European Environment Agency

Accelerating the energy efficiency renovation of residential buildings — a behavioural approach

Improving the energy performance of buildings is an important part of reaching the EU's climate, energy and air pollution targets, but requires an acceleration in renovation rates. This briefing identifies behavioural factors that influence decisions on renovation investment. It also explores how understanding these factors can inform the design of policies that more effectively encourage the renovation of residential buildings, contributing to achieving climate neutrality.

Key messages

- Buildings currently account for more than one third of energy-related EU greenhouse gas emissions. Renovations to improve buildings' energy performance will contribute significantly to achieving the EU's goal of becoming climate neutral by mid-century. To achieve this, the energy renovation rate needs to at least double from its current level. This will demand considerable investment.
- By considering human and behavioural factors in policy design, policymakers can better account for the drivers of and barriers to investment in renovation. This requires a better understanding of the variety of stakeholders involved in making decisions on investing in improving the energy efficiency of residential buildings.

- Owners play a key role in making decisions to invest in renovation. Moreover, installers and contractors are influential through the advice they provide to owners and in turn are influenced by factors such as the culture and social influence of their workplaces and the behaviour of their peers.
- Key behavioural non-monetary factors that influence owners' investment decisions include improved living and building conditions, the perceived level of effort and potential disruption required to complete energy renovations, and uncertainties on the outcome of the investment. The influence of these factors differs between owners who live in the property they own and those who rent it out.
- By considering stakeholders' motives to invest and the heterogeneity of population groups, the design of policies and measures could help to increase the rate of energy efficiency renovations. This could involve better designing communication actions (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.
- Even if the renovation rate does increase, a rebound effect may jeopardise the resulting increases in energy efficiency. Addressing behavioural factors can help to mitigate the rebound effect after renovation.
- Behavioural initiatives should not be regarded as standalone solutions. Rather, they should be seen as part of a holistic approach to policymaking that combines behavioural insights and traditional approaches based on economic instruments and pricing.

A need to invest in the energy efficiency renovation of Europe's buildings

In 2020, energy use in buildings accounted for 42% of the EU's total energy consumption, 35% of energy-related greenhouse gas emissions and a significant share of air pollutant emissions (EEA, 2022c, d, EEA, 2023). To achieve the EU's energy, climate and air quality targets, reducing the energy consumption of buildings is critical, in parallel with decarbonising the heating, cooling and electricity sectors (JRC, 2021a). This creates an imperative for new buildings to be carbon neutral and existing buildings to be renovated to improve their energy performance (EEA, 2022a).

To achieve this, the EU's renovation wave aims to at least double the annual energy renovation rate of residential and non-residential buildings by 2030 and initiate deep energy renovations that could reduce buildings' energy consumption by at least 60% (EC, 2020a, b, c). However, despite progress

and demonstrated potential, current investment in improving the energy performance of EU buildings is too low to meet the EU's climate objectives (EEFIG, 2021).

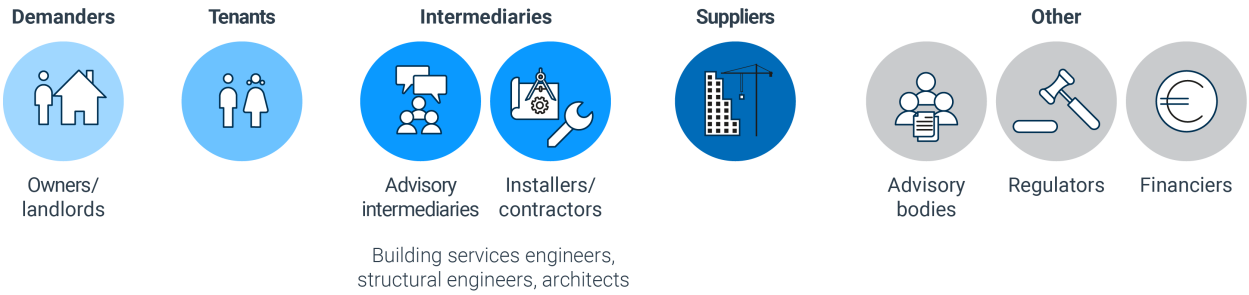
As Figure 1 illustrates, a number of stakeholders are often involved in deciding whether or not to invest in building renovation. The role of human behaviour in determining whether to undertake energy renovation in buildings is often overlooked by policies, which tend to focus on monetary and financial incentives (e.g. subsidies, low interest loans, tax cuts). This briefing, and the report on which it builds, explores how an approach that takes behavioural insights[1] into account could help to inform the development of policies aimed at increasing residential building renovation rates.

