Energy Renovation Roadmap - REER - for Households in the Bükk-Region

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Abbreviations used in this document:

REER	Rural Energy Efficiency Roadmap
DREEM	Dynamic High-Resolution Demand Management Model (DSM) Dynamic high-Resolution dE-mand-sidE Management
EU	European Union
LAG	Local Action Group
EEOS	Energy Efficiency Obligation Scheme
NECP	National Energy and Climate Plan
MEKH	Hungarian Energy and Public Utility Regulatory Authority
ÉMOR	Building Renovation Monitoring System
ÉKM	calculation of building energy performance
RRF	Recovery and Resilience Facility

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ABOUT THE RENOVERTY PROJECT

The RENOVERTY project promotes the energy efficiency renovation of residential buildings in Central and Eastern Europe, Southeast Europe and Southern Europe. It provides a methodological and practical framework for developing financially viable and socially fair roadmaps for the renovation of vulnerable rural areas.

The project aims to provide tools and resources to local and regional actors and support them in developing and implementing practical roadmaps to help with energy renovation of residential buildings in rural areas. A scalable model facilitates the widespread use of roadmaps in other regions and their implementation at EU level by other actors. Strategically, the project contributes to reducing the logistical, financial, administrative and legal burden caused by the complex and multi-stakeholder home renovation process. RENOVERTY will also ensure that the renovation of buildings takes social aspects into account by incorporating safety, comfort and accessibility into roadmaps to further improve the quality of life of vulnerable populations.

The roadmaps prepared within the framework of the three-year project provide direct assistance in seven pilot areas: Sveta Nedelja (Croatia), Tartu (Estonia), Bükki and Somló-Marcalmente-Bakonyalja (Hungary), Zasavje (Slovenia), Parma (Italy), Coimbra (Portugal) and Osona (Spain) and can be integrated into rural and peri-urban development policy processes in the long term.

SYNOPSIS

This document serves as a roadmap for stakeholders addressing energy poverty, aimed at facilitating the energy renovation of residential buildings and single-family homes.

The Rural Energy Efficiency Roadmap (REER) is designed to assist a wide range of actors involved in the energy renovation process, including homeowners planning to renovate their properties, organisations supporting household renovation efforts—such as municipalities, NGOs, experts, energy consultants, and local action groups (LAGs).

While the first section of REER focuses on technical aspects, the second section addresses structural and community-related challenges associated with renovating rural households impacted by energy poverty. This part delves into overcoming non-technical barriers, such as legislative, financial, and administrative obstacles.

The development of REER has been a collaborative effort, involving contributions from a variety of local, regional, and national stakeholders—including municipalities, service providers, NGOs, and local action groups—through joint workshops and consultations. Importantly, individuals directly affected by energy poverty were actively engaged in the roadmap's creation, ensuring it reflects the fundamental needs of local communities.

1 THE CURRENT STATE AND CHALLENGES OF ENERGY POVERTY IN HUNGARY AND BÜKK-REGION

The European Union identifies households affected by energy poverty as those unable to maintain adequate indoor temperatures during winter or effectively cool their homes in summer. According to the EU-SILC survey, energy poverty in Hungary affected 7.2% of the population in 2023, placing the country among the most favourable third in the EU. Remarkably, Hungary performs better than economically stronger nations such as Germany.[1] This favourable figure is likely due to government-regulated electricity and gas prices, which are kept low. However, this regulation creates challenges for and slows down the energy renovation of residential buildings.

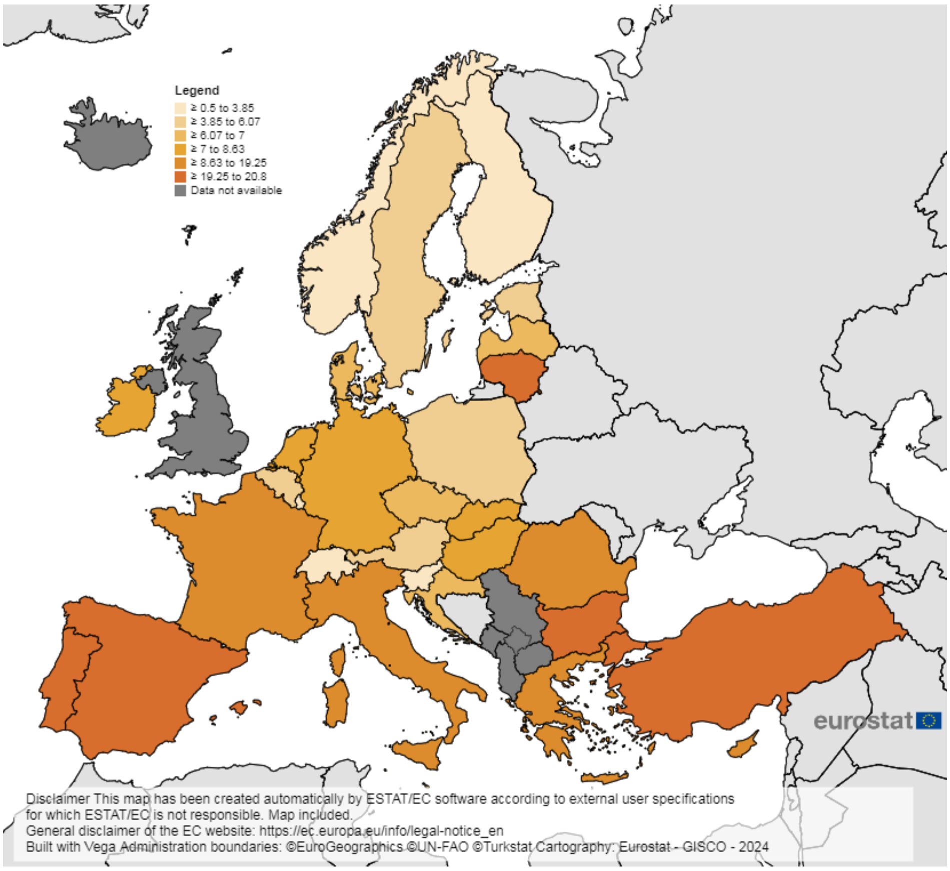

Figure 1 - Energy poverty in EU Member States

[1] *Inability to keep home adequately warm - Findings from the EU-SILC survey (2023)*

Comprehensive data on the energy performance of Hungary's residential building stock is limited. Currently, there is no national database offering sufficient information on the actual condition of residential buildings to support the development of targeted and effective strategic measures. In 2018, energy consumption in the residential sector amounted to 244 PJ, representing 33% of the country's total final energy consumption. Approximately half of this energy consumption stems from natural gas, with one-quarter derived from renewable energy sources. However, in the case of renewable energy, the primary sources are biomass and firewood. Consequently, residential energy consumption accounts for around 13% of Hungary's national greenhouse gas emissions, largely due to fossil fuel combustion. Notably, over 70% of residential energy consumption is attributed to heating.

