BRIEF: HEAT TRANSITION OPTIONS FOR THE LEAST PERFORMING BUILDINGS IN HUNGARY

Author: Marilyn Smith, based the study of Dr. Tamás Csoknyai On Heat Transition Options for the Least Performing Buildings of Hungary

Edited by: Dr. Anna Bajomi, Energy Poverty Policy Officer, FEANTSA

Design: Bryony Martin, Communications and Events Officer, FEANTSA

Currently, as other EU member state, Hungarian policy makers and energy regulators are transposing and implementing implement policies that comply with EU directives to support a 'clean' energy transition. Closer investigation, however, reveals that stronger emphasis is necessary on key two fronts:

- making the transition 'just' for low-income houses, especially when it comes to heating, and
- prioritising measures that could capture the greatest gains in energy and emissions reductions in the near term.

Given Hungary's climate, housing stock and energy systems, heating is a particularly complex challenge. Against an average of 64% across the EU, heating accounts for 71% of household energy demand. In the lowest-performing stock, individual gas and solid fuels remain widespread heating methods.

In examining the condition of the worst-performing housing stock and the viability of diverse heating options, this brief finds that installing decarbonised and clean heating solutions is difficult and costly. Thus, to reach its climate and environmental targets, Hungary should aim to eliminate or significantly improve the heating options – i.e. gas and firewood – currently in widespread use. The brief also sets out the need for more effective policy and financial measures.

Snapshot of the Hungarian housing stock:

- Over half (53.3%) have no insulation; only 35% are fully insulated.
- Over half (52.5%) have only double-glazed windows without insulation; only 10% have triple-glazed windows in line with current standards
- Heating demand, especially in common types of detached houses, is met primarily through natural gas and biomass

Related impacts on low-income families:

- Excess energy consumption and high energy bills (relative to income)
- Opting to minimise or avoid heating
- Low uptake of renovation of building envelopes

Straight talk about current injustices – and who they impact most

Four points underpin the finding that Hungary's current efforts fall short of delivering a just, clean transition in energy for heating.

A large share (52%) of existing houses, particularly those built before 1990, lack insulation and thus have high energy demand per floor space around an average of 404 kWh/m²/year

- The vast majority of the worst-performing homes are owned by lowest-income households, which leads to energy costs being an excess burden in relation to disposable income.
- Under the current energy pricing regulation, in which price per unit increases substantially above a certain consumption threshold, low building performance drives consumption over the cap. As a result, the poorest households represent the highest share of consumers paying the higher tariffs. (While newer, efficient homes owned by high-income households are able to stay below the cap.) Unable to pay the higher tariffs, low-income households are also likely to deprive themselves of adequate heat.
- To solve the root cause of these injustices, deep retrofits (e.g. installing insulation, changing windows and doors) of the worst-performing homes are needed prior to installing clean heating options. In reality, the dwellers of such homes are least able to undertake such work.

To eliminate these injustices and their impacts on energy poverty, it is critical to re-examine building performance, energy pricing, and energy sources and systems. A recent study commissioned by FEANTSA connects the dots to demonstrate how prioritising these citizens and their dwellings can deliver the biggest gains, in the shortest time. Recognising that it would require bold action in the policy and finance arenas, as well as better integration of social considerations, this brief offers concrete recommendations that reflect critical findings. **Critically, it focuses on cost-optimal technical solutions for the clean heat transition of the worst-performing homes in Hungary.**

As EU targets improve, Hungary can do better

Across key legislation, the EU has recently embedded obligations for Member States to tackle energy poverty. The European Building Performance Directive (EBPD), for example, has set ambitious targets to reduce primary energy use of residential buildings by 16% by 2030 and 20-22% by 2035. Notably, it calls for stronger targeting of worst performing housing stock, indicating that at least 55% of the decrease should come from their renovation. The Energy Efficiency Directive (EED) requires Member States to implement a proportional share of annual energy savings among vulnerable households.

Hungary set the criteria to define energy poverty, but related targets and policies are missing or weak. In addition, the renovation rate is falling behind the necessary pace.

But the challenge is complex and full of nuances that create disconnects between aims and actual achievements.