Stakeholders influencing the energy renovation of residential buildings

Owners are the most influential stakeholder group, as they are the ones who pay for the renovations and ultimately decide whether or not to renovate. It is useful to differentiate between homeowners, who live in the property they own (e.g. a detached house or apartment), and owners who rent out their property, as making the decision to renovate can be driven by different factors in each group. Owners who rent out their property can be further categorised based on the ownership structure of the building they own (privately owned buildings, social public housing, etc.). Homeowners consume the energy and pay operating costs, for instance for gas or electricity, for the building they own. In the case of properties that are rented out, it is the residents who consume and cover the related energy costs.

An owner's decision to invest in energy renovations is often highly influenced by **installers and contractors**. They supply the technical knowledge, shape the scope of the renovations and ultimately affect energy consumption patterns. Installers and contractors are often craftspeople who carry out renovations, advise owners and provide technical and practical expertise (e.g. on materials to use, implementation techniques). Owners of single-family houses in particular tend to rely heavily on this professional advice, as the renovation process is less complex for this type of building than it is for large, multi-family buildings. This means that installers' and contractors' expertise and skills are often instrumental in determining the technical solutions implemented in residential buildings.

Figure 1. Overview of stakeholders involved in building renovation



A complex decision-making process influenced by behavioural factors

The process of deciding whether or not to invest in improving the energy efficiency of residential buildings is often complex and involves several stages and multiple decisions (see Figure 4). It can be broken down into three main phases:

1. understanding that there is a need to renovate, that is, when an owner who has not before considered an energy renovation realises that this could be beneficial
2. searching for an appropriate energy efficiency renovation measure, that is, when the owner considers technical options while planning the energy renovation
3. carrying out the renovation, that is, when the installers and contractors carry out the work involved.

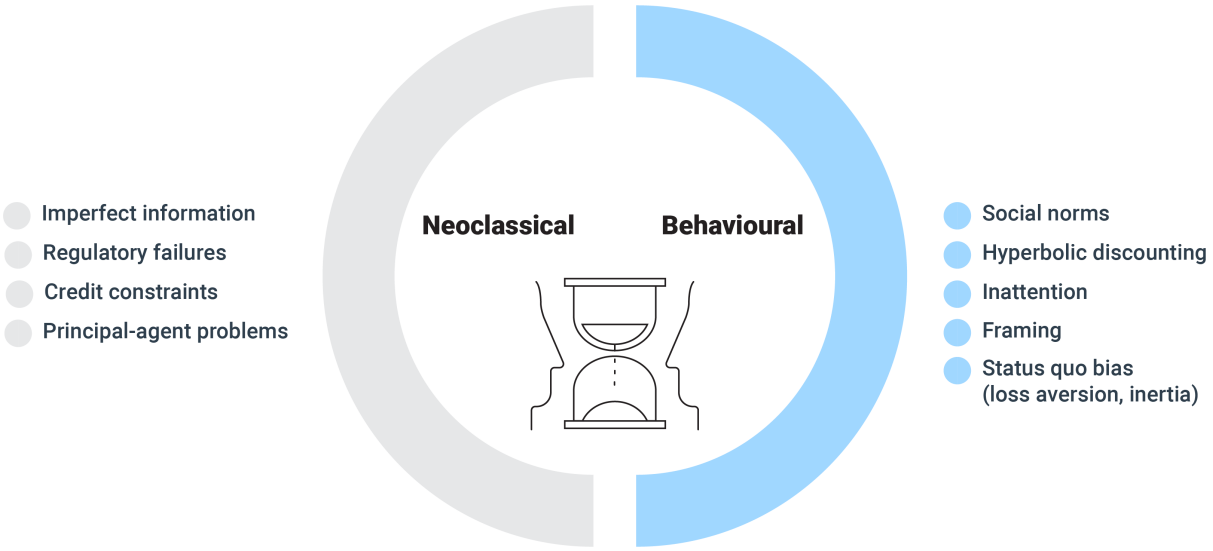
During these three phases, several important behavioural drivers and barriers influence the decisions and actions of the stakeholders involved. The way in which stakeholders, particularly residents, behave in the post-renovation phase will significantly influence the greenhouse gas emission savings and reduction in energy consumption that the renovations achieve. In addition, the individual situation of each stakeholder, which may be very different between and within European countries (e.g. in relation to well-being, income, energy poverty, education, skills, legal framework), is also a key consideration when trying to understand what influences decision-making in relation to investing in the energy efficiency of buildings and the post-renovation behaviour of stakeholders.

