and digital channels to ensure wide participation and create a network of citizens who are aware and active in improving the energy efficiency of their homes.

Input: Basic materials and expert trainers.

Actors: Local associations, residents, and expert trainers. Residents will be the main beneficiaries of the initiative, acquiring practical skills to improve the efficiency of their homes without having to resort to external labor. Local associations will play a central role in the organization and promotion of the initiative, facilitating contact with the community and providing logistical support. Experienced trainers, such as construction technicians and local craftsmen, will take care of the teaching, passing on practical knowledge and advice on materials and techniques to be used. Local administrations could support the initiative by providing public spaces for conducting the workshops and offering small subsidies for purchasing necessary materials.

Timing: 1 month for organization and promotion.

Challenges: Safety during the workshops. One of the most critical aspects concerns safety during the workshops. Since participants will be performing manual work, it will be essential to take all necessary measures to prevent injuries. To this end, insurance contracts must be taken

out to cover any accidents, and personal protective equipment (PPE), such as gloves, protective goggles, and masks, must be provided. Another difficulty concerns the quality and duration of the interventions carried out. To ensure that the techniques taught are truly effective, the workshops must be structured with a combination of theory and practice, with constant supervision by experts. Finally, community involvement is a key factor: some residents may initially be skeptical about the usefulness of the initiative. To encourage participation, symbolic incentives could be provided, such as certificates of participation or small free work tools.

More Information: Securing participants during activities.

- **Areas Involved:**
- **Legal:** Insurance contracts for participants.
- **Technical:** Teaching of light insulation and solar shading.
- **Financial:** Reduction of labor costs.
- **Local Community:** Creation of local skills.

Energy Barter Platform for Materials and Services

Objective: To facilitate the procurement of materials for renovation without money.

Activity: The initiative will be based on the creation of a physical emporium dedicated to the exchange and reuse of materials and tools, inspired by the model of the DIY Emporio by Leroy Merlin. This space will serve as a reference point for residents, artisans, and local associations interested in sharing resources for the maintenance and renovation of domestic environments. The first step will be the identification of a suitable location, which could be an unused municipal space, an associative warehouse, or an area made available by the solidarity emporium. Once the location has been defined, it will be necessary to set up shelving and storage areas. To start the project, a campaign will be organized to collect materials and tools, involving companies in the construction sector, hardware stores, department stores, and private citizens. The goal is to recover tools in good condition and reusable building materials, such as paints, tiles, wooden planks, and insulation. These products will then be made available to the community through a free loan or solidarity exchange system, using the same cards provided to citizens who access the Emporio's assistance services for food purchases. A crucial aspect will be the quality management of the materials exchanged. A verification system may be established, carried out by expert volunteers or qualified technicians who will assess the suitability and condition of the donated materials. Additionally, it will be useful to introduce a register of donations and loans to monitor the use of resources and ensure equitable access to materials.

Input: Spaces, infrastructures, materials, tools, and exchange regulations.

Actors: Local residents, businesses, and artisans.

The main actors involved in this initiative are residents, who will be able to exchange materials and services for the renovation of their homes, and local businesses and artisans, who will be

able to offer their skills in exchange for materials or other services. Local associations can play a key role in managing the platform, supporting user registration, promoting the initiative, and facilitating the resolution of any problems. Finally, the support of technical experts could be useful to ensure the quality of the exchanges by providing evaluations of the materials and the work performed.

Timing: 2 months for the identification of spaces, procurement of material, regulation, and start-up.

Challenges: The creation of a reuse emporium for building materials and equipment, inspired by Leroy Merlin's *Emporio Fai da Noi* initiative, presents several challenges that must be addressed with careful planning and strong community involvement. One of the main obstacles concerns the procurement and management of spaces. Finding a suitable location to house the emporium is not easy. The premises must be large enough for storing materials, easily accessible, and compliant with safety regulations. Another critical issue concerns the quality and safety of materials. Not all donated materials may be suitable for reuse; some may be damaged, incomplete, or non-compliant with safety standards. Therefore, it will be essential to introduce a system for selecting and verifying quality, perhaps by involving experienced artisans or qualified volunteers. Additionally, to avoid the accumulation of unusable materials, a proper disposal plan for non-reusable items must be established. From an economic perspective, ensuring the sustainability of the initiative is a major challenge. Starting the emporium requires an initial investment for setting up the space, purchasing shelving and equipment, and managing operations. In addition to seeking sponsorship from local companies, the introduction of a loan system with a deposit could be considered, allowing for a minimum economic return without compromising the accessibility of the service. Finally, the operational management of the emporium could prove challenging. Daily operations will require the constant presence of volunteers or dedicated staff, which may create difficulties in the long term. It will be necessary to develop an effective system for cataloging and distributing materials to avoid waste and accumulation. Logistics must be well-organized to ensure a continuous flow of materials available for reuse.