In Hungary, 54% of the population resides in single-family houses. Alarmingly, more than three-quarters (78%) of these homes fall into the four poorest energy-efficiency categories. For Hungary to meet both national and European climate policy targets, the residential building stock must undergo a near-complete energy renovation in the coming years.

NATIONWIDE DISTRIBUTION OF ESTIMATED ENERGY RATINGS FOR FAMILY HOUSES[2]

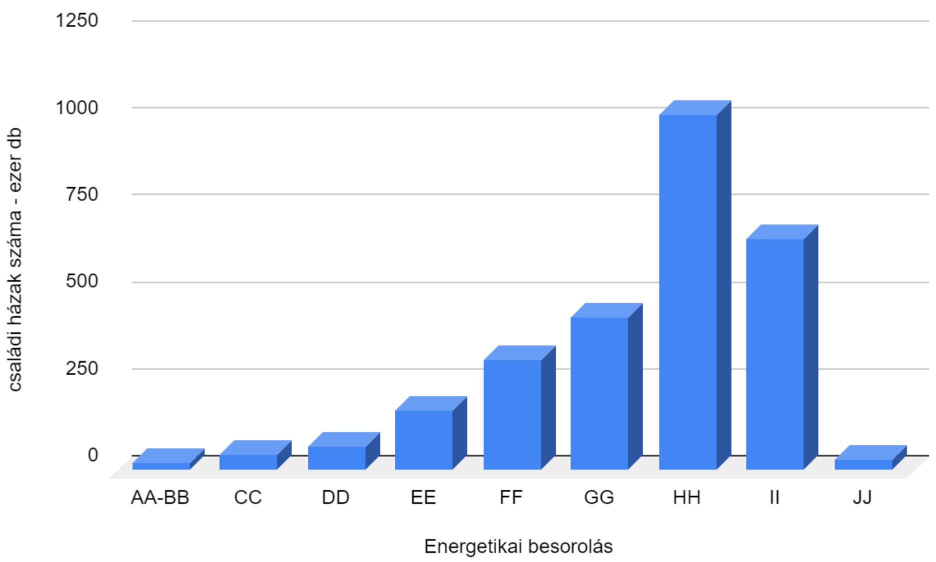

Figure 2 - Nationwide distribution of estimated energy ratings for family houses in Hungary

The most effective approach to reducing energy poverty is the energy renovation of residential buildings. This roadmap, informed by conducted surveys, outlines the associated capabilities, opportunities, and challenges.

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[2] *Source: Estimation of the energy demand of the residential real estate stock in Hungary - Mónika Bene – Antal Ertl – Áron Horváth – Gergely Mónus – Judit Székely – Credit Institution Review, Vol. 22, No. 3, September 2023, pp. 123–151.*

1.1 THE BÜKK REGION

The region is located in the beech area of the North Central Mountains. The natural and economic geography of the area surrounding the Bükk Mountains is varied. The rich flora and fauna of the western part is preserved in the Bükk National Park. The natural richness of the eastern part of the region is reflected in rivers, lakes, thermal waters and high quality casting soils. In the eastern part of the region there are industrial, construction and agricultural enterprises, while in the western part there are mainly tourism and wine-growing enterprises. The southern Bükk hills are home to high-quality grapes and fruit, and hundreds of wine cellars are tourist attractions.

The strengths of the Local Action Group (LAG) are that it is the meeting point of important European transport routes, it is rich in natural resources, underground assets, thermal water resources, building material deposits, its varied landscapes attract tourists, it is a leader in the use of renewable energy sources in Hungary, its hill farming is suitable for ecological farming, its lowland farms are viable. All these assets are combined with the community's commitment and willingness to act. In recent years, there has been a positive trend in the settlement of young families, both from the capital and from the big cities

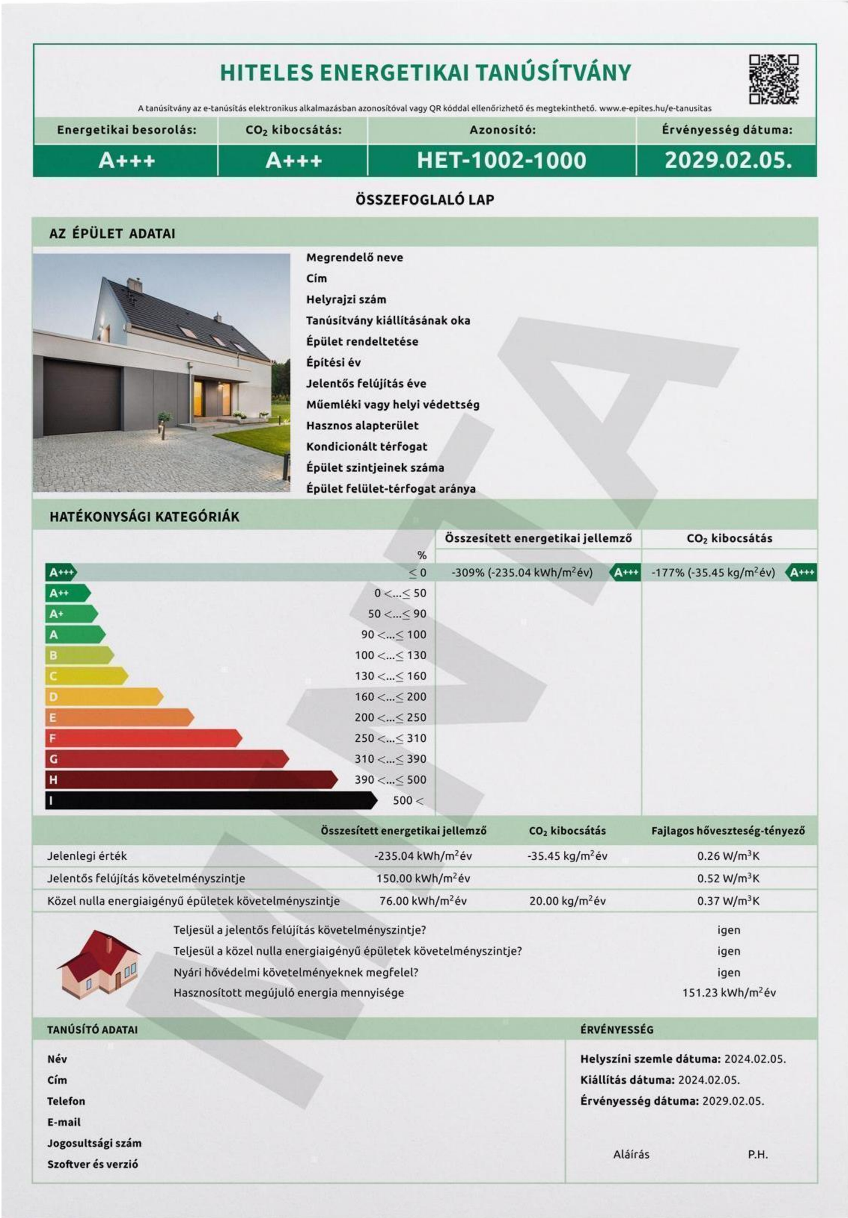
The Local Action Group (LAG) covers an area of 925.67 km^2, with a total number of 42 municipalities and a population of 76 960. 20.5% of the population has not completed the 8 grades of the primary schools. Its strengths are its natural resources: solar, wind, water, geothermal energy, the heat of air and biomass. The region's strategy focuses on environmental and sustainability issues.

