European Environment Agency



Exploring socially just energy renovation of residential buildings

EEA report

European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark

Tel.: +45 33 36 71 00
Web: eea.europa.eu
Contact us: eea.europa.eu/en/about/contact-us

Legal notice
The contents of this publication do not necessarily reflect the official opinions of the European Commission or other institutions of the European Union. Neither the European Environment Agency nor any person or company acting on behalf of the Agency is responsible for the use that may be made of the information contained in this report.

Publication policy
To protect the environment, the European Environment Agency supports only digital publications. We do not print our publications.

Copyright notice
© European Environment Agency, 2026
This publication is published under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence (https://creativecommons.org/licenses/by/4.0). This means that it may be re-used without prior permission, free of charge, for commercial or non-commercial purposes, provided that the EEA is acknowledged as the original source of the material and that the original meaning or message of the content is not distorted. For any use or reproduction of elements that are not owned by the European Environment Agency, permission may need to be sought directly from the respective rightsholders.

More information on the European Union is available on https://european-union.europa.eu/index_en.

Luxembourg: Publications Office of the European Union, 2026

ISBN: 978-92-9480-797-7
ISSN: 1977-8449
doi: 10.2800/2361704
TH-01-26-045-EN-N

EEA report 13/2026

Cover design: European Environment Agency
Cover photo: © European Environment Agency
Layout: Eworx/EEA

Contents

Key messages		4
Executive summary		6
Acknowledgements		7
Introduction		8
1	Why should Europe renovate its housing stock while considering social aspects?	9
2	EU policy framework for energy renovation	21
3	Investment in renovation yields multiple long-term benefits	28
4	Barriers to boosting renovation in the EU	34
5	Social fairness in energy renovation	41
6	Strategic tools and actions for strengthening socially fair energy renovation	47
7	Conclusion	52
References		53

Key messages

- Energy poverty remains a major challenge across the European Union (EU). Around 8.8% of the EU population were unable to adequately heat their homes in 2025. Climate change-driven heatwaves mean summer energy poverty is an urgent concern: 26% of EU households were unable to stay comfortably cool during the summer of 2023. Climate adaptation must be integrated systematically into energy renovation efforts.

- The EU has legally binding targets to be climate-neutral by 2050 and to cut greenhouse gas emissions by 55% by 2030 and 90% by 2040. To achieve these targets, buildings emissions must mainly be cut through energy renovation. This requires reversing the declining investment trend and closing the investment gap.

- Residential energy efficiency improvements can bring environmental benefits and yield immediate gains for households by cutting energy bills and improving local air quality. This could improve citizens' health and welfare and slash healthcare costs. At scale, cutting household energy consumption can reduce Europe's dependency on fossil fuel imports. Performance gaps between expected and observed energy saving need attention to ensure full, real-world delivery.

- Residential energy renovation support is often more easily available to wealthy households, while vulnerable and middle-income households face financial barriers, including high upfront costs, long payback periods and high electricity prices relative to gas. Renters face split incentives with landlords when investing in renovation, while public support mechanisms often show lower uptake by lower income groups due to a lack of awareness, low trust and administrative complexity.

- Policies tailored to the local circumstances and the socioeconomic situation of households are needed to speed up renovation, while ensuring affordability and social justice. Public subsidies can be adjusted based on income and additional social criteria, for example by targeting the most vulnerable and middle-income groups leaving in worst performing buildings, while ensuring a balance between simplicity and administrative costs. Market instruments combined with legal standards and social safeguards can address the split incentive on the private rental market. An understanding of behavioural dynamics can improve the effectiveness of policies aiming to incentivise investment inclusively.

- Proactive initiatives through one stop shops have delivered effective, tailored and local support to vulnerable households. Local municipalities understand socio-economic realities at neighbourhood level and are well-positioned to implement measures to promote residential renovation. Other community-based approaches, including energy communities, prosumerism and applying circular principles, offer further potential to engage households in a fair and affordable way.

- The ongoing development of the National Building Renovation Plans and the Social Climate Plans offer opportunities to implement consultative processes where vulnerable groups are given a voice and their concerns considered. At the policy design level, establishing data and information systems to precisely identify social groups and address the challenge of effective targeting is a priority.

Executive summary

This report explores how residential energy renovation measures can be tailored to support household decision-making and investment in a fair and inclusive way. Bottom-up and tailored policy mechanisms could support action to boost energy efficiency and reduce the energy consumption of vulnerable, lower income and middle-class households. This would cut monthly energy bills for millions of households while providing longer-term benefits to well-being.

Energy renovation investments yield multiple benefits; while they reduce fossil fuel demand, greenhouse gas (GHG) emissions and air pollution, they also bring huge health benefits, boost the local economy and improve the well-being of local communities.

These benefits are particularly valuable for low-income households, which are more likely to experience energy poverty and live in housing with poor energy performance. However, evidence from across Europe shows that financial and behavioural barriers tend to prevent vulnerable households from investing in renovation and reaping the benefits, even where public funding and support are in place.

This report documents how social fairness plays out in efforts to promote energy renovation of residential buildings. It gives examples of socially fair policy measures designed to accelerate energy renovation while ensuring vulnerable households exposed to energy price shocks, carbon pricing and extreme heat conditions are given a pathway to reliable, resilient and energy-efficient homes.

A comprehensive EU legislative framework for energy renovation, along with efforts to tackle energy poverty, both underpin these ambitions. This includes the Renovation Wave, along with key pieces of legislation (directives on energy performance of buildings, energy efficiency and renewable energy, plus the Electricity and Gas Directive), where goals are set with requirements to monitor social and climate dimensions.

Existing EU support and initiatives for the energy renovation of residential buildings that takes social criteria into considerations includes the Social Climate Fund, the European Affordable Housing Plan and Better Homes Partnerships (foreseen for 2026). These instruments can help local actions to overcome the practical, financial and behavioural barriers that households face. They build on longer-standing local support mechanisms, such as the Horizon Europe mission on climate-neutral and smart cities. The finalisation of the National Building Renovation Plans and the Social Climate Plans, expected in 2026, will mark a key milestone in the challenge to implement such actions at the national level.

Acknowledgements

The European Environment Agency (EEA) would like to thank the European Topic Centre on Sustainable Transition (ETC ST), the European Topic Centre on Climate Mitigation (ETC CM/VITO), national experts from the EEA Eionet network, European level experts from various institutions (including BPIE, EIB, Eurofound, European Commission, FRA, UNEP Copenhagen Climate Centre and RenovEco) and EEA colleagues who contributed to the project.

Introduction

The objective of this report is to explore the socio-economic dimensions that must be considered in policies supporting energy renovation of residential buildings. It provides contextual evidence, projected expectations and recent policy results. It offers examples of policies identified as being good practice and/or promising to consider social issues in energy renovation actions. The climate imperative is covered through the perspective of emissions reduction and, to a lesser extent, from the perspective of adaptation, through cooling needs in summer. The report is intended for policymakers and practitioners in the fields of housing, energy renovation, social policy, and financing. Chapters 1 to 3 of the report analyses of the socioeconomic and political context of energy renovation of residential buildings while Chapters 4 to 6 showcase examples of policy measures and good practices.

The first chapter details ongoing progress, the recent socio-economic context and challenges from recent energy renovation policies. The second chapter describes the current political and legal framework for addressing energy renovation at the EU level, including a large range of new tools and initiatives to support implementation at national and local levels. Chapters 3 and 4 explore investment, expected benefits and financial and non-financial barriers, along with distributive considerations. Chapter 5 aims to clarify the exact meaning of social justice in energy renovation (distributive, procedural and recognitional). It details examples of good practice (along with previously analysed obstacles) in terms of funded measures, demonstrable influence and accountable outcomes. Chapter 6 digs further into the nature of a just transition, exploring strategic actions available for policymakers to engage vulnerable households.

This report draws on the technical report Residential energy renovations: benefits and enablers for a just transition, produced by the European Topic Centre on Sustainability Transitions (ETC ST) in 2025, along with recent data gathered by the European Environment Agency (EEA). Further details and analysis are available in that full technical report.

The ETC ST report reflects the results of a one-year project involving several national and EU experts from the EEA, the European Environment Information and Observation Network (Eionet) and several others EU level institutions. It includes data from a literature review and qualitative information collected from national EEA-Eionet experts through interviews and workshops.

1 Why should Europe renovate its housing stock while considering social aspects?

The climate and energy imperative

Europe's building stock is characterised by relatively low energy efficiency and high share of EU GHG emissions and is a major source of air pollution (EEA, 2025d). Buildings (residential and non-residential) are responsible for 32% of the EU's total GHG emissions (EEA, 2025a) and 40% of final energy consumption in 2024. In a context where 75% of buildings have poor energy efficiency, the average annual energy renovation rate stands at only 1%.

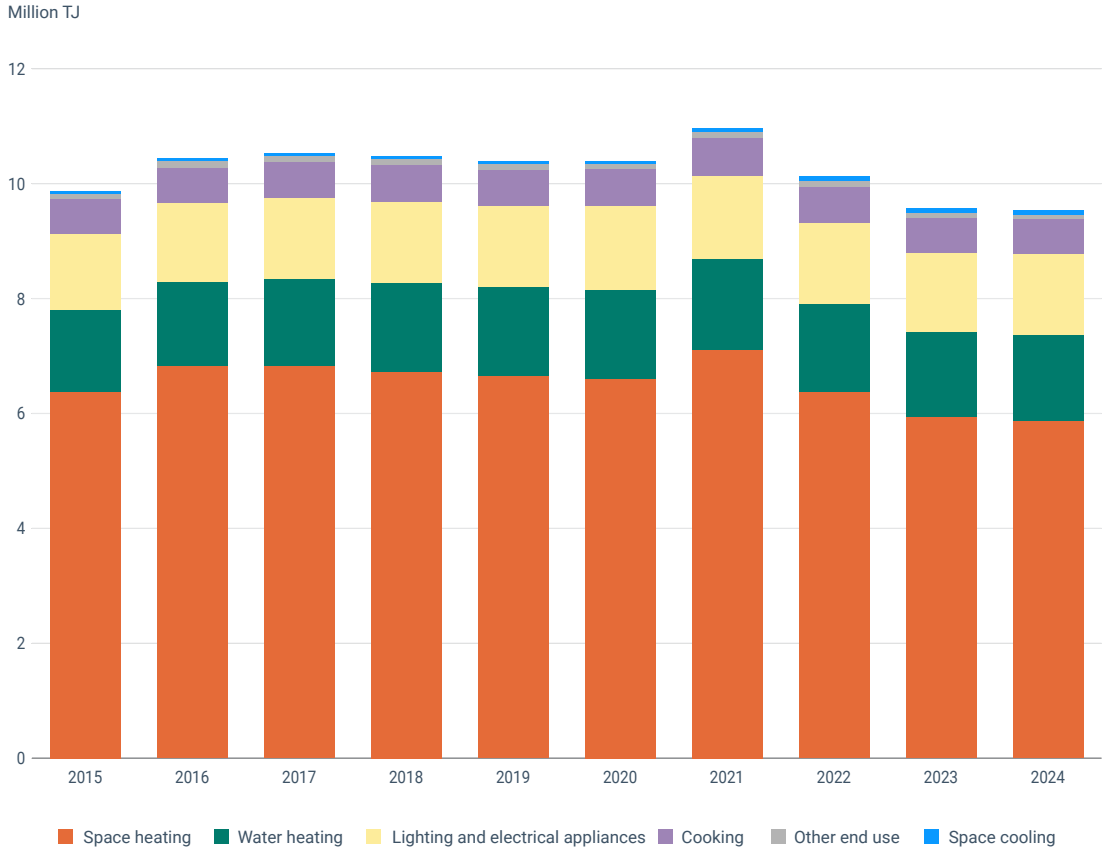
Residential buildings alone consume two thirds of all energy used in buildings, mainly for space and water heating, and represent 63% of all GHG emissions from buildings (residential and non-residential).

Heating homes, the most energy-intensive end use, represented 61.5% of households' final energy consumption in 2024 (Figures 1.1, 1.2 and 1.3). At the EU level, 50% of residential heating is based on the direct use of fossil fuels in boilers (mainly natural gas). This drives emissions and exposes citizens to volatile prices in the context of current geopolitical tensions. Around 32% of residential heating relies on renewables and biofuels (such as biomass used in domestic heat stoves).

Energy used for cooling in residential buildings (mainly electricity) represents a modest, but growing share of household total final energy use (0.4% in 2019 and 0.8% in 2024). This percentage was far higher in countries such as Cyprus (16%), Malta (15%) and Greece (7%). In the future, energy use for cooling is expected to rise, particularly in Mediterranean countries (EEA, 2023b, EEA, 2024d).

Some progress has been seen in residential buildings, reflecting improvements in energy efficiency and the decarbonisation of heating and electricity generation (Figure 1.4) (EEA, 2025a). For example, GHG emissions fell by 33% between 2015 and 2024. By contrast, energy consumption in residential buildings fell by just 3,3% over this period. Efficiency gains were offset by larger floor areas per person, growing energy demand for cooling and the increased use of appliances. Part of the decline in energy use and emissions occurred after 2021, a period marked by exceptionally high energy prices following the energy crisis and Russia's full-scale invasion of Ukraine. This also contributed to reductions in household energy demand, such as through more rational use of energy for heating and cooling.

Figure 1.1 **Final energy consumption in the residential sector by end use, 2015-2024**

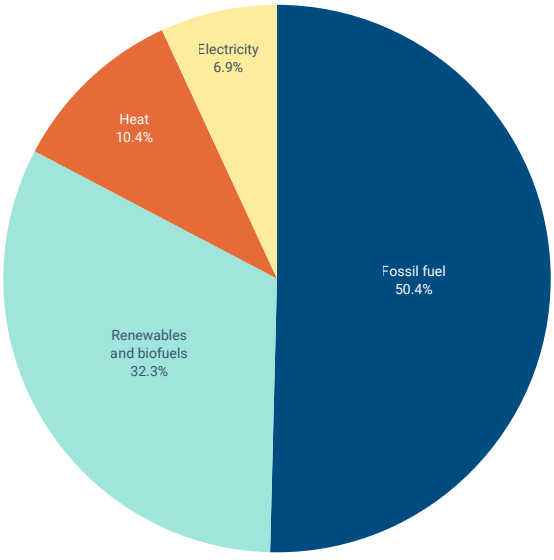


Notes: FEC, final energy consumption; TJ, terajoules.

View the interactive version of the chart.

Source: Eurostat.

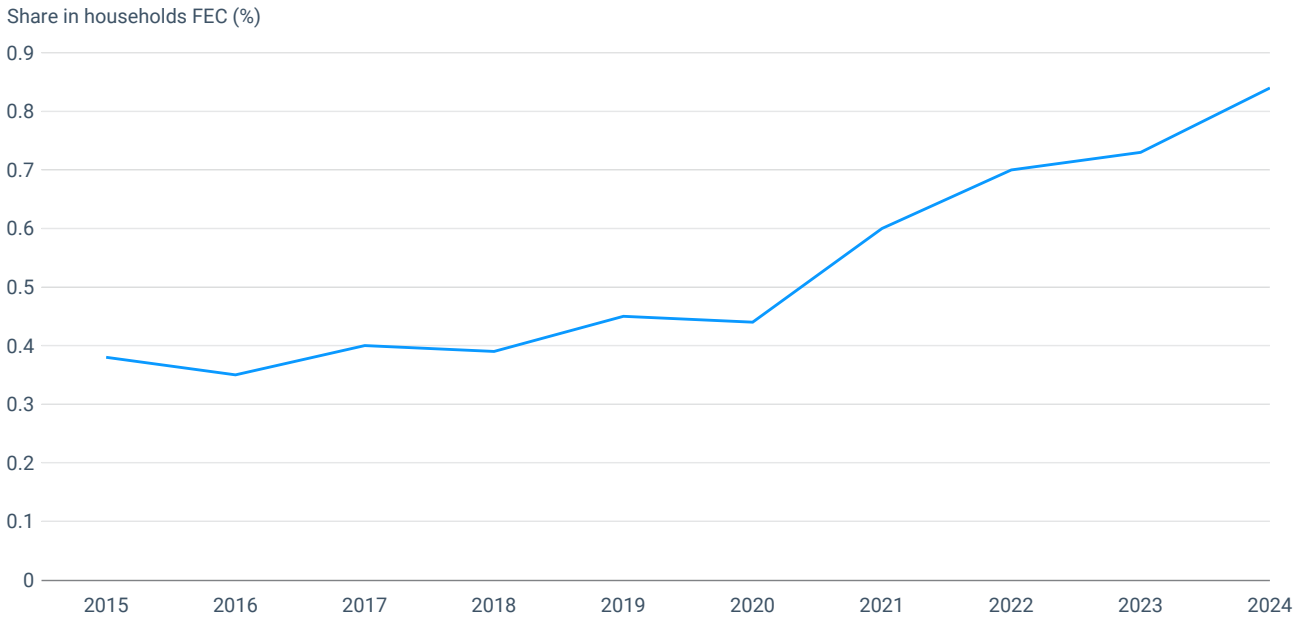
Figure 1.2 **Space heating energy use in residential by type of fuel, 2024, percentage share of total use of energy for heating**



Note: View the interactive version of the chart.

Source: Eurostat.

Figure 1.3 **Residential energy consumption for cooling, 2015-2024, percentage share households FEC**



Note: View the interactive version of the chart.

Source: Eurostat.

By 2050, more than 85% of today's buildings are expected to still be in use (EEA, 2022b). Under the European Climate Law, the EU aims to be climate-neutral by this point. The law sets intermediate targets to reduce net GHG emissions by at least 55% by 2030 and by 90% by 2040, compared with 1990 levels. The Energy Performance of Buildings Directive (EPBD) aims to transform the EU's building stock to the Zero-Emission Building (ZEB) level by 2050. It targets a reduction in average primary energy use across residential buildings of at least 16% in 2030 compared with 2020 levels and 20-22% by 2035 (I4CE, 2026a; EC, 2024a).

