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Rural Energy Efficiency Roadmap – REER for Kääpa 6 building

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About RENOVERTY

RENOVERTY will foster energy efficiency building upgrades in Central and Eastern Europe (CEE), South-eastern Europe (SEE) countries, as well as Southern European countries (SE), 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.

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EXECUTIVE SUMMARY

The RENOVERTY project has released Rural Energy Efficiency Roadmaps (REER) across 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. This document is the REER for the Estonian Kääpa 6 building and outlines strategies to renovate multi-apartment residential buildings in rural Estonia. The document highlights Estonia's housing situation, where a significant number of buildings, built during the Soviet era, require deep renovation to enhance energy efficiency and living conditions. The roadmap provides a structured renovation process, including technical assessments, financial planning, regulatory compliance, and stakeholder engagement. A major focus is on securing funding, as grants cover 50% of renovation costs, with additional financing sourced through loans.

Key renovation measures for Kääpa 6 include insulation of walls, roofs, and foundations, replacement of windows and heating systems, and the installation of modern ventilation and renewable energy solutions, like solar panels. The roadmap also emphasizes community participation, ensuring that residents are involved in decision-making and benefit from improved living standards.

Challenges such as financing difficulties, low property values, and decision-making complexities among homeowners are addressed through policy recommendations, loan guarantees, and expert consultations. The document concludes with strategies for scaling and replicating the roadmap across other rural areas in Estonia and the EU, promoting sustainable and financially viable renovation models.

While the first chapter of the REER, targeted towards citizens and homeowner associations is facultative and technical, and can be used as a renovation guide for the Kääpa 6 building, the second chapter is conceptual and addresses the main stakeholders and their role in the renovation process.

1. Technical considerations for the refurbishment of households in Kääpa 6 building affected by energy poverty

1.1. Introduction: Background on the area and specifics of renovating multi-apartment residential buildings in Estonia

The housing situation in Estonia is somewhat unique while also similar to other Baltic countries due to historical circumstances under Soviet occupation. Civilian occupation and the influx of foreign workers from other regions of the Soviet Union after WWII, which coincided with industrialization in other European countries, resulted in a shortage of housing. Hence, the development of large industrial facilities specialized in serial production of pre-cast concrete buildings served as a resolution for the housing problem. Production of such buildings in Western Europe was stopped during the oil crises of the 70s, while in the Soviet Union, this continued until the early 90s. As a result, approximately 70% of Estonians live in apartment buildings, with 50% living in apartment buildings built during the 70s and 80s of the 20th century.

To tackle the task of renovating an ageing and inadequate housing stock, the KredEx Fund (now part of the Estonian Business and Innovation Agency - EIS) started issuing renovation grants (see chapter 1.1). In order to qualify for such a grant, an applying apartment association (AA) has to meet a combination of administrative and technical criteria, including for comprehensive reconstruction renovation. It means at least insulation of building envelope, renovation of heating system and ventilation system. Other technical systems are optional but mostly included to renovation package. Goal is to achieve energy performance class "C" (150 kWh/m^2 a) at least. The rather strict criteria significantly narrows the opportunities for co-creation of renovation plan and expected results of renovation.

On the other hand, the grant, covering 50% of all expenses for the renovation of rural apartment buildings, effectively excludes the renovation of buildings without applying for a grant.

On the downside, in the beginning, calls for grants were planned to occur regularly and even annually. Unfortunately, dependent on various adverse conditions (financial crises, starting of a new financial period in the EU, COVID, change of government) the regularity has not happened.

Introduction of renovation Grant for apartment buildings in Estonia

For the 2022-2027 period, the state has allocated 330 million euros from the European Union Structural Funds for apartment building reconstruction grants. We opened the second application round for the grant on October 28, 2024, at 10:00. The available funds for the round total 170 million euros, which are divided into budgets for counties, reconstruction using prefabricated elements, heritage and environmentally valuable apartment buildings, neighbourhood-based reconstructions, and large apartment buildings. (Ministerial regulation)

The grant funds both the comprehensive reconstruction of apartment buildings and, as a separate activity, the replacement of gas, stove, or electric heating systems in apartment buildings with heating devices using renewable energy sources or the connection of these apartment buildings to the district heating network. The supported activities enable energy efficiency improvements for apartment buildings and promote the use of renewable energy.

The amendment to the grant regulation comes into effect on September 27, 2024. Last regulation is accessible (in Estonian language) in webpage of EIS renovation service.

Main conditions are:

- The grant can be applied for the renovation of an apartment building built before 2000that has an apartment association
- The grant can only be applied for those reconstruction works that are reflected in the appropriate main project. The construction project necessary for the reconstruction of an apartment building that has been prepared in accordance with the requirements established by § 13 (3) of the Building Code, the standard EVS 932 or equivalent requirements and the requirements of the regulation, and the architect of which must be at least on the professional level 7 of authorised architect. The project must have been approved by the Board of the Apartment Association.
- The applicant must conclude a contract with the technical consultant or the company through which the technical consultant provides the service, except if the applicant did not receive any bids for reasons beyond their control. The contract between the technical consultant and the Apartment Association is concluded no later than the moment the application is submitted.
- The cost of preparing the construction project (including conducting the construction survey and building audit on which the construction project is based) and the service of a technical consultant are eligible for the grant before the date of application submission to the implementation unit. If the technical consultant also performs owner supervision, the cost of performing owner supervision is not eligible for the grant before the date of the start of project activities specified in the decision to approve the application.
- Etc

Grant rate and maximum grant amount (some main points, whole document available here):

- In Tallinn and Tartu: 30%, or 50% when using prefabricated elements for reconstruction.
- In settlements adjacent to Tallinn and Tartu where the market value of real estate in the year preceding the application exceeds 500 €/m² according to the Land Board transaction database, and in Ilmatsalu, Märja, Haapsalu, Keila, Kohila, Kuressaare, Maardu, Otepää, Paikuse, Pärnu, Rakvere, Rapla, Sauga, Uuemõisa, and Viljandi: 40%, or 50% when using prefabricated elements for reconstruction.
- In the rest of Estonia: 50%, or 55% when using prefabricated elements for reconstruction.
- In other regions, excluding Tallinn and Tartu, it is possible to apply for a grant that is 10% lower if all the specified conditions are not met (e.g., no heat recovery ventilation is installed, or window thermal bridging requirements are not fulfilled)
- *etc

Grant eligible activities

- Reconstruction and insulation of the facade, including the design, manufacture and installation of prefabricated elements and related works.
- Reconstruction and replacement of balconies and loggias, installation of glass and related works.
- Reconstruction and insulation of the roof and roof ceiling, including the design, manufacture and installation of prefabricated elements and related works.
- Replacement or renovation of windows and exterior and fire doors and related works.
- Basement reconstruction and insulation and related works.
- Foundation reconstruction and insulation and related works.
- Replacement, reconstruction and balancing of the heating system, replacement of the heating unit, preparation of the protocol for balancing the heating system and related works.
- Installation, replacement or reconstruction of the water and sewage system, including the construction and reconstruction of systems necessary for the soaking, use or drainage delay of rainwater, and related works.
- Construction of a ventilation system with heat recovery or reconstruction of a ventilation system, preparation of a measurement protocol for the ventilation system and related works.
- Building a cooling system or integrating a cooling unit into a central ventilation system.