Legislation to tackle energy poverty in Hungary

In line with obligations set for Member States in the Clean Energy Package[1] (CEP), the Hungarian energy efficiency law[2] sets the criteria for assessing the number of households in energy poverty. Specifically, it defines a 'household to be supported' as a 'vulnerable household whose annual energy cost for heating the dwelling to 20°C and producing hot water in the dwelling house exceeds 25% of the household's annual income.' [Act 2015/57 on Energy Efficiency], para. 1/28.b).

Figure 1: Characteristics of the three worst-performing homes in Hungary

Types 1 and 2 are adobe village houses built before WWII. The main distinction is that Type 1 typically lacks a foundation. Both have little or no insulation and still rely on wood stoves for heating, although some have had a gas connection added. Their renovation is the most difficult due to their building material and fabric degradation. Over 500 000 such adobe homes are currently in use (Census 2022).

Built in the 1960s and 1970s, **Type 5** is the most common in Hungary. Equipped with gas convectors (20%) or gas boilers (41%), they have slightly higher thermal comfort than Types 1 through 4. Still, 37% of these homes are heated with firewood.

Type 7 includes 2- or 3-storey homes designed for multi-generational living. Today's reality is that the young generation is leaving, making the houses oversized for older generations who have limited incomes. Most seek to limit energy costs by heating only certain rooms.

The EED for example, requires that all Member States develop Heating and Cooling Plans. The obligation, however, applies only to communities of more than 45 000 citizens. In Hungary, the reality is that a significant share of lowest-performing homes and lowest-income households are dispersed in rural areas. As such, they risk being 'left behind'… again.

Exploring cost-effective strategies to better meet the energy needs of households occupying the worst-performing homes while also providing clean, affordable heating (and cooling) is a key mechanism to reach climate targets with the best possible social outcomes.

FEANTSA hopes that this study will be a useful input for the development of adequate, socially inclusive renovation programs. Such programs should aim to ensure access to healthy, affordable heating and cooling for those households that currently struggle to maintain adequate temperatures and face difficulties paying their energy costs.

Quality of the housing stock as a root energy injustice

Across 23 building types, FEANTSA analysis identified the three worst-performing homes (Figure 1). The characteristics of these homes, including their form, materials and architectural features, influence their thermal comfort and energy consumption. Also notable is that they are inhabited by low-income families, and are typically larger than apartments, representing greater area requiring space heating.

At present, only 35% of residential buildings nationwide are fully insulated. The share with attic and floor slab insulation rises slightly to 45%. While doors and windows are well-known for heat transfer (in both winter and summer), slightly more than half (52.5%) of Hungarian homes have insulated doors and windows. Notably, only 10% of those windows are triple-glazed. In some homes, technical building systems have been exchanged but remain inefficient.

The study finds that among single family homes (SFHs), the smaller and older the house, the higher its specific energy consumption (i.e. the worse the specific heat loss coefficient). The highest consumption is linked to detached, SFHs built before 1990 (Types 1-8), which represent 52% of homes in Hungary. Low insulation in these homes means low performance – and the need for excessive amounts of energy to achieve thermal comfort.

While the three worst-performing homes are found throughout Hungary, they make up particularly large shares of the housing stock in villages, small towns, and the outskirts of large urban centres. Most are inhabited by lower-income families. By also gathering data on household income, the study revealed that income shows an inverse relationship with the age of buildings. In short, Hungarians with the lowest incomes are most likely to live in the worst SFHs (highlighted in the box in Figure X). Low thermal comfort has negative impacts on their health and well-being while high energy costs constrain their social and economic situations. In effect, their houses trap them in not just energy poverty but poverty more broadly (Figure 2).

'Progressive' energy pricing schemes exacerbate injustices

In 2010, Hungary took the decision to detach residential gas prices from gas market, largely to reduce the financial burden of home heating. By 2013, the residential gas price was €4.22/MWh, the second-lowest in EU. In 2022, it was reduced to the lowest at just €2.64/MWh. This policy achieved its overarching goal: for households with two earners, the proportional cost for gas and electricity fell from 7% to 2.6% of disposable income.

Everything changed in 2022. Russia's invasion of Ukraine triggered tight supply and price spikes on the EU and global gas markets, making the price cap unsustainable. The government abruptly introduced an amendment that linked tariffs to actual consumption, aiming to keep reduced prices in place for low consumers. For natural gas, the reduced price would remain applicable to consumption up to 1 729 m3/year. Each unit of consumption above this amount would pay the 'market price'.