More Information: Involve local associations for management.

Areas Involved:

- **Legal:** Creation of regulations for the exchange.
- **Technical:** Evaluation of the quality of the materials exchanged.
- **Financial:** Elimination of monetary costs through barter.
- **Local Community:** Stimulation of cooperation between residents.

Microcredit Schemes for Individuals

Objective: Facilitate access to financial resources for families with limited economic resources.

Activity: Establishment of a guarantee fund, negotiation of agreements with financial institutions, and monitoring of loans.
The first step is the establishment of a guarantee fund, which will cover part of the risk of insolvency and incentivize banks to grant loans at reduced rates. This fund could be financed through contributions from local cooperatives, donations from non-profit organizations, and partnerships with public administrations. Additionally, it is crucial to establish agreements with credit institutions willing to participate in the program. The conditions for accessing microcredit, such as the maximum loan amount, interest rates, and repayment terms, must be defined in agreement with all the parties involved. Another essential aspect is the monitoring of disbursed loans. A control system should be created to ensure that the funds are used responsibly and to reduce the risk of non-repayment. This could be achieved through the assistance of local cooperatives and advice from microfinance organizations already active in the area.

Input: Start-up funds, membership of cooperatives, and partnerships with banks.

Actors: Local cooperatives, banks, non-profit organizations, and residents.
The involvement of various stakeholders is essential. Local cooperatives play a central role by contributing to the creation of the guarantee fund and providing assistance to beneficiaries. Banks are key players, as they disburse loans and define loan conditions. Non-profit organizations can support fundraising and offer financial assistance to applicants. Finally, residents are the primary recipients of the initiative: low-income families who need support to carry out energy efficiency interventions or cover essential expenses. Broad community participation is crucial to ensure the project's success and to create a sustainable, replicable solidarity system over time.

Timing: 3–4 months for the activation of the fund.

Challenges: Identifying initial funds and management of insolvency risk.
One of the main obstacles is securing the initial funds required to establish the guarantee fund. To overcome this challenge, it is possible to involve various actors, including local administrations, banking foundations, microcredit organizations, and other third-sector entities. Another critical issue is the management of the risk of insolvency. It is important to carefully select beneficiaries, ensuring their ability to repay the loan through an assessment of their economic situation and potential savings from energy-efficiency measures financed by the program. A possible solution could be to tie loans to the implementation of certified energy interventions, which can reduce utility costs and improve the ability of households to repay the loans.

Other Information: Involve microfinance organizations already present in the area.

Areas Involved:

- **Legal:** Drafting contracts for microcredit.

- **Technical:** Binding of loans to the implementation of certified energy interventions.
- **Financial:** Facilitated access to low-interest loans.
- **Local Community:** Creation of a solidarity fund for vulnerable families.

Partnership with Third Sector Entities for the Fight Against Energy Poverty

This specific action stands out from other initiatives because it focuses specifically on the most vulnerable sections of the population. While the other actions aim to raise awareness, inform, and incentivize energy renovations, this one aims to directly remove economic obstacles, providing concrete support to those who do not have the resources to invest in energy efficiency. The aim is to ensure that no one is left out of the transition to more sustainable and comfortable housing.

Objective: Finance renovation interventions for families in difficulty.