The Reflex Environmental Association has carried out energy audits for 4 detached houses with the region's stakeholders (Holocen Nature Conservation Association). The houses were selected to represent the building materials and construction methods typical of the area.

1.2 THE ENERGY AUDIT[3]

An energy audit is a comprehensive examination that assesses the energy efficiency of a building, identifies energy losses, and evaluates processes related to its usage. It provides a detailed analysis of the building and its operational characteristics. During the audit, the energy expert (auditor) evaluates the property and its operating methods, delivering a tailored set of recommendations to cost-effectively reduce energy consumption. The resulting expert report specifies where and how energy is used, in what quantities, and the associated costs.

[3] Figure 3 - The Authentic Energy Certificate - *Source: National Certification Centre* https://otk.hu/tanusitvany-tartalom-minta



HITELES ENERGETIKAI TANÚSÍTVÁNY

A tanúsítvány az e-tanúsítás elektronikus alkalmazásban azonosítóval vagy QR kóddal ellenőrizhető és megtekinthető. www.e-epites.hu/e-tanusitas

Energetikai besorolás:	CO_2 kibocsátás:	Azonosító:	Érvényesség dátuma:
A+++	A+++	HET-1002-1000	2029.02.05.

ÖSSZEFOGLALÓ LAP

AZ ÉPÜLET ADATAI

Megrendelő neve
Cím
Helyrajzi szám
Tanúsítvány kiállításának oka
Épület rendeltetése
Építési év
Jelentős felújítás éve
Műemléki vagy helyi védettség
Hasznos alapterület
Kondicionált térfogat
Épület szintjeinek száma
Épület felület-térfogat aránya

HATÉKONYSÁGI KATEGÓRIÁK

	%	Összesített energetikai jellemző	CO_2 kibocsátás
A+++	≤ 0	-309% (-235.04 kWh/m²év) A+++	-177% (-35.45 kg/m²év) A+++
A++	0 <...≤ 50		
A+	50 <...≤ 90		
A	90 <...≤ 100		
B	100 <...≤ 130		
C	130 <...≤ 160		
D	160 <...≤ 200		
E	200 <...≤ 250		
F	250 <...≤ 310		
G	310 <...≤ 390		
H	390 <...≤ 500		
I	500 <		

	Összesített energetikai jellemző	CO_2 kibocsátás	Fajlagos hőveszteség-tényező
Jelenlegi érték	-235.04 kWh/m²év	-35.45 kg/m²év	0.26 W/m³K
Jelentős felújítás követelményszintje	150.00 kWh/m²év		0.52 W/m³K
Közel nulla energiaigényű épületek követelményszintje	76.00 kWh/m²év	20.00 kg/m²év	0.37 W/m³K

Teljesül a jelentős felújítás követelményszintje?	igen
Teljesül a közel nulla energiaigényű épületek követelményszintje?	igen
Nyári hővédelmi követelményeknek megfelel?	igen
Hasznosított megújuló energia mennyisége	151.23 kWh/m²év

TANÚSÍTÓ ADATAI

Név
Cím
Telefon
E-mail
Jogosultsági szám
Szoftver és verzió

ÉRVÉNYESSÉG

Helyszíni szemle dátuma: 2024.02.05.
Kiállítás dátuma: 2024.02.05.
Érvényesség dátuma: 2029.02.05.

Aláírás P.H.

Figure 3 - The layout of the Authentic Energy Certificate

Energy audits in Hungary can only be performed by authorised professionals. Accreditation is managed by the Hungarian Chamber of Engineers, and only qualified expert engineers who have completed the required training are eligible to become energy auditors. The Hungarian Energy and Public Utility Regulatory Authority (MEKH)4 maintains a list of accredited experts. Energy audits are regulated by a government decree5, based on which energy performance certificates are issued for residential buildings. These certificates facilitate the energy renovation of

[4] List of energy auditors

[5] Government Decree No. 176/2008 of 30 June 2008 on the certification of the energy performance of buildings

buildings and provide valuable information for those buying or renting real estate. They guide property owners and tenants toward cost-effective solutions for energy-efficient renovations. The energy performance certificate consists of four main sections:

1. Summary Sheet: The first page is standardised across all certifiers, generated by the National Building Register. It contains key information about the property, the client, the engineer, the energy calculations' results, and the classification achieved.
2. Energy Calculations: This section includes the parameters of the building's structures and detailed calculations of the mechanical systems.
3. Renovation Proposal: This section outlines recommended upgrades and measures that can be implemented to improve the property's energy performance.
4. Supporting Documents: The final section contains relevant attachments and photographs of the property.

1.3 EXAMINATION OF SAMPLE FAMILY HOUSES IN THE BÜKK REGION

To select the households, we asked for the help of local actors - local action groups, NGOs - who possess strong local knowledge. We published a call for proposals, which was promoted by the Bükk - Regional Leader Association. On the basis of the call, interested parties were asked to fill in a short questionnaire to indicate their willingness to cooperate, which, in addition to the information needed to contact them, also asked about the main characteristics of the residential buildings: date of construction, building materials used, date of last renovation. The households were also consulted in person by representatives of Reflex and the Holocen Association, who informed them about the possibilities for energy modernisation. The energy audits were carried out by registered experts who personally visited the residential buildings to assess the building's characteristics and draw up energy performance certificates, suggesting the steps to be taken and the expected impact of the modernisation.

In the Bükk area, we audited four family houses. Most of these households consist of 1-4 residents, who occupy the homes primarily after working hours, from the afternoon until morning, and throughout the weekends. The construction dates of the surveyed buildings range from 1868 to 1996. Selection criteria focused on examining buildings that are representative of the region, including traditional farmhouses, the prevalent "Kádár cubes" from the post-1960s era, and newer constructions.

