Mapping socio-economic barriers to the implementation of energy efficiency policies in the UK building sector

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Abstract

In 2015 the UK building sector accounted for 43% (29% domestic, 14% commercial) of the national energy consumption, thereby positioning this sector as critical in meeting national energy efficiency targets. However, barriers to energy efficiency are vast and complex, and overcoming them is a key challenge for effective implementation of energy efficiency policies. This paper describes the findings from a review of literature and an expert survey to map and assess the key social, cultural, educational, economic and institutional barriers (in terms of small, medium and high impact) to implementing energy efficiency policies across the UK building sector.

Overall the barriers are found to be strongly linked with consumer behaviour. They are often highly complex with multiple inter-relations. The barriers with the highest impact comprise the undervaluing of energy efficiency, lack of motivation and inertia within consumers/end users, infrastructural and planning barriers to medium sized energy projects as well as practical and construction-related barriers such as a lack of skills and adequate standards. Economic barriers such as upfront/capital costs and the lack of adequate or misaligned financial incentives also appear to be significant. Surveys of experts showed that the top two most important barriers in the building sector to overcome were the socio-economic status of building users (11.7% of experts) and lack of funds or access to finance (10% of experts). Although there are several UK policies that aim to target some of these barriers, a number of UK's energy policies (Green Deal, Zero Carbon Homes) have recently been scrapped, and consultation is out on how to proceed in terms of UK national energy efficiency policy within this sector.

INTRODUCTION

In 2007 European Union (EU) leaders set binding greenhouse gas (GHG) emissions targets for 2020; 20% reduction from 1990 levels. Following this, in 2014, a target for 2030, 40% reduction from 1990 levels, was adopted(Commission, 2017). To meet EU targets as a minimum, the UK established the legally binding Climate Change Act of 2008, a target to reduce the UK's GHG emissions by at least 80% below 1990 levels by 2050. Further to achieve this target, the Act introduced a system of carbon budgets which provide legally binding limits on the amount of emissions that may be produced in successive five-year periods, beginning in 2008 (CCC, 2017). By 2015, the building sector accounted for 43% (14% services, 29% residential) of the UK's total energy consumption (DBEIS, 2016). This positions the building sector as critical in terms of meeting international, European and national carbon reduction and energy efficiency (EE) targets.

Energy efficiency in buildings, until recently, had been encouraged through a series of economic incentives and regulatory policy measures[1] such as 'The Green Deal', a finance measure created to remove the upfront costs to the consumer of energy efficiency, with the cost being recouped through savings on their energy bills and the Energy Company Obligation (ECO); which followed on from policy measures such as the Energy Efficiency Commitment (1 and 2) and the Carbon Emissions Reduction Target (CERT) which required energy companies both to reduce emissions through undertaking solid wall insulation and to tackle fuel poverty by installing central heating systems, replacing boilers, and subsidising cavity wall and loft insulation. One of the most important building related economic policy measures for the UK Government over the past several years, the Green Deal, is now discontinued (Syal, 2016). The Green Deal and the ECO (regulatory for energy companies) in combination, helped households insulate their homes and ensure that they have access to trusted information about energy efficiency. The Green Deal was also complemented by the domestic renewable heat incentive (RHI) and the Feed-in Tariff (FiT) scheme (economic) and the Green Open Homes initiative (dissemination and awareness measure) (DECC, 2014).