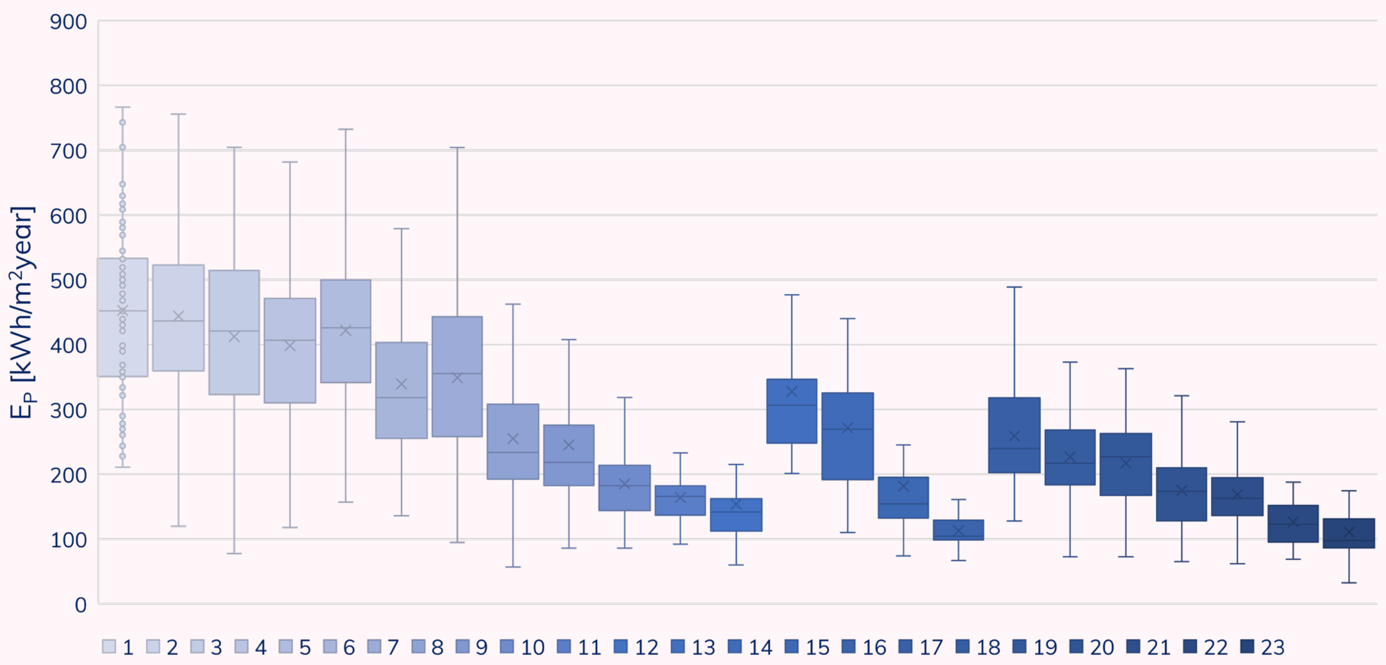


Figure 2: Specific primary energy use (kWh/m2year) of residential building types[8] (based on database from [9] for building types)

In theory, Hungary might well be applauded as an 'early mover' in regulating energy pricing with the specific intent of placing heavier tariffs on households that have excessive use. The new regulation sends a clear message that consumers can save money by using less gas and by implementing energy efficiency measures.

In reality, implementing this scheme in the current Hungarian context is counterproductive. With so many homes (52% of total residential stock) being in the worst performing categories, it is the house itself that triggers excessive energy consumption. And who lives in these homes? As noted above, those in the lowest income groups. For SFHs in Types 1-8, the 144 m3 set as the monthly average eligible for reduced tariffs amounts to only 41-54% of actual consumption; the rest falls into the market price category, which is 7-10 times higher. By reducing the temperature to 20-21°C, some households manage to keep their consumption below the market price threshold; others pay high prices to keep that level of heat or subsist in cold homes.

Meanwhile, richer families in more efficient homes can easily stay below the threshold and enjoy the lowest tariffs for all units consumed. The tariff amendment did lead to energy savings but, as few households could afford retrofits, the savings mostly reflect self-restriction of use. Also, where households had access to both gas and firewood, they opted for the latter to reduce consumption of the former. Clearly, the tariff scheme was revised to reduce the overall costs to the public budget and was implemented in the absence of social elements and any parallel state-funded programmes.