TYPES OF BUILDINGS

In rural Hungary, family houses are the predominant form of residential construction, typically positioned freely on the plot or along the property boundary. Many of these buildings have cellars and are predominantly single-storey, with two-storey structures being less common. It is rare to find panel-built residential buildings using industrial methods in rural areas. Family houses have evolved in design and function over time, adapting to the prevailing trends and available resources.

The most common type is the "**Kádár cube**," built between the 1950s and 1970s. These one-storey, square brick structures (80-100 m²) feature a pitched roof and were often adapted (in the '60s and '70s) from traditional farmhouses along the street front. During the 1980s and 1990s, many of these buildings were expanded with attic conversions or additional floors. The houses audited in this study were constructed between 1868 and 1996, typically single-storey with some featuring basements. The average total floor area is 145.76 m², with an average habitable area of 114.06 m².

BUILDING MATERIALS

The construction materials of family houses have historically been sourced locally. Common masonry materials include adobe, stone, wood, and later, brick. Traditional roofing materials in Hungary were reeds, straw, and tiles. From the 1950s onward, brick and ceramic masonry elements became standard, with aerated concrete also used in certain regions. Doors and windows are primarily wooden (typically with two glazed wings), featuring a beam frame design. Modern replacements—double-glazed plastic doors and windows—began appearing in the 1990s. Concrete and reinforced concrete became prevalent for foundations and floors since the 1950s. Asbestos slate, commonly used for roofing - in combination with tiles - from the 1950s to 1970s, was later found to pose significant health risks.

The selected audited buildings include a variety of construction types beyond the typical Kádár cubes, with brick being the dominant material. Stone and adobe walls are also present in each building. Partial renovations have replaced original wooden doors and windows with plastic alternatives in several houses. Shell materials include tiles for seven houses and asbestos slate for one.

HEATING SYSTEMS

In rural Hungary, residential heating is typically managed at the property level. Traditionally, individual rooms were heated using stoves fueled by firewood or coal. From the 1970s, central heating systems became more common alongside the expansion of the natural gas network in rural areas. This led to the adoption of gas convectors and later central gas boilers in family homes. The audited houses feature various heating systems, including central heating with multi-fuel boilers (wood and coal), gas boilers, tiled stoves, and gas convectors. The total heating capacity for each house ranges between 24-30 kW.

IMPLEMENTED ENERGY RENOVATIONS

Of the four audited family houses, three had undergone partial but insufficient energy renovations. External wall insulation was either lacking or inadequately thick. In two buildings, the original double-glazed wooden doors and windows were replaced with double-glazed plastic versions, offering improved thermal insulation.

1.4 BARRIERS AND CHALLENGES

The barriers and challenges related to energy renovations in Hungary and the Bükk-region are similar to those faced in other European countries. These challenges are often interconnected and can be addressed progressively in stages.

Lack of Information - Households experiencing energy poverty are often poorly informed and ill-prepared to address the issue. While they are aware of the financial strain caused by high energy costs, they often lack knowledge about available solutions, services, and support programmes. Initiatives such as RENOVERTY, which present practical, locally relevant examples, play a crucial role in raising awareness. Expanding access to information and offering free advisory services beyond short-term campaigns—through collaboration with state, municipal, and civil society organisations—would be essential for long-term impact.

Impact of Utility Cost Reductions - In Hungary, the government subsidises residential energy costs, making electricity and natural gas available at prices significantly lower than market rates. Households benefit from electricity priced at a reduced rate up to an average consumption of 2,523 kWh per year and natural gas up to 63,645 MJ per year (or approximately 1,729 m^3 per year). While this policy alleviates short-term financial pressure, it also extends the payback period for energy efficiency investments, reducing the incentive for households to undertake renovation efforts. Redirecting state funds from utility subsidies to energy renovation programmes would require a central government decision, which is unlikely under the current administration.

Social and Financial Constraints - Households affected by energy poverty often lack the financial resources to invest in energy-efficient renovations. Many do not have sufficient savings, nor are they adequately informed about the complexity of energy renovations. Without targeted financial support, these vulnerable groups are unable to initiate renovation projects. To enable these projects, accessible funding mechanisms and resources must be provided.

Challenges in Support Programmes - Available support options in Hungary are discussed in detail in Section 3.4. However, a major challenge in planning energy renovation projects is the absence of long-term, continuous programmes, which makes it difficult for households to engage in structured, multi-phase renovation projects.

Fragmented Planning Processes - Due to the limited and sporadic availability of financial resources, energy renovation efforts are often dictated by funding opportunities rather than a strategic, step-by-step renovation plan. Households tend to implement upgrades based on the eligibility criteria of specific grants rather than following an optimised, sequential renovation process. This fragmented approach can lead to inefficient investments and missed opportunities for comprehensive energy efficiency improvements.

Construction and Workforce Shortages - The implementation of planned renovations is further complicated by a shortage of qualified professionals. Skilled workers are often booked several months in advance or engaged as subcontractors for larger projects, making them less available for smaller-scale residential renovations. Additionally, hiring a general contractor significantly increases renovation costs. To mitigate these challenges, solutions such as maintaining a database of qualified professionals, establishing expert networks, and ensuring timely planning and contractual agreements with contractors would help streamline renovation processes.

2 ACTION TO TACKLE ENERGY POVERTY: ENERGY RENOVATION OF SINGLE-FAMILY HOUSES

The second section of the Rural Energy Efficiency Roadmap (REER) focuses on practical solutions for addressing energy poverty through the renovation of single-family houses. This section provides step-by-step guidance for rural citizens on implementing energy-efficient renovations, from initial planning to the execution of practical, financially viable upgrades.

The roadmap also introduces practical renovation options, supported by calculations from the DREEM model[6], to help stakeholders evaluate the most effective and cost-efficient solutions. By following these structured recommendations, homeowners, policymakers, and professionals can better navigate the challenges of energy efficiency improvements, ensuring sustainable and impactful renovations in rural communities.

2.1 SETTING EXPECTATIONS AND INDICATORS FOR THE RENOVATION OF RURAL HOUSING

The energy renovation of residential buildings, including slab and wall insulation, window replacement, and heating system upgrades, generally does not require building authority permits in Hungary. However, exceptions apply to buildings located in protected areas or historically significant environments, where additional regulatory approvals may be necessary.

Hungarian building energy performance legislation sets[7] specific expectations and standards only for newly constructed residential buildings or renovations involving significant expansion.

[6] The DREEM model (Dynamic high-Resolution dE-mandsidE Management) is a tool used to assess various energy efficiency measures based on their energy-saving potential and techno-economic feasibility. The measures considered include external wall insulation, replacing windows with double glazing, roof insulation, upgrading heating systems (gas, biomass, or heat pumps), and efficient lighting (LED lamps). Modeling results show that the effectiveness of the measures strongly depends on the initial condition of the building and the existing heating systems. This highlights the importance of targeted interventions to achieve significant improvements in energy efficiency and environmental sustainability.