The UK Government implemented the regulatory policy instrument[2], the Energy Savings Opportunity Scheme (ESOS), to comply with Article 8 of the Energy Efficiency Directive. This scheme provides large enterprises with cost-effective recommendations for energy efficiency improvements every four years. It is estimated that ESOS alone will result in overall net benefits to the UK economy of 2.7 billion EUR between 2015 and 2030, and drive around 3TWh of energy savings annually (DECC, 2014). In addition to this, the UK is leading the way on the roll out of smart meters with in-home displays (dissemination and awareness instrument/regulatory for energy companies). This programme is considered essential to empowering consumers by providing them with access to the information they need to make informed decisions about their energy consumption (DECC, 2014). During 2014, industry partners including the Data and Communications Company and its contractors, energy suppliers, network operators and manufacturers have continued to develop the systems that will deliver smart meters to consumers when the main installation phase begins (DECC, 2013b). In addition, there is the urgent need to support ways of heating buildings whilst reducing GHG emissions. Through the RHI and Renewable Heat Premium Payment, over 130,000 low carbon heat installations are expected to be carried out by 2020. At the same time the UK Government will work with local authorities, where appropriate, to lay the foundations for district heating networks, particularly in urban areas with more densely packed demand for heat. This should enable the long-term delivery of heat from low carbon sources (DECC, 2011).

[1] Policy measures are focused actions aimed at specific issues. They are individual interventions or packages of related measures. Specific measures might include actions which promote the chosen policy direction (Niang-Diop et al., 2005)

[2] Policy instruments are defined as the set of all techniques (steps, mechanisms, approaches, tactics), which a government has to implement the objectives of a selected policy. They contain all the necessary details for the framework under which a policy or measure will be implemented. The policy instruments that are used for the implementation of national policies are classified into four main categories: Regulatory, voluntary, economic, and dissemination.

In the building sector, the basic objective of reducing energy use and cutting down on waste in the UK, is so that energy bills can be reduced for economically disadvantaged consumers; make energy supplies more secure and reduce reliance on overseas imports; and drive down GHG emissions cost-effectively. There is also the view that investment in energy efficiency will increase productivity and support long-term growth in the UK. In 2011/2012, the UK's energy efficiency market accounted for around 136,000 jobs and sales of over 25.5 billion EUR (DECC, 2014). Though there are effective policies in place, there is concern that the UK will not meet its Carbon Budgets given economic and political complications (Tallat-Kelpsaite et al., 2014). Furthermore, a number of policy measures and tools are being abandoned (Treasury, 2015).

Within this context, this paper describes the findings from a review of literature and an expert survey to map and assess the key social, cultural, educational, economic and institutional barriers (in terms of small, medium and high impact) to implementing energy efficiency policies across the UK building sector (residential and non-residential). Following the review of barriers, expert opinion is used to substantiate findings with regard to how important particular barriers are to policy formation and impact. The purpose of this work is to lay the foundation to assess the impact of these barriers on future policy scenarios. The research is part of a wider EU funded Horizon 2020 project on Forward-looking socio-economic research on Energy Efficiency in EU countries (HERON). The HERON project is made up of eight partner counties: Belgium, Bulgaria, Estonia, Germany, Greece, Italy, Serbia, and the UK. This paper only focuses on the building sector findings for the UK, though it will present some findings from the expert review for the other EU countries on the project, it is not within the scope of this paper to present detailed findings or policy details for the other EU countries.

RESEARCH METHOD

To develop a list of relevant barriers to present to the surveyed EE experts, the first step was to review EE policy literature. To summarise the review of building sector EE barriers[3] in the UK, the identified barriers were assessed in terms of their impact, from 'High' to 'Low', with the following criteria taken into consideration:

1. The number of different resources that identified the same barrier;
2. The number of sub-sectors that were linked with the same barrier;
3. The easiness with which the barrier can be confronted;
4. The duration of the barrier (how long it is cited as problem);
5. The number of different policy instruments that were linked with the same type of barrier.

Resources used in the review included Government policy reports such as the *UK National Energy Efficiency Action Plan* (DECC, 2014) and the *Energy Efficiency Strategy* (DECC, 2013a); non-government organisation reports such as *Europe's buildings under the microscope*

[3] A barrier, as defined here, is an element that limits the individuals' willingness to invest in energy efficiency. For instance, difficulties in trusting new technologies or lack of information about potential energy efficiency benefits are considered barriers.

