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Assessing the relevance of barriers to energy efficiency implementation in the building and transport sectors in eight European countries

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A B S T R A C T

The paper maps and evaluates the main economic, institutional, and behavioural barriers to the implementation of energy efficiency in final uses. Barriers prevent the achievement of targets of energy efficiency policies and measures. Assessing the relevance of barriers can lead to their consideration in goal-setting by policy-makers either by reducing ambition or by incorporating solutions to mitigate barriers. We consider three main categories of barriers: economic, institutional, and behavioural ones, in buildings and transport sectors. In order to assess the relevance of each specific barrier in these categories, a survey to experts in eight Countries (Bulgaria, Germany, Greece, Estonia, United Kingdom, Italy, Belgium and Serbia) has been performed. The relevance of barriers is assessed by two levels of analysis: 1. their impact on policies and measures, and 2. their impact on the diffusion of key clean technologies and interventions in the two sectors. In the building sector, we find that the most relevant barriers relate to economic and behavioural categories. In the transport sector, we find that the most relevant barriers relate to institutional and economic categories. Economic barriers are also the most relevant in limiting the diffusion of technologies and interventions in both sectors. Results highlight the relevance of identifying and assessing barriers in order to improve policy design.

1. Introduction

The relevance of energy transition in contrasting climate change has led to increasing awareness about energy efficiency by policy-makers at all governance levels. This requires the consideration of the whole energy flow, from primary energy to final energy consumption. Losses and inefficiencies occur within the processes of energy transformation, transmission, and distribution, as well as in the final uses of energy (Morvaj and Bukaric, 2010). The increase in energy efficiency in the first three phases mainly concerns technological improvement, while energy final use, which is the focus of the paper, should be managed by both technical and non-technical measures with the aim to affect consumers’ behaviour and lifestyle. The European Union (EU) has been playing a front runner role in energy efficiency policy. However, results are inferior to expectations (Varone and Aebischer, 2001; Morvaj and Bukaric, 2010). Difficulties in achieving energy efficiency goals are linked to barriers (Schleich, 2004; Lah, 2015; Gerarden et al., 2017; Cattaneo, 2019). The paper aims to identify and assess those barriers in eight European Countries (Belgium, Bulgaria, Estonia, Germany, Greece, Italy, Serbia, United Kingdom), focusing on building and transport sectors which are characterized by high energy consumption and CO2 emissions.

We consider three categories of barriers: 1) economic, 2) institutional, and 3) behavioural ones. Those categories of barriers widely limit the achievement of policy goals, both at the European and national level in the two examined sectors. The relevance of barriers is assessed by two levels of analysis. First, we assess the barriers according to their capacity to hamper energy efficiency policies and measures in each sector. Then we analyse the impact of barriers in slowing the diffusion of key energy efficiency technologies in each sector. In fact, energy efficiency policies and measures involve either the development of new technologies or the diffusion of existing technologies. In this study we do not envision the development of new technologies considering a relatively short time-horizon up to 2030. The goals of the paper are:

• to assess the relevance of barrier affecting energy efficiency policies and measures,
• to assess the influence of barriers on the diffusion of key energy efficiency technologies and interventions,
• to highlight possible solutions to overcome barriers through policy design.

The analysis refers to building and transport sectors and puts in
evidence the differences in the eight considered Countries.

An online survey has been developed in order to assess the impact of barriers on policies and technological diffusion. The survey collected 184 experts’ and stakeholders’ evaluations on the relevance of barriers in each of the eight Countries.

The paper is structured in five sections beyond Introduction. Section 2 summarizes the European policy framework on energy efficiency in the building and transport sectors. Section 3 presents a categorization of the main barriers affecting energy efficiency policies and measures, and the diffusion of related technologies and interventions. Section 4 describes the methodological approach. Section 5 discusses the main results. Section 6 presents the implication for policy design. Conclusions provides addresses for policy-making and future research.