- Acquisition and installation of equipment necessary for the use of local renewable energy and related works.
- Partial or complete reconstruction of the lift control system and drive or replacement of the lift and related works.
- Replacement or reconstruction of the electrical system located in public areas, including the installation of an electric car charging infrastructure within the meaning of the Building Code and the creation of the possibility to switch the heating unit to external electrical power and related works.
- Installation of the levelled insulation for windows of the common areas and apartments and the restoration of the interior finish resulting from the construction of the heating and ventilation system.
- Construction or installation of a ramp to provide an entrance and exit for the building, reconstruction of the porch, installation of handrails, installation of a lift for the disabled and construction of a lift that complies with the standard EVS-EN 81-70 or equivalent requirements and related works.
- The work related to connecting the building to the district heating network within the boundaries of the property.
- Construction or reconstruction of a waste building or acquisition and installation of a deep collection container.
- Construction or reconstruction of a bicycle parking area.
- Acquisition and installation of necessary equipment to ensure energy supply security and fire safety and related works.
- Preparation of the construction project necessary for the execution of the works in the above-mentioned sections, including the construction survey and building audit that form the basis of the construction project.
- Using the service of a technical consultant.
- Carrying out owner supervision

Rest of information are available in the webpage of renovation grant.

1.2. Energy audit

An energy audit is by its very nature a comprehensive energy analysis of a building. The most general goal of an energy audit is to identify, in detail, the specifics of a building's energy use and, based on this, to define savings opportunities.

During the energy audit, the building's energy balance is drawn up, where it is defined how the energy supplied to the building (mainly electricity and thermal energy) has actually been used in the building during a certain period. In other words, how much of it has been lost through various external barriers (walls, roof, floor, doors, windows), how much has left the building with sewage water, how much has been vented out, etc.

During the energy audit, an assessment is also given about the equipment that produces, distributes, and uses energy in the building (boiler house/heating unit, heating system, electrical system, water pipeline, ventilation system), evaluating their efficiency and the possibility of saving measures.

This is done so as to find the costs of all savings options. By comparing costs and achievable savings, it is possible to rank the application of different savings measures, for example, according to simple payback times. In this way, it is easy to define which order of works produces the largest savings or to estimate the total need for money for the implementation of savings measures and the total savings.

It is also possible to perform an energy audit based on the design materials of the building’s shell. However, if the energy balance is based on the amount of energy actually used in the building, measuring the thermal conductivity of the outer walls with a thermal camera gives a more accurate result, as the actual thermal conductivity of the property’s perimeter is determined as a result of the measurement, which, in addition to the physical properties of the materials used, also largely depends on the quality of the materials and the work performed.

1.3. On-site visit to Kääpa 6

The renovation rate of rural multi-residential apartment buildings is one of the lowest in the sector, and the national refurbishment effort has not improved the situation. As many of these buildings have not been renovated since their manufacturing in the 1960s and 1970s, their energy performance and indoor quality are not up to modern standards. As an outcome of a lack of refurbishment efforts and do-it-yourself modifications in the heating systems, these buildings often offer only a substandard quality of life to their inhabitants, who otherwise have very few opportunities for choosing alternative housing. At the same time, these buildings are continuing to provide essential housing services for rural centres that have not seen significant economic development during the last 30 years.

The Kääpa village in the Mustvee parish, in Eastern Estonia, is an active community. The village houses a museum of Kalevipoeg, an Estonian mystical hero and a corresponding small theme park. The community has been participating in other projects such as the ongoing project StartSun under the Interreg framework in Baltic Sea Region.

1.4. The building

The building was built in 1985. It has 12 apartments, of which 6 are three-room apartments, 4 are four-room apartments and 2 one room apartments. Windows have double glazing with plastic frames. Heated area is 710,8 m². According to the building's Energy Performance Certificate (EPC), the weighted energy use of this building is 281 kWh/m², which corresponds to energy class "G".

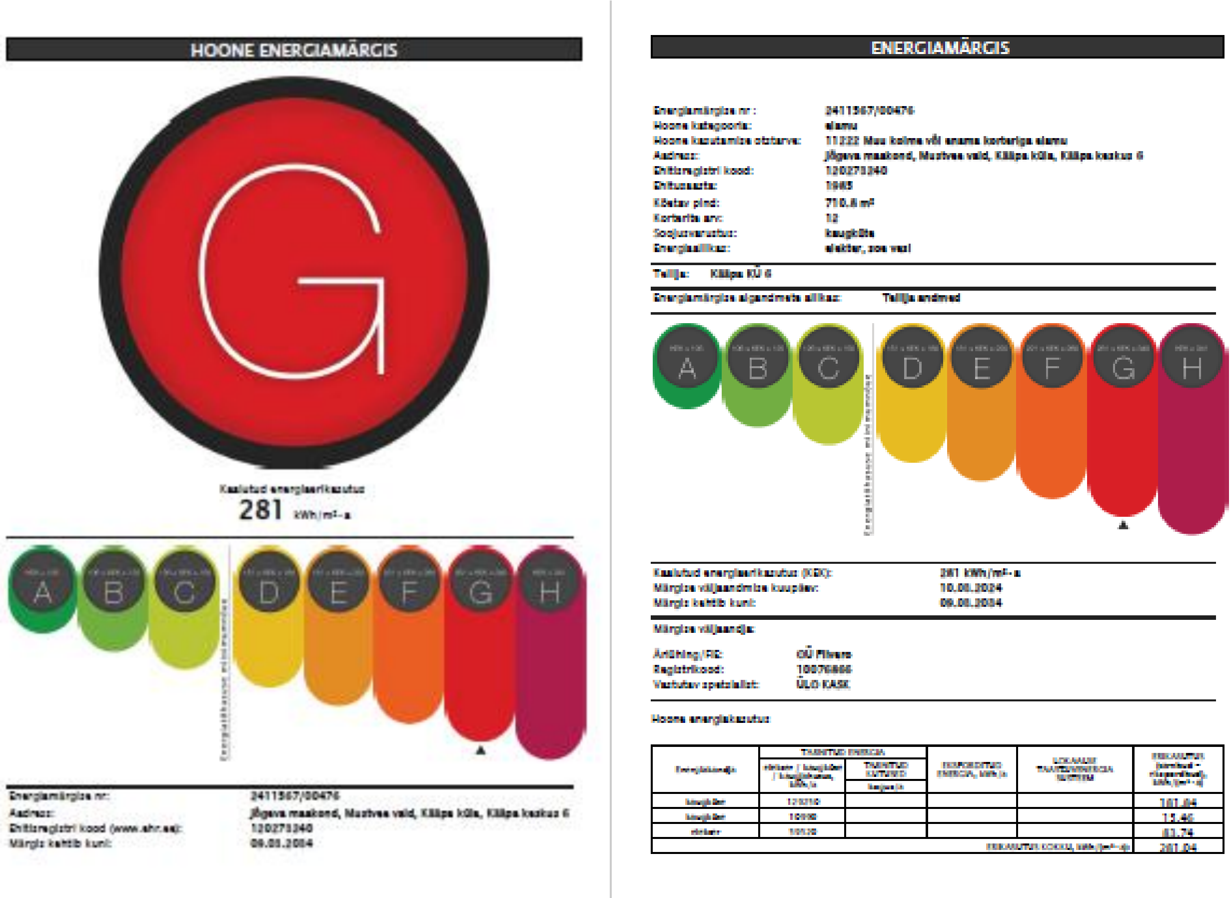

Figure 1, EPC class "G" 281 kWh/m²a

The load-bearing walls in this building are made of aerated concrete. Aerated concrete, used in Estonia in the second half of the last century, was also known as the Palivere block. The production technology consists of grinding lime, sand, and impurities in a disintegrator mill and subsequent autoclaving. In Estonia, these blocks were produced with different compositions and in different production modes at the Palivere and Aravete factories, which is why it is impossible to assess the exact physical properties of the blocks used for a specific building without knowing the time, place and conditions of their manufacture. Large blocks with similar technology were also produced in Narva and Ahtme using shale ash and cement in addition to, or instead of lime. In general, the wall thickness of the Kääpa building considered to be 30 cm and the thermal transmittance U≈0.9 W/m²K.

