

UNDERSTANDING END-USER NEEDS AND EXPECTATIONS OF THE NEXT- GENERATION ENERGY PERFORMANCE CERTIFICATES SCHEME

OCTOBER 2020





eXTENDING the energy performance assessment and certification schemes via a mOdular approach

Legal Notice

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1 INTRODUCTION

1.1 Overview of the project

The X-tendo project (2019 - 2022) is developing a framework of 10 "next-generation EPC features" aiming to improve compliance, usability and reliability of EPCs. The target countries are Austria, Belgium (Flanders) Denmark, Estonia, Greece, Italy, Poland, Portugal and the United Kingdom (Scotland).¹ The features that will be explored in the project fall into two broad categories:

1. New technical features used within energy performance assessment processes and enabling the inclusion of new indicators on EPCs
2. Innovative approaches to handle EPC data and maximise their value for building owners and other end-users.

The 10 features are displayed in Figure 1, which provides an overview of the scope: green features focus on innovative handling of EPC data and orange features explore new EPC indicators. The figure is encircled by the four cross-cutting criteria: economic feasibility, compliance with international standards, quality and reliability, and user-friendliness. The cross-cutting criteria will feed into the overall work and the development of each feature.



Figure 1: X-tendo features

¹ In Belgium and the UK, where the EPC design and implementation are mainly regional, the focus will be on the situations in Flanders and Scotland respectively.

Feature 1: Smart readiness indicator. Smart technologies in buildings have the potential to contribute to increasing the energy efficiency of the building stock, to enhance the flexibility in smart energy grids, and to improve the comfort of building occupants. In order to increase the visibility and uptake of smart technologies in the European building stock, the introduction of a smart readiness indicator² for buildings is included as optional in the current amendments of the Energy Performance of Building Directive (EPBD). This indicator would allow assessment of the level of smartness of a given building in a reliable and meaningful way for building owners, tenants and users.

Feature 2: Comfort indicator. Although ensuring adequate levels of indoor air quality, thermal comfort, lighting and acoustics within buildings are among the most potent drivers for renovation, they are rarely covered by EPCs. This indicator would allow for assessing a building's levels of comfort in terms of indoor environmental quality through reliable and evidence-based inputs.

Feature 3: Outdoor air pollution indicator. Approximately one in eight deaths in 2012³ was attributed to air pollution according to the World Health Organization, making it a crucial factor of health. A significant contributor to air pollution is the building sector, which still uses highly polluting fuels and technologies in many Member States to cover heating, hot water and cooking needs. This indicator would describe the influence of both buildings on outdoor air pollution and outdoor air pollution on indoor air quality.

Feature 4: Real energy consumption data. The gap between real energy performance and EPC modelled performance is usually a source of confusion to EPC users. X-tendo investigates if, and to what extent, actual consumption data can be integrated into EPCs. The project also explores how this information can best be communicated to end-users, including possible explanations for the discrepancy like user behaviour and climatic conditions.

Feature 5: District energy systems. The project is developing the capacity of EPCs to assess and report on the potential for the building to benefit from – or contribute to – future development of district heating (and if relevant also district cooling) networks. This concerns the future decarbonisation of heat generation in district heating systems, as well as the required transformation of district heating towards next generation (smart, lower temperature) systems.

Feature 6: EPC databases. X-tendo explores the value of EPC databases as a tool for quality assurance and data mining to enable more effective retrofit policies and programmes, which has been demonstrated in several Member States. The project specifies how public authorities, with different EPC database systems, can take steps towards improving quality assurance.

² <https://smartreadinessindicator.eu/> (accessed 29 September 2020)

³ www.who.int/mediacentre/news/releases/2014/air-pollution/en (accessed 20 July 2020)

Feature 7: Building logbooks. Logbooks have been recognised and developed in some countries as a way to engage building owners and maximise the value of EPC data. The project will identify how EPC registers and systems at different stages of development can support the development of more dynamic logbooks.

Feature 8: Tailored recommendations. Cost and time constraints often result in EPCs containing generic, and not so useful, recommendations to the homeowner. The project is exploring approaches to deliver tailored renovation recommendations, including as part of countries' long-term renovation strategies. The final goal is to use these recommendations to enhance renovation activities.

Feature 9: Financing options. The project will identify sources of information on financial support that can be provided alongside, or integrated in, EPC recommendations. Financing options will mainly focus on public support schemes like soft loans and subsidy schemes, or incentives provided by energy retailers under their energy-saving obligations.

Feature 10: One-stop-shops for deep energy retrofits. One-stop-shops are seen as a key means to reduce barriers and transaction costs for finding information regarding support schemes, tradespeople, public authorities and other guidance on energy renovation. These functionalities of one-stop-shops could and should also be linked to EPCs, as has been done in a couple of cases already.

1.2 Aim of this report

Understanding end-user perspectives is crucial for the development and roll-out of new features for energy performance certificates (EPCs). Without a full insight into what end-users want and need for the next generation of EPCs it will be difficult to make effective use of these new features.

Within the scope of this project Ipsos Belgium has conducted a survey with end-users of EPCs, such as (potential future) building owners and occupants, of their needs, expectations, and views on the innovative features of next-generation EPCs. Insights were gathered through a series of digital surveys conducted by Ipsos in five countries and were adjusted according to the findings of the project. The gathered insights will be used to tailor the methodologies for developing the framework described in chapter 1.1.

2 METHODOLOGY⁴

This section gives a short insight into the methodology of the survey design, how the countries were chosen and how the questions were designed. The task of the survey was to learn more about the specific needs of the building owners and occupants regarding the innovative EPC features when renting, buying, selling or renovating a house or apartment. Since the number of EPCs in the residential sector is significantly higher than for the commercial sector, which works more with other certifications, and it is not possible to reach both sectors with one set of questions, therefore, this survey targeted only the residential sector.

In order to cover a representative sample of countries, a quick analysis of the project's implementation countries (Poland, Portugal, Greece, Romania and Denmark) was carried out. These countries were checked regarding:

- ⊙ Inclusion as test countries in the X-tendo project
- ⊙ Geographic representation (South, North, East and Central Europe)
- ⊙ Country size
- ⊙ Tenure status in the population (variation in share of owners vs tenants)⁵
- ⊙ Percentage (%) of consumers having moved in the past five years⁶
- ⊙ EPC regime (variation in the strength of EPC compliance checking and compliance rates)⁷

2.1 Questionnaire development

The questionnaire was developed based on the 10 features which are being developed in the X-tendo project. Each partner responsible for the work and development of a feature developed questions targeting end-users, which will help in defining how the features can be best designed to fit the needs of respondents. This is important to make sure that the features are user-friendly and will be helpful for homeowners, buyers, tenants, sellers and landlords.

The questionnaire was translated into the national languages of the surveyed countries and the survey was conducted online in April 2020.

The **final sample size was 2,563**, with varying sample sizes of 501 to 519 per country.

For the survey report the following dimensions were looked at more closely to find significant differences between the results:

- ⊙ Demographics (age, location, family etc.)

⁴ For more details on how the data was validated and processed by Ipsos, please refer to the Ipsos report in Annex I

⁵ See Eurostat database [ilc_lvho02]

⁶ See Eurostat database [ilc_hcmp05]

⁷ <https://ec.europa.eu/energy/en/studies/energy-performance-buildings-directive-epbd-%E2%80%93-study-compliance> (accessed 2 August 2020)

- ⊙ Location (urban, rural etc.)
- ⊙ Tenure status (owner-occupied/rented)
- ⊙ Type of building (detached, semi-detached etc.)
- ⊙ Countries

The results of the survey were analysed by Ipsos in detail, looking at the five dimensions and pointing out significant differences between countries and demographic groups. They were then analysed in more depth regarding the needs of the feature development leads and country implementation partners in order to find the results most relevant for the project. These results, including an analysis performed by the expert consortium, can be found in sections three and four. The Ipsos report on the survey results can be found in full in Annex I. The entire questionnaire in English can be found in Annex II.

2.2 Sample size

A total of 2,563 end-users took part in the survey, which covered homeowners, landlords and tenants (18 years or older) who had:

- ⊙ Bought, rented, sold, let or renovated property in the past five years (2015 - 2020)
- ⊙ Attempted to buy, rent, sell, let or renovate property in the past five years (2015 - 2020)
- ⊙ Taken first steps to buy, rent, sell, let or renovate property.

The tables below show the distribution of respondents in each category by country.

Table 1: Respondents who bought, rented, sold, let or completed a renovation in the past five years

	Denmark (n=512)	Greece (n=519)	Poland (n=501)	Portugal (n=514)	Romania (n=517)
Bought	26.5%	11.8%	32.8%	21.4%	26.3%
Rented	21.3%	29.6%	13.6%	20.3%	14.1%
Sold	10.7%	8.7%	6.3%	12.4%	11.6%
Let	10.8%	22.6%	12.7%	12.1%	12.5%
Renovated	54.2%	62.1%	82.1%	52.3%	73.2%

Table 2: Respondents who attempted to buy, rent, sell or let in the past five years

Attempted to...	Denmark (n=512)	Greece (n=519)	Poland (n=501)	Portugal (n=514)	Romania (n=517)
Buy	19.9%	16.4%	22.6%	24.7%	25.7%
Rent	22.4%	33.9%	19.1%	5.1%	17.8%
Sell	12.0%	17.1%	13.2%	20.8%	17.6%
Let	9.5%	19.5%	7.3%	25.4%	13.6%

Table 3: Respondents who planned to buy, rent, sell or let in the past five years

Planning to...	Denmark (n=512)	Greece (n=519)	Poland (n=501)	Portugal (n=514)	Romania (n=517)
Buy	20.8%	23.4%	30.8%	35.2%	35.5%
Rent	15.9%	22.8%	14.7%	3.1%	13.2%
Sell	13.1%	15.5%	13.7%	22.6%	17.7%
Let	7.5%	12.6%	9.3%	16.4%	14.2%

For the questions of attempting to renovate and planning to renovate the respondents were not asked these questions directly but they were asked about their plans to renovate, which can be seen below:

Table 4: Respondents renovation activities in the past five years

Please select...	Denmark (n=512)	Greece (n=519)	Poland (n=501)	Portugal (n=514)	Romania (n=517)
Currently renovating	11.3%	8.0%	9.5%	9.0%	9.2%
Currently finalising plans for renovating	7.4%	10.2%	8.9%	10.9%	11.2%
Planning renovations to be done in the near future	18.9%	30.2%	38.3%	21.0%	29.9%
Thinking about renovations as a possibility	17.4%	25.7%	22.2%	30.3%	27.0%
Currently not thinking about renovations	45.1%	25.9%	21.1%	28.7%	22.8%

These tables demonstrate a balanced sample in terms of the three different target groups (homeowners, landlords and tenants).

- ⦿ The vast majority of respondents were homeowners themselves (69%). Almost one-third (30%) owned at least one rental property. Among the respondents that bought a property or had attempted/started to do so, the majority (58%) used or intended to use the property as their primary residence; only 8% planned to rent it out.
- ⦿ Half (52%) of respondents had planned or thought about renovating in the near future, while 29% were not thinking about renovations. Two-thirds (67%) strongly agreed that renovations could reduce their household's energy use.

A large proportion of the sample (total 2,563 respondents) had tried to reduce the amount of energy they used at home (78%) or thought there was more they could do to reduce their usage (72%). Still, 40% were more concerned about having a warm and comfortable home than saving energy.

Most of the respondents lived in a flat/apartment (41%) or detached house (35%), fewer in a semi-detached or terraced house (6% and 7%, respectively). However, the proportions varied slightly between the survey countries. Overall, 62% lived in a large city or the suburbs/outskirts of a large city, while 13% resided in a rural area, though here as well differences could be observed between countries. The majority of respondents described



their household as a 'couple' with (40%) or without (25%) children. Half were full-time employed (51%).

2.3 Incidence rates

An overall higher incidence rate⁸ of 85% was calculated based on the overall participation, which was ensured through the screening questions at the beginning of the survey. An initial incidence rate test was also conducted with 100 respondents in each country to assess the target group and to check if the eligibility criteria needed adjustment. This is because, if the survey is too targeted, it may result in lower incidence rates. The screening questions helped in eliminating respondent bias. The focus of the survey was on a very specific audience of people who have bought, rented, sold, let or renovated property in the past five years.

After the final survey was conducted, a variation in incidence rates was noticed for the five surveyed countries with the highest being 94% for Poland and the lowest being 71% for Denmark. This is because people who were shown not to have enough knowledge about the topic during the screening questions were eliminated from the final sample size considered in the analysis. This was done to ensure quality but could of course lead to some difference between countries in the final results. This will be taken into account in this report.

⁸ Incidence rate is the rate of qualified responses



3 FEATURE RESULTS

3.1 Smart readiness

The smart readiness indicator (SRI)⁹ is a methodology developed to assess the availability of smart services within a building. SRI measures the capacity of a building to use information and communication technologies embedded in the Internet of Things (IoT) to improve the performance of a building. Good smartness levels include the presence of automated appliances and data-based management systems to communicate with the grid and the users. Building smartness has high potential to have an impact on the building's functionality and its presence is associated with better energy performance and improved comfort and well-being for end-users. Smart buildings have also been identified and acknowledged as key enablers of future energy systems, which will include a larger share of renewables and more distributed supply- and demand-side energy flexibility. To investigate how citizens across different EU countries perceive the deployment of smart technologies on the building level the questions were focused on three areas:

- ⊙ Potential benefits such as the **energy savings** and improvements in **comfort and well-being**
- ⊙ Concerns such as **data security** and **willingness to have smart technology** when buying and renting
- ⊙ Integration of smartness levels in the EPC, in relation to X-tendo's main goal

Demographics

The findings show that the larger the size of the city people live in, the more familiar people are with smart technology. This could be connected to the fact that younger people are more familiar with smart technology (Figure 2) and statistically people living in the countryside are older.

⁹ <https://smartreadinessindicator.eu/milestones-and-documents> (accessed 2 September 2020)

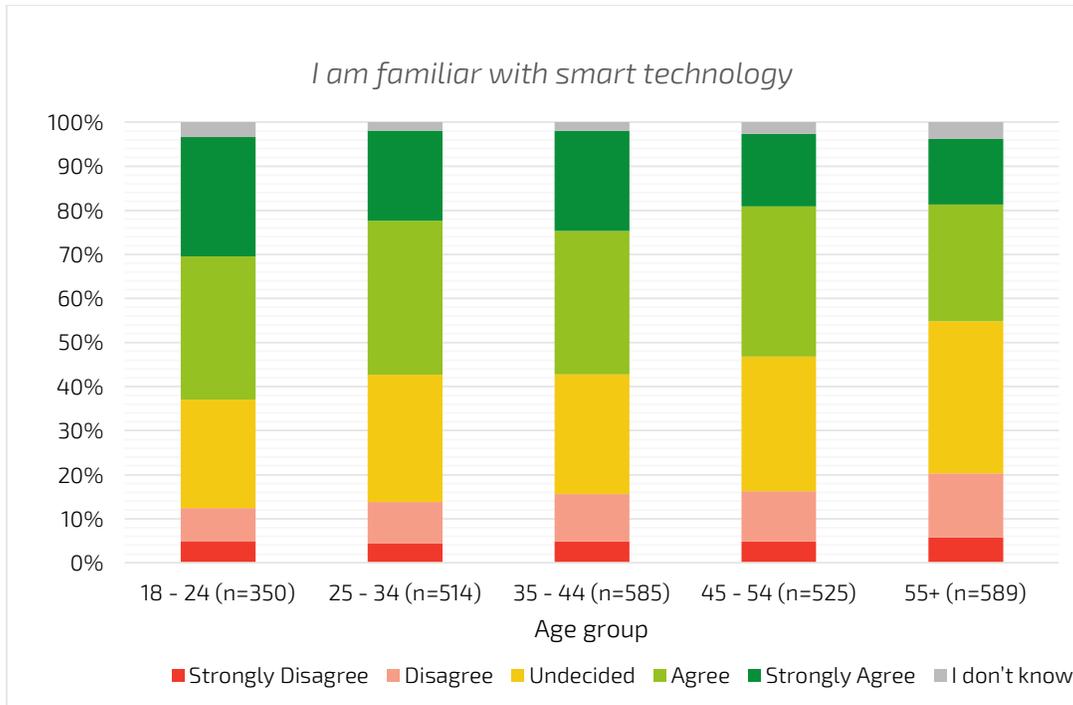


Figure 2: Age in relation to familiarity with smart technology

These results point to important differences in age when it comes to building smartness and suggest a need to adapt communication to the type of audience. At the same time, it can be expected that younger populations will be more likely to benefit from the deployment of smart technologies. Another contrasting dimension to look at is that the built environment can support the development of solutions that enable older people to remain autonomous, independent, safe and healthy at home.¹⁰

¹⁰ Carnemolla, P. 2018. Ageing in place and the internet of things – how smart home technologies, the built environment and caregiving intersect. *Vis. Eng.* 6(1).



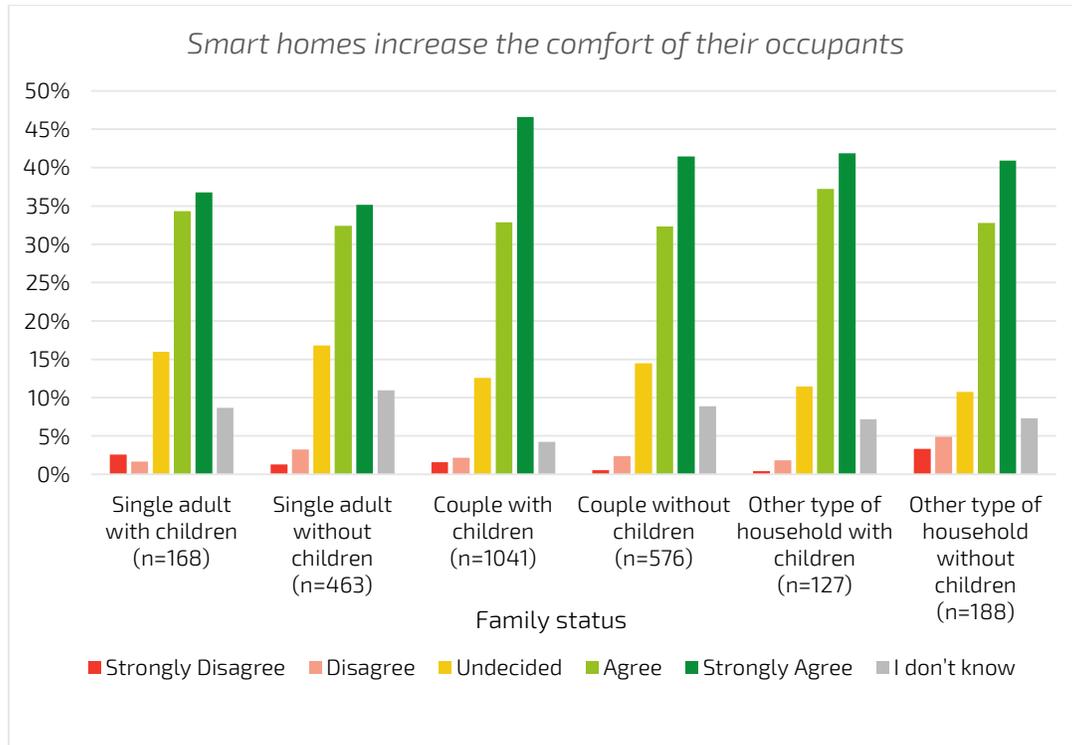


Figure 3: Perceived increase in comfort of smart homes by family status

Figure 3 shows that couples with children perceive the increase in comfort driven by smart technologies as much higher than singles without children (when adding “agree” and “strongly agree”). This is interesting as it suggests that smart technologies might have a positive impact on improving comfort in family households. This benefit needs to be communicated better to these groups and can be used as an argument for smart technology when targeting couples with children.



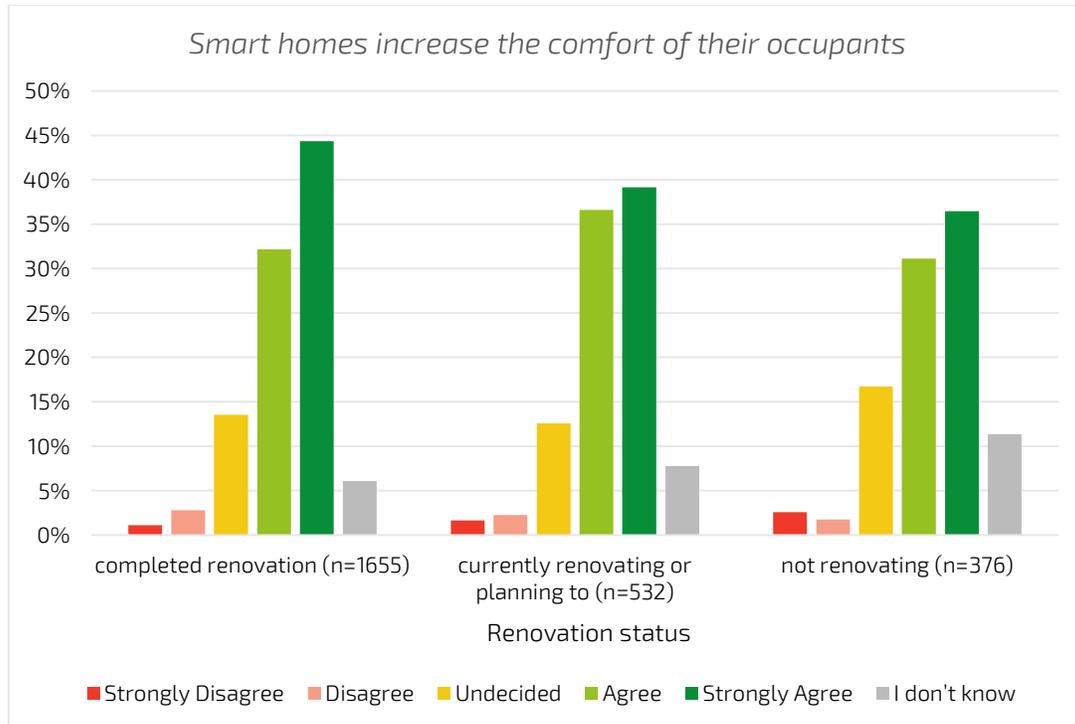


Figure 4: Attitude towards smart technology as a way to increase comfort according to renovation status

Figure 4 shows a clear connection between home renovations and smart technology. People who have completed or are planning/in the middle of a renovation are more likely to agree that smart technology increases comfort in the home. This is important because it shows that smart technologies are earning a place in the future of building renovation as a way to improve wellbeing. A positive view of smart home technologies was also found in a national survey of both end-users and industry in the UK.¹¹ However, certain data security risks and privacy issues were of major concern in this context.

¹¹ Wilson, C., Hargreaves, T., Hauxwell-Baldwin, R. 2017. Benefits and risks of smart home technologies. *Energy Policy* 103: 72-83, <https://doi.org/10.1016/j.enpol.2016.12.047>



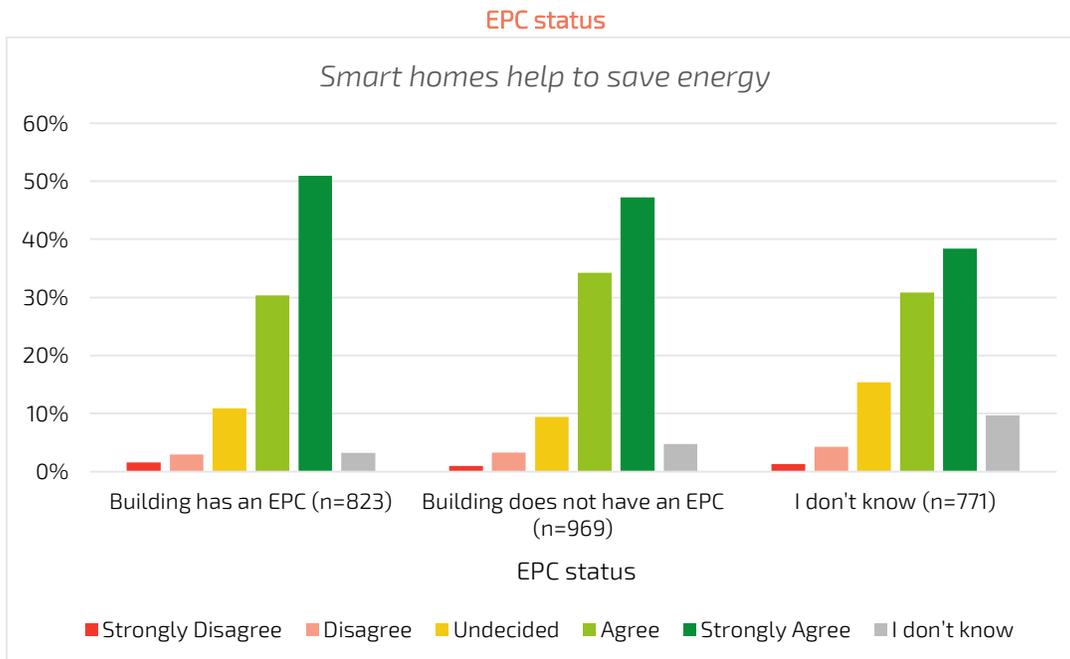


Figure 5 suggests that having an EPC has a positive impact on people's opinion/knowledge on whether smart technology can help save energy. People whose buildings have an EPC agree more with the fact that smart homes contribute to saving energy (50% vs. 38%) and to increasing comfort (47% vs. 37%). This might be explained by the fact that they know more about their building and believe that energy savings can be achieved.

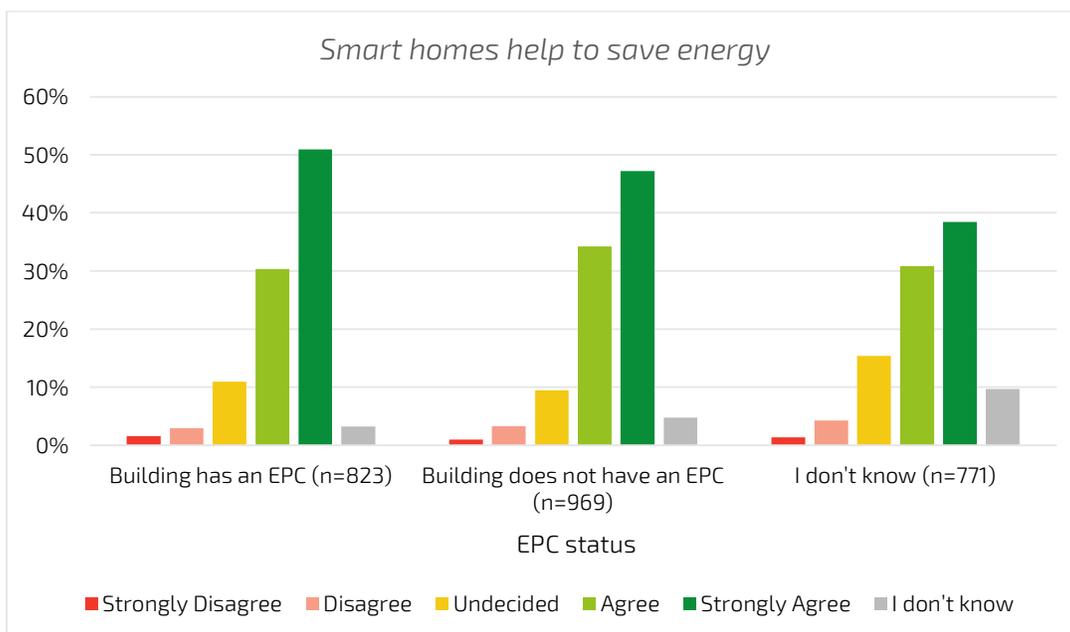


Figure 5: Relation between having an EPC and perceiving smart technology can save energy

Those living in apartments are more eager to live in a smart home than those living in a house. While again this fact might be the result of age, as younger citizens are more likely to



live in apartments, apartments might be better suited for the implementation of smart technology (Figure 6: Relation between type of home and eagerness to live in a smart home).

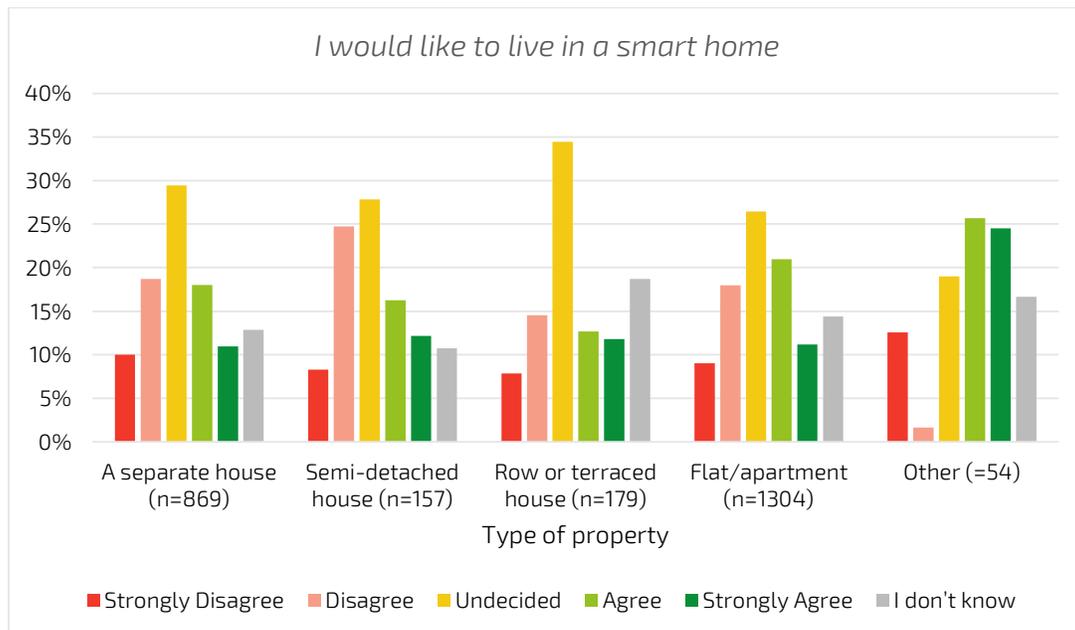


Figure 6: Relation between type of home and eagerness to live in a smart home

Country results

Contrary to the initial expectations, respondents in the frontrunner country, Denmark, had lower familiarity with smart technology (Figure 7). This might be explained by the Dunning-Kruger effect, which says that people with lower competence levels are actually also poor at evaluating their own level of competence. Nevertheless, this explanation is mainly hypothetical and further research should dig into this question.



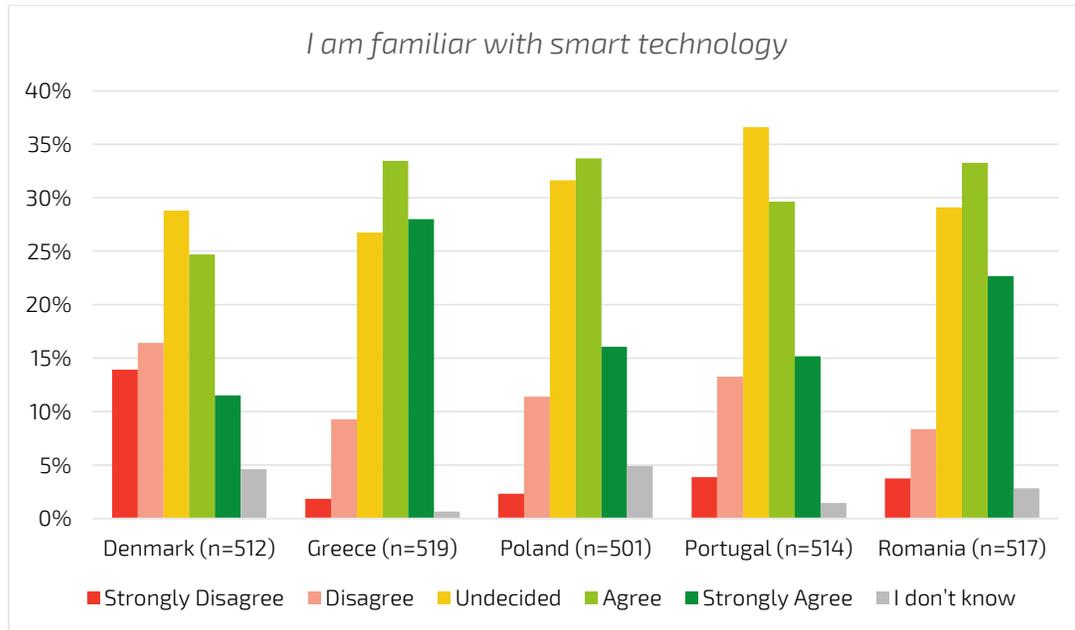


Figure 7: Familiarity of respondents with smart technology by country

Overall, comparable results can be seen across countries and a good interest in smart homes. People are eager to live in smart homes and they consider smart homes as positive for comfort and energy savings. However, results also show that more knowledge is needed as only half the respondents were familiar with smart technology. Generally, smartness is not an important factor when buying a house.

Countries overall have a good perception of smart homes as means to save energy and improve comfort. Interestingly, there are not big differences between slow starters and cautious adopters and it is the frontrunner (Denmark) that surprisingly shows less knowledge of smart homes. Only one in three people is concerned about safety issues related to smart homes. Most respondents would like to have information on the presence of smart technology in their EPC.

The fact that Denmark shows the lowest predisposition towards smart homes despite being the frontrunner country is an interesting and unexpected output. The fact that smart technology is more frequently addressed in public discourses in this country (as proposed in the text) is an explanation. However, it does not justify why only 36% of Danish respondents are familiar with smart technology.

Conclusions

Although most respondents claim to still lack knowledge on smart technologies, they agree on their benefits to save energy and improve health and comfort in the built environment.

Survey results also show that younger urban residents are often more aware of the benefits that smart technologies can provide. However, respondents showed an overall (across countries and ages) lack of knowledge regarding security risks related to smart technology implementation.



Finally, respondents who have an EPC are better informed about smart technology. This is a key finding, as it suggests that including building smartness in the EPC could help tackle the overall lack of knowledge on smart technologies which was observed.

In a nutshell:

- ⦿ Smart homes increase the comfort of their occupants.
- ⦿ Smart homes help to save energy.
- ⦿ Smart homes might raise security issues.
- ⦿ Respondents overall lack knowledge about smart technologies.
- ⦿ Inserting a smart readiness indicator in the EPC could be a positive way to improve citizen knowledge about these technologies.

3.2 Comfort

Even though indoor air quality (IAQ), thermal comfort, lighting and acoustics within buildings have a significant impact on human health and are among the most important benefits and drivers for renovation, they are mostly not covered by EPCs.¹² In the X-tendo project, a method is being developed to demonstrate the evaluation of indoor environmental quality that will allow comfort levels to be assessed through reliable and evidence-based inputs.

The comfort feature is very relatable to most end-users. At the same time, it is a term which can be understood differently and is also perceived very subjectively by participants. The survey tried to overcome this by looking at how people view different forms of comfort and giving examples of what this could be. The questions were framed within two key aspects for end-users:

- ⦿ Is the comfort¹³ (thermal comfort, indoor air quality, noise and lighting) of the home considered an important aspect?
- ⦿ What are the expectations of a more comfortable home?

The survey investigated the importance of comfort among other decision-making aspects of buying/renting a property, like price, size or location. The respondents were also asked to rank the indoor comfort parameters based on their personal preferences, and whether they were interested in having information on comfort displayed in EPCs.

Demographics

Looking at the age groups, there are some significant differences regarding comfort between people aged over 55 and those aged 18-24 (Figure 89). People aged 55+ gave the highest preference to comfort when buying or renting a house compared to other age groups. It is observed that older age groups are more susceptible to uncomfortable indoor

¹² [Energy Performance Certificates: Assessing their status and potential](#)

¹³ 'Comfort' is synonymous with indoor environmental quality (IEQ) and was used in the survey as a simpler term that end-users could understand more easily.

environmental conditions inside homes. In general, research on the elderly highlights similar trends and comfort expectations.¹⁴

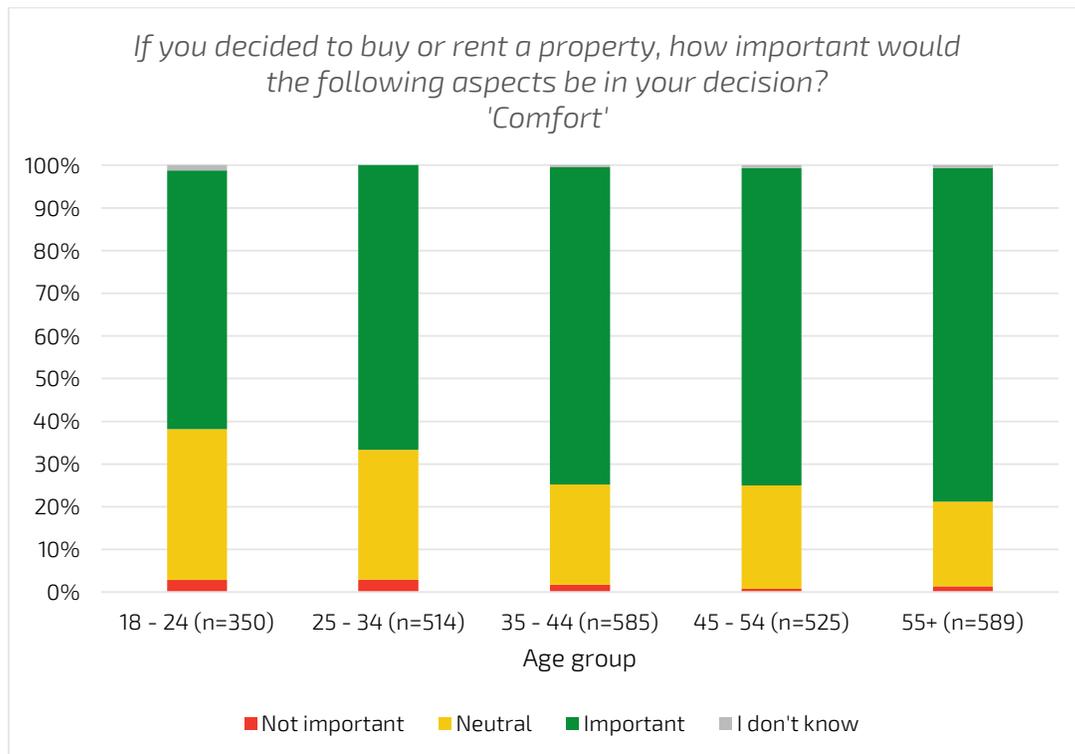


Figure 8: Preference for comfort among different age groups when buying or renting a house

Looking at people's financial status, it can be seen in Figure 9 that those who consider their financial situation to be "impossible" are much less likely than others to consider comfort as an important factor. Those of better financial standing are ready to pay for a comfortable home in general. Although the long-term benefits of better indoor environmental quality are not well known¹⁵, it is still considered a deal-breaker by people with a better financial situation as visible from a significant number of responses that consider comfort "important".

¹⁴ Schellen, L., van Hoof, J. 2016. Thermal Comfort in Smart Homes for an Aging Population. Handbook of Smart Homes, Health Care and Well-Being.

¹⁵ Al horr, Y., Arif, M., Katafygiotou, M., Mazroei, A., Kaushik, A., Elsarrag, E. 2016. Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature. *Intern. Journal of Sus. Built Environ.* 5(1): 1-11.



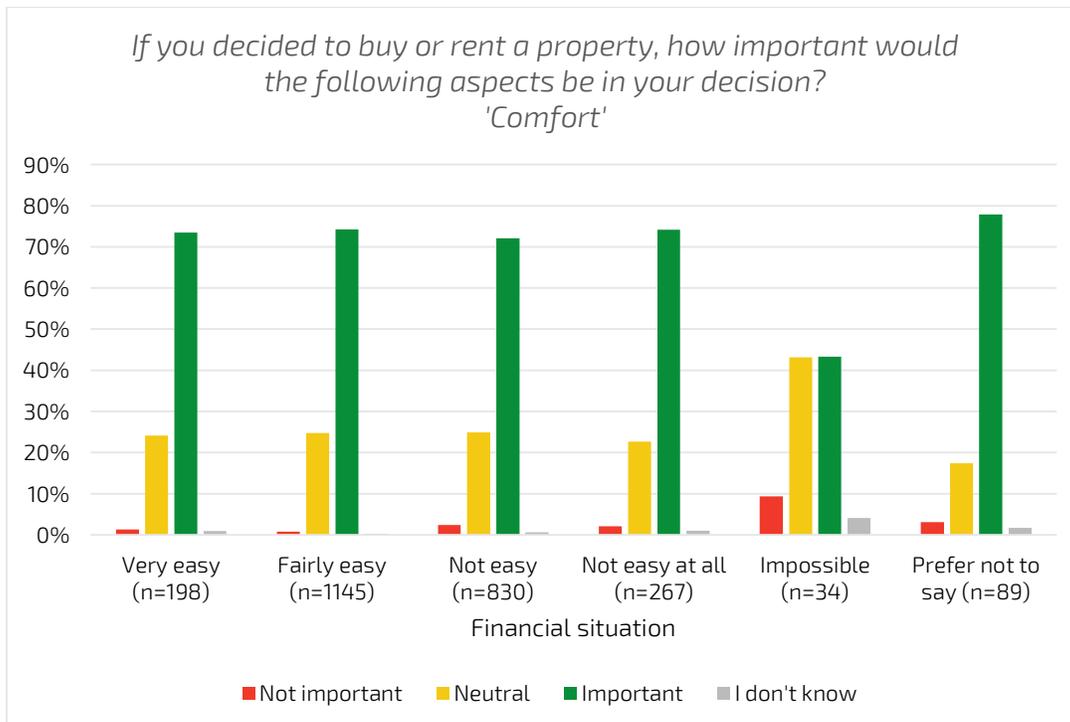


Figure 9: Importance of comfort based on financial situation when buying or renting a house

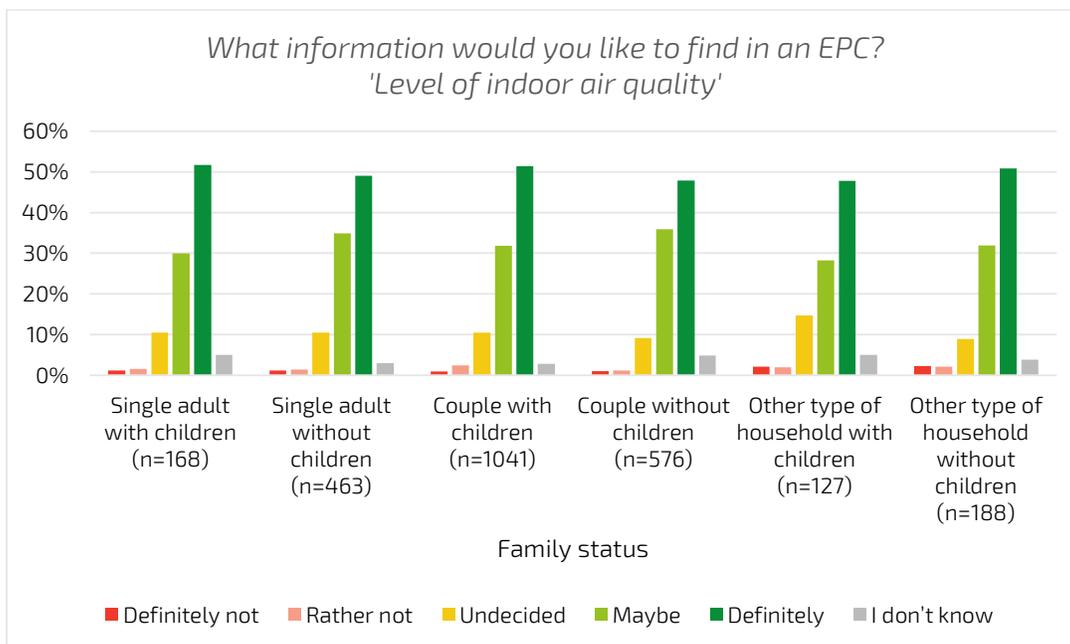


Figure 10: Interest in comfort-related information in EPCs by family status (n=2563)

Figure 10 indicates that around half of end-users across all types of family status are interested in receiving comfort-related information in EPCs. A primary reason is the



increasing awareness of the benefits of EPCs among end-users and their importance in property transactions and enforcement of renovation instruments by Member States.¹⁶

Tenure status

Looking at the tenure status of respondents shows no significant difference between people renting and owning their house regarding the importance of comfort (Figure 11). People who rent/own agree that comfort is more important than saving energy, primarily due to awareness. In general, people are becoming more affluent and pay more attention to such aspects as they foresee that it would eventually impact their health.