(Economidou et al., 2011), and peer-reviewed articles such as *Barriers perceived to engaging with climate change among the UK public and their policy implications* (Lorenzoni et al., 2007). Sub-sectors considered were domestic and non-domestic, new-build and retrofit. An example of cross-cutting barriers among all sub-sectors include: undervaluing EE (DECC, 2013a), mistrust of technologies (Radov et al., 2007) and social norms and accepted behaviours (Lorenzoni et al., 2007). One example of a barrier with a large number of policy instruments linked is *Lack of financial incentives.* Policies include regulatory e.g. EPCs, DECs; dissemination and awareness e.g. Energy saving advice service; Economic e.g. Government buying standards, FiT, and RHI.

Following the review of literature on barriers, the findings were used to construct a survey for the building sector professionals to identify current working opinion on the barriers that hinder EE in the building sector. Barriers in both residential and non-residential sub-sectors are combined to create a list of potential barriers that in most cases are phrased so that they may be applicable throughout the building sector. The aim of the survey was to collect expert opinions on the impact / relevance of the reported barriers from their perspective. The survey was available on the web-platform *Qualtrics*, chosen for its flexibility and analytical functionalities, from 2 February 2016 until 7 March 2016 and was disseminated to 374 organizations in the partner countries in eight different languages. The survey was not randomized nor designed to provide a representative sample of any sector or professional background. The organizations, invited by email, were representative of key target groups and stakeholders of energy efficiency policies, in particular experts and policy makers. In total there were 441 respondents. The survey covered the building sector and the transport sector separately; however, the building sector results are only presented here. As the survey's intent was to evaluate expert opinion on barriers, bias was not considered a limitation. Some bias may exist, for example, a professional may identify a barrier which if overcome would benefit them financially or professionally; however, this would also indicate the significance of the barrier itself. Another expected bias would stem from the respondent’s experience as a homeowner / consumer. It is expected that this would have some influence on their responses.

Based on a previous review of National Energy Efficiency Action Plans in the partner countries, the project team concluded that the following measures and technologies are found to be high priority EE measures amongst the partner countries. These measures are organised into the categories of: building fabric upgrade in general, heat pumps (efficient heating/cooling), LEDs (efficient lighting, efficient appliances, and building energy management systems (BEMS) (energy consumption management). These categories guided the development of the survey. With this information, the survey was structured as follows:

1. Introduction and purpose of the survey, with key information on the expected compilation time, data management and ethical principles to be followed by project partners within the survey, future use of the data, funding of the project, contacts for further information, glossary of terms used in the survey;

2. Questions on barriers to energy efficiency in the building sector, structured in:

a. General questions about implementation of EE policies;
b. Barriers limiting interventions for building fabric upgrade;
c. Barriers limiting the adoption of heat pumps;
d. Barriers limiting the adoption of LEDs;
e. Barriers limiting the adoption of more efficient appliances (A++ or A+++);
f. Barriers limiting the adoption of BEMS and building automation systems.

The survey comprised both closed and open questions. The closed questions were aimed to obtain a rating of the important barriers as determined through the literature review. Each closed question asked the respondent to provide a grade (none, low, medium, high, or don't know) to a single barrier. Example of a closed question: *According to your expertise, to what extent are the following barriers relevant in limiting interventions for building fabric upgrade? (select: none / low / medium / high / don't know)*

- Lack of interest and undervaluing energy efficiency benefits; social group interactions (some individuals may negatively affect consumers that are willing to invest in new EE technologies).

- Lack of funds or access to finance, lack of financial incentives, high capital costs and financial risk.

- Etc…

The open questions were aimed to collect suggestions on additional barriers, their importance and possible ways to overcome them. The open questions for each type category (e.g. economic, institutional) were as in the following example: *Can you identify any other specific barrier/s that limits building fabric upgrades? If yes, specify and give a relevance grade (Low, Medium, High).*

Overall, 302 experts in the building sector across the partner countries from the following categories were surveyed: energy efficiency policy planning, policy makers, energy utilities, sector professionals, consumer associations and NGLS, and financial institutions. Of these, 174 responses were collected from the building sector specifically and 128 from respondents with expertise in multiple sectors (one of which is the building sector). About 46% of the respondents reported an experience of more than five years.