The opportunity to correct this injustice is clear. Improving the energy efficiency of the worst-performing stock homes that are occupied by low-income households delivers higher social benefits compared with public renovations schemes typically taken up by middle- and upper-income households.

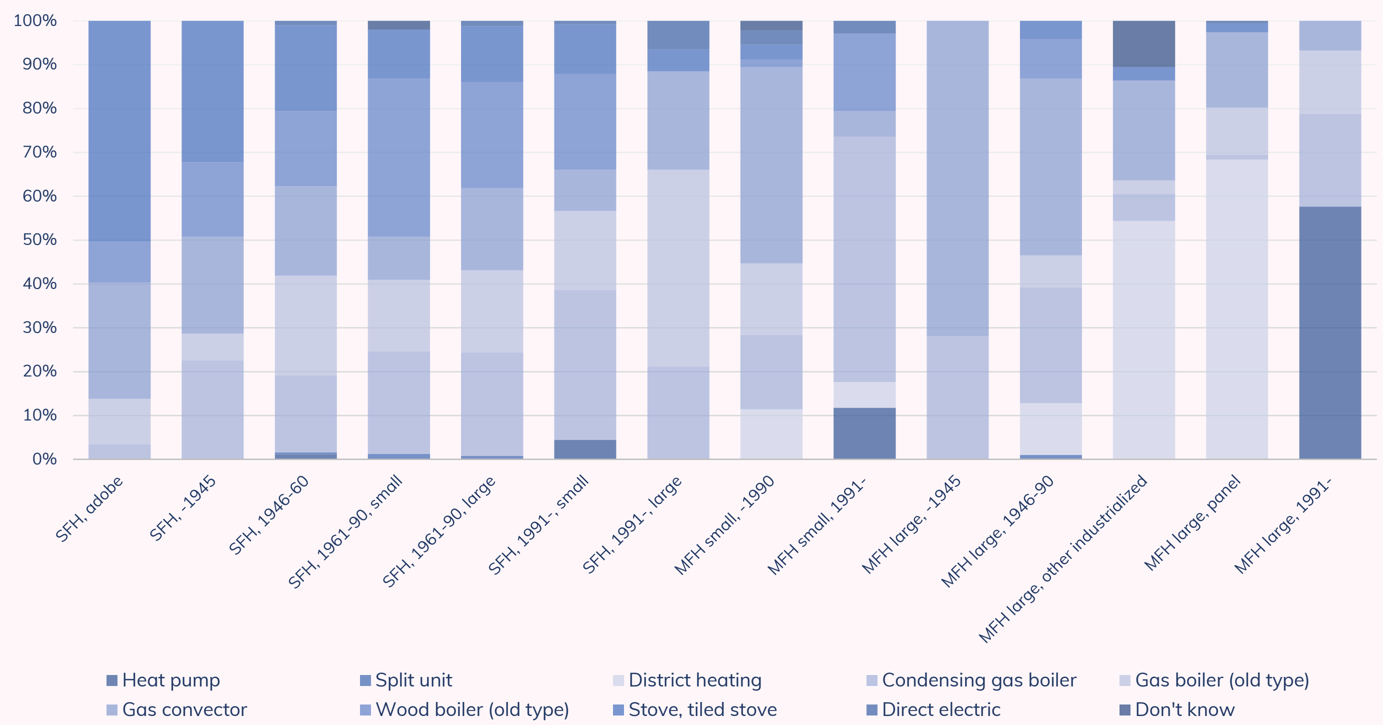


Figure 3 Applied heating system types used as primary heat generators according to building type, 2022[10]