Activity: Creation of a renovation fund, activate a consultancy service for incentives and microcredit, partnership with associations to identify beneficiaries.
The strategy is developed through three main actions. The first is the creation of a fund for energy renovation, intended to finance interventions in the homes of families in difficulty. This fund will be financed by public and private contributions, with the involvement of local authorities, banking foundations, and companies in the energy sector, which will be able to participate through donations or corporate social responsibility programs. Additionally, collaborations with local utility companies will be evaluated so that part of their revenues can be allocated to projects to combat energy poverty. At the same time, a consultancy desk on incentives and microcredit will be activated, offering personalized support to families in accessing subsidized loans, public tenders, and energy bonuses. This service will be available both online, through a digital platform, and in person, thanks to assistance points activated in collaboration with the municipalities of the Province of Parma. Here, technicians and experts in the field will provide free advice to help citizens navigate the available opportunities and identify the solutions that best suit their needs. Another key aspect is collaboration with associations and NGOs to identify beneficiaries of the interventions. Energy poverty is often a condition that is not very visible and does not always emerge from traditional economic indicators such as the ISEE. For this reason, it will be essential to work closely with organizations such as Caritas, social cooperatives, and voluntary associations, which operate daily in the area and can report the most critical situations. Through a network of collaboration with social services and municipalities, a fair and transparent allocation of resources will be guaranteed.

Input: Public/private funds for renovations, subsidized financing instruments.

Actors Involved: NGOs, banks, credit institutions, and local administrations.
The success of this initiative will depend on the collaboration between different actors. NGOs and associations in the third sector will play a central role in the involvement of families and the

management of aid. Banks and credit institutions will be essential to make ad hoc financial instruments available, such as microcredit for energy efficiency. Local administrations of Parma Province will have the task of facilitating access to public funds and supporting the management of resources. Energy companies and utilities will be able to contribute with dedicated funding and incentives, while universities and research centers, such as the University of Parma, could be involved to develop low-cost energy efficiency strategies and monitor the effectiveness of the adopted solutions.

Timing: 3–4 months for the activation of the first funding.

Challenges: Identification of the most vulnerable families, creation of an efficient fund management system.
The implementation of this project presents some difficulties. One of the main challenges will be to effectively identify the families most in need, preventing some situations of hardship from being excluded due to lack of bureaucratic requirements or difficulties in accessing information. It will therefore be necessary to develop clear selection criteria and activate a widespread reporting network in the territory. Another critical issue concerns the management of the renovation fund, which will have to be transparent and efficient to avoid waste or poorly targeted allocations. A monitoring system will need to be put in place to assess the impact of interventions and ensure that funds are used as effectively as possible. Finally, it will be essential to involve the private sector, convincing companies and credit institutions to participate in the initiative. To attract investors and sponsors, concrete incentives will have to be created, such as tax breaks or public recognition for companies that contribute to the project.

Areas Involved:

- **Legal:** Contracts for financing and incentives.
- **Technical:** Selection of priority interventions.
- **Financial:** Fund management and access to credit.
- **Local Community:** Active involvement in reporting and support processes.

Purchasing Groups for Building Materials and Energy Technologies

Objective: Reducing the costs of materials and technologies for energy renovation interventions.
Activities: Identification of suppliers, negotiation of competitive prices, and logistics management of orders.
The first step in organizing the purchasing group is the identification of local suppliers of building materials and energy efficiency solutions. There are several potential partners for this type of initiative in the Province of Parma. Once the suppliers have been identified, the initiative moves to the negotiation phase, where it is essential to establish clear agreements on prices and purchase conditions, ensuring that the quality of the materials is adequate. Following this, it

becomes necessary to coordinate the collection of orders among participants and organize the logistics for material distribution. Involving suppliers with transportation services can simplify this operation and ensure timely and efficient deliveries.

Input: Supplier database, participant membership, tools for managing collective purchasing.

Actors: Local residents, construction companies, cooperatives, energy technology suppliers, and trade associations.
The success of the purchasing group depends on the active involvement of various actors. Local residents are at the heart of the initiative, as they are the main beneficiaries of cost reductions and energy improvements to their homes. The greater their participation, the more it will be possible to obtain advantageous prices. A key role is also played by construction companies in the Province of Parma, which will benefit from reduced-cost materials and offer installation services for renovation projects. Their involvement is important both for ensuring the quality of the work and for promoting local economic development. Cooperatives and consortia in the area can represent strategic support in managing collective purchases and negotiating with suppliers. Another key player is represented by energy technology providers, which offer innovative solutions for improving building energy efficiency. Identifying local partners in this sector can reduce transportation costs and facilitate after-sales assistance.