Most represented professions of the respondents were 1) experts in energy efficiency and energy policy, as well as of regional/local planning, 2) policy makers and regulators, and 3) energy utilities and other energy companies. The majority of respondents do not belong to any specific type of organization included in the options in table 1 however; that is, the category of "Other" was selected by about one third of respondents in each sector division.

Table 1, Type of organization / sector of respondents

Type of organization	**Building sector**		**Building & other sector mix**	
	N	%	N	%
Consumer association	1	0.6	0	0
Energy utility	11	6.3	9	7.0
Government institutions	40	23.0	33	25.8
Non-profit organization	15	8.6	14	10.9
University / Research centres	20	11.5	18	14.1
Other	50	28.7	43	33.6
Not specified	37	21.3	11	8.6
Total	174	100	128	100

RESEARCH RESULTS

For the analysis of the impact of barriers, the barriers were categorised into the following categories: social, cultural, educational, economic and Institutional. Blanks indicate that the barrier is not mentioned in the respective country's literature but does not necessarily indicate the barrier does not exist. In the UK, in terms of the main social / cultural and educational barriers with the highest potential impact, the majority related to the *lack of interest and undervaluing EE* and *unwillingness and/or inability to undertake energy efficiency improvements*, particularly through a *lack of motivation (inertia), awareness, knowledge and understanding* as well as *habitual behaviours* and the *socio-economic and demographic profiles of the end-users*. The main economic barriers within the building sector related to prohibitive *upfront/capital costs of energy efficiency measures* (from national to local-scale), the *lack of (or misaligned) financial incentives* in terms of payback expectations and investment horizons as well as the *embryonic energy efficiency market* that requires substantial input in order to ensure economic growth and a self-sustaining energy efficiency market. The main institutional barriers included infrastructural and planning barriers (particularly in relation to medium-sized energy projects), as well as practical and construction-related barriers such as the *inherent difficulties of the UK's building stock in terms of suitable skills, standards and compliance*, which subsequently results in the performance gap.

Each project partner also performed a review of barriers for their respective country. The following table lists common barriers across all countries in the listed categories with their impact (H = high impact, M = medium, and L = low). The table is designed to show the pre-survey assessment of (only) the same barriers which were selected by survey respondents as 'highly relevant' among all countries. There were, however, many other barriers assessed in the review.

Table 2, Impact of common barriers (BE = Belgium, BG = Bulgaria, ES = Estonia, DE = Germany, GR = Greece, IT = Italy, RS = Serbia, UK = United Kingdom)

	BE	**BG**	**ES**	**DE**	**GR**	**IT**	**RS**	**UK**
Socio-Economic status of building users (Social)	M		**H**		L	L	M	**H**
Lack of funds or access to finance (Economic)	**H**		**H**		M	M	M	**H**
Customs, habits and relevant behavioural aspects (Cultural)	**H**	M	**H**		**H**	**H**	M	M
Lack of awareness on savings potential (Educational)			M	M	**H**		**H**	**H**
Lack of interest and undervaluing EE (Social)	**H**	M	M	**H**	L	H	M	**H**
Limited payback expectations and investment horizons (Economic)				**H**	M	L	L	**H**
Complex / inadequate regulatory procedures (Institutional)		**H**	L	M	M	M	M	M
Building stock characteristics (Institutional)	L		**H**		**H**	**H**		**H**
Split incentive (Institutional)	M	**H**	**H**	**H**	M	M	M	**H**
Lack of trusted information and experience (Educational)		M	M		M		**H**	**H**
Lack of relevant legislation (Institutional)		M			M	**H**	M	M
Training and skills of professionals (Educational)	M	M	**H**		**H**	M	L	M
Uncertainty on investment (Economic)	L	**H**		M	M			M
Difficulties in using new EE technologies (Educational)	M		M	L	M			M
Social group interactions (Social)	**H**			M	L	M	L	M

Among the partner countries, the cultural barrier of *lack of interest and undervaluing EE* and the institutional barrier of *split incentives*[4] are the most common barriers. *Lack of interest and undervaluing EE* is a complex barrier that is related to aspects such as *lack of knowledge, inertia and habit*. Behavioural aspects linked to *social norms and habits* are also a major barrier across the majority of the countries. This refers to social norms and expectations requiring carbon-dependent lifestyles. The most cited institutional barrier, *split incentives*, refers mainly to the landlord-tenant split. This also appears where there are multiple owners and/or occupiers of buildings.