While an estimated 11% of the EU's building stock undergoes renovation each year, most renovations fail to address energy performance. Annual energy renovation remains around 1% (EC, 2020). 'Deep' renovations, which aim to maximise energy performance (see Box 1), happen in just 0.2% of the overall building stock each year. Projections from the Buildings Performance Institute Europe (BPIE) suggest that achieving climate neutrality by 2050 would requires the annual renovation rate to increase to 3%, with 70% of these delivering 'deep' renovations (BPIE, 2021). This represents a major departure from current trends and implies a significant scaling-up of financing, investment, workforce capacity and administrative support.

The social imperative

Recent crisis and energy poverty

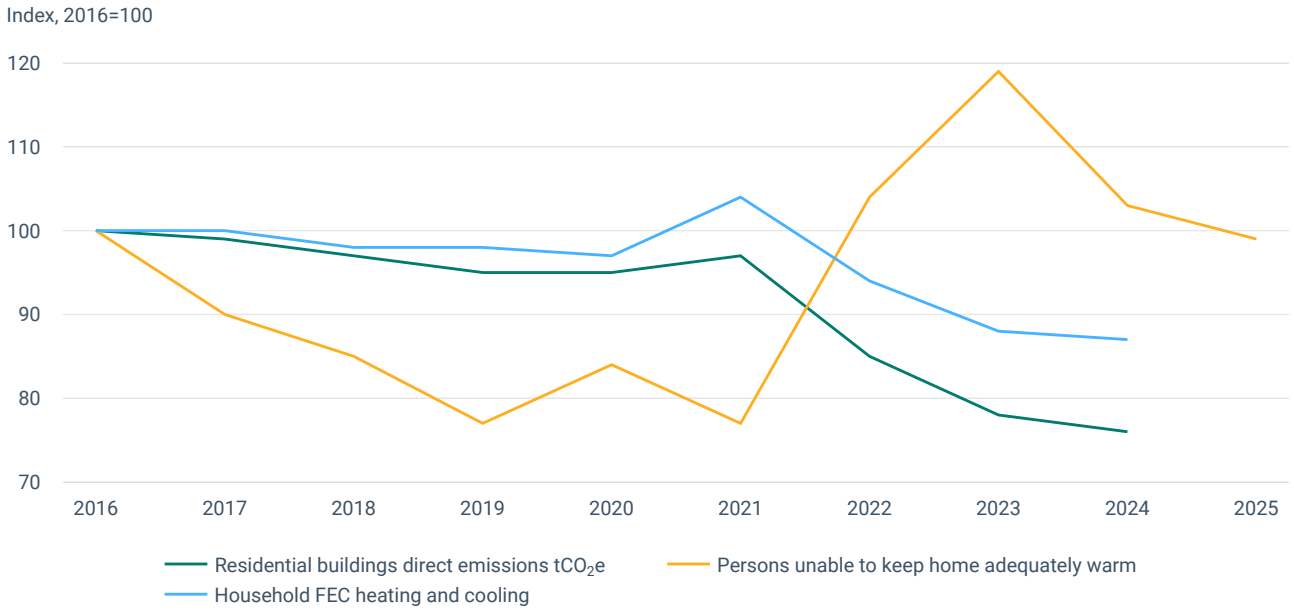
There is a clear social imperative for investing in the energy renovation of the EU's building stock.

In 2025, 8.8% of the EU population were unable to keep their homes adequately warm, an indicator used to measure energy poverty (see Figure 1.4 and Map 1.1). Following energy price increase, this share markedly increased in recent years, from 6.9% in 2021 to 10.6% in 2023, 9.2% in 2024 and 8.8% in 2025. Significant variation exists between EU Member States. Finland has the lowest share at 2.6%, while in Bulgaria, Greece, Lithuania, Portugal and Spain the share reached over 15% in 2025 (Eurostat, 2026a).

Winter and summer energy poverty are closely correlated. In 2023, 57.5% of EU households that were unable to keep their homes adequately warm also reported difficulties keeping them cool in summer. Among households without heating difficulties, the corresponding share was only 21.5%. The same pattern is observed in most EU countries and is particularly strong in southern Europe (Greece, Italy, Romania, Spain). Summer energy poverty in the EU, measured as a percentage of a household's inability to keep its dwelling comfortably cool during summer fell until 2012 but has since risen, reaching 26% in 2023 [1], nearly the same level in 2007 (JRC, 2026a).

More broadly, around 93 million people across the EU were at risk of poverty or social exclusion in 2025, equivalent to 21% of the population (Eurostat, 2025).

Figure 1.4 **Trend in direct CO_2 emissions from residential buildings, number of persons unable to keep home warm and final energy consumption for heating and cooling, EU-27**



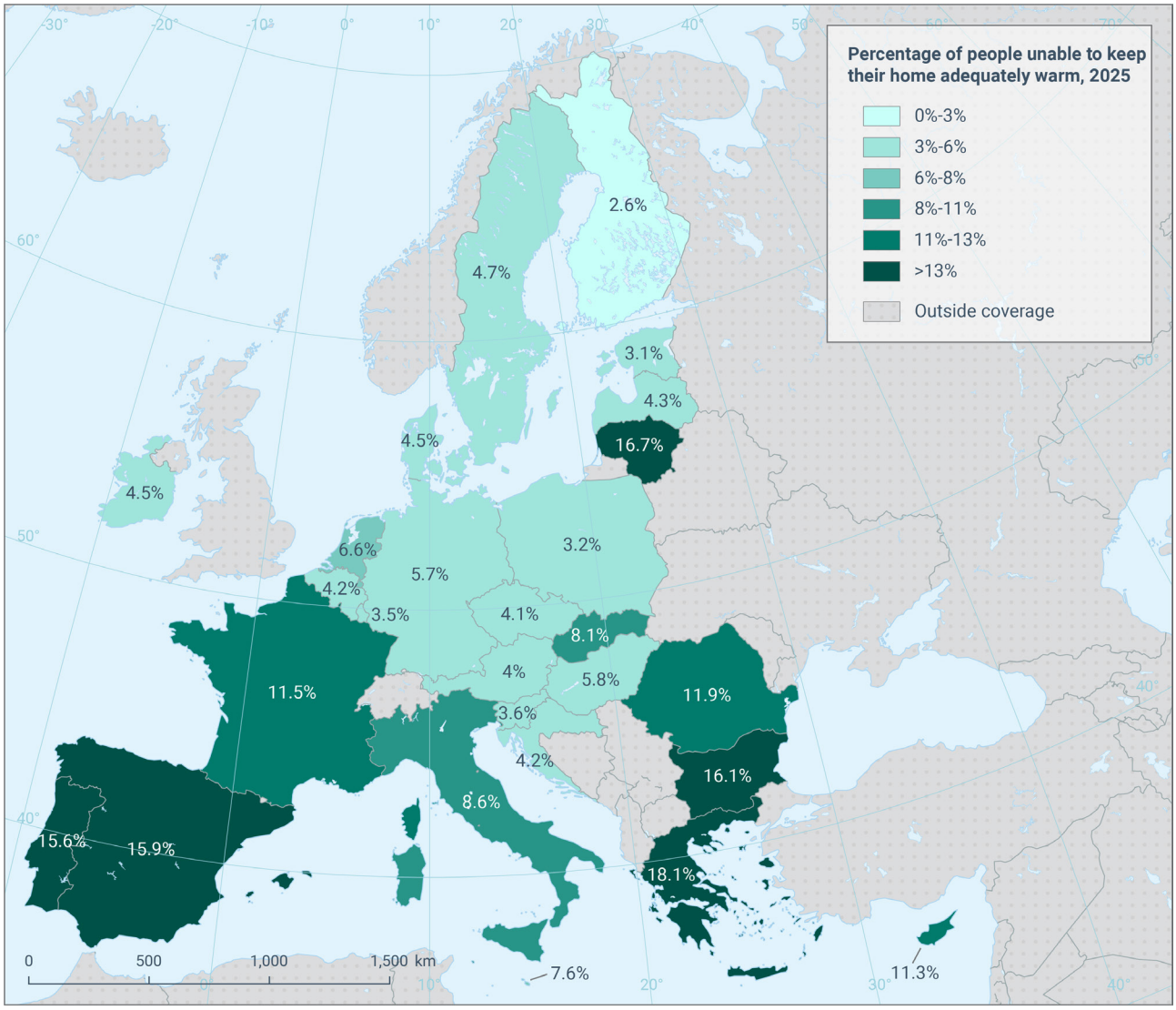
Notes: FEC, final energy consumption; t, tonnes.

View the interactive version of the chart.

Sources: EEA and Eurostat.

(1) In 2025, 38.2% of EU households could not afford to keep their home adequately cool in summer according to Eurofound EQLS e-survey; this figure should be interpreted cautiously since the method is based on a non-representative sample (EEA, 2026a).

Map 1.1 Share of households unable to keep their home adequately warm, 2025



Reference data: © EuroGeographics, © FAO (UN), © TurkStat Source: European Commission – Eurostat/GISCO

Source: Eurostat.

Box 1.1

Definition of energy poverty and vulnerable households

The 2023 Energy Efficiency Directive defines energy poverty as follows: 'Energy poverty' means a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health. This includes adequate heating, hot water, cooling, lighting and energy to power appliances in the relevant national context, existing national social policy and other relevant national policies.'

Following the Commission's 2020 and 2023 recommendations on energy poverty and accompanying Staff Working Documents, the three underlying causes are stated as being a high proportion of household expenditure spent on energy, low income, and low energy performance of buildings and appliances.

Article 2(28) of the recast Energy Performance Building Directive defines 'vulnerable households' as households in energy poverty or households (including lower middle-income households) particularly exposed to high energy costs and which lack the means to renovate the building they occupy.

Source: Energy Efficiency Directive and Energy Performance of Buildings Directive.

Electricity and gas prices (including taxes) for households rose steadily after 2021, following the Russian invasion of Ukraine. They peaked in the first half of 2024 and did not show a clear decreasing trend in 2025 (Eurostat, 2026b). In 2026, the Iran war has reintroduced similar dynamics to those seen after the invasion of Ukraine, with rising fossil fuel prices, renewed inflationary pressures and supply chain risks. The cost of gas-fired power across Europe has increased by over 50% due to the spike in gas prices in the beginning of the conflict (EMBER, 2026).

Looking ahead, the introduction of the EU's new Emissions Trading System 2 (ETS2) in the buildings sector will affect the cost of fossil fuel heating across the economy (ETC CM, 2026). Through a price signal, it will incentivise consumers to decrease fossil fuel use and progressively change the economic case of heating technologies in favour of electrification. However, a carbon price puts proportionally more financial burden on lower- and middle-income households, as energy takes a comparatively larger share of their overall budget. The Social Climate Fund (SCF) aims to safeguard a just transition by supporting targeted investments and measures under Member States' social climate plans (SCPs). These will be partly financed through revenues from the auctioning of ETS2 emission allowances (EEA, 2026b). The overall goal of the SCF is to support vulnerable households in reducing their energy consumption and transitioning away from fossil fuels.

Households facing energy poverty (see Box 1 for definition) are compelled to reduce heating energy consumption to a degree that negatively impacts their inhabitants' health and well-being. Energy poverty issues in the EU predate the recent energy crisis: for example, the share of the population not able to keep their houses warm stood at 11.2% in 2012. In summer, active cooling solutions, such as air conditioning — even if the equipment is affordable — lead to higher electricity costs [2]. In the context of price increases, this would push households with the lowest incomes into summer energy poverty.

(2) See for instance the 2026 situation in Italy: Many Italians Long Resisted Air-Conditioning. Then Europe Got Hotter. - The New York Times, 3 Sept 2026.

Research shows that energy poverty (both winter and summer) results from the interaction of multiple factors, including low income and broader economic conditions, energy prices, weather conditions, household characteristics and the energy performance of dwellings, as well as the efficiency of governance processes (Bouzarovski, 2013; Ben Cheikh et al., 2023; Certomà et al. 2023; Rodriguez-Alvarez et al., 2021; JRC, 2026a et al., 2026).

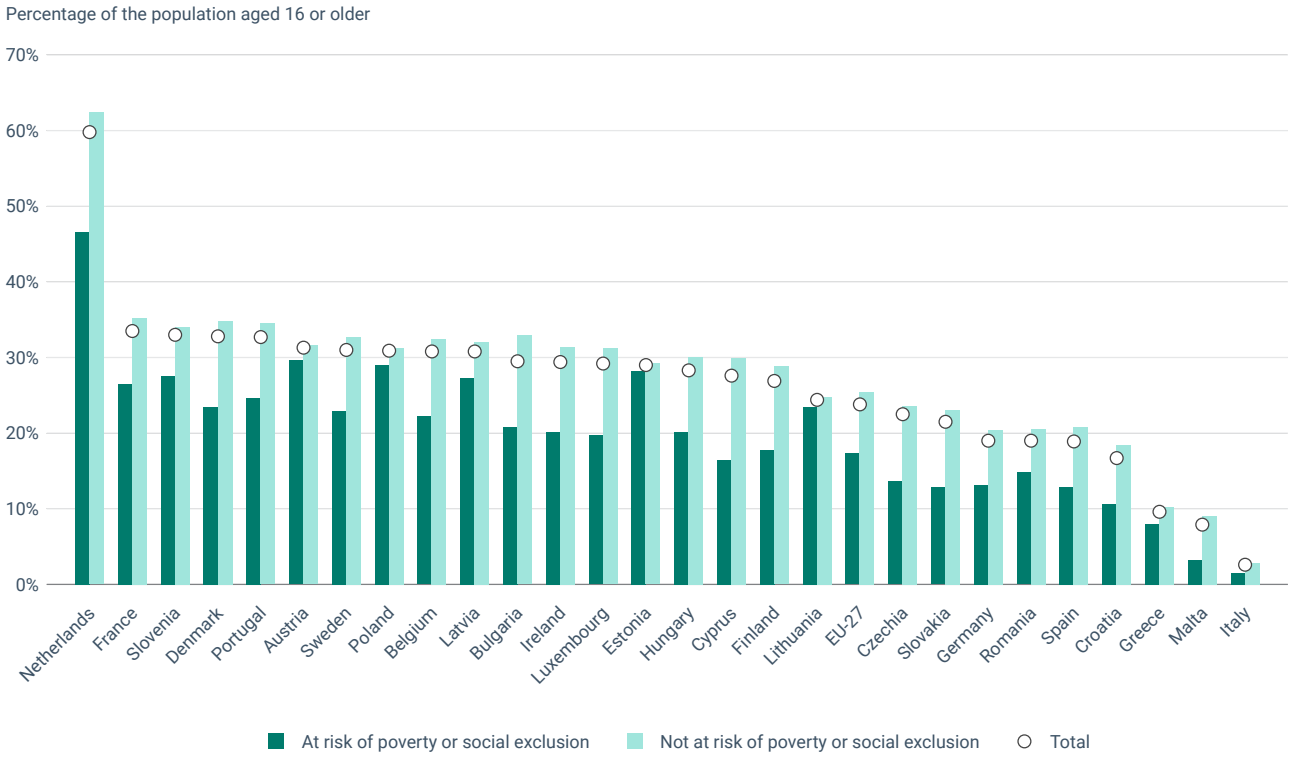
Dwelling improvement measures tend to disproportionately benefit higher-income homeowners

Households in a vulnerable situation (See Box 1 for definition) are well positioned to benefit from improved housing energy performance. It can ease access to adequate housing, cut energy bills, reduce dependency on fossil fuels and in turn reduce inequalities (Giandomenico et al., 2022; EEA and Eurofound, 2021; FRA, 2026). Benefits of energy renovation for low-income households include better mental health, lower anxiety regarding finances due to lower arrears, improved school attendance and better social inclusion (Eurofound, 2023).

However, in practice energy renovation improvement measures tend to disproportionately benefit higher-income homeowners who can afford to subsidise energy renovation (EP, 2023; EEA, 2026a; FRA, 2026). As shown in Figure 1.5, relatively fewer people at risk of poverty and social exclusion benefited from improvements in home energy efficiency between 2020 and 2025 compared to those not facing such risks. It may partly reflect the effect of national subsidy programmes. This pattern was seen consistently across all Member States, except Estonia.

This finding is supported by ex post policy evaluations. Schleich (2019) found that in Italy, Poland, Romania, Spain and Sweden, people belonging to the lowest homeowner income quartile are associated with statistically significantly lower retrofit adoption propensity than homeowners belonging to the highest income quartile. In Germany, the funding programme for efficient buildings was found to be primarily used by high-income households (Braungardt et al., 2023). An analysis of Italy's Superbonus policy finds that higher-income households were more likely to undertake retrofitting and receive a greater share of public funds (Forni et al., 2025). Expert interviews from Germany, Spain and Slovakia confirmed this general pattern (ETC ST, 2025), which was also seen for climate-resilience measures such as shading and cooling (EEA, 2026).

Figure 1.5 **People living in dwellings in which energy efficiency improved between 2020 and 2025, by risk of poverty or social exclusion situation (in % of the population aged 16 or older)**



Notes: Germany: data not fully reliable; Lithuania: provisional data.

View the interactive version of the chart.

Source: Eurostat.