[7] 9/2023. (V. 25.) ÉKM (calculation of building energy performance) decree

Certain renovation grant programmes, however, do impose specific energy efficiency targets. For instance, the Home Renovation Programme, detailed in Section 2.5, requires that energy renovation measures result in a minimum 30% reduction in specific primary energy consumption compared to the pre-renovation state.

Hungary does not currently define official national indicators related to energy poverty. However, under the European directive on energy poverty, households affected by energy poverty are those unable to heat their homes to an adequate temperature in winter or cool them during the summer. While the directive does not specify exact temperature thresholds, in practice, a heating range of 20-22°C is widely accepted as an appropriate indoor temperature during winter.

In rural Hungary, artificial summer cooling of buildings using air conditioning remains uncommon. However, due to increasingly frequent heatwaves, many households install air conditioners as an early measure, often preceding comprehensive energy renovation efforts.

GOALS OF THE RENOVATION OF SINGLE-FAMILY HOUSES

The renovation of households affected by energy poverty is aimed at improving living conditions, reducing energy costs, and enhancing overall well-being. The primary objective is to increase energy efficiency through a combination of retrofitting boundary structures, insulating or replacing windows, upgrading heating systems and major household appliances. These measures lead to lower energy consumption, which in turn reduces utility costs, providing both economic and environmental benefits.

Beyond energy savings, renovations play a crucial role in ensuring homes meet modern health and safety standards. Poorly insulated and energy-inefficient buildings often suffer from moisture-related problems, such as condensation and mould growth, which can cause respiratory and other health issues. Energy renovations should therefore prioritise not only efficiency improvements but also the creation of a healthier indoor environment for residents.

At a broader level, energy-efficient renovations contribute to national and international climate policy goals by reducing greenhouse gas emissions. Enhancing the energy performance of buildings helps countries meet their commitments to carbon reduction, playing a key role in the transition to a more sustainable energy system.

Finally, energy renovation projects combat energy poverty and promote social justice. Energy-efficient homes improve the quality of life for low-income families, reducing socioeconomic disparities and enhancing social inclusion. By investing in the renovation of energy-poor households, governments and organisations provide not only immediate financial relief but also long-term sustainability, improved health, and greater social equity.

INDICATORS TO MEASURE RENOVATION GOALS AND PROGRESS

Target	Indicator	Expected result
- Improving the energy efficiency of the residential building	- Energy saved (kWh) - Saved energy per unit area (kWh/m2) - Improved energy efficiency rating.	- Energy demand per unit of living space (1 m2) is reduced to 50-90 kWh/year - The energy rating of the building will be improved by at least two classes (e.g. from G to E)
- Reducing household overhead costs	- Reduction in utility bills (HUF)	A 20% to 50% reduction in energy bills.
- Improving quality of life - thermal comfort, indoor air quality	- Increase / decrease in indoor temperature in winter (°C) - Ideal indoor humidity - mould eliminated - Reduction of indoor particulate matter	- The indoor humidity does not reach 50% - Mould growth is eliminated
- Reducing the carbon footprint of the household	- Reduction of carbon dioxide emissions (kg) - Reduction of carbon dioxide emissions per unit area (kg/m2)	- Carbon dioxide emissions reduced by 20-50%

Table 1 - Targets, indicators and expected results of energy renovation

2.2 PLANNING THE RENOVATION

Planning the energy renovation of households affected by energy poverty requires a structured approach to ensure maximum energy efficiency, reduced utility costs, and improved living comfort. The process involves several key steps, beginning with an energy audit, as outlined in the previous section. The audit helps to identify the most effective renovation measures tailored to the specific needs of the building and its occupants.

One of the primary focuses of renovation is improving the thermal insulation of building envelopes, including walls, roofs, and floors, to minimise heat loss. Ensuring proper insulation or replacing outdated doors and windows further enhances energy efficiency. Another crucial step is upgrading heating systems to improve energy performance and reduce costs.

To further reduce reliance on fossil fuels, integrating renewable energy sources into the renovation plan should be considered. The installation of solar panels or the use of heat pumps can provide a cleaner, more sustainable energy supply while lowering household energy expenses in the long run.

A well-planned renovation strategy ensures that households benefit from renovation efforts in a cost-effective and sustainable manner, leading to improved living conditions, enhanced energy efficiency, and long-term financial savings.

SCHEDULING ACCORDING TO COSTS AND AVAILABLE GRANTS

A critical aspect of planning an energy renovation is assessing costs and identifying available financial support. Households affected by energy poverty often lack the resources to carry out necessary renovation measures without subsidies. However, in Hungary, financial resources for residential energy renovations are limited, difficult to access, and do not comprehensively support all necessary renovation processes. Given these constraints, the renovation process should follow a structured schedule to optimiSe both efficiency and affordability.

1. The first step in the renovation process is a **general condition assessment** of the building, which identifies critical issues that must be addressed before energy renovation works can begin. These may include replacing outdated electrical wiring, repairing or replacing a deteriorated roof, and ensuring adequate waterproofing of walls or floors. Without resolving these fundamental structural problems, further energy efficiency upgrades may be ineffective or even counterproductive.

2. Following the general assessment, a **building energy audit** should be conducted. This evaluation helps to identify the weak points of the building and determine the most effective energy renovation steps. The audit provides crucial data on heat loss, insulation efficiency, heating system performance, and potential energy savings, guiding homeowners in making informed renovation decisions.

3. Once the energy audit is complete, a **rational sequence of renovation steps** should be established, considering the interdependencies of each process and any external factors that may impact implementation. The first priority should be **ensuring or maintaining ideal indoor humidity levels**, as replacing windows and doors in homes with high humidity often leads to increased condensation and mold growth. Proper ventilation must be considered when selecting materials and structural solutions.

One of the most immediate and cost-effective measures is the **insulation or replacement of doors and windows**, as the greatest heat loss in single-family homes typically occurs through these openings. If full replacement is not financially feasible, simple insulation measures can be undertaken to improve efficiency. However, switching from poorly sealed wooden windows to airtight plastic alternatives must be carefully considered, as modern materials, while offering better insulation, also prevent natural moisture transfer, which can exacerbate humidity-related issues.

Another highly effective and relatively affordable upgrade is **slab insulation** in houses with unbuilt attic spaces. This process, which has seen advancements in environmentally friendly techniques, helps insulate hard-to-reach areas, particularly between wooden structures. The next step, **external wall insulation**, is a crucial component of energy efficiency but requires professional calculation and expert guidance. The effectiveness of insulation materials has significantly improved in recent years, making it advisable to choose the thickest feasible insulation while considering building characteristics such as ledge width. In the case of adobe masonry, special attention must be given to using breathable insulation materials, such as glass wool, instead of polystyrene.

