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RENOINVEST

sustainable renovation of buildings

D5.1 Documentation on PILOT CASES

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Table of contents

List of figures

1 RENOINVEST PROJECT

The RENOINVEST project is co-funded by the European Union under the LIFE programme. The project intends to reflect cross-border challenges and opportunities for sustainable building renovation in the private and public sectors. The main aim of the project is to develop action plans on smart investments in sustainable renovation of buildings for 2025-2030 for Austria, Hungary and Slovenia by establishing three national roundtables building on the activities of the Sustainable Energy Investment Forums.

RENOINVEST provides a platform for open dialogue involving key financial, private and public experts through the green finance thematic working group activities to identify barriers to the upscaling of long-term financing instruments and propose improvements to support the development of large-scale investment programmes in existing private and public buildings. Three national policy briefs and a cross-border recommendation package will also be delivered.

Assessing the implementation of the Long-term building renovation strategies and documents and reviewing existing financial solutions and market conditions for stimulating financing of energy efficiency improvement of the existing building stock is an important starting point of the project.

Sharing knowledge among project partners, experts, national stakeholders and similar EU projects three international cross-border exchange events with site-visits will be organized to showcase collected 50+ good practices and elaborate six case studies to foster the roll out of smart financing possibilities.

The added value of RENOINVEST is that the consortium is providing specific technical knowledge by engaging key actors representing legislative advisory organizations, research institutes, large engineering manufacturers, SMEs and financial experts in three CE countries fostering sustainable investments.

2 PROJECT CONSORTIUM

1. Institute for Transport Science and Quality Control in Building (KTI) legal successor of ÉMI Építésügyi Minőségellenőrző Innovációs Nonprofit Kft (ÉMI) - HUNGARY, coordinator

2. Solar Tech-Investment Tervezési Fejlesztési Tanácsadó Kft. (Archenerg cluster) – HUNGARY

3. Zavod za gradbeništvo Slovenije (ZAG) – SLOVENIA
   Slovenian National Building and Civil Engineering Institute

4. Gospodarska zbornica Slovenije (CCIS) – SLOVENIA
   Chamber of Construction and Building Materials Industry of Slovenia

5. RENOWAVE.AT e.G (RENOWAVE) – AUSTRIA

6. Institut für Immobilien, Bauen und Wohnen GmbH (IIBW) – AUSTRIA
   Institute for Real Estate, Construction and Housing Ltd.

3 EXECUTIVE SUMMARY

The pilot cases in Austria, Hungary, and Slovenia serve as real-world case studies to support the development of actionable financing strategies for deep energy renovation in both the private and public sectors. Each country selected two pilot cases - one in the private sector (e.g., residential condominiums in Vienna and Ljubljana) and one in the public sector (e.g., social housing in Bad Eisenkappel and a community center in Kecskemét) - to reflect the diverse challenges and opportunities in sustainable renovation across Central Europe.

In Austria, the pilot cases focus on a 19th-century residential building in Vienna (Rosaliagasse 5 & 7), featuring innovative façade greening, photovoltaic integration, and modular steel structures, alongside a social housing project in Bad Eisenkappel (LeiSan), which prioritizes accessibility, energy efficiency, and community benefits. Slovenia's pilot cases include a large residential condominium in Ljubljana (Celovška cesta 83, 85, 87) requiring façade insulation and a community building in Sežana (Vaški dom Križ), combining energy renovation with structural reinforcement and potential PV expansion. Meanwhile, Hungary's pilot cases address a heritage-listed condominium in Budapest (Rákóczi út 11) and a municipal cultural center in Kecskemét (Hírös Agora), both focusing on deep renovation, renewable energy integration, and modernized heating systems. These pilot cases provide concrete data, financing models, and lessons learned to inform the project's action plans for 2025–2030 and beyond, ensuring that recommendations are both realistic and replicable.

The pilot cases confirm that deep energy renovation is technically feasible but requires blended financing models. Public subsidies covering 30-60% of costs, combined with low-interest loans and innovative models like crowd-investing or energy performance contracts, prove most effective. Technical solutions - thermal insulation, renewable energy integration, and accessibility upgrades - deliver 40-90% energy savings but need supportive policy frameworks. Stakeholder engagement and transparent communication are critical to overcoming consent barriers, particularly for the owner approval requirement in multi-owner buildings (from majority vote up to 100 % depending on country and measures). Economic viability remains challenging due to high upfront costs and low energy prices, though non-financial benefits, such as CO_2 reductions of 7-173 tonnes/year and property value increases up to €400/m², are substantial. Scalability depends on long-term financing options, standardized advisory services, and targeted policy support.

4 INTRODUCTION

The establishment of pilot cases in each of the three participating countries - Austria, Hungary, and Slovenia - highlights the practical orientation of the action plan[1]s developed within the RENOINVEST project. Under Task 5.1, two pilot cases - one in the private sector and one in the public sector - were selected per country to test and evaluate financing models for deep energy renovation of existing buildings. The selection process was conducted in two stages: initially based on the willingness of stakeholders and prior project engagement, followed by a focus on innovative financing approaches to ensure broader applicability and replicability. These pilot cases not only serve as best-practice examples but are actively disseminated via social media, project websites, and national roundtables to maximize their visibility and impact.

The emphasis on action plans rather than theoretical roadmaps was chosen to provide tangible solutions for financial institutions, property owners, and public decision-makers. Only through concrete, implementable frameworks can the project's findings be directly applied, serving as a foundation for similar initiatives. This approach ensures that the results are not merely theoretical but actionable and scalable, fostering real-world transformation in sustainable building renovation across Central Europe.

Each of the six pilot cases is structured to provide a comprehensive overview of the building, its renovation concept, financing model, results, and challenges, ensuring a holistic understanding of the project's approach. For each case, the building description includes key details such as type, year built, energy performance before and after renovation, and ownership, while the renovation concept outlines the technical interventions, target values, and implementation timeline. The financing models section highlights the financial mechanisms used, including subsidies, loans, or innovative models like crowd-investing, and compares different scenarios where applicable. Results and analysis summarize the financial performance, energy savings, and benefits, while challenges and lessons learned address obstacles encountered and key takeaways. The replication and upscaling section discusses the potential for broader application of the financing models and technical solutions, providing actionable insights for stakeholders. This structured format ensures that the pilot cases serve as practical examples, supporting the development of actionable financing strategies for sustainable building renovation.

[1] Deliverable 4.1: Action Plans for Austria, Hungary and Slovenia is available on the RENOINVEST website: https://www.archenerg.eu/en/renoinvest/results/deliverables

Overview Pilot Cases and Key Data

	Country / Location	Building Type & Year Built	Energy Performance (Before/After)	Key Renovation Features	Financing Models
Rosaliagasse 5 & 7 PRIVATE SECTOR	Austria / Vienna	4 residential buildings (1872, 1900)	D → B	Modular steel façade system with climbing plants, PV integration, and thermal insulation	**FM1:** Bank loan (15–30 years, 3.5% interest) for condominium association; **FM2:** Crowd-investing via Klimja (min. €200 000, 8% interest for 5 years, then increasing by 1% annually) to reduce loan burden
Komposch Ebene PUBLIC SECTOR	Austria / Bad Eisenkappel	Social housing (1983)	C → A	Deep renovation with wood-fiber insulation, district heating, elevator installation, and attic conversion (optional)	**FM1:** Subsidies + reserves + long-term loan + rent increase. **FM2:** Two-phase renovation; subsidies + loan + gradual district heating. **FM3:** Building rights model + non-profit cooperative financing
Celovška cesta 83, 85, 87 PRIVATE SECTOR	Slovenia / Ljubljana	Condominium (1963)	D → B2	Façade thermal insulation (20 cm), elimination of thermal bridges, staircase and balcony renovations	**FM1:** Eco Fund subsidy (up to €60/m² façade) + low-interest loan (0.5%); **FM2:** Green bank loan (2.7% interest); **FM3:** Debt purchase model (higher initial cost, but avoids 100% owner consent requirement)
Vaški dom Križ PUBLIC SECTOR	Slovenia / Sežana	Community building (1980)	G → B2	Static reinforcement, deep energy renovation, optional PV installation, and extension (90 m²)	**FM1:** 100% grant for revitalization of public infrastructure in border areas (up to €1M); **FM2:** National grants + municipal contribution (€200 000) for energy efficiency and RES integration
Rákóczi út 11 PRIVATE SECTOR	Hungary / Budapest	Condominium (1901)	G → D	Internal façade insulation, roof refurbishment, heating system modernization, and heritage-compliant interventions	**FM1 (Deep Renovation):** Grants (€259.7k) + condominium savings (€97.8k) + energy savings certificates (HEM, €96.8k) + subsidized bank loan (15 years, 1.88 - 4.39% interest); **FM2 (Cost-effective I)** and **FM3 (Cost-effective II)** reduce investment scope with similar financing mix
Hírös Agora PUBLIC SECTOR	Hungary / Kecskemét	Cultural center (1974)	D → B	External wall and roof insulation, triple-glazed windows, radiant ceiling heating, PV system (60 kWp), and LED lighting retrofit	**FM1:** Deep renovation financed mainly by TOP_PLUSZ-2.1.2-21-SL1 grant (~99.5%) + HEM certificates (~0.5%). **FM2:** Heating-focused renovation financed by TOP_PLUSZ-2.1.2-21-SL1 grant (~98.9%) + HEM certificates (~1.1%)

Figure 1: Overview Pilot Cases

5 METHODOLOGY

The methodology for the pilot cases in the RENOINVEST project is designed to ensure a structured and replicable approach to deep energy renovation financing. The Pilot Design focuses on selecting two representative buildings per country - one in the private sector and one in the public sector - based on their energy efficiency potential, stakeholder engagement, and alignment with national renovation strategies. The buildings are chosen to reflect diverse ownership structures, building typologies, and financing challenges, ensuring broad applicability of the findings.

For the Financing Mechanism, each pilot case explores a mix of traditional and innovative financing models, including direct subsidies, low-interest loans from public funds (e.g., Eco Fund in Slovenia, national grants in Hungary), bank loans, and alternative models like crowd-investing or energy performance contracts. The financial models are tailored to the specific needs of condominiums, social housing, or public buildings, often combining multiple sources to achieve cost-effectiveness and long-term sustainability. This approach allows for a comparison of different financing scenarios, highlighting the most viable options for upscaling.

The Implementation Process follows a phased approach, with detailed renovation concepts that prioritize minimal disruption to occupants and alignment with local regulations and heritage constraints. Technical interventions are planned to maximize energy savings, improve comfort, and enhance building value, while the process includes stakeholder engagement, cost tracking, and performance monitoring to ensure accountability. This structured methodology ensures that the pilot cases not only demonstrate technical and financial feasibility but also provide actionable insights for policymakers, financial institutions, and building owners aiming to replicate successful renovation projects.

The six feasibility studies all follow the same structure and format for clarity and consistency. Calculations for financing costs (including subsidies), potential energy and CO_2 savings, revenue and value increases, payback periods, and Return on Investment (ROI) were performed using a standardized Excel template with pre-prepared formulas. This enabled cross-country comparability, though comparisons are limited by differences in national funding models, energy prices, and conversion factors for energy generation and CO_2 emissions, which lead to variations in savings calculations.

As the pilot cases were designed to reflect realistic scenarios for their respective countries and national action plans, Chapter 7 includes both cross-country and country-specific recommendations.