Specific challenges in the rented sector

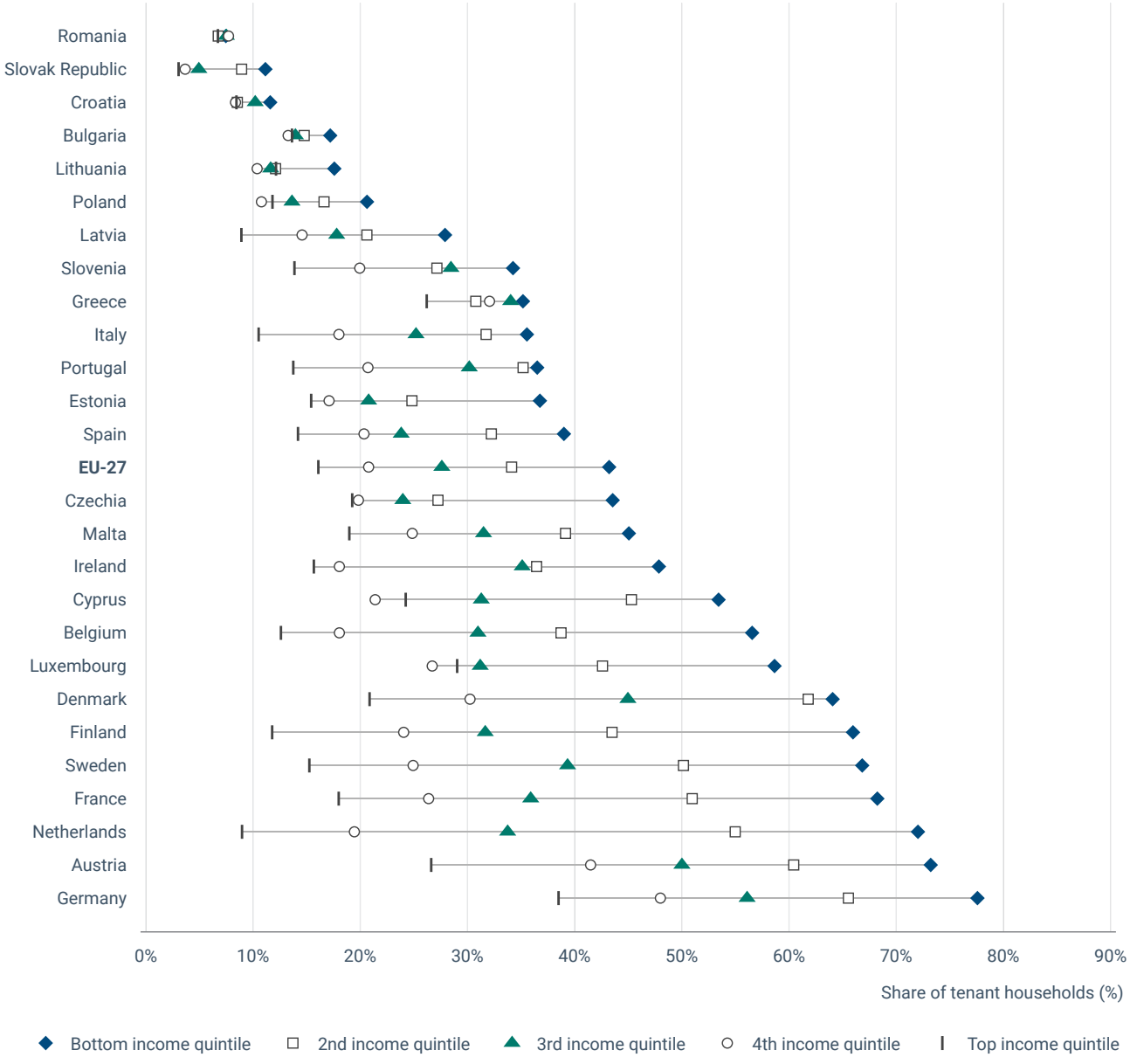
In 2025, 16.7% of tenants in the EU reported energy-efficiency improvements to their home over the past five years, compared with 26.9% of owners (Eurostat, 2025). This gap is consistent with the well-recognised landlord-tenant dilemma, whereby landlords bear renovation costs and tenants capture the resulting energy savings as well as non-economic benefits. Energy renovation costs for rented buildings may also ultimately fall on those least able to afford them through rent increases, even when the cost is partially covered by public subsidies.

These are significant concerns in countries where the rental market share is high and lower-income households tend disproportionally to live in rented housing. In 10 Member States, over 30% of the population live in rented housing. In Germany and Austria, almost half of the population lived in rented housing in 2024, compared with an average of 32% across the EU. Only 22% and 27% of the bottom quintile (the 20% lowest income households) owns their home in these countries (against an EU average of 57%) (Figure 1.5). (OECD, 2026a; and Eurostat, 2025).

The same situation, albeit to a lesser extent, is present in the Netherlands, France, Sweden, Finland, Denmark, Luxembourg and Belgium. In these countries, profit-driven retrofits pose a significant issue in the rental market. Renovations lead to rent increases, which disproportionately weigh on lower-income households. Renovated homes may also increase property values and accelerate gentrification. Residents

in housing with low energy performance (often low-income renters) are particularly exposed to rental market shifts and price shocks (EEA, 2024c).

Figure 1.6 **Share of households renting their house (including other and unknown) across the income distribution in 2024**



Note: Data for Hungary not available.

View the interactive version of the chart.

Source: OECD, Affordable housing database.

Economic pressure on energy renovation finance

Recent economic conditions make financing renovations challenging for many households. House prices and rents across the EU increased by an average of 53% and 25%, respectively, between 2010 and 2024 (albeit very unevenly across Member States) (Eurostat, 2025). Inflation was 39% over the same period, again with substantial differences between Member States (Eurostat, 2025). Real wages

declined across the euro area during a period of high inflation in 2022, before largely recovering by early 2025 (ECB, 2025). To counter inflation, interest rates were raised from historically low levels between 2022 and 2024. This made credit more expensive and harder to access, particularly for lower-income households and first-time borrowers (ETC ST, 2026). Interest rates began to fall again in June 2024 and increased again in 2026.

Alongside these household financing pressures, public support for energy renovation competes with other spending priorities and may face budget reductions or tighter targeting where governments seek fiscal savings (OECDb, 2026). European Commission (EC) simulations of the 2026 energy price shock indicate that low-income households would be the most affected by higher energy and food prices, as these items account for a larger share of their consumption basket (EC, 2026a).

Policy design should improve to increase participation among low-income, energy-poor and vulnerable households and to protect them against disproportional unintended effects. This means considering eligibility criteria, subsidy rates, financing mechanisms or accompanying support services. This is an opportunity to accelerate the energy renovation rate. Without such considerations, there is a risk that policies could widen housing and energy inequalities and trigger social rejection.

Diverse pathways to renovation

There are several well-known technical options and strategies to cut emissions and energy demand for heating and cooling from buildings, while keeping homes warm and cool.

Energy demand for heating and cooling can be reduced through energy efficiency and design measures, such as insulation, thermal mass, bioclimatic architecture, ventilation, passive cooling and heating, efficient active technologies (e.g. reversible heat pumps), green roofs, and façades, shading and shutters.

Energy for heating and active cooling can also be decarbonised via renewable electricity from the grid, bioenergy, solar roof PV panels and hybrid options, solar thermal for example. Decarbonised heat and cooling can also be sourced from district systems.

Nature-based solutions in the surrounding of buildings, urban cooling measures reduce emissions, as does the application of circular economy principles, including using biobased insulation products, reuse of materials and optimisation of the use of available space (EEA, 2022a, 2022b, 2022c, 2023a, 2023b, 2024a).

The behaviour of final users can also be influenced. Education, communication, nudging and providing information on energy bills have all proven to be effective measures, both for heating in winter and cooling in summer (EEA, 2023b) [(3)].

Starting points and pathways for socially just renovations differ across Member States and building types. The challenge is to identify and deploy the optimal

(3) Although not the focus of this report, storage for electricity and thermal energy is a key enabler for the integration of renewable energy sources and the electrification of energy demand needed in buildings. Personalised environmental control systems (PECS) may also be considered as a complementary measure within building renovation strategies, alongside improvements to the building envelope and heating and cooling systems. This is particularly true where more individualised or localised provision of thermal comfort can avoid unnecessary heating and cooling of entire spaces. However, much of the available evidence on PECs is based on laboratory or simulation studies and evidence from real-world residential applications remains limited (Al-Assaad et al., 2025; Olsen et al., 2026).

combination of options. There is no one-size-fits-all strategy, as the building stock varies between and within Member States, with their unique geographical differences, climatic conditions and variety of construction types.

Technical solutions must therefore be tailored depending on present contexts, future climatic conditions, existing infrastructures and locally available renewable energy and material resources (such as the sustainable use of locally produced biomass resource).

The capacity, needs and preferences of inhabitants and the present and future use of the building must also be considered when designing solutions.

On the business side, renovation deployment requires aligning homeowners (individuals or associations of owners of multi-family buildings), tenants, building managers, financial institutions, contractors and public authorities. Their knowledge, incentives, capacities and timelines can differ. All these data can significantly influence the path, technical feasibility, cost-effectiveness and sequencing of renovation and heating and cooling decarbonisation measures. This is partly addressed in the recast EPBD (see Box 1.2 and 2.2).

Box 1.2

Definition of deep energy renovation

So far, the concept of 'deep renovation' has not yet been defined in EU law.

The recast EPBD (2024) introduces a definition in Article 2(20), namely a renovation in line with the 'energy efficiency first' principle. This focuses on essential building elements and those which transform a building or unit into a near-zero or zero-emission building before 1 January 2030 and from 1 January 2030, respectively.

Furthermore, Art 2(21) EPBD (2024) introduces the definition of 'staged deep renovation' as a deep renovation carried out in a maximum number of steps.

Recital 45 also stipulates that a deep renovation for energy performance purposes may also be a prime opportunity to address other aspects, such as indoor environmental quality, living conditions of vulnerable households, climate resilience, resilience against disaster risks (e.g. seismic resilience, fire safety, the removal of hazardous substances like asbestos) and accessibility for people with disabilities.

Article 17(16) additionally provides that, for the purposes of financial incentives under that paragraph, where transformation into a zero-emission building is not technically or economically feasible, a renovation achieving at least a 60% reduction in primary energy use is considered a deep renovation.

Source: Energy Performance of Buildings Directive.


© Westersoe via Getty Images

2 EU policy framework for energy renovation

Action to promote energy efficiency and alleviate energy poverty

Energy renovation was a cornerstone of the European Green Deal (2019) and remains a priority under the 2025 Competitiveness Compass. The 2020 Renovation Wave set the goal of renovating 35 million buildings in the EU by 2030, at least doubling the annual rate of energy renovations. The strategy had a broad set of objectives, including cutting energy consumption and GHG emissions, creating jobs in construction and tackling energy poverty, as well as decarbonising heating and cooling.

In the context of the Fit for 55 package, new or revised legislation steering energy renovations of residential buildings includes:

- the recast Energy Performance of Buildings Directive (EPBD, 2024), which defines new targets for the renovation of the residential building stock and introduces strengthened national planning tools, information tools and technical assistance, with a focus on supporting vulnerable households;
- the Energy Efficiency Directive (EED, 2023), which requires Member States to reduce final use of energy in residential buildings by accelerating cost-effective energy efficiency improvements and alleviating energy poverty, based on the energy efficiency first principle (see Box 2.1);
- the Renewable Energy Directive (RED, 2023), which sets the indicative target that the buildings sector sources at least 49% of final energy consumption from renewables by 2030.

Box 2.1

Definitions and principles in the Energy Efficiency Directive (EED)

The EED embeds the energy efficiency first principle and state:

"Member States shall promote and, where cost-benefit analyses are required, ensure the application of, and make publicly available, cost-benefit methodologies that allow proper assessment of the wider benefits of energy efficiency solutions where appropriate, taking into account the entire life cycle and long-term perspective, system and cost efficiency, security of supply and quantification from the societal, health, economic and climate neutrality perspectives, sustainability and circular economy principles in transition to climate neutrality."

The EED states that:

"People facing or risking energy poverty, vulnerable customers, including final users, low- and medium-income households, and people living in social housing should benefit from the application of the energy efficiency first principle. Energy efficiency measures should be implemented as a priority to improve the situations of those individuals and households and to alleviate energy poverty, and should not encourage any disproportionate increase in housing, mobility or energy costs. A holistic approach in policymaking and in implementing policies and measures requires Member States to ensure that other policies and measures have no adverse effect on those individuals and households."

Source: Energy Efficiency Directive.

In their revised versions of 2023 and 2024, both the EED and the EPBD took a step forward in their consideration of socioeconomic dimensions, the multiple co-benefits of energy renovation, the development of renewable energy, climate adaptation and circular economy principles. Both directives call on Member States to implement energy efficiency measures that address those affected by energy poverty, vulnerable customers and, where applicable, people living in social housing and to monitor their impact. Tools like energy performance certificates and renovation passports target behavioural dimensions and step-by-step renovation simultaneously (Box 2.1). They align with the EC Recommendation on energy poverty (EC/2023/4080), its guidance document and the renewed Joint Declaration on enhanced consumer protection for the winter.

The energy efficiency first principle stipulates that wider benefits are to be considered (Box 2.1) and the revised 2024 EPBD explicitly broadens the cost optimality calculation. Member States use this EU-required method to identify the cheapest level of renovation over a building stock's lifetime. This in turn shapes how ambitious national requirements are. By obliging Member States to factor in the cost of carbon emissions, health impacts and environmental externalities, the EPBD directive makes energy renovation benefits more appealing and aims to justify greater ambition.

The EPBD also promotes the integration of renewable energy, for example by the installation of solar PV production systems on roofs. This is also addressed in the Renewable Energy Directive (RED). The circularity dimension of the renovation wave is reflected in life-cycle approaches to decarbonise European buildings and is supported by the construction products regulations. These increasingly include environmental and sustainability-related characteristics under the revised EPBD regulation.

From a practical planning perspective, the EPBD mandates Member States to submit draft National Building Renovation Plans by December 2025 and final plans by the end of 2026. The plans should support the progressive renovation of residential buildings setting quantified milestones. Sixteen draft plans were submitted between December 2025 and May 2026.

The effectiveness of the EPBD will only become clear once it has been fully transposed into national law.

Box 2.2

Measures to boost the renovation of residential buildings under the EPBD

Under the EPBD, each Member State must develop its own national building renovation plan, setting out the national strategy to decarbonise the building stock, including areas such as financing and training skilled workers. These plans will be tailored to the national building stock and circumstances and build upon the current long-term renovation strategies.

For the **residential building stock,** each Member State will adopt its own national trajectory to reduce the average primary energy use of residential buildings by 16% by 2030 and 20-22% by 2035. This allows sufficient flexibility to account for national circumstances. EU countries are free to choose which buildings to target, and which measures to take, as long as at least 55% of the decrease in the average primary energy use is achieved through the renovation of 43% of the worst-performing buildings.

Recognising the differences between EU countries as regards the existing building stock, geography and climate, the directive allows governments to decide on the **renovation measures best suited** to their specific national context. Countries can also exempt various categories of buildings from renovation requirements, including historical buildings and holiday homes.

Information tools will support building owners in their renovation journey. Strengthened **energy performance certificates (EPCs),** based on a common template and common criteria for energy performance categories, will increase citizens' awareness of the energy performance of the building they inhabit and help mobilise bank financing. The newly introduced **building renovation passports** will guide building owners who wish to carry out an energy renovation in several steps.

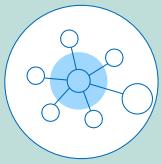
Source: Energy Performance of Buildings Directive.

Box 2.3

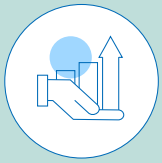
One-stop shops for building renovation and energy efficiency



They aim to **accelerate the uptake of energy efficiency and simplify the renovation journey**, making it shorter and easier to manage - with support from experts on identifying cost-effective measures, improving the sustainability and quality of energy renovations and facilitating access to public aid and finance.



They serve as **centralised hubs** where citizens and enterprises can get comprehensive information and support at all stages of this journey.



They **address barriers** which might discourage building owners from renovations and **encourage to improve the building's energy performance**, and more broadly to adopt **energy efficiency measures**.

Source: European Commission.

In March 2026, the European Commission published a support package to boost energy efficiency financing, including a recommendation to unlock private investment and practical guidance on the establishment of one-stop shops for improving the energy efficiency and performance of buildings (Box 2.2). The July 2026 Electrification Action Plan includes relevant objectives for the residential buildings sector. This includes addressing disparities in electricity and gas prices, as well as doubling the heat pump installation rate to 4 million per year by 2030, with a long-term goal of 100 million installed units.

Overall, while EU directives provide clear goals and frameworks, their success depends heavily on ambitious and effective implementation at national and local levels, where financing schemes, social targeting mechanisms and institutional capacities are largely determined.

ETS2 and the Social Climate Fund

ETS2 goes hand in hand with the Social Climate Fund (SCF), which is funded by revenues from auctioning allowances and Member State contributions. The SCF will support people and very small businesses across the EU. In relation to households, it will focus on those vulnerable to rising heating and fuel prices, including those in energy and transport poverty. More support from the SCF will be available in EU countries where incomes are lower and energy or transport poverty is more widespread.

The SCF should safeguard a just transition by supporting targeted investments and measures under the social climate plans that each Member State must submit to the European Commission. The plan must set out the measures planned in 2026-2032 to support those most affected by the green transition. The Commission will assess each plan and release funding once key milestones and targets set for each measure are met.

Effective implementation and acceptance of ETS2 and the SCF will require robust stakeholder engagement, transparency both in processes and the use of auctioning revenues, coherent communication and the delivery of tangible and immediate co-benefits from funded actions. They include energy poverty reduction, improved health outcomes and lower energy bills (EEA, 2026).

Action on affordability and neighbourhood regeneration

Under the auspices of the European Commissioner for Energy and Housing, the 2025 European Affordable Housing Plan sets out a plan for affordable, sustainable and quality housing, as a response to the EU housing crisis and associated social concerns. Recognising that energy costs represent a major share of household expenditure, the plan foresees action to cut energy bills by speeding up renovation, to increase the energy performance of residential buildings and support the development of National Building Renovation Plans under the EPBD.

The affordable housing plan is complemented by the March 2026 Citizens' Energy Package, which aims to further lower energy bills, deliver a just transition and eradicate energy poverty. The EC recommendation on empowering energy communities and self-consumption of April 2026, accompanied by the Energy Communities Action Plan, sets out practical measures to empower communities and households to produce their own renewable energy and save on their energy bills. These include tools to tackle existing administrative, technical and financial barriers.