If part or all of the attic is built-in or planned for future use, **roof insulation** should be considered. This step is often complex, requiring the dismantling of existing structures, and therefore necessitates professional planning. Similarly, **floor insulation** should not be overlooked, as heat loss through flooring can be substantial, particularly in single-story houses with large floor areas.

Upgrading the heating system is another critical step in the renovation process and requires the expertise of mechanical engineers. The building's overall energy performance depends on multiple interconnected factors, making it essential to conduct detailed calculations before selecting a heating system. While heating system upgrades are generally positioned later in the renovation sequence, in cases where gas convectors are being replaced with a central heating system or heat pumps, structural modifications may necessitate completing this step earlier in the process.

Throughout the modernisation process, renewable energy integration should be considered, particularly the potential for solar energy utilisation through solar panels or solar collectors. However, system design must account for both current and future household energy needs, as oversizing can lead to excessive costs that are difficult to recover.

4. Given the financial constraints of energy-poor households, **accessing available grants and subsidies** is essential. Although funding opportunities for residential energy renovations in Hungary are currently limited, this situation is expected to improve. It is advisable to review existing grant programs in light of the planned renovation steps and consider applying for financial assistance. Details of currently available funding options are outlined in Section 2.5.

5. Finally, the **implementation phase of the renovation process** must align with the terms of any grant agreements, which may dictate specific timelines, including the earliest and latest start dates, deadlines for completion, and maximum project duration. Additional external factors, such as weather conditions and building occupancy considerations, should also be taken into account. Careful pre-planning is essential, including ensuring the availability of necessary materials and skilled professionals, checking supplier and contractor options, and securing appropriate agreements. Certain funding programmes, such as the Home Renovation Programme, restrict the selection of materials and service providers to pre-approved lists, making it important to confirm eligibility before proceeding with purchases or hiring professionals.

By following a well-structured renovation schedule, households can maximise energy efficiency improvements while ensuring that financial resources are utilised effectively and strategically, leading to long-term sustainability and reduced energy costs.

POSSIBLE STEPS OF RENOVATION BASED ON THE DREEM MODEL IN BÜKK PILOT HOUSEHOLDS

The RENOVERTY project utilised the DREEM model to analyse the potential energy savings achievable through various energy renovation measures. The model was applied to experimental households in the Bükk region to determine the impact of different renovation steps on overall energy efficiency.

The findings provide quantitative insights into the energy savings associated with each renovation measure. These results offer a data-driven approach for homeowners, policymakers, and energy experts to prioritise renovations based on cost-effectiveness and impact.

The table below presents the energy savings that can be achieved through different renovation steps (energy efficiency measures - EEM):

Modernisation activites	Energy saved (kWh)	Energysavings (%)
EEM1 - Thermal insulation of external walls	16,196	39.5
EEM2 - Replacement of doors and windows	2,503	6.1
EEM3 - Floor insulation	13,275	32.4
EEM4 - Heating modernisation - natural gas	10,477	25.6
EEM5 - Heating modernisation - biomass	8,149	19.9
EEM6 - Heat pump	29,415	71.8
EEM7 - Energy efficient luminaires	390	1.0

Table 2 - Energy saving potential of energy efficiency measures (EEM) by using the DREEM model

For energy audits carried out in the Somló-Marcalmente-Bakonyalja areas and the DREEM model recommends modernisation steps as follows:

	Replacement of doors and windows	***Thermal insulation of slabs***	***Thermal insulation of external walls***	***Thermal insulation of floors***	***Heating modernisation***
ET_01638040					
ET_01638423					
ET_01638936					
ET_01639698					

Table 3 - Recommended steps of the DREEM model

The cost-effectiveness and return on investment of the renovation activities examined are shown in the Figure 4 below.

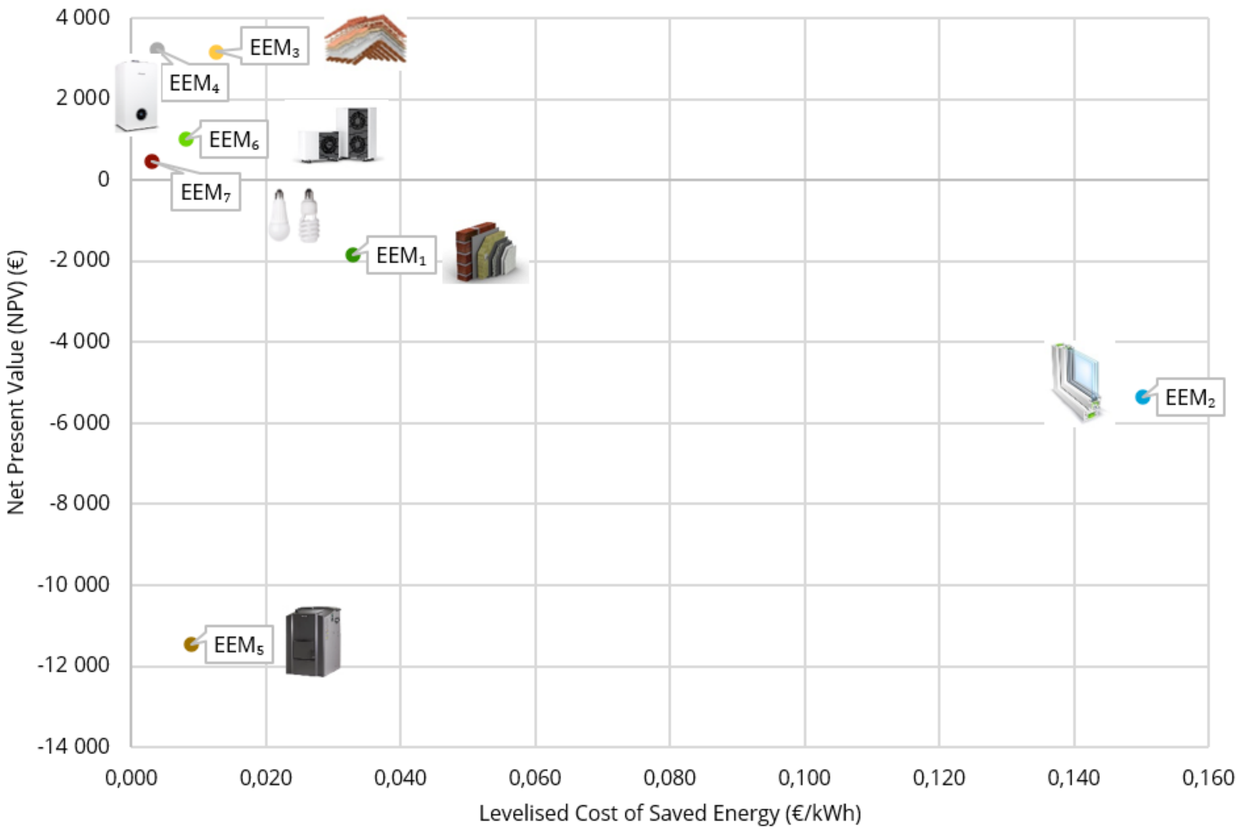


Figure 4 - Cost-effectiveness and return on investment of DREEM model renovation activities

With 50-75% support, the activities are financially profitable even with the current, reduced utility prices.