6 PILOT CASES IN DETAIL

6.1 AUSTRIA

6.1.1 Apartment buildings Rosaliagasse 1, 3, 5, 7 Vienna, Meidlinger L

BUILDING DESCRIPTION

Green balcony trellises Rosaliagasse in Vienna 1120, visualization (c) EIGENSINN by Sigrid Mayer/RATAPLAN

Type	4 Condominiums
Usage	Apartment building
Year built	1872 (5), 1900 (7)
Number of units	27 apartments (5,7)
Size	1 363 m^2 (5) 1 002 m^2 (7)
Ownership	27 Private owners
Energy class before renovation	D (5)
Energy class after renovation	B (5)
Heating energy demand before renovation	180 kWh/m^2a (5)
Heating energy demand after renovation	45 kWh/m^2a (5)
CO_2 reduction	92 % (~ 80 kg/a)

Figure 2: Overview Building Data Rosaliagasse 5&7

The project comprises four adjacent residential buildings located on Rosaliagasse in Vienna's 12th district, Meidling. The buildings form part of a dense founder's period urban structure and are situated directly along the street alignment, without setback.

With slight variation in their exact year of construction, the four apartment buildings can be categorized as typical late Founder's Period buildings (German: *Gründerzeit*), dating from approximately 1870 to 1919. This building typology is characterized by solid masonry construction with uniform use of brick in the external load-bearing walls as well as in the basement ceiling constructions. The buildings originally feature wooden box-type windows and generous room heights. In terms of urban configuration, two of the buildings are street-facing structures, while the other two are designed as corner buildings.

As is typical for many residential buildings of this period, the structures form part of the historic building stock and have undergone varying degrees of modernization over time. While some of the buildings already comply with contemporary requirements regarding the thermal quality of the building envelope, others still require improvements.

Beyond conventional refurbishment measures, the project introduces an innovative façade system that combines balcony retrofitting with intensive façade greening. The balconies will be suspended within so-called “trellises,” which will function as support structures for climbing plants to provide shading and façade protection. At the same time, these structures will accommodate photovoltaic elements.

In Rosaliagasse 1, there are long-term tenancies with low rents and small-scale apartments; after storm and flood damage, a roof and façade renovation was carried out. The owner is currently showing little investment interest in the demo project.

Rosaliagasse 3 is a condominium building with a heterogeneous ownership structure and passive management; two owners take an opposing position. A 100% approval of the building submission seems unrealistic in the 2nd year.

Please note that for the reasons outlined above, the objects at Rosaliagasse 1 and Rosaliagasse 3 are omitted from the following chapters.

In Rosaliagasse 5 & 7, the 27 owners and the property management companies are actively involved; the technical planning and coordination will be continued in a targeted manner.

Since the street is close to the well-known Meidlinger Markt, a reorganization of public space and mobility (transformation & mobility concept) is also being planned. Synthesis with properties and interfaces (e.g. market logistics) is carried out. A conversion into a residential street is favoured.

Renovation Concept

As part of the project, a modular overall structural system will be implemented on the existing buildings in Rosaliagasse. The core of the implementation is the construction of a free-standing, multi-storey climbing and balcony racking system as an upstream supporting structure on the façades. This system also serves as a constructive basis for greening, energy generation and new recreational areas.

Renovation of the building with full thermal insulation: This results in a thermal improvement of the building envelope through façade measures and a reduction in cooling requirements.

Load-bearing structure and construction: Erection of a steel structure made of moulded tube sections with additional rolled sections in highly stressed areas. Vertical load transfer via columns; Floor-by-storey anchoring to the existing façade by means of steel brackets. Use of

composite columns on ground floors and first floors to ensure the required fire resistance. Development of an adapted foundation concept, taking into account existing pipes and installations in the pavement and street area.

Balconies and building connections: Production of new balcony structures as an extension of residential use. Implementation of necessary door openings in the facades to open up the balconies. Formation of connection details between the existing and the new supporting structure (balcony structure, consoles, railings).

Integration of photovoltaics: Installation of partially transparent PV glass elements in balcony balustrades (approx. 20–50 % transparency) as fall protection and energy generation area. Installation of full-surface PV modules on roofs of the structure for electricity production and weather protection. Integration of the electrical infrastructure into the supporting structure as well as the implementation of joint energy use. A potential integration into energy communities to optimize use is planned.

Façade and building greening: Implementation of a combined system of vertical and horizontal greening elements (climbing aids, plant troughs, ground-bound and trough-bound vegetation). Training of irrigation systems with zoning, technical room, frost resistance and maintenance access. Green inspection walkways for care and maintenance.

Rainwater and climate adaptation measures: Use of the roofing areas to collect rainwater for the irrigation of the green structures. Contribution to the improvement of the microclimate through shading, evaporation and reduction of urban heat islands.

Adjustments to the interior of the building: Local structural interventions to connect the new balconies and to integrate technical systems. Coordination with static requirements, without deterioration of the structural load-bearing capacity of the existing building.

Measures in public space: Redesign of the street space to integrate the trellis and accompanying green spaces. Reduction of individual parking spaces in favour of the structural structure and greenery. Supplemented by bicycle parking facilities, mobility solutions and green accompanying lanes.

Overview

Planned technical interventions:

- Thermal renovation Rosaliagasse 5
  - Window replacement
  - Cellar ceiling insulation
  - Façade inner insulation
- Installation of a steel support structure serving as the load-bearing framework and growth base for the living wall system:
  - Construction extends from the street level up to the lower edge of the roof
  - Façade extension by 1.8 m
  - Implementation of structural steel with minimum yield strength between 235 and 355 MPa (N/mm^2)
- Construction of individual balcony modules Rosaliagasse 5 and 7
- Greening:
  - Multi-level horizontal greening in the street area and balcony-integrated plant-trough and garden.
  - Vertical greening through a living wall
- Installation of roof- and balcony integrated semi-transparent photovoltaic system

Target values

- Thermal renovation Rosaliagasse 5
  - Reduction of heating energy demand by 75%
  - Reduction of CO_2 emissions by 92%
  - Reduction of primary energy demand by 82%

- U-Values
  - Exterior walls: 0,21 W/m²K
  - Building base: 0,21 W/m²K
  - Basement ceiling to unheated space: 0,32 W/m²K
  - Windows: 0.8 W/m²K
- Photovoltaic system
  - Annual PV-yield of 18.5 MWh/a
- Greening measures
  - 25% coverage rate of the living wall within 3 years and 95% within 10 years
  - 15% improvement in thermal comfort during the cooling season.

Implementation timeline: The duration of the project is 36 months, with the estimated deadline of 30.09.2027.

Renovation circumstances regarding occupancy: The renovation is planned to take place while the occupants stay in the building do not interfere with their stay in the building.

Financial Models

Financing will take place via a hybrid model, which means that different financing options will be combined.

FM1:
Financing amount via a credit institution, a classical loan. There are 9 offers from 2 banks that offer terms between 15, 20 and 30 years with fixed interest and variable interest rates.

In the case of a loan to a condominium association (WEG), banks usually require several collaterals, because it is not an individual owner, but the community that acts as the borrower. What is required is a condominium resolution to take out a loan (majority or qualified resolution depending on the measure), a power of attorney from the property management company to process and subscribe to the loan, legally compliant cost allocation according to co-ownership shares and proof that the measure is likely to increase maintenance or value (e.g. renovation, energy).

The total amount is EUR 1 631 860 and a fixed interest rate per interest period is applied, the interest rate for the first interest period is 3.5% p.a.

FM2:
Part of the project will be financed through private investors via Klimja crowd-investing platform. The minimal investment is set to EUR 200 000 which will be subtracted from the initial bank loan of EUR 1 631 860. The total cost of funding is estimated at 12% with a fixed interest rate of 8% per annum during the initial five-year period. After the first five years, the interest rate increases by 1% for each additional year. The loan will be administered by the property management company, which will oversee all financial operations and investor servicing.

The investment agreement is structured around three dimensions of return: financial, social, and ecological. In addition to regular financial returns based on the agreed interest schedule, the project is committed to delivering measurable social and environmental impact. Both ecological and social outcomes will be clearly defined, transparently documented, and regularly reported to investors using established impact metrics to ensure accountability and credibility.

To account for the yearly rate raise of 1% by the end of the fifth year the financial model is further divided into two variants FM2a and FM2b. FM2a shows the scenario where the Klimja loan term is 15 years, accounting for the yearly 1% rate rise. FM2b shows the scenario in which priority is given to load term of 5 years to Klimja loan. The bank loan in both cases has loan term of 15 years.

Results and Analysis

Financial performance:

RENOVATION COSTS - FM1	
Total costs of renovation (€)	1 631 860
Total available subsidies (€)	0
Net-Investement (€)	1 631 860
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	179 500
Cost savings (€ per year)	23 335
$CO_{2equ.}$ savings / year	79 568
Calculated revenue	2 848 209
ROI (%)	**33**
Pay back period (years)	**17**

Figure 3: FM1 for facade renovation Rosaliagasse 5&7

RENOVATION COSTS - FM 2a	
Total costs of renovation (€)	1 631 860
Total available subsidies (€)	0
Net-Investement (€)	1 631 860
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	179 500
Cost savings (€ per year)	23 335
$CO_{2equ.}$ savings / year	79 568
Calculated revenue	2 848 209
ROI (%)	**21**
Pay back period (years)	**25**

RENOVATION COSTS - FM 2b	
Total costs of renovation (€)	1 631 860
Total available subsidies (€)	0
Net-Investement (€)	1 631 860
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	179 500
Cost savings (€ per year)	23 335
$CO_{2equ.}$ savings / year	79 568
Calculated revenue	2 848 209
ROI (%)	**33**
Pay back period (years)	**17**

Figure 4: FM2a and 2b for facade renovation Rosaliagasse 5&7

Energy performance: The installed photovoltaic system supplies 25% of the total annual electricity demand of the 27 apartments. In combination with the implemented renovation measures, it contributes to a potential primary energy reduction of 82% in the building located at Rosaligasse 5 - 7. Additionally, the living wall installation has been shown to reduce the façade surface temperature by up to 15 °C, as well as decrease the incident solar radiation on the façade by approximately 60% during cooling periods. With active cooling planned, these effects are expected to have a positive impact on cooling energy demand reduction.

Benefits resulting from renovation: The renovation measures outlined above are designed to increase energy efficiency within the building sector at the same time improving occupant comfort. Extensive greening in densely built areas has been shown to be an effective measure against urban heat islands, while also offering attractive residential benefits.

Stakeholder feedback: The feedback from stakeholders has been positive. In the condominium association, all owners approved the project and expressed their support for the planned measures.

Challenges and Lessons Learned

Challenges: Public subsidies were withdrawn, which made it necessary to restructure the financing plan. In addition, the available loan term was too short to fully match the financial needs of the project. These developments highlighted the importance of flexible financing models and early financial risk assessment in complex renovation projects.

Lessons learned: The project demonstrated that innovative renovation concepts require not only technical feasibility, but also stable financial and institutional frameworks. Early coordination with funding bodies, banks, property management companies, and owners is essential in order to respond effectively to changing boundary conditions.

Replication and Upscaling

The project shows strong potential for replication and upscaling, particularly in dense urban areas with a large stock of Gründerzeit residential buildings. The modular steel support structure with integrated balconies, greening elements, and photovoltaic systems can be adapted to similar building typologies across Vienna and other European cities.

The approach is especially relevant for multi-owner residential buildings where conventional renovation measures alone may not be sufficient to address climate adaptation, energy efficiency, and quality of life at the same time. By combining thermal refurbishment with façade greening, renewable energy generation, and the creation of additional outdoor living space, the concept provides a multifunctional solution with broad applicability.

For large-scale implementation, however, supportive financing schemes, legal clarity in condominium decision-making, and strong cooperation between owners, property managers, and public authorities are crucial. If these framework conditions are ensured, the concept could become a scalable model for climate-resilient refurbishment of historic urban housing stock.