At the time of its production, a relatively good wall material was considered to have a low resistance to cold cycles. However, slanted rain easily penetrates the pores of the blocks, and when it is followed by frost, it breaks the structure of the block. Therefore, it is important that the aerated concrete blocks are protected on the outside, for example, with plaster. However, damage to the plaster surface can lead to deeper deterioration of the blocks so the outer surface of large aerated concrete blocks must be covered. For example, during a renovation, the building can be insulated from the outside and lined with weatherproof material. Then, the mineral part is protected and stays constantly in plus degrees. When using porous insulation material, a suitable wind barrier must also be used.

District heating is only available during the heating period, meaning that during the summer months, an alternative must be used and domestic hot water must be heated by electric boilers.

1.5. Meeting with households

Meetings with households (members of AA) and several stakeholders took place in 2024 on May 16th, September 30th, and October 15th. In the meetings participated representatives (it was open to all citizens living in those buildings) of households, municipality representatives, local development group members. Although the first meeting with homeowners was organized only on May 16th, negotiations with leaders of the community and parish had been going on even earlier.

In the meetings, the expectations of owners and inhabitants in the frame of available grants were brought to light. Discussions were held about the need for renovation (energy efficiency, comfort, cost savings), allowing for the identification of common concerns and expectations among residents, and for awareness raising on available financing options, grants, and loans.

1.6. Customer journey of the renovation of multi-apartment buildings

The renovation of multi-apartment buildings follows a structured process set by EIS and technical consultant, involving multiple stakeholders, from initial awareness to project completion.

Below is a step-by-step outline, across following steps, of the entire renovation flow in Estonia.

1. **Evaluate the technical condition of the building and involve a technical consultant.** Start by assessing the technical condition of the building. If you lack the necessary knowledge, it is essential to involve experts in technical systems and construction. It is advisable for the apartment association to hire a technical consultant when planning the work. In the case of applying for subsidies, involving a technical consultant is mandatory.

2. **Prepare the project brief along with an initial budget and schedule.** When planning renovation work, it's important not to focus solely on the payback period of specific tasks and potential energy savings, but to look at the building as a whole, considering energy efficiency, safety, and preservation.

3. **Investigate the possibility of obtaining a bank loan.** After the project brief is completed, it's time to investigate the possibility of obtaining a bank loan. Since the best result in building reconstruction is achieved through a comprehensive approach, the cost of construction work is typically such that, in addition to personal funds, it is necessary to involve loan money and, if possible, state support. Based on the initial reconstruction budget, you can contact the bank and inquire about the conditions and extent to which a loan can be obtained for the reconstruction. However, the exact budget will only be clear after the construction project is completed and the tender process is conducted, as different technical solutions will also affect the total cost of reconstruction.

4. **Call a general meeting of the apartment association.** Next, it's time to hold the general meeting of the apartment association to make decision to choose the package of work to be done, the loan amount, and authorize the board to carry out the reconstruction. The decision form for the meeting is best provided by the bank. When improving the energy class of the building, a qualified majority must be reached at the general meeting.

5. **Obtain offers and order the construction project (design).** If a project has not been prepared earlier, it is necessary to obtain offers and order the preparation of the construction project. The project must be prepared in such a way that it allows for accurate construction cost estimates and must meet both the regulation and

project requirements. The construction project creator must have the appropriate registration, which can be verified in the business register.

6. **Submit a loan application to the bank and a subsidy application to the EIS.** If applying for a subsidy and/or loan, the applications must now be submitted and a decision received.

7. **Organize tenders to find a builder and owner supervision.** Before starting the renovation, tenders must be organized to find a builder and owner supervision. Owner supervision is crucial to achieving a high-quality final result,and cutting corners on this can have costly consequences. This is followed by the signing of contracts.

8. **Enjoy lower heating bills and better indoor climate in the renovated building!** The process ends with the completion of the building's reconstruction and the acceptance of the work. Before accepting the work, it is essential to perform the necessary settings (heating, ventilation, etc.).

1.7. Setting renovation expectations and indicators for households of Kääpa 6

Owners of houses (buildings, having a energy performance certificates "C" or better or having environmental certificates, including energy-efficient buildings) often have specific expectations and advantages when considering energy renovation. These factors typically revolve around cost savings, environmental impact, and comfort improvements. The common expectations in energy renovation are detailed below:

Lower energy costs (which can be achieved with deep and full renovation) Homeowners of certified family houses expect energy renovations to lead to reduced heating, cooling, and electricity expenses. Since these homes are already designed for efficiency, further upgrades—such as improved insulation, better windows, or solar panels—can significantly cut utility bills. Over time, these savings help offset the initial investment in renovations.

Improved indoor comfort (which can be achieved with deep and full renovation) Usually, homes are renovated with high-performance materials and energy-efficient designs, but some aspects, such as insulation or ventilation, may need upgrades over time. Homeowners expect renovations to enhance indoor comfort by eliminating drafts, stabilizing indoor temperatures, and ensuring better humidity control. These improvements lead to a more pleasant and healthier living environment.

Increased property value (which can be achieved with deep and full renovation) Energy-efficient renovations are often seen as an investment in the property's future marketability. Homebuyers are becoming more interested in sustainable living and lower operating costs, making energy-efficient homes more attractive. Renovations that improve energy performance—such as triple-glazed windows, advanced HVAC systems, or smart home energy management—can increase resale value and demand.

Compliance with new regulations (which can be achieved with deep and full renovation)
Governments and regulatory bodies frequently update building codes and energy efficiency standards. Homeowners expect renovations to ensure their property remains compliant with evolving legal requirements, avoiding potential fines or mandatory upgrades in the future. Additionally, meeting these standards can unlock financial incentives like tax credits or subsidies.

Smart home integration (which can be achieved with deep and full renovation)
As technology advances, homeowners expect energy renovations to incorporate smart home features that enhance energy management. Upgrades such as programmable thermostats, smart lighting, and automated shading systems allow for real-time energy monitoring and optimization, making homes more convenient and cost-effective to operate.

Sustainability & reduced carbon footprint (which can be achieved with deep and full renovation)
Renovated buildings should fulfil sustainability criteria and be climate resilient even after 30-40 years. Some of the owners are environmentally conscious and expect renovations to align with sustainability principles. They seek energy solutions that minimize carbon emissions, such as using renewable energy sources, high-efficiency heat pumps, or eco-friendly insulation materials. These choices contribute to long-term environmental benefits while maintaining or improving the home's certification standards.