2. The European Policy framework

The EU set challenging targets for energy efficiency improvements with the 2030 horizon of the climate and energy package (EEA, 2019). In 2018, as part of the “Clean Energy for all Europeans package”, the revised Energy Efficiency Directive (EED, 2018/2002) which updates the policy framework to 2030 and beyond was adopted (European Commission, 2019). The key element is a headline energy efficiency target for 2030 of at least 32.5 % (European Parliament, 2018; EEA, 2019). Within the framework, Member States are required to adopt integrated National Climate and Energy Plans (NECPs) for the period 2021–2030 (Regulation EU, 2018/1999). The EED has established a common framework of measures for the promotion of energy efficiency to ensure the achievement of the target. Despite EU Countries have adopted several measures to improve energy efficiency, energy consumption in Europe increased between 2014 and 2018 (EEA, 2019). In 2018, energy consumption in EU was 5 % above the efficiency target set for 2020, and 22 % away from the 2030 target (Eurostat, 2019). The achieving of the 2020 targets is increasingly uncertain, and this also underlines the challenges of later achieving the more ambitious 2030 targets (EEA, 2019), with many differences among EU Member States.

The transport sector played a determinant role in the final energy consumption increase registered at the European level in recent years (EEA, 2019). One major reason is that renewable energy sources account for a small share in transport: as of 2018, their share is not in line with the achievement of the 10 % renewables target for the sector by 2020 (Eurostat, 2019; EEA, 2019). The building sector is another key area where further energy efficiency interventions are needed: currently, in Europe, around 35 % of the buildings are over 50 years old and almost 75 % of the building stock is energy inefficient (Trinomics, 2016). The renovation rate in residential building stock ranges from 0.5 % to 2.5 % per year depending on the Country (Esser et al., 2019). Renovation of existing buildings can lead to significant energy savings and reduce the EU’s total energy consumption by 5–6 % and lower CO2 emissions by about 5 % (European Commission, 2019).

The shortcomings of current energy efficiency policy schemes depend on two main factors: 1) the setting of ambitious targets which exceed the real capacity of Countries to achieve those goals, 2) the overestimation of the true impact of energy efficiency policies (European Commission, 2019). The profitable potential of policy in improving energy efficiency is not fully exploited, primarily because of persistent barriers to the deployment of energy efficiency measures (ODYSSEE-MURE, 2015). A suitable policy mix in the field of energy efficiency should not only be able to break down these barriers, but also make use of the driving forces which facilitate the implementation of energy-saving measures.

However, it is important to notice that the usual trend of energy consumption has been strongly affected by the exceptional circumstances stemming from the Covid-19 pandemic, which has slowed transport, trade and economic activity across the globe. The IEA Global Energy Review (2020) shows that Countries in full lockdown are experiencing an average 25 % decline in energy demand per week and Countries in partial lockdown an average 18 % decline. However, the Covid-19 effects on energy consumption trend should not reduce Countries’ commitment in terms of energy efficiency, which remain a key target for European energy and climate policies in the long term, as displayed by the European Green Deal which defines a new roadmap and investment plan for making the EU’s economy sustainable (European Commission, 2020).

3. Categorization of energy efficiency barriers

The existence of a gap between energy efficiency policies potential and effective achievement – the so-called “energy efficiency gap” – has been clearly recognized in the literature (Schleich, 2004; Sorrell et al., 2004; Thollander et al., 2010). The gap is mainly due to barriers affecting energy efficiency policies and measures (Gillingham and Palmer, 2014). The identification of specific barriers is a crucial process to support policy design and ensure the success of policy implementation (Varone and Aebischer, 2001).

Sorrell et al. (2004) define a barrier to energy efficiency as “a mechanism that inhibits a decision or behaviour that appears to be both energy efficient and economically efficient”.

We group barriers identified in literature into three main categories: 1) economic, 2) institutional, and 3) behavioural (including social, cultural and educational - see Table 1). Economic barriers refer to difficulties in accessing credit, insufficient and unstable available funding, high risk for investors and financial institutions (Sorrell et al., 2004; Thollander et al., 2010; Galarraga et al., 2011; Castellazzi et al., 2017; Gupta and Gregg, 2017). Institutional barriers are related to political obstruction, conflicting guidelines in the governance structure, and lack of policy coordination (Langlois-Bertrand et al., 2015; Bithas and Nijkamp, 2017; D’Oca et al., 2018; Cattaneo, 2019). Behavioural barriers refer to low awareness about energy efficiency and non-energy benefits, lack of information or behavioural anomalies in processing information, lack of trust, customer attitude, lifestyle, etc (Lah, 2015; Frederiks et al., 2015; Gupta and Gregg, 2017; Labanca and Bertoldi, 2018; Gillingham and Tsvetanov, 2018; Biresielloglu et al., 2018; Ebrahimigharebaghi et al., 2019).

The three categories of barriers strongly affect the achievement of energy efficiency goals, reducing the effectiveness of policies, and limiting the diffusion of technologies and interventions.