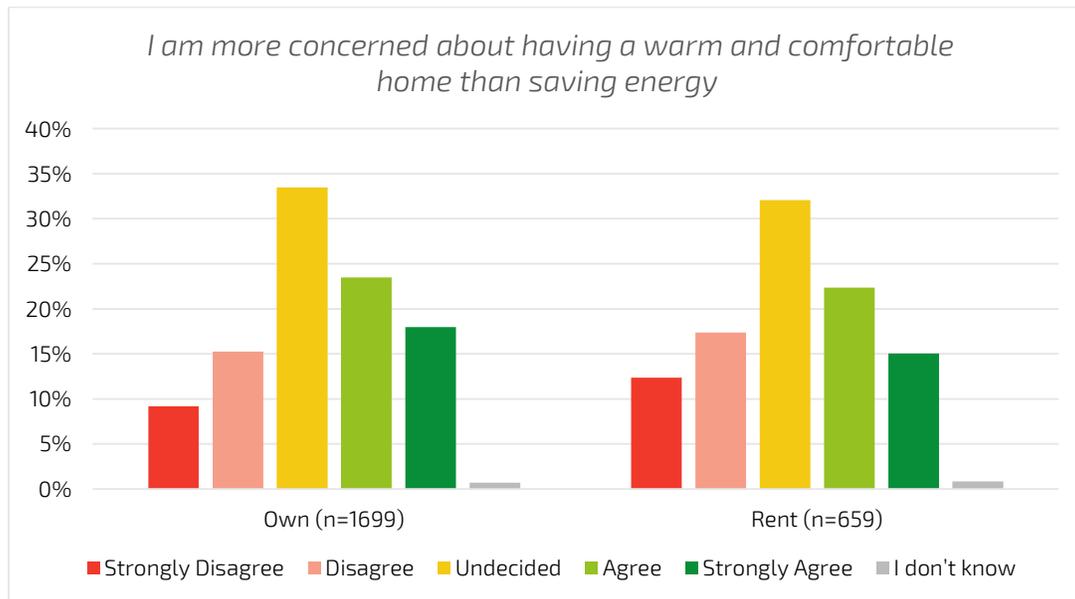


Figure 11: Differences between owners and tenants concerning the importance of comfort

¹⁶ Charalambides, A., Maxoulis, C., Kyriacou, O., Blakeley, E., & Frances., L. 2019. The impact of Energy Performance Certificates on building deep energy renovation targets. *Intern. Journal of Sust. Energy* 38(1): 1-12. <https://doi.org/10.1080/14786451.2018.1448399>



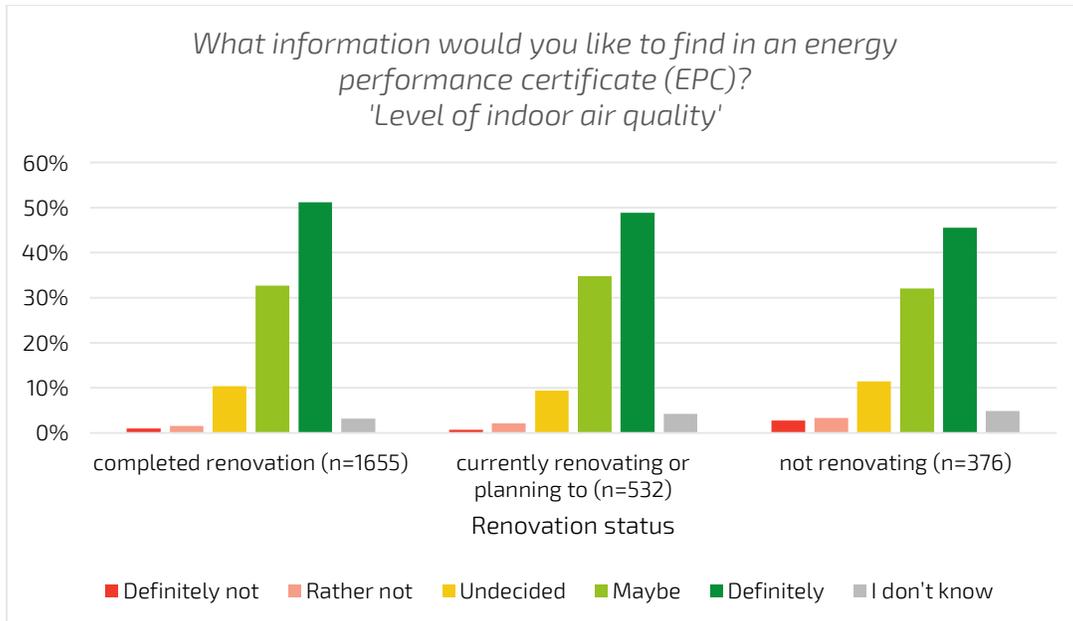


Figure 12: Preference for IAQ information in an EPC based on renovation status

In all countries, end-users who have completed renovation or are planning to renovate saw information on IAQ in EPCs as important (Figure 12). This holds true for all type of houses people live in, suggesting the replicability potential for this feature is high across EU Member States.

Country results

As none of the countries surveyed include comfort aspects in their EPCs, it is interesting to see the ranking attributed to different indicators of comfort in Figure 13 by the respondents from the five countries.



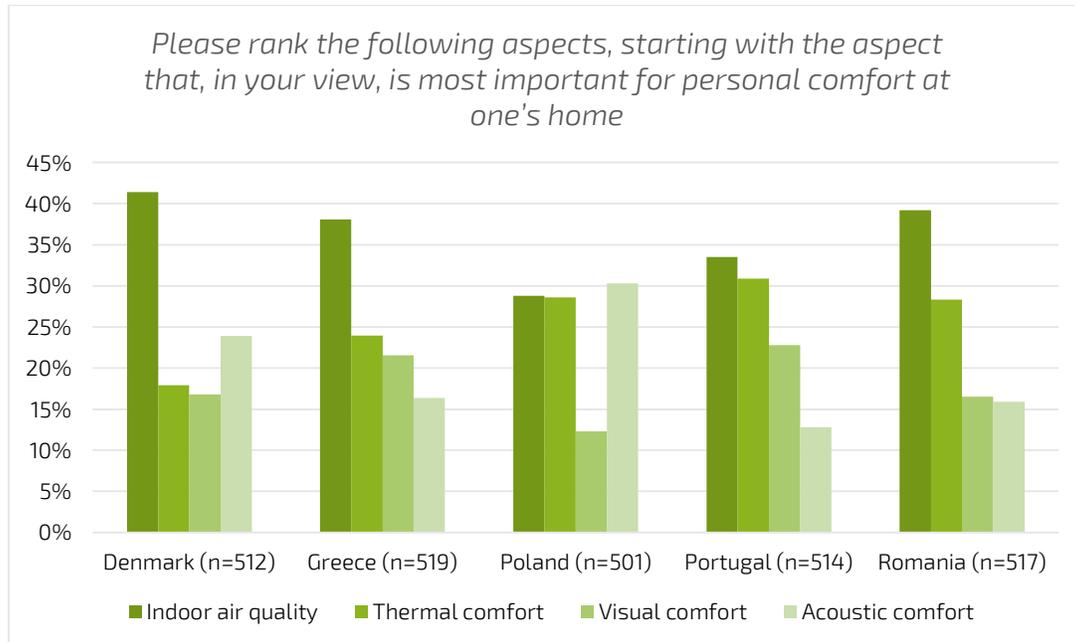


Figure 13: Importance of comfort aspects ranked by respondents from each country

There is significant variability towards different indicators by respondents from different countries. One major factor is how these indicators are understood by end-users and their own comfort experience in their respective countries. Denmark and Greece ranked thermal comfort lower than the other three countries. Denmark has stricter building regulations and it is normal to expect high thermal comfort in homes,¹⁷ while it could be speculated that in Greece people have high thermal satisfaction in their homes.

Greece and Portugal gave higher preference to visual comfort than other countries, which may be explained by just by the fact that end-users in these countries value outdoor and natural views (e.g. having access to ocean views) more than the other countries. They also have milder climatic conditions compared to the other three countries.

In Poland, noise nuisance seems to be a greater problem compared to other countries, primarily due to the status of existing buildings – which may include poorly insulated windows and thin internal partitions within multifamily residential buildings. Previous studies have found poor residential acoustic insulation and acoustic comfort in Poland.¹⁸

Danish respondents valued indoor air quality higher than the other countries, which may be due to the time (80-90%)¹⁹ they spend indoors. Danes spend around 16 hours a day in their

¹⁷ [Indoor air quality, thermal comfort and daylight: Analysis of residential building regulations in eight EU member states](#)

¹⁸ Łowicka, D. and Piotrowskab, S. 2015. Monetary valuation of road noise. Residential property prices as an indicator of the acoustic climate quality. *Ecological Indicators* 52: 472-479 <https://doi.org/10.1016/j.ecolind.2015.01.002>

¹⁹ [Indoor climate and health in homes](#) (accessed 2 September 2020)

homes, so may feel the impact of poor indoor air quality more than other indicators that primarily affect their comfort.

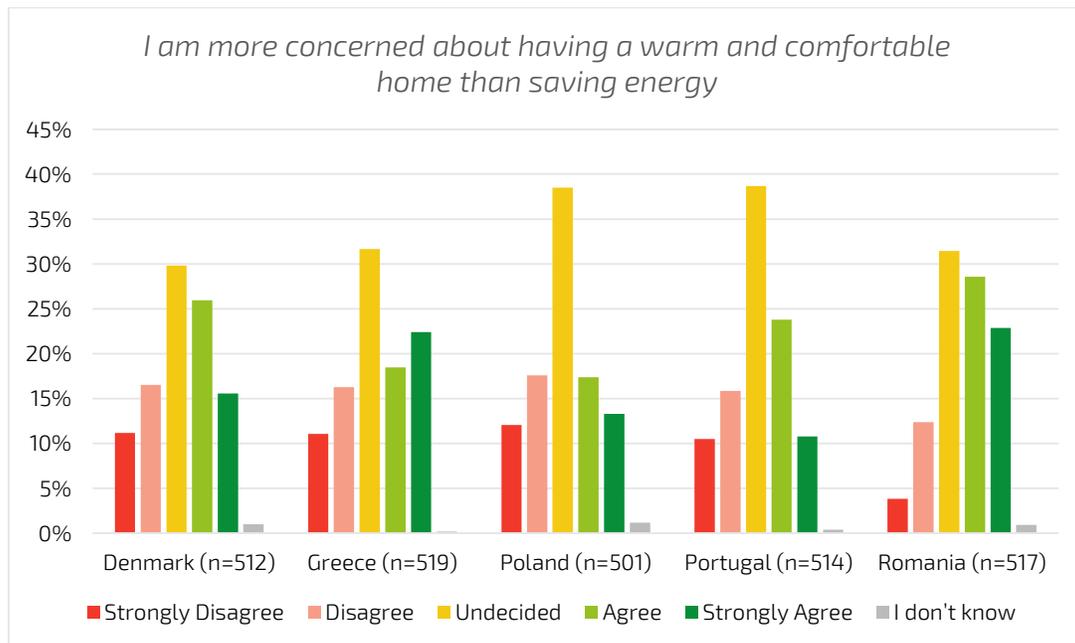


Figure 14: Country attitudes to having a more comfortable home versus saving energy

Figure 14 shows that a higher number of respondents from Romania believe having a more comfortable home is more important than saving energy compared to the other four countries. This could be because buildings are leaky and require more effort and energy to maintain indoor temperatures: 80% of the Romanian building stock needs to be renovated to stop heat losses through the building envelope and to decrease energy consumption.²⁰ However, a higher percentage of neutral (undecided) responses highlights the dilemma that end-users still face in optimising their comfort while minimising energy costs.²¹

²⁰ Muresan, A., Attia, S. 2017. Energy efficiency in the Romanian residential building stock: A literature review. *Renewable and Sustainable Energy Reviews* 74: 349-363.

²¹ Yang, L., Haiyan, Y., Lam, J. 2014. Thermal comfort and building energy consumption implications – A review. *Applied Energy* 115: 164-173



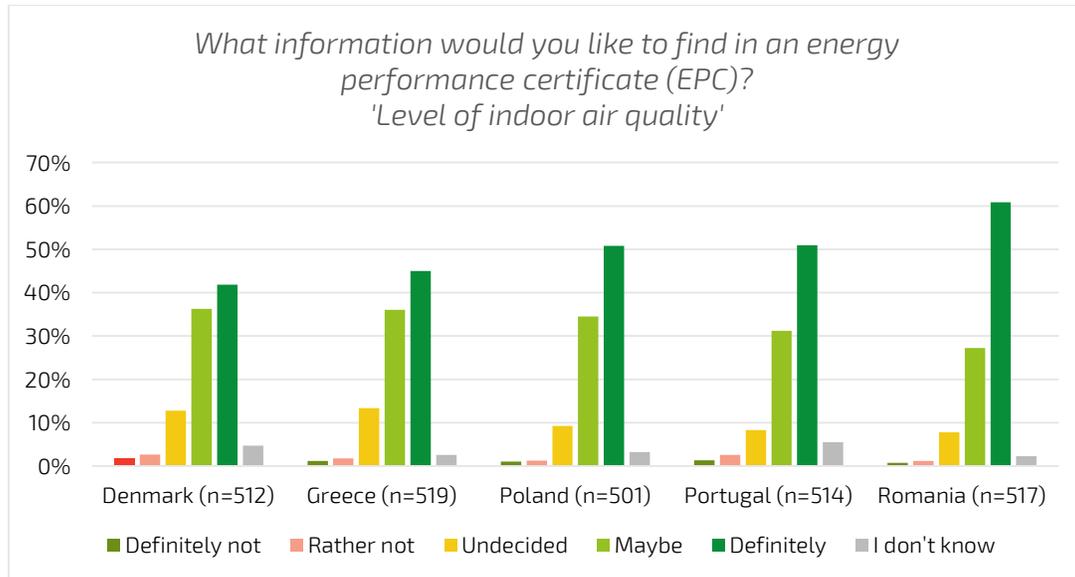


Figure 15: Preference to receive comfort (indoor air quality) information in EPCs

Danish respondents have the least interest in receiving information on comfort, perhaps because of a low awareness of the benefits.²² In contrast, such information in Romania is highly valued²³ and probably perceived as helpful to improve the comfort of people's homes.

Conclusions

Comfort, from indoor air quality to visual comfort, is important to all end-users, no matter how old or where they live. There are, however, differences in which aspects of comfort people value, with IAQ seen as most important, followed by thermal comfort. Noise nuisance and visual comfort were ranked as less important. Improving visual comfort is challenging within existing buildings. End-users don't see any direct relation of noise nuisance to energy expenses, therefore, it may not hold high importance for end-users.

From the country comparison, it can be seen that countries with stricter regulations, such as Denmark, see less value in thermal comfort-related information in an EPC compared to countries like Poland, whose citizens often live in poorly insulated buildings. Connected to this, Polish citizens also have greater issues with noise nuisance.

Romania in general sees a greater value in comfort-related information being available when buying or renting property. The housing law in Romania stipulates a minimum acceptable comfort level in houses being rented or bought based on construction technology (e.g. thermal insulation). However, the existing building stock is thermally inefficient, which could explain the high importance among end-users.

²² Frontczak, M., Andersen, R., Wargocki, P. 2012. Questionnaire survey on factors influencing comfort with indoor environmental quality in Danish housing. *Building and Environment* 50: 56-64.

²³ http://bpie.eu/wp-content/uploads/2018/01/iBROAD_CountryFactsheet_ROMANIA-2018.pdf (accessed 2 September 2020)

In summary:

- ⦿ End-users give priority to comfort when buying or renting a property.
- ⦿ There is a great interest in seeing information on the EPC about comfort levels of a property.
- ⦿ IAQ and thermal comfort are seen as the most important elements of comfort at home.
- ⦿ Adding information about comfort would give a better comparison with energy savings in buildings and help in planning.

3.3 Outdoor air pollution

Air pollution is the most important environmental risk to human health. Buildings both affect the quality of the outside air (pollutant emissions) and the quality of the indoor air (air filtration). Currently these aspects are mostly not covered by EPCs. Indicators of outdoor air pollution methodology include the Local Air Pollution Contributor Index and Indoor Air Purity Index; incorporating these in EPCs can increase the awareness of building owners, users and occupants on their impact on smog development as well as the importance of air filtration efficiency within ventilation systems.

The questions in the survey were developed in order to investigate how important aspects of air pollution in terms of emissions and air filtration are for respondents in comparison with other information within EPCs.

Demographics

Looking at demographics there is no significant difference between age groups in attitudes to outdoor air pollution (Figure 16). However, people with children are significantly more interested than those without in receiving information on the impact of outdoor air pollution on indoor air quality in their EPCs.

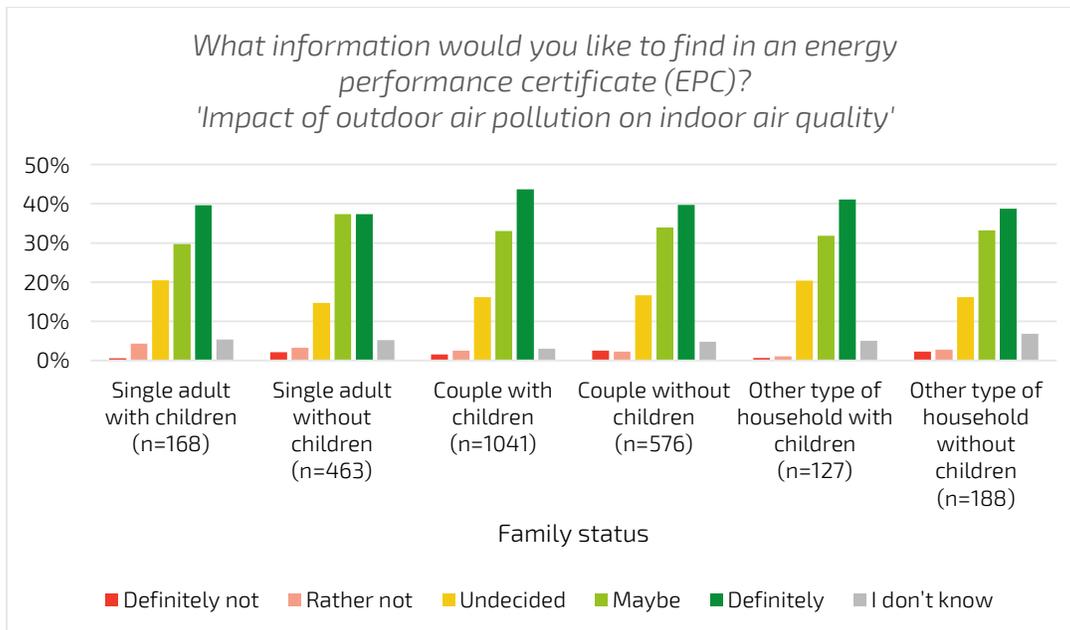


Figure 16: Interest in outdoor air pollution information in EPCs by family status

There are few significant differences when looking at the financial situation of the respondents (Figure 17). Only people who said their financial situation was "impossible" showed lower interest in knowing about outdoor air pollution. This was also seen for the comfort feature and is probably related to the fact that their financial worries mean they are not able to prioritize health aspects.

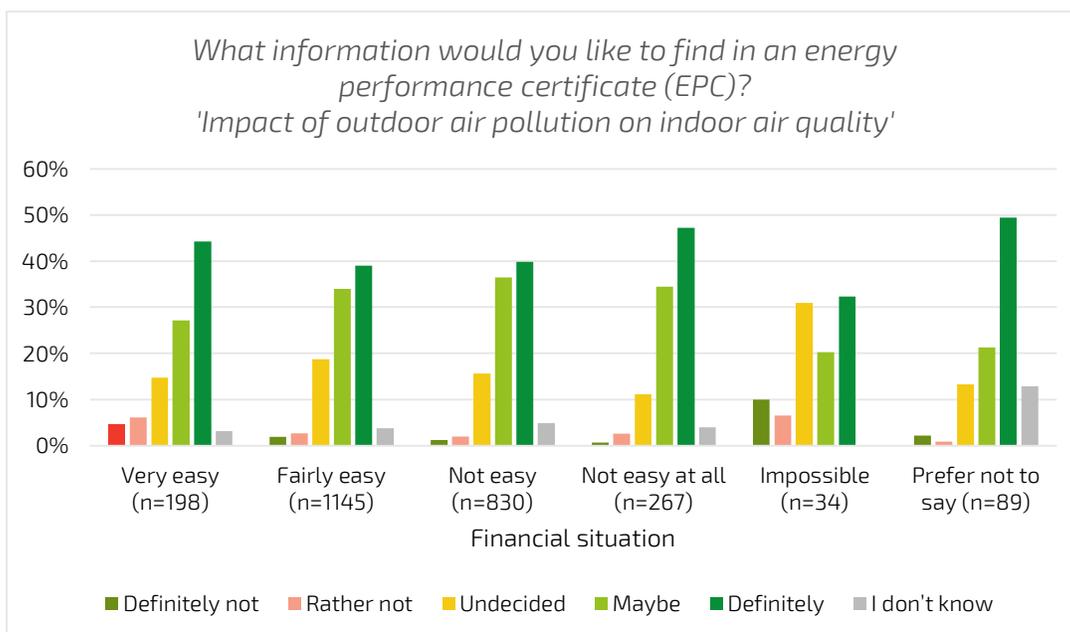


Figure 17: Interest in outdoor air pollution information in EPCs by financial situation



Renovation status

Respondents who are currently undergoing renovation, plan to do so in the future or have recently renovated showed a higher interest in including information on the building's impact on outdoor air pollution in the EPC (Figure 18). In general, respondents do not show very high interest in this feature or are still undecided (combining "undecided" and "maybe"), no matter what their renovation status. This may be related to them linking the building modernisation with a reduction in energy demand and not with a reduction in pollutant emissions.

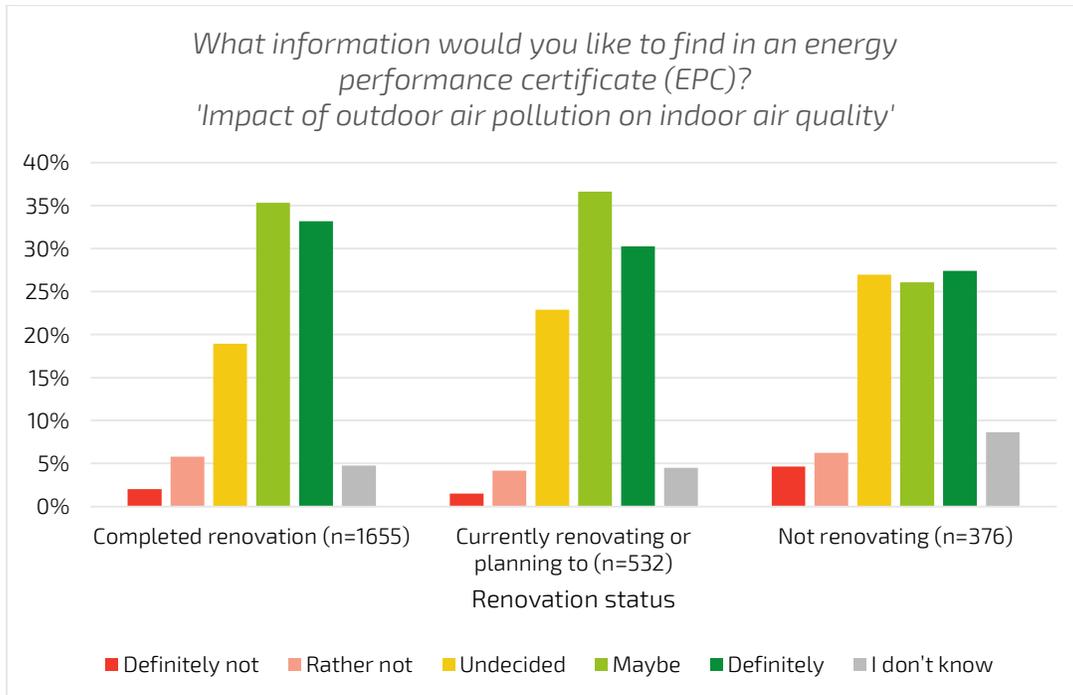


Figure 18: Interest in outdoor air pollution information in EPCs by renovation status

Location

People in rural areas are more interested in knowing the impact of the outdoor air pollution on indoor air quality than people in cities (Figure 19). They are also the largest undecided group. People in larger cities would rather not know what impact the outdoor air pollution has on the indoor air quality, which might be because there is often not much they can do about it. In most cases in rural areas individual heating sources are used and people can directly estimate the pollutant emissions, while in larger cities a district heating network is commonly used, and direct emissions are not noticeable and often not possible to change.



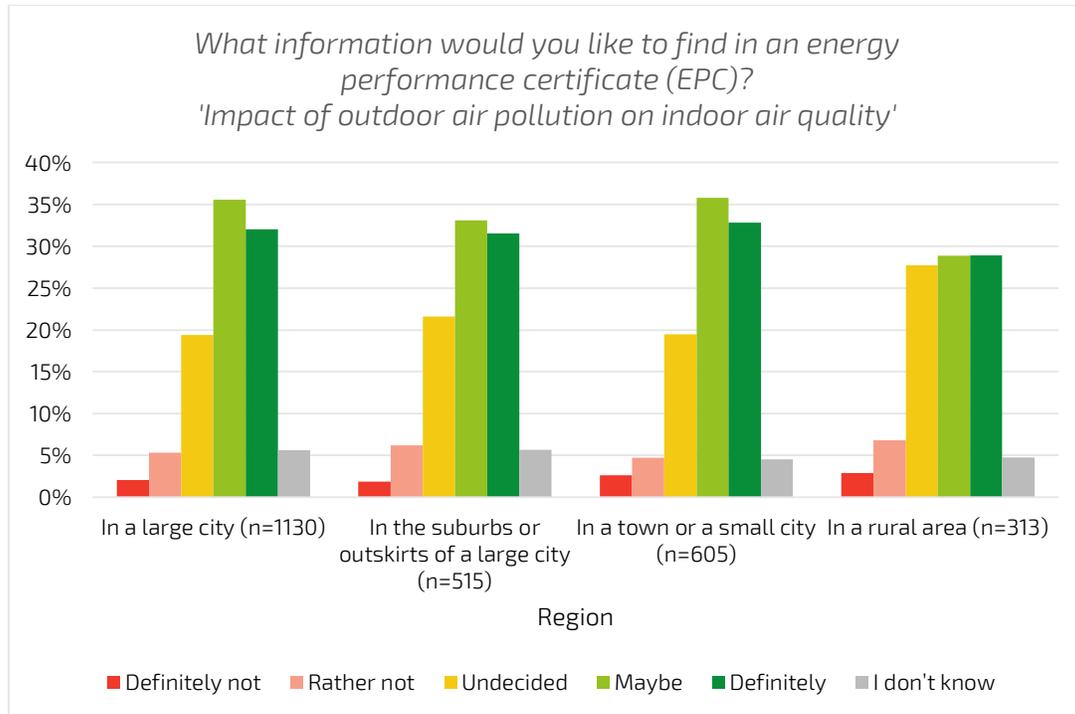


Figure 19: Interest in outdoor air pollution information in EPCs by location

There are some interesting results when looking at outdoor air pollution and employment status (Figure 20). It can be seen that it is important to all respondents, except those "unemployed and not looking for a job" and "long-term sick and disabled". Both show higher rates for "definitely not" than the others. This makes sense as both groups are often not in the position to move to a better building even if they wanted to. At the same time the respondents across all employment types seem very unsure as to the importance of this feature with high rankings both for "undecided" and "maybe". This could point to the fact that respondents don't know enough about how outdoor air pollution affects indoor air quality.



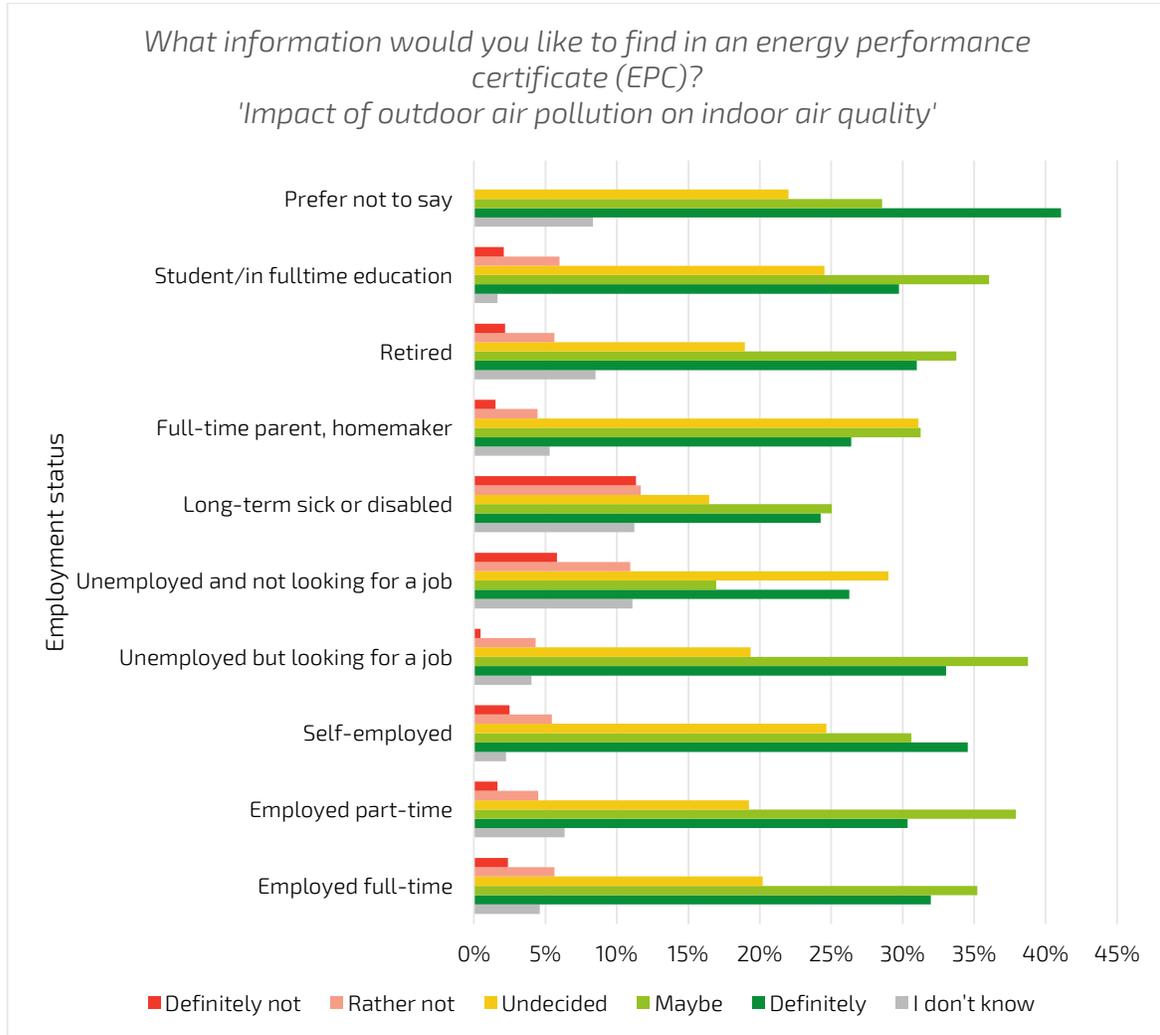


Figure 20: Impact of outdoor air pollution and employment status (n=2563)

Country results

The five countries show similar results for this feature. The impact of a building on outdoor air pollution and the impact of outdoor air pollution on indoor air quality are more important to end-users in Poland and Romania, especially when looking at the answer “definitely”, than in Denmark (Figure 21 and Figure 22). This is probably related to people’s awareness of building energy consumption and heating source type being connected to air pollution. The problem of air pollution (and smog) is a major issue in Poland²⁴ and Romania²⁵, and in many cases is related to the building’s heating source. In a majority of the cases, in rural areas and the suburbs of large cities individual boilers are used in which solid or liquid fuel is burned.

²⁴ [How the EU is helping fight deadly air pollution in Poland](#) (accessed 4 September 2020)

²⁵ [www.iamat.org/country/romania/risk/air-pollution#](#) (accessed 4 September 2020)



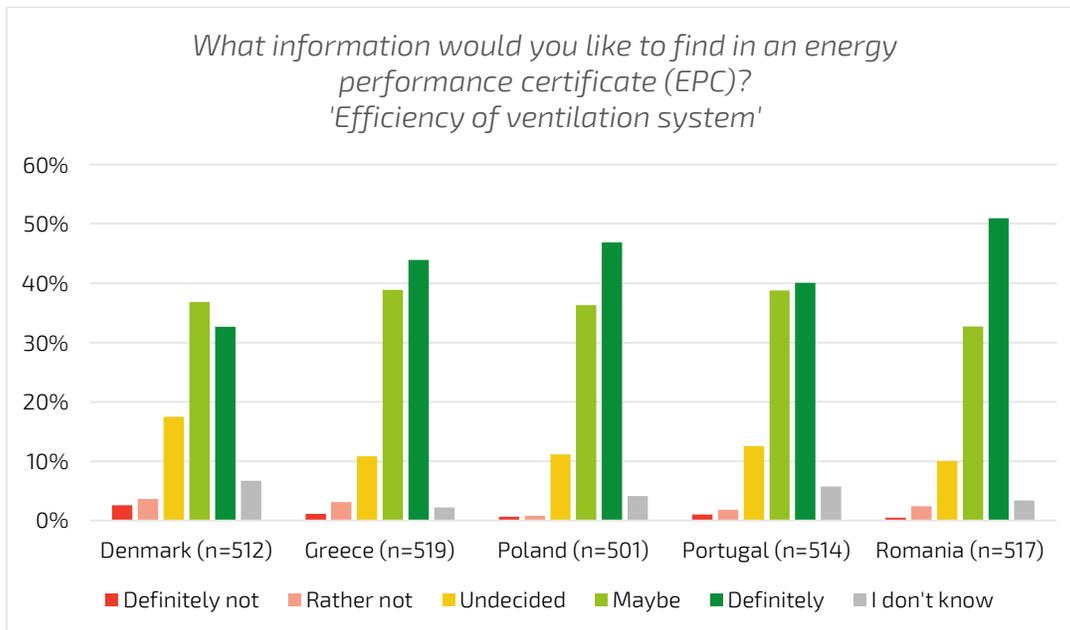


Figure 21: Country comparison for interest in information on efficiency of ventilation system

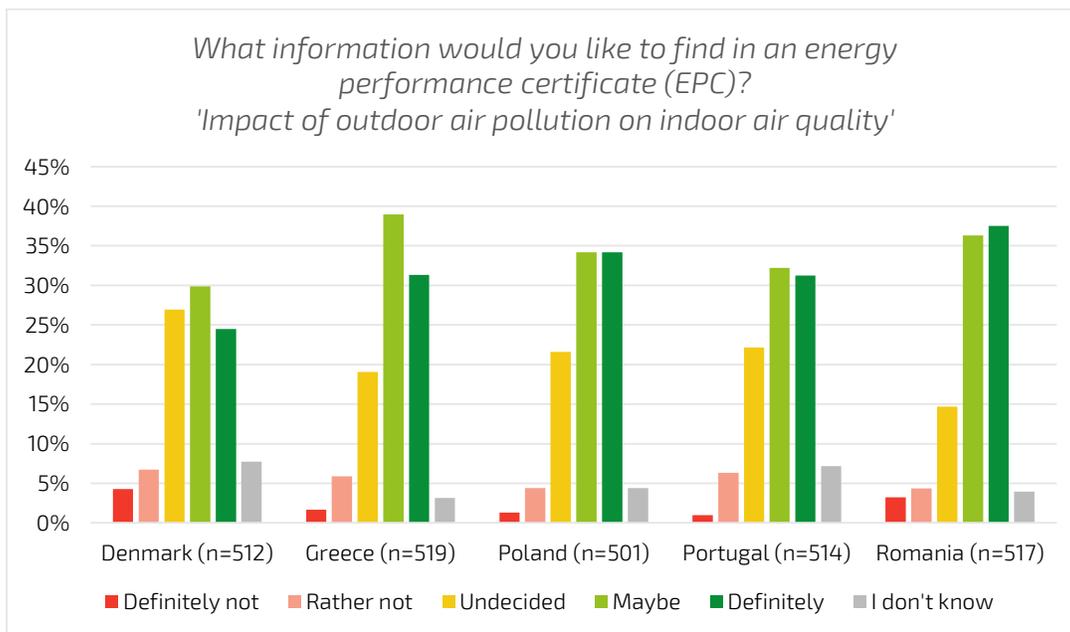


Figure 22: Country comparison for interest in information on buildings' impact on outdoor air pollution

The observed results may be related to other countries having lower building energy performance in comparison to Denmark. A similar difference can be seen for ventilation systems' efficiency. The issue of outdoor air pollution and users' desire to have pure indoor air may explain why this is more of a priority in Poland and Romania than in Denmark.

In all countries, there is interest in including the issues of buildings' impact on outdoor air pollution, impact of outdoor air pollution on indoor air quality and efficiency of ventilation



systems (if present) in an EPC. This indicates that the replicability potential of this feature to other Member States is high.

Conclusions

In Poland and Romania, the interest in buildings' impact on outdoor air pollution and the impact of outdoor air pollution on indoor air quality is high, though it is more important for some groups of respondents than others. In Denmark, where air pollution is a less pressing issue, respondents show less interest in this kind of information.

Notably, the issue of indoor air quality, which has an impact on health, is very important in all countries regardless of age, financial situation or tenure – even more so than energy efficiency.

The three issues of a building's impact on outdoor air pollution, the impact of outdoor air pollution on indoor air quality and the efficiency of the ventilation system are linked to each other. Pollutants are emitted due to a building's energy consumption, which influence outdoor air pollution, which in turn can affect indoor air quality and the need for an efficient ventilation system.

3.4 Real energy consumption

The method for the determination of energy performance based on real energy use can be implemented as a standalone energy performance of buildings certification method or in addition to existing EPC methods. It is introduced within X-tendo to better link EPCs with energy billing information, to enhance renovation advice and to improve user acceptance and policy instruments.

The questions have been chosen to obtain insight on the value of information on real energy use and related assets for the end-user and what type of information would be most valuable to them. Additional questions were included to support analysis of the potential for large-scale roll-out of technologies to include real energy use information in EPCs. Questions also covered end-user willingness to accept such technologies, for instance to consent to share data, and other assets related to real energy consumption. End-user attitudes on the usefulness of tailored renovation advice, real-time feedback on energy use or information on, for instance, district heating, comfort and databases also provide valuable insights.

Demographics

While the majority of respondents find real-time energy information helpful to very helpful, younger respondents (age <35) tend to rank it a little lower (Figure 23).

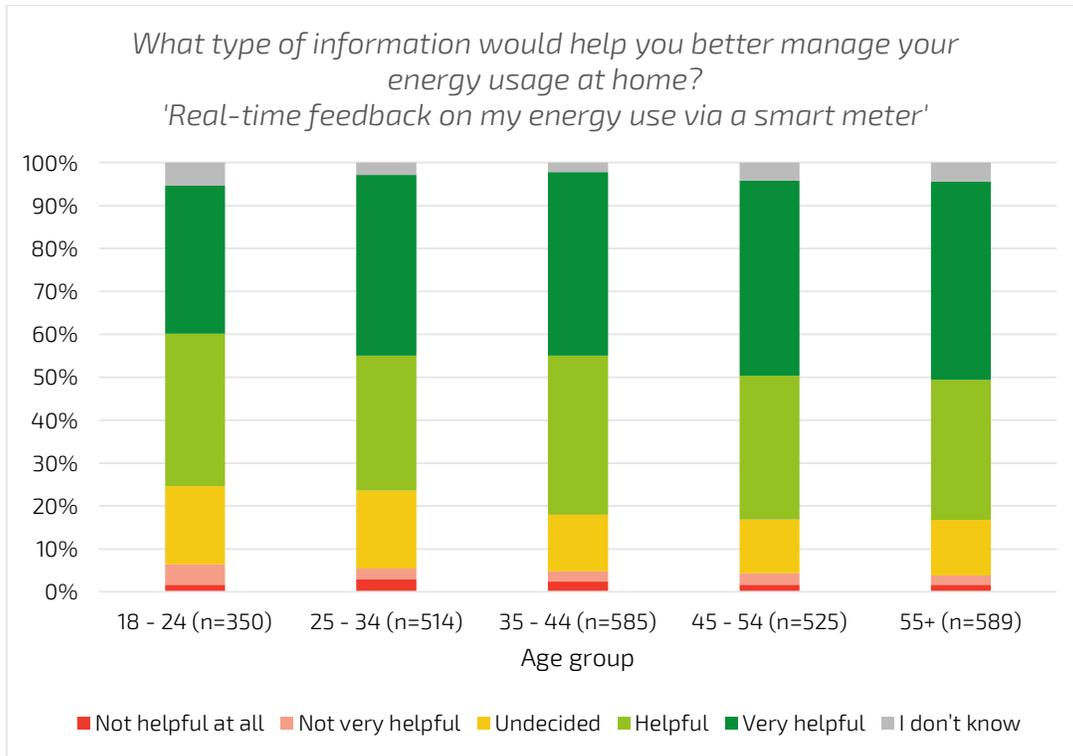


Figure 23: Helpfulness of real-time feedback on energy use via smart meter by age

The majority of respondents also find the inclusion in EPCs of information on energy use and costs of previous owners 'relevant' to 'very relevant'. In contrast to the above findings, the 25-34 age group rated this feature the highest.

Most respondents thought including an energy performance score of similar buildings nearby 'relevant' to 'very relevant' (Figure 24). Receiving such information may motivate end-users to think critically about renovating their home and improving its energy efficiency. As above, the 25-34 age group were most interested in this information, with the 18-24 age group showing the least interest.