Interviews with homeowners have also highlighted the specifics of residents' motivation for renovation in relation to different levels or solutions of renovation. In Figure 2, residents' expectations for renovation are placed in a pyramid. The first level of the pyramid is the need to preserve the building and the importance of accident prevention. This is where the most common reasons for renovation arise, since, for example, depreciated technical systems can lead to extensive damage. There are generally no disagreements between residents at this level. It is understood that these works are necessary and must be undertaken as soon as possible. However, the members of the apartment association may have major disagreements regarding the next three levels, as comfort, aesthetics, and efficiency are of different importance to the residents. Within these groups,the greatest difficulty is to reach a common agreement on a technical solution or design. The last level usually includes innovations that are less common in renovation. These can include new technologies (e.g. solar panels, home automation, factory renovation) as well as the scope of renovation (e.g. external solutions). The top of the triangle is only addressed when all other levels have reached consensus, and the association also has the financial capacity to carry out any renovations.

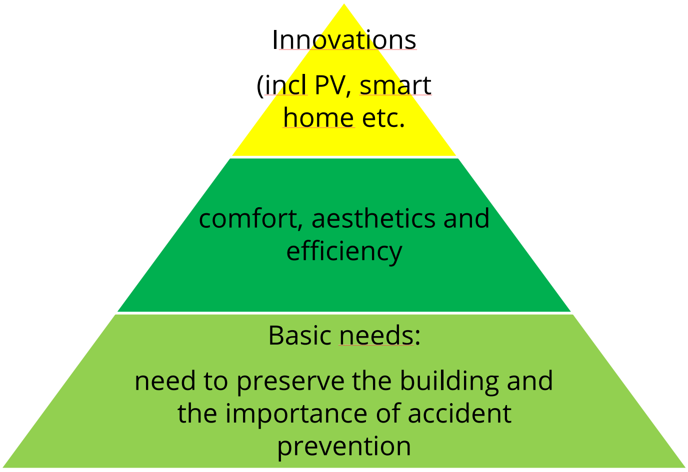

Figure 2. Residents' motivation for renovation measures.

Planning the renovation

When renovating a apartment building in Estonia, owners and apartment associations must choose between **comprehensive renovation (all activities at once)** or a **step-by-step approach (gradual renovation over 10-20 years)**. Both methods have their advantages, depending on financial resources, project complexity, and long-term goals. In Table 1, the comparison of a full versus a step-by-step renovation is provided.

Factor	Full Renovation (All at Once)	Step-by-Step Renovation
Energy Savings	Immediate and maximum (50-70%)	Gradual, spread over years
Financing & Subsidies	More government/EU support	Some subsidies available, but lower amounts
Property Value	Increases significantly in short term	Gradual increase over time
Disruption to Residents	High but only once	Lower per step, but repeated over years
Cost Control	Fixed cost at today's prices	More flexible but affected by inflation
Efficiency of Renovation	All systems are optimized together	Risk of mismatches in older vs. newer upgrades

Long-Term Cost Savings	No need for repeated work	Possible extra costs for redoing some parts

Table 1. Comparison of a full vs a step-by-step renovation

In Estonia today, a grant is provided only for full renovation. As mentioned earlier, renovating apartment buildings without using a renovation grant is unpopular. Only inevitable repairs are carried out without using a grant. Thus, the expectations and indicators for improvements are connected to certain technical requirements that a apartment association has to achieve to be eligible for the grant. Additionally, the apartment associations must follow the indications of the New European Bauhaus.

Technical basic requirements to be eligible for the EIS grant are as follows:

- Attain an energy efficiency class of C (≤150 kWh/m²a);
- Reconstruct the heating system to enable regulating room temperature in the interval 18-25°C;
- Additionally insulate walls up to U≤0.20 W/m²K;
- Replace all windows that have not been replaced yet with windows having heat transfer less than 1.10 W/m²K;
- Install all windows at the level of insulation or additionally insulate window panes;
- Reconstruct and insulate the roof up to heat transfer less than 0.12 W/m²K;
- Install an intake and exhaust ventilation system with heat recovery;
- Ensure that the energy used for space heating, hot water production and ventilation air heating in the heat unit can be separately measured if there are corresponding heat consumers;
- Achieve intake air flow rates of at least 10 l/s in bedrooms and living rooms at a noise level of no more than 25 dB(A);
- Achieve exhaust air flow rates in the toilet and laundry room of 1-room apartments at least 10 l/s and in the kitchen 6 l/s, in the toilet and laundry room of 2-room apartments at least 15 l/s and in the kitchen 8 l/s, in 3- and more-room apartments in the WC of apartments at least 10 l/s, in the laundry room at least 15 l/s and in the kitchen 8 l/s;
- In an apartment building with district heating, create the option of switching the heating unit to external electricity.

Spatial solutions under the New European Bauhaus should be simultaneously beautiful (aesthetics), inclusive (accessibility, affordability) and sustainable (climate goals). Based on the New European Bauhaus Compass, the opportunities and needs of ambitions have been adapted to the practice of reconstructing apartment buildings in Estonia.

The construction design must include at least the following from the Estonian rules New European Bauhaus related with technical design of renovation :

A BEAUTIFUL reconstruction solution

Activates

- has been created in cooperation with residents and a qualified architect. The architectural part of the explanatory memorandum to the reconstruction project appropriately describes the implementation of the principles of the New European Bauhaus.
- fits into the regional milieu, the suitability of materials and the colour scheme have been considered
- increases the quality of the yard area surrounding the building (e.g. outdoor furniture, playground, bicycle racks, etc.), if possible and necessary (size of the plot, density of surrounding buildings);

Combines

- increases the quality of the yard area surrounding the building (e.g. outdoor furniture, playground, bicycle racks, etc.), if possible and necessary (size of the plot, density of surrounding buildings);

Relates

- is based on the wishes of the association and has been developed in a co-creation process, the expression of which is the decision of the general meeting.
- supports the long-term sustainable development of the place and connections with the regional developments of the district.

An INCLUSIVE reconstruction solution

Allows

- improves accessibility (access to and near the building) and access to social services (e.g. common areas/rooms)
- maintains the affordability of living in the neighbourhood, avoids a sharp increase in the cost of living (the cost of solutions does not significantly increase monthly costs)

Bind

- takes into account the needs of vulnerable groups (young families, older people, people with special needs)

- increases the security of the building and the surrounding area (e.g. lighting, prevention of vandalism and other crime)
- brings about change

… improves the living conditions of the inhabitants (better indoor climate, improved energy efficiency, improved building functionality)

A SUSTAINABLE reconstruction solution

Preserving

- ensures the durability of the existing building, increases energy efficiency and is in line with national climate goals
- integrates renewable energy solutions

Circular

- implements reconstruction technologies and processes that promote resource efficiency.

Environmentally friendly

- supports urban biodiversity (e.g. renovation does not result in the removal of viable tall greenery)
- When tidying up the threshold space, the green areas around the building are solved (depending on the possibilities, e.g. the size of the plot, etc.)

The most relevant measures for Kääpa 6 in the framework of the RENOVERTY project, several energy efficiency measures (EEM) that could be applied in Estonia were selected and analysed through 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. These are as follows:

- EEM_1 - Insulation of exterior walls: Insulation of the exterior walls of a building.
- EEM_2 - Double-glazed windows: Replacing single-glazed windows with more energy-efficient windows (double-glazed IZO windows) to reduce heat loss.
- EEM_3 – Thermal insulation of the roof: Insulation between and under the rafters of the roof reduces the overall heat transfer coefficient by adding materials with low thermal conductivity.