6.1.2 LeiSan – Social housing / Austria / Bad Eisenkappel n° 331

Building description

Picture: Frontside of house n°331 - Komposchebene; Bad Eisenkappel © Renowave.at, Christina Böckl

Type	Municipality owned social housing
Usage	Residential building
Year built	1983
Number of units	12 apartments
Size	893 m2
Ownership	Municipality owned building
Energy class before renovation	C
Energy class after renovation	A
Heating energy demand before renovation	99.8 kWh/m2a
Heating energy demand after renovation	35.7 kWh/m2a
CO_2 reduction	7 200 kg/a

Figure 5: Overview building data Bad Eisenkappel 331

House No. 331 is part of the "Komposch Ebene" neighbourhood in the rural municipality of Eisenkappel-Vellach, Carinthia. The neighbourhood lies above the village centre of Bad Eisenkappel and consists of single-family homes and a cluster of multi-unit residential buildings from the 1960s. House No. 331 was added in the 1980s on a hillside as an extension of the municipal housing estate. Locally, it is nicknamed the "Birdhouse" because of its distinctive gabled architecture. The settlement offers attractive living conditions thanks to its proximity to an outdoor swimming pool and generous green spaces.

Despite these advantages, House No. 331 is in urgent need of renovation due to a backlog of maintenance and lack of reserves. The building contains 12 apartments ranging from 61 to 93 m^2; all currently rented at very low rates - even by rural and social housing standards. The resident mix is socially diverse, including some hardship cases. The municipality aims to maintain affordable rents to provide housing for all generations and prevent young people from moving to urban areas.

Structurally, the building reflects typical 1980s Austrian construction: reinforced concrete walls and ceilings in the basement and upper floors, clad inside and out with wood-chip insulation boards. Sound insulation nearly meets current standards, but the fire protection concept must be updated. The hillside location results in a narrow staircase, and the building lacks barrier-free access. Wooden window frames are in good condition and may be retained with energy upgrades. The most critical issue is the deteriorating balconies, which require immediate replacement. Heating is currently provided by individual stoves; conversion to a central heating system is planned. Existing chimneys also need urgent refurbishment to comply with regulations.

Renovation Concept

The renovation concept for the social housing building in Bad Eisenkappel follows a minimal-invasive approach, carefully balancing energy efficiency, safety, and accessibility while preserving the building's architectural character. The building envelope is upgraded with external wood-fibre insulation boards, finished in red lime plaster, and the roof is refurbished using new clay tiles combined with above-rafter insulation to enhance thermal performance and durability. To improve energy efficiency while maintaining the historic wooden window frames, these are retained and upgraded to modern insulating glazing, and defective external shading is replaced with aluminium shutters for durability and better control.

The balconies, which have deteriorated over time, are fully renovated by removing the old wooden structures and installing flat steel railings for a modern yet low-maintenance solution. A key focus of the project is the transition from individual stoves to a district heating system, paired with the installation of low-temperature radiators to ensure efficient energy use. Additionally, the concept includes provisions for photovoltaic (PV) installation on the roof, preparing the building for future renewable energy integration.

Accessibility is significantly improved through the addition of a new elevator shaft on the north side, serving nine of the twelve apartments, ensuring barrier-free access for residents. An optional but practical extension includes the conversion of the attic into a new apartment of approximately 53 m², which can be implemented if budget allows. Complementary upgrades cover the electrical system renewal, introduction of centralized hot water, and enhanced fire safety measures, such as installing EI230-C S200 fire doors.

The renovation aims for a deep renovation as defined by the Energy Performance of Buildings Directive (EPBD), targeting a heating demand of approximately 22.8 kWh/m²·year and an energy efficiency factor (fGEE) of 0,80. The goal is to achieve an energy class improvement from E/F to C/B, with a CO_2 reduction of around 70% thanks to district heating and improved building envelope performance

The implementation timeline is structured as a staged renovation in twelve measure packages, beginning in the first quarter of 2026 and expected to complete by the fourth quarter of the same year. This phased approach minimizes disruption to residents, and while most works are scheduled, there is flexibility to postpone the attic conversion or roof dormer enlargement if budget constraints arise. Throughout the renovation, works are planned in phases to minimize disruption, with the elevator and heating system installation carefully coordinated with tenant agreements. Safety and temporary access are ensured throughout the construction period, maintaining a secure and functional environment for both residents and workers.

Financing Models

Many municipalities own apartment buildings dating back to the 1960s to the early 1980s that serve to offer affordable housing for vulnerable groups. Today, many of these municipal housing buildings are **in need of significant renovations** due to aging infrastructure, outdated building codes, and lack of maintenance. The Austrian restrictions of the tenant law (MRG-Mietrechtgesetz) as well as the municipal necessity to offer attractive housing for young families and low-income households to avoid rural exodus (especially from small communities) pose a financial challenge for municipalities. Low rents result in small rent reserves and the need for long-term loans (about 30 to 40 years) to be able to refinance deep renovations. In the pilot case the rents are even beneath the legal reference rent, and the reserves are also quite low.

An additional **densification** with one to two apartments in the attic was considered for all three financing models but was rejected by the municipality due to the relatively high construction costs due to the subdivided structure of the building ((raising the existing roof, subsequent elevator installation)). Another reason is the demographic structure of the municipality (a community experiencing rural exodus) and concerns about whether these new apartments will be in demand at higher rents in the future to cover the additional construction and renovation costs. Selling the property is not an option for the municipality.

FM 1:
The first financial model employs a **mixed approach utilizing public subsidies, existing reserves, and a long-term loan**. All available subsidies from the federal government (renovation bonus and boiler replacement) and from the housing promotion of the state of Carinthia for renovation and boiler replacement are utilized, covering approximately 40% of the renovation costs. The remaining 60% are financed partly from the rent reserves accumulated over the years, with the majority coming from a long-term loan with a term between 30 and 35 years. Since the current rents average only EUR 3.50 or less, a moderate increase in rents to EUR 4 per m² is necessary to cover the loan instalments and the pre-financing costs until the subsidy is paid out after the final accounting. This model is preferred by the municipality as it enables the energy renovation, including the switch to renewable district heating, in one step. However, to implement this model, full consent from all tenants is required for the connection to district heating and the unlimited increase in rents. For vulnerable groups, a portion of this moderate increase can be offset by the Carinthian housing allowance.

FM 2:
The second alternative financial model also utilizes public subsidies from the federal and state governments and consists of **two renovation phases**. The first phase involves the energy-efficient retrofitting of the building envelope (façade, windows, roof, lowest floor ceiling, balcony renovation) using the federal renovation bonus and the housing promotion from the state of Carinthia. Approximately 40% to 50% of the costs can be covered through these subsidies. The remaining costs are financed through rent reserves and a long-term loan. This first step can proceed without a rent increase but is very tightly budgeted. The second phase includes the conversion of individual stoves to renewable district heating. Since tenant consent is required for this conversion, it will be implemented gradually for individual apartments, either at the request of existing tenants or during a tenant change. The federal subsidy for the decarbonization of heating systems can be claimed in this case, but the state of Carinthia requires a 100% conversion of all apartments in one step and would not be included in this financing model. Therefore, a slight increase in rent is also necessary for phase 2.

Additionally, for FM1 and FM2 there is the possibility to **utilize the roof surfaces for PV installations** connected to the existing energy community. This allows residents to access cost-effective renewable electricity through the energy community, and the surpluses can be used by the municipality as the building owner to cover the financing costs. This reduces the need for rent increases. Due to the stepped structure of the roof surfaces, the available area for PV modules is limited and thus only moderately attractive for external providers unless two adjacent houses (also owned by the municipality) are included.

FM 3:

The third financing model is a **building rights model.** The municipality transfers the building to a non-profit cooperative or a building community under building rights with the mandate for renovation. A building rights contract of at least 40 to 50 years with a renovation agreement is concluded between the building owner and the building rights holder. During this period, all rights and obligations under the existing contracts as well as new lease agreements are transferred to the building rights holder. For the municipality, the advantage lies primarily in the fact that it remains the owner of the building but does not have to concern itself with the general renovation. A non-profit building cooperative usually has better access to housing promotion funds and favourable loans. However, this model requires the conversion of lease agreements to usage agreements according to the Housing Common Utility Law (WGG) to enable the cooperative to collect the monthly maintenance and improvement contribution (EVB) from the tenants. Since in this specific case the energy performance of the existing building is poor and energy costs are high, the additional costs through the EVB would be offset by the lower energy costs. The municipality views this model as attractive but prefers that the building remains part of the municipal settlement complex of the Komposch-Ebene under municipal administration.

Results and Analysis

Financial performance:

RENOVATION COSTS - FM1	
Total costs of renovation (€)	1 180 000
Total available subsidies (€)	475 000
Net-Investement (€)	705 000
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	89 344
Cost savings (€ per year)	7 200
$CO_{2equ.}$ savings / year	7 120
Calculated revenue	1 296 560
ROI (%)	**19.5**
Pay back period (years)	**26.5**

Figure 6: FM1 blended finance model Bad Eisenkappel 331

RENOVATION COSTS - FM2 Phase 1	
Total costs of renovation (€)	980 000
Total available subsidies (€)	420 000
Net-Investement (€)	560 000
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	84 200
Cost savings (€ per year)	6 800
$CO_{2equ.}$ savings / year	3 540
Calculated revenue	887 120
ROI (%)	**13.7**
Pay back period (years)	**25.4**

RENOVATION COSTS - FM2 Phase 2	
Total costs of renovation (€)	150 000
Total available subsidies (€)	25 500
Net-Investement (€)	124 500
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	5 100
Cost savings (€ per year)	500
$CO_{2equ.}$ savings / year	3 540
Calculated revenue	162 070
ROI (%)	**30.2**
Pay back period (years)	**24.3**

Figure 7: FM2 phase model – phase 1 and phase 2 Bad Eisenkappel 331

For FM2 the 2-phase model the possible energy savings and calculated revenue are split in two tables due to the staggered measures over a period of 3 to 5 years and are estimates for phase two depending on available funding.

For FM3 the building rights model the calculation for the costs and energy savings would be similar to the FM1 however the calculated revenue and ROI as well as payback cannot be calculated due to lack of data for possible increases in rent and EVB.

Energy performance: In a one-step implementation as planned in financing model FM1, approximately 60-70% savings in heating demand can be achieved after the completion of the renovation. By switching from individual stoves (gas, wood, coke) and hot water generation with electric boilers to 100% renewable district heating for heating and hot water, efficiency gains of about 20 to 30% are also possible. In financing model FM2, the planned energy savings are to be achieved gradually in 2 to 3 phases over the next 3 to 5 years. In financing model FM3, significant savings can also be achieved by setting renovation targets in the building rights contract.

A possible addition of a PV installation was calculated for house 331 and two additional residential buildings in the immediate vicinity (energy community), and all three installations together can achieve an annual energy yield of 85 700 kWh with an installed module capacity of 89.7 kWp. A Carinthian energy service provider, who already operates an energy community in the region, has expressed interest in also connecting this installation and acting as a contractor for its construction. In connection with the already existing installations in the settlement, surpluses can be achieved, and a plus-energy settlement can be realized.

Benefits resulting from renovation: Through comprehensive energy renovation and connection to renewable district heating, both the municipality as the building owner and the tenant's benefit. The municipality can significantly increase the building value through the renovation measures (around 400 EUR/m2) and generate more income from rents for refinancing and building rent reserves in the future. Additionally, this project serves as a showcase for sustainable renovation in municipal housing. For the residents, the living comfort improves significantly compared to the current poor condition, energy costs can be saved, and rents will only be moderately increased. Vulnerable groups are additionally financially supported by the municipality or the state of Carinthia through housing allowances. Furthermore, the accompanying communication in the form of individual conversations and workshops, in which wishes were considered as far as possible, has greatly improved the communication climate among the residents and has created a sense of community.

Stakeholder feedback: Initially, the residents were rather sceptical about the renovation, as it had been discussed for a long time, but little had happened due to the poor financial situation. Additionally, the sense of community within the building was almost non-existent, and the overall mood was quite negative. However, during the workshops and conversations, many concerns were addressed, and a positive dynamic emerged not only among the residents but also with the municipality itself. Now, at the end of the process and after many efforts by the project team and the municipality to secure the financing, all parties involved are relatively satisfied and eagerly await the implementation of the measures in the summer/autumn of 2026.