Timeline: 1–2 months for organization and first order.

Challenges: Coordination between participants, logistical constraints for distribution. One of the main obstacles to this initiative is coordination between participants. Ensuring clear communication between residents, construction companies, and other stakeholders is key to consolidating orders and meeting deadlines. To address this, the creation of a local organizing committee could help facilitate project management and actively involve all stakeholders. Another challenge is the logistics of distribution, especially in peripheral and rural areas, which can complicate the efficient delivery of materials. To overcome this challenge, the initiative can partner with local suppliers offering transportation services, ensuring smoother distribution management.

Areas Involved:

- **Legal:** Collective agreements for shared purchases.
- **Technical:** Selection of certified high-efficiency materials.
- **Financial:** Economic savings through economies of scale.
- **Local Community:** Collaboration between residents to maximize participation.

Promotion of Renewable Energy Communities (RECs)

Objective: Creating energy communities for the production and sharing of renewable energy.

Activities: Raising awareness of the advantages of RECs, creation of purchasing groups for photovoltaic systems, and support for the legal establishment of RECs.

Input: Guidelines for the establishment, tools for energy monitoring and management, and agreements with suppliers for installations.

Actors Involved: Residents, local businesses, municipalities, and technology providers.

Timeline: 4–6 months for the creation of the first RECs.

Challenges: Bureaucratic complexity for the establishment and initial investments for systems.

Areas Involved:

- **Legal:** Energy management contracts.
- **Technical:** Design and installation.
- **Financial:** Incentives and financing instruments.
- **Local Community:** Active involvement.

Creation of Local Energy Cooperatives

Objective: Shared management of renewable energy systems.

Activity: Legal establishment of the cooperative and systems' installation.
The first step in setting up an energy cooperative is its legal establishment, which involves defining the articles of association, establishing the governance model, and officially registering the organization as a private association or cooperative. This process requires the support of legal advisors who are experts in corporate and energy law to ensure compliance with current legislation. Once the cooperative has been formalized, the second fundamental step is the installation of renewable energy production systems, which may include solar panels, biomass systems, or other technologically and economically viable solutions. It is essential to draw up detailed quotes and identify reliable partners among companies in the energy sector, such as firms specializing in photovoltaics or bioenergy. At the same time, it is important to launch a membership campaign to involve as many residents as possible. The greater the number of members, the more advantageous the distribution of costs and benefits will be. Additionally, the cooperative must manage the administrative and operational activities related to the produced energy, ensuring equitable distribution among members and entering into any sales agreements with the national electricity grid.

Input: Statute of the cooperative, quotes for the systems, and memberships.

Actors: Residents, energy companies, and legal advisors.
The success of the cooperative relies on the collaboration of various stakeholders. Residents are the key players in the project, as cooperative members and direct beneficiaries of the energy produced. Their involvement is crucial to ensuring the initiative's economic sustainability. Energy

companies play a vital role in the installation and maintenance of the systems, providing the necessary technology and technical support. Legal advisors are indispensable for handling the bureaucratic and regulatory processes related to the cooperative's establishment and the sale of the generated energy.

Timing: 4–6 months for establishment and start-up.

Challenges: Initial engagement and raising capital.
One of the main obstacles is initial community involvement, as many citizens may be skeptical about the benefits of an energy cooperative or fearful of the initial investment. To overcome this, it is crucial to provide clear information on the economic and environmental benefits, organize public meetings, and involve local associations to raise awareness. Another critical issue is capital raising for the installation of the systems. To make participation more accessible, incentives for founding members can be introduced. Additionally, exploring subsidized financing options, crowdfunding, or partnerships with public and private entities can help cover part of the initial costs.

More Info: Offer tax advantages to founding members.

Areas Involved:

- **Legal:** Incorporation as a private association or cooperative.
- **Technology:** Centralized management of solar or biomass systems.
- **Financial:** Distribution of costs and benefits among members.
- **Local Community:** Strengthening of the sense of community belonging.

Turnkey Bids from Private Consortia of Local Businesses

Objective: Offer integrated solutions for energy renovation without complications for citizens.

