PROFEEDBACK

COST
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the European Union

PROFEEDBACK POLICY BRIEF

RENOVATING THE WORST PERFORMING RESIDENTIAL BUILDINGS – EXAMPLES FROM HUNGARY AND OTHER EUROPEAN COUNTRIES

Prepared by
András VARRÓ
Gábor JAKAB
Hétfa Research Institute

COST Association AISBL
Avenue du Boulevard – Bolwerklaan 21 | 1210 Brussels, Belgium
T +32 (0)2 533 3800 | office@cost.eu | www.cost.eu

Introduction

Most European buildings are not energy-efficient. Policymakers have long been aware of this problem, but the green transition, the post-COVID-19 recovery, and the energy crisis triggered by the Russian-Ukrainian war have highlighted the importance of the issue more sharply than before.

The European Union's target is to reduce greenhouse gas emissions by 55% by 2030 compared to 1990 levels (the "Fit for 55!" package). A key element of this target is the construction sector: by 2030, buildings' GHG emissions must be reduced by 60% compared to 2015 levels, their final energy consumption by 14%, and their heating and cooling energy use by 18%. However, the renovation rate of buildings is inadequate. According to EU data, only 11% of the building stock undergoes some level of renovation annually, and such works rarely aim at improving energy efficiency. Only 0.2% of the building stock undergoes renovations that achieve at least 60% energy savings, and there are many regions within the EU where virtually no energy-related renovations take place[1].

According to the European Commission's 2020 assessment[2], 85% of the EU's building stock—around 220 million buildings—was built before 2001, and 85–95% of today's buildings will still be standing in 2050. Another problem is that building heating most often relies on fossil fuels, and the proportion of outdated technologies and energy-wasting equipment remains high. Buildings are responsible for about 40% of the EU's energy consumption and 36% of its greenhouse gas emissions.

Yet such renovations not only reduce households' energy bills, but also bring multiple social, environmental, and economic benefits. Renovations make buildings healthier, more environmentally friendly, and more resilient to extreme natural events. Investment in buildings stimulates the construction industry and the wider economy. It boosts the labour market, increases investment rates, and generates demand for

[1] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives (2020/662

[2] European Commission (2020)

energy-efficient equipment, while also raising property values. For this reason, the European Union aims to at least double the annual energy renovation rate of buildings by 2030 and to significantly increase the number of deep energy renovations.

The poor energy performance of residential buildings is also one of the main drivers of energy poverty. Dwellings with above-average energy needs—especially those housing children, persons with disabilities, or elderly people—are considered high-risk groups in terms of energy poverty. The “Fit for 55!” initiative offers a comprehensive approach to tackling energy poverty. EU Member States are required to present, in their national energy and climate plans, the solutions they intend to use to address energy poverty, and the European Commission supports them in developing these proposals[3].

It is clear, therefore, that improving the energy efficiency of buildings is a highly complex and challenging task. It is simultaneously a climate issue (due to the need to reduce GHG emissions), a social issue (because of energy poverty), an economic issue (due to energy-related costs for households and Member States), and a geopolitical issue (reducing energy demand could be beneficial for Member States in the situation that has arisen following Russian aggression, when they wish to significantly reduce or eliminate their purchases of Russian fossil fuels.). This study presents the potential socio-economic impacts of building renovations and of meeting EU targets, examines the progress of the EU’s building renovation strategy, highlights the key obstacles to accelerating renovation rates, and formulates recommendations to improve the effectiveness of renovation strategies.