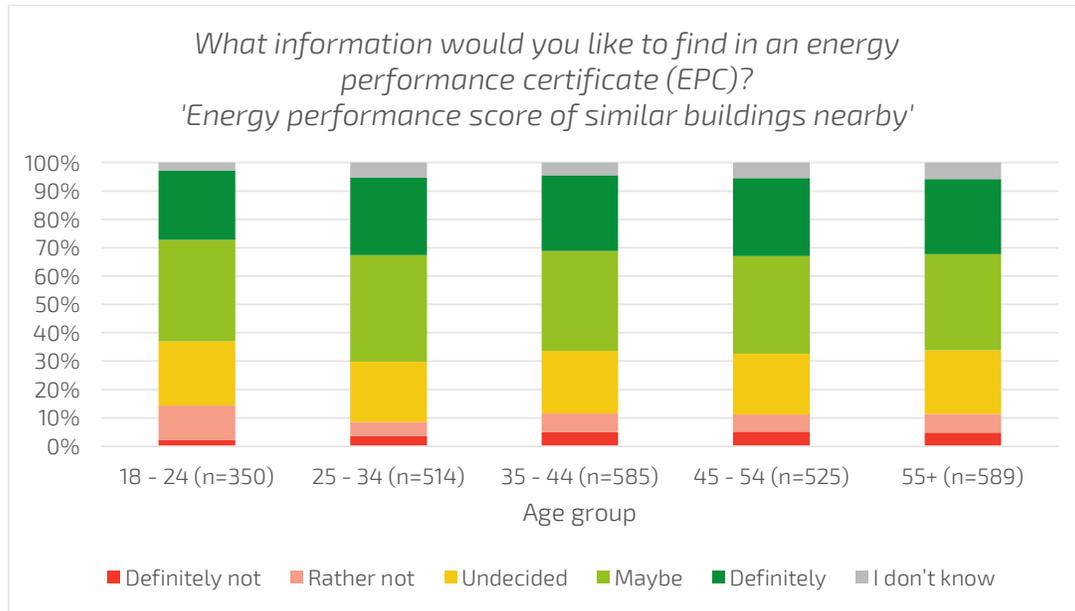


Figure 24: Interest in energy performance of buildings nearby by age group

Looking at respondents' financial situation, most groups thought information on real energy consumption of household appliances²⁶ to better manage energy use at home would be 'helpful' or 'very helpful' – particularly those who find it not 'not easy at all' to meet their monthly outgoings, where more than half rated this aspect as 'very helpful' (Figure 25: Financial situation and feedback on energy consumption of each appliance). Those who find it 'impossible' to meet their monthly outgoings were much less likely to view this information as helpful.

²⁶ According to the Cambridge dictionary, an appliance is a device, machine, or piece of equipment, especially an electrical one that is used in the house, such as a cooker, refrigerator or washing machine.



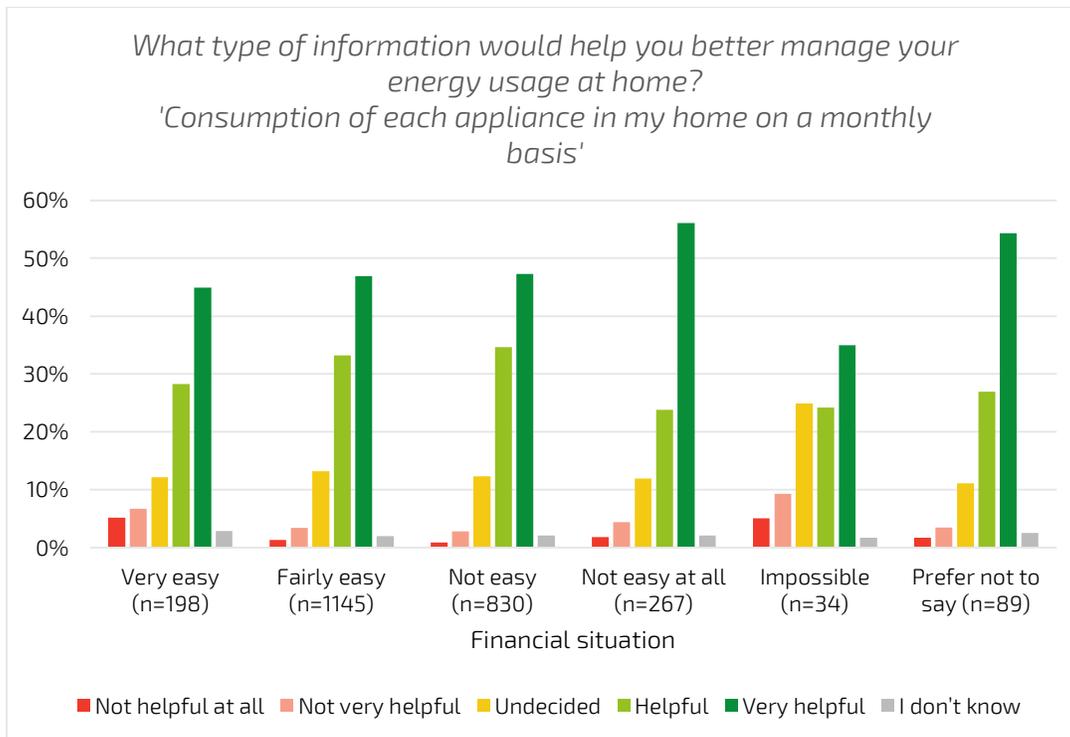


Figure 25: Financial situation and feedback on energy consumption of each appliance

Tenure status

Looking at tenure status, it can be seen that feedback via smart meters as well as comparison of energy use with that of the previous year is considered slightly more 'helpful' to owners compared to tenants (Figure 26). Although, tenants are more likely to see it as 'very helpful' based on the results. However, previous research on providing homeowners with feedback on energy consumption has shown little evidence of its efficacy in reducing energy consumption.²⁷

²⁷ Buchanan, K., Russo, R., and Anderson, B. 2015. The question of energy reduction: The problem(s) with feedback. *Energy Policy* 77: 89-96 <https://doi.org/10.1016/j.enpol.2014.12.008>

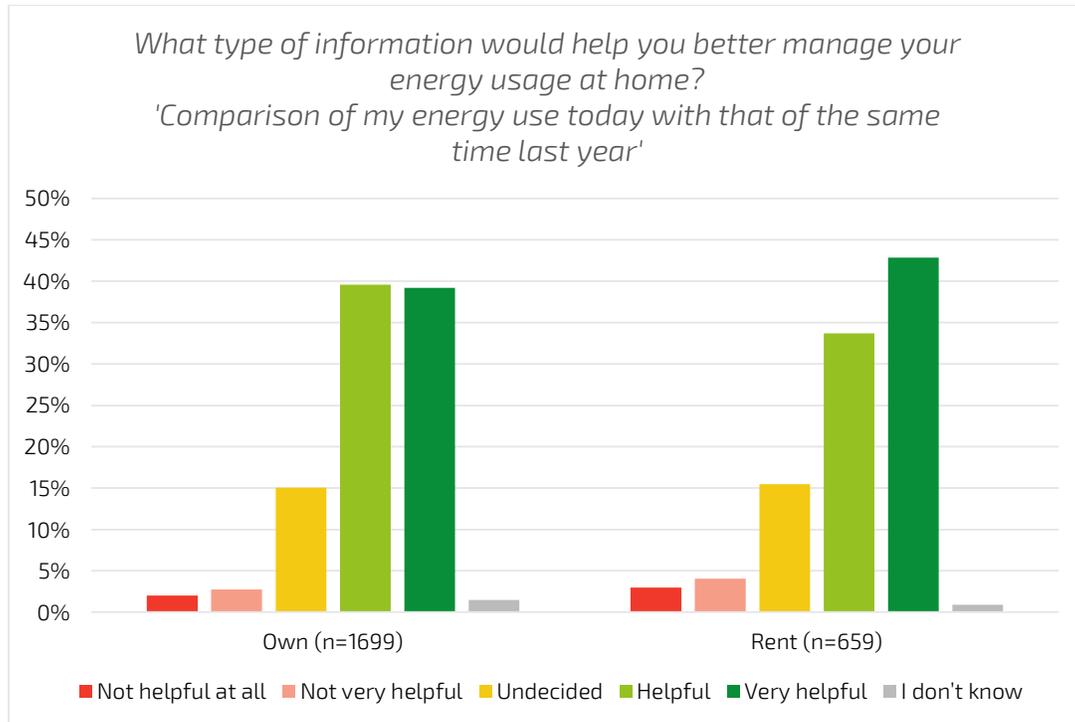


Figure 26: Usefulness of energy data compared to previous year to owners and tenants

Countries

The results presented in Figure 27, Figure 28 and Figure 29 show the majority of respondents in all countries find information on real energy consumption (real-time feedback, consumption of appliances, comparison with other households, historical comparison) 'helpful' to 'very helpful'. Respondents in Denmark were significantly less likely to see this information as helpful compared to other countries. Every household in Denmark has access to their updated yearly energy consumption data free of charge, so respondents may see it as redundant information in EPCs.²⁸

²⁸ Kitzing, L., Katz, J., Schröder, S. T., Morthorst, P. E., & Møller Andersen, F. 2016. [The residential electricity sector in Denmark: A description of current conditions](#). DTU Management Engineering.

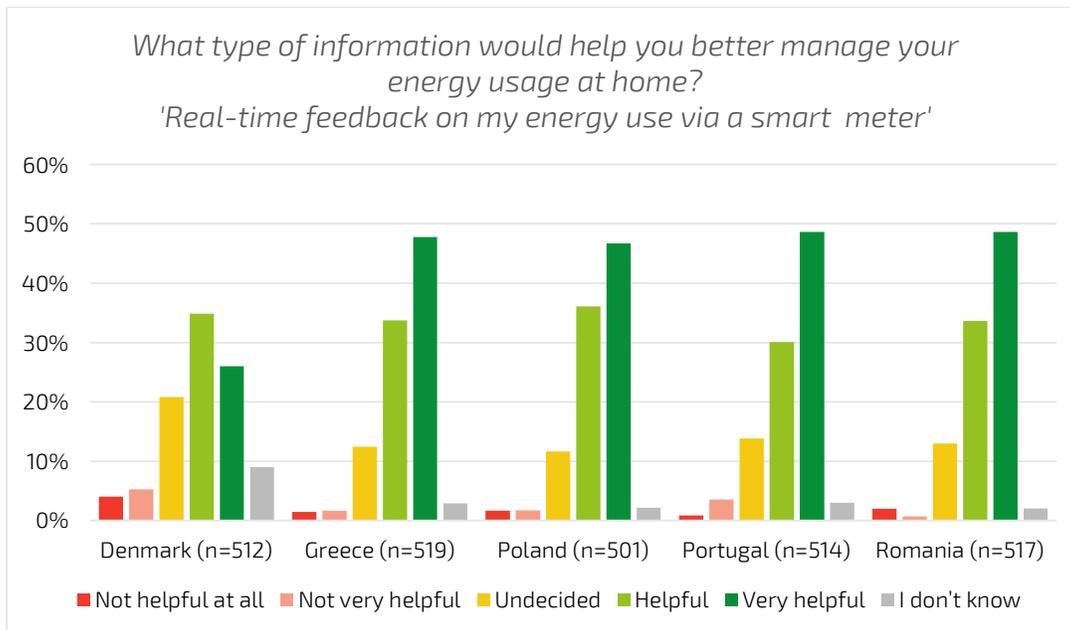


Figure 27: Importance of real-time feedback on energy use by country

The majority of respondents find the inclusion in EPCs of information on previous users' energy use and costs 'relevant' or 'very relevant', especially in Romania and Poland (Figure 28). There is slightly less interest in Portugal.

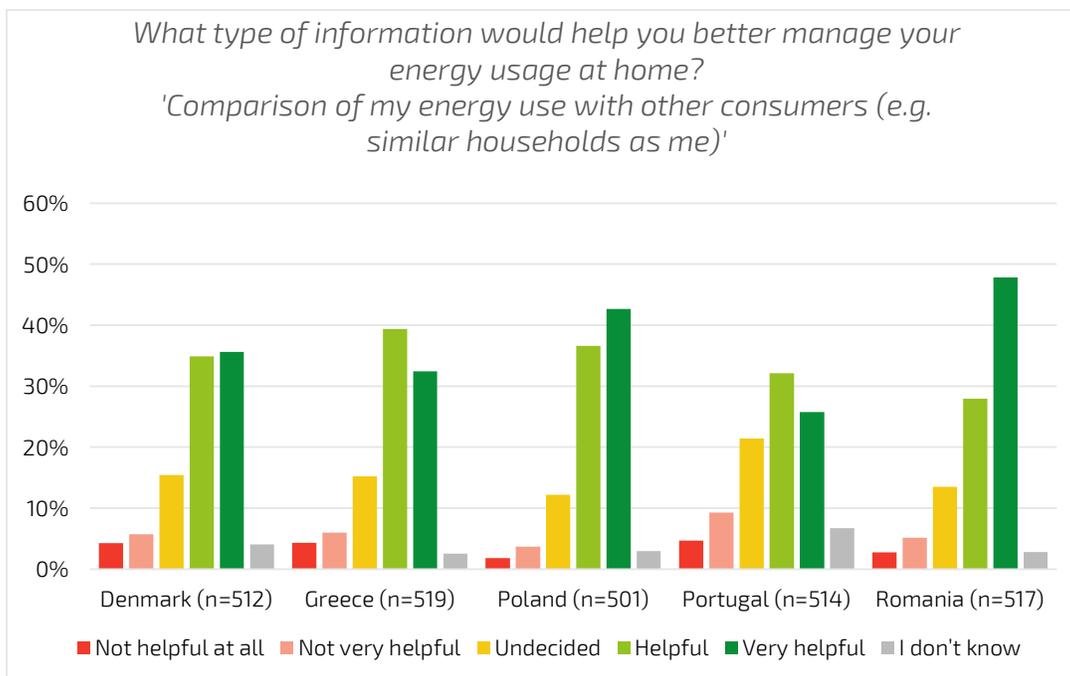


Figure 28: Interest in energy use and cost of previous owners by country

Including the energy performance score of similar households in the EPC is generally ranked as 'helpful' or 'very helpful' (Figure 29). Interest is lower in Denmark, where households already have access to this information.



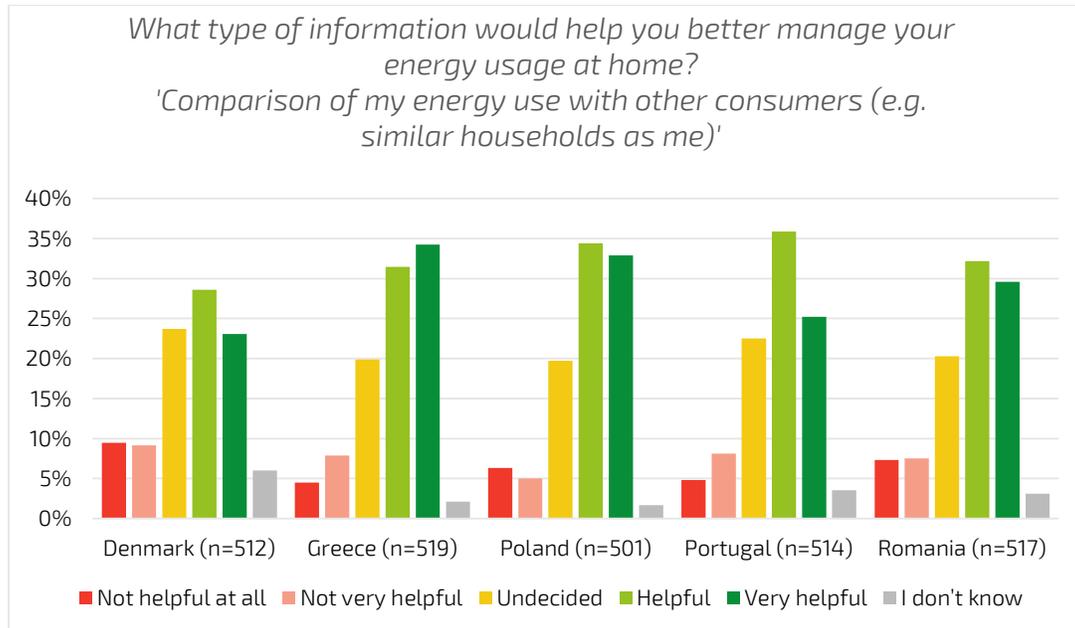


Figure 29: Interest in comparison of energy use with similar households by country

Interest in including information on real energy consumption in EPCs is high across all countries, which indicates a high replicability potential. This can of course only be done in compliance with data protection and General Data Protection Regulations (GDPR).

Conclusions

The majority of respondents find information concerning real energy consumption 'helpful' or 'very helpful' and would like to see it added in the EPC. Although small differences are observed between geographical location, age, gender (more female drop-out answers), tenure and financial situation, the potential to include this feature in next-generation EPCs can be considered very high. Remarkable in that respect are the different results (significance level= 0.5%) obtained in Denmark, where, compared to the other countries involved, the enthusiasm is slightly lower (but still quite high). In Denmark more than half to more than 2/3 of respondents answered in the top two categories ('helpful' to 'very helpful') on all four real energy consumption related questions. Interest in Denmark was considerably lower, likely because data on real energy consumption is already available in Denmark.

The high level of undecided respondents seems strange. This may be related to the perceived lack of reliability that is sometimes connected with EPCs.

3.5 District energy

Within the district energy feature, X-tendo is looking to develop two different types of indicators: a) indicators related to the performance of the district heating system in the proximity of the building (e.g. primary energy, CO₂ and renewable energy factors), and b) indicators related to the building relevant for district heating (e.g. necessary flow temperature and expectable return temperature of the heating system in the building).



The target group for this survey were residential building owners and building occupants, for whom the indicators in group a) are more relevant. In the survey, they were asked about their interest in different sets of these indicators in order to better understand their needs and the factors their interest depends on. This feature excluded participants in Portugal because there are currently no relevant²⁹ district heating systems and none planned in the foreseeable future.

Demographics

All age groups except for the youngest (18-24 years) thought that information on district heating systems was 'interesting' or 'very interesting' (Figure 30), with young people choosing 'very interesting' less often than other age groups. This suggests a broad interest across all age groups with experience of managing a household.

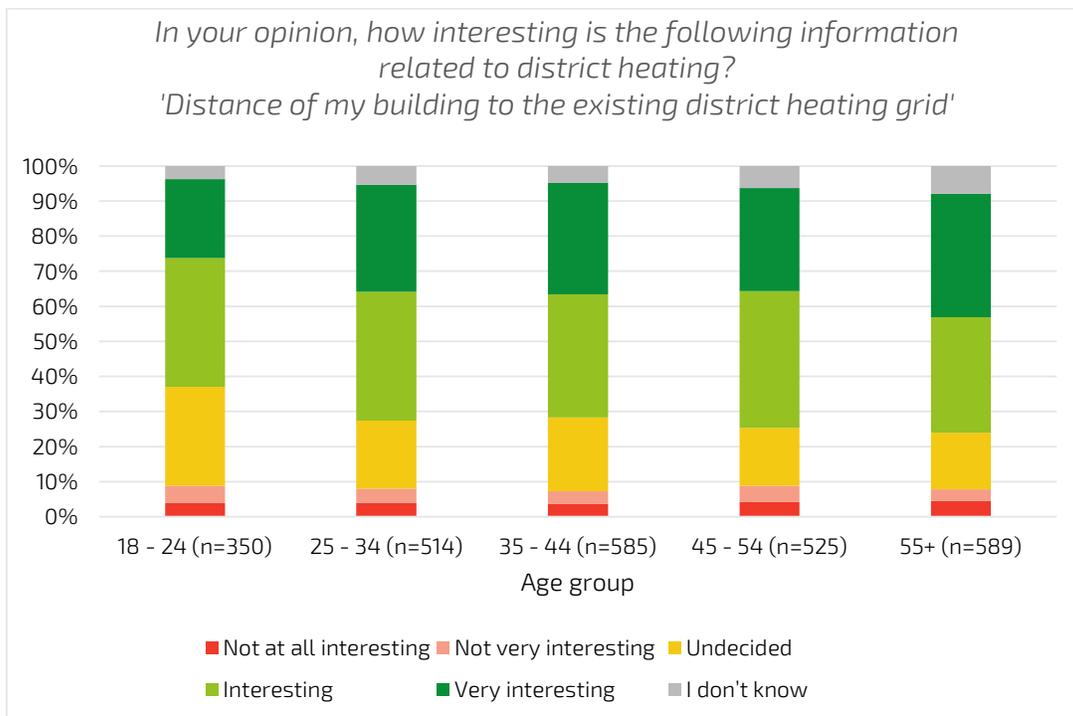


Figure 30: Interest in information on the closest district heating system by age group

²⁹ There is one district heating system in Lisbon, implemented in 1998.



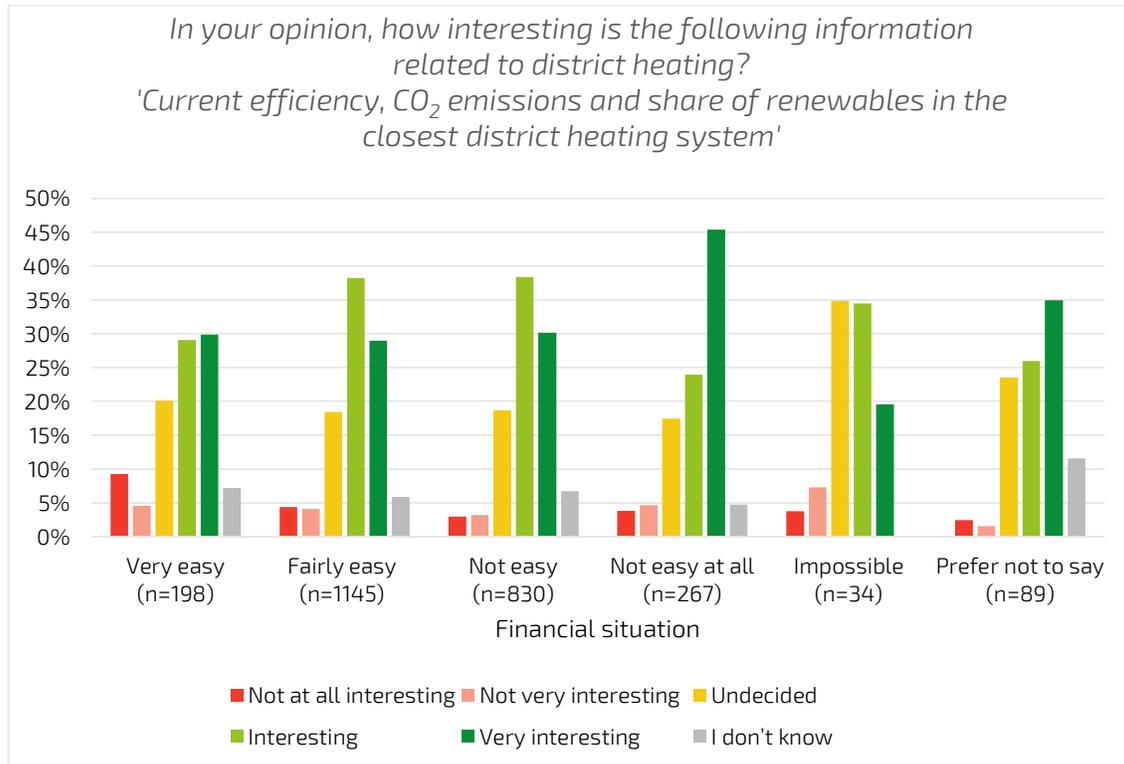


Figure 31: Interest in estimated future efficiency, CO₂ emissions and share of renewables in the closest district heating system by financial situation

Looking at the financial situation of respondents, all groups presented in Figure 31 show interest in the information on district heating. However, there is less interest among those who find it 'impossible' to make ends meet every month and, conversely, those who find it 'very easy'. In general, financial constraints limit end-users' interest in such information.

Location

Inhabitants of cities and towns are more interested in district heating information than those in the suburbs or rural areas (Figure 32) – which is to be expected, as district heating plays a more important role in areas of high population density. Looking at tenure and type of building, people who own flats are most interested in information on district heating. This is again no surprise as the share of flats is greater in densely populated areas served by district heating systems.



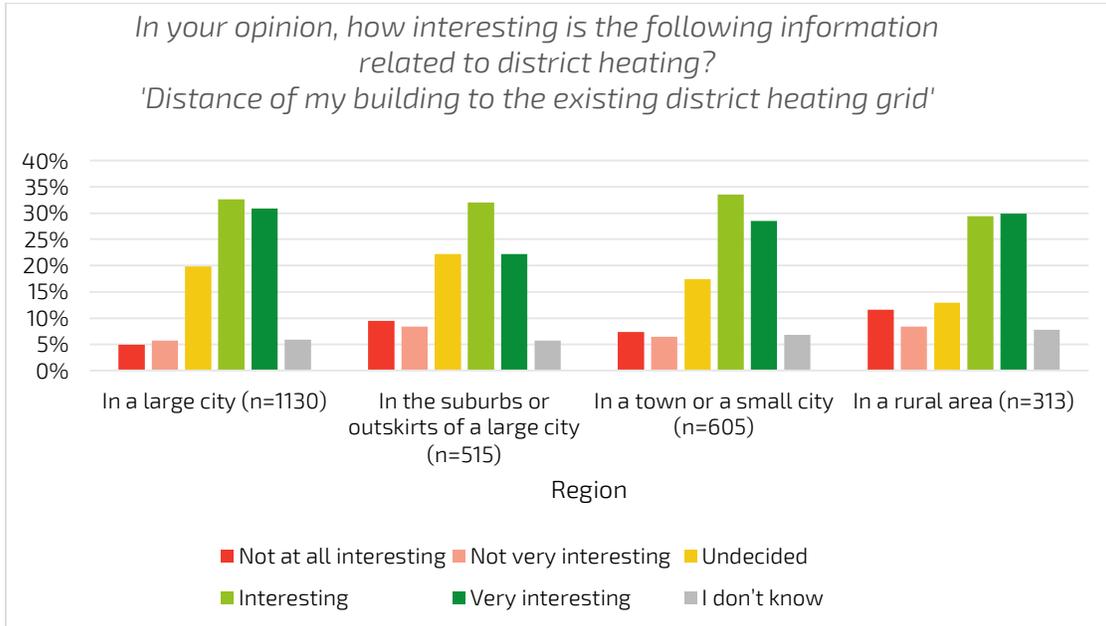


Figure 32: Interest in distance of the nearest district heating network according to location

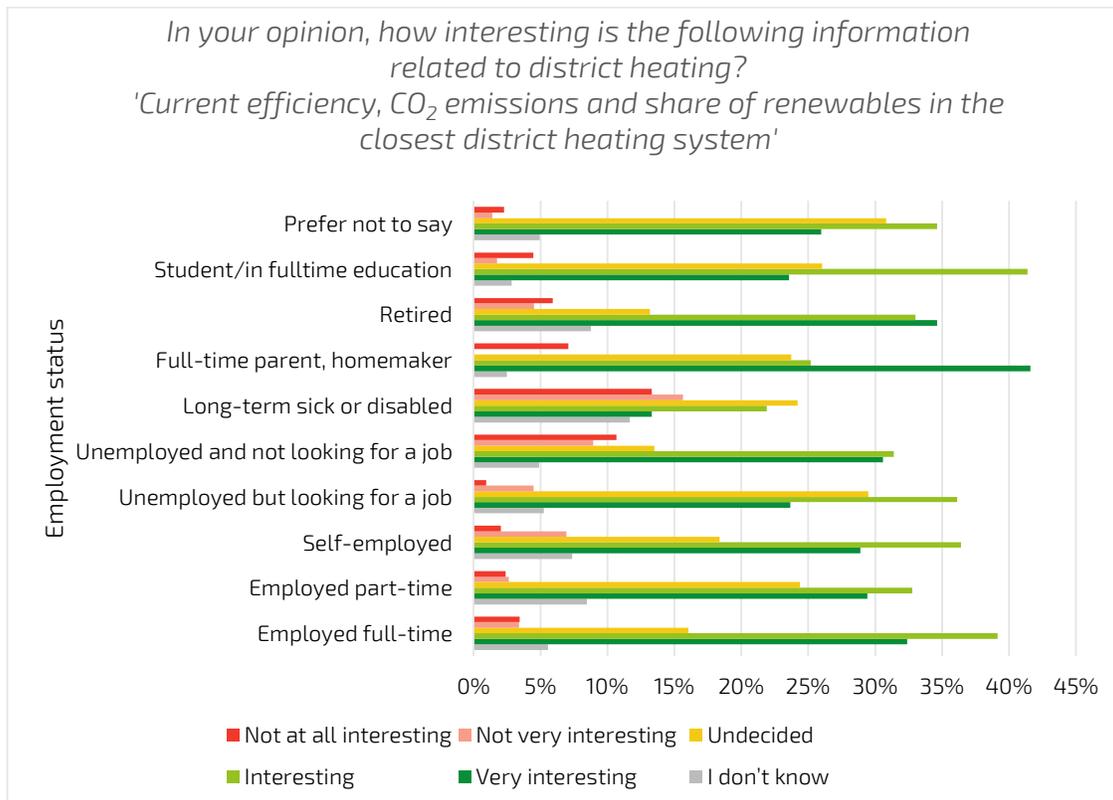


Figure 33: Interest in current efficiency and share of renewables of the closest district heating system by employment status (n=2049)

Full-time employees and full-time parents/homemakers are significantly more interested in district heating information (Figure 33) while long-term sick or disabled people find this



feature least interesting. The current parameters of the district heating grid are once again significantly more interesting for full-time employed persons and significantly less interesting for long-term sick or disabled and persons which are unemployed and not looking for a job.

Countries

For all questions on district heating, Danish end-users showed less interest than those in other countries – presumably because there is already greater awareness about the energy system in Denmark (Figure 34). Nearly two-thirds (63%) of the population in Denmark is already connected to a district heating system.³⁰

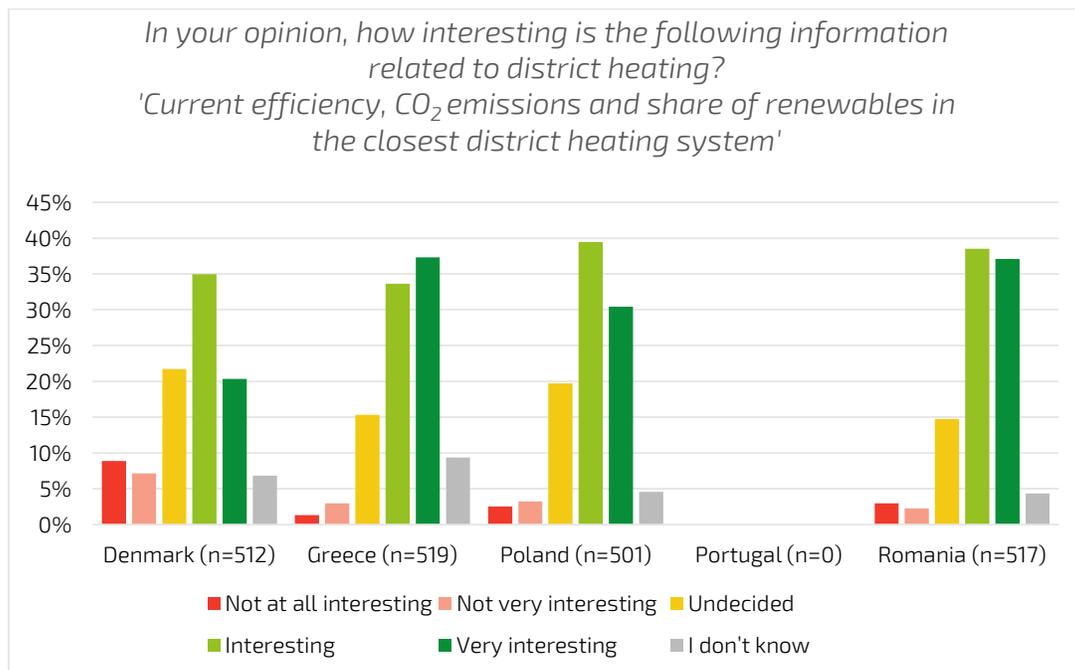


Figure 34: Interest in current efficiency and share of renewables of the closest district heating system by country

The difference between results in Denmark and the other countries makes it difficult to estimate the transferability of results to other Member States. Thus, it can be suggested that interest is likely to be greater in countries with less experience of district heating. The high interest may also be due to the large number of people with above secondary and tertiary education in the target group, who had a greater awareness of the importance of district heating.

Another explanation of the low interest in the questions found in Denmark may be linked to the fact that the municipality chooses the heating system according to socio-economic optimality calculations, so people do not see choosing the best heating system as their job.

³⁰ [Top District Heating Countries – Euroheat & Power](#) (accessed 4 September 2020)



The chosen system doesn't have to be district heating – it could also be a heat pump, solar power or biomass, for example.

Conclusions

Generally, all groups are more or less interested in the parameters suggested for district energy. This shows that including information about the nearest district heating grid would be a benefit for EPC users. As expected, the parameters are more interesting for homeowners than tenants, especially in denser areas such as cities. It could make sense to develop a system to decide whether or not to include this information in the EPC depending on the distance to the nearest district heating grid.

These findings provide useful insights for authorities, demonstrating the broad interest in district heating. This could be a starting point for feasibility studies or various projects to expand and improve district heating systems.

3.6 EPC databases

This feature aims at developing a method for providing quality control³¹ of EPC databases (which can be national and/or regional, depending on the country). For this feature, a direct link between X-tendo's methodology and EPC end-users does not exist. The main target group of the feature is public authorities who would profit from the developed methodology. With more reliable EPC database information, various further activities can follow: feedback to EPC auditors and issuers, building-stock related data mining, design of energy efficiency policies etc.

Because of this, there is limited information to be gained from a residential end-user survey. Questions focused on end-users' interest in receiving more transparent information (which should be provided by the EPC databases) and comparing their energy performance indicators with similar buildings.

Tenure status

From the results presented in Figure 35 and

Figure 36: Interest in energy performance of all properties in the country when buying or renting, when buying or renting a property, respondents consider a comparison of the energy efficiency score with other properties in the neighbourhood more useful than with all properties in the country.

³¹ [Quality control schemes make EPCs more reliable](#) (accessed 4 September 2020)

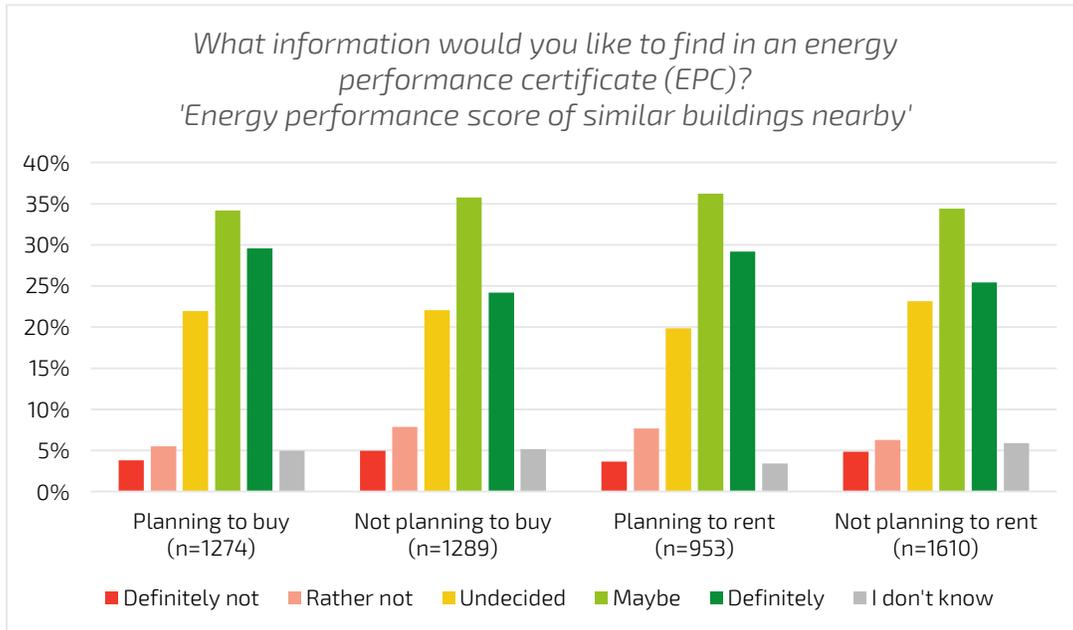


Figure 35: Interest in energy performance score of buildings nearby when buying or renting

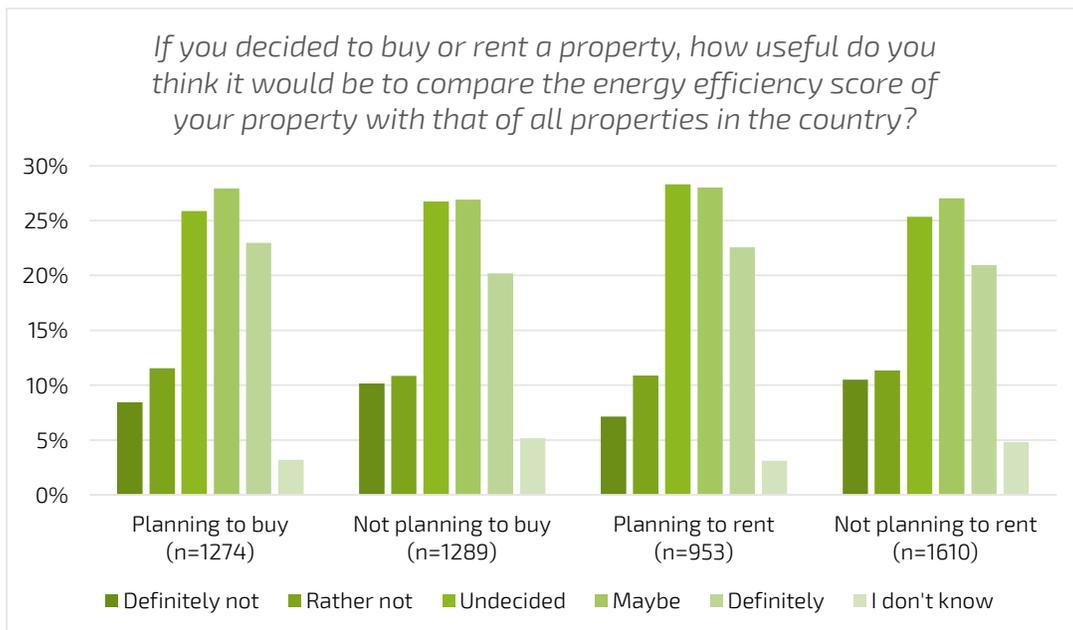


Figure 36: Interest in energy performance of all properties in the country when buying or renting

Conclusions

Overall, building owners and occupants show a strong interest in knowing more about the energy performance of similar buildings nearby (about two-thirds of respondents) or in the country (about half of the respondents). In particular, this is the case for respondents planning to buy or rent a property.



These results highlight the potential value of making data in EPC databases publicly available, in line with data protection regulations, as is already the case as in Denmark. However, this will only have a corresponding positive impact if the information is provided in an easily accessible format, and probably linked to information on the specific building, potentially by means of the building logbook (see the following chapter).

3.7 Building logbook

A number of European countries have implemented initiatives resembling logbooks.³² They come in various formats, address different target audiences and serve various purposes. Examples include building passports, home information packs, building files, operation and maintenance logs, etc. A common feature of all the above tools is that they were mainly government-led and that, despite their clear benefits, most have had limited uptake due mainly to the lack of support from market players, who perceived the logbook as an additional administrative burden.³³ To avoid biases and confusion around terminology, the X-tendo survey inquired about the general benefits and availability of building documentation systems or information folders, without referring explicitly to any existing logbook-type initiatives.

Demographics

As Figure 37 illustrates, older generations (>45) seem to be more interested in having a building documentation system in place and are more inclined to see the benefit of it, especially for purchasing or renting decisions. As the survey did not specify whether the logbook would be paper-based or a digital tool, discrepancies in terms of digital literacy did not skew the answers according to age group.

³² <https://ibroad-project.eu> (accessed 4 September 2020)

³³ European Commission, Study on the Development of an EU Framework for a Digital Building Logbook, forthcoming in 2020.

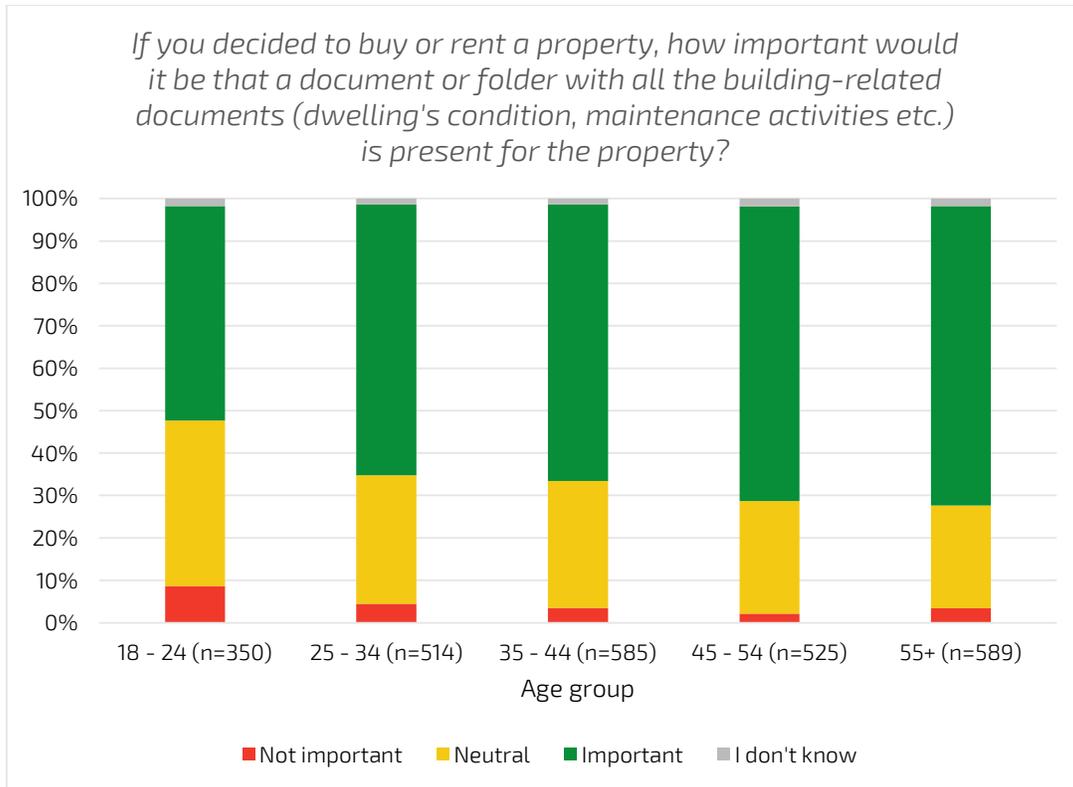


Figure 37: Importance of a logbook to end-users based on age

Older generations consistently believed that information about the condition of walls and roofs as well as the quality of windows and insulation are the most important data points the logbook could include. Age profiling is a relevant finding, not just for the scope of the data contained in the logbook, but for the user interface and the need to make the logbook accessible for all age categories (e.g. to avoid creating a digital divide among generations).

Building types

Owners and tenants of detached houses (44%) are more likely to have received logbooks compared to those of flats (30%) as shown in Figure 38.