- EEM$_4$ - Energy Efficient Heating System (Boiler Upgrade - Gas): In this case, the existing heating system is replaced by a more efficient gas boiler with a higher efficiency rate. The gas heating system was analysed solely for financial indicators, but given its negative impact on the environment and contribution to climate change, it is recommended to switch to sustainable heating systems that use renewable energy sources, such as heat pumps and biomass.
- EEM$_5$ - Energy Efficient Heating System (Boiler Upgrade - Biomass): In this case, the existing heating system is replaced by a more efficient biomass boiler with a higher efficiency rate.
- EEM$_6$ - Energy Efficient Heating System (Heat Pump): In this case, the outdated heating system is replaced by a heat pump with a higher degree of operation.
- EEM$_7$ – LED lighting: In this case, fluorescent and incandescent bulbs are replaced by high-efficiency LED lamps.

Annual energy savings (kWh) (MFH, Tartu, Estonia)		
	Energy savings (kWh)	**Reduction (%)**
EEM$_1$: Exterior wall insulation	5,522.1	28.1
EEM$_2$: Double-glazed windows	1,959.7	10.0
EEM$_4$: Boiler upgrade - gas	3,602.1	18.4
EEM$_5$: Boiler upgrade - biomass	728.4	3.7
EEM$_6$: Heat pump	10,837.2	55.2
EEM$_7$: Energy efficient light bulbs	85.4	0.4

Tabel 2. Annual total energy savings (in kWh) for the different EEMs in the MFH typology in the rural region of Tartu in Estonia

Measures EEM1, EEM3 and EEM7 are considered the most financially relevant while measures EE1 lead to the most energy savings, meaning that measures EEM1, EEM3 and EE7 are the most beneficial ones to be implemented. In the case of the Kääpa 6 building, **EEM1, EEM3, EEM7** measures will be implemented to achieve deep renovations.

Co-creation and Design of the Renovation

After acknowledging the need to renovate, the process starts with the general meeting of homeowners in apartment association. The meeting assembly has to decide to renovate the building, to list in general terms the works that need to be performed, and accept the possibility to take a loan in order to finance construction works. Usually also the meeting authorises the board to go on with proceedings.

The proceedings then start with hiring a technical consultant (TC), which refers to an obligatory step included in the conditions to qualify for a grant. A TC is a professional with a degree in construction and who has passed special training courses on renovation.

The next step is designing the renovation. Within the general framework of requirements (physical characteristics of perimeter and ventilation) the tenants can and should choose the specific solutions such as type of cladding, system of ventilation and in cases where the house is not connected to district heating grid the type of heat source.

Here is where the TC comes in, as the tenants and/or homeowners rarely have qualifications and knowledge to make these decisions. The TC consults in making these decisions and helps to choose the best solutions for an apartment building in question. In our case experts form Tartu Regional Energy Agency (TREA) are fulfilling this role as this part of the overall renovation process is the one that can be called “co-creation”. The result of co-creation is a formal task for technical design.

After that, there is the TC´s task to conduct a design procurement and follow the design process. During the design process, the TC introduces the preliminary solutions to homeowners and relays feedback to designers if needed.

Homeowners are encouraged to include in the list of works also those not directly related to lowering energy consumption of the building, such as erecting auxiliary structures like bike sheds, repairing access to the building, and reconstructing water and sewage piping. A lot of these works are also covered by the grant.

By the end of the design process, there is a possibility for a first cost estimate of construction works. Practicing TCs are capable of estimating further costs even before the designing based on similar solutions (hundreds of apartment buildings renovated in Estonia) for similar buildings.

Apartment associations board member or other authorized person then negotiates conditions for renovation loan with the banks. There may be a few reasons for a loan proposal not being sufficient for carrying out all the needed renovation. The reasons may include low market price of real estate (below 500€ per square meter), unsatisfactory credit record of apartment association, house being too small (less than 12 apartments) etc. In this case, there is a possibility to apply for a loan guarantee from EIS (formerly KredEx), or in case the banks refuse to place a loan altogether apply for a loan direct from EIS.

After submitting all necessary application documents, there is an up to 120 days waiting period during which decisions are made on providing the grants. Upon receiving a positive decision from the EIS apartment association together with TC start procurement of construction works. The procurement is to be organized through Public Procurement Register. Procurement process may take from two months up to over half a year and only then the actual construction works may begin.

Initial task for renovation

The following initial task (plan for renovation, the description of tasks, actions and expectations of owners as input for technical designer what should be involved in technical design of renovation like architectural and construction part, technical systems, etc) was developed as a base (input) for a technical design and construction works for the Kääpa 6 building. It was composed in co-creation by technical consultant (TC) and owners and on the template provided by EIS (grant provider).

In the next Figure 3 is shown the template of Kääpa 6 building renovation initial task. In a first colum are asked information by EIS, in the second and third colums are answers form apartment association.

Client's data:

Address	**Kääpa 6, Kääpa village, Mustvee Parish**

The building to be reconstructed:

Building Code in the Register of Buildings	120273240
Number of floors	3
Number of apartments	12
Heating source (district heating, gas boiler, stoves, etc.)	District heating
Gas appliances in apartments (none/have – list of appliances)	None

Available base materials:

	YES / NO	**Comments (provided by TC and owners)**
Inventory drawings	yes	
Energy audit	yes	
Energy performance certificate	yes	"G" 281 kWh/m² a

Exterior works

The exact scope of the work will be determined after the technical condition of the building has been inspected by the designer. Planned works:

	YES / NO	Comments
Demolition of exterior staircases and construction of new ones	yes	
Removal of paving strip and construction of new ones (concrete, stone)	yes	
Concrete gutters will be installed to direct rainwater away from the building	yes	
Removal of awnings and construction of new ones	no	
Handrails for exterior stairs	yes	
Ramps for external stairs	yes	
Construction of a bicycle parking lot	yes	

Foundation, plinth and basement

	YES / NO	Comments
Insulation of the plinth (composite system [SILS], ventilated system)	yes	SILS
Plinth finishing (façade board, plaster, other)	Yes	Facade board
Insulation of the underground part of the foundation	yes	
Insulation of the basement ceiling	no	
Renovation of the basement floor (new floor, dust-free of the existing one)	yes	
Renovation of technical rooms	no	

Exterior walls

The building envelopes will be additionally insulated in such a way that cold bridges (fRsi≥0.8; window-exterior wall when connecting fRsi≥0.7) would be avoided and that the heat loss of the barriers would ensure the achievement of the technical conditions of the support measure and the target energy efficiency number.

	Comments
Insulation system (composite system [SILS], ventilated system, other, to be decided in cooperation with the designer)	To be decided in cooperation with the designer
Facade finishing material (thin plaster, façade board, façade stone, other, to be decided in cooperation with the designer)	Facade board
The exterior walls are insulated with prefabricated elements in the factory	No

Roof

Ventilation shafts and chimneys that are not in use are demolished starting from the attic or roof level. Unnecessary communication systems will be removed from the roof. The ventilation shafts that remain in use will be renovated and rebuilt according to the ventilation solution to be designed.