Activities: Creation of the consortium, definition of intervention packages, and promotion of the service.
The first phase of this activity consists of the creation of the consortium, bringing together various companies in the construction and systems engineering sectors in the Province of Parma. The aim is to establish a single entity capable of managing all renovation phases in an integrated way, from design to execution, up to post-intervention monitoring. Once the consortium has been formed, it will be necessary to define the packages of interventions, developing predefined solutions for different types of buildings and needs. This step requires a detailed technical analysis to ensure that the interventions are effective and compliant with regulations.

Input: List of local construction companies and feasibility study for predefined packages.

Actors: Consortia of companies, residents, and technical professionals.
The first key element is represented by the construction and system engineering companies,

which must join the consortium and guarantee the quality of the service. Residents are the primary beneficiaries of the initiative, benefiting from a simplified process for improving the energy efficiency of their homes. To encourage participation, it is essential to provide clear information on the economic and technical benefits of the proposed solutions. Another key player is represented by technical professionals, such as engineers and surveyors, who will be responsible for the design and certification of the interventions.

Timing: 1–2 months for the establishment of the consortium.

Challenges: Coordination between companies and quality assurance of the interventions. One of the greatest difficulties of this activity is the coordination between companies. An efficient consortium must ensure that all the renovation phases are managed in an integrated manner, avoiding delays or inefficiencies for customers. To achieve this, it is crucial to define clear processes and establish centralized project management. Another major challenge is quality assurance of the interventions. To protect citizens, it is important to implement quality control mechanisms and provide penalties for delays or poorly executed works. The stipulation of detailed contracts regulating these aspects is an effective solution to prevent problems and hold the participating companies accountable.

More Information: Implement penalties for poorly executed or delayed work.

Areas Involved:

- **Legal:** Single contracts with penalties for delays or poorly executed work.
- **Technical:** Integrated coordination between design, execution, and monitoring of interventions.
- **Financial:** Direct instalments through the consortium.
- **Local Community:** Use of local labor to stimulate the rural economy.

Free Energy Audit Packages Offered by Private Companies – Difficult Feasibility

Objective: Promote energy renovation through free audits.

Activity: Service promotion, audit execution.
The initiative involves selecting private companies specializing in energy audits to offer free assessments to a select group of residents. A database of partner companies must be created, along with clear participation criteria to ensure service quality and reliability. Once partners are defined, the next step is identifying target buildings, prioritizing those with significant energy inefficiencies or high potential for improvement. Promoting the service is crucial for success. Information campaigns, public meetings, and collaboration with local associations will help raise awareness about the value of energy audits and renovation opportunities. After completing the audits, companies will provide residents with detailed reports outlining identified issues and potential solutions. To ensure sustainability, participating companies may be granted the opportunity to propose subsequent paid services.

Input: Database of partner companies, list of target buildings.

Actors: Energy companies, residents.

Key actors include certified companies and professionals conducting audits, offering their technical expertise, and recommending energy efficiency improvements. Residents benefit from free assessments, gaining insight into their energy consumption and potential savings. Local associations and public bodies will be able to support the initiative by facilitating communication with residents, promoting the service, and ensuring transparency throughout the whole process.

Timing: 1–2 months to organize the service.

Challenges: Engaging companies without immediate financial return.
One of the main challenges is engaging companies without an immediate economic return. Businesses may be reluctant to invest resources in free audits without the assurance of a subsequent profit. To overcome this issue, a mechanism could be introduced to encourage their participation, such as promotional visibility or the opportunity to join accredited supplier networks for future renovation projects. Another critical aspect concerns the transparency of assessments. It is essential to prevent free audits from becoming a tool for aggressive marketing aimed at selling unnecessary services.

The final challenge is ensuring the active involvement of residents. Many may be skeptical or unaware of the benefits of an energy audit. For this reason, effective communication is crucial, providing concrete examples of cost savings and improvements achievable through renovations.

Other Info: Allow companies to propose paid interventions following free audits.

Areas Involved:

- **Legal:** Service contracts with data transparency clauses.
- **Technical:** Energy audits to identify priorities.
- **Financial:** Opportunity to propose paid service packages.
- **Local Community:** Promoting energy awareness.