Expert survey results

[4] Split incentive is a 'circumstance in which the flow of investments and benefits are not properly rationed among the parties to a transaction or exchange' (Bird and Hernandez, 2012), and can act as a barrier to the deployment of energy efficiency measures. An example of this is when the tenant is responsible for the energy/utility bills, there is little or no incentive for the landlord to increase his or her own expense to acquire efficient equipment (e.g., refrigerators, heaters, and light bulbs) because the landlord does not bear the burden of the operating costs and will not reap the benefits of reducing those costs.

To identify the most important barriers, those barriers rated only as 'highly relevant' were summed to obtain the total number of respondent's votes. Figure 1 shows the percentage of 'highly relevant' votes for each barrier among all responses; the data in figure 1 sum to 100 per cent of barriers considered 'highly relevant' by survey respondents.

Accordingly, the two most important barriers in the building sector are:

- *Socio-economic status of building users*, which represents 11,7% of the total grade;
- *Lack of funds or access to finance, lack of financial incentives, high capital costs and financial risk*, which represents a 10% of the total grade.

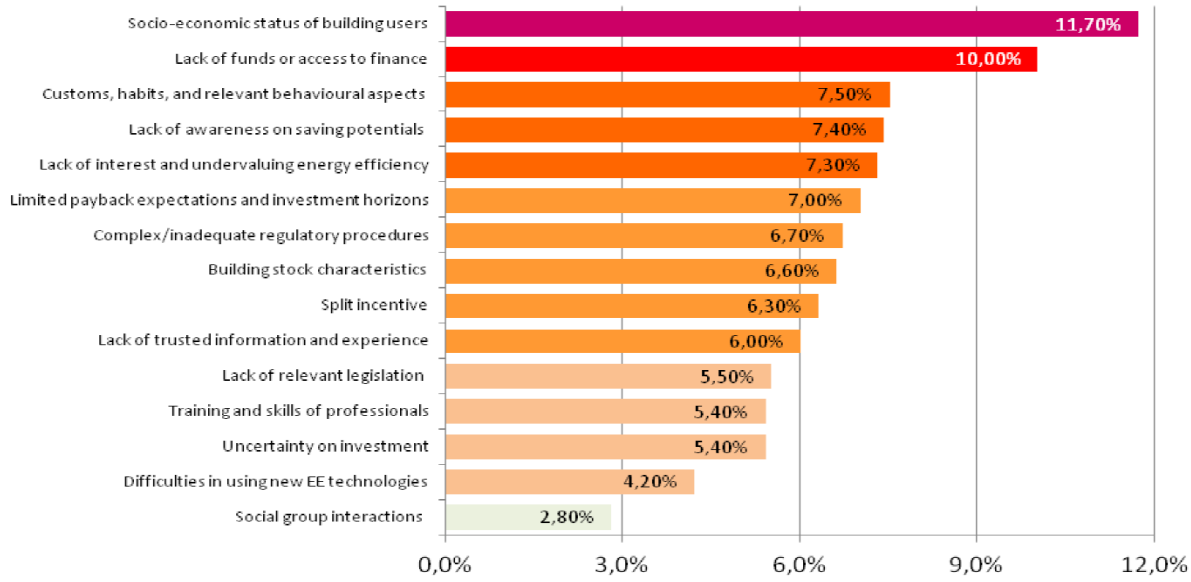

Figure 1, Per cent of votes for "highly relevant" barriers in the building sector among all countries