Behavioural insights approach

In recent decades, the traditional neoclassical economic approach has been supplemented by a behavioural approach. The latter incorporates experimental and empirical evidence nuancing the traditional assumption of the economic rationality of human behaviour (Bavel, 2021). Both approaches are valuable for guiding effective policy development. This is particularly true in an area as complex and multifaceted as energy policy, which often takes an economic approach. While such economic incentives are often successful and increase energy efficiency[2], to achieve their full potential, energy policies could benefit from a more holistic approach that incorporate better behavioural insight (JRC, 2021b).

Behavioural insights and biases explain how behaviours are shaped by psychological factors (EEA, 2022b). Figure 2 presents examples of insights and biases that are relevant for energy efficiency investment decision-making, divided into the neoclassical and behavioural approaches[3]. Considering behavioural factors helps us to understand why owners do not always make rational decisions on investing in energy efficiency renovations, even when the economic benefits of such renovations are clear. Therefore, it is essential to investigate which factors have most influence over stakeholders' decisions, with the aim of shaping energy efficiency policies in a behaviourally informed way and addressing potential inconsistencies. For instance, considering behavioural factors can help to ensure that communication actions are better designed (e.g. targeting the most influential stakeholders, addressing key trigger points) and that interventions are more tailored to specific target groups (e.g. one-stop shops, financial support).

Figure 2. Factors that influence the energy efficiency renovation of buildings



Social norms
People are generally influenced by the attitudes and behaviours of others and tend to follow different social norms in respective communities.

Hyperbolic discounting
People tend to discount long-term benefits against short-term rewards.

Inattention
Even in cases where costs and benefits are clearly communicated, people may still make suboptimal decisions if they are not aware of them due to inattention.

Framing
People's decisions are influenced by which choices are available and how they are presented.