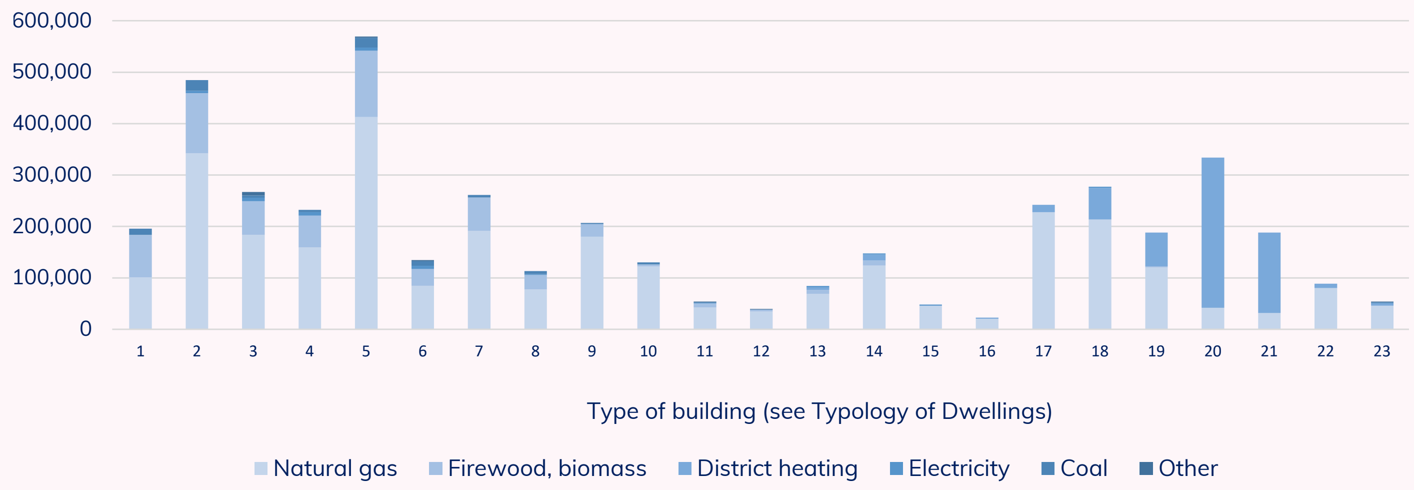


Figure 4: Number of dwellings (units of dwellings) and the distribution of primary energy carriers for heating purposes by building type in Hungary (2015)[11,12] (based on database from [[13]])

Energy sources and systems for home heating in Hungary

Natural gas and biomass are major heating fuels in Hungary, especially for SFHs. In the older SFHs described above, consumption of both fuels is high in relation to floor space not only because of poor-performing building shells but also because old combustion devices are very inefficient. Having poor control, such devices deliver low and unreliable thermal comfort. Many SFHs have access to gas but also operate secondary heat generators, mostly biomass stoves for extra warmth, balancing energy costs or as a back-up security. Once again, this matrix of contributing factors is strongly linked to energy poverty.

The gas price shocks in 2022 profoundly affected household energy choices in Hungary, particularly for the low-income deciles. Households relying on both gas and biomass heating increased significantly their biomass use, such that higher demand pushed up the price of wood. In turn, this left who have only firewood heating – mostly the poorest households – in a desperate situation.

Nationally, gas represents 64% of home heating, comprising individual gas convectors (23%), condensing boilers (17%) and old-type gas boilers (14%). Biomass heating (individually or combined with gas) is around 30% nationally, with about 15% of homes relying on firewood burning stoves in individual rooms. Notably, while heat pumps are widely promoted as a key solution for cleaner heating, they currently account for just 2.6% of home heating in Hungary.

Inherent challenges in Hungary's heat transitions

The poor quality of old SFHs inhabited by low-income households in Hungary undermines the viability of current heat transition strategies that are proving effective in other contexts. Due to the poor state of homes and relatively high prices for electricity in Hungary, electric heating (including with heat pumps) cannot be directly recommended for those most vulnerable to or already experiencing energy poverty.

Heat pumps are, in many contexts, a thermodynamically and economically justifiable alternative to traditional heat sources. Air-source heat pumps are inexpensive but as they heat only a small space, they cannot meet heating requirements in poorly insulated homes during cold periods. Installing multiple units to heat several spaces would drive up electricity demand and prove costly. Another consideration is that they are not compatible with producing hot water. Ground- and water-source heat pumps are simply not applicable in vast majority of homes in Hungary, in part because they require much higher investment costs than air-source heat pumps.

In many ways, surface (floor) heating is the ideal option as it is efficient and provides even heat throughout homes. In many of Hungary's SFHs, however, it would be difficult to implement and prohibitively expensive. In homes heated with individual gas or wood room heaters, a new heating system should also be installed before benefitting from the heat provided by air to water heat pumps.