The European Housing Alliance, launched in May 2026 under the new European Affordable Housing Plan, aims to connect all levels of governance to harness housing expertise and best practices from across Europe. The aim is to move beyond consultation, towards action to support, coordinate and amplify local, regional and national efforts that reflect Europe's diverse housing needs and systems.

The forthcoming Pan-European Investment Platform for Affordable and Sustainable Housing will help better coordinate existing EU, national and local financing instruments and improve their combined effectiveness, ensuring the efficient use of available resources. This includes promoting blended finance and stronger project pipelines to mobilise investment at scale. The new Better Homes Partnerships, foreseen for 2026, should help overcome practical barriers at the local level to delivering finance and achieving scale. These initiatives build on longer-standing support at the local level, such as the Horizon Europe mission on climate-neutral and smart cities and the Energy Poverty Advisory Hub. This leading EU initiative aims to eradicate energy poverty and provide technical assistance to local authorities to diagnose and act on it, including by helping low-income households to renovate. More broadly, the New European Bauhaus initiative promotes neighbourhood regeneration and improves access to funding for community-led solutions for affordable housing.

EU funding for renovation

EU public funding streams for the 2021-2027 programming period are substantial. The multi-annual financial framework (MFF) already allocates significant resources to energy efficiency in buildings. Complementing these funds, the Recovery and Resilience Facility (RRF) was established in 2021 as a temporary instrument to support the EU's recovery from the COVID-19 pandemic, providing additional exceptional funding for investments including building energy renovation.

The RRF allocated around EUR 79.4 billion to energy efficiency in buildings (EC, 2026b), representing around 77% of the total allocation for energy efficiency. One study found

that 58% of RRF funding in 18 Member States is concentrated in the residential sector (Renovate Europe, 2023). In early 2026, nearly 40% of the RRF remains undisbursed (Coface, 2026).

The Cohesion Policy Funds for improving the energy performance of buildings, including money pledged by Member States from their own budgets, has reached EUR 29 billion. Around 32% of this is allocated for housing (Renovate Europe, 2023, EC, 2026b).

Revenues from auctioned ETS1 allowances bring further resources for Member States to use directly for energy renovation of buildings. They also feed the Modernisation Fund, which is designed to help lower-income Member States improve energy efficiency and modernise their energy systems. By the end of 2023, the fund had disbursed EUR 3 billion for energy efficiency investments. This figure is expected to reach EUR 6.8 billion by the end of 2027 (EC, 2026b). Energy efficiency investment and the development of innovative financing for building renovation is supported by the 2026 comprehensive support package for energy efficiency financing. Looking ahead, the Social Climate Fund, funded by revenues from ETS2, adds additional targeted funding of EUR 86.7 billion to support energy efficiency and sustainable transport.

An unprecedented volume of EU-level financing for the 2021-2027 period has therefore been made available for renovation. However, these funds cannot cover all investment needs. Private funding is also needed and Member States must ensure the funding delivers expected results (Renovate Europe, 2023). The EU Taxonomy for sustainable activities can indirectly further catalyse private finance for energy renovation.



© Ferenc Erdélyi, My City/EEA

3 Investment in renovation yields multiple long-term benefits

Investment needs for the energy renovation of residential buildings

To reach EU targets for the reduction in primary energy demand from residential housing by 2030 and 2040, the level of investment in renovation of both residential and non-residential buildings remain below its potential (FIEC, 2026) and must be boosted significantly (I4CE, 2026a).

The Institute for Climate Economics estimates that a minimum of EUR 97 billion per year until 2030 is needed in the residential buildings sector alone. This is in addition to the EUR 59 billion needed for heat pumps (Figure 3.1) (I4CE, 2026a). Total investment in the residential sector was EUR 70 billion In 2025. This leaves an investment deficit of EUR 85 billion against the estimated yearly need (I4CE, 2026a) [(4)]. If considered together, residential and non-residential buildings and heat pumps require an investment of EUR 276 billion per year, leaving a gap of EUR 164 billion (I4CE, 2026a). These figures align well with the estimates made by Bruegel (2004): a need of EUR 297 billion and a gap of EUR 149 billion (Bruegel, 2024).

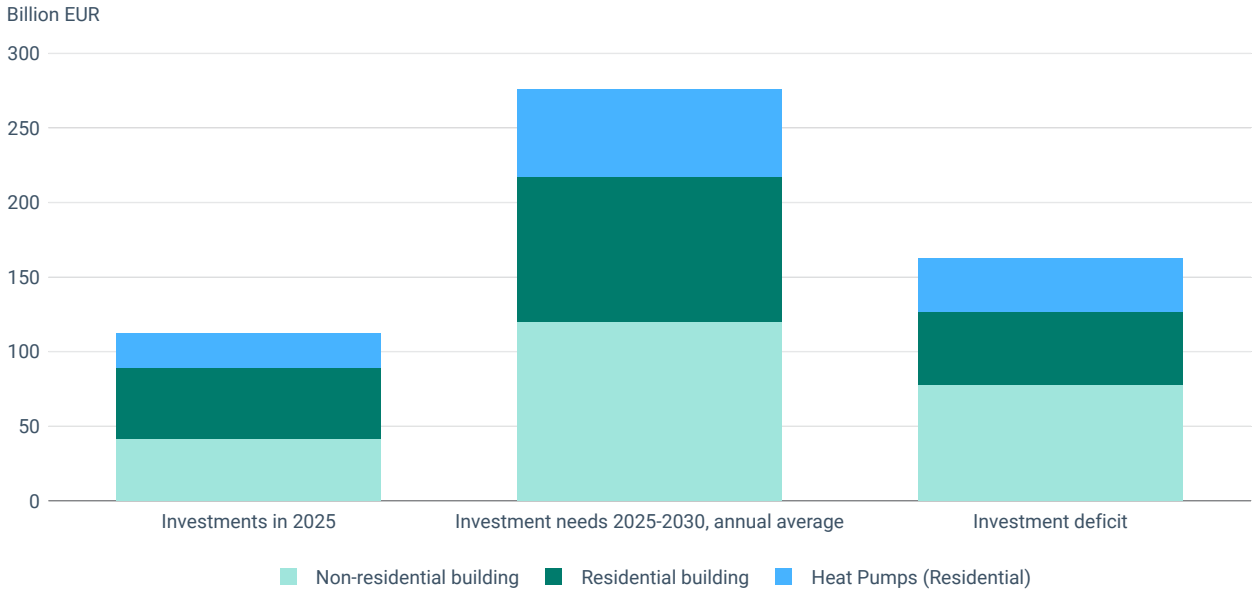
Depending on the scope considered and the deepness of the renovation assumed in studies, estimates of the yearly investment need may be higher. Looking ahead, the European Commission estimates that between EUR 218 billion and EUR 243 billion is needed each year from 2030 to 2040 to deliver the necessary energy renovation in the residential sector. This includes renovation of heating and cooling, electrical appliances and lighting (EC, 2024a). Climate & Partner estimates a need of EUR 222 billion per year from 2023 to 2050 to deeply renovate (following the EPBD definition) all EU homes and residential buildings (Climate Strategy & Partners, 2023).

EU-level data and evidence are lacking for the required level of summer comfort investment. Existing data should be treated carefully. Specific studies suggest addressing this need effectively may increase investment needs (Monge Palma et al., 2024). Additional costs, from the difference in price between a deep energy retrofit and the same operation considering summer comfort (including boosted night ventilation, insulation with good thermal inertia, solar shading and Canadian wells) is estimated at around 10% (I4CE, 2024; EC, 2026c).

The figures are significant but within reach. As a point of comparison, the EU imported more than EUR 100 billion of natural gas in 2025 (Eurostat, 2026b).

(4) 'Residential buildings' includes exclusively investment needs for thermal renovation of homes (only medium and deep renovation) and excludes needs for the installation of heat pumps. 'Heat pumps' covers only the installation of heat pumps in the residential sector to reach the target the 2030 REPowerEU targets of over 30 million heat pumps installed in the residential sector.

Figure 3.1 **Average yearly investment needs and deficit to achieve EPBD target for building renovation**



Notes: All data are in euros.

View the interactive version of the chart.

Source: I4CE.

Multiple benefits of investing in building renovation

Studies can provide estimates as to the potential direct benefits and co-benefits of energy renovation. They are based on a variety of modelling, assumptions and projections that may differ from reality. Results of the studies are therefore not always directly comparable and should be interpreted caution [(5)]; however, overall they show that renovation delivers direct benefits and co-benefits, with returns far exceeding upfront costs once the full set of socio-economic benefits is counted.

Regarding direct benefits, expanding the energy renovation of buildings has the potential to reduce energy demand, keep energy bills under check, improve energy security, shift demand towards sustainable heating technologies, reduce dependency on fossil fuels and exposure to price hikes and boost the value of buildings. As more buildings connect to electrified systems, new consumption patterns emerge, with implications for pricing and energy infrastructure and opportunities from the transformation of the electricity system (EEA, 2024d).

Energy renovation is expected to deliver significant improvements in health and well-being through improved housing conditions and lower air pollution. Going further, the reduction of energy poverty has broader societal impacts, including decreased public spending on social aid and health and improved social stability.

Boosting renovation influences labour markets, creating jobs in the construction and maintenance sectors. Renovate Europe (2020) estimates that every EUR 1 million investment in energy renovation created 15 to 29 local jobs, depending on Member States context (an average of 18 in the EU). In addition to financial savings, economic

(5) A detailed analysis of the methodology used in the studies cited is beyond the scope of this short report and is not discussed in this analysis.

growth and the boost to local economies, social and environmental benefits contribute to greater urban liveability and community cohesion, while fostering public acceptance of changes in the built environment (IEA, 2025b).

Examples of the direct benefits and co-benefits of energy renovation are described below.

Examples of direct benefits

- **Energy savings**: every EUR 1 invested in energy efficiency translates into EUR 12 in savings on energy costs over the lifetime of the housing investment (EC, 2026b). Estimates suggest energy efficiency measures implemented in buildings between 2020 and 2024 generated energy savings of around 25 million tonnes of oil equivalent (Mtoe), corresponding to the cumulative gross inland energy consumption of Hungary in 2024 (EC, 2024b).

- **Structural energy poverty cuts**: energy renovations can alleviate the burden of high energy costs, particularly for vulnerable populations in urban areas with inadequate housing and high energy expenses (EC, 2025b, JRC, 2025). It also prevents households in a vulnerable situation from falling into energy poverty.

- **EU energy security**: energy security is a major political concern for the EU. The 2022 energy crisis exposed how directly the EU's security of supply is tied to the fossil energy demand of its building stock. Around 36% of EU natural gas imports are used for heating buildings (EC, 2026d)):

  - Energy renovation is one of the few structural levers able to reduce the EU's gas dependency permanently. It addresses the crisis at its root by reducing energy demand (European Scientific Advisory Bord on Climate Change, 2023) and contributes to a structural shift both in terms of consumption levels and fuel type.

  - The Commission's spring 2026 analysis attributes the EU's reduced vulnerability to the 2026 fossil energy shock to structural shifts, including energy renovation. By permanently lowering the heating demand that drives the EU's gas-import exposure, investment in energy renovation contributes durably to improvements in energy security.

- **Energy system efficiency**: well-designed energy renovation enables better management of energy demand overall, including during daily pick demand whereby well-insulated buildings reduce the strain on the grid at its most critical and expensive times. This points to a significant co-benefit: less need for additional backup power plant capacity, while some investments in transmission and distribution infrastructure can be reduced or deferred. On average, energy efficiency costs less than half the amount it would cost to build new capacity and grid infrastructure (IEA, 2025a).

Examples of co-benefits

- **Environmental benefits**: in regions where residential heating relies on fuelwood, improved building energy efficiency can reduce wood demand and thereby ease pressure on forest resources (Harmat et al., 2026). Bio-based materials for insulation can temporarily store carbon (Galimshina et al., 2022). From a life cycle perspective, deep renovation can lower life-cycle environmental pressures (where renovation substitutes for demolition and replacement construction) (EEA, 2024a).

- **Health benefits from improved indoor conditions**: energy renovation improves housing conditions by reducing damp and mould and improving thermal comfort. This can bring health benefits (e.g. cardiovascular and respiratory) to residents (Li L. et al, 2025). Such benefits at scale can translate into reduced mortality, reduced morbidity and cost savings for the health system while improving productivity in the labour force. Potential savings from improving indoor conditions are estimated at over EUR 600 billion by 2050, mainly through productivity gains (RAND, 2022). One study estimated that inadequate housing costs the EU EUR 167 billion annually in health-related costs alone. For every EUR 3 invested, EUR 2 is returned each year (Eurofound, 2023). Solid fuel use (e.g. fireplace/stove) may also affect indoor air quality and be associated with health risks (Mehta et al., 2023).

- **Health benefits from improved outdoor air quality**: residential heating is a key driver of air pollutant emissions such as particulate matter ($PM_{2.5}$), SO_2 and NO_2. Burning solid biomass and fossil fuels for residential heating contributes significantly to $PM_{2.5}$ emissions in some Member States. In the EU-27, 182,000 deaths were attributable to exposure to $PM_{2.5}$ concentrations above the WHO guideline level of 5µg/m^3 in 2023. This resulted in 1,914,000 years of life lost (YLL) (EEA, 2026). Around 63% of $PM_{2.5}$ emissions in the EU were from residential, commercial and institutional buildings in 2023 (EEA, 2025b). As such, air pollutant emissions from buildings contribute to an estimated EUR 600 billion in losses each year in the EU, representing 4% of total EU GDP (Mejino-López and Oliu-Barton, 2024). By impacting cognitive performance and long-term health, these emissions also perpetuate social inequality. Improving insulation and upgrading heating systems as well as installing low-emission boilers or switching to cleaner fuel types help to reduce $PM_{2.5}$ emissions (EEA, 2025b).

- **Benefits to mental health and well-being**: greater control over energy expenses fosters a sense of financial security, while visible home improvements can enhance social status and self-esteem. Reducing thermal discomfort and fuel poverty tend to decrease anxiety, stress and depression, particularly when complemented by financial support mechanisms and strong community engagement to fight poverty (IEA, 2025b; Eurofound, 2023). Lower pollutant emissions due to clean heating are also expected to reduce dementia (Eurofound 2025). The combined costs of poor air quality, damp, a lack of light, noise in dwellings and inability to keep the house adequately warm are estimated at EUR 258 billion per year for 14 European countries (RAND, 2022).

- **Benefit in terms of heat-related mortality**: building energy renovation, if well designed with thermal phase shift materials, can bring benefits both in winter and in summer (EEA, 2022c) and help to reduce fatalities in summer [(6)]. Heatwaves were responsible for 86-91% of fatalities caused by climate-related extreme events between 1980 and 2020, causing 77,000-129,000 deaths across the 32 EEA member countries (EEA, 2022c). The summers of 2022 and 2023 saw more than 60,000 and 47,690 heat-related deaths in Europe, respectively. Italy, Spain, Germany, France and Greece bore the heaviest burden (Ballester et al., 2023). As such, adapting Europe's housing to ensure people can remain cool during heatwaves is urgently needed and identified as a core element for reducing heat exposure (WHO, 2026).

(6) Winter (cold-related) mortality is currently far higher than heat-related mortality in Europe, with an approximate 8:1 ratio; heat mortality is six times higher in southern Europe than in northern Europe. However, this gap is projected to narrow under future warming scenarios as heat-related mortality rises faster than declines in cold-related mortality (Garcia L. et al., 2024).

Energy performance gap, prebound and rebound effect

Studies acknowledge energy savings achieved through building renovations may be lower than those projected by simulation models or energy performance certificates (Giraudet and Vivier, 2024; Ramboll, 2022; Astier et al., 2024; European Court of Auditors, 2026). Modelling and software are valuable tools but generate a persistent gap between predicted and actual energy performance (OECD/IPEEC, 2019, Filippidou et al., 2019; Giraudet and Vivier, 2024; Hajian et al., 2024). Behavioural factors, quality issues, occupancy patterns, weather data and technical assumptions all influence real world energy use that models fail to capture adequately. This indicates knowledge gaps that require further attention.

From a behavioural perspective, the direct rebound effect (consumer tendency to use more energy due to the economic gains achieved through efficiency improvements) reflects users heating and cooling rooms more intensively or frequently than anticipated for comfort reasons. Before renovation, low-income households in poorly performing buildings (or with no installed heating and cooling systems) consume markedly less energy than needed for full thermal comfort (Sunikka-Blank & Galvin, 2012; Galvin & Sunikka-Blank, 2016). Consequently, renovation may initially increase energy consumption as households begin to enjoy adequate thermal comfort, heating to higher indoor temperatures than previously affordable and removing some of the direct benefits (Sunikka-Blank & Galvin, 2012). This rebound nonetheless delivers real co-benefits, often captured by low-income households, such as a noticeable improvement in living comfort and health conditions. However, actual energy savings may fall short of original expectations (Ramboll, 2022). The rebound effect in the residential buildings sector tends to decrease over time. Its size is highly dependent on contexts including income level, initial situation and personal habits and can range from 0% to 100% (Ramboll, 2022; EEA, 2023a).

Environmental benefits in the form of lower forestry pressure due to the electrification of heating (heat pumps) may not be always guaranteed. For instance, households retaining wood-burning appliances may increase their use of wood alongside heat pumps when electricity prices are high or volatile (Kilpeläinen et al., 2025). Material sourcing for energy renovation and energy use may contribute to competition between biomass production for construction or energy use and agricultural production or conservation priorities (ETC ST, 2026).

The performance gap may also result from inadequate choices, incorrect advice and quality defects during renovation and installation (Giraudet and Vivier, 2024; ETC ST 2026). Well-insulated building envelopes can improve both winter energy performance and summer heat resistance. However, inadequate renovation choices can result in overheating during summer (Ramboll, 2022; Taylor et al., 2023). Overheating is observed in new or recently renovated homes, especially when thermal design has focused on keeping the house warm in winter, omitting the necessary thermal mass for any future temperature increases and excluding shading strategies (EEA, 2022c).