Leasing Services for Advanced Energy Systems

Objective: Make energy technologies accessible without upfront costs.

Activity: Negotiation with suppliers, drafting leasing contracts.

Input: Supplier list, contract templates.

Actors: Energy companies, residents.

Timing: 2–3 months to define contracts.

Challenges: Managing maintenance and buyout options at the end of the lease.

More Info: Offer optional buyout options for citizens.

Areas Involved:

- **Legal:** Transparent leasing contracts.
- **Technical:** Guaranteed installation and maintenance.
- **Financial:** Periodic payments, no initial costs.
- **Local Community:** Affordable solutions for low-income families.

Partnerships with Agricultural Companies for Biomass Supply

Objective: Reduce heating costs using local resources.

Activity: Establish supply agreements, collect biomass.
The initiative will begin with identifying agricultural enterprises willing to supply biomass, such as pruning residues, agricultural waste, and wood. A key step will be mapping companies in the province of Parma that have suitable raw materials, ensuring that the biomass is certified, sustainable, and compatible with existing combustion systems. Next, supply agreements between agricultural producers and either residents or energy companies will be established. These contracts should clearly define quantities, collection and distribution methods, pricing, and timelines, with a strong focus on ensuring a stable supply during colder periods. Transportation logistics will also be crucial. To minimize costs and prevent material losses, solutions such as centralized collection points or purchasing cooperatives could be implemented to streamline distribution and reduce transport expenses. Finally, to encourage the adoption of biomass as a heating source, it will be essential to promote high-efficiency boilers and facilitate the conversion of existing systems. This could be supported through measures such as tax incentives or grants for purchasing new systems.

Input: Contractual agreements, transport logistics.

Actors: Agricultural enterprises, residents, energy companies.

Agricultural enterprises will be the primary suppliers of biomass, providing processing residues and other materials suitable for combustion. Residents will benefit from a more affordable and sustainable heating system, gaining access to a local energy source at lower costs than traditional fuels. Energy companies will play a strategic role in managing the process, from collection to distribution, and will provide technical support for the installation and optimization of biomass systems. Local institutions and trade associations can facilitate partnerships by promoting incentives, clear regulations, and awareness campaigns on the benefits of using biomass.

Timing: 3 months for the start of supplies.

Challenges: Managing logistics and ensuring stable supply.
One of the main challenges is coordinating logistics. Biomass has a significant volume and must be collected, stored, and distributed in an organized manner to prevent waste and delays.

Additionally, it will be crucial to balance supply and demand to avoid shortages during periods of high consumption or unused surpluses. Another critical issue concerns the quality of the biomass. It is essential that the material used is certified and meets environmental standards, preventing the use of contaminated waste or materials with high moisture content, which could reduce energy efficiency and increase pollutant emissions. Finally, securing the participation of farmers may not be immediate. Some may be reluctant to invest in biomass collection and processing if profit margins are not sufficiently attractive.

More Info: Promote the use of certified biomass.

Areas Involved:

- **Legal:** Private supply contracts.
- **Technical:** High-efficiency biomass boilers usage.
- **Financial:** Lower heating costs.
- **Local Community:** Collaboration between agricultural enterprises and residents.

2.3. Identify All Relevant Actors and Stakeholders

To successfully implement roadmaps, it is essential to identify and involve key stakeholders, categorising them based on their expertise and operational scope.

1) **Local Level**

At the local level, the initial step involves directly engaging associations and organizations operating within the area. These include:

- Trade Associations: Organizations like Confagricoltura, Coldiretti, CNA and Confcommercio.
- Professional Associations: Groups such as the Order of Architects and the Order of Engineers, which offer technical expertise and support for designing and implementing projects.
- Universities and Research Centres: Academic institutions, especially faculties such as Architecture, Engineering, Law, and History can contribute a multidisciplinary approach by integrating technical, regulatory and socio-cultural perspectives.
- Local Public Entities: Municipalities, territorial energy agencies, and, if applicable, Local Action Groups (LAGs). These entities play a critical role in engaging with citizens and expediting the approval for necessary permits.
- Local Funding Institutions: Organizations that assist with financing renovation projects, prioritizing support for economically disadvantaged families.