	Comments
Existing roofing (bitumen roll material, sheet metal, eternit, other)	Eternit roofing
Roof covering to be designed (bitumen roll material, sheet metal, eternit, other)	eternit
Roof structures (if possible, preserved, replaced)	If possible, preserved
Rainwater systems (preserved, replaced if possible)	Replaced
Roof or attic hatches (if possible, preserved, replaced)	Preserved
Access routes to the roof or attic (if possible, preserved, replaced)	if possible, preserved

Openings

Windows and doors replacement

	YES / NO	Comments
Replace all windows[1]	yes	
Window frame material (PVC, wood, wood-aluminium)	yes	PVC
Window frame tone (white, some other shade)	yes	white
Sun protection glasses	yes	In order to reduce the high room temperature in summer, sun protection glass is installed on windows facing south and west. It is not recommended to choose the solar transmittance coefficient (g) of glazing units below 0.4 to ensure sufficient natural light access.
The windows are installed at the level of the insulation	yes	
Openability of apartment windows (all windows can be opened at an angle and swivel, at least 50% of the window area can be opened)	yes	All windows can be opened at an angle and swivel.
Openability of staircase and basement windows	yes	
Cutting window openings (cutting the outer "edges" of the window opening, cutting the window opening larger downwards)	yes	
Size of new windows [2] (windows to be installed can be up to 3 cm smaller than the existing window opening on all sides)	no	
Replacing the front doors of the stairwell	yes	
Replacement of apartment doors	no	The doors to be installed meet the requirements of the sound insulation index Rw 38dB and the fire resistance class EI30.

[1] When reconstructing with prefabricated elements, all windows must be replaced with new ones.

[2] When reconstructing with prefabricated elements, the permissible tolerance of the size of the windows should also be noted.

Replacing the doors of the basement, technical rooms, etc.	yes	
Serialization of locks in public areas	yes	

Heat supply and heating

Pipes in rooms that are not heated (basement, attic, etc.) are insulated.

	YES / NO	Comments
The existing heating distribution system will be upgraded (a new two-pipe radiator system will be installed)	yes	
The existing heating source is replaced with a new one (switching to a heat pump, switching to district heating, etc.)	no	
The existing heating source will be reconstructed (district heating substation, gas boiler, etc.)	no	
The heating substation will be replaced with a new one	yes	
Bathroom pipes (removed, stored, replaced with new ones)	yes	replaced with new ones
Installation of individual cost meters	no	

Ventilation

The air flow rates of the ventilation system must be ensured around the clock. In the ventilation project, the air movement inside the apartment (incl. the movement of transfer air) and the functioning of the kitchen hoods must be solved.

Air exchange should also be provided in stairwells, basements and technical rooms. The smoke extraction of the escape routes must be solved.

Ventilation chimneys on the roof that are not in use must be demolished starting from the surface of the flat roof or attic, and be properly insulated. The ventilation ducts that remain in use will be cleaned. For ventilation shafts that remain in use, the project must include an assessment of the technical condition (flue survey, etc.).

	Comments
The ventilation system has heat recovery or no heat recovery (mechanical extraction)	Heat recovery
Heat recovery solution (central ventilation unit, exhaust air heat pump, apartment-based ventilation unit, to be decided in cooperation with the designer)	Central ventilation unit

Water supply and sewerage

Assess the condition of the existing rainwater system and, if necessary, design a new rainwater system, install gutters under the spits and ensure that rainwater is directed away from the building.

The need for drainage and its technical feasibility are decided in cooperation with the designer.

The construction of water supply and sewerage systems, which is directly related to the heating and ventilation system, must also be solved within the scope of the design.

	YES / NO	Comments
The water metering unit will be renovated		
Cold water pipes will be replaced (risers, trunks)	yes	
The hot water pipeline will be replaced (risers, trunks)		
A new central hot water system will be established	yes	
The water meters of the apartments will be replaced (new meters can be read remotely)	yes	new meters can be read remotely
Domestic water sewerage pipes will be replaced (risers, trunks, up to external wells)	yes	
Storm water sewerage pipes will be replaced (up to external wells)	no	

Electrical installation

The new technical systems to be installed will be supplied with electricity. Emergency lighting in the stairwells must be solved. If the junction box of the building is located on the outer wall of the building, the need to relocate the junction box is also decided in cooperation with the designer.

If the designed technical systems require a separate automation solution for control, then the control systems of the technical systems are also designed.

	YES / NO	Comments
The main switchboard is replaced	yes	
Switchboards will be replaced	yes	
Trunk lines will be replaced	yes	
Lighting in public areas will be replaced (control with motion sensors)	yes	
Evacuation lighting is installed	yes	
Outdoor lighting will be replaced		
Building automation system for monitoring and controlling the operation of technical systems	yes	
Intercom system		
Construction of charging infrastructure for electric cars (readiness of charging points, installation of charging points)	yes	
Creating the possibility of an external power supply to the heating substation	yes	

Renewable energy

If the capacity of the renewable energy system is not specified in the terms of reference, the capacity of the system is determined in cooperation with the designer.

	YES / NO	Comments
Installation of solar panels (for electricity generation)	yes	
Installation of solar collectors (for heat production)	no	

Figure 3. Kääpa 6 initial task for renovation design

Costs allocation

The cost of renovation may vary depending on the size of a building and type of works to be undertaken, and is usually between 450€ and 1000€ per square meter of net closed area of the building. In this particular case, the cost on construction works is expected to be around 650€ to 700€ per square meter.

At the same time, renovation grants cover a substantial part of most costs of renovating. In rural areas, the grant covers 50% of all costs, including the fee for technical consultants, the cost of design of renovation, mandatory building inspection, construction works, and also the potential surveys needed to establish the state of building before or during design phase.

After bids for construction are received the homeowners need to decide what to do next. The options are to either accept the winning bid, or in case allocated funds are insufficient to cover the cost, decide on further proceedings. The possibilities are to declare procurement void and start anew with an altered design or to renovate without using a renovation grant.

If the winning bid is accepted and construction is commenced, then, there will be a substantial role in communication between the construction crew and the occupiers of the apartments. As the works will be carried out while the apartments are occupied, all works that require access to private apartments need to be scheduled in detail and schedules need to be communicated to all stakeholders. The importance of proper communication has proven to be a crucial factor in carrying out construction works efficiently. Usually, a person is assigned to take responsibility for all communication between owners and builders. The person may be assigned by construction company, he/she may be a member of the board of apartment association or probably, in the best case, the person would be a property manager of the building, if such a post has been established.

1.8. Identifying and overcoming barriers and challenges

Inevitably, the main challenge in renovations pertains to financing issues.

To borrow or not to borrow

Despite the seemingly generous grant, the cost of renovation is still high. This is especially true considering that in most rural areas, the current market price for a square meter of living area approximates the cost of renovating the same square meter. Thus, to claim that renovating one's apartment raises the price of an apartment is not valid, at least not entirely. This circumstance, being well known to banks, prevents borrowing in the amount required to complete the full renovation.

Some apartment associations have tried to renovate without the grant in the past by conducting construction works step-by-step, by either borrowing smaller amounts and undertaking the next task when most of the first loan is paid back, or not borrowing at all and relying on raising fund by themselves. The latter case presents an additional barrier to renovation, as when borrowing money from banks for renovating and the interest rates are discounted, banks require a proper inspection to be carried out for construction works, and most banks have hired technical advisors to see that the borrowed money is spent well and purposefully. In case homeowners are able to raise the funds themselves, they often lack both technical and legal support to carry out the renovations.

Trust and expertise

Another challenge often present when renovating is trust issues that occur among homeowners, in terms of whether money spent on renovation is spent well or not, and if the investment is worth it to begin with. This is clearly a social and political issue. In the long run, this challenge will most likely resolve itself as more positive feedback will be received by owners of renovated apartment buildings. However, negative examples of failed renovations are more often and more colourfully reflected in media. Despite this, word of mouth and the "better than neighbours´" effect will likely help in building trust in successful renovations.