3.1. Building sector barriers

Looking at the building sector, economic barriers undermine the

| Type of Barrier | Description |
|----------------|-------------|
| Economic       | Lack of financial incentives, lack/difficult access to finance, high risk for investors, uncertainty of investments. |
| Institutional  | Lack of / complex legislative procedures and regulatory provisions, non-integrated and conflicting policies and targets, limitations of existing infrastructure (transport side). |
| Behavioural    | Social group interactions, inertia, lack of a ‘culture of saving’, lack of awareness on savings potential, lack of access to trusted information and knowledge, lack of expertise (skills & training) and highly qualified specialists, habits and relevant behavioural aspects, undervaluing energy efficiency, mistrust/negative perception of new technologies. |
effectiveness of regulation on contractual forms, energy saving obligations, and economic instruments as Energy Performance Certifications (EPCs) (Beillan et al., 2011; Palm and Reindl, 2018). In particular, the small incidence of energy costs on companies/families involves a general lack of incentives to invest in energy efficiency (Castellazzi et al., 2017). Split incentives and principal-agent problems affect energy efficiency investments as tenants have limited incentive to invest in energy efficiency (Franke and Nadler, 2019). Difficulties in accessing credit caused by economic stagnation also limit energy efficiency investments, affecting both building administrators and ESCo companies.

The channels through which institutional barriers operate are many and include: lack of normative schemes; dyscrasia between national, supra-national and local norms which implies redundancy legislation, delays in adopting policy schemes, uncertainty as well as coordination failures; lack of transparency and long times for authorizations (Croci et al., 2016). Institutional barriers often constitute significant limitations to the promotion and diffusion of energy efficiency technologies, undermining the success of government regulation (Langlois-Bertrand et al., 2015).

Behavioural barriers are related to people consumption practices, misperception of economic returns, different purchasing choice, limited trust in local and national public administration (Gupta and Gregg, 2017). Those barriers are most of the time linked to knowledge gaps which both affect energy efficiency improvement (Schleie, 2004; Gerarden et al., 2017; Al- addous and Albatayneh, 2020) and energy-efficient technologies implementation (D’Oca et al., 2018). These reduce the awareness of individuals on energy savings and limit the diffusion of a culture of saving both at individual and community level.

3.2. Transport sector barriers

As for the transport sector, economic barriers are connected to high upfront/capital costs of energy efficiency measures and long payback periods, low purchasing power of consumers, and financial crisis (Gallagher et al., 2015). The costs for private investments in energy efficiency are higher in Countries/sectors where public investments in infrastructure are lacking (Biresseloiulgu et al., 2018).

Institutional barriers are related to the lack of infrastructures and planning, also for bike and pedestrian mobility, the scarce attention in the public transport concession of qualitative standards of services and myopia for long-term vision regarding the future of transport infrastructures (Croci et al., 2016).

Behavioural barriers influence the use of personal transport modes, which is affected by low satisfaction with public transport and habit and social norms. Individuals tend to be driven by irrational behaviour and therefore favour the most cost-effective choice, even though it may be morally objectionable (Lah, 2015). When behavioural factors (prestige, freedom, inertia) prevail (Steinhiber et al., 2013), the preference of private over public transportation can undermine the effectiveness of economic and regulatory policy measures.

4. Assessment of barriers

Energy efficiency barriers in the building and transport sectors\(^1\) have been assessed through a survey\(^2\), with the aim to collect experts’ opinions on the relevance of several barriers belonging to the three categories (economic, institutional, behavioural) per each Country.

The survey was structured into two main parts. In the first part, we ask to rate the relevance of barriers in affecting the implementation of energy efficiency policies on the qualitative scale “not relevant”, “partially relevant”, “relevant”, and “highly relevant”. Considered barriers are listed in Table 2.

In the second part, we ask to rate the relevance of the three categories of barriers (economic, institutional, and behavioural) in limiting the diffusion of specific technologies and interventions, listed in Table 3. Technologies refer to energy-efficient equipment and appliances (e.g. electric vehicles in the transport sector and high-performance domestic heating systems in the building sector), while interventions refer to solutions designed to improve energy performance (e.g. building fabric upgrade in the building sector, and intermodal solutions in the transport sector).