Challenges and Lessons Learned

Renovating municipal housing in Austria is fraught with **financial and legal challenges**. Funding constraints, including limited public subsidies and high renovation costs, make it difficult to undertake comprehensive renovations. Tenant protections under Austrian law further complicate the process, as any additional costs or disruptions must be carefully managed to avoid legal disputes.

Municipalities, especially in the affordable and municipal housing sector, need more professional support during the planning phase, communication with residents, and the presentation of possible financing options. The process of setting up a renovation project is time- and cost-intensive to involve all stakeholders and find good solutions for everyone. In the specific case, the processes and the search for solutions were supported by the RENOINVEST project, and the findings are being distributed by Renowave.at and IIBW to other municipalities to promote more energy-efficient renovations in municipal housing. Particularly, "difficult" cases like the one in Bad Eisenkappel show that targeted subsidies and long-term financing models with favourable conditions are needed in municipal housing to preserve the existing housing stock, create living comfort for the residents, and enable affordable housing.

Replication and Upscaling

The strategies and processes applied here can be adopted by other municipalities in Austria. The insights and recommendations regarding the promotion and long-term financing of municipal housing have also been incorporated into the national action plan for Austria. In particular, the moderate and permanent increases in rent and possible safety nets for vulnerable groups are heavily restricted by the tenancy law in Austria. The project demonstrated the importance of transparent and comprehensive communication and the involvement of residents, ultimately leading to a joint decision in a tenants' assembly.

This pilot case is also used by Renowave.at and IIBW as an example in communication with and demands to the responsible housing ministry as well as for housing promotion to demonstrate that municipalities need permanent and reliable support in this area.

6.2 HUNGARY

6.2.1 Apartment building 1088. Rákóczi út 11. /Budapest/Hungary

BUILDING DESCRIPTION

Picture: Multi-apartment residential building, Rákóczi Street 11. @Dorottya Hujber (KTI)

Type	Condominium building
Usage	Residential
Year built	1901
Number of units	95
Size	6978 m²
Ownership	Private
Energy class before renovation	G
Energy class after renovation	D
Overall primary energy performance (EP value) before renovation	232.89 kWh/m²a
Overall primary energy performance (EP value) after renovation	141.33 kWh/m²a
CO_2 reduction	~ 170 t/a

Figure 8: Overview building data Rákóczi út 11

The property was constructed in the early 20th century, in a row development, with an imposing scale and eclectic architectural features. The building comprises ground floor + 4 upper levels + mansard roof level, covered with pitched roofs. It includes one main staircase and two secondary staircases, apartments accessible via open-air corridors, and basement/cellar areas. A passenger elevator is installed in the main staircase.

The overall condition of the building is average. From a heritage protection perspective, it is situated within a designated heritage environment (defined by the heritage protection zone of the Headquarters of the National Association of Hungarian Civil Servants, as well as the ex lege heritage environment of the University). In addition, the property is subject to archaeological protection in connection with the Üllői road - Mária street - Kőfaragó street - Vas street - Rákóczi street – Múzeum boulevard site (part of downtown Budapest).

The building has 78 appartements of different sizes (5 601 m2) plus 860 m² of shop and office area that can be rented (although they are not rented at present), and more than 500 m² of common spaces.

Renovation Concept

The first phase of the renovation consists of establishing the building's energy envelope, which includes the refurbishment of the roof structure and covering, the thermal insulation of the top slab, the internal insulation of the facades, as well as the sealing of the external surfaces of the windows and the installation of internal thermal insulation. Since the internal insulation is wood fibre based, vapor control calculations are required to avoid potential damage.

The second phase of the investment covers the installation of energy generation and heat emission systems, control and measurement technology, as well as the construction of a new electrical network, considering the performance of the energy envelope.

The project, together with the structurally inevitable refurbishment of the open-corridor supporting structures, can be organized and implemented while residents remain in place, provided that a precise organizational plan is developed in terms of both time and space.

OVERVIEW:

- Planned technical interventions:
    - Street-facing roof sections – tile roofing with mansard windows, highly articulated
    - Inner courtyard roof sections – tile roofing
    - Inner courtyard roof sections – roof flashing
    - Insulation top floor ceiling
    - Internal thermal insulation of facades
    - Renovation and reconstruction of doors and windows
    - Steel panel radiators, installation of heating and DHW (domestic hot water) system fittings
    - Smart radiator valve with mobile control
    - Heating cost allocators with remote radio reading, data collection, analysis
    - Complete renovation of the electrical network
    - Renovation of hanging corridors – first and rear courtyard section

- Target values:
    - In accordance with Government Decree 9/2023 (V.25.) ÉKM, protected historic buildings and buildings under local heritage protection are exempt from compliance with minimum energy performance requirements where such compliance would compromise their heritage value. This exemption also applies to historic gardens, landscapes and protected heritage areas. Therefore, meeting the target value of the building energy performance classification is not mandatory in these cases
    - Total energy savings is 91.56 kWh/m2a
    - Target energy class after renovation is not mandatory
    - CO_2 reduction: 173 050 kg/year

- Implementation timeline:
    - The renovation of the complex is predicted as one stage process

- Renovation circumstances as regard the occupancy:
    - The renovation is planned to take place while the occupants use the building as the works usually do not interfere with their stay in the building.

The estimated costs of the implementation of the above detailed renovation concept (deep renovation) amount to a total of **EUR 2 755 443**.

Financing Models

For the financing of deep renovations of buildings operated by condominiums of this size and building age, there are no targeted national-level programs available. The City of Budapest together with a number of its districts has launched a deep renovation program for condominiums with prefabricated panel buildings as a first step. The different districts of Budapest (23 districts altogether) have very different grant programs open for condominiums in their districts. The 8th district, where the building is located, does not offer larger volume grants which would help in the case of deep renovations, only smaller size of grants for certain elements of the refurbishment of a building. However, a minimum level of grant has been assumed and taken into consideration in the model calculations, as the estimated size of the investment cannot be financed on market basis only. Thus, the financing structure is a blended model with a minimum level of grants blended with the own resources of the condominium (accumulated on the savings account of the condo) and the value of the tradeable energy certificates (so-called HEM i.e. validated energy savings based on the Energy Efficiency Obligation Scheme) and the remaining part is a bank loan, the so-called condominium loan product. As no other financing mix is available on the Hungarian market at the time of preparing this report, we have assumed three scenarios corresponding to different levels of investment: the first scenario is the deep renovation as described above (FM1), the second scenario is a cost effective scenario called cost-effective I., which would implement the elements of the above concept focusing on insulation mainly, targeting the energy savings (FM2), and the third scenario is also a cost effective scenario called cost-effective II., which would implement the crucial elements of the concept targeting the energy savings only (FM3).

FM1:
This scenario assumes the total costs of implementing the deep renovation concept, i.e. EUR 2 755.5 thousand. The financing mix consists of a grant element of EUR 259.7 thousand, the own contribution of the condominium (accumulated on its savings account, as of 31. December, 2025) EUR 97.8 thousand, and the value of HEM (validated energy savings sold), EUR 96.8 thousand, based on the market price (weighted average price of HEM as of March 2026) and the quantity of energy savings to be delivered by the investment. These three elements make up EUR 454.3 thousand altogether, with a remaining financing need of EUR 2 301 thousand (*equity-like elements altogether 16.49 %, loan 83.51 %)***.** This EUR 2.3 million would be financed by the condominium loan product available at the commercial banks, with a maturity of 15 years, with an interest rate subsidy of 70 % in the first five-year period and an interest rate subsidy of 30 % in the second and third five-year periods. Based on the median value of the 12 months Budapest Interbank Offered Rate (BUBOR) fixing until March 9, 2026, which was 6.27 %, the subsidized interest rate for the first five-year period would be 1.88 %, and for the remaining period the interest rate would be 4.39 % (the financing models are calculated on HUF basis then changed to EUR with an exchange rate of HUF/EUR 385). With these interest rates and the 15-year loan maturity the total amount of debt finance is equal to EUR 2 859 thousand (amount to be repaid).

FM2:
The cost-effective I. scenario assumes reduced investment costs compared to the deep renovation concept, including the main elements necessary to deliver the planned savings in heating (gas consumption), the amount of investment in FM2 is EUR 1 960 thousand. The financing mix consists of the

same three equity-like elements as described above (grant element, own contribution of the condominium and the value of the validated energy savings sold, amounting to EUR 454.3 thousand altogether, with a remaining financing need of EUR 1 505.6 thousand (*equity-like elements together 23.18 %, loan 76.82 %).* This EUR 1.5 million would be financed by the same condominium loan product available at the commercial banks as described above, with the same 15 years maturity and subsidized interest terms, thus the total amount of debt finance is equal to EUR 1 870.7 thousand (amount to be repaid).

FM3:
The cost-effective II. scenario assumes further reduced investment costs compared to the deep renovation concept, including only the crucial elements necessary to deliver the planned savings in heating (gas consumption), the amount of investment in FM3 is EUR 1 472.7 thousand. The financing mix consists of the same three equity-like elements as described above (grant element, own contribution of the condominium and the value of the validated energy savings sold, amounting to EUR 454.3 thousand altogether, with a remaining financing need of EUR 1 018.3 thousand (*equity-like elements together 30.85 %, loan 69.15 %).* This EUR 1 million would be financed by the same condominium loan product available at the commercial banks as described above, with the same 15 years maturity and subsidized interest rate terms, thus the total amount of debt finance is equal to EUR 1 265.2 thousand (amount to be repaid).

Results and Analysis

Financial performance: Analysis of the possible financial outcomes, including cost savings, return on investment, and payback period is presented on the Figures 18 and 19. The planned renovation, especially the deep renovation (FM1) is very investment-intensive, considering that the building itself is huge, and building materials prices are high, it amounts to more than EUR 2.7 million. The elements of the renovation plan regarding insulation of roofs and facades result in a 49.37 % reduction in energy consumption including both gas and electricity, based on consumption in kWh/year, however, this means a lower level of reduction in operating costs (gas and electricity together) would decrease only by 27.83% (while heating costs would be reduced by 60 %, electricity costs would remain at the same level). The costs of consumption (including both gas and electricity) per m^2 of the building is reduced from EUR 10.83 to EUR 7.82. The difference in the level of reduction regarding consumption on kWh/m^{2}a basis and the costs of consumption is due to the significant difference in the gas and electricity prices paid by the condo (gas is 0.033 EUR/kWh and electricity is 0.164 EUR/kWh). The very high level of loan financing in all three scenarios – more than 80 % in FM1 and still almost 70 % in FM3 – make the economic feasibility of the investment vague: ROI for FM1 is 5.6%, for FM2 it is 17.7%, while for FM3 is 74%. Due to the high investment in the renovation and the very high level of loan financing, the payback period for the first two cases is very long, 26.9 years for FM1, 14.3 for FM2 and somewhat better for FM3: 9.7 years.

DEEP RENOVATION RENOVATION COSTS - FM1	
Total costs of renovation (€)	2 755 445
Total available subsidies (€)	454 339
Net-Investement (€)	2 301 106
Real investment needed (€)	2 858 986
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	650 196
Cost savings (€ per year)	21 037
$CO_{2equ.}$ savings / year	173 050
Calculated revenue	3 018 544
ROI (%)	**5.6**
Pay back period (years)	**26.9**

Figure 9: FM1 deep renovation scenario II for Rákóczi út 11.

COST EFFECTIVE I. RENOVATION COSTS - FM2	
Total costs of renovation (€)	1 959 984
Total available subsidies (€)	454 339
Net-Investement (€)	1 505 644
Real investment needed (€)	1 870 673
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	650 196
Cost savings (€ per year)	21 037
$CO_{2equ.}$ savings / year	173 050
Calculated revenue	2 201 441
ROI (%)	**17.7**
Pay back period (years)	**14.3**

Figure 10: FM2 cost effective scenario I for Rákóczi út 11

COST EFFECTIVE II. RENOVATION COSTS - FM3	
Total costs of renovation (€)	1 472 675
Total available subsidies (€)	454 339
Net-Investement (€)	1 018 336
Real investment needed (€)	1 265 221
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	650 196
Cost savings (€ per year)	21 037
$CO_{2equ.}$ savings / year	173 050
Calculated revenue	2 201 441
ROI (%)	**74**
Pay back period (years)	**9.7**

Figure 11: FM3 cost effective scenario for Rákóczi út 11

Energy performance: The planned energy efficiency renovation of the building with the installation of thermal insulation will strongly affect the building's heat losses. The building's natural gas consumption will be reduced by more than 60% because of the renovation works.