For a short period of time, installation of solar panels for heating was common in Hungary, in part because net metering schemes allowed owners to earn some revenue by feeding excess generation to the grid. Since the shift, in 2022, to gross metering and the removal of subsidies, installations have fallen off dramatically. The potential for use of solar for heating must be carefully considered in the Hungarian climate context. Monthly comparisons of electricity demand and solar panel production are necessary to assess seasonal asynchrony (high electricity demand in winter vs high production in summer). Having the highest roof space to floor area ratio, Building Type 1 has the most favourable conditions for solar energy use. However, summer production typically exceeds demand, while winter production falls short – especially in homes lacking insulation. Until mechanisms for seasonal storage are developed, solar installations should be sized to support other energy needs (such as electricity for lighting and appliances).

Beyond individual homes, electric heat carries broader challenges in Hungary. Before widespread heat pump installation can even be considered, large portions of the electricity grid would need to be switched to high-current systems. Electric heat is also counterproductive to emissions reduction as fossil fuels still account for a large share of Hungary's power generation.

In reality, biomass-based heat remains a realistic option for heat decarbonisation – but only if complete building envelope insulation is carried out and modern wood gasification or pellet boilers are used. The latter would also require the installation of a centralized heating system in homes heated with individual stoves. While firewood use is criticized for health and environmental impacts linked to pollutants, the inefficiency of both old houses and old combustion devices has a heavy influence on the equations. The need to combust more material to achieve even poor heat in individual homes drives pollution to levels that affect the health of all, ultimately carrying heavy costs for the healthcare system.

Payback considerations linked to deep renovation of low-performing homes in Hungary

To determine whether deep retrofits are 'affordable', calculations typically consider the upfront costs and potential savings on energy demand (and thus on energy bills) to determine the payback period.

In Hungary, current energy pricing schemes pay an out-sized role in the equation. For houses consuming above the subsidized threshold (Types 1-8), the exponentially higher tariffs on additional energy make the payback period an order of magnitude lower than for houses consuming near or below the subsidized threshold (Types 9-10).

The order in which retrofit measures are implemented also affects payback periods. If one measure brings heating costs below the subsidized threshold, the payback periods of other measures increase significantly.

In short, despite requiring very high initial investments, the potential for higher savings currently indicates favourable payback periods for building Types 1 to 8.

Notably, the negative impacts of the gas pricing amendment have driven those in older SFH to shift back to firewood. In turn, skyrocketing demand pushed up firewood prices, with those in the lowest quintile being most reliant and most affected. This is especially true for homes that lack a gas connection and have to option to balance between gas and wood consumption.

Installing electric radiators in homes with high heat demand (because of poor insulation) is not recommended. Even though installation of devices is low-cost and simple, electricity is relatively expensive and not generated from clean sources.

To derive the greatest household and societal benefits from all of the heating energy options above, the much more costly and complex task of insulating homes must be tackled first to 'right size' heating devices and ensure they operate efficiently. After renovation, the most favourable case is comfort supplied by air-to-water heat pumps. However, the cost of thermal insulation, exchanging windows, and installing heat pumps with adequate heating systems is high.

Deep energy renovation delivers multiple benefits, including to governments

At present in Hungary, efforts to modernise residential buildings are typically limited to replacement of windows and doors, exchanging old boilers with condensing boilers, and insulating attic ceilings, façades, and possibly roofs. Figures show a huge gap in improving the building envelope, which would be the most important step towards decarbonisation.

The direct benefits of deep energy renovations to households are obvious: improved thermal comfort and lower energy bills. Policy makers may be less aware of indirect and societal benefits that must be appropriately considered in decision-making across energy, economic and other policy areas.

- Public investments in improving the energy efficiency of low-income households (relative to middle and higher-income groups) deliver significantly higher returns.[3]
- Savings on energy costs increase the disposable income that can be spent on other goods and services, thereby boosting local economies.
- Healthier homes mean fewer sick days, which enhances personal well-being and boosts performance at school and work.[4]
- Better health and well-being translates to important savings for the healthcare budget.
- Better school performance and higher employment translates to increased tax incomes for central budgets.

Analysis of data from the Warm Up NZ: Heat Smart programme in New Zealand indicated that renovation of homes of those on low to modest incomes could be linked to monetised benefits valued at USD 519 per year – more than double the USD 183 realised for higher income households.[5] In fact, the total benefits to low-income homes were 1.5 to 2.0 times the magnitude of the cost of retrofitting insulation.[6]

The economic case for deep renovations of worst-performing homes

Across Hungary, Type 1-8 homes typically require heat energy consumption that exceeds the regulated low-tariff threshold, driving up levels of energy poverty among low-income families. Often, the case is made that the cost of deep renovation measures is difficult to justify as the real estate value may be below the upgrade costs (which is true for some homes).