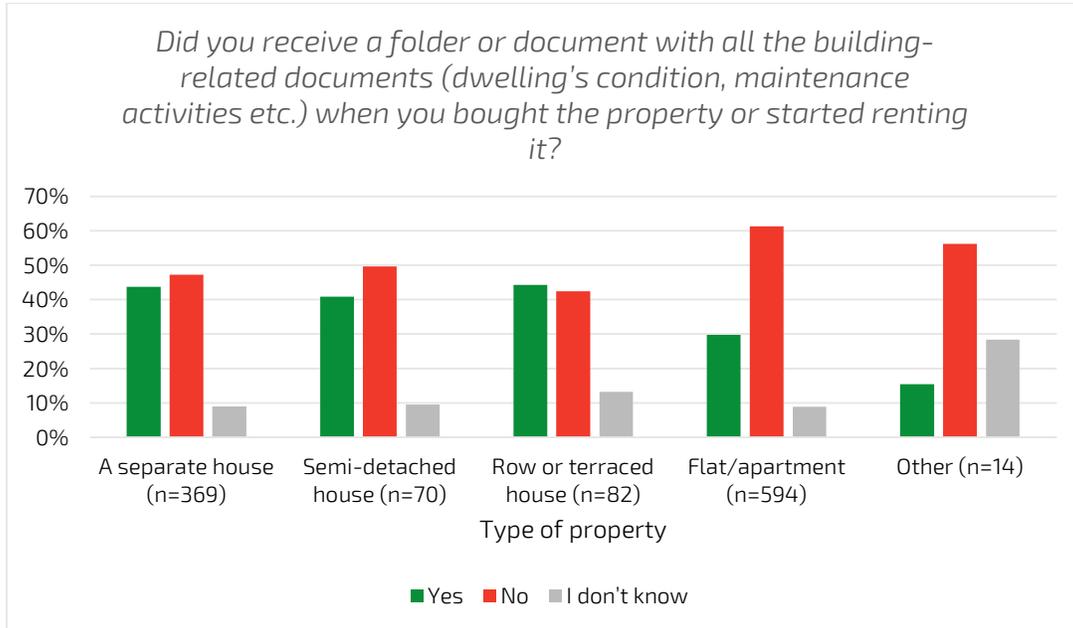


Figure 38: End-users who received building-related documentation when buying or renting the property

Tenure status

As expected, people living in houses across all countries surveyed are consistently more likely to receive building information than tenants (Figure 409).

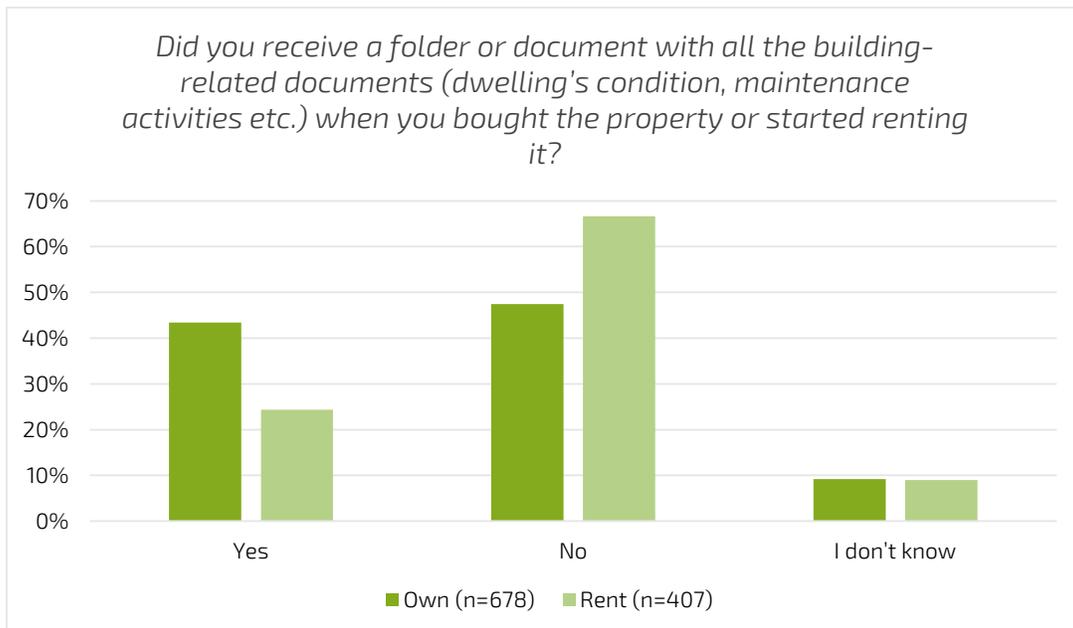


Figure 39: Having received building documentation by tenure status

However, a significant percentage of tenants also receive or have access to building files (Figure 39: Having received building documentation by tenure status): this is surprising as



usually the owner is the one with the building documentation and the tenants do not usually receive it as they are not responsible for renovations. It is possible that tenants' responses are affected by the information they currently receive in EPCs on building energy use, which are handed over when renting an apartment but is not the same as a building logbook or a full documentation of the buildings condition.

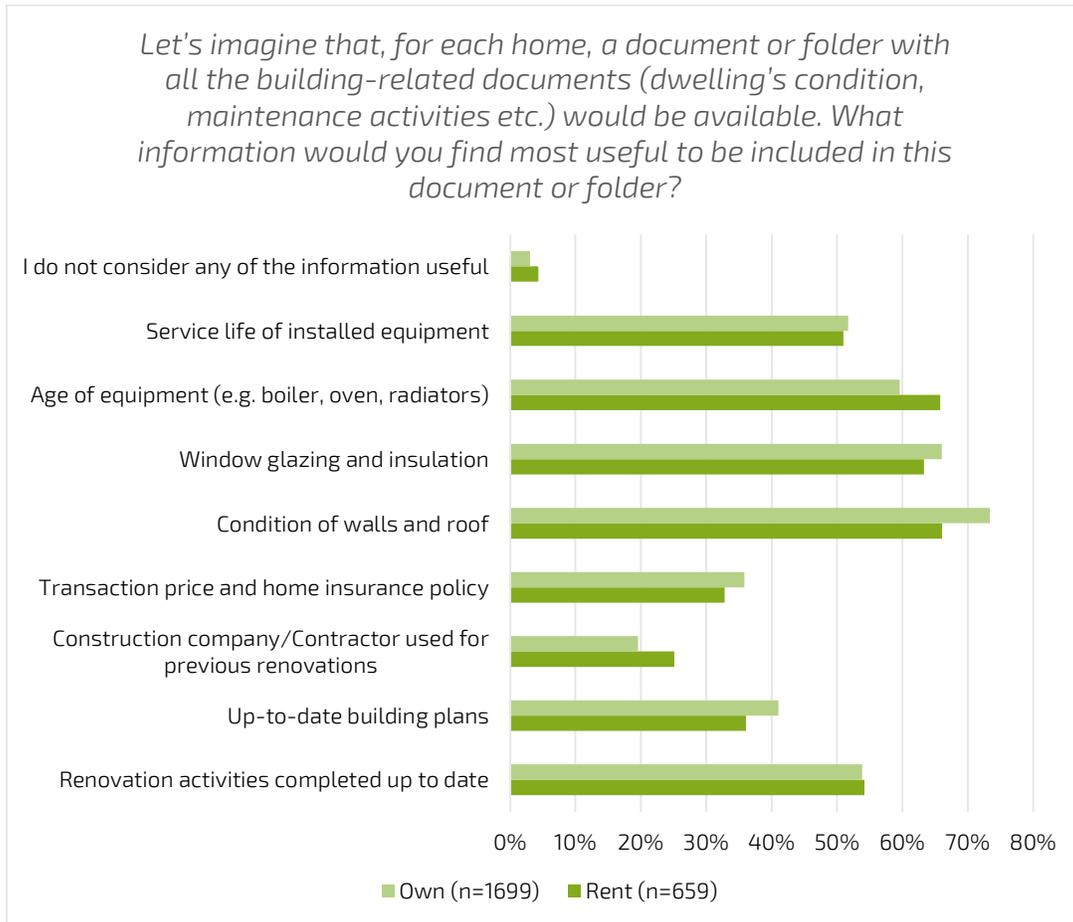


Figure 40: Expectation on information on building by tenure

Regarding the information people would like to see in a logbook, Figure 41 shows that tenants are more likely to prioritise the age and maintenance of the building equipment (heating, boiler, air conditioning).



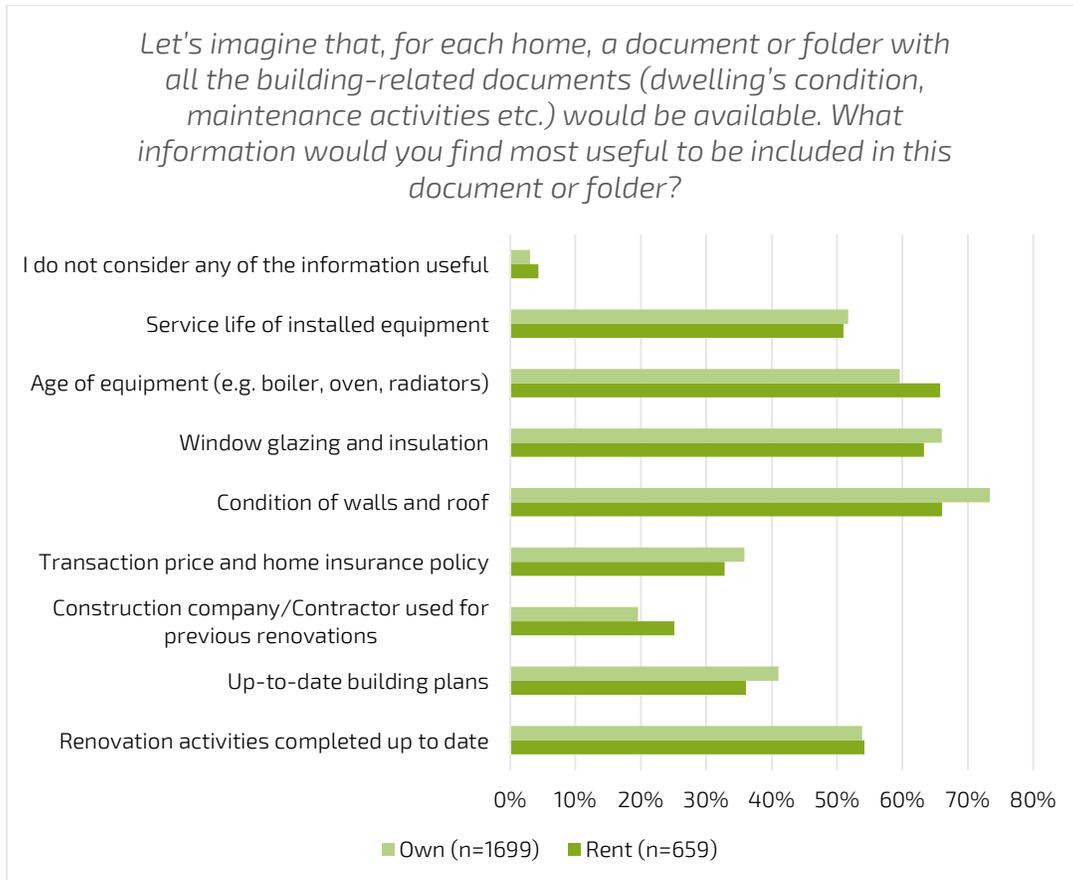


Figure 41: Most useful information to be included in building logbook according to owners and tenants

Countries

There are considerable discrepancies between the surveyed countries in terms of the availability and use of building information files (Figure 42). Building files are more consistently handed over to buyers and tenants in Denmark (66% of owners/40% of tenants), Romania and Portugal (45% of owners/13% of tenants), whereas in Poland and Greece, building files are used less frequently.



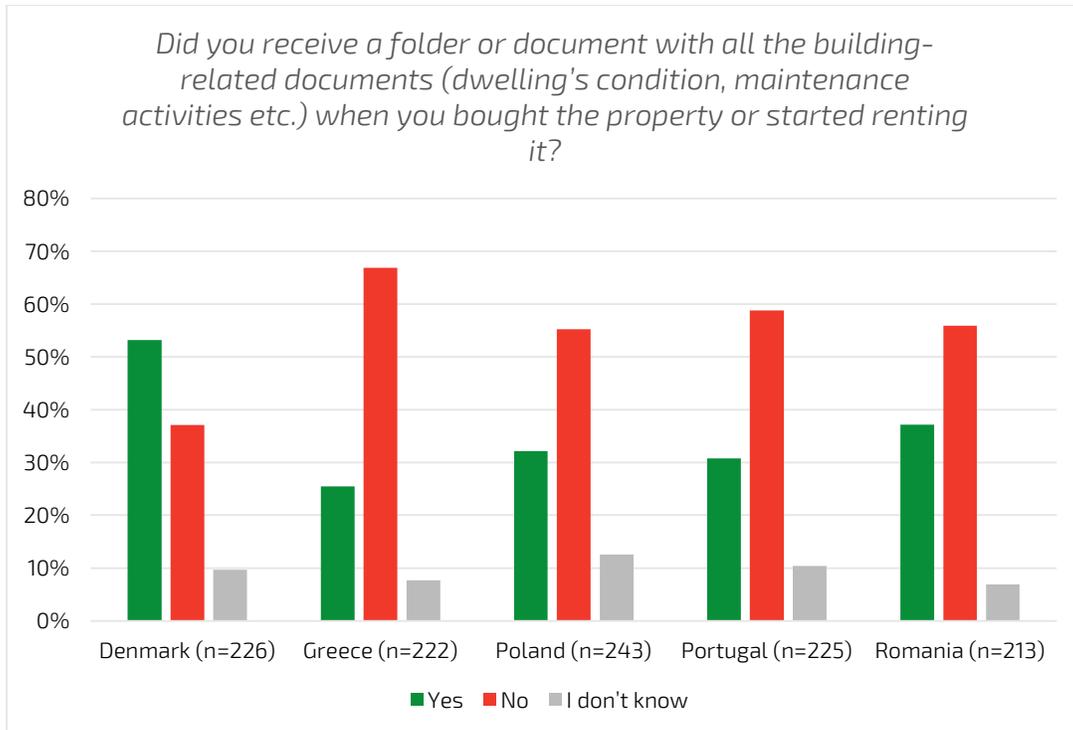


Figure 42: Country comparison of end-users who received a building logbook when buying or renting a property

Interestingly, the wider availability of building files is not directly correlated with the perception of usefulness and value in keeping the data up to date (Figure 43). Quite the contrary: in Denmark, which is frontrunner country for the availability of building files, a larger percentage of owners and tenants think these tools are not useful and are not keeping them up to date. This could be because this information is already well documented under other schemes³⁴ by Danish end-users and they do not see any additional need for a building logbook.

³⁴ <http://bpie.eu/wp-content/uploads/2018/03/iBRoad-The-Concept-of-the-Individual-Building-Renovation-Roadmap.pdf> (accessed 4 September 2020)



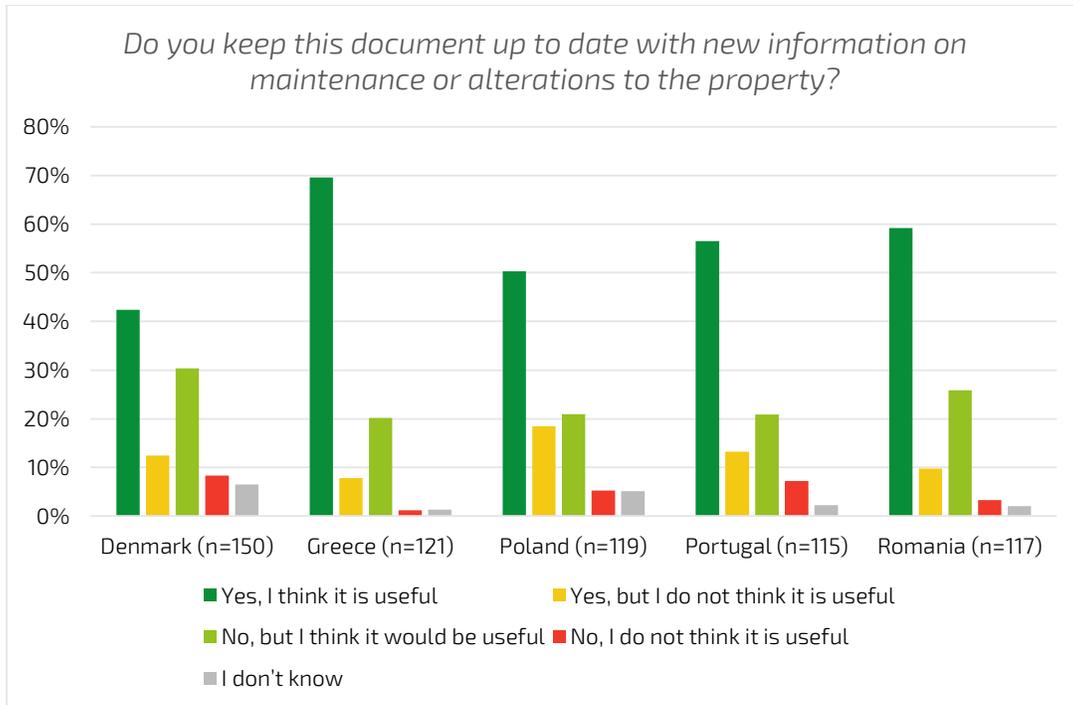


Figure 43: Usefulness of a building logbook with up-to-date information by country

By contrast, in Greece, where building files are the least established,³⁵ more respondents think that this is a useful tool and, should they have one, they would keep it up to date (Figure 44). To confirm this insight, 50% of respondents from Greece indicated that they are putting together themselves a folder with all their building-related documents, such as maintenance activities and alterations. In comparison, only 15% of Danish respondents are taking care of the organisation of their building-related documents.

³⁵ <https://ibroad-project.eu/> (accessed 4 September 2020)



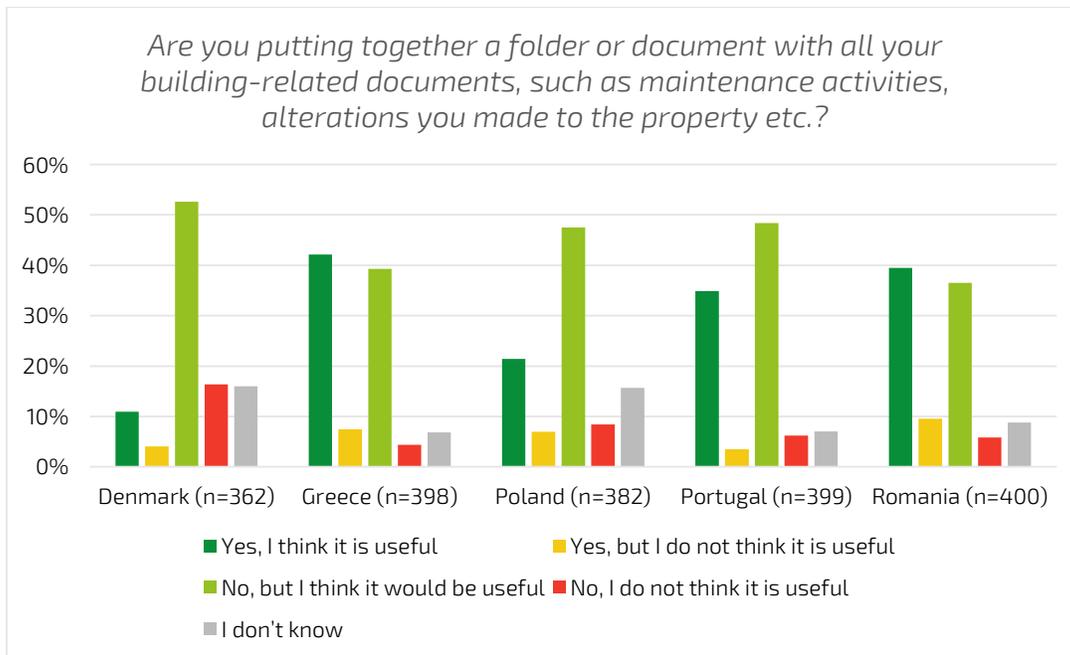


Figure 44: Usefulness of recording documentation on maintenance and alterations by country

The availability of building files is strongly linked to the existence of an EPC and recent renovation activities. This is a relevant message for X-tendo given that the logbook is going to be designed mainly on the basis of the data available in EPCs.

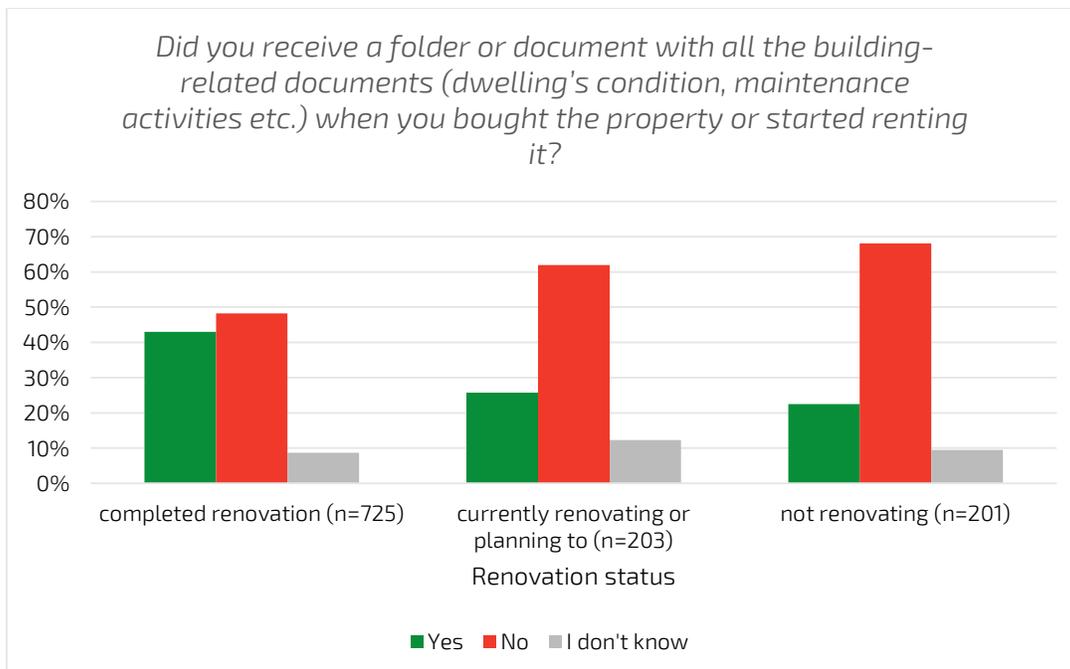


Figure 45: Share of end-users who received a building logbook and their renovation status



The ranking of the most relevant data fields in the logbook is relatively consistent across countries, demography and tenure states, which indicates a high replicability potential for a harmonised organisation and categorisation of building data.

Conclusions

The large majority of respondents believe that the availability and accessibility of building-related information is useful, regardless whether they have access already to a logbook (or similar building files). Although differences are observed between countries in terms of availability of building files, the responses are consistent across location, age, gender, tenure and financial situation.

The availability of a logbook is perceived as a crucial factor affecting the decision whether to buy or rent the property.

3.8 Tailored recommendations

The methodology developed in the X-tendo project for this feature³⁶ will deliver tailored recommendations based on EPC data to enhance the end-user's awareness about renovation options and targets. The survey results should provide insights about general end-user interest in tailored recommendations and, more specifically, what kind of recommendations they are most interested in receiving.

Demographics

Looking at the responses by age group (Figure 46), older age groups aged over 35 see tailored recommendations as more useful than younger respondents aged 18-24. This could be because the former are more likely to own their own properties and therefore to be interested in conducting renovations.

³⁶ <https://www.epbd-ca.eu/wp-content/uploads/2011/05/CA-EPBD-EPC-recommendations.pdf> (accessed 7 September 2020)

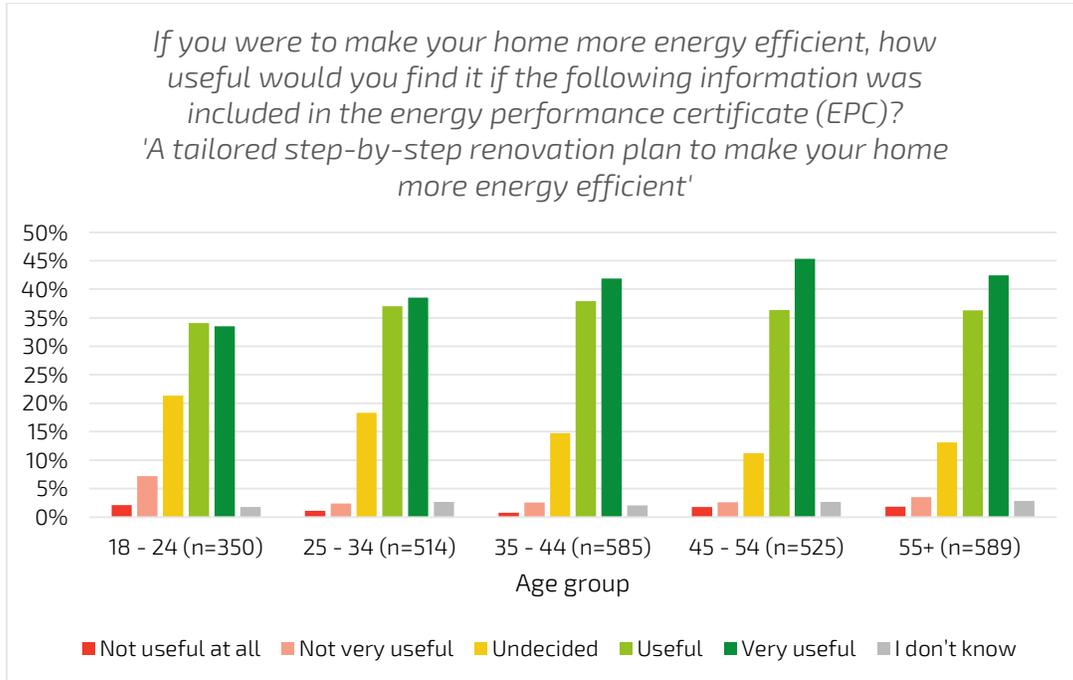


Figure 46: Usefulness of tailored recommendations by age group

End-users who are conscious³⁷ about their energy use and who consider energy efficiency important when buying or renting property are more interested in tailored recommendations (Figure 47).

³⁷ This was determined by asking to what extent respondents agreed with the following statements: I have tried to reduce the amount of energy I use at home; I think there is more I could do to reduce the amount of energy I use at home; My household's energy use can be reduced by renovating; and I am more concerned about having a warm and comfortable home than saving energy



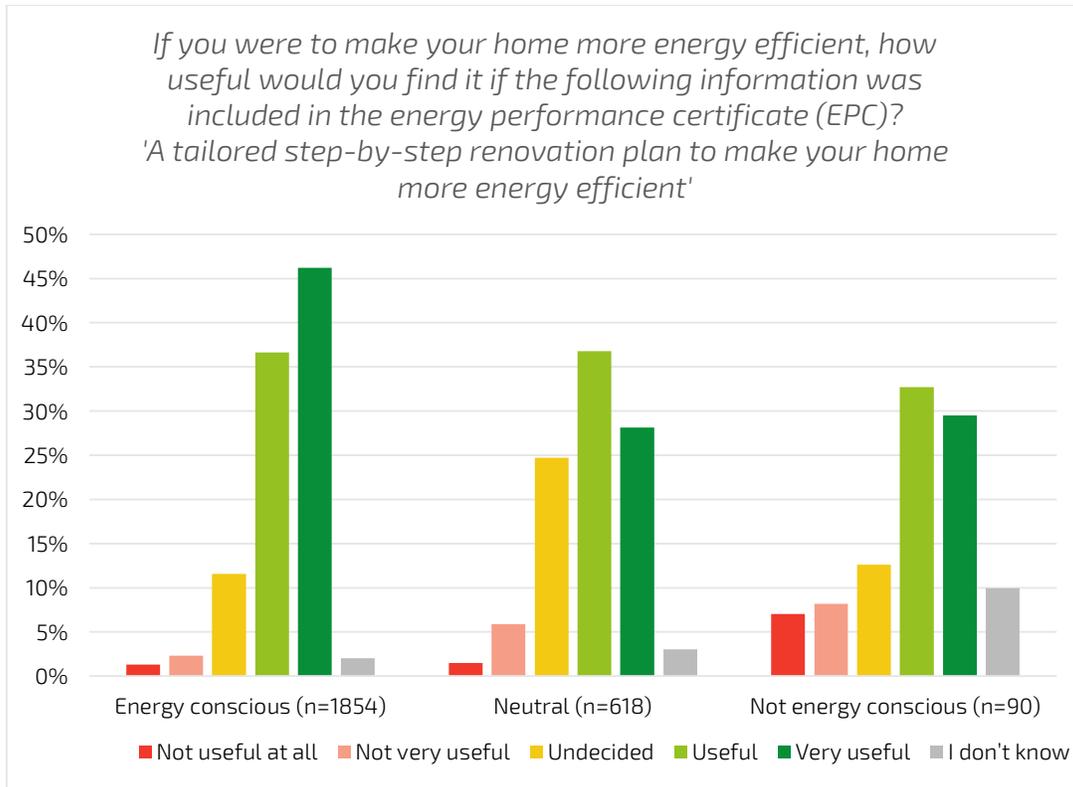


Figure 47: Interest in tailored renovation plan by energy consciousness of end-users

Location, tenure and building types

Figure 48 shows that most people find tailored recommendations very useful or useful, with no major differences according to whether they live in urban, suburban or rural areas. Tenants expressed a higher interest than owners in tailored recommendations (Figure 49) despite in most cases not being able to carry out renovations. They might be interested in this information for awareness purposes. End-users living in a flat/apartment were more interested than those in other building types in receiving tailored recommendations (Figure 50).



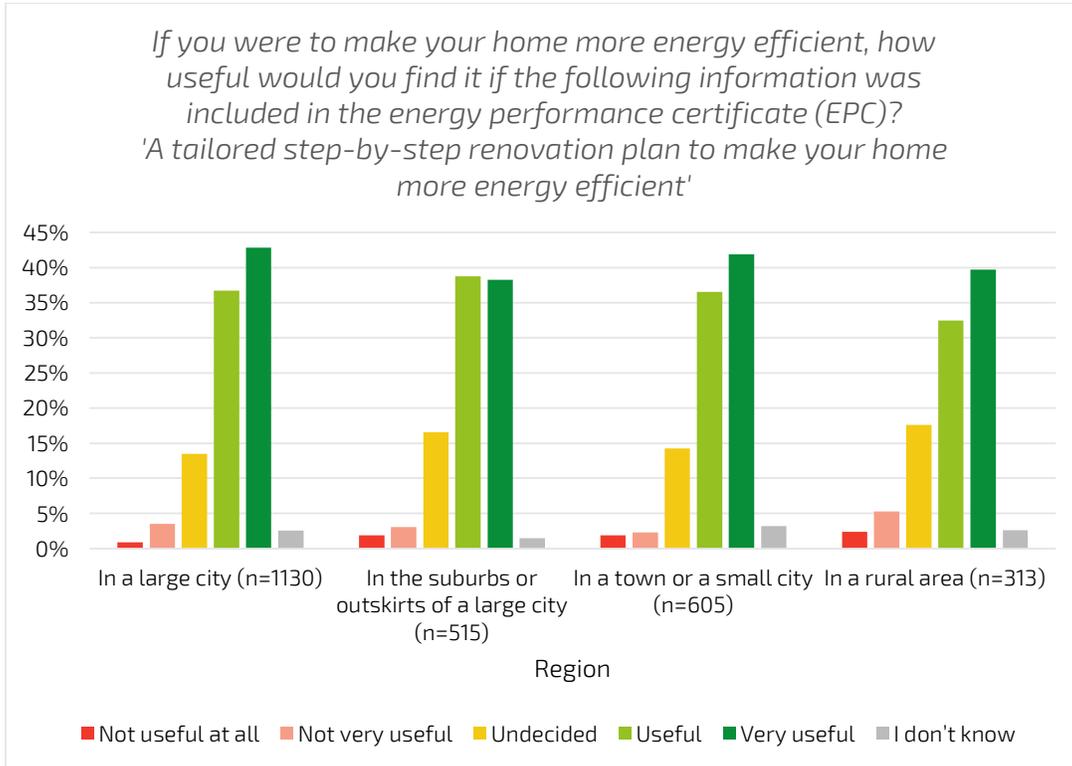


Figure 48: Interest in tailored recommendations by location

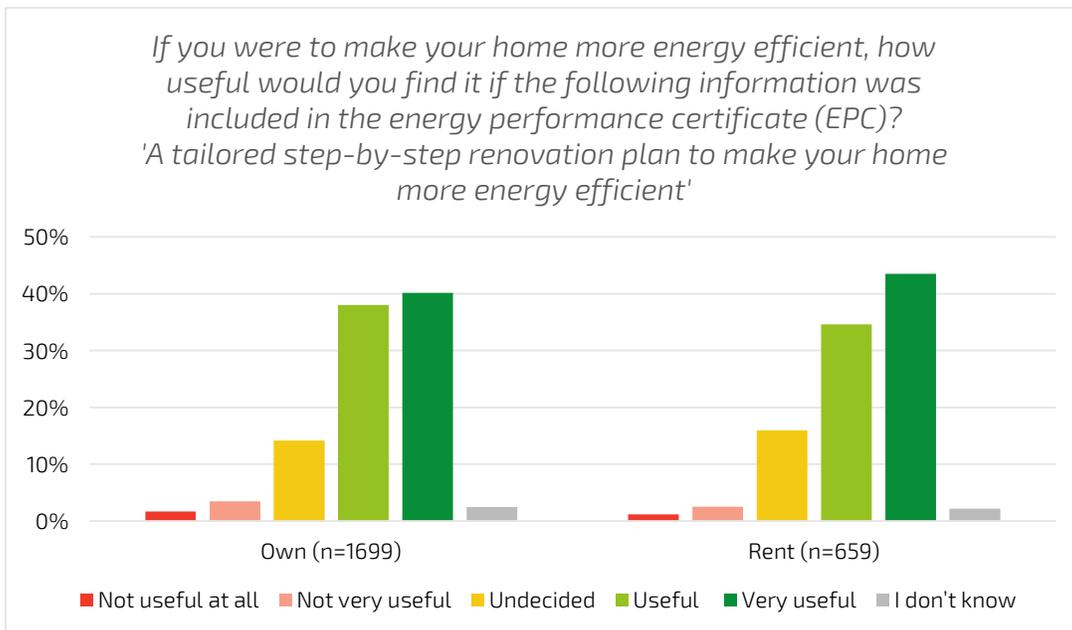


Figure 49: Interest in tailored recommendations by tenure status



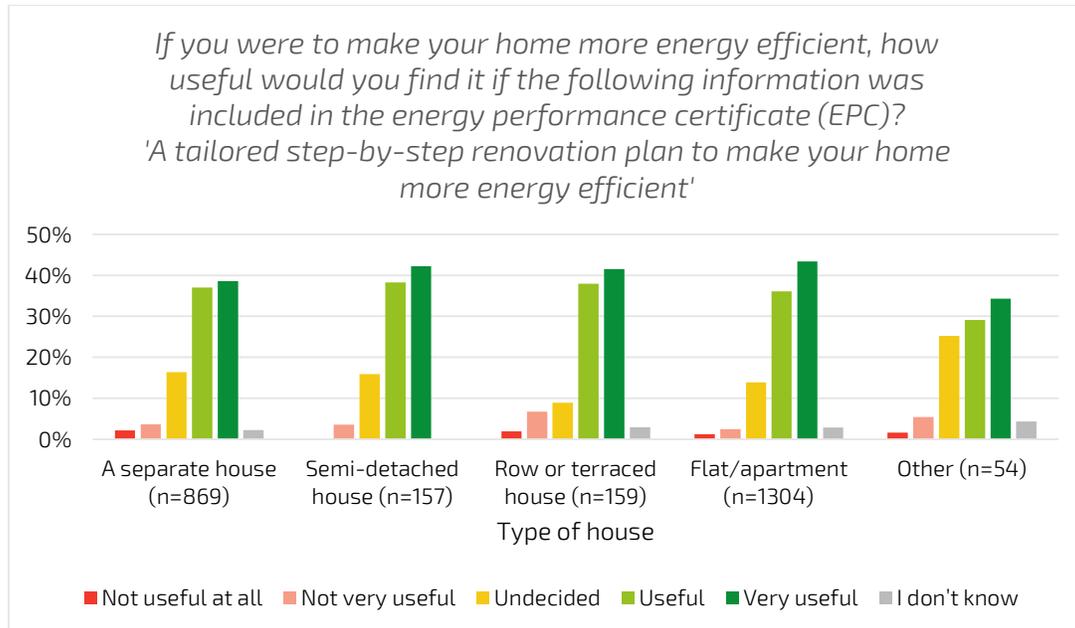


Figure 50: Interest in tailored recommendations by building type

Countries

Respondents were shown a list of different type of recommendations, covering aspects such as timing and sequence of the renovation measures, technical specifications, costs, comfort and expected impact on energy and CO₂ indicators. They were then asked which types of recommendations they were most interested in:

1. Technical information for each renovation measure
2. Estimated cost for each renovation measure
3. Payback time of renovation
4. Expected impact of renovation on energy performance
5. Expected impact of renovation on energy costs
6. Expected benefit of the renovation on CO₂ emissions
7. Expected benefit of the renovation on indoor comfort
8. Time required to complete each renovation measure
9. How to prioritise the renovation measures
10. Recommended order to implement the renovation measures
11. Information on maintenance requirements for the renovation
12. Maintenance and operation costs linked to the renovation
13. None of these options

When looking at which recommendations are of interest in different countries (Figure 51), it can be seen that cost (estimated renovation costs, impacts on energy costs, maintenance costs) is a priority in all countries. After that, the expected benefits on indoor comfort is also of interest in all countries, as was observed earlier in the comfort feature.

In all countries, the impact of the renovation on the energy performance is not as important as the impact on the cost of energy. This provides an insight into how to target the tailored recommendations to end-users.

	Denmark (n=512)	Greece (n=519)	Poland (n=501)	Portugal (n=514)	Romania (n=517)
Technical information for each renovation measure	31%	38%	29%	34%	39%
Estimated cost for each renovation measure	58%	64%	63%	63%	71%
Payback time of the renovation	36%	47%	45%	48%	42%
Expected impact of renovation on energy performance	40%	42%	40%	49%	47%
Expected impact of renovation on energy costs	53%	49%	52%	52%	45%
Expected benefit of renovation on CO ₂ emissions	36%	32%	35%	34%	27%
Expected benefit of renovation on indoor comfort	41%	45%	40%	55%	48%
Time required to complete each renovation measure	32%	45%	36%	34%	51%
How to prioritise the renovation measures	37%	25%	21%	25%	31%
Recommended order to implement the renovation measures	29%	30%	32%	18%	33%
Information on maintenance requirements for the renovation	35%	43%	28%	30%	29%
Maintenance and operation costs linked to the renovation	49%	65%	57%	61%	65%
None of the above	9%	3%	5%	3%	2%

Figure 51: Useful information for end-users in tailored recommendations by country (multiple answers possible)

Conclusions

The results show that EPC end-users are mostly interested in cost-related information. Currently, in many Member States recommendations focus more on technical aspects,³⁸ potentially because of a lack of access to data on materials costs. The X-tendo methodology will try to bridge this gap by developing a modular calculation procedure of tailored recommendations, which will enable technical and/or economic recommendations to be provided, based on EPC data and links with external databases (such as material costs databases).

3.9 Financing options

The EPBD (Energy Performance Building Directive) and EED (Energy Efficiency Directive) require countries to identify financing instruments to support energy renovations and provide guidance to link these instruments to support tools and evaluation criteria like EPCs. EPCs and related data thus play a direct role in meeting the objectives of these two directives. Providing information on financial support alongside EPC recommendations can

³⁸ www.epbd-ca.eu/wp-content/uploads/2011/05/CA-EPBD-EPC-recommendations.pdf (accessed 7 September 2020)



help persuade building owners to undertake renovations and grow the market for a better-performing building stock. It will also facilitate the interaction between building owners/users and the construction and financing sectors.

The X-tendo project will identify what information on public and private financial schemes can be provided alongside the EPC and how it could be integrated. It will describe approaches and mechanisms on how to source and link data on available financing options with the EPC as well as how to communicate this in the best way to building owners/users.

The survey questions looked at what data end-users would be most interested in seeing in the EPC.

Demographics

In general, older respondents 45-54 and 55+ are more interested in information on renovation measures (see also previous section), but when looking at information on energy and cost savings, the 45-54 age group shows the greatest interest (Figure 52). The youngest age group shows the least interest in all aspects.

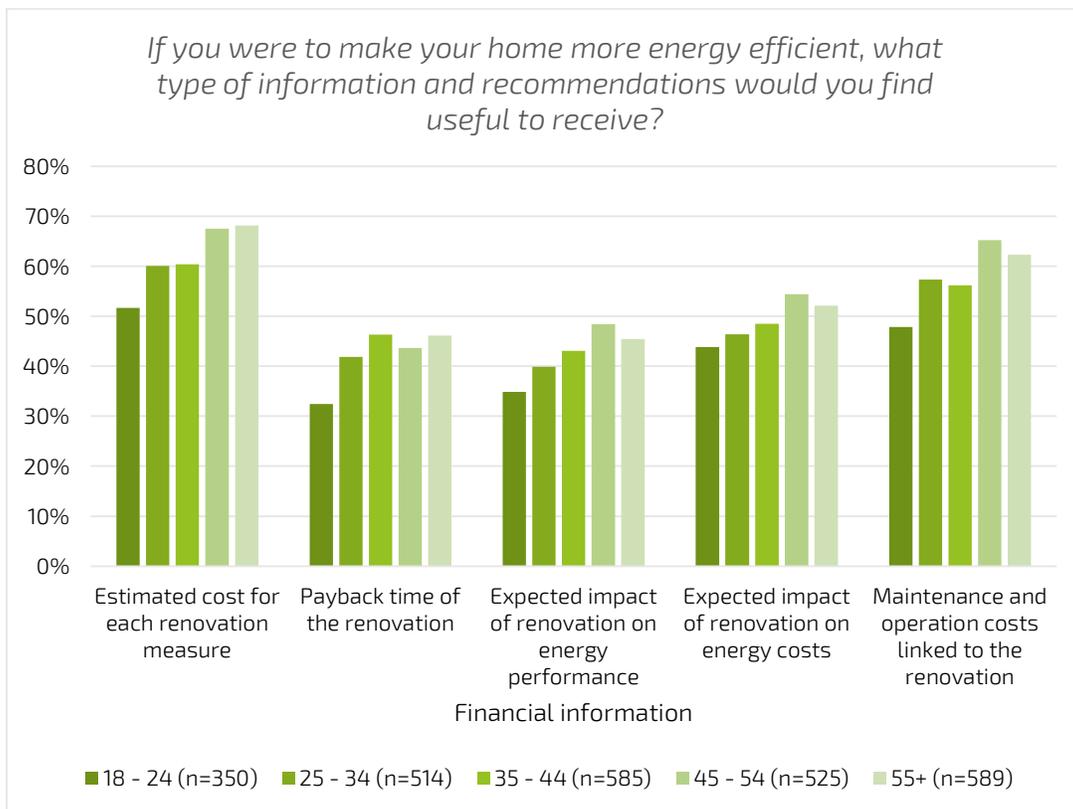


Figure 52: Most useful financial information to make home energy efficient by age group

Groups in all financial situations thought that real-time information on available financing options would be useful (Figure 53), though those who described their financial situation as 'not easy at all' were significantly more like to say this was 'very relevant'. People whose situation 'impossible' showed relatively less interest or didn't want to answer the question



– which is understandable, as they most probably lack the funds to pay for efficiency measures.