Methodology

In order to prepare this study, we reviewed the most relevant EU-level documents relating to building renovation in order to contextualize the topic of the study and identify the most important objectives. We present the socio-economic benefits of renovations based on the available literature, and we also performed our own

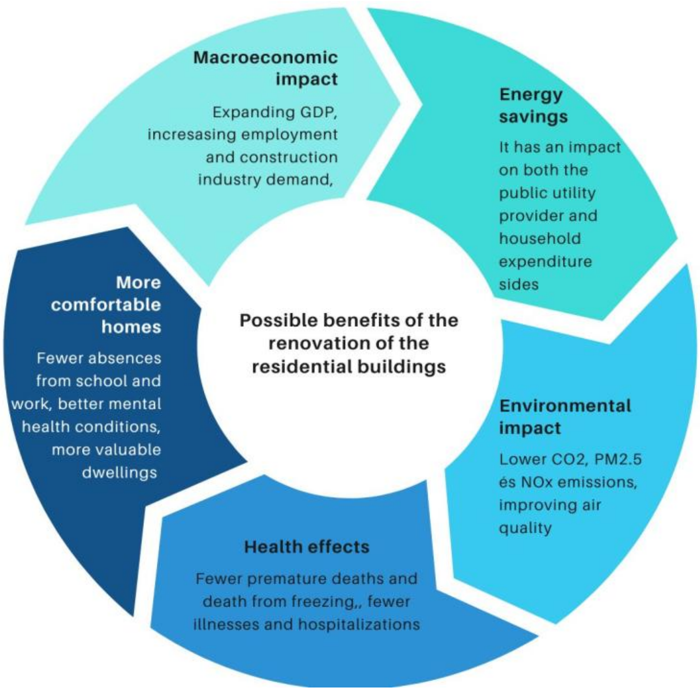
[3] Commission Recommendation (EU) 2023/2407 of 20 October 2023 on energy poverty

calculations using the HÉTFA CGE (Computable General Equilibrium) model. In the conclusions and recommendations section, we make suggestions based on our calculations that could help achieve the objectives.

The socio-economic impacts of building renovations

As presented above, the European Commission primarily seeks to increase the volume of building renovations in order to achieve climate protection goals; in addition, an important objective is to reduce energy poverty and to promote access to energy in an inclusive manner. Economic benefits are expected from boosting demand for the construction industry and from the resulting positive effects on the labour market. The benefits:

1. Figure: Summary figure of the benefits of building renovations



Source: Own compilation

Among the above impacts, through the application of an input-output (IO) model based on the Leontief inverse, we are able to quantify several effects appearing at the macro level. Using a building typology developed in 2015 for the Hungarian building renovation strategy[4], with the help of the model we can estimate the economic benefits generated by increasing the pace of building renovations. The building typology classifies Hungarian residential properties into 23 types, according to the year of construction and their characteristics. For each type we know its specific size, its specific energy consumption, as well as its specific energy consumption after renovation at cost optimum.

In our analysis, we assumed that such a large-scale residential renovation program would have two distinct economic effects. One is that the program directly creates a significant demand for the construction industry. This direct increase in demand will indirectly affect inter-sectoral demand, prices, and sectoral employment through input-output linkages.

The other assumed impact is to be found in the change within the consumer basket. In our calculations, we first identified by how much the energy costs of a representative household are expected to decrease as a result of renovations. Furthermore, improved household energy efficiency reduces CO_2 equivalent pollutant emissions, which in turn decreases demand for the healthcare sector, thanks to improved air quality. We also assumed that these saved amounts are spent by households in other sectors, proportionally. This demand enters the economy entirely exogenously, from the outside. Within the present framework, influencing households to such an extent would lead to only limitedly reliable results due to the non-linear nature of the model. At the same time, it can be assumed that this approach properly identifies the upper boundaries of the impact. As for the change in consumption, the aggregate total of the savings was taken into account, considering the changes caused by already renovated houses during the simulation period.