Ventilation systems in highly insulated dwellings must be taken into account, to avoid compromising air quality from radon exposure, for example. They must also be used correctly to achieve their full efficiency potential. A recent study of 1,023 heat pumps across central Europe found that a considerable proportion of the systems either underperformed or were incorrectly sized (Brudermüller et al., 2025). Systems that require frequent maintenance or repair can quickly become frustrating, reducing acceptance and uptake (Ramboll, 2022). This highlights the importance of reliability and longevity of the technology (Camarasa et al., 2021). Similarly, environmental concerns include pollutants in certain insulation materials, emissions of fluorinated

greenhouse gases (F-gases) from ageing heat pumps and local noise.

At the building stock level, the floor area has grown faster than the EU population over the past decade, driving additional energy consumption and offsetting a share of achieved efficiency gains.

These findings highlight several key factors to consider, including: post-installation energy performance monitoring; transparent reporting on real energy savings; integration of climate adaptation considerations into the energy renovation; policies to ensure energy renovation quality; careful coordination with nature conservation and biomass resources; and ensuring a skilled labour force is available on the market. Beyond technical aspects, the size of the residential building stock and its use rate must also be factored in.



© welcomia via Getty Images

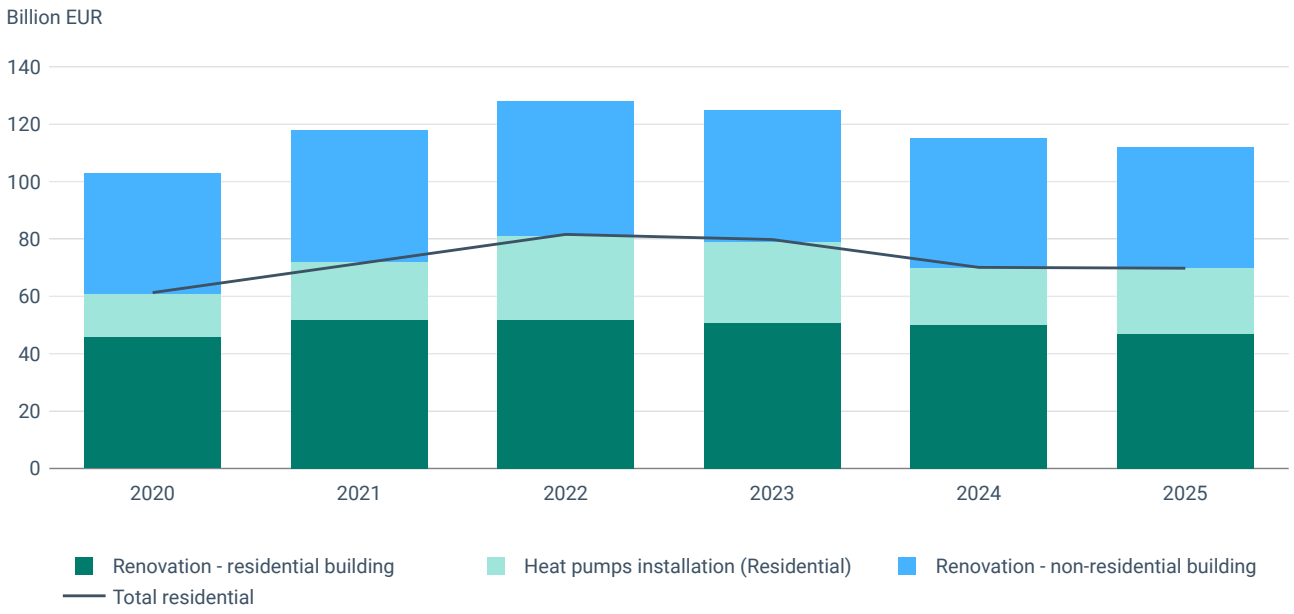
4 Barriers to boosting renovation in the EU

The financing of energy renovation will be largely covered by private investment, with public funding required to make investments more attractive and address social inequity. The economic viability and attractiveness of household energy renovation is strongly influenced by incentives (including subsidies and fiscal measures), financing conditions and energy prices.

Economic barriers continue to slow the pace of renovation across the EU, including the high upfront cost of renovation, contradictory price signals, long payback periods for cost recovery and split incentives between landlords and tenants (32% of households live in rented housing in the EU).

As show in Figure 4.1, investment in residential building energy renovations has declined since 2022. Investment in residential buildings decreased from EUR 45 billion to EUR 42 billion between 2024 and 2025 (I4CE, 2026a). The IEA expects a slight increase in 2026 (IEA, 2026). Combined, investment in residential renovation and heat pumps fell from EUR 129 billion in 2022 to EUR 112 billion in 2025. Fifteen Member States reported a decrease in energy efficiency improvements in residential buildings between 2023 and 2025 (Eurostat, 2025). In contrast, investment in heat pump deployment in residential buildings began to rise again in 2025, from EUR 20 billion in 2024 to EUR 23 billion, albeit still lower than the EUR 29 billion peak of 2022.

Figure 4.1 **Investment trends for building energy renovation and heat pump deployment, EU**



Notes: All data are in 2025 euros.

View the interactive version of the chart.

Source: I4CE, 2026.

High cost of renovation

Thermal insulation (adapted for both winter and summer) is by nature labour intensive and hence costly. Construction costs, house prices and rents remain at historically high levels, significantly affecting the affordability of both building renovations and new housing (Eurostat, 2025). For instance, in France, between 2019 and 2024, the cost of energy renovations rose by 35% to 60%, depending on the type of action, while inflation was +17% over the same period. Salary increase and cost of construction material explain only partly this increase. Other drivers may include an increase of company margins and inflationary effects of support schemes; additional research is however needed to analyse this effect (I4CE, 2026b).

Over the longer term, industrialised prefabricated solutions, integrated service models or the use of digital tools for improved productivity may reduce costs (Giraudet et al, 2024). A 2023 projection suggests that, with continued innovation, heat-pump costs could fall by an order of magnitude of 40% by 2030 (Agora Energiewende, 2023).

Coordinated deep energy renovation of entire buildings achieves a higher energy performance at lower overall costs compared with step-by-step measures (Giraudet and Vivier, 2024). However, in practice, deep renovation is expensive and upfront cost is a key obstacle for homeowners. Step-by-step renovation strategies, while potentially less cost-effective overall, play an important role in overcoming barriers provided they do not lock in in sub-optimal trajectories. The building renovation passport tool introduced by the recast EPBD targets this specific aspect (see Box 2.2). Productivity gains may help to accelerate renovation, yet uncertainties exist in how innovations develop and scale up (BPIE, 2025b) [(7)].

Social innovations can also generate savings. The European Commission estimates that the average household saves EUR 1,100 per year by participating in an energy community (EC, 2025a). Prosumer and circular-economy approaches offer further potential, including reusing, repurposing, shared models and partial renovations (EEA, 2022b). Beyond individual buildings, neighbourhood-scale renovation approaches combined with Renewable Energy Communities can create promising synergies between energy efficiency, local renewable generation and energy affordability. They can improve the cost-effectiveness of renovation compared with interventions undertaken building by building, particularly where buildings have similar characteristics and renovation needs (Fernández-Luzuriaga et al., 2021; Rose, J. et al., 2021). Under the new European Affordable Housing Plan, the European Housing Alliance is an innovative approach to address affordability, energy consumption and GHG emissions at the local and community level. It aims to move beyond consultation towards action to support, coordinate and amplify local, regional and national efforts that reflect Europe's diverse housing needs and systems.

Aligning energy price signals and securing stable renovation funding

Differences in national financing systems, administrative capacity and housing markets drive diverging renovation rates across Europe (ETS-ST, 2026). It is crucial

(7) Several EU-funded projects can be mentioned in the area of research and innovation. The Horizon Europe Partnership Built4People aims to fund R&I dedicated to the built environment, with a strong focus on creating a climate-neutral and sustainable built environment. The SPHEERE project is developing a renovation system that can be adapted to different types of buildings and climates, combining digital design, off-site manufacturing and circular construction methods. The Clean Energy Transition Partnership, which aims to accelerate the transition to clean energy (one transition initiative is dedicated to integration into the built environment). Industry-led initiatives also offer support, such as PropTech Denmark, a non-profit for real estate innovation which promotes collaboration and knowledge sharing across the real estate value chain (PropTech Denmark, 2026).

to address two dimensions of national conditions in order to reversing the downward trend in investment in renovation:

- Firstly, price signals to consumers should be coherent and favour electricity [8] to avoid discouraging the electrification of heating and the uptake of heat pumps (see figure 4.2). Price signals are managed at national level through a range of taxes and levies and the tariff structure consumers face.

- Secondly, there is a need to ensure the availability and stability of funds for public programmes and measures to support energy renovations across the EU. Significant declines in energy renovation investment is expected if budgetary priorities are not reversed and new funding schemes do not emerge (IEA, 2025b; I4CE, 2026a).

Project-level financial calculations

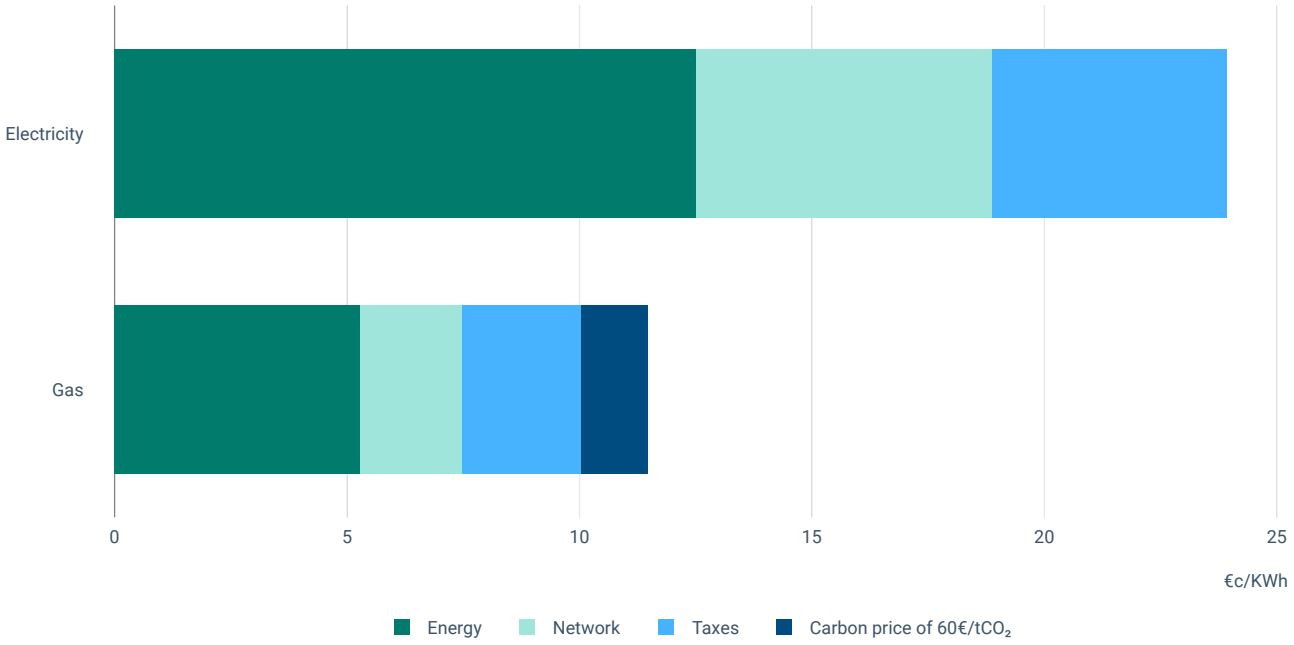
In financial terms, a household should be motivated to invest in renovation based on its net present value (NPV). This is the difference between today's value of all future financial benefits resulting from the investment, such as energy savings or increased house value or rental income, and the initial renovation costs (discounted over the lifespan of the project). In practice, this bar is rarely met without external support. For example, a recent French study estimates that only 26% of residential renovations would be considered cost effective on this basis (CAE, 2024). Three structural reasons explain why household-level calculations of NPV by financing institutions offering credit often fail to justify an investment in renovation.

Firstly, investment costs for deep renovations quickly exceed household investment budgets. While basic measures start at a few thousand euros, deep renovations of detached houses regularly exceed EUR 20,000. Heat pump installation alone ranges from EUR 8,000 to EUR 30,000, with significant differences between countries (Meyer et al., 2024; Palma et al., 2022; Miara and Rosenow, 2026; (I4CE, 2026b)) [9]. For lower-income households, deep renovation costs can equal or exceed disposable income for an entire year, making self-financing impossible (Bruegel, 2024). Payback periods lasting between 15 and 25 years further erode the case, combined with actual savings that often fall 30-50% below projections due to rebound effects, whereby households increase their overall energy use (Giraudet and Vivier, 2024).

Secondly, the gas/electricity price ratio can undermine the heat pump case. Where electricity is taxed more heavily than gas, as is currently the case across much of the EU, this reduces cost savings from electrified heating reduce. In some cases, it makes the use of electricity more expensive. In countries where gas can be one quarter of the cost of electricity, switching to a heat pump may increase energy bills despite lower overall energy consumption (IEA, 2024; Sgaravatti, 2024). Although some countries have started to address the problem, average EU household energy prices for electricity versus gas (see Figure 4.2) favour gas and fail to incentivise investment in electrified heating and cooling.

(8) Attention to price signal for biomass and biogas is also needed by considering sustainability and local availability.
(9) Price and cost of individual projects are given for illustration. They vary from country to country and significant increase are seen in the last 5 years (I4CE, 2026b).

Figure 4.2 A comparison of household energy prices, May 2024



Notes: EU average in eurocents/kilowatt hour. tCO_2, tonne of carbon dioxide.

View the interactive version of the chart.

Source: Bruegel, 2024, based on Eurostat.

Finally, financial institutions systematically miss key value drivers. Standard credit models do not count projected energy savings as future disposable income. Neither do they incorporate property value uplifts from renovation; sale price premium for residential buildings is estimated at 3-12% in France, Germany and Italy (IEA, 2025b). Even if energy renovation brings real savings, the borrowing capacity of the project holder does not increase. The credit models of private banks also ignore co-benefits, such as health gains, reductions in energy poverty, protection against heat and lower public healthcare costs. These benefits are well-documented but invisible to lenders (RAND, 2022; Ferreira et al., 2017).

The role of public measures in boosting investment in energy renovation projects

The development of innovative tools to address up-front cost issues is being encouraged. These include, for example, on-bill payment systems and mechanisms that spread repayment costs over time through energy bills [10]. Several have been tested in the EU, though they remain pilot projects (RenOnBill, 2022; Barbosa and Almeida, 2025; ETC-ST, 2026). They can be particularly useful for middle-income households with sufficient repayment capacity, but which may lack the savings or conventional finance access needed to cover the upfront costs of renovation. For occupant owners, the value of the property can be a source of collateral through the mortgage loan system providing collateral to banks (Bruegel, 2024; Climate Strategy & Partners, 2023).

(10) In an on-bill payment system (OBS), the cost of the renovation is covered by the utility provider and subsequently repaid by households through their utility bills. Repayments are commonly offset by the resulting energy savings. The UK implemented a policy framework seeking to foster the uptake of OBS as part of the 2013 'Green Deal' initiative (Mundaca and Kloke, 2018). The Netherlands introduced 'Energiesprong', an initiative to fund renovations through savings on the energy bill over the next 30 years. Here the recipient pays a monthly fee corresponding to the difference between actual and previous bills (Ricardo, 2025). In most EU countries, OBS remains at the pilot stage (RenOnBill, 2022).

For households with higher risk profiles, public support is needed. One option is to use public funding to cover the financing costs of renovation loans rather than the investment itself. This allows banks to provide zero-interest loans while households remain responsible for repaying the principal. Experiences in France (see Box 5.1) and Germany demonstrate success. In the Netherlands, the National Heat Fund offers zero-interest loans, including to people who may not qualify for conventional bank loans.

For lower income households, public support in form of grant and subsidies is needed. Optimal solutions require public schema combining different options. They need to be tailored to different profiles to best use the available public money, meet social fairness criteria and maximise private money leveraging. One study suggests an overall 25/75 split of public to private funding: EUR 500 billion of public funding is then used to leverage EUR 1.5 trillion of private finance by 2030 (Climate Strategy & Partners, 2023). Financing options and means to leverage private money vary by household category [(11)]:

- For energy poor households (around 16 million EU households), public grants should cover the full cost. Grants address affordability constraints.
- Households with poor finances (40 million EU households, including renters and homeowners with low credit capacity) need blended financing, combining public grants and private financing. This is to address partial affordability constraints and liquidity/financing constraints.
- Standard households (100 million EU households), with stable finances that can afford loans, need tax incentives and technical assistance to provide appealing liquidity/financing solutions.
- Wealthy households' (48 million EU households) need mainly awareness and innovative private instruments.

Behavioural, informational, administrative and trust-related barriers to renovation

A household's decision to renovate is not constrained by cost and the availability of money alone, but also by a cluster of behavioural, informational, procedural/ administrative and trust-related factors. A recent study found that financial constraints rank as the single most important obstacle in the EU. However, when taken together, non-financial barriers such as tenure (renting), lack of knowledge and uncertainty outweigh financial constraint (BPIE, 2025a). Designing effective policies requires an understanding of the variety of stakeholders involved in the decision-making regarding investments to improve energy efficiency in residential buildings (EEA, 2023). Homeowners play a key role. Moreover, installers and contractors hold influence through the advice they provide to homeowners. They are influenced in turn by factors such as the culture and social influence of their workplaces and the behaviour of their peers.