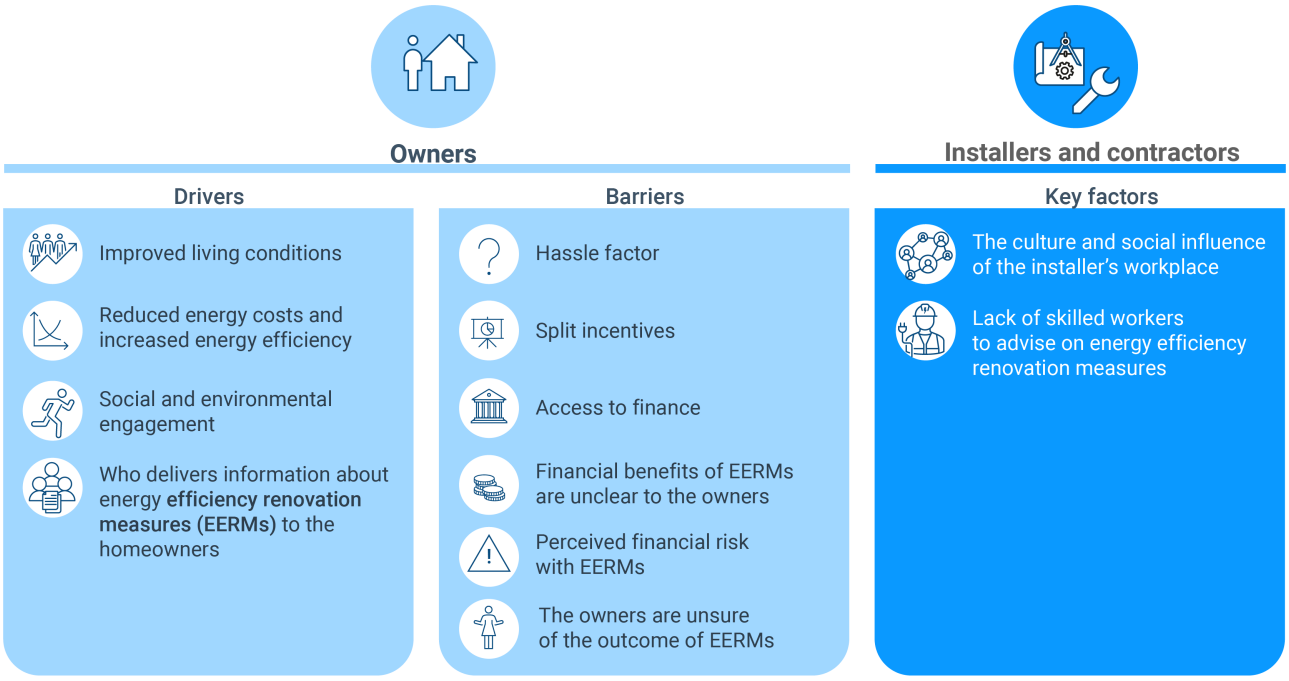
Status quo bias
People tend to prefer to maintain the current situation, such as sticking with the default option, even when an alternative may yield a more advantageous outcome.

Note: Further definitions and explanations are available in the background report

The most prominent practical factors affecting stakeholders' decision-making

A broad range of drivers and barriers influences stakeholders' decision-making in relation to investing in energy efficiency renovations. These drivers and barriers are summarised below (figure 3) and can be explained by one or several of the behavioural factors illustrated in Figure 2.

Figure 3. Prominent drivers and barriers influencing owners, installers and contractors



Note: EERM, energy efficiency renovation measure.

Main drivers for owners

- **Improved living and building conditions** are among the most important drivers of owners investing in energy efficiency renovations. The analysis showed that owners value having adequate thermal comfort and indoor living conditions and are likely to make the building envelope of their home more energy efficient to achieve this. In addition, the intention to improve their homes' appearance seems to motivate homeowners to carry out renovations. This also applies to owners who rent out their property, as renovating a building increases tenant satisfaction, minimises potential technical problems and complaints, increases property value and may make it easier to rent out the building at a higher price[4].
- **Reducing energy consumption is perceived as only a side benefit** of renovation. However, the **salience** of the sudden increase in energy costs in 2022[5] has increased owners' awareness of their energy consumption levels and the importance of being more resilient to future price shocks. This experience may continue to affect owners' behaviour in the future,

particularly those who live in their property and bear the energy bill costs.

- **The most socially and environmentally engaged owners are most likely to carry out energy efficiency renovations**. Significant evidence highlights that a sense of social responsibility (e.g. towards fulfilling tenant needs) can be a primary driver of investing in energy renovations for both private and public housing organisations. Decision-making among social housing building owners might be affected by a sense of responsibility or 'moral obligation' to provide good accommodation and housing services to their residents. Homeowners who express pro-environmental beliefs are also more likely to implement energy efficiency renovations[6]. Factors such as **gender, age and education level** also affect stakeholders' level of social and environmental engagement and tendency to implement energy efficiency renovations.
- **Owners are more likely to listen to advice on energy efficiency renovation measures when it comes from a source they trust**. Information from personal contacts such as friends and family is likely to influence a homeowner's decision more than information from other sources, such as public information campaigns. **Peers such as neighbours and the homeowner's community also exert a significant influence**, since they determine what is socially approved or considered acceptable behaviour. Conversely, advice from professionals such as installers and contractors seems to be of higher importance only when the owner has already decided to renovate.