In our simulation, we examined the impacts of a renovation program running from 2025 to 2040. In Hungary, the annual renewal rate of buildings that also include energy

[4] Nemzeti Épületenergetikai Stratégia (Hungarian National Building Energy Strategy) (2015)

efficiency investments is about 1%[5]. In our model, in line with the European Union's target, we examined the impacts of 3 different scenarios:

1. The annual renovation rate doubles to 2% for all building types.
2. The renovation rate of buildings constructed before 1990 increases to 2.5%, while for all other building types it remains at 1% (resulting in a total renovation rate of 1.9%).
3. The renovation rate of buildings constructed before 1990 increases to 3%, while for all other building types it remains at 1% (resulting in a total renovation rate of 2.1%).

According to our calculations, raising building renovations to such volumes would clearly have positive economic effects. In our model, under the effect of Program 1, the number of employed persons increases annually by an average of 40.7 thousand (In Hungary, the number of employed persons between age 15-64 is approximately 4,6 million). The vast majority of this increase arises in the construction sector, while the number of employees in the healthcare sector (due to lower health expenditures) and in the energy sector (due to decreasing energy consumption) declines. Government tax revenues would increase annually on average by about 189.7 billion HUF, while output would rise by 2.4%. As a result of the renovations, proportionally, the 1st income quintile would achieve the most savings—nearly 1% of aggregate total income—while in the 5th income quintile the level of savings would be about 0.03%.

The building typology contains the original CO_2 emissions and primary energy use of each building type, which allow us to quantify the level of savings as well. In the case of the above-mentioned 2% annual renewal rate, 96 thousand tons of CO_2 emissions would be saved annually, while average primary energy use would decrease by 700.5 million kWh. In 2022, Hungary's CO_2 emissions were 45.2 million tons, while primary energy use was 299.7 billion kWh, thus CO_2 emissions would decrease annually by 0.21%, while primary energy use would decrease by 0.23%.

[5] Nemzeti Épületenergetikai Stratégia (Hungarian National Building Energy Strategy) (2015)

In Scenario 1 we did not differentiate between the individual building types, although it can be assumed that with appropriate targeting of renovations, more favorable results could be achieved. To test this hypothesis, we examined what would happen if we increased the renovation rate only for buildings with the greatest potential energy savings. For this purpose, we selected single-family houses built before 1990, thus in 15 of the 23 building types the renovation rate was increased to 2.5%, while in the others we kept it at the current level in the modeling. In this way, including public buildings, the total renovation rate would increase to 1.9%. In this case, according to our modeling, the increase in the volume of investments would lead to higher impacts on output and employment, while the annual decrease in CO_2 and primary energy use would fall short of the values seen in the first scenario.

If, for the above-mentioned building types (single-family houses built before 1990), we were to increase the renovation rate to 3% annually (Scenario 3), then not only the macroeconomic effects but also the reductions in CO_2 emissions and primary energy use—crucial for achieving climate protection goals—would be higher. This latter scenario would also result in savings exceeding 0.1% in the two lowest income quintiles, while in the 5th quintile households could save 0.04% of their aggregate income thanks to lower energy expenditures.

The modeled results of the 3 examined scenarios are summarized in the table below:

1. Figure: Quantitative impacts of the examined renovation scenarions

	2% renewal rate (all building types)	2.5% renovation rate for buildings constructed before 1990	3% renovation rate for buildings constructed before 1990
Annual average change in economic output (%)	2,4	2,4	2,8
Annual average increase in the number of employed persons (persons)	40,7	41,1	48,3
Change in tax revenues (billion HUF / ~million EUR)	189,7/474,2	191,7/479,2	223,9/559,7
Annual CO_2 savings (thousand tons)	96	89	100
Annual primary energy savings (million kWh)	700,5	562,3	620
Savings as % of aggregate income by income quintile (%)			
1. quintile	0,09	0,11	0,13
2. quintile	0,07	0,09	0,11
3. quintile	0,07	0,08	0,09
4. quintile	0,05	0,06	0,08
5. quintile	0,03	0,04	0,04

Source: HÉTFA CGE model

Along the above logic, a large number of renovation scenarios can be modeled, but even the three example calculations above already point out that, in order to meet climate protection goals, it is extremely important that programs are properly planned and well targeted. For increasing macroeconomic impacts, a general increase in the renovation rate is sufficient, while the reduction of GHG emissions and primary energy use can only be maximized if the targeting is appropriate.