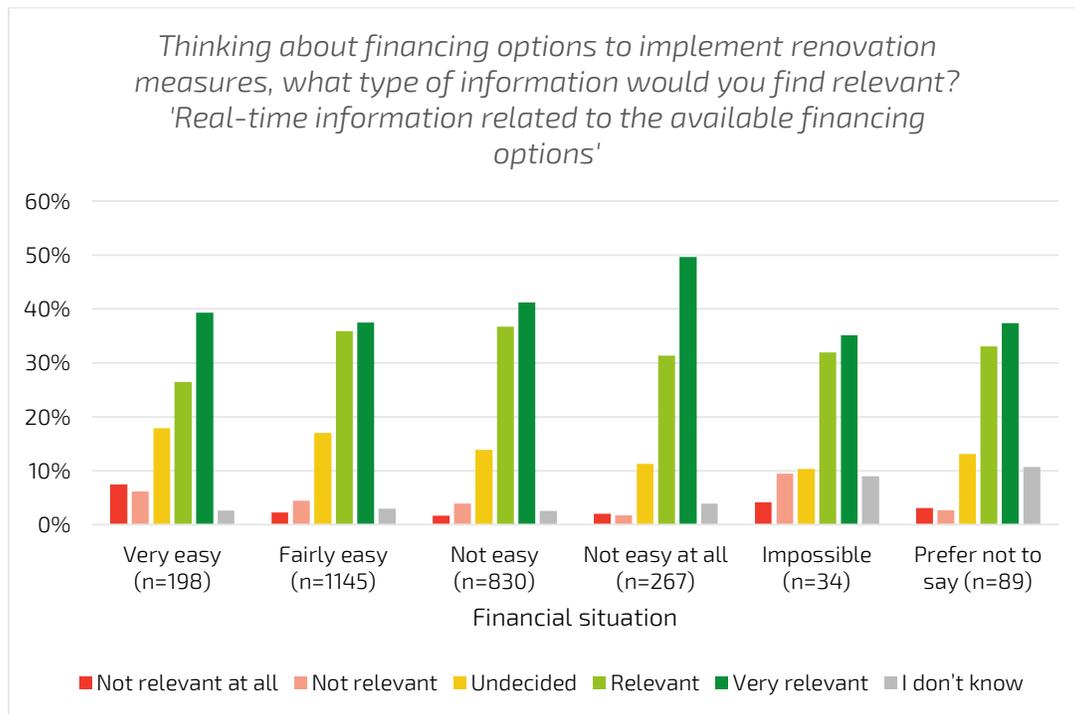


Figure 53: Relevance of real-time information on financing options based on financial situation of end-users

Countries

Maintenance and operation costs linked to renovation were seen as the most important type of information and impact on energy costs as the next most important in all countries except Denmark, where these priorities were reversed (Figure 54). Greece and Romania showed the highest interest in maintenance and operation costs, with almost two-thirds of respondents saying they find this information useful. Portugal and Greece show the most interest in receiving information on the estimated cost of renovations (48% and 47% of respondents respectively), with Denmark showing the least (36%). Portugal showed the highest interest (>48%) in receiving information on the payback time for renovation.



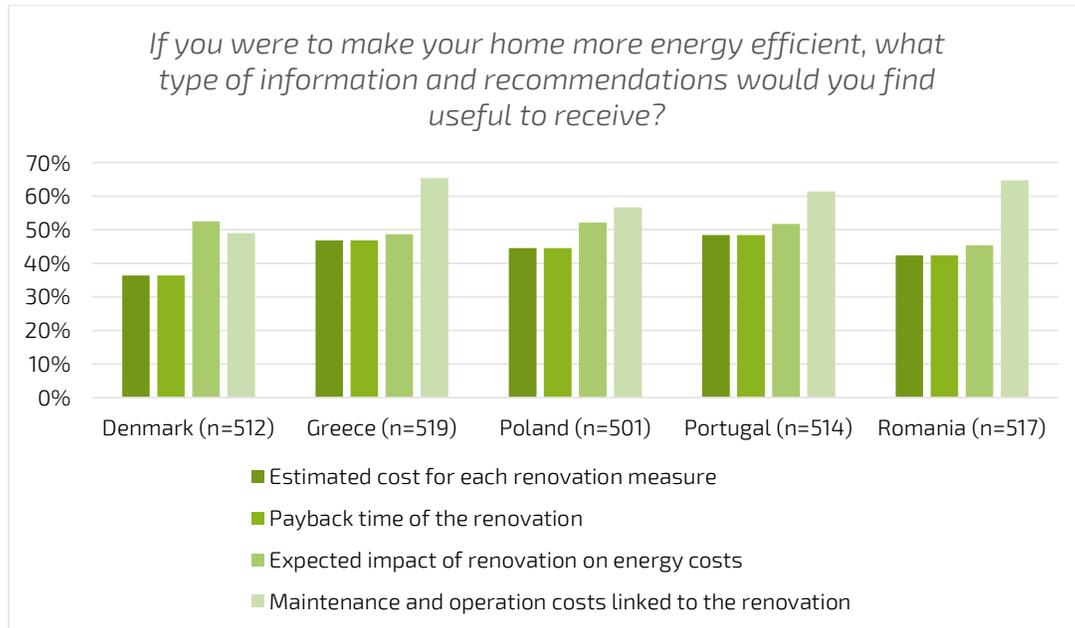


Figure 54: Most useful information on financing options by countries

Greece and Portugal represent the countries with the highest interest in all questions regarding financing options. End-users in Denmark showed the most interest in the expected impact of renovation on energy costs out of the five countries (>52%) but showed least interest overall. This may be because the cost of renovation measures is already available in Danish EPCs, but it can't be the full explanation as this is also the case for Greece.

As most respondents consider information on financing options relevant or very relevant, there is high potential for replicability in other Member States with the available options as a baseline to present financing options to building owners/tenants.

Conclusions

Financing options are a key support measure or driver needed to proceed with and increase the number of renovations. End-users across all countries show interest in financing options and only slight differences can be seen between age groups and financial situation.

Those aged 35+ are most interested in renovations, but also have lower financial capacity. The methodology to boost the financing options linked with EPCs should therefore focus on these groups.

3.10 One-stop-shops

The concept of One-stop-shops (OSS) was introduced by the amended EPBD and the establishment of long-term renovation strategies. The aim was to overcome market fragmentation on both the demand and supply side by offering holistic, whole-value-chain



renovation solutions. OSS³⁹ are considered as transparent and accessible advisory tools from the client perspective and new, innovative business models from the supplier perspective. Data from EPCs provides valuable building information that should be linked to OSS (among other data sources).

The X-tendo project will describe approaches on how to link EPC data to OSS and the applicability of these approaches for the different implementing countries, considering their corresponding existing EPC data, activities and needs.

The end-user questionnaires were based on the following questions:

- Will end-users use an OSS web portal when planning a building renovation?
- Which types of OSS services would end-users like to receive?

Demographics

Figure 55 shows that information on OSS is seen as relevant by all age groups. For all age categories, the main interest is in 'estimation of future (energy) cost savings from renovation measures. Ages 18-24 and 55+ categories show less interest in the various options. Those aged 45-54 show the highest interest in EPC information and online quotations, while those aged 35-44 are most keen on receiving basic information of previous work and EPC after the implementation of renovation plans.

³⁹ <https://e3p.irc.ec.europa.eu/publications/one-stop-shops-energy-renovations-buildings> (accessed 6 September 2020)

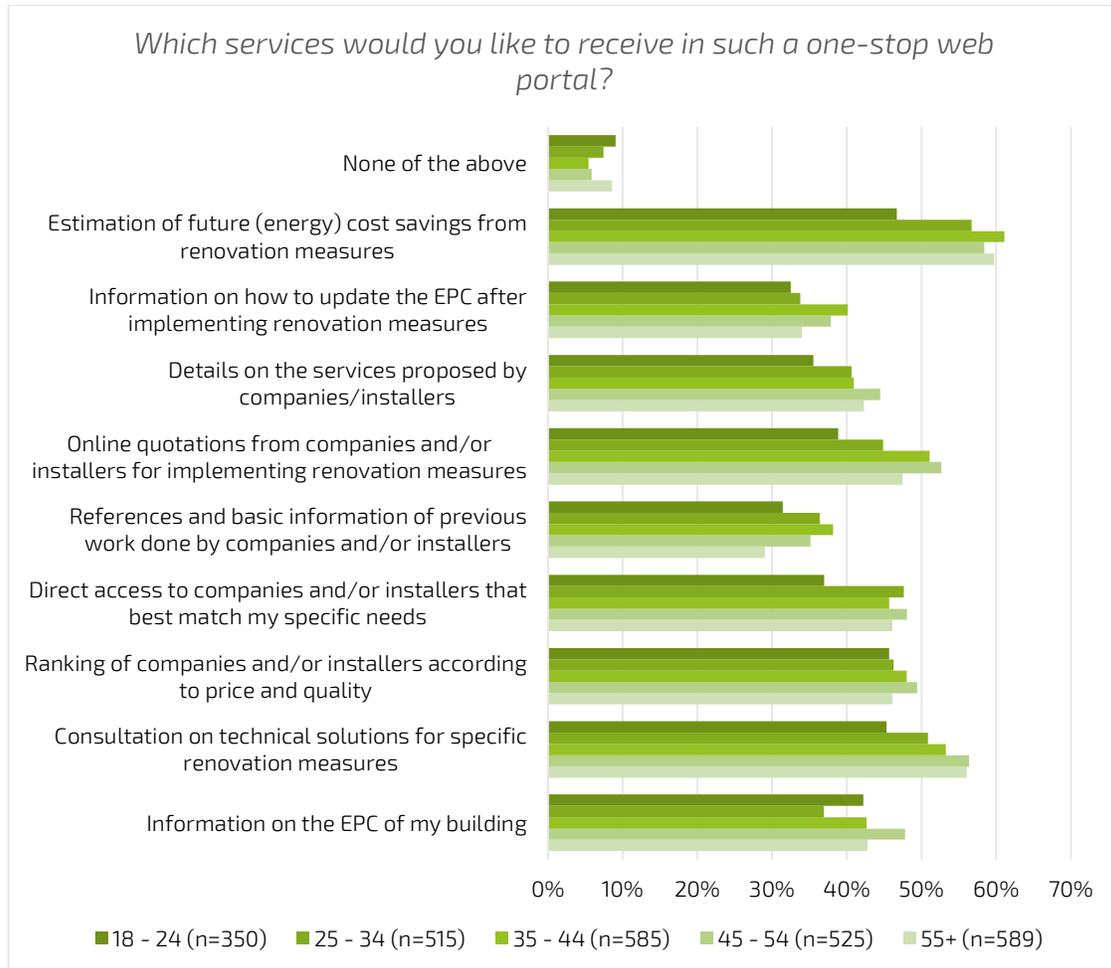


Figure 55: Interest in OSS and different information on web portal by age groups

As Figure 56 shows, people whose financial situation is 'very/fairly easy' are willing to pay a small fee to use a OSS, but those in less favourable financial situations, not surprisingly, would prefer an OSS to be free.

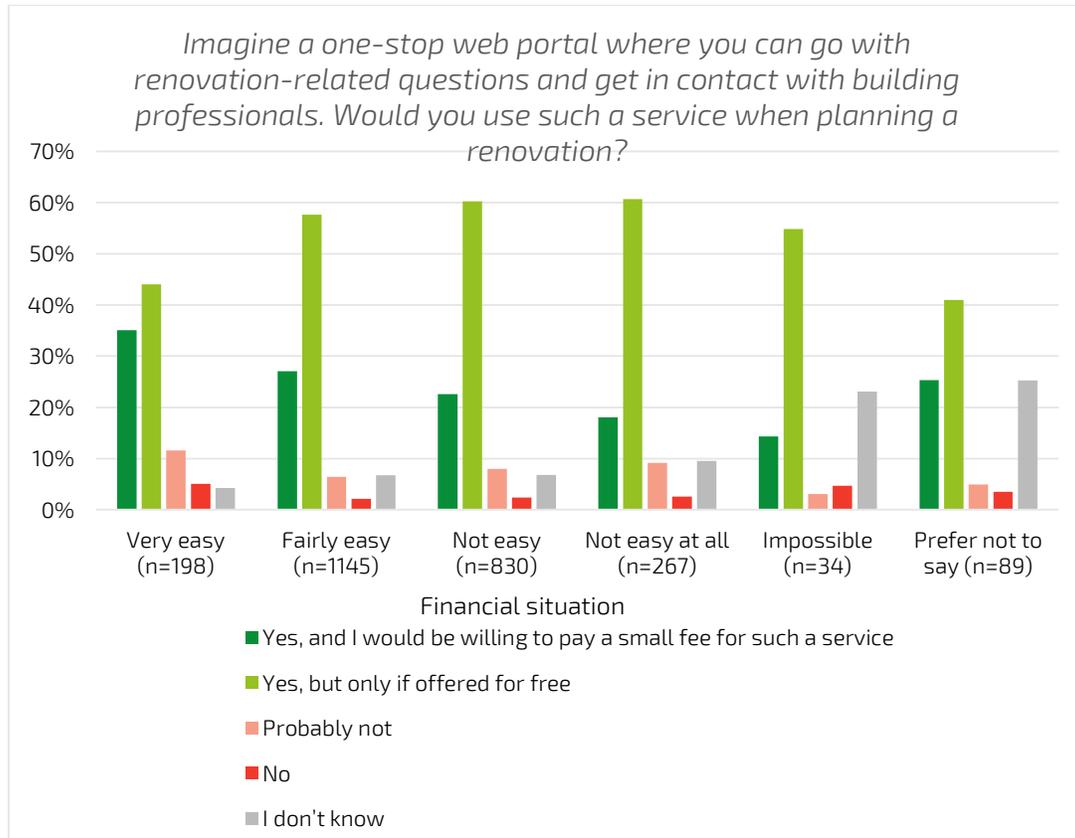


Figure 56: Willingness to pay for OSS based on financial situation

Tenure status

Regarding tenure status and willingness to pay for OSS services, Figure 57 shows that a higher percentage of people who own their home would be willing to pay a small fee for an OSS service. People who rent would prefer to use the OSS service without paying. These results may be related to their financial situation, as people who own their home are more likely to have a better financial situation and are more likely to invest into their home because it increases the value of their property. At the same time, both categories are interested in using OSS services.



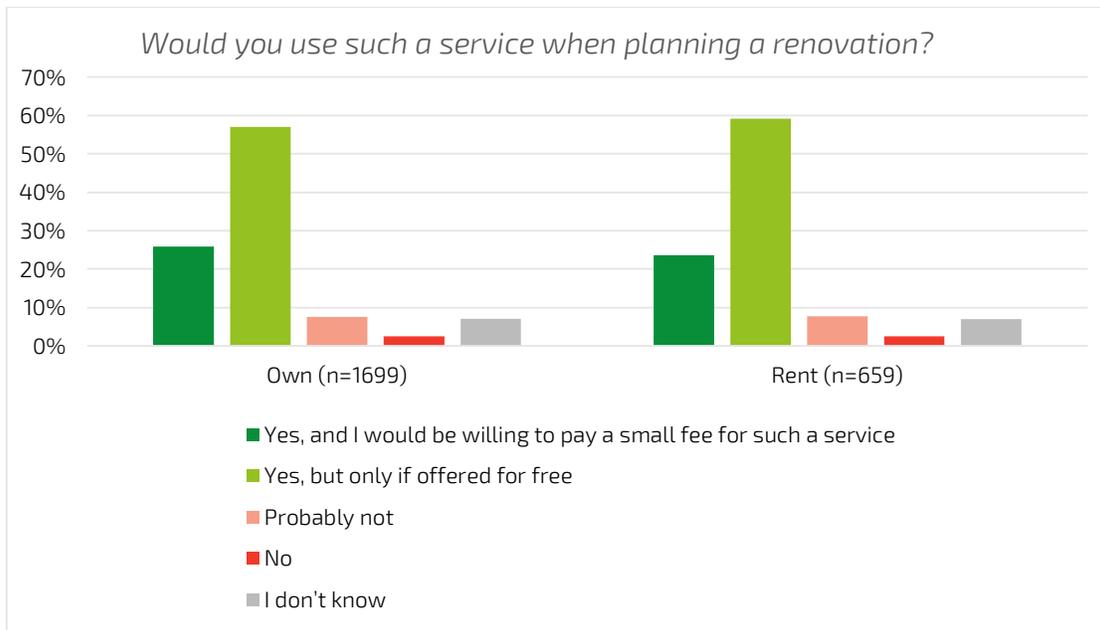


Figure 57: Correlation between owning a home and willingness to pay for OSS

Looking more closely in Figure 58 at the services people would like to see in the OSS, homeowners are more interested in technical solutions, direct access to companies and estimation of cost savings than in other options and when compared to tenants.

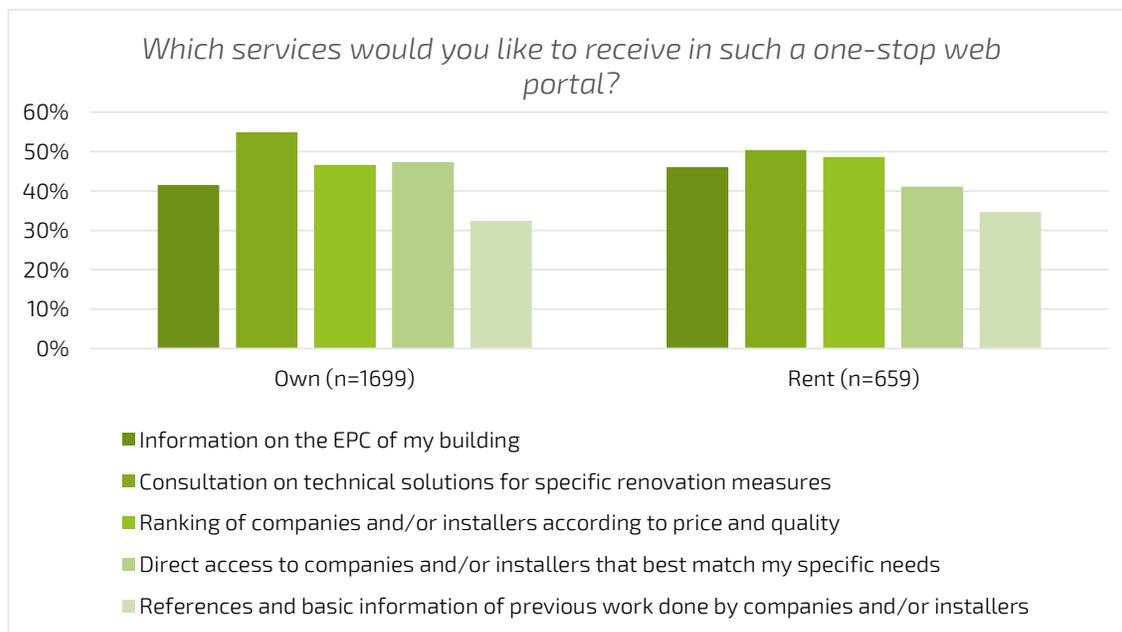


Figure 58: Interest in OSS online services by owners and renters

Countries

As seen in Figure 59: Willingness to share information on energy consumption by country across the five countries, respondents are happy to provide their data to third parties, except



to financial institutions (64% answered 'no'). This is relevant for OSS data requirements and interoperability with other platforms and databases. Greece, Poland and Portugal had higher scores for sharing information with energy advisors and contractors, Romania with utilities.

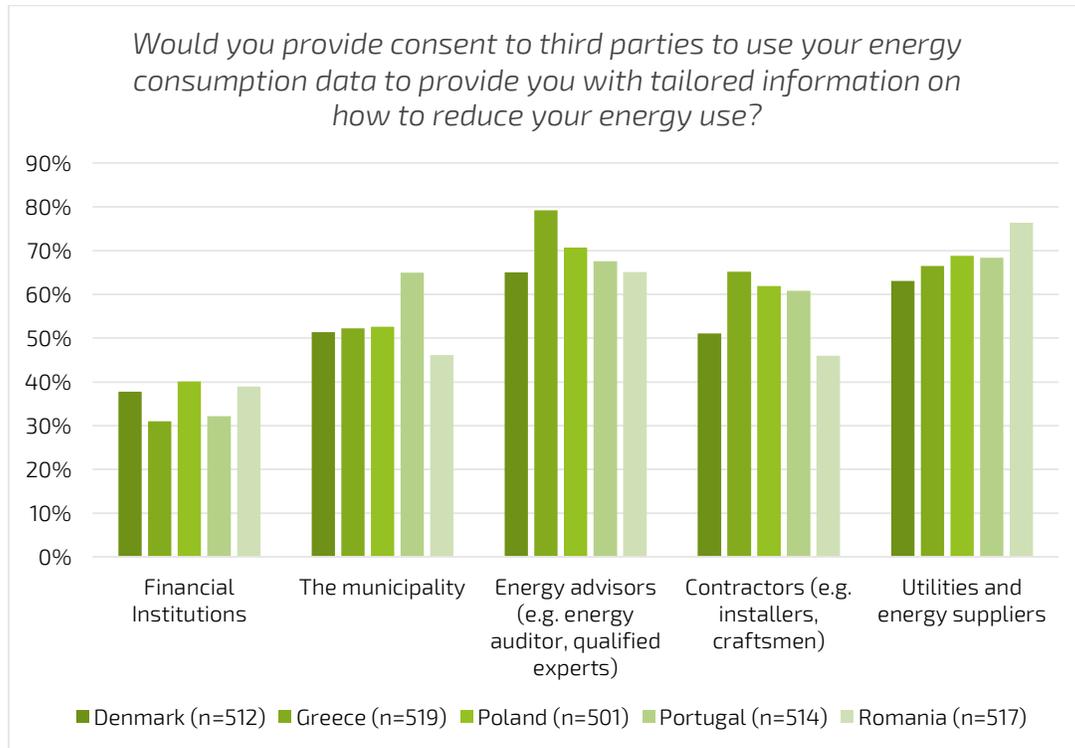


Figure 59: Willingness to share information on energy consumption by country

In Figure 60, across all countries, 57% of respondents would use an OSS but only if offered for free, while 24% would pay a small fee for the service; 2% are not interested in using it. Poland and Portugal are the countries with lower willingness to pay a small fee for OSS. Respondents in Greece, Poland and Portugal have the greatest interest in using OSS if they are free.



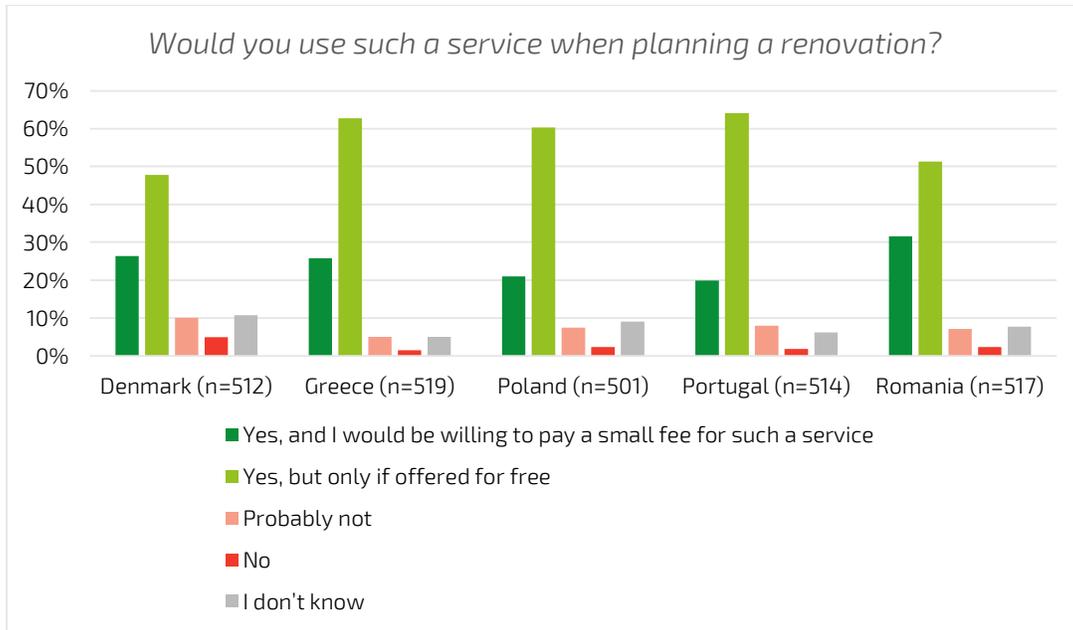


Figure 60: Interest in OSS services by country

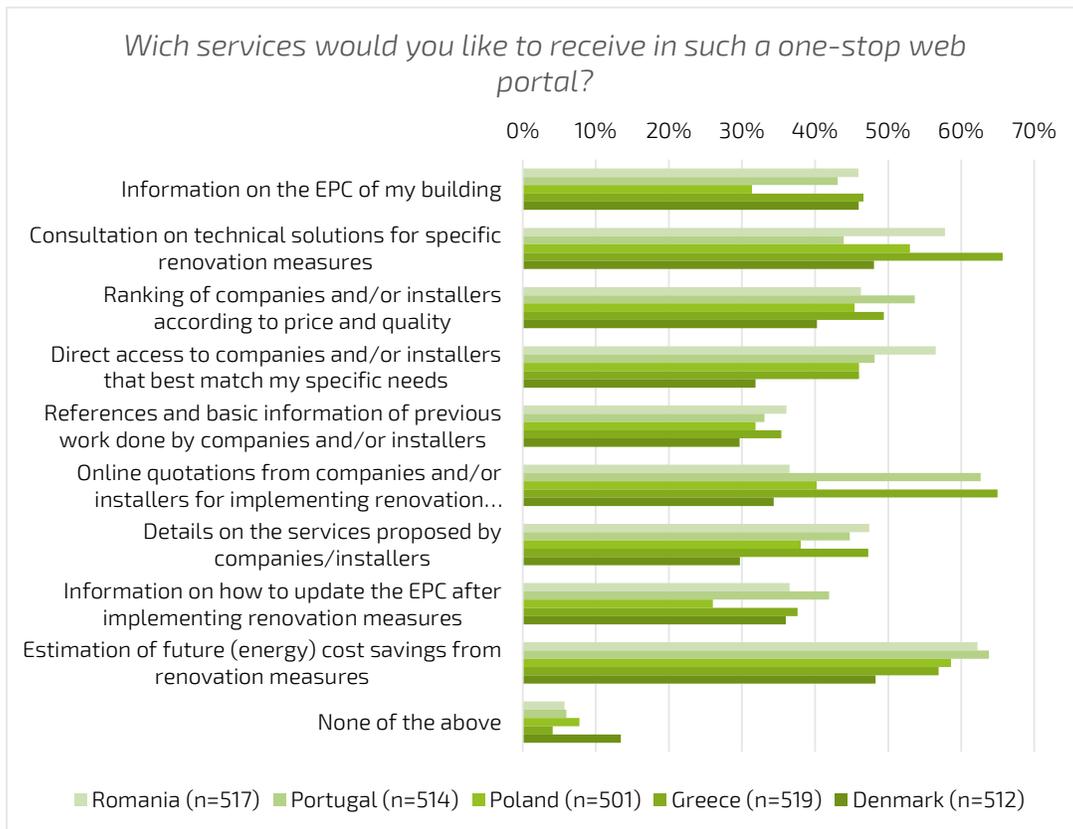


Figure 61: Preferred services by end users in OSS services by country

In Figure 61, Denmark has the most 'no' or 'I don't know' answers, and end-users showed the least interest in OSS and the services they provide. In Portugal, key concerns were ranking





companies, online quotations, information on how to update EPCs and the estimation of cost savings. Greece reveals particular interest in technical solutions and online quotations. Poland had the least interest in EPC aspects (actual and EPC after implementation). Respondents in Romania are most keen to receive services related to technical solutions, direct access to companies and cost savings.

Services like consultation on technical solutions, ranking of companies, online quotations and estimation of future cost savings are the options seen as most relevant in the analysed countries. Transferability of this feature to other Member States can be considered high.

Conclusions

OSS have a direct link with EPC databases, building logbooks and financing schemes, so these kinds of features should be considered and incorporated in the OSS feature. Overall, consent to provide EPC data to third parties is relevant to set up OSS in Member States, which may present some barriers to overcome. All nine potential OSS services were well received by respondents. With 82% of respondents expressing an interest in using OSS services, there is huge potential and acceptance for implementing this concept/service in the Member States. The methodology development should take account of the business model, related to the utilisation fee. All the 9 potential services to be include in the OSS were well received by the interviewees. This could translate into integrating all of them into the OSS services with adjustments regarding methodology for each country through the implementing partners in the project.



4 OVERVIEW OF KEY FINDINGS FOR FEATURES BY END-USER CATEGORIES

The survey delivered a rich set of information and many different results for each feature. These were grouped in five categories (see Table 5: Cross-cutting analysis of features): (i) demographics (age, education, employment, family status), (ii) tenure status/building type (single family home, multi-family home, tenant, owner), (iii) location, (iv) EPC and renovation status, and (v) financial situation/energy consciousness. The last two were grouped together as there were strong links identified between them.

Due to the nature of the survey and the different focus of each feature, not all categories could provide key findings for each feature. As discussed above, EPC databases are not developed specifically for end-users. That is why this feature has the least findings regarding end-user categories.

Within the different categories the following key findings were derived:

- ⦿ Between the age groups, younger people were more interested in smart technologies and good indoor air quality (especially families with children), while older age groups were more interested in comfort, real energy consumption, building documentation and renovation information in general.
- ⦿ The differences between owners' and tenants' responses were not that large. Both find indoor air quality quite important; they are interested in building logbooks and tailored recommendations (here especially people renting multi-family buildings) and in one-stop-shops. This shows that while tenants do not always pay the cost for renovation, it might be useful to include them in the planning, thereby partially overcoming the split-incentive dilemma.
- ⦿ The area people live in seemed to make little difference to their perception of the various features. For example, it was interesting to see that people in rural areas are more interested in knowing about outdoor air pollution, even though the air quality in urban areas is normally a larger problem. People in high density areas being more interested in district heating is easier to understand as this is more likely to be available in urban areas.
- ⦿ Homeowners who have an EPC and those who have completed a renovation project tend to be more interested in features such as smart readiness, comfort and building logbooks.
- ⦿ When looking at the financial situation, it is clear that those who are struggling financially are more interested in features that help them save money (such as energy consumption of appliances); this is true for both owners and tenants.

Table 5 below presents a summary of the main key findings, as a cross-cutting analysis between the five considered categories and the ten X-tendo features.

Table 5: Cross-cutting analysis of features

	Demographics (age, education, employment, family status)	Tenure/ building type	Location	EPC status/ renovation status	Financial situation/ energy consciousness
Smart readiness	<p>Younger people are more familiar with smart technology</p> <p>Couples with children perceive highly that comfort is driven by smart technologies</p>			<p>People who have EPCs agree that smart homes increase comfort and save energy</p> <p>People planning to renovate see smart technology as important for comfort</p>	
Comfort	<p>Older age groups are more susceptible to uncomfortable indoor conditions</p> <p>All family types showed great interest in comfort-related information in EPCs</p>	Both owners and tenants agree that comfort is more important than saving energy		People who have completed renovations are most interested in comfort information in EPCs	
Outdoor air pollution	People living with children have high interest in information about outdoor air pollution in EPCs		People in rural areas are more interested in outdoor air pollution information	Most respondents who have either renovated or not, showed little interest in outdoor air pollution information in EPCs	People with difficult financial situation showed lower interest in impact of outdoor air on IAQ
Real energy consumption	<p>Older age groups indicated that real-time energy use information would be very helpful.</p> <p>A majority of respondents showed interest in energy performance of nearby buildings</p>	Information from previous owners and tenants was considered useful by owners and tenants			Respondents with very difficult financial situation ranked information on real energy consumption of appliances very helpful





	Demographics (age, education, employment, family status)	Tenure/ building type	Location	EPC status/ renovation status	Financial situation/ energy consciousness
District energy	Younger respondents showed a higher interest in district energy related information		People in high density regions are most interested in parameters of district energy		Respondents who are in difficult financial situations are less interested in district energy information
EPC databases		When buying or renting people showed interest in energy performance of nearby properties			
Building logbook	Older generations are more interested in having building documentation in place	Owners and tenants of detached houses are more interested in building logbooks		Respondents with no EPCs are more interested in a building logbook People who have completed a renovation are most interested in a building logbook	
Tailored recommendations	Older age groups showed higher interest in tailored recommendations	Both owners and tenants considered tailored recommendations very helpful People living in flats/apartments showed higher interest in tailored recommendations compared to others	Respondents in all locations showed high interest in tailored recommendations		Tailored recommendations are more appreciated by energy-conscious end-users
Financing options	A high interest is seen in expected costs of renovation by end-users of all age groups				People with difficult financial situations consider information on financing options very relevant





	Demographics (age, education, employment, family status)	Tenure/ building type	Location	EPC status/ renovation status	Financial situation/ energy consciousness
One-stop-shops	Estimation of future energy cost savings was the most interesting OSS service to all age groups	People who own and rent a property prefer to use OSS services if they are free			People with difficult financial situations showed reluctance to pay for OSS services



5 CONCLUSIONS

The analysis in the previous section highlighted that there are variations in responses based on age, employment, tenure, financial situation and others, and that interest in specific features varies between end-user categories. There are some significant differences between age groups, rural and urban areas, financial status and tenure and across all the countries. End-users presented a clear view on most of the issues related to energy use in their buildings and their relationship to the 10 features but were also vague in their responses in some instances. A summary of end-user interest in all features is presented in Table 6. To understand the overall expectations of a specific feature in countries surveyed, the following conclusions outline the features people are most interested in:

- ⊙ Most end-users are familiar with smart-technology and believe that it can improve comfort and save energy in their homes, especially the younger age groups from all the countries. While all the countries demonstrate strong positive interest in this feature, there are concerns around the privacy and security of the shared data.
- ⊙ End-users displayed a greater understanding towards comfort indicators. The comfort aspects, especially indoor air quality and thermal comfort, are most interesting to all five countries and respondents were keen to receive this information in EPCs.
- ⊙ A lack of understanding and moderate interest was shown towards the outdoor air pollution feature by end-users in all countries except Poland, where air pollution is a growing problem. This feature may not hold high priority for other countries that do not have severe air pollution problems.
- ⊙ Though the availability of district energy is not uniform across all the countries, the end-users expressed moderate interest in this feature. End-users from Romania, where the share of district heating is still low compared to countries like Denmark or Poland, saw this information as crucial. Overall, this feature is deemed suitable for countries where district energy networks have flourished and are accessible to end-users.
- ⊙ Energy consumption feedback interests' users greatly and can inspire them to take action towards savings. The real energy consumption feature, where end-users can compare their properties with similar ones locally and nationally, received high interest from nearly all countries. This feature demonstrates the effectiveness of the information and its role in influencing end-user behaviour.
- ⊙ Though EPC databases are of direct interest to public authorities, end-users can also benefit from receiving more transparent information. Respondents from all countries showed high interest in receiving information on energy performance of nearby buildings.
- ⊙ Building documentation received strong interest from older age groups, owners and tenants, and end-users understood their importance and the need to keep them up to date. Although there were variations between categories, the fact that most end-users from all the countries considered logbooks to be important during buying, renting, letting or selling the property makes this a crucial feature for EPCs.
- ⊙ Regarding tailored recommendations, estimated renovation costs, impacts on energy costs and maintenance costs are a priority in all countries. This feature is highly important to consider as it helps end-users save money.

- ◉ A majority of end-users from all the countries would like to renovate their homes and availability of financing options received great interest. This outlines that financing options may act as a major driver for renovations in all the surveyed countries.
- ◉ A significant percentage of respondents considered provision of online OSS services would be very helpful if provided for free or with a small payment. Services like information on energy costs savings, online quotations for renovation measures and consultation for technical solutions received higher interest from end-users. The results demonstrate an appetite for provision of OSS in all the countries.
- ◉ A very interesting and surprising finding relates to the inclusion of the full coverage of the 'financial situation factor' in the 'demographics' dimension ('very easy' to 'impossible'). Although the reader might raise doubts on the usefulness of targeting the group 'impossible financial situation' as responses would be expected to be negative to all questions addressed, this initial reader's estimate is found to be mistaken as for certain topics of the survey this group responded positively. This fully justifies the surveyors' methodology and choices and could be included in the 'highlights' of the report, as it provides very relevant information on the level of awareness of the society and supports the objectives of the project.

Table 6: Country comparison of end-user interest in features

	Denmark	Greece	Poland	Portugal	Romania
Smart readiness	Lowest interest and familiarity with smart technology compared to rest four countries	Believes highly that smart technology can increase comfort	Believes highly that smart technology can increase comfort	Higher neutral perception towards use of smart technology in homes	Believes highly that smart technology can increase comfort
Comfort	Ranked IAQ highest followed by acoustic comfort	Ranked IAQ highest followed by thermal comfort	Ranked acoustic comfort highest followed by IAQ and thermal comfort equally	Ranked IAQ highest followed by thermal comfort	Ranked IAQ highest followed by thermal comfort
Outdoor air pollution	Low interest compared to other four countries in the information on impact of building on outdoor air pollution	Mostly neutral interest in information on impact of building on outdoor air pollution	Moderate interest in information on impact of building on outdoor air pollution	Moderate interest in information on impact of building on outdoor air pollution	Highest interest in information on building's impact on outdoor air pollution



	Denmark	Greece	Poland	Portugal	Romania
District energy	Below average interest in information regarding district energy	n/a	Moderate interest in district energy information	Moderate interest in district energy information	Highest interest in district energy information compared to other countries
Real energy consumption	Low interest compared to other countries in energy performance score of similar buildings on EPCs	Very high interest in energy performance score of similar buildings on EPCs	Very high interest in energy performance score of similar buildings on EPCs	High interest in energy performance score of similar buildings on EPCs	High interest in energy performance score of similar buildings on EPCs
EPC databases	High interest in energy performance score of nearby buildings	High interest in energy performance score of nearby buildings	High interest in energy performance score of nearby buildings	High interest in energy performance score of nearby buildings	High interest in energy performance score of nearby buildings
Building logbook	Building logbooks ranked not very useful	Building logbooks ranked very useful	Building logbooks ranked moderately useful	Building logbooks ranked very useful	Building logbooks ranked very useful
Tailored recommendations	High interest in impact of renovation on energy costs and cost of renovation measures	High interest in cost of renovation measures	High interest in cost of renovation measures and moderate interest in impact of renovation on energy costs	High interest in cost of renovation measures and moderate interest in impact of renovation on energy costs	Very high interest in cost of renovation measures
Financing options	Moderate interest in different financing options available	Very high interest in different financing options available	Very high interest in different financing options available	High interest in different financing options available	High interest in different financing options available





	Denmark	Greece	Poland	Portugal	Romania
One-stop-shops	Interested in information on future energy savings and consultation on technical solutions	Interested in online quotations from suppliers and consultation on technical solutions	Interested in information on future energy cost savings	Interested in information on future energy cost savings and online quotations	Interested in information on future energy cost savings, direct access to companies and consultation on technical solutions



ANNEXES

Annex I - Full Questionnaire

I. SAMPLE VARIABLES = information for scripter

Create hidden variable **COUNTRY**:

Country	Code
Denmark	1
Greece	2
Poland	3
Portugal	4
Romania	5

Create hidden variable **LANGUAGE**:

Language	Code
Danish	1 (if country =1)
Greek	2 (if country =2)
Polish	3 (if country =3)
Portuguese	4 (if country =4)
Romanian	5 (if country =5)

II. SCREENER

Base: all respondents

Age

YEAR/MONTH. What is your date of birth?

QUOTAGERANGE [Hidden]. Hidden Question - QUOTAGERANGE "this is a dummy question that will hold age breaks"

- _18_24 "18-24",
- _25_34 "25-34",
- _35_44 "35-44",
- _45_54 "45-54",
- _55_64 "55-64",
- _65 and older "65 and older"

Base: all respondents

Gender

RESP_GENDER. Are you...?

- _1 Male
- _2 Female

Base: all respondents

Education

EDU. What is the highest level of education you have achieved?

1. Less than primary, primary and lower secondary education (levels 0-2)
2. Upper secondary and post-secondary non-tertiary education (levels 3 and 4)
3. Tertiary education (levels 5-8)

Base: all respondents

S1. Do you currently own or rent your home?

[SINGLE ANSWER]

1. Own
2. Rent
3. Other

Base: all respondents

S2. Do you own any rental properties?

[SINGLE ANSWER]

1. Yes, more than one property
2. Yes, one property
3. No

Base: all respondents

S3. Which of the following situations apply to you? Select all that apply.

A property could be your primary residence or another type of property, such as a second home or rental property.

[MULTIPLE ANSWER]

1. **Bought** a property in the past 5 years (since 2015)
2. Signed a contract for **renting** a property in the past 5 years (since 2015)
3. **Sold** a property in the past 5 years (since 2015)
4. Started to **rent out/had new renters** in the past 5 years (since 2015)
5. None of the above [EXCLUSIVE]

Base: all respondents

S4. Have you attempted to buy, rent, sell or let a property in the past 5 years (since 2015)? Select all that apply.

A property could be your primary residence or another type of property, such as a second home or rental property.

[MULTIPLE ANSWER]

1. Attempted to buy
2. Attempted to rent
3. Attempted to sell
4. Attempted to let
5. None of the above [EXCLUSIVE]

Base: all respondents

S5. Are you currently planning to buy, rent, sell or let a property? Select all that apply.

[MULTIPLE ANSWER]

1. Planning to buy
2. Planning to rent
3. Planning to sell
4. Planning to let
5. None of the above [EXCLUSIVE]

Base: S3=1 or S4=1 or S5=1

S6. You replied that you have recently bought a property or have attempted to buy a property?

What type of property was this?

You replied that you are planning to buy a property? What type of property will this be?

[SINGLE ANSWER]

1. Primary residence
2. Second home
3. Property to rent out
4. Other

Base: S3=1 or S4=1 or S5=1

S7. And how about the building type?

[SINGLE ANSWER]

1. A separate house
2. Semi-detached house
3. Row or terraced house
4. Flat/apartment
5. Other
99. [S5=1 AND NOT (S3=1 OR S4=1)] I don't know yet

Base: all respondents

S8. Have you completed a renovation project in the past five years?

By renovating we mean major changes to the physical properties of your home [IF S2=1 or2, ADD: or rental property].

For example, 'renovating' may mean fitting a new bathroom, replacing the heating or the cooling system, installing new windows or insulation. 'Renovating' does not include redecorating, or changing appliances (e.g. new kitchen stove), although these may be done alongside more major renovations.

[SINGLE ANSWER]

1. Yes
2. No

Base: all respondents

S9. Please select the statement that best describes your current situation.

[SINGLE ANSWER]

1. Currently renovating
2. Currently finalising plans for renovating
3. Planning renovations to be done in the near future
4. Thinking about renovations as a possibility
5. Currently not thinking about renovations

III. QUESTIONNAIRE

Base: all respondents

[INFO]

Ipsos is conducting this survey as a component of the X-tendo project to better understand consumers' decisions, expectations and needs related to the energy performance of their homes. The X-tendo project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 847056.