Main barriers for owners

- **'Hassle' factor:** one of the primary barriers to investing in energy efficiency renovation, especially deep renovation, is the perceived level of effort and disruption that renovation can cause in the everyday life of homeowners and residents. This relates to not only the implementation phase of the energy efficiency measures, but also the pre-implementation phase, when owners need to invest time in collecting the information they need (e.g. on financing sources, contracting companies) to make a decision. When the process is perceived as too lengthy or complicated, it might result in sub-optimal decisions or no decisions being made at all. Examples include the 'hassle' for homeowners in applying for subsidies and loans, the burden on residents' daily routines caused by large-scale renovations and the lack of time, especially for young owners. Since the financial return on energy efficiency investments is often delayed, calculating the costs and benefits is also an intricate task that might stop owners from investing.
- **Perceived financial risk:** similarly, the long-term nature of the benefits stemming from implementing energy efficiency measures increases the level of associated financial risk perceived and of uncertainty around whether or not the renovation will be profitable. Uncertainty about the extent of energy and therefore cost savings that will result from renovations is part of

this. The high up-front costs are a significant barrier to investing in deep renovations for both private and public owners who rent out their property, who are generally risk averse, dislike debt and prefer to avoid the organisational burdens of large investments[7].

- **Uncertainties about the outcomes of renovation:** in addition to uncertainties about the energy savings that will result from renovations, owners may fear that renovations might negatively affect building quality or generate health risks, particularly for children. These fears point towards the need for information campaigns (e.g. on how to reduce the health risks of more insulation through better ventilation) to eradicate incorrect beliefs and address the lack of awareness of the need for and benefits of energy efficiency renovation.

Main factors influencing installers and contractors

Behavioural factors also influence the type of advice that installers and contractors choose to provide to owners. These factors are influenced by the culture and social impact of their workplaces. Personal commitment to energy efficiency also appears to be a key motivator for promoting energy efficiency interventions.

As with owners, installers and contractors are also influenced by the behaviour of their peers, such as other practitioners in the sector, and by existing positive relationships, for example with certain suppliers, which can lead them to maintain the status quo.

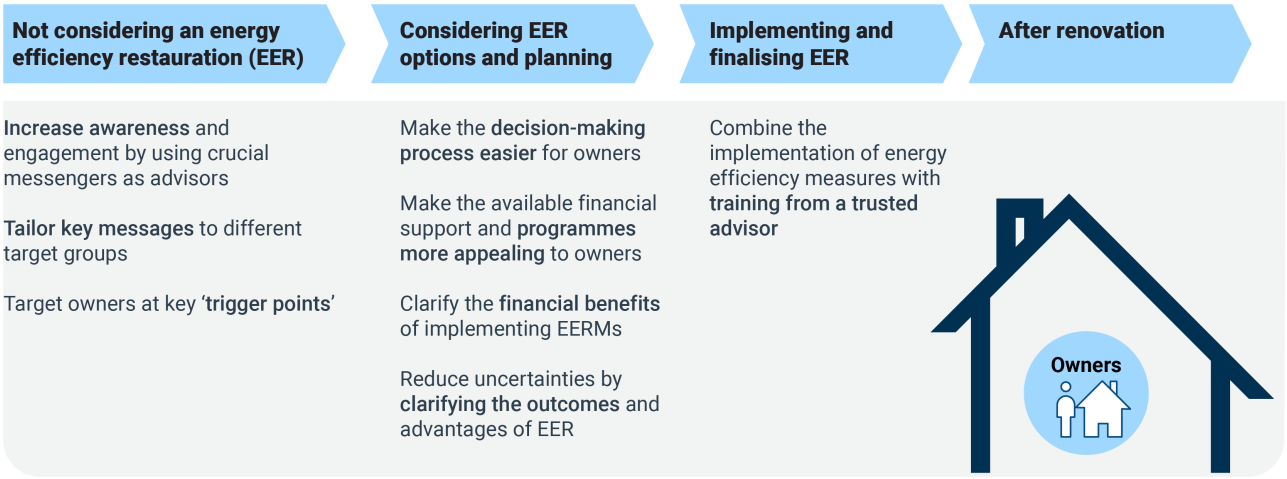
What can be done? Designing policies in a behaviourally informed way

Applying knowledge about the most prominent factors affecting stakeholders' decision-making (behaviourally informed policy design) allows policymakers to better address non-monetary motives for renovation and the heterogeneity of population groups. This may improve the effectiveness of policies and measures aiming to encourage energy efficiency renovation.