An analysis somewhat similar to ours was carried out by Kögel[6], who came to the conclusion that, based on the current situation, low-income groups in the Member States of the European Union will spend a larger share of their income on energy in 2030 than higher-income social groups. However, if the measures set out in the Renovation Wave are implemented, by 2030 this trend may be reversed, and lower-income groups may spend a smaller proportion of their income on energy than higher-income groups, in such a way that the higher the heating cost in a Member State, the greater the difference between 2019 and 2030 costs in the 1st income quintile. In other words, based on the results, it seems that the implementation of climate protection goals can be achieved with a just transition, that is, in parallel with reducing income inequalities.

Implementation challenges

At the beginning of the current EU programming period, the European Court of Auditors found in a special report[7] that although Member States are aware of the obstacles standing in the way of investments, they were generally unable to remove them due to market barriers. Such market barriers include the lack of awareness and expertise regarding the financing and benefits of energy efficiency, high upfront costs, regulatory obstacles in the case of multi-owner buildings (the need for unanimous decisions), i.e. the landlord-tenant split incentive dilemma (this latter refers to the situation when the owner bears the cost of renovation, but the savings from reduced energy consumption appear at the tenant, which the owner cannot recover). In the countries examined by the European Court of Auditors, none of the operational programmes described what obstacles stand in the way of energy efficiency investments, nor did they identify measures to overcome them. However, during the interviews, concrete measures were reported: Lithuania, for example, allowed that in the case of multi-owner apartment buildings, owners could agree on

[6] Nora Sophie Kögel B.Sc. (2022): Socioeconomic effects of EU Renovation Wave expenditure on low-income groups in the EU27, Vienna University of Economics and Business, Department of Socio-Economics

[7] European Court of Auditors (2020): Special Report 11/2020: Energy efficiency in buildings: greater focus on cost-effectiveness still needed

energy efficiency modernization by simple majority, and provided 100% state support for modernization for low-income persons. In the Czech Republic, housing cooperatives were allowed to apply for EU funding for energy efficiency investments.

The European Court of Auditors also found in its special report that, based on the selection criteria, the most cost-effective projects were not ranked first, since in several places the available budget was distributed among applicant projects on a first-come, first-served basis, in order for Managing Authorities to work with the fastest possible processing time. However, this selection method does not allow consideration of the relative costs, benefits, and co-benefits of projects, and thus projects that save the most energy at the lowest cost were not prioritized. Furthermore, the performance measurement framework did not include an indicator measuring the amount of energy saved in residential buildings.

According to the EU Buildings Climate Tracker 2024 report[8], there is a significant lag in building renovations compared to the set climate protection targets, and at the current pace the targets set for 2030 and 2050 will not be achieved. A warning sign is that the decarbonisation gap doubled between 2016 and 2022. The reason is that final energy consumption is not decreasing sufficiently, renewable energy is spreading too slowly, and renovation investments have been delayed. In terms of CO_2 savings, only 14.7% was achieved instead of 27.9%, final energy consumption decreased by only 2.8% instead of 6.5%, while the share of renewable energy sources increased by only 6.3% instead of 18% by 2022. The main obstacles to achieving climate policy targets remain the lack of building renovations, with investments reaching only 65% of the target set for the period 2015–2022.