Barriers as related to specific interventions / technologies

In detail, when analysing the rating for specific EE intervention types or technologies, the response was found to vary somewhat. Table 3 shows the highly relevant barriers as they correspond to the specific interventions / technologies questioned. Column two indicates the most commonly agreed upon barriers among the partner countries. In all cases the UK was among the countries which agreed upon the most commonly voted 'highly relevant barriers'. Though the UK respondents voted the barriers in column two as 'highly rated', the highest rated building fabric upgrade related barrier is different (column three). Though most counties (including the UK) agreed that *lack of funding / lack of financial incentives / high capital costs* was a highly relevant barrier, the UK respondents rated *difficulty in installing EE tech due to aging building stock / split incentive* as the most relevant to the intervention. This is an expected response considering the UK's housing stock is one of the oldest and least efficient in Europe (Boardman et al., 2005). Furthermore, 43% of the housing stock is considered 'hard to treat', i.e. unable to accommodate 'staple' or cost effective fabric energy efficiency measures (BRE, 2008). To put this in perspective, the UK has the greatest percentage of dwellings aged pre-1946 among all EU28 member states. Among the

remaining EU28 project partners, the given percentage of dwellings are within the pre-1946 age range: Greece 7.6%, Bulgaria 10.5%, Estonia 17%, Italy 20.7%, Germany 24.3%, Belgium 37.1% (Nicol et al., no date).

Table 3, Overall survey rating of highly relevant barriers as compared to the UK

Barriers limiting…	**Most commonly rated 'highly relevant' by partner countries (no. of countries out of 8)**	**Highest rated barrier in UK**
Interventions for building fabric upgrade	Lack of funds or access to finance / lack of financial incentives / high capital costs (7 of 8)	Difficulty in installing EE tech due to aging building stock / split incentive
Adoption of heat pumps (tie of two barriers)	Lack of funds or access to finance / lack of financial incentives / high capital costs (2 of 8)	-
	Lack of trusted information and experience / lack of expertise for professionals and technicians (2 of 8)	← Same
Adoption of LEDs	Lack of funds or access to finance / lack of financial incentives / high capital costs (3 of 8)	← Same
Adoption of efficient appliances	Lack of funds or access to finance / lack of financial incentives / high capital costs (4 of 8)	← Same
Adoption of BEMS	Lack of trusted information and experience / lack of expertise for professionals and technicians (7 of 8)	← Same

Regarding interventions on building fabric upgrades, all partner countries identified highly relevant barriers, mainly of economic and institutional type. These barriers include lack of trusted information and experience, split incentive, and low economic viability of interventions in addition to lack of funds or access to finance, lack of financial incentives, and high capital costs (table 3).

For heat pumps, only three countries identified barriers of high relevance for their adoption, mainly of economic and educational type. The open answers provided by respondents for this technology highlighted economic factors such as the high costs of this technology, and educational factors linked to the expertise of professionals as important elements.

For LEDs, half of partner countries identified barriers of high relevance, mainly of economic and cultural type. This may be due to the high purchase costs of this technology in comparison to other options, and to some technical features of LEDs which are perceived in a negative way by consumers, as highlighted in the open answers (e.g. light colour and intensity).

Also for more efficient appliances, five out of eight partner countries identified highly relevant barriers of economic and cultural type. This may be due to the higher purchase costs of these appliances in comparison to less efficient ones, and to price policies of the

vendors, as well as from cultural patterns that lead to substitute the appliance in case of breakdown, and not for energy efficiency purposes, as reported in the open answers.

For BEMS, all partner countries identified high relevance barriers, mainly of educational, socio-cultural and economic types. Educational aspects may be linked to the lack of qualification regarding this technology in the professional sectors, and also from the end-users, which have difficulties in familiarizing with it due to its complexity. The economic aspects may be linked to the high purchase costs and lack of finance for the adoption of this technology.