However, there is a lack of evidence and only some knowledge about what influences owners' decision-making and the role played by behavioural factors in the renovation process. This indicates not only the existence of a research gap in the scientific literature, but also that there is a limited number of policy instruments available to address behavioural barriers and improve the effectiveness of policies on the energy efficiency of buildings.

A few examples are shown in Figure 4 and described below of how behavioural insights could be used to inform the development of future policy measures aimed at incentivising energy renovation at each stage of the decision-making process. These measures are based on the best practice examples identified and on commonly used behavioural insights tools.

Figure 4. Possible measures to address identified barriers to and drivers of energy efficiency renovations



Note: EER, energy efficiency renovation; EERM, energy efficiency renovation measure.

Decision stage: 'not considering an energy efficiency renovation'

Increase awareness and engagement by using crucial messengers as advisors: as well as using media information campaigns to raise awareness about the benefits of energy renovation and to debunk incorrect beliefs, using influential stakeholders as **crucial messengers** could enhance existing or new policies. This could be done by, for example, providing free advice on energy savings and examples of good practice to homeowners. Energy consultants and companies could do this, and so could local communities and well-established organisations such as charities and local associations. The effectiveness of this approach was demonstrated by the Reduce Energy use and Change Habits (REACH) project, in which trusted, local institutions in the geographical area of the project provided energy efficiency advice to homeowners. When contacted by, for example, the Red Cross or Caritas through the project, owners tended to be more receptive to advice than they were if the advice came from sources they did not know. This practice could also help to reduce uncertainties around the benefits of energy efficiency renovation measures.

Tailor key messages to different target groups: While awareness campaigns aim to reduce uncertainties associated with energy efficiency, these could also be tailored to **specific target groups**. On the one hand, communication campaigns could be directed towards groups that are

more prone to environmentally sustainable behaviour and implementing energy efficiency interventions. On the other hand, policies aimed at the more difficult-to-reach groups should be tailored to overcoming the barriers they face. For example, step-by-step renovations compatible with deep energy renovation objectives[8] should be promoted among young homeowners and tenants, since these renovations are less costly and easier to implement, while large-scale renovations may better suit the daily routine of older homeowners. As property owners are diverse (resident, small owners who rent out their property, real estate companies, etc.), have different needs and face different challenges, different instruments need to be combined to effectively overcome barriers to energy efficiency renovation. For instance, this could involve combining regulation and financial incentives with effective communication[9].

Target owners at key 'trigger points': most homeowners decide to renovate their homes, especially through deep renovation, at **key trigger points**. These include the end-of-life replacement of a heating system or other major piece of equipment, when taking out a mortgage or during a major building renovation (initially for reasons other than energy efficiency), etc (BPIE, 2017). Shallow retrofits (e.g. draught-proofing) could be triggered by minor renovations (e.g. redecorating a room). Therefore, policymakers should target policies aimed at encouraging energy efficiency interventions concurrently with these trigger points. For example, they could introduce incentives for renovating when buying a new property and combine this with financial instruments that are targeted to house buyers.

Decision stage: 'considering energy efficiency renovation options and planning'

Make the decision-making process easier for owners: the **'hassle' factor** is a major barrier for owners, both homeowners and owners who rent out their property, and there is a major need to simplify the decision-making process and reduce the perceived or actual effort involved. This requires simplifying the administrative procedures involved in applying for subsidies or loans by helping owners to find reliable contractors and adapting procedures to the needs of specific target groups. As shown by the ReFURB project, providing a full end-to-end service via one-stop shops that offer a choice of financial advice and renovation packages tailored to different target groups (e.g. young families, empty nesters) can help owners to access all the required information in a single place, significantly simplifying their decision-making process. Clearly, the one-stop shop needs to be tailored to the target group. For example, websites and internet tools could work well for younger homeowners and setting up physical contact points might work better for older people, while business-to-business communication could work well for real estate companies. Another practice that has proven to be effective in reducing the perceived burden for private and public owners who rent out their property is performing step-by-step renovations, as this may better suit tenants' needs.