Naturally, in the case of implementation challenges, the issue of financing cannot be avoided. The Bruegel Institute's analysis[9] highlighted that, in order to reach the emission reduction targets, set in the Energy Performance Directive for 2030, at EU

[8] BPIE (Buildings Performance Institute Europe) (2024). EU Building Climate Tracker, 3rd edition: Transforming buildings, empowering Europe: A pathway to prosperity, equity and resilience. Available at: https://www.bpie.eu/publication/eu-buildings-climatetracker-3rd-edition/

[9] Bruegel (2024): How to finance the European Union's building decarbonisation plan

level an annual investment need of EUR 150 billion must be filled, while through energy savings achieved by renovations the renovation costs can be reduced, thus the investment gap can be cut by more than half. Their analysis also found that traditional state subsidies failed to adequately involve the banking sector, even though the promotion of public-private financing mechanisms is crucial for achieving the targets. The ex-ante assessment of the Urban Agenda of the European Union[10] states that in 2018 Member States identified the investment need around 130 billion per year. This study also emphasises that local authorities have to take action to accelerate the renovation of the buildings, as the interaction of their renovation strategies interatcio with national-level climate and energy policies was limited.

Monitoring and evaluation is also crucial, before beginning a renovation project, specific, quantifiable, achievable, relevant and time-bound goals and objectives should be defined which adhere the SMART (Specific, Measurable, Achievable, Relevant, Time-bound) objectives.[11] The monitoring process should include regular data collection, status updates and progress reports, stakeholders' involvement and lessons learned documentation.[12]

Conclusions and recommendations

As can be seen from the above, the renovation of residential buildings is of key importance for achieving climate protection goals. At the same time, due to the complexity of housing, it is not only a climate protection issue but also a social and economic challenge.

As shown by our model calculations – and by earlier studies from researchers – building renovation can have positive impacts in many respects for the European Union, the national economies, as well as households. Nevertheless, due to market

[10] Lorimer (2024): Ex-ante assessment of the "Building decarbonisation: Integrated renovation programmes and local heating and cooling plans" thematic area under the Urban Agenda for the European Union, Final report
[11] Angelakoglu et al. (2023): Monitoring the sustainability of building renovation projects – A tailored key performance indicator repository
[12] Angelakoglu et al. (2023)

barriers, the Member States of the European Union, and the European Union as a whole, are lagging behind in building renovations; with the current pace of renovation, the emission reduction targets set for 2030 and 2050 will not be achieved. Below we formulate some recommendations that may help accelerate the pace of building renovations:

Recommendations	Addressees/ Relevant stakeholders
Accelerating public renovation programmes: The governments of EU Member States need to urgently scale up state-led initiatives targeting the renovation of the residential building stock, given the considerable lag relative to the 2030 targets. Evidence from past programmes and modelling exercises indicates that such interventions can generate multiple socio-economic co-benefits, including stimulating economic growth, expanding employment opportunities, improving public health, enhancing household income positions, and supporting the achievement of environmental and climate objectives.	National and EU level policy makers
Prioritisation of deep renovations: Schemes, national-level or local renovation programmes should be designed to foster deep renovations. This requires knowledge of the energy class of the building to be renovated, and the intensity of the subsidy is determined based on the expected improvement resulting from the renovations. Studies show that Member States are lagging behind in increasing the renovation pace, but the increase itself is not enough, renovations must bring significant energy savings in order to reach the climate-related goals.	National and EU-level policy makers

Mobilising private sector resources: Achieving the established targets will require substantial additional investment from the private sector. Analytical consensus suggests that current EU budget allocations alone will be insufficient. While the benefits of building renovations and the implementation challenges have been extensively studied, resource mobilisation remains underexplored. Targeted research is needed to examine banks' experiences with renovation lending, identify perceived risk factors, map the incentives used to guide clients towards energy efficiency investments, and analyse renovation loan portfolios. Such insights are critical for designing effective public-private financing mechanisms.	National and EU level policy makers, financial institutions
Prioritising cost-effectiveness: State-supported renovation programmes should prioritise cost-effectiveness over sheer scale. The quality and anticipated impact of interventions are key determinants of programme success. This aligns with findings from the European Court of Auditors' 2020 report. Advanced modelling, based on the specific energy consumption profiles of different building typologies, can support the calibration of programmes and provide reliable estimates of potential energy savings.	National-level policy makers, Researchers
Targeting by territorial and income characteristics: Renovation initiatives should adopt differentiated targeting strategies, taking into account regional and socio-economic disparities. Owners of high-potential, energy-inefficient buildings—typically older and in poor condition—often lack the financial capacity to undertake renovations independently. Support intensity should therefore be designed regressively, with lower-income households or lower-value properties receiving proportionally higher assistance.	National-level policy makers