Unfortunately, there have been issues with less than expected qualified builders and foul play with procurement. To avoid these problems in the future and to raise trust, EIS (formerly KredEx) has simplified the procurement process by setting specific qualification requirements for technical personnel of contractors who participate in tender bids. Optionally, homeowners can authorize EIS to conduct the administrative part of the procurement process, leaving technical issues to the TC.

Available companies/installers

There have been calls for renovation grants in Estonia since 2011. Since then, close to 1000 residential buildings have been deeply renovated, and a whole branch of the construction industry has emerged with technical designers, contractors and now even manufacturers of prefabricated wooden elements (used for large block insulation) specialized in renovating multi-apartment buildings.

The call for renovation grants of October 28th, 2024, allows tenders to be made by consortia that include design offices together with contractors and even wood element manufacturers with the aim of simplifying the whole process of renovating for homeowners.

2. What's next? Conceptualizing and applying actions to reduce energy poverty in rural areas

2.1. Recapitulation of key characteristics of housing in the region

Multi-apartment residential buildings in Estonian rural areas were mainly built during the 1970s and 1980s and were an integral part of the mass collectivisation policy of agriculture. These buildings mainly appeared in so called "central settlements" (built close to and mostly by state or collectively owned agricultural farms in Soviet Union on soviet time) together with concentrated infrastructure: schools, kindergartens, medical and cultural services, but also machine workshops, storage buildings for crops and supplies etc.

Houses built in the beginning were small, consisting of 4 to 8 apartments, but by the late 1980s, up to 48-storey apartment blocks were built. The average size of buildings still remained between 12 and 24 apartments.

The main material used for load bearing walls was aerated one storey high concrete blocks (see also 1.1 "Buildings"). The floor plans were considered more spacious than those of apartment houses built in cities. Usually a rural apartment had about 50% more living area than a "city apartment" with the same number of rooms. Windows had double wooden frames and roofs were built of asbestos-cement almost without exception.

Due to the use of aerated concrete in the external walls, which was different from widely used reinforced concrete or sand-lime bricks, the U value of these walls was slightly better (0,7-0,9 W/m^2K vs 1,0-1,1 W/m^2K). On the other hand, these houses were built having in mind district heating provided by the local boiler house, which provided heat also to all the infrastructure in the villages. With the collapse of the Soviet Union and collective agriculture, the heating grid was usually shut down and apartment houses were heated as best as possible. In the early 90s, it meant direct electric heating, central heating by a single boiler in a building, or local heating with wood via masonry ovens usually built illegally in apartments. By now, central heating is mostly terminated, and air-to-air heat pumps are widespread.

Energy performance of such buildings in generally is, as expected class "F-G" – one of the worst classes on the scale.

In Kääpa case, though, the local administration has managed to keep the district heating grid operational and they are planning to restore the provision of heat for domestic water in the summer.

2.2. Definition of Renovation Objectives, Indicators and Possible Interventions

The main goals of energy renovation projects in rural areas are to improve the living conditions of families affected by energy poverty, reduce household energy costs, and promote environmental sustainability. These objectives lead to concrete social, economic, and environmental benefits.

Reducing Energy Poverty: Energy-efficient building upgrades help lower energy costs by enhancing the overall efficiency of buildings and reducing energy consumption. This makes it easier for households to afford heating in the winter and cooling in the summer, easing the financial burden of energy bills.

Improving Living Conditions: Renovations such as thermal insulation, window and door replacements, and the installation of more efficient heating systems improve indoor thermal comfort, creating a healthier and more comfortable living environment for families.

Reducing CO_2 Emissions: By boosting energy efficiency and decreasing energy consumption, homes can significantly reduce their environmental footprint. This plays a key role in combating climate change and promoting the sustainable use of natural resources. Incorporating renewable energy sources, like solar panels or heat pumps, further supports the transition from fossil fuels.

Stimulating Local Economies: Energy renovation projects generate employment opportunities for local businesses and professionals in construction and green technology sectors. These initiatives help strengthen the economies of rural areas, which often face economic challenges compared to urban regions.

Fostering Social Resilience: Energy-efficient homes help protect families from extreme weather conditions, such as harsh winters and scorching summers. This enhances housing security, reduces health risks, and provides greater stability for households
Enabling Higher Productivity: Efficiency improvements drive productivity, especially by lowering maintenance costs and increasing output per unit of input. Furthermore, enhancements in operational performance and process reliability can reduce instances of equipment downtime, shutdowns, or system failures. Optimizing processes for efficiency also

minimizes the time staff spend on operations and scheduling, while decreasing the likelihood of human error.

2.3. Identifying barriers, challenges and how to Overcome Them

General barriers and challenges to renovating rural apartment buildings in Estonia:

1. Decision making in diverse groups of people. Homeowners as a group are by no means a homogenous group. They usually have different opinions on almost everything. Making this kind of group to reach a decision is a hard task.
2. Acquiring a loan for renovation may be problematic in rural regions where market price for apartments is low – less than 500 €/m² i.e. close to cost of renovation.
3. Trust / distrust issues may appear towards contractors, building inspectors and technical consultants. There have allegedly been foul play cases concerning the procurement procedure.

Solutions to overcome challenges and barriers

1. The renovation of multi-apartment buildings has been an in Estonia since 2009, when renovation loans with discounted rate became available. At the same time, EIS (then KredEx Fund) launched a campaign aiming to explain all sides of renovation. Every homeowners' group had a chance to invite an expert to speak about renovation and conditions for a loan and grant. Since 2011, the legal framework of decision making among homeowners changed as well. Today, for a decision to pass, a 50%+1vote of homeowners is needed, as well as 50%+1 vote of living space meterage. All counties have a person on their payroll whose task is counselling on matters concerning renovation.
2. In case acquiring a loan for renovation is hard to obtain, there is a possibility to apply for a loan guarantee from EIS, or if banks refuse the loan, there is an option to obtain the loan directly from EIS. Unfortunately, it is not possible to renovate step by step using the renovation passport. This option would be favoured by those homeowners associations who do not like to obtain a rather long-term loan.
3. In order to resolve distrust issues, EIS has improved proceedings using renovation grants. Any actor may not have commercial interests towards the rest of the actors. Concerning the procurement procedure, there is an option available that EIS will be responsible for the proceedings. The procurement has to be carried out through the Public Procurement Register.

2.4. Identifying all relevant actors and stakeholders

Apartment Owners & Apartment Associations (Korteriühistu) role is to initiate and approve the renovation project, manage the collective decision-making process among apartment owners, apply for financial support, including EIS grants and bank loans, hire professionals (energy auditors, engineers, contractors) and oversee financial obligations and loan repayment.

A full renovation cannot proceed without the approval and financial commitment of the apartment owners. The apartment association ensures structured decision-making and represents the interests of all owners. They act as a key intermediary between banks, contractors, and government authorities.

Government & Support Institutions (EIS, Local Municipalities, State Agencies) role is to provide financial assistance (grants, subsidies, and loan guarantees EIS. These enforce building regulations and oversee compliance with national energy efficiency targets, support project planning through technical consultations and guidance, and monitor the impact of renovations on sustainability and energy efficiency.

Government programs like EIS grant help reduce the financial burden of renovations, making them feasible. State agencies ensure that renovations align with Estonia's climate goals and EU energy efficiency regulations. Municipalities may offer additional funding and streamline permit approvals, expediting the process.

Financial Institutions (Banks & Credit Providers: Swedbank, SEB, LHV, Coop Pank) have a role to provide renovation loans to apartment associations and individual homeowners, assess financial viability and repayment capacity of applicants, offer financial advisory services to structure loans appropriately.