Make the available financial support and programmes more appealing to owners: financially related barriers, such as perceived financial risk and uncertainty around financial benefits, could be addressed by making financial support more broadly available and increasing the appeal of programmes addressing owners' decision-making. These could help clarify benefits, make investment profitable and address owners' perceptions of risk. Simplifying the administrative process for accessing financial support could ease access, while innovative solutions aimed at ensuring clear guidance for homeowners on which institutions can provide financial support for energy efficiency renovations may increase adoption rates. An example of a project that adopted these measures is the SustaiNAVility project in Spain, which used attractive regional grants to boost or drive energy efficiency-related investments in projects incorporating state-of-the-art technology and funding schemes.

Clarify the financial benefits of implementing energy efficiency renovation measures: the up-front costs of renovation are a major barrier to investing in energy efficiency in residential buildings. This is because owners are not always fully aware of how much they will save on energy costs as a result of increased efficiency and instead focus on the immediate investment costs. While this behavioural pattern is well known in the literature, estimates of the amount of energy that will be saved thanks to renovations need to be reliable[10]) and policymakers should prioritise communication aimed at highlighting the resulting energy cost savings. The current energy crisis in Europe has reduced the payback period of renovation, and people are becoming more aware of the importance of being resilient to future price shocks, as they are directly facing the impact of their energy bills. This is particularly true for homeowners, but owners who rent out their property might also experience more pressure from their tenants to implement energy efficiency measures.

Reduce uncertainties by clarifying the outcomes and advantages of energy efficiency renovation: estimates of energy use and costs before and after implementing a renovation should be more accurate and transparent. While energy performance certificates are a valuable tool for understanding the energy performance of a building during sale and lease transactions (EC, 2023d), the information provided in these certificates does not directly determine the energy-related operating expenses for the user before or after renovation. More transparent information could allow owners to make more informed decisions and provide incentives for investing at key trigger points. In this sense, policymakers could ask utility companies to include on each energy bill the amount of energy and corresponding cost savings that could be achieved if the dwelling's energy class were to be improved.

Decision stage: 'implementing and finalising energy efficiency renovation'

Combine the implementation of energy efficiency measures with training from a trusted

advisor: training is an essential aspect of energy efficiency renovation, as it helps to ensure that renovation measures result in significant energy and emission reductions. On the one hand, providing training to the user at the same time as the new technology (or other energy efficiency intervention) is adopted has been proven to be effective in addressing the rebound effect after renovation. Evidence shows that combining education on energy saving behaviour and the effective use of newly installed products helps to reduce energy consumption compared with installation without education. On the other hand, providing training to the workers who carry out the renovation ensures that the energy efficiency measure is implemented correctly and that its benefits are realised. The lack of skilled installers and contractors can in some cases lead to poorly installed renovations, thereby reducing their energy efficiency potential. To counteract this, policies should include training programmes for installers and contractors, as well as appliance standards.

What happens after renovation? Behavioural insights and the rebound effect

Even if policy interventions are successful in encouraging investment in energy efficient buildings, the result in terms of energy savings in reality might not be as would be expected in a theoretical, techno-economic world, without considering behavioural factors. The rebound effect[11], also known as the Jevons paradox, has been identified as a risk to the achievement of sustainability goals (Trincado et al., 2021). Recent studies conclude that, even if the rebound effect in the buildings sector tends to decrease over time, its size is very context dependent (e.g. income level) and can range from 0% to 100%[12]. These findings also highlight the importance of moving beyond fossil fuel use in buildings if we are to decrease greenhouse gas and air pollutant emissions.