Calculations demonstrate, however, that if upgrading works on such home and their devices bring the heating costs below the threshold, the payback period is an order of magnitude lower than for schemes that target homes already consuming below the regulated threshold.

Similarly, in most EU27 countries, lower energy bills deriving from energy efficiency improvements are expected to be most impactful for low-income groups (especially those in the lowest 20% quintile).[7] Strict requirements for renovation subsidies in Hungary are currently a barrier to their uptake, particularly by the groups with greatest need – where the greatest gains can be captured.

Effective strategies for action in Hungary

For the long-term health of Hungarian citizens and their environment, the government needs to shift its priorities from capturing the 'low-hanging fruit' and tackling the roots problems of energy poverty, reducing overall energy demand and slashing emissions.

The research undertaken by FEANTSA clearly shows that targeting energy efficiency measures at the worst-performing SFHs (i.e. those built before 1990) offers the greatest potential to reduce energy consumption and associated emissions in Hungary. Across the enormous stock of homes in Types 1-2, 5 and 7, improving the building shell and then installing an appropriate and right-sized heating system could reduce energy consumptions by 60-70% (assuming the building is fully heated).

But it also reveals a pressing dilemma. Due to the peculiarities of the current energy price structure, residents of such homes have the greatest motivation to save energy, but they lack the financial means to carry out even the most basic works. Many people living in such houses can only save energy by operation – e.g. heating only part of the dwelling – often at the cost of decreased thermal comfort.

Maintaining the (partially) capped gas and fully capped district heat tariffs require heavy subsidies from Hungary's central budget. At the same time, subsidies targeting residential energy retrofit measures are moderate and unpredictable, while generous housing upgrade and construction support schemes do not prioritize energy savings. Furthermore, housing support schemes often exclude vulnerable households for multiple reasons beyond low incomes. In fact, the study makes clear that existing housing-related support schemes, which do not consider energy efficiency in holistic ways and often require upfront financing, are unsuitable for addressing energy poverty. Moreover, the process to apply for support is often a heavy administrative burden for the segment of the population that would gain the most from access to assistance.

These considerations draw attention to the social aspects of a just, clean heating transition.

Designing a socially just energy transition for Hungary

Analysis of the first year of the Hungary's Energy Efficiency Performance Regulation (EEPR) mirrors the experience in other countries: i.e. that trying to address residential energy renovation and energy poverty solely through efficiency strategies is insufficient. While the EEPR strategies describe overarching goals and objectives, the specific measures for renovating the worst-performing building stock remain inadequately defined.

In the near term, the most important action would be to rescind ineffective price controls on fossil energy sources that create unfair cost burdens for households trapped in SFHs that require excessive consumption to achieve thermal comfort and to protect firewood users from price increases.

In turn, the government should implement support mechanisms for deep renovation of such homes. From a technical perspective, installing thermal insulation and effective heating systems controls is a critical first step. While it has been demonstrated that residential solar systems cannot cover heating needs in cold seasons, where conditions are suitable, they can provide savings by meeting a substantial share of electrical demand (other than heating) throughout the year.

In the longer term, these measures would facilitate the switch to appropriately sized heat pumps and/or split units, as local electrical network are modernised.

The greatest benefit can be achieved by making near-term targets substantially more ambitious and coupling them with policy measures that respond to the needs of households. Realising this potential, however, will require a more complex coordination of technical, financial and awareness-raising policies. Controlled change is very important across these two areas, as they carry the risk of dramatically increasing levels of energy poverty.

Endnotes

1 Regulation on the Governance of the Energy Union and Climate Action, 2018, art. 29; Directive 2019/944 on the Common Rules for the Internal Market for Electricity, art. 29.

2 Évi LVII. Törvény Az Energiahatékonyságról [Act 2015/57 on Energy Efficiency], 2015

3 Matthias Reuter, Martin, Patel, Wolfgang Eichhammer, Bruno Lapillonne, Karine Pollier: A comprehensive indicator set for measuring multiple benefits of energy efficiency Energy Policy, Volume 139, April 2020, 111284.