Several behavioural factors influence homeowners' decisions on renovation investment. Exploring and understanding these factors can inform the design of policies so that they more effectively encourage the renovation of residential buildings, contributing to achieving climate neutrality (EEA, 2023a). Key behavioural barriers to homeowners' investment decisions include the perceived level of effort and disruption ('hassle factor') required to complete energy renovations, as well as uncertainties as to the outcome of the investment ('fear points') (EEA, 2023a).

(11) A similar targeted approach for financing was implemented by Opengela one-stop shop in the Basque Country (see Box 6.1).

Among the 'hassle factors', the complexity of administrative processes to receive support stands out. Even when funds exist, complex eligibility rules and limited access to clear information when applying can demotivate and discourage rather than encourage renovation (Barbosa and Almeida, 2025; Prieto et al., 2024). This implies mistrust of administration. If experts' recommendations or administrative processes, such as funding procedures, are perceived as opaque, unreliable or even 'too good to be true', people are less likely to renovate (Eurofound, 2016).

Better consideration of various stakeholders' motives and fears may improve the effectiveness of policies and measures to promote renovation. Beyond simplification of administrative processes, this could involve designing better communications (e.g. targeting the most influential stakeholders, addressing key trigger points) and tailoring interventions (e.g. one-stop shops, financial support) to specific target groups (EEA, 2023). Effectively engaging low-income, middle-income, non-digital and vulnerable households presents a challenge. The capacity and willingness of these households to invest in renovation are shaped by awareness, structural inequalities, perceived fairness and access to public support.

'Trust' in this context also refers to the relationship between homeowner and installer. Lack of skilled workers to advise on energy efficiency and persistent expertise and skills shortages are a widespread issue across the EU. There are potential links between these shortages and performance gaps (ETC ST, 2026; Eurofound 2024; EEA, 2023). Increasing vocational training, standardising certification or ensuring mutual recognition of relevant qualifications are essential to ensure renovation measures deliver results in energy saving and emissions reductions (ETC ST 2026; Eurofound 2024; EEA, 2023). On heat-related renovations, (Taylor et al. 2023) identified limited industry knowledge and experience of hotter climates as being critical barriers, along with the need for professional upskilling and practical guidance.

Considering behavioural factors represents a promising way to mitigate the rebound effect after renovation. This means raising awareness about energy efficiency through mass-media campaigns. Additionally, encouraging smart meter adoption and including additional information about energy consumption levels on bills have both been shown to reduce the direct rebound effect from efficiency improvements (EEA, 2023). Post-renovation follow-ups to check for the proper use of newly installed passive or active technologies may also help. These actions are valid both for heating and cooling behaviour.



© Ilona Slezák, ZeroWaste PIX/EEA

5 Social fairness in energy renovation

Dimensions of social fairness in energy renovation include the distribution of costs and benefits across society (distributional justice); access to and participation in decision-making (procedural justice); and consideration of diverse needs, cultures and perspectives (recognitional justice).

This section aims to clarify the exact meaning of social justice in energy renovation. It also provides examples of good practices to translate them into funded measures, demonstrable influence and accountable outcomes, while answering previously analysed obstacles.

Renovation: who pays and who benefits?

Distributive justice in residential energy renovation means sharing costs and benefits fairly, taking account of households' needs and capacity to pay. Public funding and support should enable households facing financial and practical barriers to access renovation, while protecting residents from debt or rent increases that could outweigh the benefits of lower energy bills and improved comfort.

The case of social housing

To maximise social, economic and environmental benefits, public funds should prioritise the worst performing buildings (as stipulated by the EPBD) and the most vulnerable households, characteristics that often coincide (Bruegel, 2024). Social housing [12] is recognised as a strategic building type for subsidised energy renovation because it combines climate objectives with social benefits for lower-income households (it is, however, not automatically equivalent to prioritising disadvantaged residents). Social housing represents 6% to 7% of the total housing stock of the EU, according to the European Commission, with significant differences between countries, ranging from 2% to over 20% [13] (OECD, 2026a).

Pilot project evaluations have demonstrated benefits in practice (SHAPE-EU, 2023; Portal et al., 2021), but large-scale programmes to energy retrofit social housing are needed (JRC, 2025). In the 2026 draft National Buildings Renovation Plans analysed by the JRC in July 2026 (JRC,2026a), examples of good practices are included; for example an agreement in the Netherlands between the relevant ministry and (social) housing associations to develop further actions. However, significant opportunities can still be exploited (JRC, 2026b).

Criteria for targeting eligible households

With regard to the criteria for selecting households eligible for progressive public finance measures, linking support levels to household income have proven successful. This allows targeted measures to reach the right social categories while achieving

(12) Social housing can be considered housing provided at prices below normal market rates to target groups of disadvantaged people, socially less-advantaged people or key workers (OECD Affordable Housing Database).

(13) Over 20% of the total housing stock in Austria, Denmark and the Netherlands, between 10% and 19% in Finland, France and Ireland and between 2% and 10% in other Member States (OECD Affordable Housing Database).

climate targets. Additional criteria can improve the effectiveness and fairness of financial support, including geographical location, family situation, age, level of household energy bills and the carbon intensity of energy used (ETC ST, 2026).

Introducing such targeted criteria requires additional, integrated data, as it can complicate measures and increase the administrative burden. One key challenge is to strike a balance between simple measures that might lead to misallocation and targeted measures that require more data and significant administrative effort and cost. In several Member States, the main challenge lies in limited administrative capacity at the national level, as has been seen with the development of the National Social Climate Plans (AK Europa, 2025; Jüngling et al., 2025).

Member States have adopted varied approaches. For example, Estonia is targeting the worst-performing 43% of residential buildings, while Slovenia prioritises buildings with poor seismic, fire safety and energy efficiency ratings (features closely linked to energy deprivation and social vulnerability) (BUILD UP, 2025). France's MaPrimeRénov' scheme (Box 5.1) is an energy renovation policy designed to deliver social fairness through income-based grants.

Box 5.1

Example of policy schema addressing distributive fairness: France's MaPrimeRénov'

France's MaPrimeRénov' scheme aims to ensure social fairness by providing renovation grants based on household income, differentiated by geographical locations (Paris region or rest of France). It considers the potential for building energy efficiency improvements, therefore targeting renovation on buildings that perform poorly in energy efficiency (Classes E, F and G). The assessment criteria integrate these two dimensions. Higher funding is awarded to households that are worse off economically, while living in buildings that achieve the highest potential improvement in energy efficiency relative to the current performance.

Subsidies range from 10% to 80%, with a ceiling of EUR 30,000 to EUR 40,000. It can benefit owners and low-income owners that have rented out the dwelling for at least six years.

Both owner-occupier and renting households can finance the share of renovation costs not covered by subsidies with an interest-free loan of up to EUR 50,000 known as a zero-rate eco loan. This is repayable over up to 20 years and offers a streamlined application process at the bank.

In addition, the cost of the energy renovation benefits from a reduced VAT rate of 5.5%. This is combined with a one-stop shop system that connects individuals with renovation coaches, who support the household in applying for funding and developing a renovation plan.

Recent evaluations suggest that access to the zero-rate eco loan has significantly improved the availability of financing for energy renovations for middle- and low-income households in France over the past 10 years (Bruegel, 2024).

Source: MaPrimeRénov'.

Split incentives and the just transition: the landlord tenant dilemma

There are two major distributive justice challenges in the rental sector. First, landlords have no incentive to invest because the benefits are gained only by tenants. Second, when a renovation is done, the costs may be passed from the owner to renters, even when public funds were used to finance the renovation. Lower-income households are disproportionately represented among renters in many countries, meaning that these impacts can be particularly acute for vulnerable households.

Minimum Energy Performance Standards (MEPS) and other regulatory measures targeting worst energy performant buildings are recognised tools to address this dilemma. In France, the 2021 Climate and Resilience Law prohibit any rent increase for dwellings with an energy performance rating of F or G (Légifrance, 2021). As of January 1, 2025, properties rated G on the Energy Performance Certificate (DPE) are officially banned from being rented out and the rental condition will progressively tighten up to 2034. A recent evaluation of the UK policy restricting rental for F and G dwellings suggest that MEPS has successfully driven improvements in building energy efficiency without inducing rent inflation (Fuerst et al, 2026). Wallonia introduced as well explicit renovation obligations for F and G dwellings in its policy (JRC, 2026b). Attention to tensions these measures can creates on the housing rental market is however needed.

To accompany MEPS and other legal measures, specific social safeguards are also needed to avoid gentrification and the costs of (subsidised) improved energy standards being disproportionally passed onto low-income households, as well as maintaining housing affordability (Sunderland, 2020; Weber and Wolff, 2018; FRA, 2026). A guiding principle is that if owners fund renovation with public funds, this should be conditional on no future rent increases that outweigh the energy savings. For example, in Germany when a building owner receives public funding for energy renovations, it must be deducted from the renovation costs that can legally be passed onto tenants through rent increases. In the Netherlands, the housing valuation scheme is mandatory (Affordable Rent Act of 2024) and prescribes a maximum rent based on a score that rates the quality of a house in terms of floor area and energy performance class.

The draft National Building Renovation Plans (NBPR) of Wallonia and Spain include the following split incentive actions (JRC, 2026b):

- **Wallonia:** strengthened access to regional aid subject to a rent cap; a rental stock monitoring tool to track rent levels; facilitation of the temporary relocation of tenants during renovation works, with a guaranteed right of return and transparent financial conditions; and strengthened communication through regional roundtables with landlord and tenant associations, AIS (a social real estate agency) and public authorities.

- **Spain:** for tenants, the measures focus on strengthening the legal framework of rented housing renovation, incentives, protection against eviction, a guarantee that the funding support is managed by social services and other advisory mechanisms.

Further policy development, experimentation and rigorous evaluation of the effectiveness and distributional impacts of measures addressing split incentives are needed.

Fair access to decision-making on public measures to foster energy renovation

Fair access to decision-making processes regarding energy renovation policies can boost support and engagement, particularly regarding the accessibility, transparency

and inclusivity of renovation policies. Lager et. al (2023) argue that across policy sectors in Europe, vulnerable groups are at a heightened risk of having less influence on decision-making processes regarding justice and equity concerns. When residents perceive outcomes as equitably distributed, public support for renovations and related action to mitigate climate change increases (EEA; 2023 Eurofound 2021; EC, 2025a).

Delivering procedural justice in practice requires two elements:

1. Fair representation in decision-making institutions supported through participatory approaches designed to empower residents and reinforce local ownership and social cohesion.

2. Ensuring that procedures are inclusive and meaningful at every stage. Key inclusivity challenges are found for instance in participatory actions and programmes demanding high levels of digital literacy or complicated administrative burdens, placing them out of reach of people with limited time, flexibility, digital capacity or trust in public institutions (EEA, 2023a).

Good practice examples of inclusive decision-making processes for renovation from across the Member States include the following:

- In Croatia, the Long-term Renovation Strategy was shaped through an open partnership dialogue that connected local/state actors, academia and industry experts, facilitating inclusive governance (EC, 2023b);

- Poland's Ministry of Climate established a multistakeholder working group to define energy poverty and collect best practices, ensuring cross-sectoral input and local relevance (EC, 2023b);

- The ARCE 2050 project, launched by Spain's Ministry of Housing and Urban Agenda (MIVAU) in January 2025, exemplifies a broad, participatory process to revise and update the national energy renovation strategy. This initiative brings together public bodies, professionals and citizens (ARCE 2050, 2025).

Respecting households' diverse situations and needs

Delivering social justice in energy renovation requires the acknowledgment and respect for the identities, specific circumstances and needs of different social groups, as well as their lack of awareness or mistrust in institutions. For example, a 2023 survey of immigrants and descendants of immigrants of African descent resident in 13 Member States (FRA, 2023) found that:

- 32% of respondents face difficulties making ends meet (against an EU average of 18%);

- 14% cannot afford to heat their home (against an EU average of 7%);

- 18% are in arrears on utility bills (against an EU average of 6%);

- 45% live in overcrowded housing (against an EU average of 17%).

The risk of stigmatisation is also a concern. When policies focus on the worst performing buildings, inhabitants with disproportionately low incomes can feel singled out, as can the elderly or vulnerable (ETC ST, 2025).

To ensure fairness, policymakers should be careful not to exclude groups from support due to their specific circumstances. For example, tax incentives provide no benefit to households below the tax threshold. Likewise, relying on tax returns

to assess eligibility for support excludes low-income households not required to file taxes. The requirement to provide a formal rental contract excludes those households not able to provide one. This is a widespread issue in Slovakia and Slovenia and one that also affects access to tax benefits in Croatia (Eurofound, 2023). In Amsterdam and Riga, renovation programmes failed to access vulnerable households as older adults and migrants were less likely to sign up for renovation schemes, due to a lack of understanding or trust (ETC ST, 2025). Marginalised communities may be disqualified from financial support for renovation programmes and lack access to energy supply when living in informal settlements. Such groups include people from the Roma community, migrants and homeless people (FRA, 2024b). For example, in Cañada Real (an informal settlement of 8,000 people near Madrid) half of the community was disconnected from electricity in 2020 following technical changes on the grid (ETC ST, 2025; Ruiz-Rivas et al., 2023).

Responding to these contexts requires tailored, culturally sensitive and accessible support structures. Table 5.1 below sets out a range of socio-economic situations and corresponding vulnerabilities and possible solutions to support access to energy renovation.

Table 5.1 Key vulnerabilities and possible solutions to support access to energy renovation for vulnerable groups

Socioeconomic situation	Key vulnerabilities	Possible solutions
Low-income private tenants	High energy costs, limited access to renovation funds, weak procedural rights, risk of eviction	Targeted subsidies, strengthened tenant protections, public–private partnerships, facilitated low-cost renovation options
Homeowners without mortgages	Lack of liquid assets, limited access to affordable credit, digital literacy gaps, low institutional trust, limited procedural inclusion	Targeted financial support, tailored credit, simplified procedures, one-stop shop facilitation
Marginalised communities	Exclusion from formal programmes due to informal housing, lack of procedural participation, unrecognised identities	Recognition of informal housing, tailored outreach, dedicated support, culturally sensitive programmes
Elderly and persons with disabilities	High upfront renovation costs, limited and fixed incomes, digital exclusion, insufficient recognition of accessibility and social needs	Accessible application processes, targeted financial and technical support, inclusion of accessibility needs, non- digital one-stop shops
Women-headed households	Lower wages, higher childcare expenses, limited access to affordable housing, insufficient recognition in national renovation strategies	Gender-sensitive renovation programmes, targeted financial and advisory support
Uncontracted tenants	Informal rental arrangements, exclusion from subsidies and energy support schemes	Measures to formalise tenancy, equitable access to renovation support
Middle-income households	May fall into a 'support gap', where they earn too much for targeted assistance but lack disposable income for major renovations, limited trust in renovation markets, perceived inconvenience of renovation processes	Tailored support via one-stop shop, staged renovation options, targeted credit products, awareness campaigns
Rural households	Large, inefficient homes with partial occupancy; limited access to renovation providers and advisory services; higher exposure to energy poverty; reluctance to disrupt daily routines	Rural-focused one-stop shop (e.g. itinerant one-stop shop services), flexible renovation standards, tailored outreach, community-based renovation support



© Clorinda Galasso, My City/EEA

6 Strategic tools and actions for strengthening socially fair energy renovation

The aim of this section is to dig deeper into the just transition dimensions through strategic actions available to policymakers.

Across EU Member States, experiences demonstrate that building local, trusted and integrated capacity to deliver support to vulnerable groups can help translate available funding into renovation at scale. In this context, participatory approaches play a dominant role in enhancing policy uptake. This includes legitimacy and overall effectiveness, including deliberation, benchmarking and iterative public dialogue.

Four strategic areas of action stand out for strengthening procedural, recognitional justice in practice.

Reinforce proactive engagement and stronger one-stop shops

One-stop shops offer tailored services such as free or low-cost energy audits, personalised financial guidance and assistance with navigating funding schemes and administrative procedures. They are now binding by the recast EPBD. They have shown promise in enhancing renovation uptake and realising the large untapped potential. Long-term effectiveness needs proper funding and service quality.

It is also important to acknowledge that energy vulnerability and poverty are highly dependent on local contexts. Involvement at the sub-national level (region, city) is important to fully grasp the key local peculiarities and needs in energy renovation actions (JRC, 2026b). The Covenant of Mayors and the Energy Poverty Advisory Hub (EPAH) embrace energy poverty from multiple perspectives, including the socio-economic and the building and facilities standpoints, promoting integrated approaches in the solutions that recognise co-benefits such as reductions in vulnerabilities, the alleviation of energy poverty and improved energy efficiency.

The following areas emerge as key dimensions for success:

- **Outreach**: targeted outreach and inclusive design for vulnerable groups entails efforts to proactively identify and engage low-income households, renters and socially isolated populations, as well as non-digital citizens, by providing tailored support such as language assistance and personalised guidance;
- **Governance and partnerships**: embed one-stop shops in municipal governance and foster strong collaboration with trusted local intermediaries, social partners and NGOs, leveraging their local presence and expertise to build trust and provide a comprehensive ecosystem of social and advisory support;
- **Integrated service delivery**: provide comprehensive support tailored to meet the specific needs of each household, covering technical, financial and administrative aspects. Both digital and non-digital one-stop shops are needed. One-stop shops act as critical intermediaries to foster trust and dialogue among diverse stakeholders, bridging gaps where public administrations may lack credibility.

Box 6.1 highlights examples of one-stop shops operating at a local level in Belgium and Spain.

Box 6.1

Scaling one-stop shops for a just transition works best when they are proximity-based and embedded in municipal social services

In Ghent, Belgium, the one-stop shop model De Energiecentrale addresses energy poverty through a multi-level strategy (Habitat for Humanity International, 2024b). It raises awareness of renovation opportunities among vulnerable, low-income households and facilitates their participation. These one-stop shops also promote and support basic energy efficiency renovations through tailored guidance. As a free service, they provide personalised advice to improve the energy performance of private dwellings, including single-family homes and condominiums. Its core mission is to alleviate concerns related to energy renovation. To effectively tackle energy poverty, De Energiecentrale collaborates closely with a range of social partners. Its success illustrates how one-stop shop models can overcome access barriers and deliver tangible equity outcomes when embedded in municipal governance and social services. The project's integrated renovation coaching model, which combines financial advice, contractor coordination and administrative support, has resulted in over EUR 58 million in investment (Thöne et al., 2023).