SUPPORT OPPORTUNITIES FOR ENERGY MODERNISATION PROCESSES

The financial resources and grants outlined in Section 2.5 of the roadmap provide various funding opportunities for the energy renovation of single-family houses. These support mechanisms can be utilised to implement different renovation measures, making energy efficiency improvements more accessible for homeowners, particularly those affected by energy poverty.

The table below outlines how the available financial resources can be applied to different energy renovation processes.

	External insulation of building	Replacement of external doors and windows	Modernisation of heating systems	Hot water system modernisation	Slab insulation	Photovoltaic system
Home Renovation Programme 2024	■	■	■	■		
Energy Efficiency Obligation Scheme (EEOS)					■	
Solar Energy Plus Programme						■
"Village CSOK" - Family Housing Allowance	■	■	■	■	■	■
Rural Home Improvement Programme	■	■	■	■	■	■

Table 4 - Subsidies available for the renovations

2.3 NECESSARY SPECIALISTS AND ENTERPRISES

The energy renovation of single-family houses involves multiple technical tasks, many of which require the expertise of qualified professionals and enterprises. For complex, deep renovations, hiring a general contractor can be beneficial, as they coordinate and manage the various specialists required for the project. While this approach reduces the workload for the homeowner, it also increases costs. Additionally, some financial support programmes impose restrictions on eligible professionals and contractors, which can further impact the overall budget.

Before hiring or contracting a specialist or enterprise, it is essential to verify the quality of their previous work. Checking references, certifications, and past projects helps ensure reliable execution and long-term efficiency of the renovation.

KEY PROFESSIONALS AND BUSINESSES INVOLVED IN THE RENOVATION PROCESS

Planners play a crucial role in the initial stages of energy renovations. Registered energy auditors conduct building energy assessments and help determine the most effective renovation measures. Structural alterations, heating system upgrades (such as switching from individual heating to central heating), or the installation of photovoltaic systems require the expertise of certified designers. In solar energy projects, contractors often provide their own design specialists to ensure compliance with technical and regulatory requirements.

Masons typically handle thermal insulation, door and window replacements, as well as traditional tasks like plastering, concreting, and masonry work. However, due to increasing specialisation, dedicated insulation and window installation professionals are more commonly involved in these specific areas.

Window installers specialise in the installation and replacement of doors and windows. Many of these specialists are independent contractors or companies that also manufacture custom-built energy-efficient windows.

Heat Insulation Specialists focus on thermal insulation for walls, roofs, and floors. They often work with specific insulation systems, such as attic floor insulation or external wall insulation, ensuring optimal energy efficiency.

Painters are not only responsible for surface finishing but may also undertake façade insulation work, making them relevant in external renovations.

HVAC Specialists (Heating, Ventilation, and Air Conditioning) include gas and plumbing professionals, who are required for upgrading heating and domestic hot water systems. Their role is critical when installing energy-efficient boilers, upgrading water heating systems, or implementing central heating solutions.

Carpenters and Roofers are necessary for roof insulation projects, as roof renovation often involves structural modifications. These professionals ensure that the roof structure remains stable while optimising thermal insulation.

Photovoltaic System, Heat Pump, and Air Conditioning Installers specialise in the installation of renewable energy systems and energy-efficient heating and cooling solutions. It is advisable to hire certified contractors for such installations, as they ensure compliance with technical requirements and maximise energy efficiency.

Electricians play an essential role when renovations involve upgrades to the household electrical system. If a renovation includes solar panels, heat pumps, or other high-energy consumption systems, electricians must upgrade the electrical network to handle the increased load safely and efficiently.

Each of these specialists and enterprises contributes to different aspects of energy modernisation, ensuring that renovations meet efficiency goals, comply with regulations, and improve long-term sustainability. Proper planning and hiring of skilled professionals is key to a successful and cost-effective renovation process.

2.4 SETTING TARGETS FOR ENERGY RENOVATIONS

Renovating rural households affected by energy poverty aims to improve living conditions, reduce energy costs, and enhance indoor air quality. This section outlines the expectations associated with the renovation measures and proposes indicators to effectively measure progress.

The goal related to energy moderniastion	**Indicators for measuring goals**
Households in need should have access to funds for energy renovations.	Number of vulnerable households included in the scheme
Improvement of the quality of life in residential buildings.	Number of households included in the scheme. Decrease of exposure to damp and mould. Increased comfort in the home.
Reduction of energy costs for households in need.	Decreasing expenditure.
Improvement of energy efficiency by X% (in line with DREEM).	Improved energy efficiency rating of the building. An ideal improvement corresponds to a jump of at least two energy classes (e.g., from G to E).
Improvement of thermal comfort in the residential building.	Warmer living spaces in winter, cooler in summer.
Improvement of indoor air quality.	Lower amount of particulate matter. Lower humidity. Repelled mold.
Development of alternative heating options.	Number of alternative heating systems installed.
To empower and help vulnerable households to join energy communities.	Number of households joining an energy community.

To prepare households for disasters - flash floods, storm damage.	Number of households prepared.

Table 5 - Renovation objectives and their measurement

2.5 2.5 FINANCIAL RESOURCES AND GRANTS

Currently, there is no continuous support programme in Hungary dedicated to financing the energy renovation of rural residential buildings and family houses. Existing funding sources are fragmented and lack a centralised platform where individuals can access comprehensive and up-to-date information about available and upcoming grants. The Home Renovation Programme is expected to be revised soon, with additional funding programmes anticipated in the Just Transition regions of Borsod-Abaúj-Zemplén, Heves, and Baranya counties.

At the time of preparing this roadmap, the below-mentioned financial resources are available to be used.:

HOME RENOVATION PROGRAMME 2024

Period: 01.07.2024 – 31.12.2025 (or until funds are exhausted)

Budget: HUF 108.24 billion

Expected number of eligible projects: up to 20,000 households

This programme is part of the Recovery and Resilience Facility (RRF), funded by the European Union, and supports energy renovations for habitually inhabited, single- and multi-family homes built before December 31, 1990. Eligible properties include detached houses, terraced houses, semi-detached houses, and homes registered as indoor, outdoor, or closed-garden dwellings. To qualify for support, the renovation must achieve at least a 30% reduction in primary energy consumption compared to the initial state.