DISCUSSION

Many barriers to enhanced energy efficiency in the building sector exist, which are highly complex with multiple inter-relations. Barriers are often specific to subsectors within the building sector (e.g. domestic / nondomestic, existing / new builds, specific technology types) but some are also relevant across all sub-sectors. The main barriers relevant to all subsectors are classified as mainly social, cultural and economic; emphasising the importance of policy instruments and measures that consider the socio-cultural context and the capacity of key actors involved.

There is a range of policy instrument types that seek to address these barriers including regulatory, economic, dissemination and awareness, and research and development. The majority of the barriers have been (or are being) addressed through previous and existing policies; using a variety of policy instruments including regulatory, economic, dissemination and awareness, and research and development. Such policy instruments include measures that have been (or are being) undertaken at national, regional and local levels. However, a recent change in UK Government has seen a number of key energy efficiency policy measures, that were critical in overcoming economic, institutional, social and cultural barriers scrapped and as this report is being written, there is uncertainty in terms of if and when replacements will be provided and if so, how they will look.

The socio-economic factors appear to be highly relevant across many EU countries. Almost all of them, seven out eight respectively, identified the social economic status of building users and the lack of funds as a highly relevant barrier concerning the implementation of EE policies in the building sector. Also the limited payback expectations and investments horizons, which are also connected to the economic dimension of the investment, were rated as high in several countries (five out of eight). Cultural and behavioural aspects, such as the lack of interest in energy efficiency and customs and habits, were rated as highly important in half of the partner countries, together with educational barriers such as the lack of trusted information and experience. In addition, institutional barriers like the complexity of regulatory procedures emerged as highly important in half partner countries.

Other barriers of educational type e.g., lack of awareness on energy savings potentials, and of institutional type e.g., the building stock characteristics and the split incentive, were rated high in a smaller number of countries, only three countries. Other barriers of economic type e.g., uncertainty on investments, was rated as highly relevant only in two countries (Greece and Italy); understandably the two European countries with the greatest

public debt (E.C., 2017). The specific educational issue linked to training and skills of professionals was highly important only in Greece. The difficulties in using new EE technologies as well as social group interactions do not emerge as highly relevant barriers in any of the partner countries.

In the open question section of the survey most respondents identified additional institutional factors as significant barriers to all EE interventions except for EE appliances. For building fabric upgrades, institutional barriers included cultural heritage protection regulation in the UK and complexity of bureaucracy and length of waiting for approval in Serbia. Regarding heat pumps, negative perception of noise (Belgium, Estonia, Germany and the UK) and visual impact (Estonia and UK) were significant additions. For efficient lighting (LEDs), barriers include distrust of advertised bulb life and performance (Belgium, Bulgaria, Estonia, and Greece), light output (Bulgaria, Greece, and UK), colour (Belgium, Bulgaria, Germany, and UK), and compatibility with existing lamps (UK). Specifically, the higher purchase cost of EE appliances was the most significant barrier for appliance uptake (Bulgaria, Serbia, Italy, and UK). Finally, for BEMS, complexity and perceived disappointment with performance were notable barriers.

CONCLUSION

This report presents the key results from the literature and online-based questionnaire performed by HERON partners to obtain from experts and stakeholders a rating of barriers to energy efficiency policies in the building sector in their respective countries. The economic aspects, related to the lack of funding, access to finance, lack of financial incentives, high capital costs and financial risk, emerge as key barriers in all partner countries. Socio-cultural and behavioural aspects are of great importance in the building sector. The top two most important barriers in the building sector to overcome across the countries were the socio-economic status of building users (11.7% of experts) and lack of funds or access to finance (10% of experts).

General suggestions for the building sector, also based on inputs provided by respondents, call for more ambitious policies and mandatory requirements for energy efficiency in this sector, to be accompanied by specific legislative and financial support as well as educational and awareness policies for all actors involved, from the building owners to tenants to professionals. In general, the results of the survey call upon the need to further explore the behavioural and cultural dimensions of EE policies potentially by targeting consumers through surveys. Consumer access to information related to incentive programs and to the existent policy tools aimed at promoting EE seems crucial for achieving more ambitious policy targets.

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