Benefits resulting from renovation: The major benefit of the renovation is the savings in the consumption regarding heating which would somewhat decrease the costs for the appartement owners and the for the condominium itself. If the whole renovation concept could be implemented it would also benefit from improved roofs, inner corridors and an up-to-date heating and electricity system, which would improve the owners´ comfort. At the end of the day the renovation could further increase the appartements´ market value, or rather the owners´ ability to exploit the appartements by renting (market prices on the exact location in Budapest are rather high already and there has been a steep increase in prices in recent years).

Stakeholder feedback: An investment of such a volume would require a very high level of long-term commitment from the condominium, i.e. each of the appartement owners, and tremendous effort and effective work from the condominium manager, including the involvement of several types of experts (technical experts, legal and financial expertise) and requires high level of communication skills. It would also require high level of commitment from the participating bank as well.

Challenges and Lessons Learned

Challenges: The renovation, especially the deep renovation of these types of buildings are still **very expensive** - both building material prices and the price of the works to be performed are high. This condominium has a savings account, and the owners do pay a contribution in each month (EUR 0.34/m2/month) to this account as a part of their monthly condominium costs bill. The amount collected until 31. December 2025, EUR 97.8 thousand is very low compared to the amount of the renovation costs, only 3.55 % of them. Even if a strong commitment of the owners were to reach and the monthly contribution could be doubled, which would mean high increase of their monthly bills, it would take very long years to increase the level of savings to a level that would be comparable with the volume of the investment needed.

The value of the validated energy savings is also relatively low compared to the investment costs, 3.51%. The investment is supposed to result in total savings of 650.2 MWh/year (2 341 GJ/year), which means that a total investment of more than EUR 2.7 million has to be made in the case of this building, in order to save 2 341 GJ energy yearly, therefore 1 GJ of energy saving would cost EUR 1 177 investment, while the present price of the validated savings is 41.35 EUR/GJ in the Hungarian electricity market. This is a huge difference.

As it can be clearly seen from the economic feasibility and the model calculations, such a volume of investment cannot be implemented with a high loan ratio: the ratio of the loan financing is between 70-83 % in the models described, which makes the payback period extraordinarily high in all three cases, even with subsidized interest rates. Banks usually would not be willing to finance more than 50 % of an investment anyway. For payback purposes additional revenues were also considered: if the renovation were implemented the condo would be able to rent the shop/office spaces, or part of them. Based on the model calculations even those revenues would not be covering the payback (capital and interests) in at least 4-5 years of the term in FM1.

Lessons learned: An investment of such a volume cannot be financed from the sources that are available at present in Hungary. There are still a large number of buildings in similar condition and of similar age in the country which require renovations of this volume so it is imperative that a long-term and well-planned energy efficiency financing framework be formulated to detail and launched in due course. From the size of equity-like sources presented above (own contribution from the savings account, validated energy savings sold) it can be seen that these have to be supplemented with targeted grant elements that should be blended with loan financing (see the recommendations of the Hungarian Action Plan, 2.1, 2.2. and 2.3).

Such an investment would require a very high level of commitment from the condominium and the owners, even in a situation where their contribution to the common costs had to be increased with regard to the loan payback, in spite of the savings achieved, which would definitely be quite difficult - almost impossible - to manage.

A further issue is the energy pricing, for retail consumers' gas prices are kept very low (up to a certain level of consumption), while electricity prices are kept at a somewhat higher level. The low gas prices are not enough motivation to invest high amounts of money in energy efficiency as the low gas price makes returns longer, while the alternative solutions based on electrification could well increase the costs of heating as compared to the low gas prices, therefore, the prices prevailing at present make larger investments in energy efficiency economically very questionable.

Replication and Upscaling

As it can be clearly seen from the above, the presently available financing model cannot be recommended for replication and upscaling, certainly not for other countries. In the case of a blended model, if a well targeted grant element could be taken into consideration, amounting to 40-50 % of the investment costs, it could be blended with 5-10 % own contribution and 45-50 % loan financing. Such a blended model would provide better return on investment and shorter payback period, which could be a model for replication and upscaling.

6.2.2 Híròs Agora – Multifunctional Community Center, 6000 Kecskemét, Deák Ferenc tér 1, Hungary

Building description

Picture: Híròs Agora Cultural and Yourth Center @Dorottya Hujber (KTI)

Type	Community Center in Kecskemét
Usage	Public
Year built	1974
Number of units	-
Size	6568 m²
Ownership	Municipality of Kecskemét
Energy class before renovation	D
Energy class after renovation	B
Overall primary energy performance (EP value) before renovation	102.92 kWh/m²a
Overall primary energy performance (EP value) after renovation	60.53 kWh/m²a
CO_2 reduction	~ 60 t/a

Figure 12: Overview building data Híròs Agora

The building was constructed in 1974 using a monolithic reinforced concrete frame and slab structural system, which makes it suitable for the spatial transformations required by the planned functions. The facility currently operates as a cultural centre; however, most of its spaces still reflect their original construction-era condition. The basement primarily accommodates storage functions and a small gymnasium, while the ground floor contains the main lobby, service and community spaces. The upper-level houses office areas as well as a 600-seat theatre hall. The building has a compact massing, which is advantageous in achieving the targeted performance levels during the planned energy renovation. Located within a dense urban fabric, the façade design will play a defining role in shaping the surrounding public space.

Renovation Concept

There are currently two 405 kW gas boilers in the building, with a good annual efficiency (~92%). The heating of the 600-seat auditorium is provided by controlling the temperature of the ventilation air, while the service rooms and other common areas are heated by radiator heat emitters.

The existing heat-generating equipment will be retained, while the hydraulic and control systems will be modernized and partial surface heating will be installed. This will enable the next development phase, which is not part of the current project, to allow for the installation of new condensing gas boilers and air-to-water heat pumps, depending on the results of the energy calculations, as well as the implementation of full surface heating.

A rooftop photovoltaic system with a total installed capacity of approximately 60 kWp was considered in the refurbishment concept. The PV system is intended to offset a portion of the building's electricity demand, thereby reducing both grid electricity consumption and the overall primary energy demand. As a result, the building's total energy performance indicator decreases to a level that meets the regulatory reference requirement.

OVERVIEW:

- Planned technical interventions:
    - External wall insulation (20 cm wood-fiber)
    - Replacement of windows (triple glazing with shading)
    - Curtain wall (triple glazing, aluminium type)
    - Flat roof refurbishment (waterproofing + 30 cm insulation)
    - Basement wall insulation
    - Radiant ceiling heating installation (heat emission side)
    - Heating system modernization (pumps, controls, balancing)
    - LED lighting retrofit (offices and ground floor spaces)
    - Auditorium basic lighting (general, guidance and emergency lighting, excluding stage technology)
    - Air handling unit (optimization, control upgrade and integration works)
    - PV system (60 kWp)
    - Battery storage (self-consumption optimization ~100 kWh / 50 kW)

- Target values:
    - In accordance with Government Decree 9/2023 (V.25.) ÉKM:
      Renovation Level: Deep renovation (EPBD definition)
    - Reference building primary energy performance: 70.28 kWh/m²a
    - Overall primary energy performance (EP value) after renovation: 60.53 kWh/m²a
    - Energy efficiency factor (fGEE): 0.86
    - Total energy savings is 42.39 kWh/m2a
    - Energy class after renovation is B. The renovation achieves the performance level required for deep renovation under the applicable national regulations.
    - CO_2 reduction: 60 754 kg/year

- Implementation timeline:
    - The renovation of the complex is predicted as one stage process

- Renovation circumstances as regard the occupancy:
    - The operation of the building will be suspended during the renovation works

Financing Models

The function of this building is first of all cultural, the building hosts a 600-seat theatre hall where a large variety of cultural programs take place throughout the year. The company operating the building and the theatre is 100 % owned by the Municipality of Kecskemét and operates as a not-for-profit organisation. Although the building has approx. 3 000 m^2 of office space, which is rented out, the operating company has revenues from the offices, and also from renting out the theatre, the main function of the building still remains public; therefore, the operating company receives an amount of subsidy from the municipality about twice as high as its revenues. As to the financing model of the renovation, we have only calculated with the operational costs of the building regarding heating and electricity on the cost side and with the revenues from office rentals, on revenue side (i.e. the PL of the operating company is to a great extent different).

In Hungary, for the financing of deep renovations of public buildings of this size and function, owned by municipalities, the only way is to tender for state subsidies. At the time of writing this report, there is a tender window open for sustainable energy efficiency investments (deep renovations) corresponding to Article 9th of the European Regional Development Fund (ERDF) Resolution of the European Parliament and Council, it is called TOP_PLUSZ-2.1.2-21-SL1. Beneficiaries of this grant can be not-for-profit organisations belonging to institutions within the stage-budget. The grant is targeted at deep renovations focusing on energy efficiency if the investment is aimed at reducing the emission of GHG gases. The operating company is eligible to this grant window.

Neither the operating company, nor the owner municipality have any own resources to finance the investment and municipalities in Hungary are not encouraged to take out investment loans or enter Energy Performance Contracting (EPC) structures at present (for more detail see the Hungarian Action Plan document). The only financing means which could reduce the grant amount is the value of the tradeable energy certificates (so-called HEM i.e. validated energy savings based on the Energy Efficiency Obligation Scheme), which has been considered in the model calculation.

As the estimated amount of total investment required for the above detailed deep renovation is very high, EUR 2 400 288.78, we have considered two versions of the investment, FM1: the total deep renovation and FM2: where only the reduction of energy necessary to heating takes place, the heating only version requires an investment of EUR 1 832 261.94.

FM1:
The deep renovation of the building costs EUR 2.4 million and it is financed by the grant program TOP_PLUSZ-2.1.2-21-SL1 and the market value of the tradeable energy certificates (HEM). The HEM accounts for 0.53 % of the total investment costs while the grant is 99.47 % of the total investment.

FM2:
The heating only version costs somewhat more than EUR 1.8 million, and it is financed by the grant program TOP_PLUSZ-2.1.2-21-SL1 and the market value of the tradeable energy certificates (HEM). The HEM accounts for 1.09 % of the total investment costs while the grant is 98.91 % of the total investment.

Results and Analysis

Financial performance: Analysis of the possible financial outcomes, including cost savings, return on investment, and payback period is presented on the Figures 1 and 2. The planned renovation, especially the deep renovation (FM1) is very investment-intensive, considering that the building itself is quite large, and building materials prices are high. The elements of the deep renovation plan result in a 16.09 % reduction in total energy consumption including both gas and electricity, based on consumption in kWh/year, and this means a reduction in operating costs (gas and electricity together) of 18.45 % The costs of consumption (including both gas and electricity) per m^2 of the building is reduced from EUR 10.09 to EUR 8.23. For the model calculations we have taken into consideration a somewhat increased rental fee revenue for the office space (5,32 EUR/m^2/month), thus the calculated income over lifetime amounts to EUR 1.8 million. In FM2, improvement of the heating is considered only, resulting in a 32,37 % reduction in gas consumption. Based on these parameters the economic feasibility of the investment is still vague: ROI for FM1 is -24.6%, and for FM2 it is -1.3%. The payback period for FM1 is very long, 19.9 years and for FM1 is somewhat better with 15.2 years.