The application process requires the submission of a cost plan at an MFB Point before applying for funding. Once the budget is approved, the grant application can be submitted, and if successful, the lending bank disburses the full loan amount. The state-supported loan is interest-free, with a maximum repayment period of ten years. An authentic energy performance certificate must be presented both before and after the renovation to verify the improvement. Renovation works must be completed within two years, with a possible six-month extension. The total support available ranges from HUF 2.5 to 6 million, consisting of an interest-free loan and a non-refundable state grant. A prerequisite for the use is a deductible, which amounts to HUF 1 million in the case of the total 6 million grant, and a proportional amount in the case of a smaller budget.

The level of grant funding is primarily determined by the average income of the applicant's district. In areas where the average income is below 75% of the national average, applicants may receive HUF 3.5 million in non-refundable support. In districts where income falls between 75% and 110% of the national average, the grant is HUF 3 million, while households in districts with an average income above 110% of the national average can receive HUF 2.5 million - List of districts.

The grant covers costs related to external insulation, the replacement of doors and windows, heating system and hot water system upgrades.

The Home Renovation Programme requires the use of specific products and registered professionals, although this is not mandatory. The lists of recommended construction materials, heat and hot water generation equipments and registered contractors are publicly available. However, experience with the programme in its initial months has been mixed. Administrative requirements are complex, with applications typically requiring more than twenty different documents, totaling 70 to 80 pages. Separate contracts must be signed with different contractors for each category of work, even if multiple energy efficiency upgrades are being carried out simultaneously. Moreover, unsubsidised works are often requested and the strict bureaucratic requirements pose challenges for both homeowners and contractors.

The consultants registered in the Home Renovation Programme help the loan applicant - they provide general information, help in the technical-professional energy preparation of investments and provide technical-professional support until the implementation of the investment.

The Hungarian government is currently working on modifications to improve accessibility and ease of implementation.

ATTIC FLOOR INSULATION - ENERGY EFFICIENCY OBLIGATION SCHEME (EEOS)

The Energy Efficiency Obligation Scheme (EEOS) is a market-based mechanism that obliges designated actors in the energy market to achieve a certain level of energy savings for end-users in proportion to their energy sales. Under this scheme, energy savings achieved by users are verified and certified by accredited audit organisations. Once validated, these Certified Energy Savings (HEMs) can be sold to energy traders as a form of tradable property right. Through this system, participating households can access significant financial resources to fund energy efficiency upgrades.

Since the summer of 2024, an increasing number of market participants have begun offering free attic floor insulation, a practice that may seem unusual at first. Small construction teams complete the insulation of unoccupied attic spaces in single-family houses within just a few hours. This business model is likely to play an important role in response to the bureaucratic challenges and administrative burden of the EU-funded Home Renovation Programme, which has seen relatively low participation. The growing demand for slab insulation has been particularly noticeable since spring, especially in smaller rural settlements. While the government is considering modifications to the programme that supports these market activities, it is unlikely to introduce policies that would restrict or discourage the renovation of rural homes.

As of October 2024, the total net cost of attic insulation—including the energy audit, materials, and labor—ranges between HUF 300,000 and 350,000 for an average-sized family house with an 80-100 m² attic slab. The most commonly used material is blown glass wool insulation, typically applied in 25 cm layers. For a standard home, this insulation upgrade can achieve approximately 45-50 GJ of certified energy savings (HEM). These savings can then be sold on the EEOS stock exchange, allowing traders to generate substantial profits.

Certified Energy Savings (HEMs) - *The concept of Certified Energy Savings (HEM) is integral to Hungary's 2030 climate goals, which aim to maintain the country's final energy consumption on a predetermined downward trajectory. To meet these targets, Hungary introduced the Energy Efficiency Obligation System (EEOS) in 2021, requiring electricity and natural gas traders, energy service providers, fuel sellers, and other obligated parties to implement and finance programmes that lead to measurable energy savings at the consumer level. These initiatives, such as audited thermal insulation of residential properties, are called certified energy savings or HEMs.*

Certified energy savings are tradable assets with limited transferability, meaning they can only be sold to obligated parties through bilateral agreements or structured market transactions, such as stock exchange auctions. In February 2024, a series of EEOS auctions was launched on the CEEGEX gas exchange, enabling the monetisation of verified energy savings.

SOLAR ENERGY PLUS PROGRAMME

Budget: HUF 105.8 billion

Expected number of eligible projects: 25,805

The Solar Energy Plus ProgramMmE is a government initiative that provides non-refundable financial support for households to install solar panels and energy storage systems. The program aims to enhance household energy self-sufficiency, reduce electricity bills, and alleviate pressure on the national power grid by promoting the local storage and use of renewable energy.

The programme has a total budget of HUF 105.8 billion, following a HUF 30 billion increase by the Ministry of Energy in the summer of 2024. At the time of writing, financial support remains available.

Households can receive up to HUF 5 million in grants, covering 66% of the total investment costs. By enabling local energy production and consumption, the programmE contributes to Hungary's energy sovereignty and enhances the security of domestic energy supply.

“VILLAGE CSOK” - FAMILY HOUSING ALLOWANCE

The Village CSOK is a non-refundable state grant introduced as part of the Hungarian government's family support package, which was launched on July 1, 2019. As of 2024, the programme is available exclusively in settlements with fewer than 5,000 inhabitants.

The grant provides financial assistance for second-hand housing purchases, expansions, and renovations, including energy efficiency improvements. The maximum available funding is HUF 15 million, and the exact amount granted depends on several factors, including the purpose of the support, the useful floor area of the property, and the number of existing or assumed children.

A key feature of the Village CSOK is that it is a non-repayable grant, meaning that recipients are not required to return the funds as long as they fulfill the contractual obligations, including the condition that the assumed children (1-3) are born within the agreed timeframe.

In addition to direct financial support, the grant can be combined with preferential loans, allowing families to access further financing for property purchases and renovations.

RURAL HOME IMPROVEMENT PROGRAMME

The Rural Home Improvement Programme, launched in January 2025, is designed to enhance housing conditions for families living in small settlements with fewer than 5,000 inhabitants. The program aims to support the renovation and modernisation of rural homes, promote the renewal of the housing stock, and contribute to reducing undeclared construction work.

This initiative provides non-refundable state support covering up to 50% of renovation costs, with a maximum grant amount of HUF 3 million. The specific terms and conditions of the programme are governed by regulations that have been in effect since January 1, 2025.

Unlike the Home Renovation Programme 2024, the Rural Home Improvement Programme features a simpler and more favourable application process, making it more accessible to homeowners. While the programme supports general home improvements, it also allows for energy renovation projects, providing a valuable funding source for increasing energy efficiency in rural housing.

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Co-funded by the European Union under project ID 101077272. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.