Enhancing information and monitoring systems: The success and impact assessment of renovation programmes depend on comprehensive and reliable data on building energy efficiency. The European Court of Auditors has highlighted the knowledge gap regarding the benefits of energy savings as a primary market barrier. Addressing this requires: the further development of energy performance certification systems; the establishment of robust monitoring frameworks; and proactive communication strategies emphasizing both the direct savings and secondary benefits of renovation measures. Improved information can empower households to make evidence-based decisions, favouring interventions that deliver substantial energy savings rather than purely aesthetic upgrades.	National-level policy makers, Local governments, NGOs
Accounting for administrative costs: Programme design must incorporate the administrative costs associated with implementation. Residential grant programmes entail upfront expenditures (e.g., digital application platforms, monitoring systems) and additional public administration capacity (e.g., trained staff, advisors, document management). Programmes targeting lower-income groups may require higher administrative resources to ensure equitable access.	National-level policy makers
Leveraging local actors for implementation: Evidence from prior EU and international energy efficiency programmes indicates that even where financing is available, information gaps significantly constrain uptake. Engaging local municipalities and civil society organisations in programme execution can help assess demand, facilitate access, and prevent misuse of funds, thereby increasing the effectiveness and equity of renovation interventions.	Local governments, NGOs

List of references

1. Angelakoglou, K.; Chatzigeorgiou, E.; Lampropoulos, I.; Giourka, P.; Martinopoulos, G.; Nikolopoulos, N. Monitoring the Sustainability of Building Renovation Projects—A Tailored Key Performance Indicator Repository. Buildings 2023, 13, 2046. https://doi.org/10.3390/buildings13082046
2. Bruegel Institute (2024): *How to finance the European Union's building decarbonisation plan:* https://www.bruegel.org/policy-brief/how-finance-european-unions-building-decarbonisation-plan
3. Commission Recommendation (EU) 2023/2407 of 20 October 2023 on energy poverty: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202302407

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives (2020/662): https://eur-lex.europa.eu/resource.html?uri=cellar:0638aa1d-0f02-11eb-bc07 01aa75ed71a1.0006.02/DOC_1&format=PDF

5. European Court of Auditors (2020): *Special Report 11/2020: Energy efficiency in buildings: greater focus on cost-effectiveness still needed:* https://www.eca.europa.eu/en/publications/SR20_11
6. Lorimer, Stephen (2024): *Ex-ante assessment of the "Building decarbonisation: Integrated renovation programmes and local heating and cooling plans" thematic area under the Urban Agenda for the European Union, Final report,* European Urban Initiative
7. Nemzeti Épületenergetikai Stratégia *(Hungarian National Building Energy Strategy) (2015)*
8. *Nora Sophie Kögel B.Sc. (2022): Socioeconomic effects of EU Renovation Wave expenditure on low-income groups in the EU27*, Vienna University of Economics and Business, Department of Socio-Economics
9. BPIE (Buildings Performance Institute Europe) (2024). *EU Building Climate Tracker, 3rd edition: Transforming buildings, empowering Europe: A pathway to prosperity, equity and resilience*. Available at: https://www.bpie.eu/publication/eu-buildings-climatetracker-3rd-edition/

This publication is based upon work from COST Action CA20112 PROFEEDBACK, supported by COST (European Cooperation in Science and Technology). COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation. Visit www.cost.eu

EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the European Union