Thank you very much in advance for completing this questionnaire which will take about 20 minutes to complete. All the answers to this questionnaire will remain confidential, so the answers will in no way be linked to your personal details. The answers will only be used for research on the abovementioned topic.

Base: all respondents

Q1. To what extent do you agree or disagree with each of the following statements?

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

1. I have tried to reduce the amount of energy I use at home
2. I think there is more I could do to reduce the amount of energy I use at home
3. My household's energy use can be reduced by renovating
4. I am more concerned about having a warm and comfortable home than saving energy

COLUMNS

1. Strongly disagree
- 2.
- 3.
- 4.
5. Strongly agree
99. I don't know

Base: all respondents

Q2. To what extent do you agree or disagree with the following statements about smart homes?

A smart home uses smart technology (internet-connected devices for monitoring appliances and systems) to share information between systems in order to optimise the building's performance, from heating and ventilation to air conditioning and security.

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

1. I am familiar with smart technology
2. Smart homes increase the comfort of their occupants
3. Smart homes help to save energy
4. Smart homes are not secure because they can be hacked
5. I would like to live in a smart home

COLUMNS

1. Strongly disagree
- 2.
- 3.
- 4.
5. Strongly agree
99. I don't know

Base: all respondents

Q3. If you decided to buy or rent a property, how important would the following aspects be in your decision?

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

1. Price/rent
2. Location
3. Size of the property
4. Heating source
5. Comfort (e.g. good indoor air quality and thermal comfort, no draught)
6. Energy efficiency
7. Presence of smart technology
8. Move-in date

COLUMNS

0. Not at all important
- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
10. Very important
99. I don't know

Base: (S2= 1 or 2) or (S3=3 or 4) or (S4=3 or 4) or (S5=3 or 4)

Q4. And how important do you think that each of the following aspects will be in the decision of potential buyers or renters regarding which home to buy or rent?

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

1. Comfort (e.g. good indoor air quality and thermal comfort, no draught)
2. Energy efficiency
3. Presence of smart technology

COLUMNS

0. Not at all important
- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
10. Very important
99. I don't know

Base: all respondents

Q5. Please rank the following aspects, starting with the aspect that, in your view, is most important for personal comfort at one's home.

[ENABLE RESPONDENT TO RANK ITEMS]

[RANDOMISE]

1. Indoor air quality (no stuffy, humid or mouldy air, no odour)
2. Thermal and ventilation comfort (comfortable indoor temperature, no draught)
3. Visual comfort (natural light, external view, reduced glare)
4. No noise nuisance (no noise from outside such as road traffic, construction)

Base: all respondents

Q6. What type of information would help you better manage your energy usage at home?

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

1. Real-time feedback on my energy use via a smart meter [info button: Smart meters measure how much electricity you are using, as well as what it is costing you, and display this on a handy in-home display.]
2. Consumption of each appliance in my home on a monthly basis
3. Comparison of my energy use with other consumers (e.g. similar households as me)
4. Comparison of my energy use today with that of the same time last year

COLUMNS

1. Not at all helpful
- 2.
- 3.
- 4.
5. Very helpful
99. I don't know

Base: all respondents

Q7. Would you provide consent to third parties to use your energy consumption data to provide you with tailored information on how to reduce your energy use?

[SINGLE COLLAPSIBLE GRID]

ROWS

[RANDOMISE]

1. Financial institutions
2. The municipality
3. Energy advisors (e.g. energy auditor, qualified experts)
4. Contractors (e.g. installers, craftsmen)
5. Utilities and energy suppliers

COLUMNS

1. Yes
2. No

Base: if country=1,2,3,5

Q8. In your opinion, how interesting is the following information related to district heating?

District heating systems generate heat in a centralised location and distribute it amongst multiple buildings. They can be used to provide space or water heating for residential or commercial requirements.

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

1. Estimated future efficiency, CO2 emissions and share of renewables in the closest district heating system
2. Current efficiency, CO2 emissions and share of renewables in the closest district heating system
3. Distance of my building to the existing district heating grid

COLUMNS

1. Not at all interesting
- 2.
- 3.
- 4.
5. Very interesting
99. I don't know

Base: all respondents

Q9. Do you think each of the following statements about energy performance certificates (EPC) is true or false:

[SINGLE COLLAPSIBLE GRID]

ROWS

[RANDOMISE]

1. An EPC provides an energy efficiency rating for a building, from "A" to "G"
2. An EPC needs to be available to potential buyers

3. An EPC is not needed when renting out a property
4. An EPC expires after 5 years
5. An EPC should include recommendations for improvements of the energy performance of a building

COLUMNS

1. True
2. False
99. I don't know

Base: all respondents

Q10. Current legislation specifies that, for each building that is put up for sale or rent, an Energy Performance Certificate (EPC) must be available. This certificate contains information about the energy efficiency of the building, but there might be other information that would be worth adding.

What information would you like to find in an Energy Performance Certificate (EPC)?

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

1. Energy use and energy costs of previous occupants
2. Building's impact on outdoor air pollution
3. Level of indoor air quality
4. Impact of outdoor air pollution on indoor air quality
5. Efficiency of ventilation system (if present)
6. Presence of smart technology
7. Distance of the building to the existing district heating grid
8. Energy performance score of similar buildings nearby

COLUMNS

1. Definitely not
- 2.
- 3.
- 4.
5. Definitely
99. I don't know

Base: all respondents

Q11. If you decided to buy or rent a property, how useful do you think it would be to compare the energy efficiency score of your property with that of...

[SINGLE PROGRESSIVE GRID]

ROWS

1. all properties in the country
2. all properties in your region
3. other properties in the neighbourhood
4. properties similar to the one you want to buy/rent

COLUMNS

1. Not at all useful
- 2.
- 3.
- 4.
5. Very useful
99. I don't know

Base: all respondents

Q12. Would you agree that information about your building's energy performance is included in a publicly accessible database?

[SINGLE ANSWER]

1. Yes, with exact address information
2. Yes, but only with postal code
3. Yes, but only if fully anonymous
4. No
99. I don't know

Base: all respondents

Q13. Let's imagine that, for each home, a document or folder with all the building-related documents (dwelling's condition, maintenance activities etc.) would be available. What information would you find most useful to be included in this document or folder? Select up to five options.

[FIVE ANSWERS ALLOWED, RANDOMISE 1-8]

1. Renovation activities completed up to date
2. Up-to-date building plans
3. Construction company/Contractor used for previous renovations
4. Transaction price and home insurance policy
5. Condition of walls and roof
6. Window glazing and insulation
7. Age of equipment (e.g. boiler, oven, radiators)
8. Service life of installed equipment
9. I do not consider any of the information useful [EXCLUSIVE]

Base: if S3=1 or 2

Q14. Did you receive a folder or document with all the building-related documents (dwelling's condition, maintenance activities etc.) when you bought the property or started renting it?

[SINGLE ANSWER]

1. Yes
2. No
99. I don't know

Base: if S3=3 or 4

Q15. Did you provide the buyer or renter with a folder or document with all the building-related documents (dwelling's condition, maintenance activities etc.) when you sold the property/had new renters?

[SINGLE ANSWER]

1. Yes
2. No
99. I don't know

Base: if Q14=1 or Q15=1

Q16. Do you keep this document up to date with new information on maintenance or alterations to the property?

[SINGLE ANSWER]

1. Yes, I think it is useful
2. Yes, but I do not think it is useful
3. No, but I think it would be useful
4. No, I do not think it is useful
99. I don't know

Base: if Q14 ≠1 AND Q15 ≠1

Q17. Are you putting together a folder or document with all your building related documents, such as maintenance activities, alternations you made to the property etc.?

[SINGLE ANSWER]

1. Yes, I think it is useful
2. Yes, but I do not think it is useful
3. No, but I think it would be useful
4. No, I do not think it is useful
99. I don't know

Base: all respondents

Q18. If you decided to buy or rent a property, how important would it be that a document or folder with all the building-related documents (dwelling's condition, maintenance activities etc.) is present for the property?

[SINGLE ANSWER]

0. Not at all important
- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

- 9.
- 10. Very important
- 99. I don't know

Base: S8=1 or S9=1,2,3 or 4

The next questions are about renovations to make a home more energy efficient. By energy efficient we mean making a home more efficient in saving energy, e.g. by installing wall insulation, or installing a more efficient heating system.

Q19. You replied that you renovated or are currently renovating (or that you are thinking about renovating). Does this renovation include an improvement to make your house (or rental property) more energy efficient?

[SINGLE ANSWER]

- 1. Yes
- 2. No
- 99. I don't know (yet)

Base: S8=2 and S9=5

The next questions are about renovations to make a home more energy efficient. By energy efficient we mean making a home more efficient in saving energy, e.g. by installing wall insulation, or installing a more efficient heating system.

Base: all respondents

Q20. [Q19=1] When making your home more energy efficient, how useful would you find it if the following information is included in the Energy Performance Certificate (EPC)?

[(S8=2 and S9=5) or Q19=2 or 99] If you were to make your home more energy efficient, how useful would you find it if the following information is included in the Energy Performance Certificate (EPC)?

[SINGLE PROGRESSIVE GRID]

ROWS

[RANDOMISE]

- 1. Energy saving renovations completed in the past (e.g. thermal insulation, solar panels)
- 2. A general guide about energy efficient measures
- 3. A tailored step-by-step renovation plan to make your home more energy efficient
- 4. How to access different financing options for the renovation
- 5. Recommendations on measures to improve indoor air quality and comfort

COLUMNS

- 1. Not at all useful
- 2.
- 3.
- 4.
- 5. Very useful
- 99. I don't know

Base: all respondents

Q21. [Q19=1] When making your home more energy efficient, what type of information and recommendations would you find useful to receive?

[(S8=2 and S9=5) or Q19=2 or Q19=99] **If you were to make your home more energy efficient, what type of information and recommendations would you find useful to receive?**

[MULTIPLE ANSWER, RANDOMISE 1-12]

1. Technical information for each renovation measure
2. Estimated cost for each renovation measure
3. Payback time of the renovation
4. Expected impact of renovation on energy performance
5. Expected impact of renovation on energy costs
6. Expected benefit of renovation on CO2 emission
7. Expected benefit of renovation on indoor comfort
8. Time required to complete each renovation measure
9. How to prioritize the renovation measures
10. Recommended order to implement the renovation measures
11. Information on maintenance requirements for the renovation
12. Maintenance and operation costs linked to the renovation
13. None of the above [EXCLUSIVE]

Base: all respondents

Q22. How can recommendations about energy renovations in Energy Performance Certificates be presented in the most useful way? Select the most useful way of presentation.

[SINGLE ANSWER]

1. Detailed explanation in text form
2. Summary information in text form
3. Graphical representation using icons
4. Graphical representation using a colour scheme
99. I don't know

Base: all respondents

Q23. Thinking about financing options to implement renovation measures. What type of information would you find relevant?

[SINGLE PROGRESSIVE GRID]

ROWS

1. Different financing options available
2. Realtime information related to the available financing options
3. How to apply for different financing options
4. Brief description of different financing options
5. Detailed description of available financing options
6. Contact information to learn about detailed financing options

COLUMNS

1. Not at all relevant
- 2.
- 3.
- 4.
5. Very relevant
99. I don't know

Base: all respondents

Q24. Imagine a one-stop web portal where you can go with renovation-related questions and get in contact with building professionals. Would you use such a service when planning a renovation?

[SINGLE ANSWER]

1. Yes, and I would be willing to pay a small fee for such a service
2. Yes, but only if offered for free
3. Probably not
4. No
99. I don't know

Base: all respondents

Q25. [IF Q24 = 1 or 2] Which services would you like to receive in such a one-stop web portal? Select all the apply. [IF Q24 = 3, 4 or 99] You replied that you would not use a one-stop web portal, but would you be interested in any of the services offered in a one-stop web portal?

[MULTIPLE ANSWER, RANDOMISE 1-9]

1. Information on the EPC of my building
2. Consultation on technical solutions for specific renovation measures
3. Ranking of companies and/or installers according to price and quality
4. Direct access to companies and/or installers that best match my specific needs
5. References and basic information of previous work done by companies and/or installers
6. Online quotations from companies and/or installers for implementing renovation measures
7. Details on the services proposed by companies/installers
8. Information on how to update the EPC after implementing renovation measures
9. Estimation of future (energy) cost savings from renovation measures
10. None of the above [EXCLUSIVE]

Base: all respondents

B1. This survey is almost complete. There are only a few questions left. Does your current home have an Energy Performance Certificate (EPC)?

[SINGLE ANSWER]

1. Yes
2. No
99. I don't know

Base: all respondents

B2. What type of home do you live in?

[SINGLE ANSWER]

1. A separate house
2. Semi-detached house
3. Row or terraced house
4. Flat/apartment
5. Other

Base: all respondents

B3. Where do you live?

[SINGLE ANSWER]

1. In a large city
2. In the suburbs or outskirts of a large city
3. In a town or a small city
4. In a rural area

Base: all respondents

B4. Which statement best describes your household?

[SINGLE ANSWER]

1. Single adult with children
2. Single adult without children
3. Couple with children
4. Couple without children
5. Other type of household with children
6. Other type of household without children

Base: all respondents

B5. Which of the following best describes your current work status?

[SINGLE ANSWER]

1. Employed full-time
2. Employed part-time
3. Self-employed
4. Unemployed but looking for a job
5. Unemployed and not looking for a job
6. Long-term sick or disabled
7. Full-time parent, homemaker
8. Retired
9. Student/in fulltime education
99. Prefer not to say

Base: all respondents

B6. Thinking about your household's financial situation, would you say that making ends meet every month is...?

[SINGLE ANSWER]

1. Very easy
2. Fairly easy
3. Not easy
4. Not easy at all
5. Impossible
99. Prefer not to say



Annex II - Ipsos Survey report



May 2020

exTENDING the energy performance assessment and certification schemes via a mOdular approach

Consumer Survey – Final Report



GAME CHANGERS



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Introduction

The Energy Performance Certification (EPC) contains details on the energy performance of a building, typically indicated on a scale from A to D-G. While firstly introduced in 2002, it was brought to the fore as key information document in the recast of the Energy Performance of Buildings Directive (EPBD) in 2010. The recast EPBD requests EU Member States to provide information on the purpose, content and contexts related to the use of EPCs. Furthermore, the Directive requires the inclusion of specific information in the document such as the energy efficiency of a building and the reference values, as well as recommendations for improvements of the energy performance. In addition to these requirements, most Member States have established centralised EPC registers to collect related data voluntarily, which provides the main source for EPC-related information in these countries.¹ Surveys performed by the Buildings Performance Institute Europe (BPIE) in the years following the implementation of the recast EPBD demonstrated the key role of EPCs in collecting information of the energy performance of the EU's building stock.²

The certificates are usually required for the purpose of construction, selling or renting a property. Still, 41% of respondents³ in the underlying study of this report, stated that their current home does not have an EPC. More than half of respondents from Romania made this statement. Only 17% in Poland confirmed that their current home has a certificate. Overall, 29% did not know whether there is an EPC or not. In general, the knowledge of homeowners and tenants of key characteristics of EPCs appears rather limited. 69% knew that the certificate should be available for potential buyers but fewer (36%) that the same applies when renting out a property. One-fourth (27%) believed that the EPC is valid for 5 years, only 13% knew that this was wrong, and the majority (61%) did not know whether this was true or not.⁴ More than half of respondents (61%) knew that the document should include recommendations for improvements of the energy performance of a building. In Denmark and Romania, 22% and 37%, respectively, did not know whether or not an EPC provides an energy efficiency rating for a building, from “A” to “G”.

¹ The European Commission on Energy Performance Certificates. Available at: https://ec.europa.eu/energy/eu-buildings-factsheets-topics-tree/energy-performance-certificates_en (accessed 22 April 2020)

² Buildings Performance Institute Europe (2014). Energy Performance Certificates across the EU: A mapping of national approaches. Available at: <http://bpie.eu/wp-content/uploads/2015/10/Energy-Performance-Certificates-EPC-across-the-EU.-A-mapping-of-national-approaches-2014.pdf> (accessed 22 April 2020)

³ Respondents had recent experience with activities related to buying, renting, selling, letting or renovating property.

⁴ In the five survey countries, the EPC is valid for ten years (for residential buildings).

The implementation and design of EPCs in terms of detail, consistency and compliance varies greatly between the Member States, which calls for more reliability and a wider scope of the certificate. With respect to increasing demand for energy efficient buildings – not least to cut carbon emissions – EPCs and their data management need to be improved to better serve stakeholders and consumers in their decisions related to the energy performance of buildings. The project *extENDING* the energy performance assessment and certification schemes via a *mOdular* approach (X-tendo) aims to support EU markets and authorities in improving EPCs.⁵ The central element of the project is the development of a publicly accessible online toolbox that contains ten new features (smart readiness, comfort, outdoor air pollution, real energy consumption, district heating, EPC databases, building logbook, tailored recommendations, financing options, and one-stop-shops) that are proposed in relation to EPCs. For each feature, the toolbox will contain good practices examples, methodological notes, guidelines and recommendations to assist the implementation of the features into current EPC schemes.⁶ Test projects are implemented in nine Member States (Austria, Estonia, Greece, Romania, Portugal, Italy, Denmark, United Kingdom, Poland).⁷

The consumer survey that is presented and discussed in this report forms one component of the X-tendo project. The objective of the survey is to understand expectations and views of building owners and tenants on EPCs and the ten features introduced by the project. Data was collected from 2,563 homeowners, landlords and tenants from five EU Member States (Denmark, Greece, Poland, Portugal and Romania) via an online survey. Respondents had recent experience with activities related to buying, renting, selling, letting or renovating property. The findings of the survey will help to fine-tune the innovate features and design them in a way that is most beneficial for decision-making on individual and political level.

⁵ This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847056.

⁶ European Commission on the X-tendo project. Available at: <https://www.buildup.eu/en/explore/links/x-tendo-project> (accessed 22 April 2020)

⁷ Project website: <https://x-tendo.eu/about/>

Findings

This section presents the findings of the survey for each feature that was covered by the questionnaire (smart readiness, comfort, outdoor air pollution, real energy consumption, district heating, EPC databases, building logbook, tailored recommendations, financing options, and one-stop-shops). The survey also measured general awareness and interest in home energy issues which is shortly discussed below.⁸ The findings are presented for the total sample, per survey country, and by subgroup (for example age group, tenure status, education level, area of residence) where the differences are statistically significant and relevant to the context.

An overview of the methodological approach, including how answers are reported, is provided in the Annex.

General awareness and interest in home energy issues

Comfort, heating source and energy efficiency are considered as important aspects when buying or renting property by the vast majority of homeowners and tenants surveyed (73%, 69% and 67%, respectively).⁹ A smaller but still considerable percentage (34%) indicated that the presence of smart technology is important.

The heating source is of higher relevance in Greece, Poland and Romania than in Denmark and Portugal. However, this may be explained by the fact that central heating is in general rare in Portugal and district heating is the most common heating source in Denmark, a country which is known as one of the most energy efficient economies in the world. Overall, respondents in Romania stand out as viewing the energy performance of a building as very relevant when renting or buying property. At the same time, the Individual Building Renovation Roadmaps (iBRoad) project has shown that Romania has a comparable high average residential energy consumption which may play a role in the perceived importance.¹⁰

⁸ Consumers' knowledge about EPCs is covered in the introduction (section 1).

⁹ When consumers who (attempted to) sold or let property were asked to which degree they think potential buyers or tenants consider comfort as important in their decision regarding which home to buy or rent, they assessed the aspect as slightly less important (45%) than consumers who answered from their own perspective (51%).

¹⁰ iBRoad Factsheet: Romania available at: http://bpie.eu/wp-content/uploads/2018/01/iBROAD_CountryFactsheet_ROMANIA-2018.pdf (accessed 28 April 2020)

It is also noteworthy that older homeowners and tenants surveyed attribute more weight to the heating source and energy efficiency than younger age groups. Expectedly, the same applies to respondents that are in general more conscious about energy use and energy efficiency at home.¹¹

Smart readiness

Table 1.1: shows the percentage for the total group of respondents surveyed as well as results per country. The second row indicates the smart readiness level of each country as identified through a mapping of the smart-ready built environment in Europe by the BPIE in 2017.¹² The findings do not suggest differences between countries that could be attributed to the level of smart readiness as per the BPIE mapping exercise.

The majority of consumers surveyed have a positive attitude towards smart homes.¹³ Three-fourth see its value in increasing comfort (75%) and saving energy (78%) at home. Fewer are concerned about security related risks; one-third (31%) question the security of smart homes in terms of its proneness to hacking. To which extent the opinions are based on respondents' own experiences or common perception is open – 50% stated being familiar with smart technology, 31% were unsure. Still, the majority (68%) would like to live in a smart home, though it is not seen as one of the most important aspects when buying or renting property. Around the same percentage (63%) would like to have information on the presence of smart technology in their EPC.

Table 1.1: Smart readiness

	Total	Denmark	Greece	Poland	Portugal	Romania
Smart readiness		<i>Front-runner</i>	<i>Slow starter</i>	<i>Cautious adopter</i>	<i>Slow starter</i>	<i>Cautious adopter</i>
% being familiar with smart technology	50%	36%	61%	50%	45%	56%

¹¹ The indicator 'conscious about energy used' was calculated taking the mean of Q1_1_scale, Q1_2_scale, Q1_3_scale and Q1_4_scale (reverted) and recoded as follows: 1. Yes (Q1_2_scale = 4 or 5), 2. Neutral (Q1_2_scale = 3), 3. No (Q1_2_scale = 1 or 2), excluding 'don't know' answers. For hypothetical questions, the team also looked at variable Q3_6_scale and the importance of energy efficiency when buying or renting a property.

¹² BPIE (2017). Is Europe ready for the smart buildings revolution? Available at: <http://bpie.eu/publication/is-europe-ready-for-the-smart-buildings-revolution/> (accessed 28 April 2020)

¹³ Definition used in the survey: "A smart home uses smart technology (internet-connected devices for monitoring appliances and systems) to share information between systems in order to optimise the building's performance, from heating and ventilation to air conditioning and security."

	Total	Denmark	Greece	Poland	Portugal	Romania
% agreeing that smart homes increase the comfort of their occupants	75%	58%	74%	77%	83%	83%
% agreeing that smart homes help to save energy	78%	68%	84%	74%	79%	83%
% agreeing that smart homes are not secure because they can be hacked	31%	29%	30%	32%	32%	31%
% that would like to live in a smart home	68%	48%	78%	66%	73%	76%
% that consider the presence of smart technology important when buying or renting property	34%	14%	41%	31%	34%	47%
% that would like to have information on the presence of smart technology in the EPC	63%	44%	69%	66%	60%	76%

Respondents who indicated that energy efficiency is important when buying or renting property are more likely to agree that smart technology helps to save energy (81% in contrast to 57% for whom energy efficiency is not important).

Denmark is one of the four leading EU countries when it comes to smart readiness.¹⁴ Green urban solutions and the reduction of expenses and CO₂ emissions through energy efficiency in buildings are among the most prioritised innovations at city level.¹⁵ The findings in the survey are therefore surprising at first sight. Consumers surveyed in Denmark seem less familiar with smart technology (36% indicated being familiar and 29% were unsure) than the average of the sample. The majority shows a positive attitude towards smart homes but again less than the average. This difference may stem from the circumstance that smart technology is more frequently addressed in public

¹⁴ BPIE (2017). Is Europe ready for the smart buildings revolution? Available at: <http://bpie.eu/publication/is-europe-ready-for-the-smart-buildings-revolution/> (accessed 28 April 2020)

¹⁵ For example, <https://stateofgreen.com/en/sectors/buildings/> (accessed 28 April 2020)

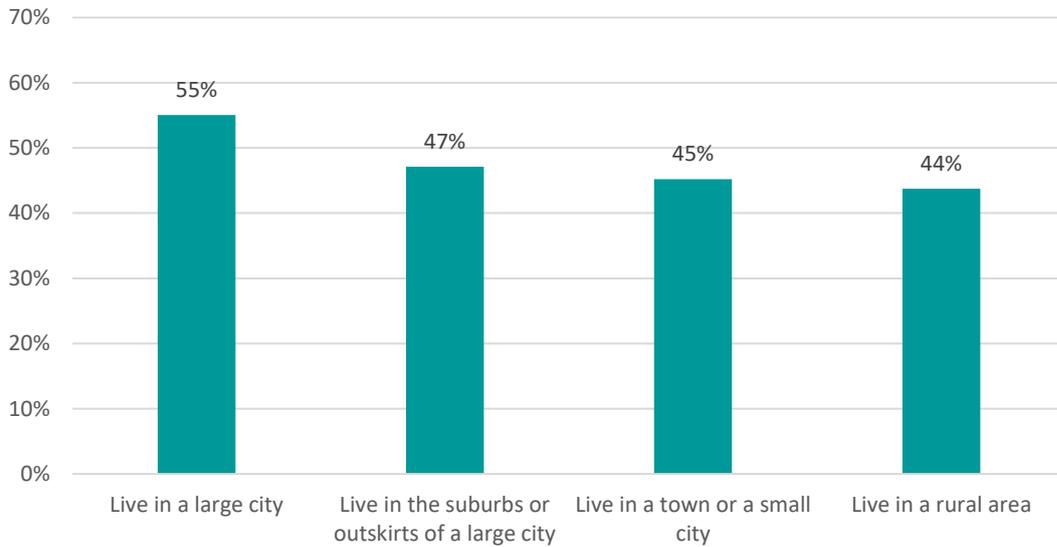
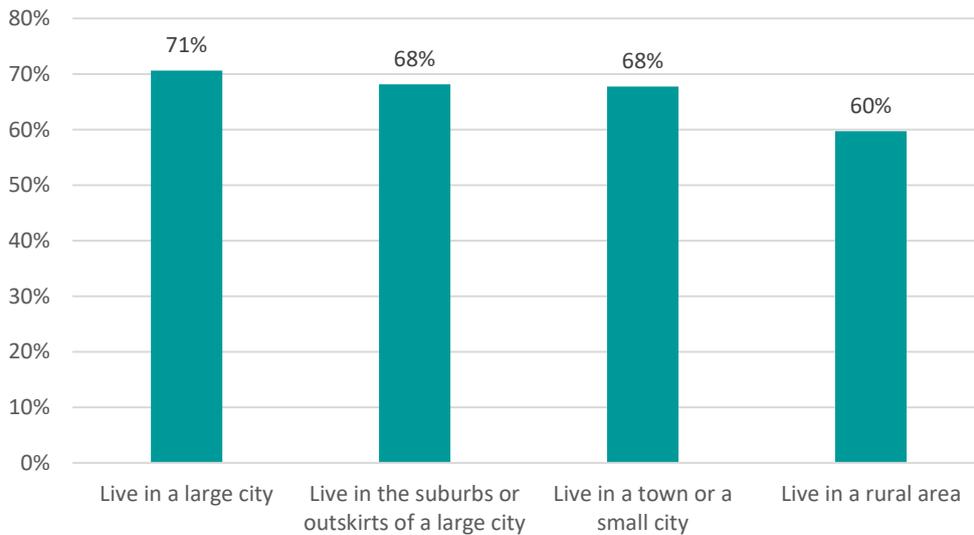
discourses, which includes both positive and negative debates that reveal the complexity of smart technology. Almost half of respondents (48%) in Denmark would like to live in a smart home but for fewer (14%) this is important when buying or renting property (which may be explained by the fact that many buildings are already equipped with some sort of monitoring system). 19% of consumers surveyed in Denmark do not want to have information on the presence of smart technology in their EPC. Some might see this information as redundant given the common practice of energy-efficient technical installations in (new) buildings.¹⁶

There are differences in socio-demographic characteristics in terms of consumers' knowledge of and opinions on smart homes. Men are more often familiar with smart technology than women (55% and 45%, respectively), but they also have less trust in its security (32% compared to 23% of women think that smart homes are not secure because of their proneness to hacking). In terms of age, younger consumers surveyed have a higher probability of having knowledge on related technology (60% of 18-24 years old and 41% of 65+ years old), while older homeowners and tenants are more confident in saving energy with smart technology (82% of 45 or older compared to 66% of 18-24 years old). The advantage of energy saving is also perceived by a larger proportion of respondents with tertiary education (82%) compared to respondents with less than primary, primary and lower secondary education (62%).

As Figures 1.2 and 1.3 show, there are also differences in knowledge and interest by the type of area where consumers live. These figures are particularly interesting considering the varying building stock characteristics between urban and rural regions, whereby buildings in rural areas tend to be older and more vulnerable to natural and man-made disasters.¹⁷

¹⁶ For example, <https://stateofgreen.com/en/sectors/buildings/> (accessed 28 April 2020)

¹⁷ For example, Tsonis, G. (2015). European building inventory framework. JRC Technical Reports.

Figure 1.2: Smart readiness - % being familiar with smart technology**Figure 1.3: Smart readiness - % that would like to live in a smart home**

Comfort and outdoor air pollution

Comfort and outdoor air pollution at home are relevant for consumers surveyed and they would like to have information on related indicators in their EPCs. Specifically, the level of indoor air quality, the efficiency of the ventilation system and the impact of outdoor air pollution on indoor air quality would be of interest for respondents. The majority of respondents (66%) also would like to have information

on the building's impact on outdoor air pollution in the EPC, but in comparison to the comfort indicators the percentage that would like to have this information is lower.

Table 1.2: provides an overview of respondents' opinions on comfort and outdoor air pollution related information in the EPC.

Table 1.2: Comfort

	Total	Denmark	Greece	Poland	Portugal	Romania
% that consider comfort important when buying or renting property	73%	63%	73%	69%	77%	83%
% that would like to have information on the level of indoor air quality in the EPC	83%	78%	81%	85%	82%	88%
% that would like to have information on the impact of outdoor air pollution on indoor air quality in the EPC	75%	64%	74%	80%	72%	83%
% that would like to have information on the efficiency of ventilation system in the EPC	80%	70%	83%	83%	79%	84%
% that would like to have information on the building's impact on outdoor air pollution in the EPC	66%	54%	70%	68%	63%	74%

Homeowners and tenants in **Denmark** see less value of the comfort related information in their EPCs which may be related to the generally better air quality in the country¹⁸ and detailed requirements on indoor air quality and ventilation in the Danish Building Regulation (BR10)¹⁹.

Various aspects are important for the personal comfort at home. In terms of environment and building characteristics, it can be differed between:

- Indoor air quality (no stuffy, humid or mouldy air, no odour)
- Thermal and ventilation comfort (comfortable indoor temperature, no draught)
- Visual comfort (natural light, external view, reduced glare)
- No noise nuisance (no noise from outside such as road traffic, construction)

Figure 1.4: illustrates how respondents rank these four indicators, starting with the most important aspect. A variation between age groups can be observed regarding visual comfort: 47% of 18-24 years old consumers surveyed rank this aspect first or second, compared to 35% of 55+ years old. This suggests that younger people perceive visual comfort as more important than older people.

¹⁸ <https://www.eea.europa.eu/themes/air/country-fact-sheets/2019-country-fact-sheets/denmark>

¹⁹ BPIE (2015). Indoor air quality, thermal comfort and daylight. Accessible at: <http://bpie.eu/publication/indoor-air-quality-thermal-comfort-and-daylight-an-analysis-of-residential-building-regulations-in-8-member-states-2015/> (accessed 29 April 2020)

Figure 1.4: Ranking of most important aspects for personal comfort at home

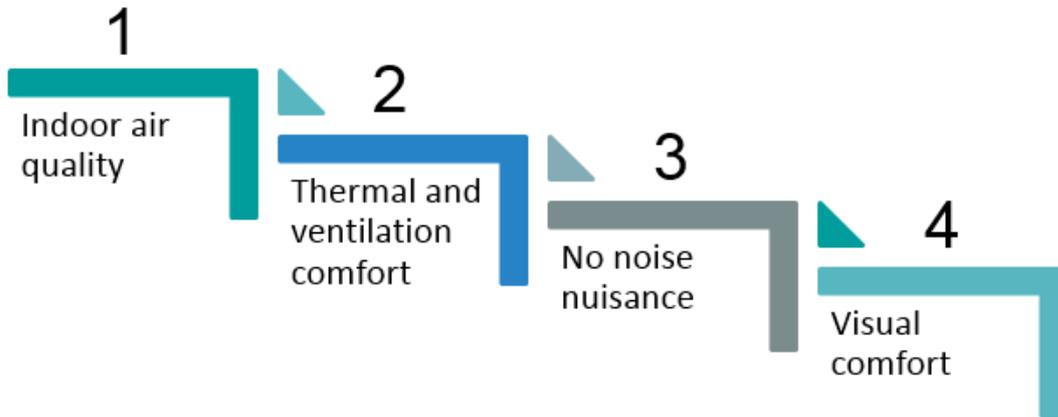
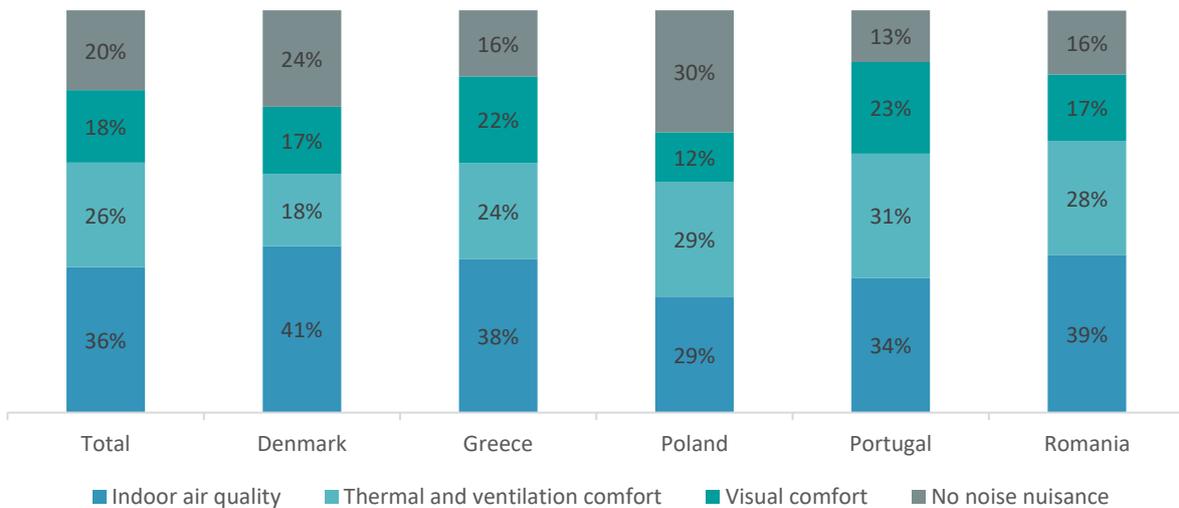


Figure 1.5 shows which proportion of respondents consider each of the four aspects as most important. In Romania, there are differences between homeowners and tenants concerning visual comfort and noise nuisance: visual comfort has a higher value for tenants (ranked first or second by 51%) than homeowners (ranked first or second by 35%). No noise nuisance is more important for consumers surveyed who own their home (ranked first or second by 38% and by 26% of those that rent).

Figure 1.5: Most important aspect for personal comfort at home by country (%)



In **Poland**, significantly more people ranked ‘no noise nuisance’ first than in the other countries (30% in contrast to 20% on average). Research on acoustic comfort has shown that residents in Poland are widely dissatisfied with the acoustic insulation of walls between dwellings and that acoustic requirements for internal walls are lower compared to other European countries.²⁰

Real energy consumption

Respondents perceive different information related to their current and past energy use (smart meters, use by appliance, and use at the same time in the previous week) as helpful in reducing their energy consumption at home, as illustrated in Table 1.3: Comparisons with similar household are also perceived as helpful by the majority of respondents (61%), though less useful than data related to the own household. A similar attitude can be observed in regards to information in the EPC: 71% would like to have information on the energy use and costs of previous occupants, i.e. related to their own home.

Table 1.3: Real energy consumption

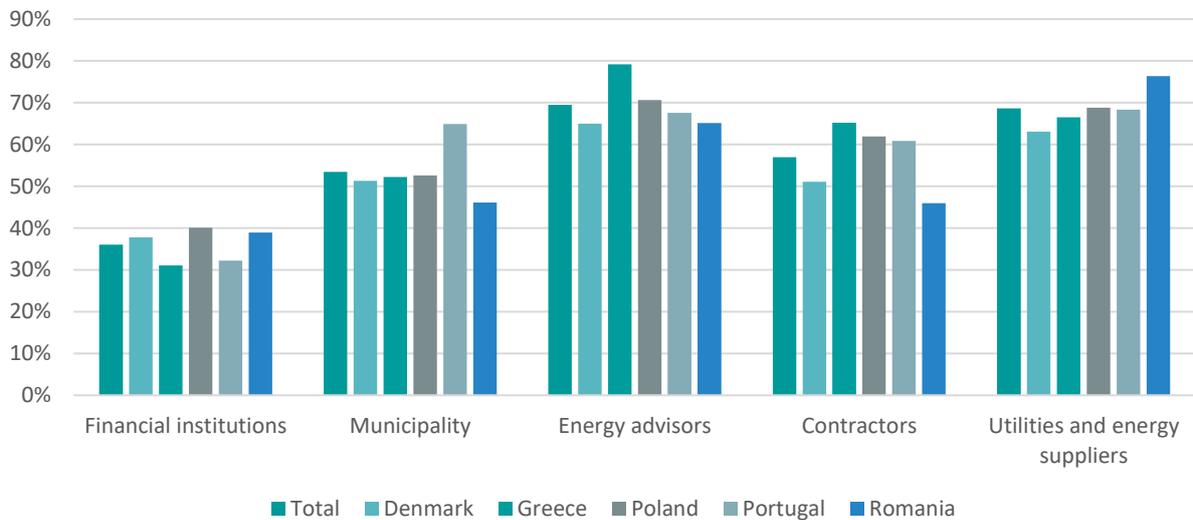
	Total	Denmark	Greece	Poland	Portugal	Romania
% that thinks real-time feedback on their energy use via a smart meter helps to better manage energy usage	77%	61%	82%	83%	79%	82%
% that thinks that a monthly overview of energy consumption of each appliance in the household helps to better manage energy usage	80%	61%	85%	85%	85%	83%

²⁰ Nowak, H., & Kania, T. (2018). National and European requirements concerning acoustic insulation from air sounds for internal walls. IOP Conference Series: Materials Science and Engineering, 415 012042.

% that thinks that a comparison of their energy use with similar households helps to better manage energy usage	61%	52%	66%	67%	61%	62%
% that thinks comparison of their energy use today with that of the same time last year helps to better manage energy usage	77%	69%	81%	80%	81%	76%
% that would like to have the energy use and energy costs of previous occupants on their EPC	71%	70%	72%	79%	58%	76%
% that would like to have the energy performance score of similar buildings nearby in their EPC	62%	56%	65%	68%	59%	61%

Respondents are most willing to give consent to energy advisors (e.g. energy auditor, qualified experts) (70%) and utilities and energy suppliers (69%) to use their energy consumption data to provide them with tailored information on how to reduce energy use (Figure 1.6:). More than half would agree to provide this information to their municipality (53%) or to contractors (e.g. installers, craftsmen) (57%). Roughly one-third (36%) would give consent to financial institutions. Consumers surveyed who are conscious about their energy use at home are in general more willing to give consent to third parties.

Figure 1.6: Willingness to provide consent to third parties to use energy consumption data for tailored information on how to reduce energy use



Portugal stands out as the country where the least percentage would like to have information on the energy use and costs of previous occupants on their EPC (58% compared to 71% on average and for example 79% in Poland). This may be related to increased energy affordability and changes in socio-economic profiles of the Portuguese population, and thus different energy consumption patterns between occupants and over time.^{21,22} Respondents in Portugal are also more willing to provide their energy consumption data to the municipality to provide them with tailored information on how to reduce energy use (65% compared to 53% on average).

District Energy²³

Two-third of respondents (67%) consider information on the current and estimated future efficiency, CO2 emissions and share of renewables in the closest district heating²⁴ system as interesting. Slightly

²¹ European Commission (2017). Energy Union Factsheet Portugal. Available at:

https://ec.europa.eu/commission/sites/beta-political/files/energy-union-factsheet-portugal_en.pdf (accessed 30 April 2020)

²² iBRoad Factsheet: Portugal available at: http://ibroad-project.eu/wp-content/uploads/2018/01/iBROAD_CountryFactsheet_PORTUGAL.pdf (accessed 08 May 2020)

²³ Respondents in Portugal were not asked about district heating since it does not exist in the country.

²⁴ Definition used in survey: District heating systems generate heat in a centralised location and distribute it amongst multiple buildings. They can be used to provide space or water heating for residential or commercial requirements.

less (61%) are also interested in the distance of their building to the existing district heating grid – more than half (57%) would like to see this information in their EPC (Table 1.4). These details are more appealing for consumers that are conscious about their energy use. Homeowners and tenants with at least secondary education show also more interest in this information than those with less than primary, primary and lower secondary education.

Table 1.4: District energy - degree of interest in information

	Total	Denmark	Greece	Poland	Romania
Estimated future efficiency, CO2 emissions and share of renewables in the closest district heating system	67%	54%	71%	69%	74%
Current efficiency, CO2 emissions and share of renewables in the closest district heating system	68%	55%	71%	70%	76%
Distance of the building to the existing district heating grid	61%	38%	71%	65%	71%

Distance of the building to the existing district heating grid in the EPC	57%	35%	65%	63%	69%
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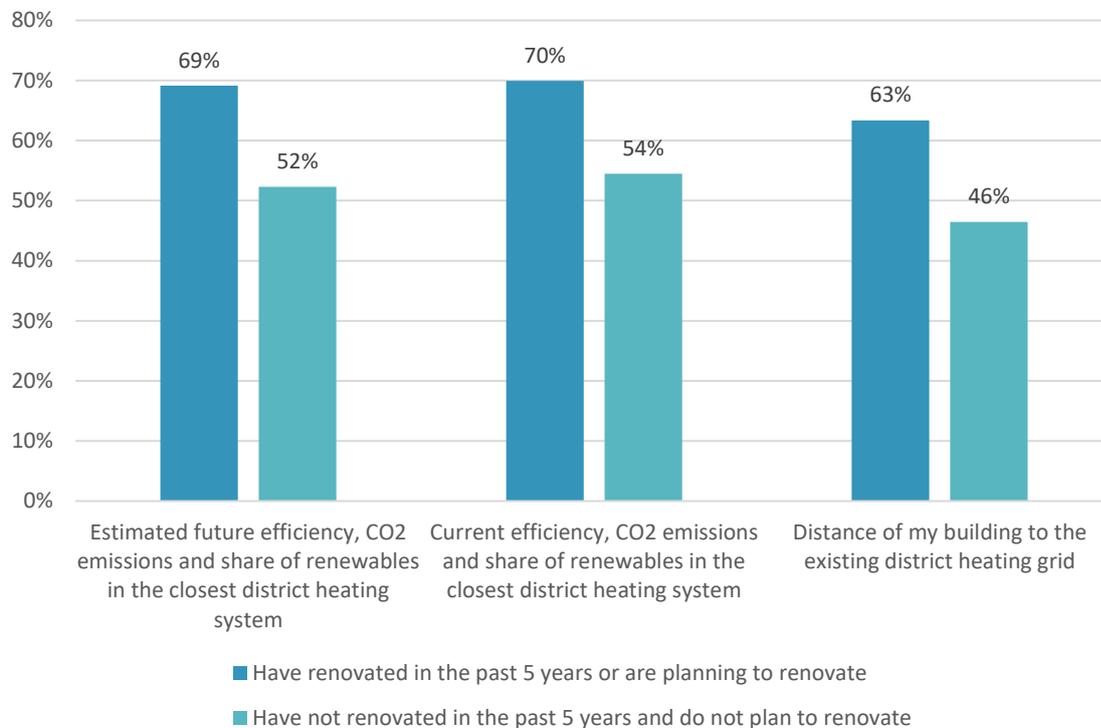
Around 64% of households in **Denmark** are connected to district heating utilised for space heating and hot water combined. In 2014, almost 50% of produced district heating came from renewable sources (and the share is rising).²⁵ Respondents in Denmark show less interest in information related to district heating which may be related to the fact that it is already an important component of the Danish energy system and incorporated in energy policy targets. District heating is mainly available

²⁵ Danish Energy Agency: <https://ens.dk/en/our-responsibilities/global-cooperation/experiences-district-heating>

to residents in urban areas and therefore of less interest for the rural population.²⁶ 62% of residents in large cities are interested in the current efficiency, CO2 emissions and share of renewables in the closest district heating system, compared to 37% in rural areas. This urban-rural difference is not observed in other countries.