DEEP RENOVATION RENOVATION COSTS - FM1	
Total costs of renovation (€)	2 400 289
Total available subsidies (€)	2 400 289
Net-Investement (€)	2 400 289
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	85 136
Cost savings (€ per year)	12 232
$CO_{2equ.}$ savings / year	60 754
Calculated revenue	1 808 671
ROI (%)	**-24.65**
Pay back period (years)	**19.9**

HEATING ONLY RENOVATION COSTS - FM2	
Total costs of renovation (€)	1 832 262
Total available subsidies (€)	1 832 262
Net-Investement (€)	1 832 262
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	133 702
Cost savings (€ per year)	9 942
$CO_{2equ.}$ savings / year	43 316
Calculated revenue	1 808 671
ROI (%)	**-1.29**
Pay back period (years)	**15.2**

Figure 13: FM1 deep renovation and FM2 heating exchange only with grant program TOP_PLUSZ-2.1.2-21-SL1 for Hírös Agora

Energy performance: The planned energy efficiency renovation of the building with the installation of thermal insulation will strongly affect the building's heat losses. The building's natural gas consumption is reduced by more than 32% as a result of the renovation works. According to the energy performance calculation, total electricity consumption decreases by 45%.

Benefits resulting from renovation: The major benefit of the renovation is definitely the savings in the consumption regarding heating which would decrease the costs for the operating company paid for gas. If the whole renovation concept could be implemented it would also benefit from improved electricity networks, a roof-top photovoltaic system with battery storage roofs, hence the higher CO_2 savings in FM1. These measures would definitely improve the place´s comfort. As the building is a public cultural building, owned and operated by the local city municipality, the building´s market value is difficult to estimate as there are no comparable transactions on the market. However, the deep renovation of the building would definitely add to achieving the municipality´s sustainability goals (e.g. CO_2 reduction) in the so-called "GreenKecskemét" program.

Stakeholder feedback: An investment of such a volume would require a very high level of long-term commitment from the operating company, as well as from the municipality as submitting a tender in the above specified grant program requires large effort and effective work from the municipality's experts and the management of the operating company. including the involvement of several types of experts (technical experts, legal and financial expertise) and requires high level of communication skills

Challenges and Lessons Learned

Challenges: The renovation, especially the deep renovation of these types of buildings are still very expensive - both building material prices and the price of the works to be performed are high. Neither the municipality, nor the operating company have any own resources or savings for investment purposes, as the municipality operates from state-budget funding based on the tasks it has to perform, and the operating company is a not-for-profit organisation, therefore neither of them can accumulate funds for future investments. The operating company has revenues amounting to approx. EUR 1 million altogether from the office renting and revenues of the theatre, however, to cover its total operational costs (including material costs, wages and depreciation), it requires another approx. EUR 2.8 million in subsidy from the municipality, based on its public functions.

The value of the validated energy savings is also relatively low compared to the investment costs, 0.52% and 1.09 % in FM1 and FM2 respectively. The investment is supposed to result in total savings of 85.1 MWh/year (306.5 GJ/year), which means that a total investment of more than EUR 2.4 million has to be made in the case of this building, in order to save 306.5 GJ energy yearly, therefore 1 GJ of energy saving would cost EUR 7 832 investment, while the present price of the validated savings is 41.35 EUR/GJ in the Hungarian electricity market. This is a huge difference.

As it can be clearly seen from the economic feasibility and the model calculations, even with the level of increased revenues from renting, the ROI is negative and the payback period is extraordinarily high which usually prevents investors from taking the risk. A favourable effect could be although, with regard to the cost reduction in gas consumption, that the municipality could reduce the amount of subsidy paid for operating the company after the renovation (this would require higher level calculations which is out of the scope of this project).

Lessons learned: An investment of such a volume in the public sphere can only be financed from the grants made available to the municipalities or their daughter companies by the Hungarian state. It would be imperative to make it possible for the municipalities to enter into EPC type structures (see the recommendation of the Action Plan 1.2) so that they could analyse their portfolio and select those projects where revenues can be earned and, in that way, have acceptable ROIs and payback periods, and those projects could thus wholly or partly be eligible for market-based funding. In enabling environment Energy Performance Contracting (EPC) contractors or Energy Service Companies (ESCO) could be able to collect and bundle similar projects therefore creating a higher chance of getting financed by market terms. However, renovations of large public buildings with public functions and with low ROIs and long payback periods are still likely to remain within the state-budget.

Replication and Upscaling

As it can be clearly seen from the above, the presently available financing model is not an innovative way of financing. If EPC models were to be encouraged in the near future, it would be possible to go deeper into analysis and find the ways of bundling similar types of renovations and/or engage in staged renovation of the public buildings as a result of which at least a certain level of private finance could be involved the renovation of public buildings. A lot depends on the future development of gas and electricity prices, and how public organisations, like municipalities will pay those costs.

6.3 SLOVENIA

6.3.1 Apartment building Celovška cesta 83, 85, 87 / Slovenia / Ljubljana

BUILDING DESCRIPTION

Picture: Slovene private pilot building Celovška cesta 83, 85, 87, Ljubljana Photo: archive ZAG.

Type	Condominium
Usage	Apartment building
Year built	1963
Number of units	139 apartments
Size	12 692.7 m²
Ownership	Private owners
Energy class before renovation	D
Energy class after renovation	B2
Heating energy demand before renovation	98 kWh/m²a
Heating energy demand after renovation	30 kWh/m²a
CO_2 reduction	100 t/a

Figure 14: Overview building data Celovška cesta 83, 85, 87

The apartment building Celovška cesta 83, 85, 87 is a free-standing condominium in a simple cubical longitudinal shape, combined from three directly connected building blocks with three separated entrances. This 11 floors-building (including a basement) comprises 139 residential, privately owned units. It is located in Šiška district, parallel to Celovška cesta in Ljubljana.

The basic building structure was carried out using various materials, majority being the concrete and brick. The complex is connected to the electricity, water supply, sewage, and gas networks. Gas is used as a source of energy for heating of all indoor spaces. The flat roof was renovated in 2004; the windows were all gradually replaced in last decade with new more efficient ones. The façade that is partially finished in plaster and partially in brick has no thermal insulation. The building is in quite good physical condition.

RENOVATION CONCEPT

This energy renovation is limited to façade only. It encompasses a refurbishment of all opaque elements of façade together with thermal insulation layer in the thickness of 20 cm and thermal conductivity under 0.04 W/mK to fulfil the criteria for state subsidy. The finalisation of the façade is predicted to follow the existing appearance in plaster and brick (with brick tiles substituting the whole bricks). Windows replacement is not predicted, as it was already carried out individually by the apartment owners. Also, the heating system stays the same. Additionally, the predicted renovation works include the reconstruction of the staircases, railings, and flower planters.

OVERVIEW:

- Planned technical interventions:
  - Façade renovation with energy efficiency measures – the installation of thermal insulation (d = 20 cm, λ < 0.04 W/mK) and the elimination of thermal bridges; the finishing layers according to existing appearance in plaster and brick.
- Target values:
  - Energy renovation of façade according to definitions in Slovene regulation which are aligned with EPBD and with the requirements for incentives of Eco Fund - the prescribed ratio between thermal conductivity (λ) and thickness (d) of the new thermal insulation of facade needs to be **≤ 0.2 W/(m^{2}K)**.
- Implementation timeline:
  - The renovation of the complex is predicted as one stage process starting in December 2025 and finishing in early days of 2026.
- Renovation circumstances as regard the occupancy:
  - The renovation is planned to take place while the occupants use the building as the works usually do not interfere with their stay in the building.

FINANCIAL MODELS

In case of apartment blocks/condominiums, there are not many possibilities as regard to financial models for renovation in Slovenia. In any case it has sense to apply for the energy renovation grant to the Eco Fund of Republic of Slovenia (RS), where the owners may obtain a share of non-refundable financial incentives to carry out the façade renovation. The subsidy is very limited, not only with the percentage of total eligible costs, but also with maximum value of 60 EUR/m^2 of façade for high rise buildings (the incentives is always the lower of the two values). The owners (actually the entity) can also apply for a very favourable loan to Eco Fund of RS with a fixed interest rate of 0.5%. This loan is also capped at a maximum of EUR 300 000. But, according to law the loans require 100% consent from the owners, which is usually extremely difficult to achieve. Another obstacle is the fact that housing communities are not legal entities.

FM 1:

The first financial option for this large building, where investment in amount of EUR 493 268 is involved, is combination of the Eco Fund mechanisms, the subsidy of EUR 184 975 and Eco Fund loan with fixed interest rate 0,5% and max amount of EUR 300 000. These two together with owner's savings (EUR 13 680) are sufficient, to cover all renovation needs. But the loan requires 100% consent from all 152 owners and housing community is not a legal entity.

FM 2:

Second financial option is based on same starting position: the investment into façade renovation is EUR 493 268, mechanism to cover the costs is merging the Eco Fund subsidy of EUR 184 975 and owner's savings of EUR 13 680. For the remaining investment needs a "green" loan from commercial bank with fixed interest rate at 2.7% in amount of around EUR 300 000 can be used. However, the issue with 100% consent from all 152 owners and legal entity status stays the same.

FM 3:

Last option, which is now used in Slovenia, bypasses the 100% owner consent for taking out a loan. This is a financial model with the purchase of receivables. The owners (not necessarily 100% but at least a majority) take a decision on the investment, which includes the value of the investment, the payment schedule (e.g. 10 years), and the agreement that the payment obligations can be transferred to a third party. In this case, the contractor's offer is correspondingly higher, it amounts to EUR 616 585, as it offers its receivables to the commercial bank. The bank usually pays the contractor immediately and is entitled to monthly repayment rates from the owners. Each owner owes its share of the investment based on its co-ownership share. The owners then gradually repay the investment funds to the bank through a reserve fund managed by the building manager. This financial model includes energy renovation grant from the Eco Fund of RS in amount of EUR 184 975 and owner's savings of EUR 13 680.

Results and Analysis

Financial performance: Analysis of the possible financial outcomes, including cost savings, return on investment, and payback period is presented on the Figures 1 and 2. The planned energy renovation of the facade is investment-intensive, but results in a drastic reduction in energy consumption for heating, which also means a significant reduction in operating heating costs. Annual heating costs are reduced by more than two-thirds (by EUR 26 287). The heating price per m^2 of the apartment is reduced from EUR 0.42 to EUR 0.13. The ROI for FM1 is 146%, for FM2 it is 123%, while for FM3 is 83%. Due to the relatively high investment in the renovation of the facade, the payback period for all three cases is quite long and amoun ts to 11.9, 13.1 and 15.9 years, respectively.

RENOVATION COSTS - FM1	
Total costs of renovation (€)	493 268
Total available subsidies (€)	184 976
Net-Investement (€)	294 613
Real investment needed (€)	312 000
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	503 388
Cost savings (€ per year)	26 287
$CO_{2equ.}$ savings / year	100 678
Calculated revenue	26 287
ROI (%)	**146**
Pay back period (years)	**11.9**

RENOVATION COSTS - FM2	
Total costs of renovation (€)	493 268
Total available subsidies (€)	184 976
Net-Investement (€)	294 613
Real investment needed (€)	343 219
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	503 388
Cost savings (€ per year)	26 287
$CO_{2equ.}$ savings / year	100 678
Calculated revenue	26 287
ROI (%)	**123**
Pay back period (years)	**13.1**

Figure 15: FM1 and FM2 for facade renovation Celovška cesta

RENOVATION COSTS - FM3	
Total costs of renovation (€)	616 585
Total available subsidies (€)	184 976
Net-Investement (€)	417 930
Real investment needed (€)	417 930
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	503 388
Cost savings (€ per year)	26 287
$CO_{2equ.}$ savings / year	100 678
Calculated revenue	26 287
ROI (%)	**83**
Pay back period (years)	**15.9**

Figure 16: FM3 for facade renovation Celovška cesta 83, 85, 87

Energy performance: The planned energy efficiency renovation of the façade with the installation of thermal insulation and elimination of thermal bridges, will strongly affect the building's heat losses. The building heat losses will be reduced to one third of existing energy consumption that will result in much better energy efficiency class B (previous D).