2) Regional Level

At the regional level, fostering collaboration with regional authorities is crucial for:

- Regional Funding: Identifying and accessing regional funds dedicated to promoting and implementing the roadmaps. In this case it is necessary to interact with policymakers at the regional level, interacting with the various regional councillors.
- Regional Regulatory Adjustments: Partnering with authorities to align and simplify regional regulations, particularly those involving exclusive regional competencies.
- Synergy with Municipalities: Ensuring consistent regulatory practices and providing effective administrative support at the municipal level. in this case it is necessary to address the mayors and city councils.

3) National Level

At the national level, it is necessary to engage with government institutions and research organizations to align local and regional efforts with national strategies. Key actors include:

Relevant Ministries:

- Ministry of Enterprise and Made in Italy;
- Ministry of the Environment and Energy Security;
- Ministry of Infrastructure and Transport.

National Research and Development Bodies:

- ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development);
- ISPRA (Higher Institute for Environmental Protection and Research);
- CREA (Council for Agricultural Research and Analysis of Agricultural Economics).

In addition, collaboration with private sector players and prominent environmental and consumer associations is indispensable for ensuring the availability of technical, financial and operational resources:

- Energy Companies: Major corporations like ENI and Enel, which are deeply involved in the energy transition and promote initiatives like Renewable Energy Communities (RECs).
- Environmental Organizations: Key groups include Legambiente, WWF Italy and Greenpeace Italy, which focus on the environment and sustainability.
- Consumer Associations: Associations such as Adiconsum, Altroconsumo and Federconsumatori ensure that citizens' voices are heard and their interests protected.

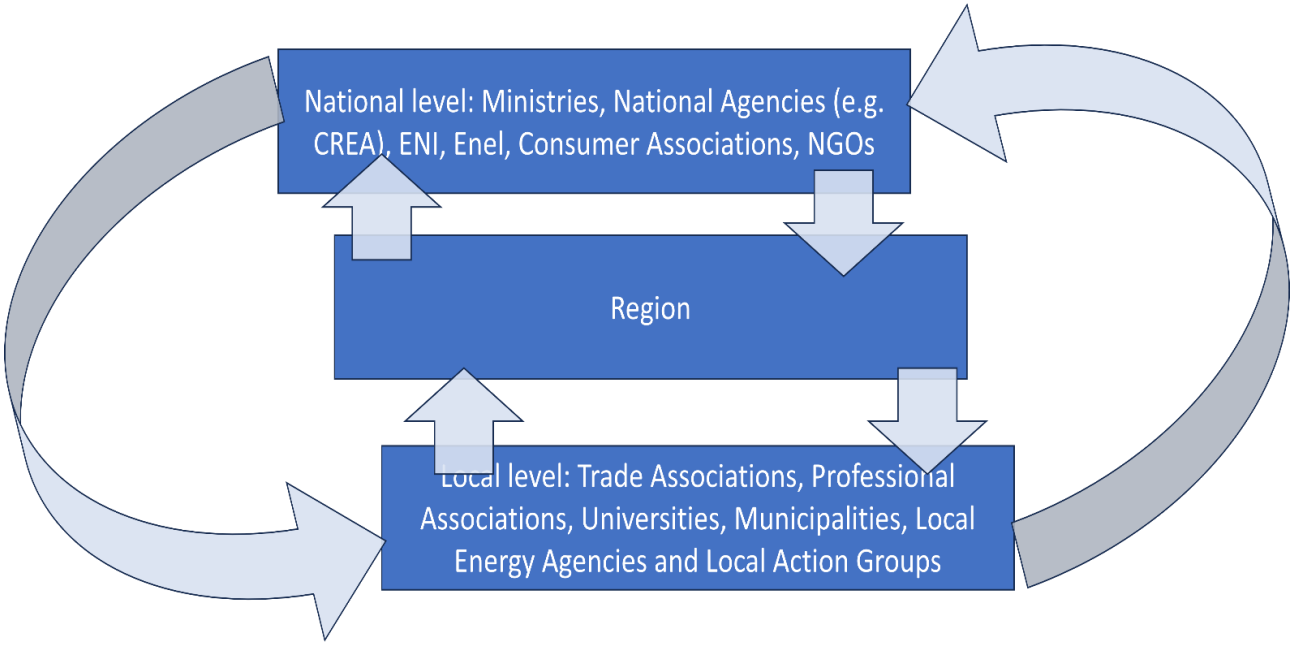


Figure 6: Communication and interaction betweent different levels

2.4. Scalability and Replicability

Scalability and replicability are key components to ensure that the roadmaps can be applied to a variety of contexts, reaching an ever-growing number of beneficiaries. These principles make it possible for the adopted measures, strategies and best practices to be expanded and adapted to different situations, resulting in a significant and lasting social, economic and environmental impact.