Banks ensure that financing is available for large-scale renovations, which often require significant investment. Loan guarantees from EIS help mitigate financial risks for lenders, making loans more accessible. A well-structured financial plan prevents project delays due to budget shortfalls.

Technical & Construction Experts (Energy Auditors, Engineers, Contractors, Supervisors) playing a crucial role like:

Energy Auditors conduct preliminary assessments and determine necessary energy-saving measures. **Architects & Engineers develop the technical** design and technical solutions that comply with building codes. **Construction Companies c**arry out renovation work (insulation, heating upgrades, window replacement, etc.). **Supervisors & Inspectors:** Monitor construction progress and ensure quality control.

Without technical expertise, the renovation would fail to meet modern energy efficiency and safety standards. Energy audits are mandatory for assessing a building "energy health" and defining cost-effective renovation measures. Quality control ensures that renovations results will last for decades, preventing additional costs in the future.

Regulatory Authorities (Ministry of Climate, Environmental Agencies) implement building codes and energy efficiency policies.

Regulations ensure that renovations increase the safety, efficiency, and lifespan of buildings. The Ministry of Climate sets Estonia's long-term renovation strategy and ensures alignment with EU directives. Environmental agencies ensure sustainable renovation practices, such as proper waste disposal and eco-friendly materials.

Residents & End Users (Building Occupants, Property Management Companies) should adapt to temporary inconveniences during construction (noise, dust, temporary relocations). They benefit from lower energy costs, better indoor air quality, and increased property value, maintain and use new heating, ventilation, and insulation systems efficiently. Property management companies ensure long-term maintenance and upkeep. Residents are the main beneficiaries of the renovations—without their approval and cooperation, renovations cannot proceed. Educating residents ensures that new energy-efficient systems are used properly to maximize savings. A well-maintained building extends the lifespan of renovations, preventing deterioration and future costly repairs

2.5. Scalability and replicability

To make the **Rural Energy Efficiency Roadmap (REER)** scalable and replicable across other rural areas in Estonia and the EU, several **key strategies** must be implemented. Below are specific recommendations to ensure that the roadmap can be adapted and effectively used in different locations. To **scale and replicate** the renovation roadmap successfully, it is essential to:

1. **Standardization of processes and technical guidelines**

To ensure that the renovation roadmap can be implemented in multiple rural regions, it is crucial to develop a standardized yet flexible model that can be adapted to different building types and local conditions.

A modular and adaptable renovation roadmap should be created, offering clear step-by-step guidelines applicable across different regions. This template should include:

- Technical and financial guidelines for conducting deep renovations.
- Checklists and best practices based on lessons learned from pilot projects.
- Legal and regulatory compliance measures to align with EU and national policies.

Aligning renovation projects with European and national energy efficiency targets will facilitate smoother implementation. This involves:

- Ensuring compliance with the Estonian Energy efficiency measures (and EU Energy Performance of Buildings Directive (EPBD)).
- Defining minimum energy efficiency standards (e.g., requiring at least class C energy performance). Is done by EIS (Kredex), grant provider in Estonia, and are in compliance national regulations for Energy Efficiency.
- Encouraging the use of renewable energy and smart home technologies.

Also, a **centralized platform should be established** where stakeholders, such as municipalities, apartment associations, and energy agencies, can access standardized tools and best practices. The platform should feature:

- Case studies from successfully renovated buildings.
- Guidance documents and technical blueprints for implementing roadmaps.
- Interactive tools for energy savings calculations and cost estimations.

2. Financial Mechanisms for Wide-Scale Adoption

Financing is one of the biggest challenges in deep renovations, particularly in rural areas where property values are lower. Therefore, ensuring accessibility to funding will enable wider adoption of renovation roadmaps.

Establishing Flexible Financing Models

- Implement a mix of **grants, low-interest loans, and performance-based funding** (e.g., Energy Performance Contracts).
- Expand **loan guarantee programs** through the **Estonian Business and Innovation Agency (EIS)** to reduce financial risk for rural homeowners.
- Develop **pooled financing schemes** where multiple buildings in a region can apply for funds collectively.

Partnering with Banks and Private Investors

To make large-scale renovations financially sustainable:

- Strengthen collaboration with **banks (e.g., Swedbank, SEB, LHV)** to design tailored renovation loan products.
- Involve **green investment funds and the European Investment Bank (EIB)** to provide co-financing options.

- Promote **public-private partnerships (PPPs)** to attract more private sector involvement.

Simplifying Grant and Loan Access

- Advocate for **predictable and long-term grant cycles** from EU and national programs.
- Create **pre-approved renovation packages**, where a building can apply for funding based on a predefined set of improvements, making the application process easier.
- Provide **digital financing tools** that allow associations to check grant eligibility and simulate financing options.

For example, a calculator for loan calculation was made available on the website of EIS (rekonstrueerimise-kulude-kalkulaator-korteruhistutele) The calculator helps the apartment association board to estimate the building's energy use and the monthly costs of the apartment owners before and after the reconstruction. The result of the calculation is a PDF file that can be downloaded. The results obtained with the calculator are indicative.

3. **Strengthening Local Implementation Capacity**

For the roadmap to be effectively replicated in different locations, local expertise and institutional support must be enhanced. Possible actions and measures are:

Set up **One-Stop Shops** in municipalities to provide **technical, financial, and legal** support.

- Train and certify **local construction firms and consultants** to ensure they are familiar with best practices.
- Develop regional **advisory networks** to provide long-term support.

Training Programs for Local Contractors and Energy Experts

- Implement **skill development programs** for architects, engineers, and energy auditors.
- Encourage **knowledge-sharing initiatives**, such as webinars and regional workshops.
- Establish **mentorship programs** where experienced professionals support newcomers in the field.

Engaging Communities and Homeowners

- Develop **community engagement campaigns** to educate residents on energy efficiency benefits.
- Promote **co-creation workshops** where homeowners can participate in decision-making.
- Introduce **energy savings competitions** to encourage behavioural change post-renovation.

Example: by setting-up the regional advisory networks in Estonia by EIS, in every county there is an advisor for grant information, had good impact for grant application process

4. Integrating Renovation into Regional and National Policies

To ensure that energy-efficient renovations become a long-term priority, they must be embedded into broader policy frameworks like energy- and climate action plans of counties and municipalities.

5. Digital Tools and Data-Driven Decision Making

Leveraging digital innovations can enhance the efficiency and scalability of renovation projects.

Developing a **digital (building) renovation passport** and making them accessible to homeowners, banks, and policymakers to facilitate future improvements.

Provide **smart home integration options and** deploy **real-time energy monitoring systems** for better energy management to optimize efficiency.

REFERENCES

https://www.bpie.eu/wp-content/uploads/2018/03/iBRoad-The-Concept-of-the-Individual-Building-Renovation-Roadmap.pdf

Public Procurement Register. https://riigihanked.riik.ee/rhr-web/#/

Calculator for Aprtment associations for renovation costs: https://eis.ee/rekonstrueerimise-kulude-kalkulaator-korteruhistutele/

National renovation strategy: https://kliimaministeerium.ee/sites/default/files/documents/2023-06/Hoonete%20rekonstrueerimise%20pikaajaline%20strateegia.pdf

Kredex (EIS renovation webpage): https://kredex.ee/en

Last renovation call regulations (into Estonian):
https://www.riigiteataja.ee/akt/124092024008?leiaKehtiv=

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