Respondents who have recently renovated or are planning to do so are more often interested in information on district heating, as illustrated by Figure 1.7:.

Figure 1.7: District energy - degree of interest in information by renovation experience



EPC databases

When buying or renting a property, respondents consider a comparison of the energy efficiency score of this property with other properties in the neighbourhood more useful (68%) than with all properties

²⁶<https://stateofgreen.com/en/partners/best-green/solutions/rural-areas-welcome-new-heating-service-100-installations-in-three-months/>

in the country (49%). Even more useful is a comparison with similar properties (78%). This perception is the same across the survey countries (Table 1.5):

Table 1.5: EPC databases - usefulness of comparing the energy efficiency score of a property with that of...

	Total	Denmark	Greece	Poland	Romania
...all properties in the country	49%	41%	58%	48%	47%
...all properties in your region	60%	47%	75%	61%	59%
...other properties in the neighbourhood	68%	61%	75%	72%	67%
...properties similar to the one you want to buy/rent	78%	71%	83%	81%	79%

The majority (62%) would like to have the energy performance score of similar buildings nearby in their EPC (Table 1.6):. This information is more interesting for homeowners and tenants that have recently renovated (or plan to renovate) (63% compared to 52% who did or do not renovate) and residents in the suburbs or outskirts of a large city (65% compared to 51% from rural areas).

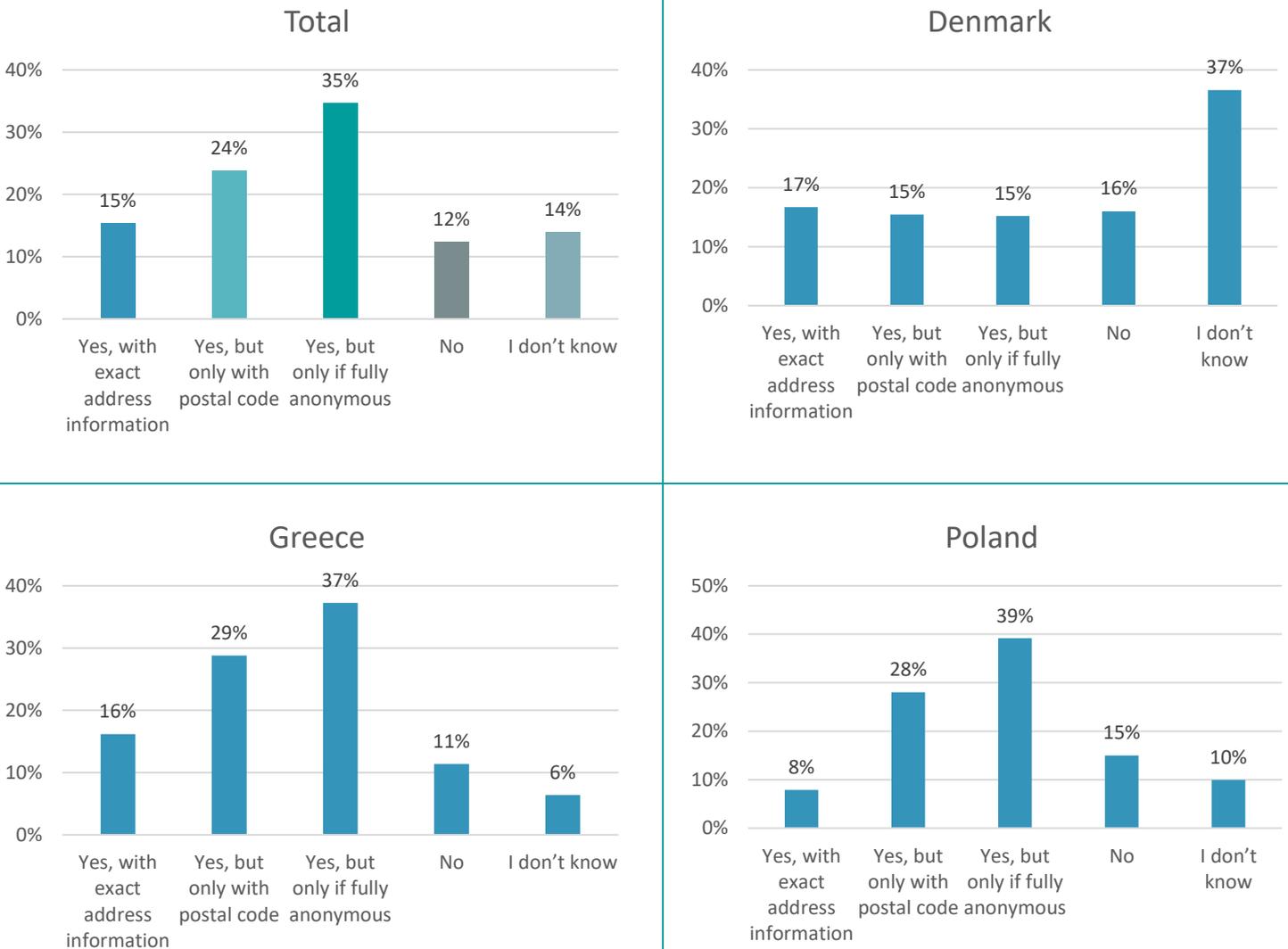
Table 1.6: EPC databases - energy performance score of similar buildings nearby in the EPC

	Total	Denmark	Greece	Poland	Romania
% that would like to have the energy performance score of similar buildings nearby in their EPC	62%	56%	65%	68%	59%

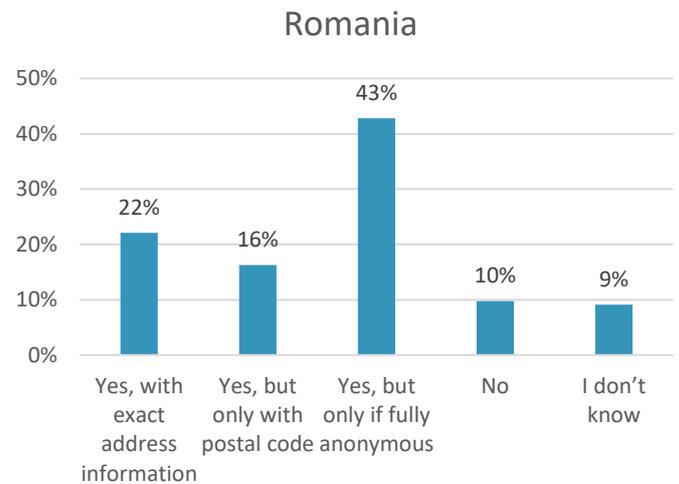
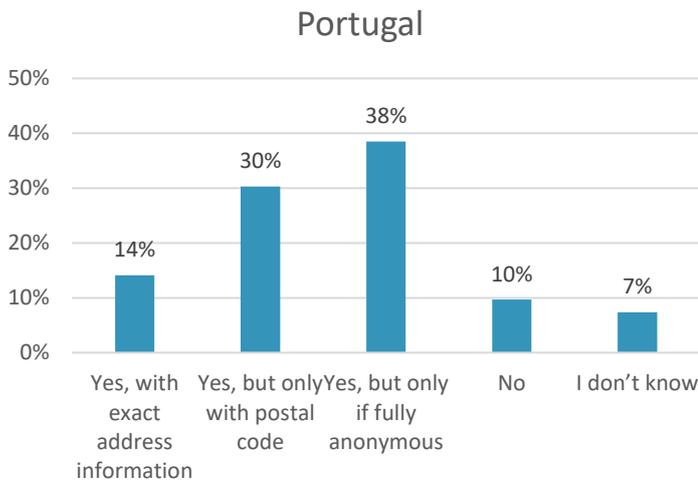
One-third of respondents (35%) would agree that information about their building's energy performance is included in a publicly accessible database if it is fully anonymous (Figure 1.8:). Fewer (24%) would agree if the postal code would be visible and again less (15%) if the exact address would be displayed. 12% would not agree to this at all and 14% do not know how they would decide. Comparing the different options (with exact address, with postal code, anonymous, not at all), Denmark stands out as the country where the answers are most equally distributed across the four

options. When comparing the number of consumers that would agree that the exact address is shown, the highest percentage is observed in Romania (22%) and the lowest in Poland (8%).

Figure 1.8: Agreement that information about the building’s energy performance is included in a publicly accessible database²⁷



²⁷ The answer 'I don't know' is not shown.



Building logbook

For the majority of respondents (66%) it would be important to receive a document or folder with all the building-related documents (dwelling’s condition, maintenance activities etc.) if they decided to buy or rent a property (Table 1.7:). The presence of this building logbook would be more important for homeowners and tenants that are conscious about their energy use, as well as for older age groups (which may be because younger consumers are more likely to think about short term rent and therefore consider a logbook less relevant; 51% of 18-24 years old consumers surveyed stated it is important compared to 71% of those older than 55).

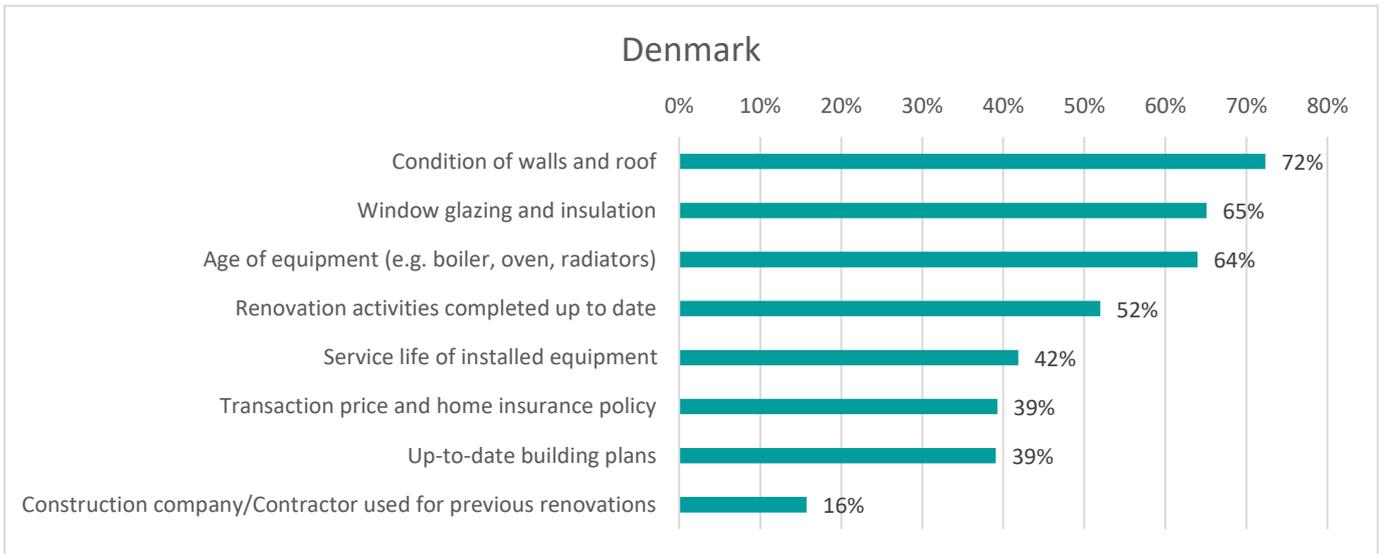
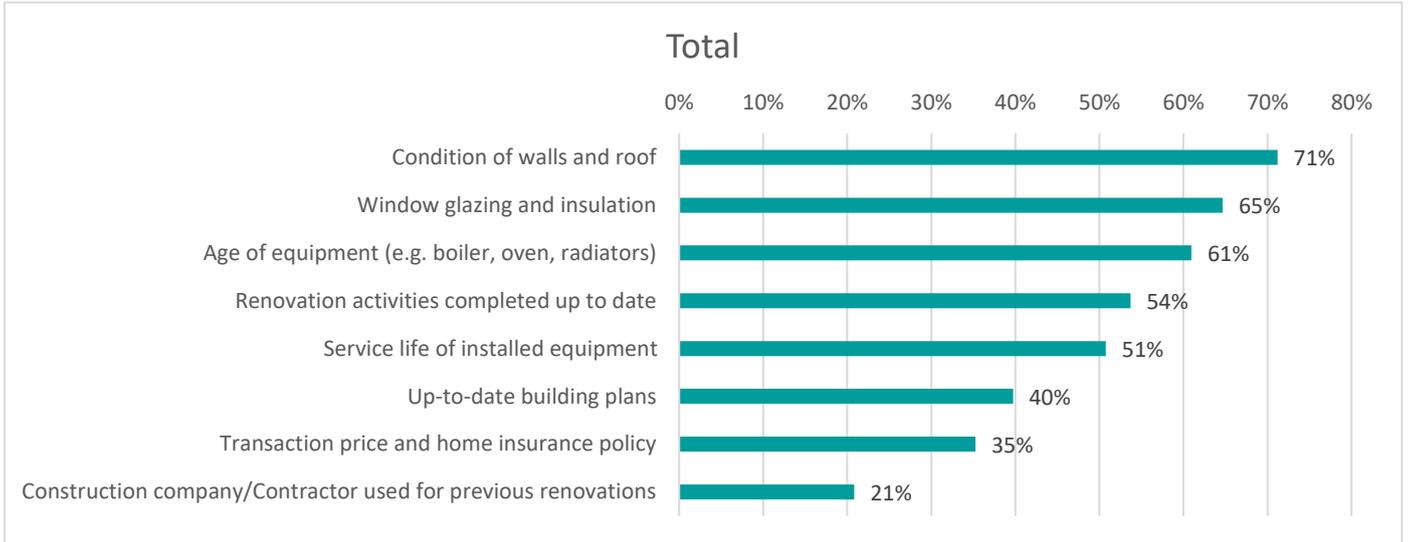
Table 1.7: Importance of availability of building logbook

	Total	Denmark	Greece	Poland	Romania
% for which it would be important to have a building logbook when buying or renting property	66%	61%	72%	60%	67%

Homeowners and tenants would find it most useful to find information on the condition of walls and roofs, window glazing and insulation, and the age of equipment in the logbook, as illustrated in Figure

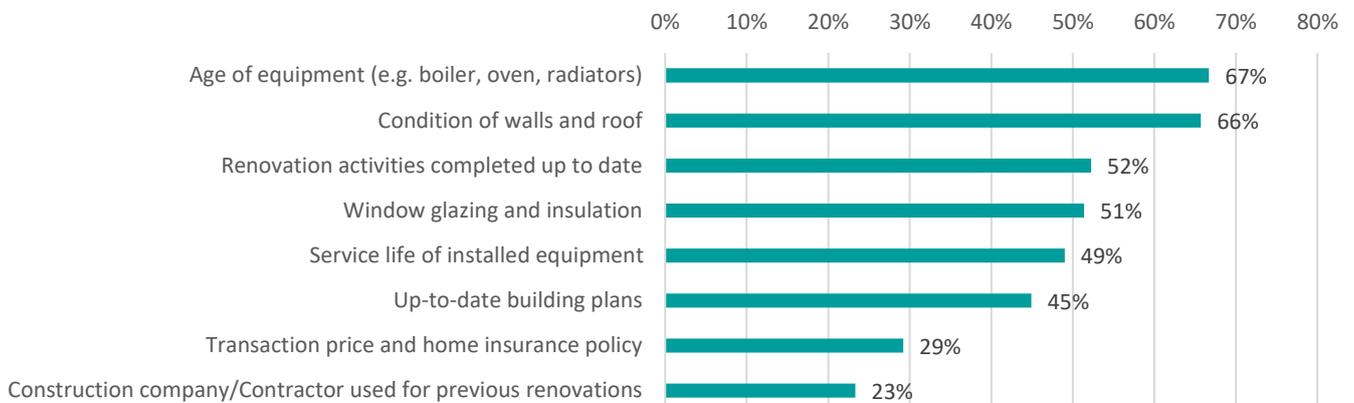
1.9:²⁸ 4% do not consider any of the information presented in the survey helpful. The perceived usefulness of each aspect is similar across the survey countries.

Figure 1.9: Perceived usefulness of different information in the building logbook by country

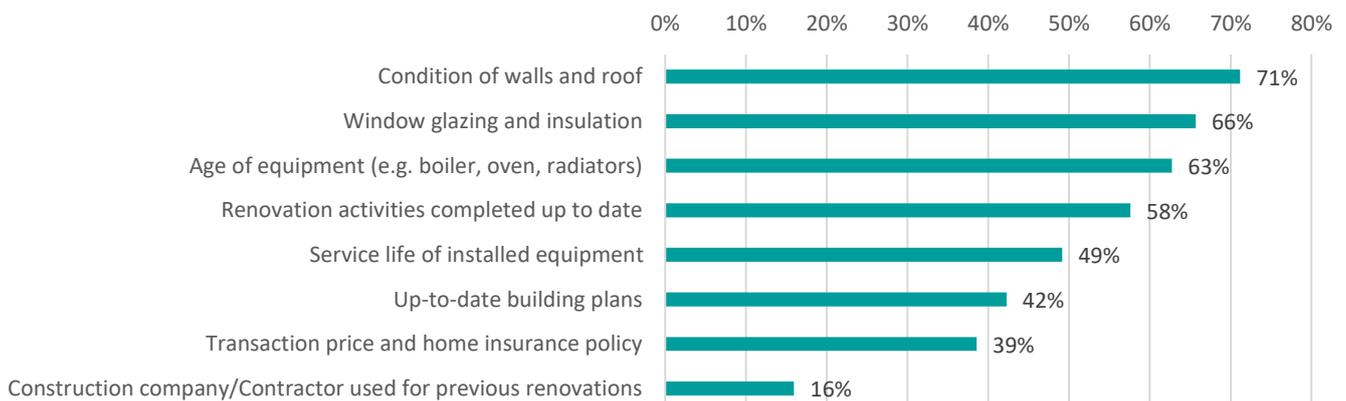


²⁸ Respondents were able to select up to 5 aspects.

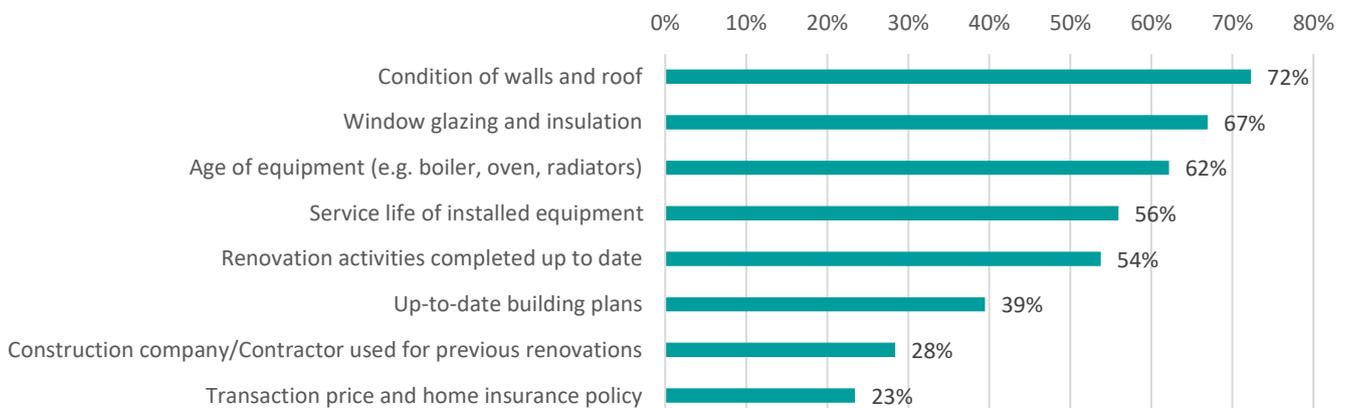
Greece

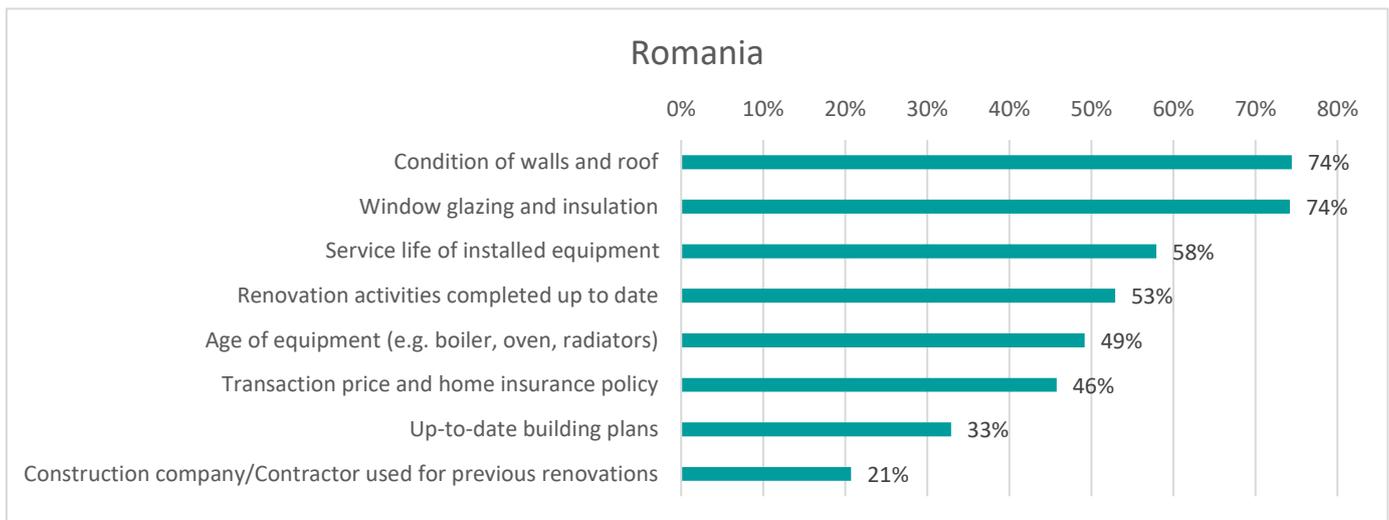


Poland



Portugal

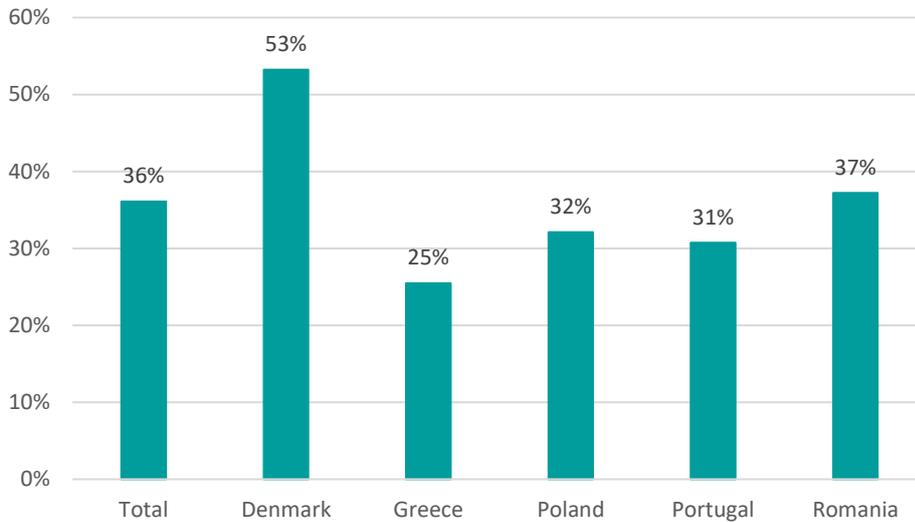




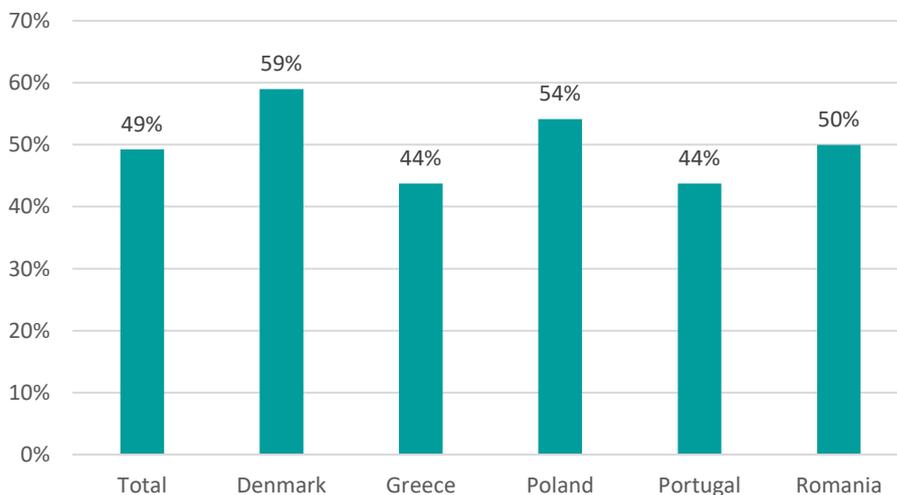
In a survey of the markets for Individual Building Renovation Roadmaps in 2017/2018, consumers in **Poland** and **Portugal** were asked which information they would like to find in a building logbook.²⁹ In the study, respondents found information related to the condition of the property and specifications of heating systems and other equipment more relevant than for example the contact details of previous contractors and transaction prices. This is in line with the findings of the survey presented in this report.

Overall, one-third of homeowners and tenants (36%) stated to have received a folder or document with all the building-related documents when they bought or started renting their home. There are variations between countries, with the highest percentage in Denmark (53%) and the lowest in Greece (25%). The survey findings also show that a building logbook is more frequently provided when property is bought (43%) than rented (24%). This is illustrated in more detail further below.

²⁹ Volt, J., et al. (2018). Understanding potential user needs. Available at: <http://ibroad-project.eu/wp-content/uploads/2018/04/iBRoad-Understanding-potential-user-needs.pdf> (accessed 30 April 2020)

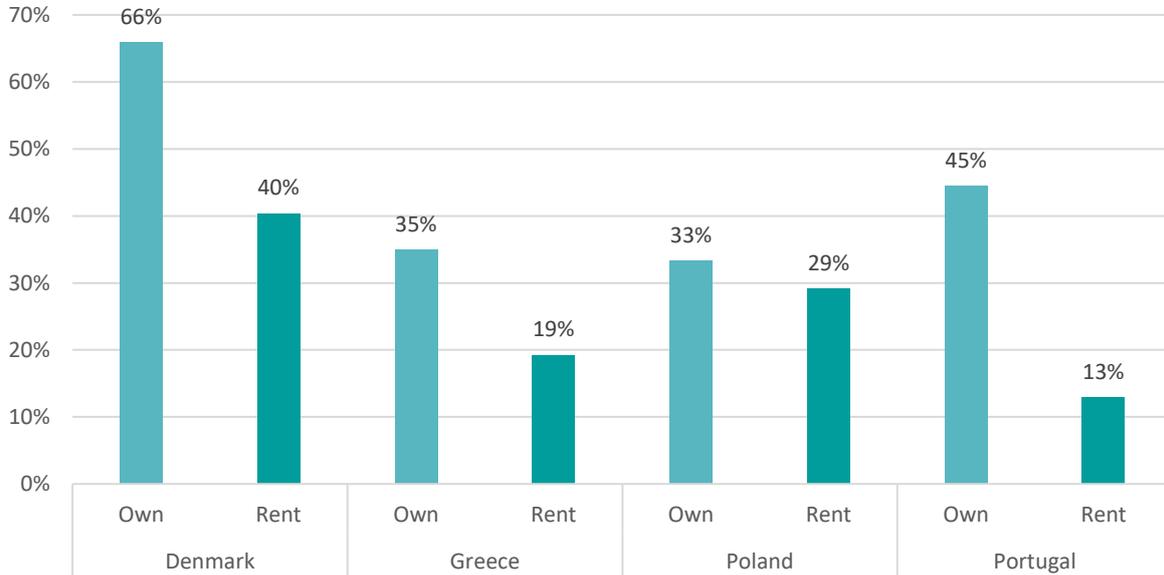
Figure 1.10: % that received a folder with all the building-related documents

More homeowners and landlords that recently sold or let property indicated that they provided a building logbook to buyers or tenants (49%, see Figure 1.11:.) than consumers confirming that they received such documentation (36%).

Figure 1.11: % that provided a folder with all the building-related documents to buyers or tenants

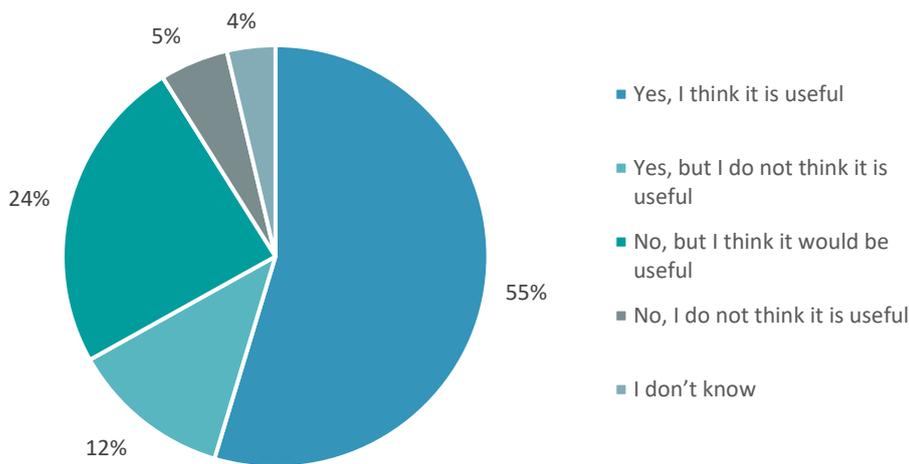
As mentioned above, the availability of a logbook varies between properties that are bought and properties that are rented. Figure 1.12: shows the differences within countries. In particular for Portugal the discrepancy is noticeable as it amounts to about 30 percentage points. In Poland, the variation between rented and owned property is smaller than in the other countries (29% and 33%, respectively).

Figure 1.12: % that received a folder with all the building-related documents by tenure status and country³⁰



Among homewoners and tenants that received a building logbook, the majority (67%) keeps it up to date and thinks it is useful (55%). One-fourth (24%) do not keep it up to date with new information on maintenance or alterations to the property, but think it would be useful.

Figure 1.13: Upkeep of the building logbook

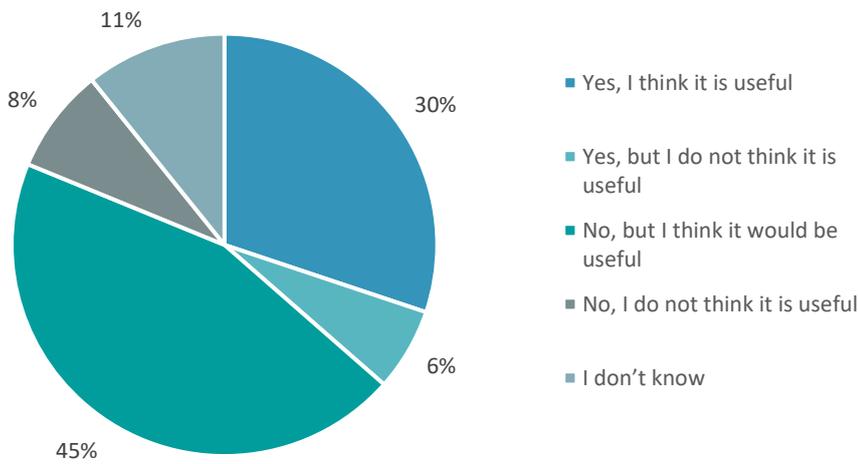


³⁰ Romania is not included in the figure because the number of tenants is 55 and thus considered as too small to be statistically meaningful.

Base: Homeowners and tenants who received a building logbook when buying/renting their home

One-third of homeowners and tenants (36%) put together a folder or document with all the building related documents if no such documentation was available, which suggests a strong interest from these consumers to have this information and documentation. Almost half of respondents (45%) have not created a logbook but think it would be useful.

Figure 1.14: Creation of a building logbook



Base: Homeowners and tenants who did not receive a building logbook when buying/renting their home

Tailored recommendations

If respondents were to make their home more energy efficient³¹, they would find it useful to have details on previous energy renovations, information on available measures and relevant recommendations in their EPCs (Table 1.8:). Younger respondents (18-24 years old) would find this information less useful than older age groups. Also homeowners and tenants in rural areas see less value in these details. Overall, recommendations are more appreciated by consumers surveyed who are conscious about their energy use and who consider energy efficiency important when buying or renting property.

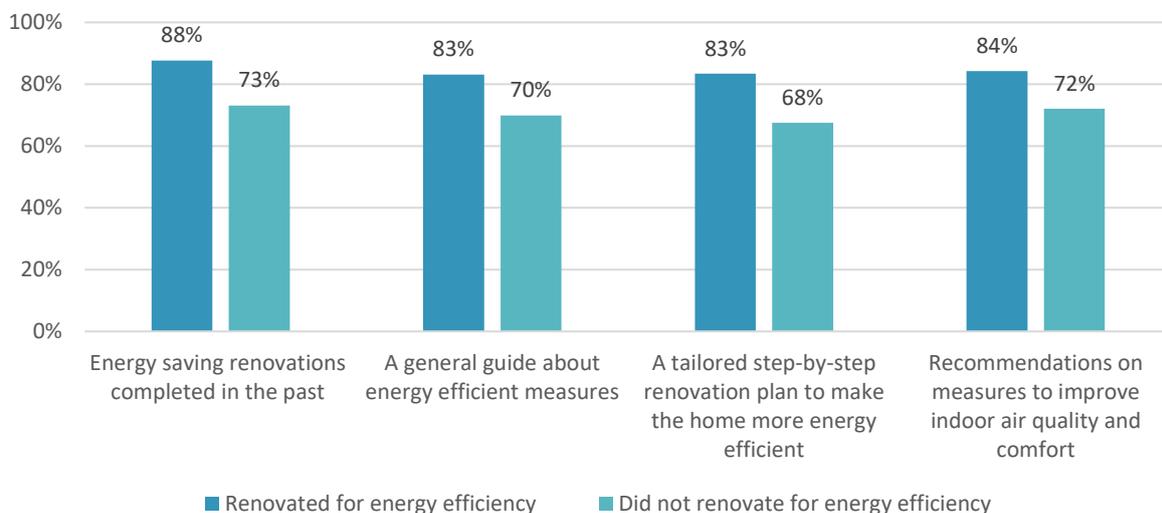
³¹ Definition of 'energy efficiency' used in the survey: "By energy efficient we mean making a home more efficient in saving energy, e.g. by installing wall insulation, or installing a more efficient heating system."

Table 1.8: Perceived usefulness of tailored recommendations in the EPC

	Total	Denmark	Greece	Poland	Portugal	Romania
Energy saving renovations completed in the past	82%	75%	87%	82%	82%	86%
A general guide about energy efficient measures	78%	71%	82%	77%	78%	82%
A tailored step-by-step renovation plan to make the home more energy efficient	78%	65%	82%	78%	82%	82%
Recommendations on measures to improve indoor air quality and comfort	80%	74%	82%	80%	83%	83%

Of those homeowners and tenants that renovated in the past five years, are currently renovating or are planning to renovate, 61% stated that this activity includes or included an improvement to make their home more energy efficient (and 22% said that this was not the case). Figure 1.15: shows the differences in the perceived usefulness of tailored recommendations in the EPC between these two groups. Expectedly, recommendations are perceived as more helpful if the renovation had the intention of improving the energy efficiency of the home.

Figure 1.15: Perceived usefulness of tailored recommendations in the EPC by reason to renovate



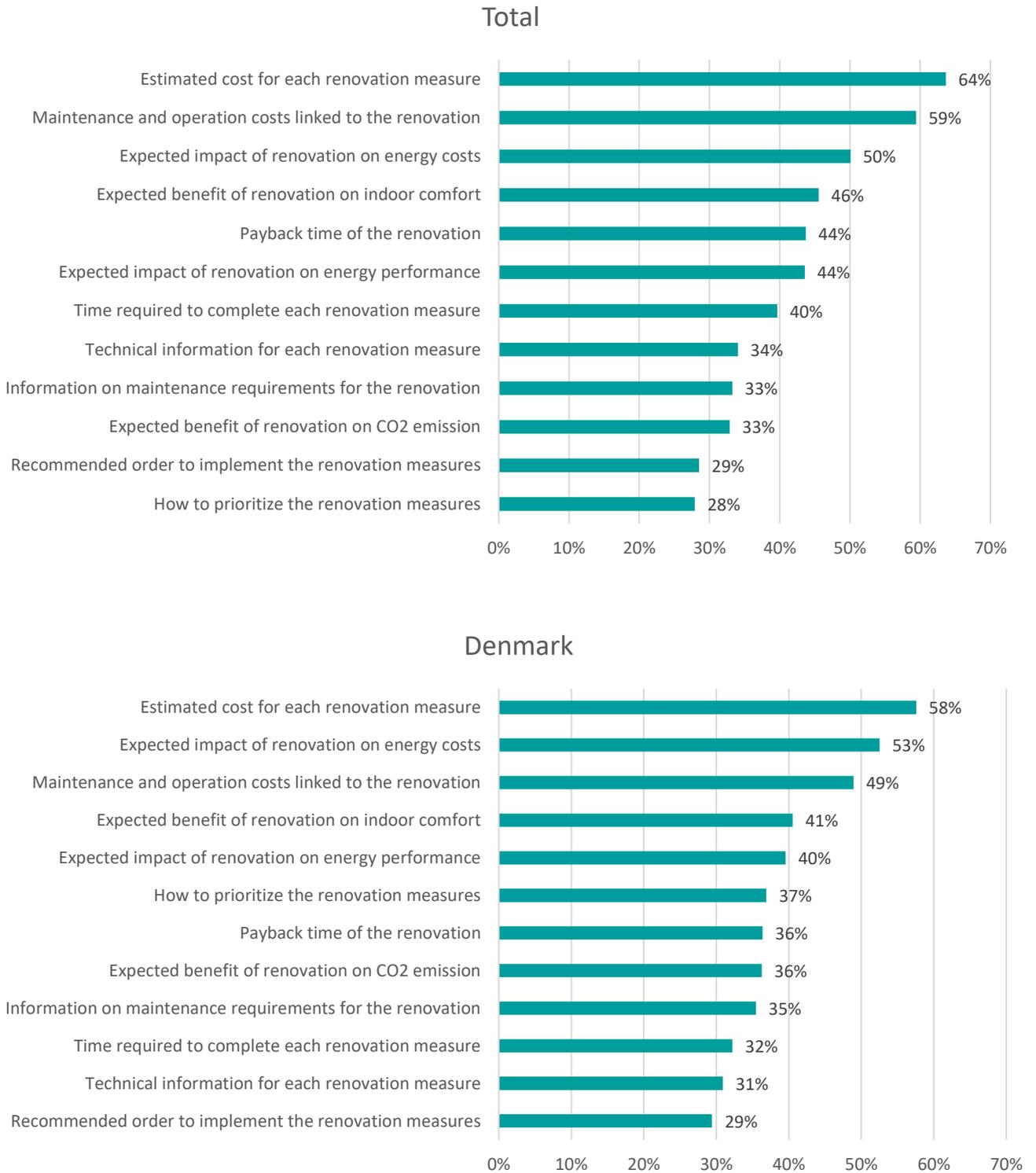
If respondents were to make their home more energy efficient, they would find it most useful to receive information and recommendations related to the costs involved. Technical details are considered as less useful, though still relevant. In particular homeowners and tenants who are conscious about their energy use consider the different information and recommendations listed in Figure 1.16: useful.

Country specificities can be observed:

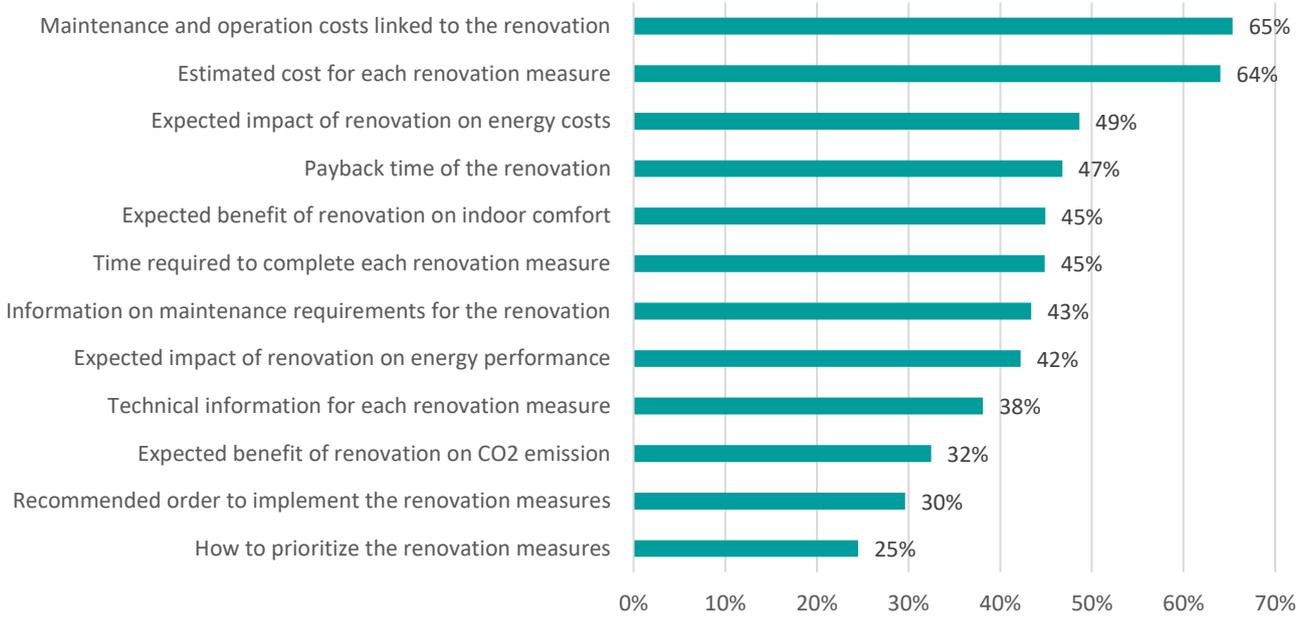
- Respondents in Denmark consider recommendations on how to prioritise measures more useful than the average (37% vs. 28%). Half of homeowners and tenants surveyed in Denmark would find maintenance and operation costs linked to the renovation informative, which is less than the average observed across the five countries (49% vs. 59%).³²
- Information on maintenance requirements for the renovation is considered more useful in Greece (43%) than across all survey countries together (33%).
- One-fifth (18%) of respondents in Portugal view recommendations on the order to implement the renovation measures as helpful, while this would be beneficial for 29% of the total sample. Homeowners and tenants surveyed in Portugal show a higher interest in the expected benefit of the renovation on indoor comfort (55%) than the average (46%).
- Half of the respondents in Romania (51%) consider that knowing the time required to complete each renovation measure is useful, while this applies to 40% of the total sample.