A questionnaire was disseminated online to 370 experts in eight Countries, representative of key stakeholders of energy efficiency policies, from 2 February 2016 to 7 March 2016 in national languages on the web platform Qualtrics. A total of 184 respondents took part in the survey. The share of the respondents per Country is the following: Belgium 14 %, Bulgaria 7 %, Estonia 16 %, Germany 7 %, Greece 13 %, Italy 10 %, Serbia 21 %, United Kingdom 12 %.

Overall, the majority of respondents belongs to the categories “Other” (29 %) and “Government institutions” (23 %), followed by “Universities/research centres” (12 %), “Non-profit organizations” (8 %), “Energy utilities” (6 %), and “Consumer associations” (1 %), with different shares according to the Country (see Fig. 1.). The category “Other”\(^3\) includes: professional associations, financial institutions, consultancies, ESCOs, energy agencies, construction companies, local authorities and networks of local authorities.

In order to identify the most important barriers in each sector and Country, a score based on the number of times a barrier is rated as of “high relevance” by the respondents is built. Then, the ratio between the number of “high relevance” ratings over the total number of ratings for each barrier and Country is computed.

5. Main results

The relevance of the three categories of barriers in limiting the implementation of energy efficiency policies and the diffusion of specific types of technologies and interventions in the building and transport sectors in the eight Countries is reported.

5.1. Building sector barriers

Table 4 shows the relevance of barriers in hindering energy efficiency policies and measures in the building sector per each Country. The two most important barriers in the sector belong to the “Economic” category are: 1) the socio-economic status of building users, rated as highly relevant in 78 % of answers provided; and 2) the lack of funds or access to finance, high capital costs and financial risk, rated as highly relevant in 67 % of answers provided (Table 4).

Economic barriers appear to be highly relevant across several Countries also in relation with the limited payback expectations and investments horizons, which is rated as high in several Countries (particularly in the United Kingdom and Estonia).

On top of such common results, some relevant differences among Countries emerge. Institutional barriers like the complexity of regulatory procedures emerged as highly important in half of Countries (in particular in Bulgaria). Behavioural barriers, such as the lack of interest in energy efficiency and customs and habits, are also rated as highly important in half of Countries (the former in particular in Greece, the latter in the United Kingdom, Germany and Belgium), together with the lack of trusted information and experience (mostly relevant in Italy and

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\( ^1\) For buildings, both residential and commercial sub-sectors are considered; for transport, both people and freight transport are considered.

\( ^2\) The survey is performed within the Horizon 2020 HERON project, see HERON Report, 2017 available from: https://heron2017.wordpress.com/publications/

\( ^3\) The respondent could specify the category he/she belonged if those provided by the questionnaire were not applicable to his/her organization.
Table 5 shows the relevance of each category of barriers in limiting the diffusion of energy efficiency technologies and interventions in the building sector. The results show that among all Countries the most influencing barriers relate to economic and behavioural barriers, except for building fabric upgrade which is also affected by institutional barriers (Table 5).

For technologies and interventions on building fabric upgrades, the difficulty of implementation mainly relies on the lack of funding and incentive measures and the lack of specific split incentives mechanism between homeowners and tenants. For heat pumps, only three Countries (Greece, United Kingdom and Serbia) identified barriers of high relevance for their adoption, mainly of economic and behavioural type. Respondents highlighted the relevance of economic barriers, such as the high costs of this technology, and behavioural barriers linked to expertise of professionals as important elements. For LEDs, half of Countries identified barriers of high relevance (Greece, United Kingdom, Estonia and Serbia) mainly in the economic and behavioural categories. This is due to the high purchase costs of these technologies in comparison to other options and to some technical features of LEDs which are perceived negatively by consumers (e.g. light colour and intensity). Also, for more efficient appliances, five out of eight Countries (Bulgaria, Greece, United Kingdom, Estonia and Serbia) identified highly relevant barriers belonging to economic and behavioural categories. This is due to higher purchase costs of these appliances, and price policies of vendors, as well as to cultural patterns that lead to substitute appliances only in case of breakdown, without considering energy efficiency. For BEMS, all Countries identified high relevance barrier mainly in the behavioural category. Those are linked to lack of trusted information and lack of expertise for professionals and technicians. Economic barriers also have high impact and may be linked to high purchase costs and lack of finance for the adoption of BEMS technology.

5.2. Transport sector barriers

Table 6 shows the relevance of barriers in hindering energy efficiency policies and measures in the transport sector per each Country. The three most important barriers in the sector are: 1) limited infrastructure investment (institutional category), rated as highly relevant in 72 % of answers; 2) lack of finance for new vehicles and public transport (economic category), rated as highly relevant in 71 % of answers; and 3) low purchasing power of consumers (economic category), rated...
as highly relevant in 67% of answers (Table 6).