In the Basque Country in Spain, the Opengela OSS, implemented in Bilbao and Eibar, targets deprived urban districts. It acts as a local service provider for the Basque Government, supporting residents with technical, financial and administrative guidance through neighbourhood offices. It combines technical and financial advisory services with proactive social outreach. These one-stop shops operate as proximity-based neighbourhood offices, designed to build trust and remove procedural barriers, particularly for older adults and tenants in multi-family buildings. By prioritising low- and middle-income households, older residents and families at risk of energy poverty, the initiative ensures equitable access to renovation opportunities for those who face the greatest challenges. In Bilbao alone, the initiative has generated 4.25GWh/year in energy savings through EUR 15.2 million in investments, while also creating local jobs in one-stop shop offices (Opengela, 2022).

Make the most of participatory approaches required by EU legislation

Improved governance, transparency, participation and inclusiveness can be operationalised through effective participatory and consultation approaches. Recent evaluation of the design and development of the Social Climate Plans (required under the Social Climate Plan Regulation) and of the National Building Renovation Plans (required under the EPBD) show good participatory practices and improvements compared with past processes, for example from the Long term Renovation Strategies in 2020 (BUILD UP, 2025; Castellazzi et al., 2022). However, several countries failed to engage with local and regional governments in developing Social Climate Plans and the quality of stakeholder engagement varies significantly between countries (CEE Bankwatch Network and E3G, 2025; ETC ST, 2025; FRA, 2026).

The National Building Renovation Plans (NBRPs) provide a multi-level governance tool with which to advance a socially fair energy transition in the built environment and address the challenges and opportunities faced by diverse communities. The 2026 JRC assessment of 16 NBRPs (JRC, 2026b) shows that public consultations were inclusive and provided opportunities for input and feedback, though their exact influence is not clear. Further progress can be made in involving vulnerable households (JRC, 2026b). Good practice includes efforts to actively engage advocacy

organisations representing vulnerable groups in Finland, trade unions engaging in public decision-making in Italy, and organisations representing vulnerable households and persons with disabilities in Lithuania (JRC, 2026b; BUILDUP, 2025).

Effective coordination between the Social Climate Plans and the NBRPs presents an opportunity to reinforce alignment between technical and social climate policies, as seen in Finland. It is also an opportunity to better align the justice dimension of local, regional and national strategies for building renovation. It could also illuminate any lack of systemic involvement of local and regional governments in the design of the national Social Climate Fund Plans (Dubeta et al., 2024).

The Citizens Energy Package offers new opportunities in participatory approaches to develop energy communities at a local level to explicitly tackle energy poverty. Energy communities and cooperatives are emerging as vital actors for inclusive access to benefits. The necessary conditions to scale these models should be created (European Court of Auditors, 2026). Following on from the Citizens Energy Package, the European Commission is expected to bring forward a new recommendation on energy poverty in 2027.

Tailored solutions in practice: the case of large rural homes

Rural communities face particular challenges in energy renovation due to their physical isolation, limited economic diversity, higher poverty rates, lower educational and employment opportunities and ageing populations. Rural households spend a larger share of their income on energy due to larger, less efficient homes, costlier heating fuels, limited access to modern energy infrastructure and lower average incomes. Across Member States where overall energy poverty exceeds the EU average, rural areas are the most affected — particularly in Bulgaria, Romania and Greece (Hormigos et al., 2025).

In rural EU areas, many families live in large homes but only use a few rooms. Insulating two or three rooms may be the most economically viable solution (While ensuring proper ventilation in other rooms to avoid condensation), yet existing policies and support schemes tend to focus on whole-building performance rather than reflecting actual consumption patterns. Rural households often lack access to advisory services or providers, with proactive, case-by-case solutions needed to identify affordable options. As an illustration, an energy solution tailored for a rural French home is described in Box 6.2.

Box 6.2

Tailored solutions in practice: an affordable, efficiency and sufficiency-based renovation for a low-income homeowner in rural France

A pilot renovation was carried out on a 100m² family house in Provence, occupied by a low-income seasonal agricultural worker facing energy poverty. The owner was supported by three local associations, forming a one-stop shop to offer expertise in financing, social integration for insulation materials and ecological building techniques.

The approach optimised spaces in the house to be heated according to the owner's actual needs, while selecting insulation materials to achieve a kWh consumption level compatible with the income of the owner (Gaia V L equation model). Energy use reduction was prioritised to achieve a target of 3,200kWh per year by insulating and heating an indoor space of 33m² instead of the entire house. The renovated 33m² achieves a performance of 97kWh/m², slightly above the French performance level set under the EPBD at 80kWh/m². Technical and financial benefits included the following:

- A local bio-sourced insulation product based on rice straw and earth, from the local Camargue region, achieves the required thermal resistance. It provides summer thermal comfort without air conditioning thanks to bio-based materials' thermal lag.
- Assisted self-renovation reduced the cost of labour.
- Final cost of EUR 24,800 instead of EUR 75,000 for a conventional full-house renovation.
- The owner contributed EUR 3,200 equivalent through self-renovation, coached by a craftsman and the bio-sourced material producer. The rest was from public subsidies.
- A threefold reduction in state and local government subsidies compared with a standard approach.
- CO_2 emission reductions from the replacement of the old fuel boiler with a heat pump.
- The owner can now afford to heat his home comfortably.

The case shows that low-cost, square metre-need based approaches combining moderate performance objectives, local materials and user participation can deliver significant energy and emissions savings while remaining accessible to vulnerable households, in a context of a strongly decarbonised electricity grid. Proactive tailored support by a one-stop shop, public subsidies, active owner involvement and trusted local institutions are decisive.

Sources: Construction21 and Gaia V L equation economic model from RenovEco.

Data challenges for socially fair energy renovations

At the policy design level, establishing data and information systems to precisely identify social groups and address the challenge of effective targeting is a priority (Jüngling et al., 2025). This includes developing information systems integrating existing socio-economic data (e.g. on incomes, tax and expenditure) with building and dwelling information on energy and GHG emissions (absolute value, per m² and per capita) so that policy design can account for the heterogeneity of situations (AK Europa, 2025). This is a clear challenge identified by administrations to better operationalise targeted policies.

Good practices are being developed to inform policy. The Spanish public entity responsible for supporting and implementing national energy policy, is for instance

developing a longitudinal study to monitor a panel of vulnerable households over three years, collecting data on energy consumption, expenditure and key factors affecting energy well-being. It combines measurements of thermal comfort-related energy use with surveys on housing characteristics, equipment and behavioural patterns (IDAE, 2022). At the local level, initiatives such as the Covenant of Mayors also support monitoring and reporting practices on vulnerabilities and energy poverty (JRC, 2026c).

However, several data and indicator gaps have been identified:

- Indicators on justice dimensions need to be developed to measure how much policies equitably reach and benefit vulnerable groups, while avoiding unintended social consequences, and such indicators should be systematically included in monitoring systems.

- Distributive and procedural justice indicators exist to some extent (e.g. energy poverty rate, data broken down by income decile, energy in household budget by decile, renovation uptake by income, diversity in stakeholder consultation, accessibility of information). However, a lack of recognitional justice indicators for energy renovation is a well identified gap (ETC ST, 2026).

- Indicators on real energy savings, energy consumption per capita and per m^2 and expost evaluation of the cost effectiveness of measures must be transparently reported, to draw lessons for future policies and define the appropriate type and level of public support (Von Platten, 2020; European Hot or Cool, 2025; Court of Auditors, 2026). Data on the costs of subsidised renovations, including labour, material and equipment costs, need to be made available to better assess the use of public funding (I4CE, 2026).

- Socio-economic assessments of energy renovation must systematically account jointly for summer and winter comfort. The absence of common adaptation indicators, targets, financing information and social vulnerability metrics prevents the systematic socio-economic consideration of summer cooling needs in the energy renovation of the EU building stock.

7 Conclusion

The transformation of the residential building stock is a massive structural change that will require significant investment. The benefits of boosting residential building energy efficiency and decarbonising heating and cooling are proven. They include lower energy bills, reduced dependency on fossil energy, a shield against fossil energy price shocks and environmental benefits such as improvements in local air quality. These can bring long-term improvements to citizen quality of life, health and social cohesion.

To reverse the declining trend in investment in energy renovation and maximise these benefits in a socially fair way, policies must carefully address who access, who pays and who benefits of energy renovation. This will help to deliver distributive justice, ensure inclusive participation and access to support (and deliver procedural justice), as well as being non-discriminatory (to deliver recognitional justice).

Combining several approaches can ensure that public financial support effectively reaches those in need of help in proportion of their situation while reducing energy demand and GHG emissions. This includes stable over time smartly targeted subsidies and loan schemes, right-price incentives and predictability, legal obligations on energy performance, tailored design of non-financial support programmes addressing behaviour and proactive outreach of vulnerable households (e.g. through one-stop shops) and inclusive consultations during policy cycles.

Social innovation combining community-led solutions, neighbourhoods and social dimensions are promising. Topics such as partial renovation, self-renovation, social electricity tariffs, new instruments to address the landlord dilemma, better use of existing building space and measures aimed at mobilising vacant housing stock all deserve further exploration. Some are included in the recent National Building Renovation Plans (JRC, 2026b).

This requires a strong integrated governance on multiple levels (local, regional, national) and domains (economic, social, environmental, building, planning) where building experts, economists, environmentalists, social policy specialists, local social practitioners, local NGOs (environmental and technical), representatives of vulnerable groups and city planners jointly define and implement policies.

Studies, EU legislation and the policies of several Member States show recognition of summer comfort as a social need and make commitments to improve access. However, there is limited evidence of integrating such commitments clearly in energy renovation policy packages, funding energy renovation mechanisms or delivering meaningful resident participation.

Socially fair renovation is a necessary condition for policy acceptance and effectiveness, optimal spending of public money and ultimately for reaching the EU's climate neutrality objectives. It should not be viewed solely as a climate policy, but also as one relating to housing, health, affordability, climate resilience and social cohesion.

The recent revision of EU legislation and initiatives for residential housing offer opportunities to boost the energy renovation of residential buildings. It addresses better social considerations and multiple benefits of energy renovation. The finalisation of the National Building Renovation Plans and the Social Climate Plans, expected in 2026, will mark a key milestone in the challenge of implementation at the national level.

References

Agora Energiewende, 2023, 'Heat pumps are the key to climate neutrality in buildings. Insights from Germany". 2023. Heat pumps are the key to climate neutrality in buildings.

AK Europa, 2025, 'ETS II and Social Climate Plans. Where do we stand?', Austrian Federal Chamber of Labour (https://www.akeuropa.eu/index.php/en/ets-ii-and-social-climate-plans-where-do-we-stand) accessed 2 September 2025.

Al-Assaad, D., et al., 2025, 'Personalized environmental control systems (PECS): A systematic review of performance evaluation methods for thermal comfort, air quality and energy', *Building and Environment* 284 (113471), DOI: 10.1016/j.buildenv.2025.113471.

ARCE 2050, Spanish Ministry of Housing and Urban Agenda (https://www.mivau.gob.es/arquitectura-edificacion/arce-2050) accessed 16 June 2025.

Astier, J., et al., 2024, 'Performance énergétique du logement et consommation d'énergie : les enseignements des données bancaires', Focus No 103, Conseil d'analyse économique (CAE), Paris.

Ballester, J., et al., 2023, 'Heat-related mortality in Europe during the summer of 2022', *Nature Medicine* 29, pp. 1857-1866 (DOI: 10.1038/s41591-023-02419-z).

Barbosa, G. & Almeida, M., 2025. *Strategies for Implementing and Scaling Renovation Passports: A Systematic Review of EU Energy Renovation Policies*. Sustainability, 17(5), 2289.

Ben Cheikh Nidhaleddine, Younes Ben Zaied, Duc Khuong Nguyen, 2023, Understanding energy poverty drivers in Europe, Energy Policy, Volume 183, 2023, 113818, ISSN 0301-4215, https://doi.org/10.1016/j.enpol.2023.113818.

Bouzarovski, S., 2014, 'Energy poverty in the European Union: landscapes of vulnerability', *WIREs Energy and Environment* 3 (3), pp. 276-289 (https://doi.org/10.1002/wene.89).

BPIE, 2025a, 'Citizens' Survey: Healthy Buildings, Healthy Lives', Buildings Performance Institute Europe.

BPIE, 2025b, 'Upscaling Innovation in Renovation: A call for a strategic approach for a competitive and sustainable construction sector', Buildings Performance Institute Eu (Upscaling-Innovation-in-Renovation.pdf).

Braungardt, S., et al., 2023, *Grossbaustelle Gebäud–sektor - Lokal und sozial die Wärmewende entfachen*, WWF Deutschland.

Brudermueller, T., Potthoff, U., Fleisch, E., Wortmann, F. & Staake, T. (2025). *Estimation of energy efficiency of heat pumps in residential buildings using real operation data*. Nature Communications, 16, Article 2834.

Bruegel, 2024, 'How to finance the European Union's building decarbonisation plan'.

BUILD UP, 2025, *National Building Renovation Plans at the national level: status of implementation*, European Commission (https://build-up.ec.europa.eu/en/news-and-events/news/national-building-renovation-plans-european-countries-level-status-implementation).

CAE, 2024, *Efficacité énergétique des logements : rénover l'action Publique*, Conseil d'Analyse Economique

Camarasa, C., et al., 2021, 'Drivers and barriers to energy-efficient technologies (EETs) in EU residential buildings', *Energy and Built Environment* 2(3), pp. 290-301 (DOI: 10.1016/j.enbenv.2020.08.002).

Castellazzi, L., et al., 2022, *Assessment of the first long-term renovation strategies under the Energy Performance of Building Directive (Art. 2a)*, European Commission (EC) (https://www.researchgate.net/publication/366030358_Assessment_of_the_first_long-term_renovation_strategies_under_the_Energy_Performance_of_Building_Directive_Art_2a).

CEE Bankwacth Network and E3G, 2025, *Climbing Together. Is the Social Climate Fund working for those who need it most?* (https://bankwatch.org/wp-content/uploads/2025/06/2025_06_Climbing-together_Is-the-Social-Climate-Fund-working-for-those-who-need-it-most.pdf).

Certomà, C., et al., 2023, 'Beyond Income and Inequality: The Role of Socio-political Factors for Alleviating Energy Poverty in Europe', *Soc Indic Res* 169, pp. 167-208 (https://doi.org/10.1007/s11205-023-03148-z).

Climate Strategy & Partners, 2023, *Turning Sustainable Finance Commitments into Household Energy Savings and Climate Resilience* (https://www.climatestrategy.es/press/2023RenovationFinanceReport.pdf).

Coface, 2026, 'Nearly Half of Europe's Recovery Funding Remains Undisbursed' (https://www.coface.be/en/news-economy-and-insights/nearly-half-of-europe-s-recovery-funding-remains-undisbursed).

Dubeta, N., et al., 2024, *Unlocking the Potential of Local and Regional Governments in the Social Climate Fund*, ACR+, CEMR, Climate Alliance, Energy Cities, Eurocities, FEDARENE, ICLEI Europe and POLIS.

EC, 2020, *A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives* (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1603122220757&uri=CELEX:52020DC0662).

EC, 2023a, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'EU wide assessment of the draft updated National Energy and Climate Plans' (COM (2023) 796 final of 18 December 2023) (https://commission.europa.eu/system/files/2023-12/EU-wide_assessment_draft_updated_National_Energy_Climate_Plans_2023.pdf).

EC, 2023b, Commission Staff Working Document (SWD/2003/647) 'EU guidance on energy poverty' (accompanying the Commission Recommendation on energy poverty (C/2023/4080).

EC, 2024a. Commission Staff Working Document (SWD(2024)63) 'Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society' (https://eur-lex.europa.eu/resource.html?uri=cellar:6c154426-c5a6-11ee-95d9- 01aa75ed71a1.0001.02/DOC_3&format=PDF).

EC, 2024b, 'Energy renovation of buildings', European Commission (https://energy.ec.europa.eu/topics/energy-efficiency/energy-performance-buildings/energy-performance-buildings-directive/energy-renovation-buildings_en).

EC, 2025a, Action Plan for Affordable Energy: Unlocking the true value of our Energy Union to secure affordable, efficient and clean energy for all Europeans.

EC, 2025b, *Perceptions of fairness and climate action in the EU*, Publications Office of the European Union (https://data.europa.eu/doi/10.2767/1292775).

EC, 2025c, *Framing summer energy poverty – Insights and recommendations for a resilient future*, Publications Office of the European Union (https://data.europa.eu/doi/10.2833/3135617).

EC, 2026a, *The Middle East energy shock*, Publications Office of the European Union (https://op.europa.eu/en/publication-detail/-/publication/21e0877a-7b57-11f1-bf5e-01aa75ed71a1/language-en).

EC, 2026b, *Energy Efficiency financing in Europe* (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52026DC0118).

EC, 2026c, *Assessment of EU and Member States adaptation investment needs*, Publications Office of the European Union (Assessment of EU and Member States adaptation investment needs - Publications Office of the EU).

EC, 2026d, In focus: Improving the energy performance of buildings - Energy

ECB, 2025, 'ECB Economic Bulletin Issue 5, 2025', European Central Bank (https://www.ecb.europa.eu/press/economic-bulletin/html/eb202505.en.html).

EEA 2026b, *EU Emissions Trading System (ETS2) and Social Climate Fund: Mechanisms, challenges and conditions for a fair decarbonisation in buildings*, EEA Briefing No 21/2025, European Environment Agency.

EEA and Eurofound, 2021, *Exploring the social challenges of low-carbon energy policies in Europe*, EEA Briefing No 11/2021.