4 https://www.sciencedirect.com/science/article/abs/pii/S0301421511009918

5 Capturing the Multiple Benefits of Energy Efficiency (windows.net), International Energy Agency, 2014

6 R Chapman, P Howden-Chapman, H Viggers, D O'Dea, M Kennedy: Retrofitting houses with insulation: A cost-benefit analysis of a randomised community trial, Journal of Epidemiology and Community Health 63(4):271-7, 2009

7 Eva Alexandri; Isha Dwesar; Ornella Dellaccio; Boglárka Molnár: 2030 EU energy efficiency target: The multiple benefits of higher ambition, Cambridge Econometrics (Belgium) Avenue des Arts 10-11 1210 Brussels, 2022, 2030 EU energy efficiency target: Multiple benefits of higher ambition (camecon.com).

8 KEOP-7.9.0/12-2013-0019/2020, Development of the 2014-2020 Development Programme and Action Plan for the Energy Efficiency Renovation of Buildings Managed by Public Bodies and Assessment of the Energy Efficiency Potential of Residential Buildings, Budapest, 2015.

9 Csoknyai Tamás: Energy modelling of the Hungarian residential building stock, possibilities of modernization (in Hungarian), DSc. dissertation, 2022

10 The possibility of phasing out Russian gas in Hungary, project report, 2023, https://rekk.hu/analysis-details/341/russian-gas-phaseout-in-hungary

11 The possibility of phasing out Russian gas in Hungary, project report, 2023, https://rekk.hu/analysis-details/341/russian-gas-phaseout-in-hungary

12 Csoknyai Tamás- Szalay Zsuzsa- Gergely László Zsolt- Szagri Dóra - Horváth Miklós-Takácsné Tóth Borbála - Kotek Péter: The impact of the rule change of the heat and electricity bill reduction on gas consumption in the Hungarian residential sector. Policy Brief, REKK, 2022, https://rekk.hu/research-paper/131/impact-of-utility-price-reduction-change-on-the-gas-consumption-of-the-hungarian-residential-building-sector

13 KEOP-7.9.0/12-2013-0019/2020, Development of the 2014-2020 Development Programme and Action Plan for the Energy Efficiency Renovation of Buildings Managed by Public Bodies and Assessment of the Energy Efficiency Potential of Residential Buildings, Budapest, 2015.

TYPOLOGY OF DWELLINGS - SINGLE FAMILY HOMES

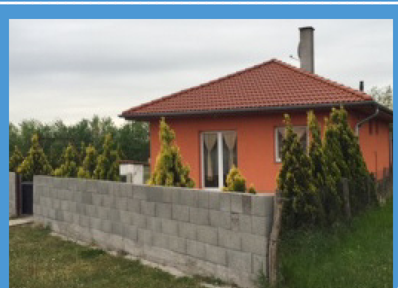
CONSTRUCTION YEAR	SMALL	LARGE	ADOBE TYPE ONE	ADOBE TYPE 2
-1944	 3			
1945-1959	 4			
1960-1979	 5	 6	 1	 2
1980-1989	 7	 8		
1990-2005	 9	 10		
2006-	 11	 12		

Table 4: Illustration of the typology of family houses [27]

TYPOLOGY OF DWELLINGS - MULTI-FLAT HOUSES

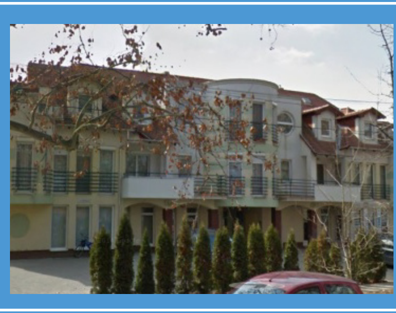
CONSTRUCTION YEAR	SMALL	LARGE		
		TRADITIONAL	PANEL	OTHER PREFABRICATED
-1944	 13	 17		
1945-1959				
1960-1979	 14	 18	 20	 19
1980-1989			 21	
1990-2005	 15	 22		
2006-	 16	 23		

Table 5: Illustration of the typology of housing associations [27]

FEANTSA

EUROPEAN FEDERATION OF NATIONAL ORGANISATIONS WORKING WITH THE HOMELESS

194 CHAUSSÉE DE LOUVAIN, 1210 BRUSSELS, BELGIUM
T +32 (0)2 538 66 69 • INFORMATION@FEANTSA.ORG

WWW.FEANTSA.ORG