Institutional barriers are rated as the most important and mainly refer to lack of efficient transport infrastructure and lack of planning (in particular in the United Kingdom and Germany). Lack of a national strategy for sustainable urban mobility and lack of integrated governance are also very relevant in half of Countries (the former in particular in Greece, Italy and Belgium and the latter in Germany and Belgium). The insufficient development of cycling/walking infrastructure is considered relevant in most Countries, but never as a key barrier.

Economic barriers also have high impact. Limited investment in infrastructure is evaluated as the most relevant barrier (particularly relevant in Bulgaria, Serbia, Germany and Belgium), together with lack of finance (particularly relevant in Bulgaria, Greece, Italy, Estonia and Serbia). Similarly, low purchasing power of consumers is identified as the third most important barrier in all Countries.

Among behavioural barriers, low satisfaction about public transport and lack of trust are identified as relevant factors in the UK and Belgium. However, behavioural barriers emerge as highly relevant in a smaller number of Countries. Low environmental concern of population is not considered particularly relevant in any Country. Interestingly, the under-development of infrastructure for recharging electric vehicles is also not identified as a key barrier in any Country, while it is identified as relatively important in Bulgaria, Belgium and Serbia. Behavioural barriers, like habits and social norms, are in general not relevant, except for Estonia and to some extent Belgium.

Table 7 shows the relevance of each category of barriers in limiting
the diffusion of energy efficiency technologies and interventions in the transport sector. Institutional and economic barriers are the most relevant, except for using more sustainable modes of transport, which is mostly affected by behavioural barriers, such as low satisfaction with public transport and social norms.

The diffusion of electric and hybrid vehicles is affected by several barriers in almost all Countries (the only exception being Germany). The most widespread barriers belong to the economic category, namely barriers in almost all Countries (the only exception being Germany). Institutional and economic barriers are the most relevant, except for using more sustainable modes of transport, which is mostly affected by behavioural barriers, such as low satisfaction with public transport and social norms.

Looking at the barriers limiting the choice of using more sustainable and efficient modes of transport for individuals, all Countries agree on institutional factors such as lack of infrastructures and planning to be a highly relevant barrier, followed by behavioural barriers such as low satisfaction about public transport (rated high in all Countries except Germany and Serbia) and habit and social norm of using traditional less efficient transport means in (Bulgaria, Germany, UK and Belgium). Economic barriers, like low purchasing power of consumers and financial crisis, are recognized as highly relevant only in Bulgaria, Greece and Serbia. Finally, six out of eight Countries identify high relevance barriers in limiting the choice of using more sustainable and efficient modes for freight transport. Several Countries (Bulgaria, Germany, Greece, Italy and Serbia) recognize the impact of the economic crisis, rating it as a highly relevant barrier, followed by more institutional barriers, such as lack of support for more sustainable and efficient transport means and limited infrastructure. Behavioural barriers are rated as highly relevant only in Germany.

6. Policies for reduction of energy efficiency barriers

Barriers to energy efficiency are vast and complex and overcoming them is a key challenge for an effective implementation of energy efficiency policies. Policy-makers can consider the presence of barriers by defining less challenging targets or by incorporating in policies
solutions able to reduce the negative impact of barriers. Michael Howlett et al. (2015) define policy design as “the deliberate and conscious attempt to define policy goals and to connect them to tools expected to realize those objectives”. Policy design process aims to define alternative options according to goals and objectives (Simon et al., 2018), with the scope to fashion policies and measures that will work in the desired manner, considering the presence of barriers which hinder the achievement of goals. Attention to barriers starts with policy design and continues during policy implementation—and thus policy monitoring—to track outcomes, identify challenges, and be alert to unintended consequences or inequities (Bhuyan et al., 2010).

In the building and transport sectors, economic barriers emerge as the most relevant, according to the analysis (Tables 4–6). To mitigate them a clear quantification and communication of economic benefits is needed in order to provide evidence of benefits. For instance, solutions could refer to reducing the payback period of investments in energy efficiency through fiscal rebates transferable to third-parties (i.e., financial operators or suppliers of goods and services). Also, public guarantee mechanisms may represent useful solutions to mitigate economic barriers mitigating financial risk, particularly relevant when financial institutions are reluctant to fund energy efficiency projects especially to medium and low-income families (Economidou et al., 2019).