EEA, 2022a, *Energy prosumers in Europe — Citizen participation in the energy transition*, EEA Report No 1/2022, European Environment Agency.

EEA, 2022b, *Building renovation: where circular economy and climate meet*, EEA Briefing No 12/2022, European Environment Agency.

EEA, 2022c, *Cooling buildings sustainably in Europe: exploring the links between climate change mitigation and adaptation, and their social impacts*, EEA Briefing no. 20/2022, European Environment Agency.

EEA, 2022d, *Air quality in Europe 2022*, EEA Report No 05/2022, European Environment Agency (https://www.eea.europa.eu/publications/air-quality-in-europe-2022) accessed 30 November 2022.

EEA, 2023a, *Accelerating the energy efficiency renovation of residential buildings — a behavioural approach*, EEA Briefing No 14/2023, European Environment Agency.

EEA, 2023b, *Decarbonising heating and cooling — a climate imperative*, Briefing No 27/2022, European Environment Agency.

EEA, 2024a, *Addressing the environmental and climate footprint of buildings*, European Environment Agency (https://data.europa.eu/doi/10.2800/1800539) accessed 10 July 2025.

EEA, 2024c, *Just sustainability transitions — From concept to practice*, EEA Report No 12/2024 (https://www.eea.europa.eu/en/analysis/publications/just-sustainability-transitions) accessed 16 November 2024.

EEA, 2024d, *Renewables, electrification and flexibility - For a competitive EU energy system transformation by 2030*, EEA Report No 16/2024, European Environment Agency.

EEA, 2025a, 'Greenhouse gas emissions from energy use in buildings in Europe', European Environment Agency (https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-energy).

EEA, 2025b, *Harm to human health from air pollution in Europe: burden of disease status, 2025*, European Environment Agency (EEA)

EEA, 2026a, *Overheated and underprepared — Europeans' experience of living with climate change*, Eurofound-EEA report No 01/2026, European Environment Agency.

EMBER, 2026, 'Latest energy shock reminds Europe of its risky gas reliance' (https://ember-energy.org/latest-insights/latest-energy-shock-reminds-europe-of-its-risky-gas-reliance/).

EP, 2023, *Policy instruments to tackle social inequalities related to climate change: study in focus*, European Parliament.

ETC CM, 2026, *ETC CM report 2025/09: EU ETS2 and Social Climate Fund: Enabling decarbonisation in transport and buildings that works for all*, European Topic Centre on Climate Change Mitigation.

ETC ST, 2026, *Report 2025/2: Residential energy renovations: benefits and enablers for a just transition*, European Topic Centre on Sustainability Transitions.

Eurofound, 2016, *Inadequate housing in Europe: Costs and consequences*, Publications Office of the European Union, Luxembourg.

Eurofound, 2023, *Unaffordable and inadequate housing in Europe*, European Foundation for the Improvement of Living and Working Conditions, Publications Office of the European Union, Luxembourg.

Eurofound, 2024, *Decarbonisation of residential heating and cooling: The heat pump challenge*, European Foundation for the Improvement of Living and Working Conditions, Publications Office of the European Union, Luxembourg.

Eurofound, 2025, *Mental health: Risk groups, trends, services and policies*, European Foundation for the Improvement of Living and Working Conditions, Publications Office of the European Union, Luxembourg.

European Court of Auditors, 2026, special report 20/2026 "Improving the energy efficiency of private homes with the RRF - Broad financial support, but weaknesses in the foundations", Publications Office of the European Union, 2026

European Scientific Advisory Board on Climate Change, 2023, Addressing the energy crisis while delivering on EU's climate objectives: recommendations to policy makers, February 2023.

Eurostat, 2025, *Housing in Europe – 2025 edition*, Eurostat (https://ec.europa.eu/eurostat/web/interactive-publications/housing-2025#house-of-flat-owning-or-renting).

Eurostat, 2026a, *Living conditions in Europe - energy efficiency in households*, Eurostat (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Living_conditions_in_Europe_-_energy_efficiency_in_households#Energy_efficiency_improvements).

Eurostat, 2026b, 'EU imports of energy products decreased again in 2025', Eurostat (https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20260325-3).

Fernández-Luzuriaga et al., 2021, 'Demand Aggregation as a Strategy for Untapping Buildings' Energy Renovation Potential: Diagnosis and Prioritization Methodology and Case Study from the Basque Country', *Sustainability* 13 (13881).

FIEC, 2026, *FIEC 2025 Statistical report*, European Construction Industry Federation (https://fiec-statistical-report.eu/european-union).

Filippidou, F., et al., 2019, 'Effectiveness of energy renovations: a reassessment based on actual consumption savings', *Energy Efficiency* 12, pp. 19-35 (https://doi.org/10.1007/s12053-018-9634-8).

Forni, L., et al., 2025, 'Are Incentives for Energy Retrofitting Regressive? Evidence from the Italian Superbonus' *SSRN* (http://dx.doi.org/10.2139/ssrn.5292174).

FRA, 2023, *Being Black in the EU: Experiences of people of African descent (Revised edition)*, European Union Agency for Fundamental Rights, Publications Office of the European Union, Luxembourg.

FRA, 2024a, *Being Muslim in the EU – Experiences of Muslims*, European Union Agency for Fundamental Rights, Publications Office of the European Union, Luxembourg.

FRA, 2024b, *Fundamental Rights Report 2024*, European Union Agency for Fundamental Rights, Publications Office of the European Union, Luxembourg.

FRA, 2026, Fundamental rights and housing in the EU's climate and energy transition, European Union Agency for Fundamental Rights, Publications Office of the European Union, Luxembourg.

Fuerst, F., et al., 2026, 'The impact of minimum energy efficiency standards on the private rental market', *Energy Policy* 210 (115039).

Galimshina, A., et al., 2022, 'Bio-based materials as a robust solution for building renovation: A case study', *Applied Energy* 316 (119102).

Galvin, R., & Sunikka-Blank, M., 2016, 'Quantification of (p)rebound effects in retrofit policies – Why does it matter?' *Energy* 95, pp. 415-424.

García-León D., et al., 2024, 'Temperature-related mortality burden and projected change in 1368 European regions: a modelling study', *The Lancet Public Health* 2024 (9), pp. 644-653.

Giandomenico L., et al., 2022, 'A Systematic Review of Energy Efficiency Home Retrofit Evaluation Studies', *Annual Review of Resource Economics* 14, pp. 689-708 (https://doi.org/10.1146/annurev-resource-111920-124353).

Giraudet, L.-G. and Vivier, L., 2024, 'Analyse socio-économique de la rénovation énergétique des logements', *Conseil d'Analyse Économique Focus* 106.

Habitat for Humanity International, 2024b, *Unlocking the potential of community-driven models to drive residential renovation: Insights from six case studies*, Habitat for Humanity International.

Hajian, H., Pylsy, P., Simson, R., Ahmed, K., Sankelo, P., Mikola, A. & Kurnitski, J., 2024. *Finnish energy renovation subsidies in multifamily apartment buildings: Lessons learnt and best practices*. Energy and Buildings, 307, 113986.

Harmat, Á., et al., 2026, 'When biomass demand exceeds supply: Forward-looking spatial analysis of residential firewood use and policy implications in Hungary', *Energy Policy* 215 (115321).

Hormigos Feliu, C., et al., 2025, *Exploring rural energy poverty and needs - Rural households spend more on energy but lead in renovations*, Joint Research Centre, Publications Office of the European Union, Luxembourg

Hot or Cool Institute, 2025, *A Climate for Sufficiency: 1.5-Degree Lifestyles Report (2025 Update)*, Hot or Cool Institute, Berlin.

I4CE, 2024, 'Adapting French buildings to heatwaves: What do we know?', Institute for Climate Economics.

I4CE, 2026a, *'The State of Europe's Climate Investment - 2026 Edition'*, Institute for Climate Economics.

I4CE, 2026b, *Hausse des prix des rénovations : quels impacts sur l'accessibilité des travaux?* Paris: I4CE, Institute for Climate Economics.

IDAE, 2022, *'El IDAE inicia un estudio de monitorización de la pobreza energética'*, Instituto para la Diversificación y Ahorro de la Energía (https://www.idae.es/noticias/el-idae-inicia-un-estudio-de-monitorizacion-de-la-pobreza-energetica) accessed 24 June 2025.

IEA, 2025a, *'Grid investments'*, International Energy Agency (https://www.iea.org/reports/grid-investments).

IEA, 2025b, *'Multiple Benefits of Energy Efficiency'*, International Energy Agency (https://iea.blob.core.windows.net/assets/c502f510-91cb-4a90-aa89-890172aace95/MultipleBenefitsofEnergyEfficiency.pdf).

IEA, 2026, *World Energy Investment 2026*, International Energy Agency (https://iea.blob.core.windows.net/assets/64594543-cf6e-4fd9-8238-d3cae35daf48/WorldEnergyInvestment2026.pdf).

JRC, 2025, *Addressing Housing Affordability and Energy Poverty: A Dual Challenge for the EU*, European Commission, Petten.

JRC, 2026a, *Addressing Residential Cooling Demand and Summer Energy Poverty in the EU - Towards a Cooler Future*, Publications Office of the European Union, Luxembourg.

JRC, 2026b, *Assessment of the first draft national building renovation plans - Part 1: Belgium (Walloon Region), Bulgaria, Denmark, Germany, Spain, France, Croatia, Cyprus, Lithuania, Netherlands, Austria, Portugal, Romania, Slovenia, Finland, Sweden*, Publications Office of the European Union, Luxembourg.

JRC, 2026c, *Covenant of Mayors 2025 Assessment*, Publications Office of the European Union, Luxembourg.

Jüngling, E., et al., 2025, 'Making the best of the new EU Social Climate Fund', Bruegel (https://www.bruegel.org/policy-brief/making-best-new-eu-social-climate-fund) accessed 3 April 2025.

Kilpeläinen, S., et al., 2025, 'Exploring diverse drivers behind hybrid heating solutions', *Buildings & Cities*, 6 (1), pp. 580-596.

Lager, F., et al., 2023, *Just Resilience for Europe: Towards measuring justice in climate change adaptation*, European Topic Centre on Climate change adaptation and LULUCF (https://doi.org/10.25424/CMCC-BATP-3M95).

Légifrance, 2021, *France Climate and Resilience Law (2021)*, Légifrance (https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000043956924).

Li, L., et al., 2025, 'How can interventions of building renovation and household energy conversion effectively improve the physical and mental health outcomes? A systematic review and meta-analysis', *Indoor and Built Environment* 34 (2), pp.281-301 (doi:10.1177/1420326X241293368).

Mehta, S. S., et al., 2023, 'Indoor wood-burning from stoves and fireplaces and incident lung cancer among Sister Study participants', *Environment International* 178 (108128) (https://doi.org/10.1016/j.envint.2023.108128).

Mejino-López, J. and M. Oliu-Barton, 2024, *'How much does Europe pay for clean air?'* Working Paper 15/2024, Bruegel, (https://www.bruegel.org/system/files/2024-06/WP%2015%202024.pdf).

Meyer, R., et al., 2024, *Heizkosten und Treibhausgasemissionen in Bestandswohngebäuden: Aktualisierung auf Basis der GEG-Novelle 2024*, Potsdam Institute for Climate Impact Research (https://publications.pik-potsdam.de/pubman/item/item_29435) accessed 14 July 2025.

Miara, M. and Rosenow, J. 2026, 'Why are heat pump installation costs so much higher in Germany? Evidence from a European comparison,' *Energy and Buildings* 369 (117998), ISSN 0378-7788 (https://doi.org/10.1016/j.enbuild.2026.117998).

Monge Palma, R. et al., 2024, 'Enhancing the building resilience in a changing climate through a passive cooling roof: A case study in Camas (Seville, Spain)', *Energy and Buildings* 321 (114680).

Mundaca, L. and Kloke, S., 2018, 'On-Bill Financing Programs to Support Low-Carbon Energy Technologies: An Agent-Oriented Assessment', *Review of Policy Research* 35(4), pp. 502-534 (doi: 10.1111/ropr.12302).

OECD, 2026a, 'OECD Affordable Housing Database', Organisation for Economic Co-operation and Development (https://www.oecd.org/content/oecd/en/data/datasets/oecd-affordable-housing-database.html). Consulted in June 2026.

OECD, 2026b, *Restoring Public Finances: Enabling Effective Government*, Organisation for Economic Co-operation and Development (https://doi.org/10.1787/fbcf9161-en).

OECD,/IPEEC, 2019, Building Energy Performance Gap Issues, An International Review, Building Energy Performance Gap Issues

Olsen, E.V., et al., 2026, 'A methodology for evaluating the effects of personalized environmental control systems (PECS) on building whole-life CO_2 emissions', Energy and Buildings 363 (117565).

Opengela, 2022, *Final results report – OPENGELA Bilbao and Eibar pilot*, European Affordable Housing Consortium (https://www.opengela.eus/en/).

Palma, P., et al., 2022, 'How much will it cost? An energy renovation analysis for the Portuguese dwelling stock', *Sustainable Cities and Society* 78, p. 103607 (doi: 10.1016/j.scs.2021.103607).

Portal, A., et al., 2021, *Targeting Energy Efficiency Renovation to Improve Housing Conditions of the Most Vulnerable: Avoiding Social Risks and Ensuring the Benefits*, European Federation of National Organisations Working with the Homeless (https://www.feantsa.org/files/Themes/Energy/2021/targeting-energy-efficiency-renovation/Targeting_Energy_Efficiency_Renovation_Report.pdf).

RAND, 2022, *Poor indoor climate. Its impact on health and life satisfaction, as well as its wider socio-economic costs*, RAND Corporation, Santa Monica (https://www.rand.org/pubs/research_reports/RRA1323-1.html).

RenOnBill, 2022, *European On-Bill Building Renovation Roadmap: Policy Roadmap*, RenOnBill Project, available at: RenOnBill Policy Roadmap

Renovate Europe, 2020, *Building Renovation: A kick-starter for the EU recovery* (https://www.renovate-europe.eu/wp-content/uploads/2020/06/BPIE-Research-Layout_FINALPDF_08.06.pdf).

Renovate Europe, 2023, *2021-2027 Cohesion policy support for energy efficiency and building renovation*.

Ricardo, 2025, *Building support measures: Assessment of supporting measures supporting the decarbonisation of ETS2 sectors*, Publications Office of the European Union, Luxembourg.

Rodriguez-Alvarez Ana, Manuel Llorca, Tooraj Jamasb, 2021, Alleviating energy poverty in Europe: Front-runners and laggards, Energy Economics, Volume 103, 2021, 105575, ISSN 0140-9883, https://doi.org/10.1016/j.eneco.2021.105575.

Rose, J., et al., 2021, 'Building renovation at district level – Lessons learned from international case studies', *Sustainable Cities and Society* 72 (103037).

Ruiz-Rivas, U., et al., 2023, 'Disconnected, yet in the spotlight: Emergency research on extreme energy poverty in the Cañada Real informal settlement, Spain', *Energy Research and Social Science* (102) (https://www.sciencedirect.com/science/article/pii/S2214629623002426?via%3Dihub).

Schleich, J., 2019, 'Energy efficient technology adoption in low-income households in the European Union – What is the evidence?', *Energy Policy* 125, pp.196-206 (https://doi.org/10.1016/j.enpol.2018.10.061).

Sgaravatti, G., 2024, 'Electricity tariffs dashboard', Bruegel (https://www.bruegel.org/dataset/electricity-tariffs-dashboard) accessed 24 September 2025.

SHAPE-EU, 2023, *Handbook of Best Practices of Affordable Renovation*, European Affordable Housing Consortium (https://shape-affordablehousing.eu/files/2024/05/SHAPE-EU_D3.2_Handbook_Best_Practices_VF.pdf).

Sunderland, L., 2020, 'Filling the policy gap: Minimum energy performance standards for European buildings'.

Sunikka-Blank, M., & Galvin, R., 2012, 'Introducing the prebound effect: the gap between performance and actual energy consumption', *Building Research & Information* 40 (3), pp. 260-273.

Taylor, J., McLeod, R., Petrou, G., Hopfe, C., Mavrogianni, A., Castaño-Rosa, R., Pelsmakers, S. & Lomas, K. (2023). *Ten questions concerning residential overheating in Central and Northern Europe*. Building and Environment, 234, 110154.

Thöne, M., et al., 2023, *Local One-Stop-Shops for home energy renovation – lessons from Belgium*, European Climate, Infrastructure and Environment Executive Agency (https://cinea.ec.europa.eu/).

Von Platten, J., et al., 2020, 'A matter of metrics? How analysing per capita energy use changes the face of energy efficient housing in Sweden and reveals injustices in the energy transition', *Energy Research & Social Science* 70 (101807) (https://doi.org/10.1016/j.erss.2020.101807).

Weber, I., and Wolff, A., 2018, 'Energy efficiency retrofits in the residential sector – analysing tenants' cost burden in a German field study', *Energy Policy* 122, pp. 680-688.

WHO (World Health Organisation), 2026, *Heat-health action plans: guidance, second edition. Copenhagen: WHO Regional Office for Europe*; 2026.
Licence: CC BY-NC-SA 3.0 IGO.

Getting in touch with the EU

In person
All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://european-union.europa.eu/contact-eu_en

On the phone or by email
Europe Direct is a service that answers your questions about the European Union. You can contact this service:
by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
or at the following standard number: +32 22 99 96 96 or by email via: https://european-union.europa.eu/contact-eu_en

Finding information about the EU

Online
Information about the European Union in all the official languages of the EU is available on the Europa website at: https://european-union.europa.eu/index_en

EU publications
You can download or order free and priced EU publications at: https://op.europa.eu/en/web/general-publications/publications.
Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://european-union.europa.eu/contact-eu_en).

European Environment Agency

European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark
Tel.: +45 33 36 71 00
Web: eea.europa.eu
Contact us: eea.europa.eu/en/about/contact-us

Publications Office
of the European Union