³² This may be related to the insight that more respondents in Denmark stated that it is (fairly) easy to make ends meet every month compared to the other survey countries, which suggests that costs are less of a concern for a higher proportion of the sample in Denmark.

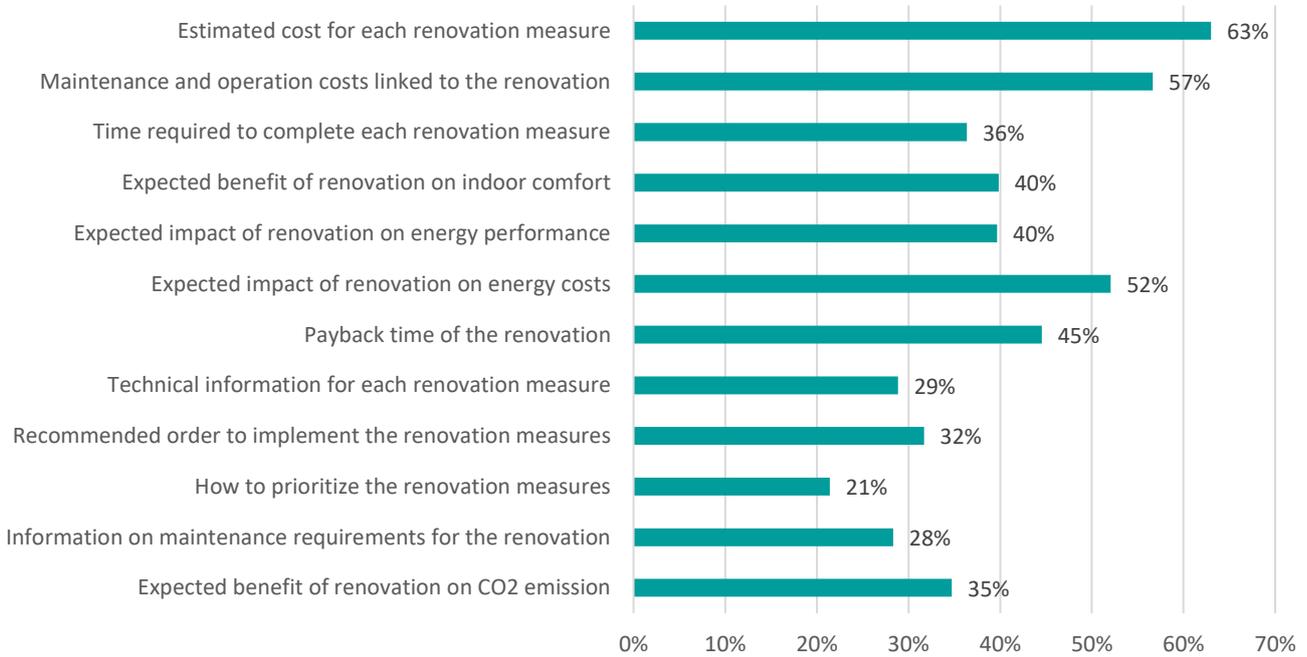
Figure 1.16: Perceived usefulness of tailored recommendations and information



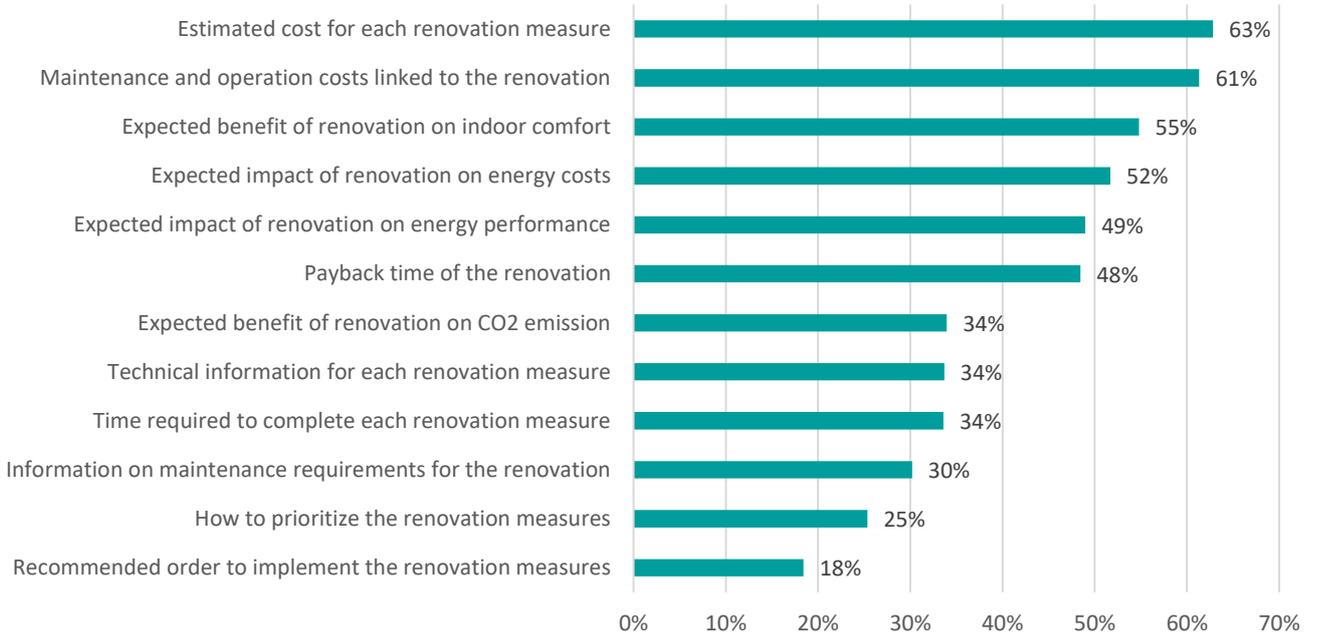
Greece



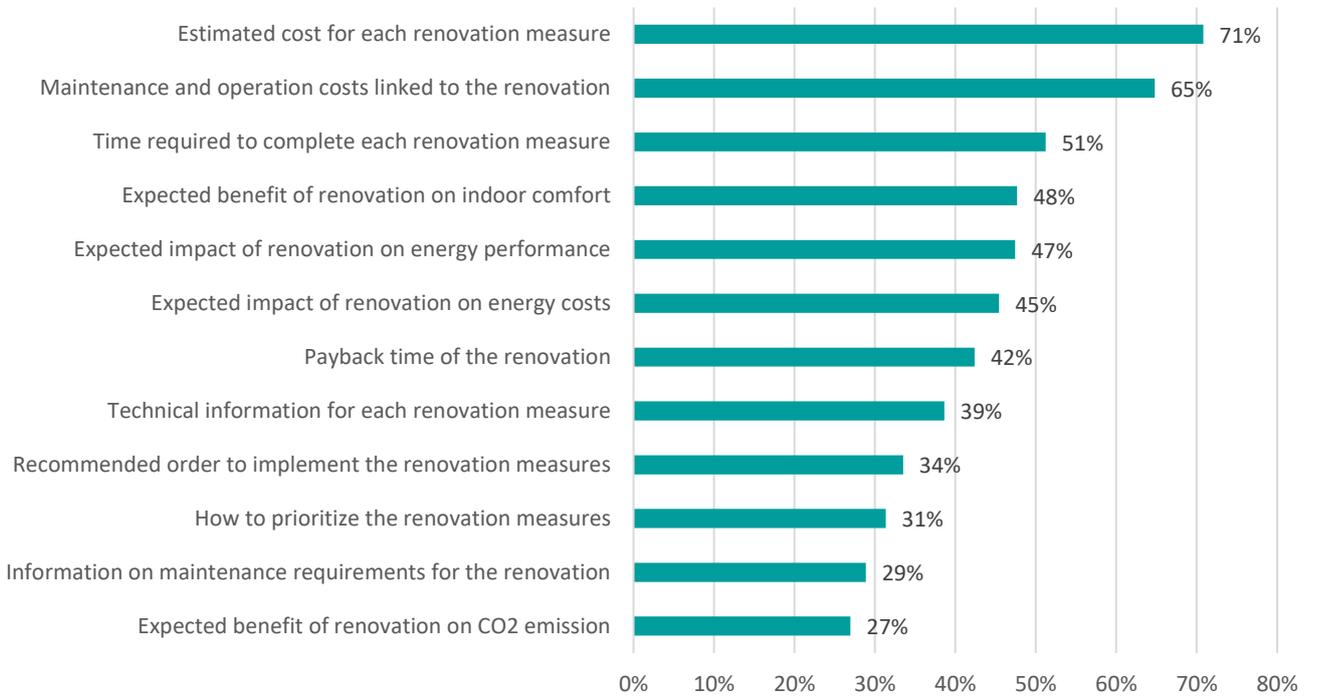
Poland



Portugal

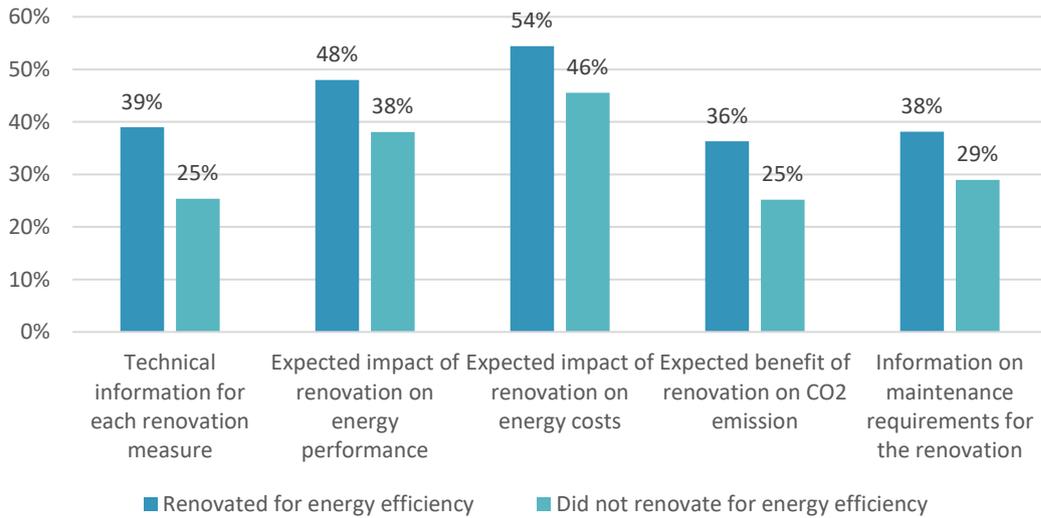


Romania



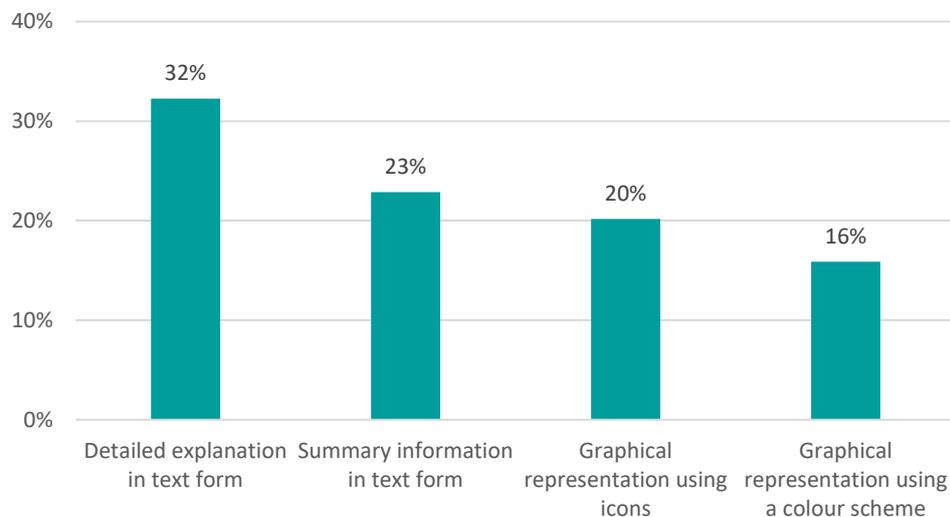
Again, specific information or recommendations are perceived as more or less useful depending on whether renovation measures were intended to make the home more energy efficient. Figure 1.17: shows the differences that are statistically significant.

Figure 1.17: Perceived usefulness of tailored recommendations and information by reason to renovate



The highest percentage of respondents think the most useful way to present recommendations about energy renovations in EPCs is a detailed explanation in text form (32%). Still, also a summary information in text form (23%), a graphical representation using icons (20%) and a graphical representation using a colour scheme (16%) are considered most beneficial by a significant proportion of consumers surveyed.

The preference order is the same in all countries, except Portugal where a graphical representation using a colour scheme is the second most selected way of useful presentation (25%). This question showed generational differences as well; a detailed explanation in text form is more interesting for older consumers (36% of the 55+ age group) than younger ones (22% of the 18-24 age group), while younger homeowners and tenants more frequently prefer a graphical representation using icons (31% compared to 16% of the 55+ age group).

Figure 1.18: Frequency of as most useful perceived way of presenting recommendations

Financing options

Respondents find it useful to have information in their EPCs on how to access different financing options for renovations (71%). This information is perceived as helpful particularly by consumers who have renovated or are currently (planning to) renovating to increase the energy efficiency of their home (77% compared to 58% who did or do not renovate for energy efficiency).

Table 1.9: Perceived usefulness of financing options in the EPC

	Total	Denmark	Greece	Poland	Portugal	Romania
How to access different financing options for renovations	71%	57%	79%	75%	68%	77%

Four-fifth of respondents in **Greece** (79%) consider it useful to have in their EPCs information on how to access financing options for renovations. Previous studies have shown that in order to encourage (energy) renovation in the country, consumers need to receive advice and information on available financial support³³ and bureaucratic barriers to receive loans from financial institutions

³³ iBRoad Factsheet: Greece available at: [http://bpie.eu/wp-](http://bpie.eu/wp-content/uploads/2018/01/iBROAD_CountryFactsheet_GREECE-2018.pdf)

[content/uploads/2018/01/iBROAD_CountryFactsheet_GREECE-2018.pdf](http://bpie.eu/wp-content/uploads/2018/01/iBROAD_CountryFactsheet_GREECE-2018.pdf) (accessed 07 May 2020)

have to be reduced³⁴. It was also noted that there is a significant financial gap for energy efficiency interventions³⁵, while at the same time residents in Greece are among the ones most affected by energy poverty in Europe³⁶.

Respondents consider various information related to financing options for renovations relevant (such as a brief description, the different options that exist and how to apply for these) Table 1.10: Again, a difference in the perceived relevance can be observed between respondents who have renovated or are currently (planning to) renovating with the intention to increase the energy efficiency of their home and those without this intention: the first group sees the information listed in Table 1.10 as more beneficial (81% on average compared to 70% on average of the second group). There are also differences in terms of other characteristics. Homeowners and tenants that are generally more conscious about energy use are more interested in financing options than the overall sample. The same applies if it is (rather) difficult for households to make ends meet at the end of the month. Homeowners and tenants in rural areas are less interested in information on financing options than the average.

Table 1.10: Relevant information on financing options to implement renovation measures

	Total	Denmark	Greece	Poland	Portugal	Romania
Different financing options available	77%	64%	84%	83%	78%	78%
Realtime information related to the available financing options	75%	57%	84%	78%	75%	79%
How to apply for different financing options	76%	60%	81%	86%	74%	81%

³⁴ Report on the long-term strategy to mobilise investment in the renovation of private and public residential and commercial buildings in the national building stock. Available at:

https://ec.europa.eu/energy/sites/ener/files/documents/el_building_renov_2017_en.pdf (accessed 07 May 2020)

³⁵ BPIE (2017). A snapshot of national renovation strategies. Examples from selected EU Member States. Available at:

http://bpie.eu/wp-content/uploads/2017/11/Renovation-Strategies_Final.pdf (accessed 07 May 2020)

³⁶ Artola, I., et al. (2016). Boosting Building Renovation: What potential and value for Europe? Brussels: European Parliament.

Brief description of different financing options	78%	65%	85%	82%	77%	79%
Detailed description of available financing options	74%	56%	79%	82%	74%	78%
Contact information to learn about detailed financing options	75%	60%	83%	83%	72%	78%

One-stop-shops

The majority of homeowners and tenants (57%) would use a one-stop web portal where they can go with renovation-related questions and get in contact with building professionals – if it was free. One-fourth (25%) would be willing to pay a small fee for such services. Those that are in general more conscious about their energy use at home would be rather willing to pay for the services.

	Total	Denmark	Greece	Poland	Portugal	Romania
% that would be willing to pay a small fee for such a service	25%	26%	26%	21%	20%	32%
% that would use the service but only if offered for free	57%	48%	63%	60%	64%	51%
% that would (probably) not use the service	10%	15%	6%	10%	10%	9%

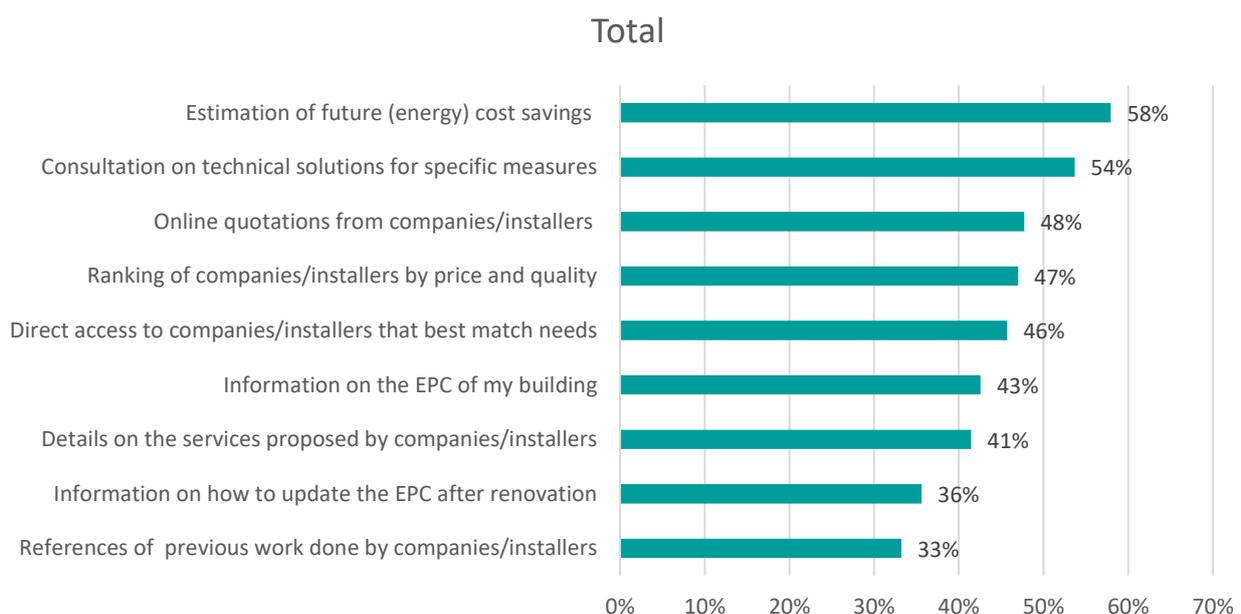
The survey findings show that no category of information or services is favoured over the other to receive in a one-stop web portal for renovation-related questions (Figure 1.19:). Calculations, advice and price quotes for renovation measures are equally interesting services for around half of homeowners and tenants. At least one-third would also like to receive information related to the EPC and specific details on companies and installers.

Noteworthy, the interest in the option of online quotations varies across the survey countries. This service appeals more to consumers in Greece (65%) and Portugal (63%) than Denmark (34%), Poland (40%) and Romania (36%). Other country specificities can be observed:

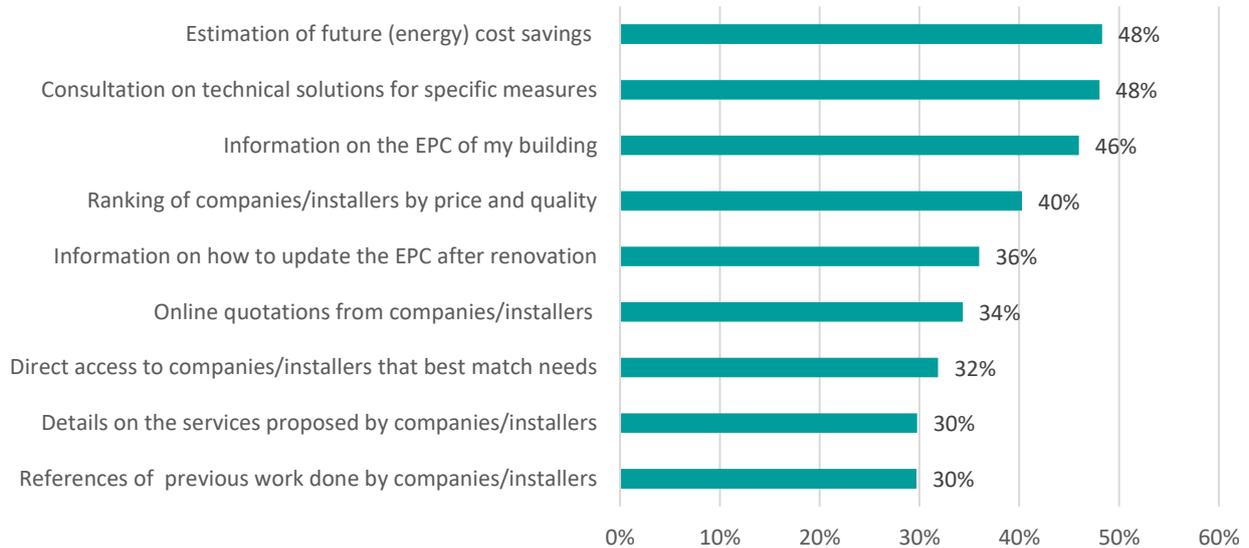
- Fewer respondents in Denmark would like to receive details on the services proposed by companies and/or installers and direct access to them.
- Consultation on technical solutions for specific measures would be particularly interesting for respondents in Greece (66%) but less so in Portugal (44%).
- The proportion of respondents interested in EPC related information is lower in Poland than in the other countries.
- Homeowners and tenants surveyed in Romania would specifically appreciate direct access to companies and/or installers that best match their needs.

A higher number of respondents with lower secondary education or less do not consider any of the services relevant to receive (14% compared to 9% and 6% of individuals with up to post-secondary non-tertiary education and tertiary education, respectively). The same applies to respondents from rural areas (13% vs 7% on average), this is particularly noticeable concerning the service to rank companies and/or installers according to price and quality; 38% of homeowners and tenants in rural areas would like to have this service compared to 52% of residents in large cities. As shown for other tools and services to improve the energy performance of the property, consumers that are generally more conscious about their energy use and those that renovate or have renovated to increase the energy efficiency of their home perceive the different services in one-stop-shops as more relevant.

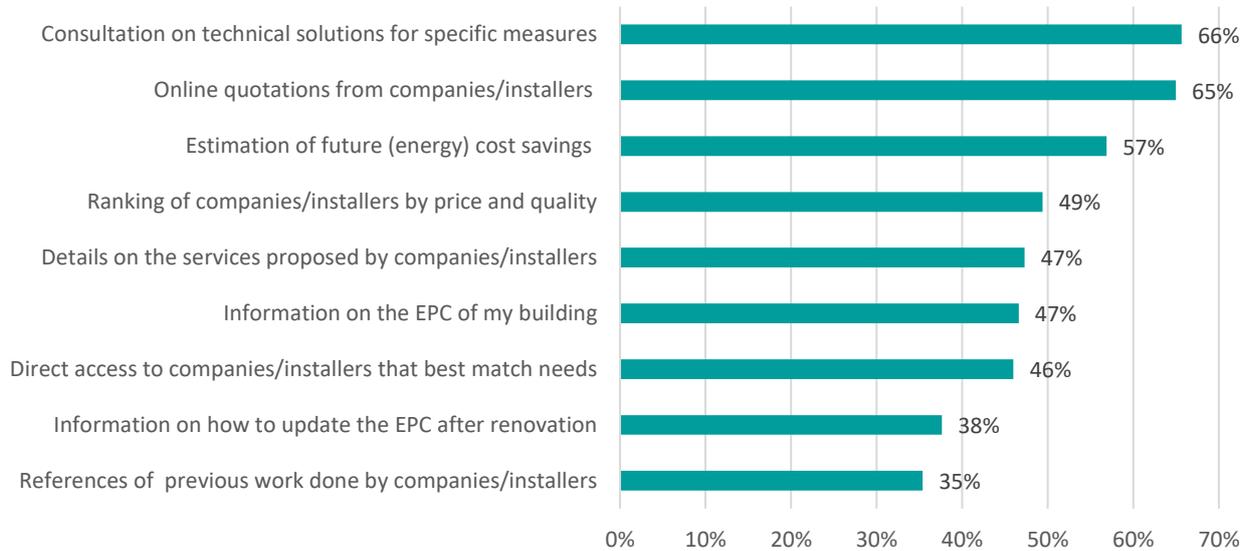
Figure 1.19: Services consumers would like to receive in a one-stop web-portal



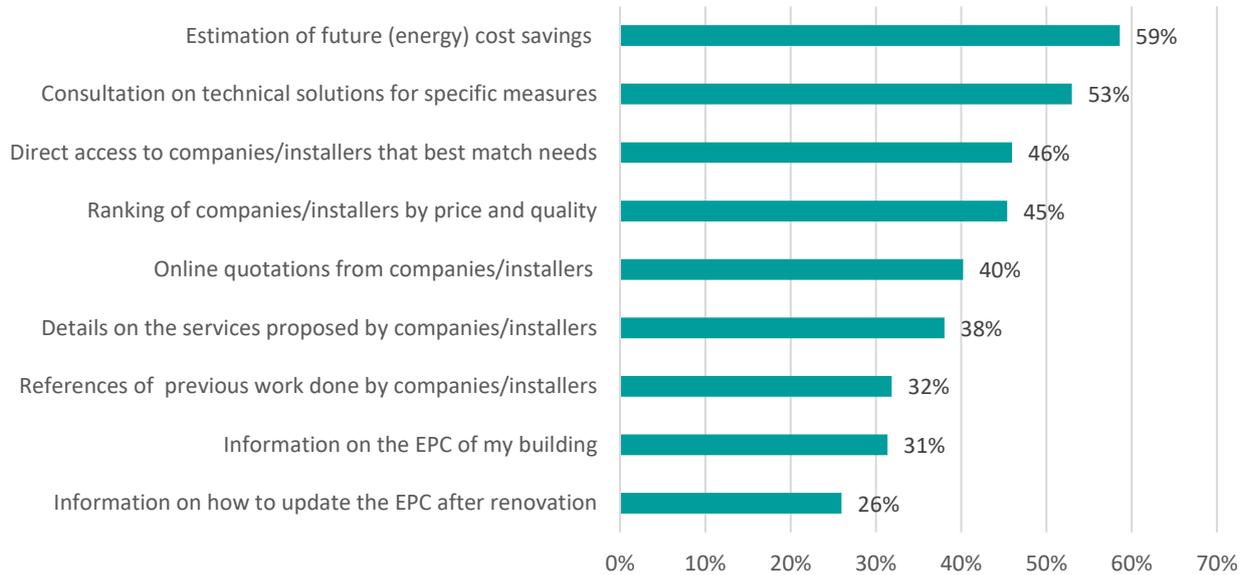
Denmark



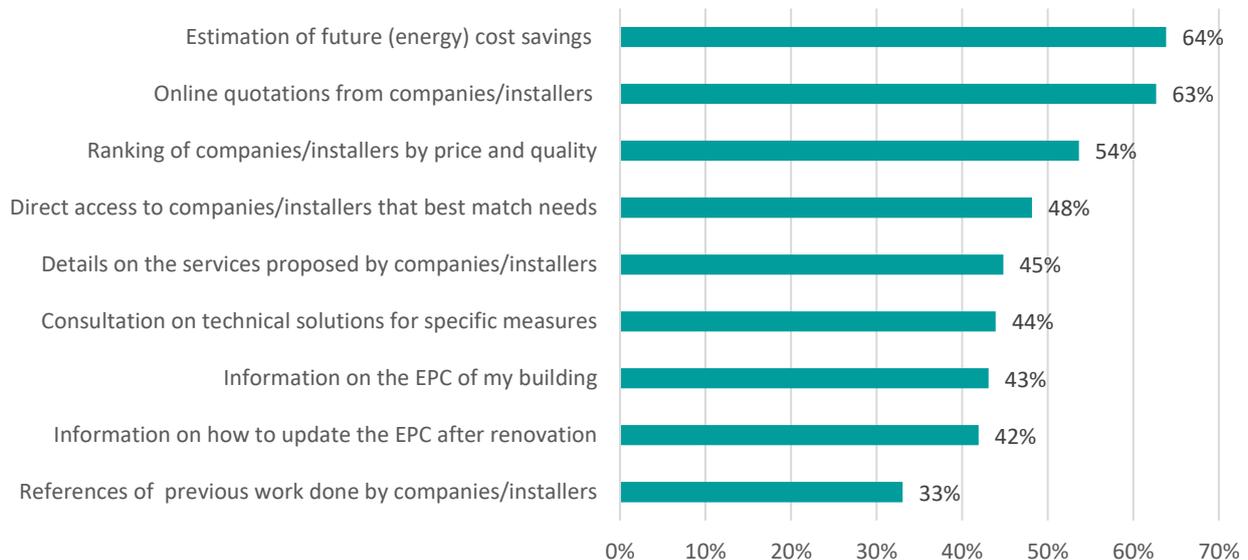
Greece



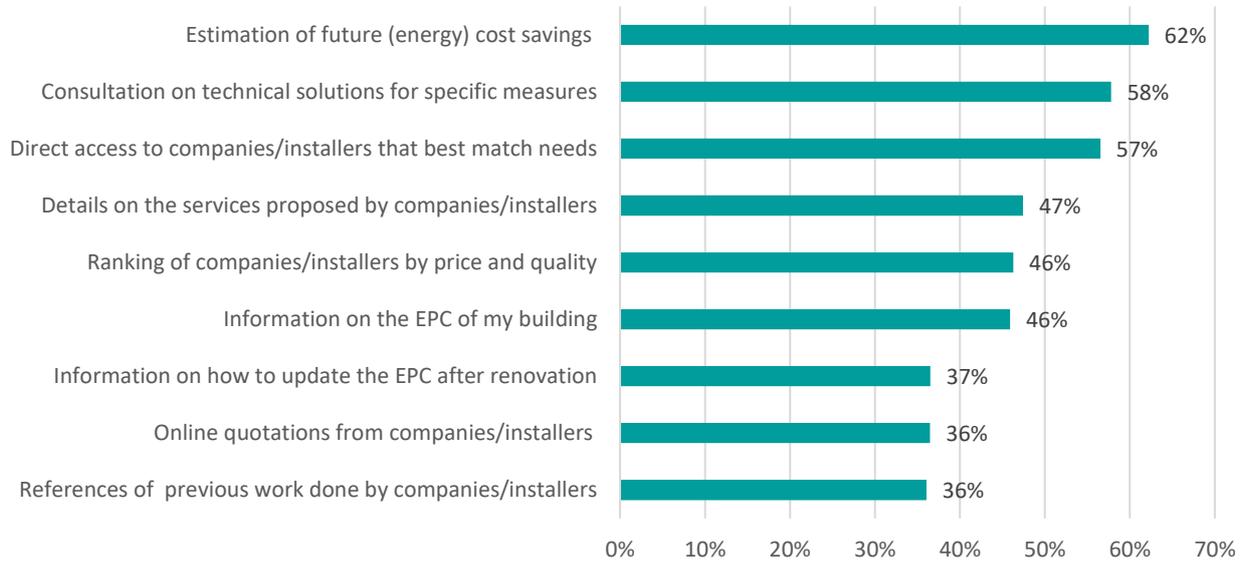
Poland



Portugal



Romania



Summary

The overall sample demonstrates a rather energy-conscious attitude and the ideas of the ten features were perceived positively, despite occasional unfamiliarity with concepts such as smart technology. There were only small differences in the perceived usefulness or importance of the different elements of the ten features, with **smart homes, comfort, real energy consumption, EPC database, tailored recommendations and financing options** being seen as slightly more beneficial or interesting than **outdoor air pollution, district heating, the building logbook and one-stop-shops**.

Overall, a higher number of respondents are interested in information that has a direct relevance for their home and household. For example, comparisons on the real energy consumption is perceived as more useful with the previous year than with similar households. For the EPC database, it would be more valuable for respondents to see the energy efficiency score of similar properties than all properties in the neighbourhood. At the same time, consumers want to ensure confidentiality of the data they share.

Tailored recommendations and financing options have a higher relevance if any renovation work is intended to improve the energy performance of the home. Regarding renovations, generally, information on costs have the highest informative value for respondents; this is visible in the sections of tailored recommendations and one-stop-shops. However, the willingness to pay for these services is rather low.

The ten features are viewed most positively if homeowners or tenants are conscious about their energy use at home and energy performance is an important aspect when buying or renting property. Likewise if respondents have recently completed or started a renovation project, particularly if this project aims to improve the energy efficiency of their homes.

Somewhat recurring variations in perceptions and attitudes can be found in relation to area of residence³⁷ and age group (for example for smart readiness, tailored recommendations and one-stop-shops). Differences between homeowners and tenants are rarely significant, at most with regards to the importance of the energy efficiency when buying or renting property or when respondents surveyed intended to make their home more energy efficient through renovations.

³⁷ The features are less appealing to rural residents although the interest is generally still high.

Methodology

This section provides a short overview of the profiles of respondents, the countries covered and the questionnaire design. It also provides key fieldwork statistics and describes how the data was validated and processed.

Profile of respondents

The target group of the survey were homeowners, landlords and tenants (18 years old or older) who had:

- bought, rented, sold, let or renovated property in the past 5 years (2015 - 2020).
- attempted to buy, rent, sell, let or renovate property in the past 5 years (2015 - 2020).
- taken first steps to buy, rent, sell, let or renovate property.

The different activities (whether they had been completed or not) are represented in the sample to the following proportions:

Buy	Rent	Sell	Let	Renovate ³⁸
46%	34%	27%	25%	86%

These figures demonstrate a balanced sample in terms of the three different target groups (homeowners, landlords and tenants).

- The vast majority of respondents were homeowners themselves (69%). Almost one-third (30%) owned at least one rental property. Among the respondents that bought a property or attempted/started to do so, the majority (58%) used or intended to use the property as primary residence; fewer to rent it out (8%).
- 65% of the respondents had completed a renovation project in the past five years. Half (52%) had planned or thought about renovating in the near future, while 29% did not think

³⁸ Renovation described to respondents: "By renovating we mean major changes to the physical properties of your home or rental property. For example, 'renovating' may mean fitting a new bathroom, replacing the heating or the cooling system, installing new windows or insulation. 'Renovating' does not include redecorating, or changing appliances (e.g. new kitchen stove), although these may be done alongside more major renovations."

about renovations. Two-third (67%) strongly agreed that renovations could reduce their household's energy use.

A large proportion of the sample had tried to reduce the amount of energy they used at home (78%) or thought there was more they could do to reduce their usage (72%). Still, 40% stated being more concerned about having a warm and comfortable home than saving energy.

Most of the respondents lived in a flat/apartment (41%) or separate house (35%), fewer in a semi-detached or row house (6% and 7%, respectively). However, the proportions varied slightly between the survey countries. 62% lived in a large city or the suburbs/outskirts of a large city. 13% resided in a rural area. Here as well country differences could be observed. The majority of respondents described their household as 'couple' with (40%) or without (25%) children. Half were full-time employed (51%).

Survey countries

The survey was conducted in five countries: Denmark, Greece, Poland, Portugal, Romania. These countries were selected as they provide a balanced mix with respect to the following six dimensions:

1. Inclusion as test countries in the X-tendo project;
2. Geographic representation (South, North, East and Central Europe);
3. Country size;
4. Tenure status in the population (variation in share of owners vs tenants)³⁹;
5. % of consumers having moved in the past five years⁴⁰; and
6. EPC regime (variation in the strength of EPC compliance checking and compliance rates)⁴¹.

The variations among the abovementioned variables were essential in order to not only analyse the survey data by country and compare countries, but also to evaluate the data as representative of the EU Member States.

Questionnaire development

The questionnaire was developed based on a set of preliminary questions provided by the BPIE. The main objective of this exercise was to formulate questions that allow to understand the expectations

³⁹ See Eurostat database ilc_lvho02

⁴⁰ For example Eurostat database ilc_hcmp05

⁴¹ See, for example, <https://ec.europa.eu/energy/en/studies/energy-performance-buildings-directive-epbd-%E2%80%93-study-compliance>

and needs of EPC end users in terms of the ten proposed features of the X-tendo project, which required a careful assessment of the informative value of each question. Desk research further informed the translation of these questions into a comprehensive and coherent questionnaire, tailored towards the use as online survey on different devices (desktop, tablet, mobile phone).

The formulation of the questions that identified the target group (i.e. homeowners, tenants and landlords that have recently bought, rented, sold, let or renovated property, or have attempted or started to do so) required particular attention. Five questions (so called screener questions) were asked to determine whether a panellist was eligible to participate before the survey's objectives were introduced and respondents were shown the first question.

Once the questionnaire had been finalised, the scripting and technical set-up of the questionnaire was managed by Ipsos Interactive Services (IIS), the team responsible for all online survey work for the Ipsos Group. The questionnaire was translated into Danish, Greek, Polish, Portuguese and Romanian by native/mother tongue speakers from a professional translation agency. The translation was followed by a single reviewing session by a second translator and afterwards implemented in the script and tested by the Ipsos project team before fieldwork commenced.

Data collection

The consumer survey was conducted in April 2020 using **online interviewing methodology** (i.e. Computer Assisted Web Interviewing; CAWI). In all countries, Ipsos (non-probability/volunteer) online access panels were used as a sampling frame.⁴² Respondents were randomly drawn from the online panels based on their profile data (gender, age, region) to ensure a sample representative of the general (online) population in terms of these three characteristics.

The survey was first launched with 100 respondents in each country. This soft launch allowed the project team to assess whether each target group (homeowners, landlords and tenants) and activity (buying, renting, selling, letting and renovating property) was represented in the sample, and - if necessary - whether the eligibility criteria needed to be reviewed. The exercise showed a good 'mix' of the different groups and therefore required no amendments to the screener questions. The coverage of the target groups and the different activities were monitored throughout fieldwork. In section **Error! Reference source not found.** it is further described how we ensured representativity in the final data set in terms of age, gender and region within the country.

⁴² An online access panel is a group of pre-recruited individuals who have agreed to take part in research.

The incidence rate was 85%, which is higher than the percentage expected based on other representative surveys and Eurostat data that cover topics such as moving houses (for example the EU Statistics on Income and Living Conditions survey), although in line with other recent studies on (energy) renovations.⁴³ The incidence rate varied across countries, ranging from 71% in Denmark to 94% in Poland. It is noteworthy that the percentage among homeowners and tenants with less than primary, primary or lower secondary education that was not eligible to participate was higher (34%) than the percentage among those with upper secondary or post-secondary education (15%) or tertiary education (11%), suggesting that the activities are more frequently performed by individuals with higher education. The fieldwork statistics also suggest that individuals aged 25 to 44 have a higher probability of performing the activities within a time frame of five years.

The **final sample size is 2,563**, with varying sample sizes of 501 to 519 per country.

Data Processing and Weighting

Data cleaning and validation

The data validation was a continuous process to ensure that the collected data is of a high quality. The objective of the validation process was to detect single interviews of poor quality. Ipsos identified these cases by assessing the following statistical criteria:

- **Duration of the interview:** Interviews that had been completed very fast were treated as suspicious and verified more in depth. However, the interview duration can also depend on the language the interview is conducted in. Some languages simply need more words to express the same thing.
- Within item blocks, Ipsos checked for “**straightliners**”. The more frequently a respondent enters an “X” in the same place, the less they think about the individual question. Excessive deviations suggest that the questions have probably been completed/answered on a chance basis.
- The **item non-response** was calculated by summing the codes of “Don’t know” and “Not applicable” of each question. This sum is afterwards divided by the total number of

⁴³ For example, DG ENERGY (2019). Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/1.final_report.pdf (accessed 23 April 2020), or Volt, J., et al. (2018). Understanding potential user needs. Available at: <http://ibroad-project.eu/wp-content/uploads/2018/04/iBRoad-Understanding-potential-user-needs.pdf> (accessed 30 April 2020)

questions that a respondent answered and contained at least one of these codes. The result is represented as a percentage.

Interviews that were flagged as having poor quality were removed from the data set and not used for the analysis. Only data of verified and completed interviews were used for the analysis and are included in the final clean data set.

Weighting

The purpose of weighting is to make the results representative for the national population in terms of socio-demographic characteristics. It rarely occurs that the raw data 100% match the survey target. In order to correct for this deviation, Ipsos applied weights. The weight value indicates how much each interview will count in the analysis.

The population distribution can ideally be obtained from national statistical institutes, but there are standardised procedures if that is not possible. For this survey, no reference statistics exist for the targeted activities and a multi-staged weighting approach was taken. The weighting targets were deducted from the survey itself. Therefore, Ipsos used the total of panellists who entered the survey as basis, including those that were screened out because they did not buy, rent, let, sell or renovate in the past five years, or attempted/started to do so. In detail, the following steps were taken:

1. After removing the interviews of poor quality from the raw data set, Ipsos applied a weight representative for age, gender and region by country to the data file (i.e. the cleaned data file with the accepted interviews and the screened-out respondents).
2. With this active weight, Ipsos computed the frequency distribution of country x gender, country x age, and region to obtain the profile of the eligible population (i.e. excluding the “screen-outs”) and create a final weight representative of this group.
3. In the final data file, Ipsos applied the final weight so that the results are representative for country x gender, country x age, and region of those who bought, rented, let, sold or renovated in the past five years, or attempted/started to do so.

Recoding

For the purpose of reporting the findings of the survey, item responses were summed to create a score for a group of items. It was proceeded as follows for the different Likert-Type Scales:

- 5-point Likert scale: The two upper and the two lower items were summed. For example: If it is reported that a respondent considers something ‘helpful’, this means they either selected 4 or 5 on the scale.

1. Not at all helpful
2.
3.
4.
5. Very helpful

- 11-point Likert scale: Items 0-3, 4-7 and 8-10 were summed. For example: If in the report something is stated as being ‘important’ for respondents, they selected either 8, 9 or 10 on the scale.

0. Not at all important
1.
2.
3.
4.
5.
6.
7.
8.
9.

10. Very important



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