To contrast institutional barriers, literature points out the relevance of simplification of procedures for energy efficiency interventions (Langlois-Bertrand et al., 2015). Simplification of administrative procedures is designed to reduce regulatory complexity and uncertainty, and to cut down the burdens created by bureaucracy. In general, a clear vision for energy efficiency needs to be established at the highest government level in order to reduce institutional barriers like policy redundancy, conflicting guidelines in the governance structure, and lack of policy coordination (Bhuyan et al., 2016; Bouwma et al., 2015; Artola et al., 2016; Castellazzi et al., 2017).

Behavioural barriers can be mainly addressed by increasing citizens’ awareness on energy efficiency benefits and reducing knowledge gaps (Ebrahimigharebaghi et al., 2019). For instance, in the building sector innovative solutions could aim to reduce the knowledge gap by promoting energy audits. Literature widely agrees on the relevance of energy audits for buildings (Schleich, 2004; Gerarden et al., 2017), in order to limit lack of knowledge, and uncertainty about costs and benefits coming from energy saving interventions (Artola et al., 2016). However, service costs, time costs (long decision-making processes in cases of multi-owner houses), imperfect information, and lack of trust limit the appeal for homeowners. It is crucial to consider all these factors in order to design effective policies and measures. Field experiments conducted in the USA, using a control groups approach, tested heterogeneous treatments to encourage homeowners to participate in energy audit. Gillingham and Tsvetanov (2018) found that information campaigns built around social norms can be more effective policies than price-based policies to improve energy saving/efficiency.

In general, the main strategies for innovating policy design relate to collect and synthesize information from various sources, facilitate regular reviews of policy implementation, share best practices and integrate lessons learned into policies and measures, and set-up mechanisms to ensure follow-up and compliance with policy directives.

Policy design is a dynamic process and requires well-established procedures for policy monitoring and evaluation that will reveal what works and what does not work in practice and provide inputs for policy improved redesign (Morvaj and Bukaric, 2010).

7. Conclusion

Despite the high potential in terms of energy savings in the building and transport sectors and the ambitions of the European policy framework, achievement of energy efficiency goals falls below expectations. Energy consumption keeps raising among European Countries and in 2018 it was 5% above the efficiency target set for 2020 and 22% away from the 2030 target (Eurostat, 2019). The current Covid-19 pandemic is strongly affecting the usual trend of energy consumption. Indeed, Countries in full lockdown had experienced an average 25% decline in energy demand per week and Countries in partial lockdown an average 18% decline (IEA, 2020). This should not hinder long-term energy efficiency strategy.

Energy efficiency policies and measures are strongly undermined by several barriers. We consider three main categories of barriers: 1) economic, 2) institutional, 3) behavioural ones.

We develop two levels of analysis in order to evaluate the relevance of each barrier in hampering energy efficiency policies and measures in the building and transport sectors in eight European Countries. First, we assess the barriers according to their capacity to hamper energy efficiency policies and measures in each sector. Then we analyse the impact of barriers in slowing the diffusion of key energy efficiency technologies and interventions in each sector. The two levels of analysis are performed based an online survey, which involved 184 experts in the selected Countries. Results show that economic barriers are key in both sectors in all Countries. Economic barriers are also the most relevant in limiting the diffusion of technologies and interventions in both sectors. For transport, institutional barriers emerge as highly important also in limiting the diffusion of technologies such as electric vehicles. Behavioural barriers have high relevance mainly in the building sector, also in limiting technology diffusion, except for buildings fabric upgrade, which is more affected by institutional barriers.

Results underscore that EU Countries need to timely address a relevant number of barriers in order to meet their 2030 targets. Policy-makers should consider the presence of different barriers by setting-up less ambitious goals or by designing energy efficiency policies able to incorporate solutions to mitigate or bypass barriers.

Addressing policy barriers requires innovative policy design which calls for institutional skills and competencies, accurate information, policy monitoring and review. It requires the ability to critically assess the nature of barriers—economic, institutional, or behavioural—and to design tailor-made solutions to address them.

Results provide indications for improving the policy-making in assessing relevant barriers and innovating policy design. Different Countries are affected by barriers to a varying extent. Understanding peculiarities in terms of barriers relevance is crucial for designing innovative solutions able to address different needs and contextual situations.

Declaration of Competing Interest

The authors declare no competing interests.

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