Benefits resulting from renovation: Highly reduced building heat losses result in much lower heating costs. However, the loans (despite the grant) continue to burden the unit-owners for 10 years to the extent that in the FM1 they pay each month EUR 0.05 per m^2 of usable area more than before, in the FM2 EUR 0.09 per m^2, and in FM3 EUR 0.17 per m^2 of usable area more than before. For an average unit (approx. 49 m^2), this means around EUR 2.70, EUR 4.40 and EUR 8.50 more per year respectively, which in 10 years amount to EUR 323.20, EUR 528.60 and EUR 1 020.10 more respectively. Regardless, the residents' investment in the renovation is to their benefit, as the estimated value of an apartment of the same size is almost EUR 2 700 higher than before the renovation. In addition, energy renovation of façade has direct and significant impact on higher indoor thermal comfort and a more aesthetic appearance of the building thus contributes significantly to better living quality.

Stakeholder feedback: To achieve the result - the implementation of the façade renovation on such a huge building - requires an enormous amount of communication. This takes place between the owners themselves, and between the manager and the owners. Without the intensive engagement of a small group of owners, the renovation would not have started. However, this was (and usually is) an extremely long and multi-year process. The role of the building manager, who acts as an intermediary between the owners and other stakeholders, is of extreme value.

Challenges and Lessons Learned

Challenges: The project requires a high financial investment, relies on the residents' willingness to bear financial burden and to proceed with the renovation, and faces limited non-refundable financial support. The main challenge is how to achieve 100% consent of the owners for taking out a loan - whether it is a favourable loan from public funds (Eco Fund) or a loan from a commercial bank. An additional obstacle is the fact that in Slovenia the status of owners is not regulated: the housing association of apartment owners is not a legal entity. Thus, the debt purchase solution began to be implemented, regardless of the fact that this further increases the already high investment costs. However, the building manager's burden on communication and formalities is very large.

Lessons learned: The key takeaway is that the decision-making process for loans in multi-apartment buildings / condominiums should be encouraged to facilitate decision making. Changing the regulated percentage for decision-making is questionable (due to financially vulnerable owners). In addition, it has been found that building managers play a strong role in this process - perhaps more financially sustainable solutions involving them should be developed.

Replication and Upscaling

The replicability of FM1 and FM2 is very low due to the two key obstacles mentioned above. Also, the FM3 as such is financially questionable for replication. It is a temporary solution in existing situation in Slovenia that would need to be improved and corrected. For the moment, it is practically the only possible financial mechanism for condominiums in Slovenia. However, it is certainly not directly transferable to other countries.

6.3.2 Vaški dom Križ / Slovenia / Sežana

Building Description

Picture: Slovene public pilot building Vaški dom Križ, Sežana
Photo: archive ZAG.

Type	Community building Križ
Usage	Multiuse building with hall, youth room, offices, conference room
Year built	1980
Number of units	/
Size	145 m²
Ownership	Municipality of Sežana
Energy class before renovation	G
Energy class after renovation	B2
Heating energy demand before renovation	350 kWh/m²a
Heating energy demand after renovation	30 kWh/m²a
CO_2 reduction	17 to 20 t/a

Figure 17: Overview building data Vaški dom Križ

The existing building is located in the centre of the village of Križ, in vicinity of city Sežana, close to the Italian border, where it currently serves as the village community centre. It is a free-standing 2 floor building (ground floor and mansard) with several common spaces, service spaces (toilets) and multi-purpose hall stretched in two-levels.

Construction material is mixed – there are mainly brick walls and reinforced concrete slabs. The building is quite old, dating from 1980 and it is regularly maintained. However, it has not undergone any major renovation work and is weak in terms of static and seismic strength (visible larger cracks). There is no thermal insulation installed on any of the building structure. The building is connected to electricity, telecommunications and water supply. It has its own heating system – the heat is provided via room radiators; the energy source is gas.

The area is characterized by the traditional architecture of Slovenia's Carst and coastal region, both in construction and materials, which is reflected in the renovation and extension plans. The extension is predicted in a size of 90 m^2 of usable area. The purpose of the renovation and the extension is to provide adequate facilities for the Križ local community.

Renovation Concept

This renovation concept predicts to include the comprehensive energy renovation and extension of the existing building.

OVERVIEW:

- Planned technical interventions:
  A. **Deep renovation without installation of PVs**:
    - Static reinforcement of the building
    - Thorough energy renovation of all existing envelope elements
    - Renovation of heating system with cooling and recuperation included
    - Installation of new sewage system
    - Complete renovation of buildings installations such as piping and electricity
    - Replacement of existing windows and doors with new energy efficient ones

  B. **Deep renovation with installation of PVs**:
    - Static reinforcement of the building
    - Thorough energy renovation of all existing envelope elements
    - Renovation of heating system with cooling and recuperation included
    - Installation of new sewage system
    - Complete renovation of buildings installations such as piping and electricity
    - Replacement of existing windows and doors with new energy efficient ones
    - The installation of photovoltaic panels on the roof

- Target values
    - Major renovation or deep renovation according to definitions in Slovene regulation which are aligned with EPBD and with the requirements for incentives of Eco Fund - the prescribed ratio between thermal conductivity (λ) and thickness (d) of the new thermal insulation of particular building element.

- Implementation timeline
    - Timeline for all renovation works is between 2026 and 2028

- Will the renovation take place when the building is in use / inhabited?
    - The predicted renovation of the building is holistic, including the static measures and indoor renovation works. Therefore, during renovation process the community activities will have to take place elsewhere.

Financing Models

FM 1:

Financing Model 1 predicts to use the call for revitalisation of public infrastructure facilities in problematic borderline areas for 2026 (Public call No. 4300-108/2025-1630-25). This financing mechanism is covering 100 % of the renovation's costs for public buildings. The subsidies are predicted for energy renovations, all additional construction works, for expansions of existing volume or addition of new spaces with the requirement that the building will hold activities for the benefit of the surrounding population. Minimum value of the subsidy for a single project is EUR 200 000 while maximum is EUR 1 000 000. Subsidies cover costs of complete renovation of building that has at least 100 m^2 of usable area and comprise at least three sustainable measures within the renovation.

FM 2:

Financing Model 2 combines several different fundings and grants. Grants are predicted through two different public tenders: 1. Investments in energy renovation of the buildings owned and used by municipalities in the period from 2023 and 2027 (JR_EKP_JOB_2024) and 2. investments in increased energy efficiency and the use of RES in buildings of local communities (119SUB-LS24).

According to prescribed requirements, the first grant can cover up to 330 EUR/m^2 of net floor area. It would also cover 7 % of documentation cost as well as additional 3 % of costs for other services. Basic requirements are the comprehensive energy renovation of the building in such way that, as far as technically possible, the entire economically justified potential for energy renovation is exploited.

Furthermore, based on the requirements from second tender, the presented project is eligible for thermal insulation of exterior walls max. 35 EUR/m^2, floor insulation on the ground with max. 20 EUR/m^2, thermal insulation of a flat roof and pitched roof, with max. 20 EUR/m^2.

Municipality of Sežana plans to contribute fundings for the renovation of public community spaces in the municipality in amount of maximum EUR 200 000. The remaining costs, around EUR 10.000, will be covered from savings of the community of Križ.

Results and Analysis

Financial performance:

Financially most favourable is financial mechanism for revitalisation of public infrastructure facilities in problematic borderline areas for 2026 as it is covering 100 % of the renovation's costs. The planned facility renovation fully meets its content and completely relieves the municipality and the municipal community of financial burden. ROI is therefore 0. It is a quite large investment, and the payback time amounts to 35 and 37 years respectively.

RENOVATION COSTS - FM1 (no PV)	
Total costs of renovation (€)	409 444
Total available subsidies (€)	409 444
Net-Investement (€)	0
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	67 200
Cost savings (€ per year)	4 755
$CO_{2equ.}$ savings / year	17 661
Calculated revenue	60 720
ROI (%)	**35**
Pay back period (years)	**0**

RENOVATION COSTS - FM2 (no PV)	
Total costs of renovation (€)	409 444
Total available subsidies (€)	200 875
Net-Investement (€)	208 569
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	67 200
Cost savings (€ per year)	4 755
$CO_{2equ.}$ savings / year	17 661
Calculated revenue	60 720
ROI (%)	**-16**
Pay back period (years)	**44**

Figure 18: Deep renovation without PV under FM1 (full subsidies) and FM2 (partial subsidies) scenarios - Vaški dom Križ

RENOVATION COSTS - FM1 (with PV)	
Total costs of renovation (€)	421 444
Total available subsidies (€)	421 444
Net-Investement (€)	0
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	67 200
Cost savings (€ per year)	5 715
$CO_{2equ.}$ savings / year	19 993
Calculated revenue	60 720
ROI (%)	**37**
Pay back period (years)	**0**

RENOVATION COSTS - FM2 (with PV)	
Total costs of renovation (€)	421 444
Total available subsidies (€)	200 875
Net-Investement (€)	220 569
POSSIBLE ENERGY SAVINGS	
Energy savings (kWh/year)	67 200
Cost savings (€ per year)	5 715
$CO_{2equ.}$ savings / year	19 993
Calculated revenue	60 720
ROI (%)	**-15**
Pay back period (years)	**39**

Figure 19 : Deep renovation with PV under FM1 (full subsidies) and FM2 (partial subsidies) scenarios - Vaški dom Križ

FM2 is a combination of two calls Public tender for co-financing the comprehensive energy renovation of buildings owned and used by municipalities for the period from 2023 to 2027, JR_EKP_JOB_2024 (still opened) and PUBLIC CALL 119SUB-LS24 Non-refundable financial incentives to local communities for new investments in greater energy efficiency and the use of renewable energy sources in buildings by Eco Fund, which together do not cover all costs due to restrictions on the amount of grants. Therefore, a contribution from municipal funds in the fixed amount of EUR 200 000 is required (predicted amount for this community for 2026). Since this is also not sufficient to cover all costs, the local community will also be financially burdened with around EUR 10 000.

Energy performance: Both cases of renovation predict a comprehensive energy renovation with elements of sustainability, in accordance with the strict requirements of Slovenian legislation. Therefore, the result of the renovation is a highly energy-efficient building with very low energy consumption, in the upgraded renovation case also covering electricity consumption.

Benefits resulting from renovation: Regardless of the use of FM1 or FM2, it is a great asset for the local community. Not only does the value of property itself increase, but the renovation also has a positive impact on the value of all community properties. The entire intervention, together with the content, brings environmental benefits, and also social benefits to the locals in terms of community support and development, joint action and connection, as it becomes the active heart of the place and the wider community.

Stakeholder feedback: Both the municipality and the local community want to carry out the renovation, they are willing to invest in it, as they are aware that it is necessary, highly desirable, and that it will revitalize local activities. Therefore, they are willing to invest and work for the benefit of its implementation.

Challenges and Lessons Learned

Challenges: The main challenge in the renovation was finding a suitable financial mechanism, as there are too few or none. And those that do exist have many limitations that make it difficult to obtain funds

Lessons learned: It takes a lot of effort, coordination of interests, and collaboration between multiple stakeholders to align needs, technical challenges, availability, and regulatory requirements.

Replication and Upscaling

The replication and upscale of such favourable financial mechanisms as *A call for revitalisation of public infrastructure facilities in problematic borderline areas for 2026* and all others are, of course, largely linked to the availability of financial resources. But replication is certainly also linked to the simultaneous preparation of technical plans (preparation in advance). In addition, replication is strongly linked to access to information (tenders, spatial conditions), to the complexity of procedures and the availability of professional staff and their workload. In Slovenia, the advisory network is underdeveloped, there are too few experts and they are underqualified.