During the preparation of the REERs, the document was carefully structured to foster both scalability and replicability. All phases and activities have been laid out with clear steps to ensure that the document is easily understood and applied, while remaining adaptable to specific territorial and legislative contexts without losing focus on the main objectives.

Steps to Ensure Scalability and Replicability:

To promote the effective and widespread implementation of REERs, a structured approach based on the following steps is recommended:

1) Mapping Stakeholders and Territorial Contexts

To ensure scalability and replicability, the process must begin with a comprehensive mapping of target regions to identify key actors and stakeholders at the local, regional, national and international levels. The creation of tools and guidelines that are easily adaptable to the specific needs of each region is essential to ensure consistent and flexible application. Additionally, fostering collaborative networks will facilitate the sharing of best practices and support the implementation of solutions on a larger scale. This approach ensures that REER remain a

relevant and effective tool in combating energy poverty while adapting to a constantly evolving social and economic landscape.

2) Engagement with National and European Networks

Once the key stakeholders are identified, the plan should be introduced to national and European networks, such as the National Association of Italian Municipalities (ANCI) and the Council for Agricultural Research and Analysis of Agricultural Economics (CREA). These organizations, with their extensive networks and expertise, can play a pivotal role in supporting the implementation of the model and amplifying its impact.

3) Promotion and Involvement of the Third Sector

It is equally important to present the roadmaps, even in their preliminary form, during events organized by third-sector entities and charitable organizations. These organizations, with their close ties to local communities and experience in tackling energy poverty, can act as effective promoters of the model, ensuring greater community engagement.

4) Gathering Feedback and Adapting Nationally

Feedback gathered from networks and social institutions should be integrated to refine and adapt the REER for wider national dissemination. At this stage, the roadmaps should address the unique needs of each region or community. This step is crucial for incorporating received observations, enhancing the document's comprehensiveness and applicability. It is vital to ensure the model's scalability, allowing it to be deployed on a larger scale across regions and, ultimately, nationwide.

5) Integration into National Strategies

A decisive step for the success of the REER is its integration into national policies and strategies through direct collaboration with relevant authorities. This integration ensures institutional support and recognition of the roadmaps as an integral part of official efforts to combat energy poverty. The Integrated National Energy and Climate Plan (PNIEC) offers a key opportunity, as it aims to reduce greenhouse gas emissions, improve energy efficiency, and promote renewable energy. Similarly, the **National Recovery and Resilience Plan (PNRR)**, funded by the European Union's Recovery and Resilience Facility, provides essential financial resources for large-scale implementation, with a focus on rural and vulnerable areas.

REER aligns seamlessly with these strategies, addressing the energy divide between urban and rural areas, enhancing energy efficiency in residential buildings, and improving the quality of life for local inhabitants. The roadmaps are in harmony with Italy's commitment to reducing emissions in the residential sector and advancing the sustainable use of energy in vulnerable communities.

6) Quantification of Benefits and Demonstration of Expected Results

To secure the support of policymakers and institutions, a detailed analysis of the anticipated economic, social, and environmental benefits at the national level is essential. Additionally, to strengthen stakeholder engagement, it is crucial to present the projected outcomes in a clear and concrete manner. Practical examples, such as achieved energy savings or reduced costs for households, can demonstrate the value of the REER, making them an effective and compelling tool for large-scale adoption.

To conclude, disseminating, implementing and replicating these roadmaps can enable an increase in residential buildings upgraded, offering solutions and alternatives to widespread obstacles. In addition, these will provide an opportunity to increase collaboration between institutions and stakeholders, ensuring greater attention to the needs of citizens and households in energy poverty.

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