Considering behavioural factors represents a promising way to mitigate the rebound effect after renovation. A growing body of evidence suggests that behaviour, lifestyle and culture have a major impact on energy demand in buildings, and that promoting pro-environmental behaviours, in particular by raising awareness about energy efficiency, can counter the direct rebound effect. Again, homeowners' peers, such as neighbours and the wider community, also exert a significant influence on behaviour, since they determine what is approved social practice and considered appropriate behaviour.

This can be achieved through regulation, for example, that promotes smart meter adoption and the inclusion of additional information on energy consumption levels on bills, both of which have been shown to reduce the direct rebound effect from efficiency improvements. Setting product and technical standards (e.g. for different types of energy efficiency renovation interventions) can also help to minimise the risk of implementing counterproductive and low-quality renovations.

Moreover, behaviour-influencing initiatives are believed to be an effective complementary strategy to promote environmentally friendly behaviours. This type of action can be pursued through mass

media campaigns by using pro-environmental role models and confronting consumers with their individual consumption levels. Ultimately, this can reduce the direct rebound effect from efficiency improvements and foster an exchange about measures taken and their success. However, evidence on how traditional information campaigns affect actual behaviours is mixed. Information campaigns could therefore accompany policy measures that guide the target group at the time decisions are made.

Importantly, it is recommended that policy pathways are designed to both encourage investment in energy renovation and mitigate the rebound effect, and that behavioural initiatives are not regarded as a standalone solution to the rebound effect. Rather, change should be brought about by a combination of economic and behavioural actions. In addition, studies show that there is likely to be an indirect rebound effect to consider: when the additional revenue generated by lower energy costs results in increased household budgets, the latter can be spent on the consumption of goods and services. As for energy efficiency investment policies, those promoting more environmentally friendly decisions by consumers (e.g. decisions consistent with circular economy principles) will be most effective if they account for factors shaping individual behaviour (EEA, 2022b).

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Notes

[1] Behavioural insights (noun): “an inductive approach to policymaking that combines insights from psychology, cognitive science and social science with empirically tested results to discover how humans actually make choices” (source: OECD, 2023, Behavioural insights).

[2] However, they may have negative distributive consequences resulting in increasing inequalities if no other actions are taken to counteract this tradeoff (EEA, 2021).

[3] In practice, some factors are difficult to categorise on the basis of these theoretical concepts. An example of this is imperfect information (which is a neoclassical factor) and information processing (which becomes biased because of behavioural factors such as inattention or framing).

[4] It is, however, important to note that options to raise the rent after an energy renovation might be limited and/or insufficient to make the investment cost effective, and the willingness to pay for energy efficiency on the rental market might also be below the energy cost saving that can be gained from the improved energy efficiency of buildings (see Taruttis and Weber, 2022).

[5] The Russian invasion of Ukraine in 2022 generated a profound shock on energy markets and a sharp increase in the price of the most commonly used fuel for indoor heating (i.e. natural gas), which, historically, has largely been imported to Europe.

[6] A similar conclusion can be drawn for those who engage in energy saving practices, such as reducing indoor temperature/air conditioning, washing clothes more efficiently and switching off the stand-by mode on appliances.

[7] One can also note that investment in energy efficiency is not always cost effective from a household’s project- level perspective, depending on the context. A recent study in the Netherlands found that after insulation of the floor, roof, facade, glass and doors to the national insulation standard, the consumption of gas in households decreased by 25%. In addition, for 6 out of 10 households, net income was greater each month than net income in the situation before these insulation measures (CPB and TNO, 2023).

[8] To avoid situations of becoming locked into lower energy performance than theoretically possible.

[9] For instance, for large property owners, increasing the value and profitability of their stock may be a key message in the communication.

[10] These estimates may vary considerably among regions and types of houses and households.

[11] The rebound effect is associated with consumers’ tendency to consume more energy due to the economic gains achieved through efficiency improvements.

[12] The rebound effect is usually higher in a low-income context. It is important to consider that when low-income households redirect new-found savings from energy efficiency towards increased

energy consumption it allows to keep a more comfortable indoor temperature. While this results in a direct rebound effect, it also improves the overall quality of their living environment.

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