7 CONCLUSION & RECOMMENDATIONS

The RENOINVEST pilot cases across Austria, Hungary and Slovenia demonstrate that deep energy renovation of existing buildings is technically feasible, environmentally impactful, and socially beneficial. However, the financial and regulatory frameworks often pose significant barriers to large-scale implementation. The six pilot cases reveal that blended financing, innovative technical solutions, and strong stakeholder engagement are critical for success. While progress is possible, scalability remains a challenge due to high upfront costs, legal hurdles, and the need for long-term commitment from all parties.

Below is a synthesis of the cross-cutting lessons and country-specific insights derived from the pilot cases, followed by actionable recommendations to accelerate the uptake of sustainable renovation.

7.1 Cross-Cutting Lessons

Financing: The Need for Blended and Innovative Models

The pilot cases reveal that no single financing model is universally applicable. Instead, successful projects rely on blended financing, combining public subsidies, low-interest loans, and less on innovative mechanisms such as crowd-investing, energy performance contracts (EPCs), or debt purchase models.

Key Observations:

1. **Public subsidies are essential**: In all three countries, national and EU subsidies (e.g., Eco Fund in Slovenia, TOP_PLUSZ in Hungary, federal/state grants in Austria) cover 30-60% of costs. In Austria (LeiSan), subsidies covered ~40% of costs, with the remainder financed via long-term loans (30-40 years) and moderate rent increases. In Slovenia (Celovška cesta), the Eco Fund subsidy (EUR 60/m²) and low-interest loans (0.5%) were critical but required 100% owner consent, a major hurdle. In Hungary (Hírös Agora), state grants for public buildings covered ~99% of costs, but the ROI remained negative due to high investment volumes and low energy prices.
2. **Innovative models show promise but face scalability issues**: Crowd-investing (Austria, Rosaliagasse): Klimja's model (8% interest, 5-year term) reduced the loan burden but required transparent impact reporting to attract investors. Debt Purchase Model (Slovenia, Celovška cesta): Bypassed the 100% consent requirement but increased costs by ~25% and shifted the responsibility to manage the funds to building managers. Building Rights Model (Austria, LeiSan): Transferred renovation obligations to non-profit cooperatives, but required legal adjustments (e.g., WGG compliance).
3. **Long-Term, low-interest loans are critical**: Projects with payback periods of 15-35 years (e.g., Austria's municipal loans, Hungary's subsidized condominium loans) were more feasible, but banks often require collateral or high owner equity (20-30%).
4. **Energy Savings Certificates (HEM) provide limited support**: In Hungary, HEMs covered <1% of investment costs, highlighting the need for higher certificate prices or supplementary grants.

Technical Solutions: Modularity and Integration

The pilot cases showcase adaptable technical interventions that can be tailored to building typologies and local contexts.

Façade and envelope upgrades: Thermal insulation (20 cm wood-fiber or mineral wool), elimination of thermal bridges, and window/door replacements were universally applied and delivered 40-90% energy savings. Slovenia (Vaški dom Križ): Achieved a 91% reduction in heating demand (from 350 to 30 kWh/m²a) via deep envelope renovation. Austria (Rosaliagasse): Combined thermal insulation with modular steel façade systems for greening and PV integration, reducing cooling demand by 15%.

Heating system modernization: Transitioning from individual stoves/gas boilers to district heating, heat pumps, or radiant systems improved efficiency by 20–60%. Heritage Constraints (Hungary, Rákóczi út): Internal insulation and heritage-compliant interventions were required, limiting energy performance improvements. High Upfront Costs (Hungary, Hírös Agora): PV and battery storage systems (60 kWp, 100 kWh) added value but required approx. EUR 2.4 million investment, with grants covering 99%.

Renewable energy integration: PV systems (rooftop or balcony-integrated) and **energy communities** (e.g., Austria's Komposch Ebene) enabled **self-consumption and community benefits**, but scalability was limited by roof space or legal frameworks.

Accessibility and social benefits: Elevator installations (e.g., Austria's LeiSan), barrier-free access, and community spaces (e.g., Slovenia's Vaški dom Križ) enhanced **social cohesion and property value** but added **10–20% to costs**.

Stakeholder Engagement: Communication and Consent

Owner/Tenant Consent is a major bottleneck: In Slovenia and Hungary, the requirement for 100% owner consent for loans or major renovations stalled projects for years. Solutions: Majority-based decision-making (e.g., 60-70% owners) or phased renovations (e.g., envelope first, heating later) reduced upfront consent requirements.

Professional support is critical: Municipalities and condominiums lacked expertise in financial planning, legal compliance, and technical coordination. External advisors (e.g., Renowave.at in Austria, ZAG in Slovenia) played a key role in navigating subsidies, tenders and stakeholder negotiations.

Transparent communication builds trust: Workshops and individual consultations (e.g., Austria's LeiSan) improved resident buy-in and reduced scepticism. In Slovenia (Celovška cesta), a small group of engaged owners drove the project forward despite initial resistance.

Regulatory and Legal Barriers

Tenant protection laws (Austria): The MRG (Mietrechtsgesetz) limits rent increases, making it difficult for municipalities to recover renovation costs. Moderate, long-term rent adjustments (e.g., + EUR 0.50/m²) and housing allowances for vulnerable groups can help.

Heritage protection (Hungary): Buildings in protected zones (e.g., Budapest's Rákóczi út) are exempt from energy performance requirements if compliance risks heritage values, limiting the scope of renovations.

Legal entity status (Slovenia): Housing associations are not automatically legal entities, complicating loan applications and debt management. The debt purchase model emerged as a workaround but is not scalable.

Municipal constraints: Local governments face budget limitations, lack of long-term financing tools, and political risks. Public-private partnerships (PPPs) or building rights models (Austria) can mitigate these risks.

Economic Viability: Balancing Costs and Benefits

High investment costs vs. energy savings: Payback periods ranged from 9-35 years, with ROI often <20% due to:

Low energy prices (Hungary): Cheap gas (EUR 0.033/kWh) reduced the financial incentive for efficiency investments.

High construction costs: In Hungary (Rákóczi út), 1 GJ of energy savings cost EUR 1 177 to achieve, while HEM certificates were priced at EUR 41/GJ - a 28x gap.

Limited revenue streams: Public buildings (e.g., Hírös Agora) rely on municipal subsidies, making ROI negative without grants.

Non-financial benefits are significant: **CO_2 Reductions**: 7 000-173 000 kg/year per project. Property value increases: over EUR 400/m² (Austria's LeiSan) or over EUR 2 700/apartment (Slovenia's Celovška cesta). Social impact: Improved comfort, health, and community resilience (e.g., urban heat island mitigation in Vienna).

7.2 Country-specific Recommendations

Austria

Key Challenges:

- High upfront costs for municipal/social housing.
- The Austrian tenancy law (MRG) restrictions on rent increases.
- Complex decision-making in multi-owner buildings (condominiums).

Recommendations:

1. **Expand subsidy programs for municipal housing**:
   Increase federal and state grants for social housing renovations to cover 50 - 70% of costs, reducing reliance on loans.
   Introduce targeted subsidies for rural areas (e.g., Bad Eisenkappel) to prevent depopulation and support affordable housing.

2. **Simplify legal frameworks for condominiums**:
   Expand and clarify the so-called privileged measures (§ 16 (5) WEG) to e.g. decarbonisation of heating systems and window exchange to facilitate the decision making.

3. **Promote innovative financing models**:
   Scale up crowd-investing platforms (e.g., Klimja) or impact investment with standardized impact metrics (e.g., CO_2 savings, social benefits).
   Pilot energy performance contracts (EPCs) for public buildings, bundling projects to improve ROI for ESCOs.

4. **Strengthen Technical and Financial Advisory Services**:
   Establish regional renovation hubs (e.g. One-Stop-Shops run by local energy agencies) to provide free or subsidized support for municipalities and building owners.
   Develop standardized renovation packages (e.g., modular façade systems) to reduce planning costs and time.

5. **Improve tenant protection law and incentives**:
   Allow temporary rent surcharges (e.g., +10% for 10 years or 5 % for 20 years), better still introduce a bonus-malus-system for energy efficient deep renovation vs. bad performing buildings, with housing allowances for vulnerable groups.
   Introduce tax incentives for private owners investing in energy efficiency independent from funding.

Hungary

Key Challenges:

- Extremely high investment costs (EUR 1 177/GJ saved).
- Low energy prices (gas: EUR 0.033/kWh) reduce financial incentives.
- Limited access to loans for condominiums/municipalities.
- Heritage protection constraints.

Recommendations:

1. **Increase grant coverage for deep renovations**:
   Introduce state grant programs to cover 50-60% of costs for condominiums, with priority for heritage buildings (e.g., Rákóczi út).
   Introduce performance-based grants (e.g., EUR 100-200/m² for achieving energy class B or higher).

2. **Enhance the value of energy savings certificates (HEM)**:
   Raise HEM prices to 100-150 EUR/GJ (from current 41 EUR/GJ) to better reflect the true cost of energy savings.
   Allow bundling of HEMs for large projects to improve liquidity and attract investors.

3. **Enable municipalities to access market-based financing**:
   Permit municipal EPC contracts (as recommended in the Hungarian Action Plan) to leverage private capital for public building renovations.
   Pilot revolving funds for municipalities, using repayment streams from energy savings to finance new projects.

4. **Simplify loan products for condominiums**:
   Develop standardized condominium loan products with 15-20-year terms, subsidized interest rates (e.g., 1–2%), and flexible collateral requirements (e.g., future energy savings).
   Allow partial guarantees from the state or EU to reduce bank risks.

5. **Address heritage protection barriers**:
   Create heritage-compliant renovation guidelines for protected buildings, pre-approving technical solutions (e.g., internal insulation, reversible interventions).
   Offer additional subsidies for heritage buildings to offset the higher costs of compliant renovations.

6. **Encourage electrification and renewables**:
   Develop further time-of-use electricity tariffs to make heat pumps and PV systems more competitive vs. gas.
   Provide subsidies for battery storage to maximize self-consumption of PV energy (e.g., Hírös Agora).

Slovenia

Key Challenges:

- 100% owner consent requirement for regular loans.
- Housing associations lack automatic legal entity status.
- Limited non-refundable support (Eco Fund grants cover <20% of costs).
- High communication burden on building managers.

Recommendations:

1. **Reform condominium act**:
   Reduce the consent threshold from 100% to e.g. 66% for energy renovations, aligning with EU directives (e.g., EPBD).
   Grant automatic legal entity status to housing associations (e.g. like in Austria quasi-legal entity governed by Condominium Act) to simplify loan applications and debt management.

2. **Expand and simplify public funding**:
   Increase Eco Fund subsidies to EUR 100 - 150/m² (from €60/m²) for façade and deep renovations and raise the loan cap from EUR 300,000 to €1M and extend terms to 20 years with 0–1% interest rates.

3. **Strengthen advisory networks**:
   Expand ECO Fund's advisory role to include financial and legal support for condominiums, funded by the state or EU.
   Train building managers in project management, financing, and communication to reduce their burden.

4. **Encourage municipal leadership**:
   Require municipalities to lead by example by renovating their own buildings (e.g., Vaški dom Križ) and sharing best practices.
   Provide municipal grants for public buildings in border areas (e.g., Sežana) to cover 100% of costs, as in the 2026 revitalization call.

CONCLUSION

The RENOINVEST pilot cases demonstrate that deep energy renovation is achievable but requires a holistic approach combining technical innovation, flexible financing, stakeholder engagement, and supportive policies. While each country faces unique challenges - whether Austria’s tenant laws, Hungary’s high costs, or Slovenia’s consent barriers - the solutions often lie in cross-border collaboration, scalable financing models, and targeted policy reforms.

By **implementing the recommendations in the national action plans**, Austria, Hungary and Slovenia can accelerate their transition to a climate-neutral building stock, while ensuring that renovations are affordable, inclusive, and replicable. The RENOINVEST project has laid the groundwork; now, it is up to policymakers, financial institutions, and building owners to turn these insights into action.

RENOINVEST

sustainable renovation of buildings