Oct, 2025
GRINS DISCUSSION PAPER SERIES DP N° 63/2025 ISSN 3035-5576

GRINS

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DP N° 63/2025

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Oct, 2025
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KEYWORDS

energy efficiency | Energy Performance of Buildings Directive | Superbonus | Environmental awareness | Italian Survey of Consumer Expectations

JEL CODE

D10, Q40, C25

ACKNOWLEDGEMENTS

This study was funded by the European Union - NextGenerationEU, in the framework of the GRINS - Growing Resilient, INclusive and Sustainable project (GRINS PE00000018). The views and opinions expressed are solely those of the authors and do not necessarily reflect those of the European Union, nor can the European Union be held responsible for them.

We are grateful to Lorenzo Forni, Tullio Jappelli and Stefania Tomasini for their feedback on the setup of the special section's questionnaire. We also thank Francesco Giovanardi, Lorenzo Prosperi and Sedric Zucchiatti for useful comments. We acknowledge funding from the European Commission, Next Generation EU, Project "GRINS - Growing Resilient, INclusive and Sustainable", id code MUR PE00000018, CUP B33D22001700006. We declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper and that the opinions expressed herein are our own and do not necessarily reflect those of the affiliated institutions. All remaining errors are our own.

CITE THIS WORK

Author(s): Elena Giarda, Filippo Giuglini, Michele Penza. Title: Households' behaviour and attitudes towards energy efficiency measures in Italy: New evidence from survey data. Publication Date: 2025.

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Households'behaviour and attitudes towards energy efficiency measures in Italy: New evidence from survey data

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This version: September 2025

Abstract

This paper explores Italian households'environmental attitudes and awareness, focusing on the role of demographic and socioeconomic factors, using data from the October 2024 wave of the Italian Survey of Consumer Expectations (ISCE). We find that awareness of energy efficiency policies is unevenly distributed among the population with renters, women, and Southern residents being less informed. Access to financial incentives, such as the Superbonus and Ecobonus schemes, favours higher-income households in Northern Italy and is influenced by both private advice and public information campaigns. Support for renovation policies is linked to prior participation in these schemes, and economic motives largely drive renovation decisions, while environmental concerns remain secondary. Financial incentives appeal more to affluent groups. These findings highlight the need for more targeted outreach and equitable policy design to strengthen the link between climate awareness and households'behaviour.

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1 Introduction

In 2022 in the EU consumption of final energy of private households in citizens'dwellings was the second highest (27%) after the transport sector (31%), followed by industry (25%), commercial and public services (13%) and agriculture, forestry and fishing (3%) (EC, 2024). Moreover, in Europe residential buildings are responsible for 11% of greenhouse gases (GHG) emissions from energy use (IEA, 2023). To boost the energy performance of buildings, the EU established a legislative framework that includes the revised Energy Performance of Buildings Directive (EPBD) and the revised Energy Efficiency Directive (EED). The directives collectively support policies aimed at achieving a highly energy-efficient and decarbonised building stock by 2050. Specifically, the latest revision of the EPBD entered into force in May 2024 and Member States have until May 29, 2026, to transpose it and align their national legislation accordingly. It includes a binding target to increase the average energy performance of the national residential building stock by 16% by 2030 in comparison to 2020, and by 20-22% by 2035.[1] The implementation of the directive is expected to pose significant challenges from both an economic and policy perspective, especially regarding how Member States will adapt it to national contexts and handle the associated fiscal and administrative burdens.

The reduction of emissions can be tackled through two broad types of intervention, supply-side technological improvements and demand-side individual or household behaviour changes, which are both critical to addressing environmental issues (Hassett et al., 2024). As far as demand-side policy measures are concerned, Italy's Government has implemented some interventions aimed at enhancing the energy efficiency of the country's housing stock. The first one—introduced with the 1998 Budget Law—consisted of a tax credit for housing renovations ("Bonus casa"), which in 2007 was expanded to target energy-efficiency upgrades ("Ecobonus"). In 2020, the "Rilancio" Decree introduced a 110% tax credit for energy efficiency renovations, conditional on improving building's energy performance by two classes, the so-called "Superbonus 110%". Given the huge burden on Italy's public finances—the measure cost €124.2 billion between 2020 and 2024 (ENEA, 2024)—the tax credit was reduced to 70% in 2024 and to 65% in 2025 and will drop to 36% thereafter. Despite the drawback of its cost, the measure was effective in enhancing the overall energy efficiency of Italy's residential stock, with a steady fall in the percentage of buildings in the

[1] For a quantification of the costs and benefits of the EPBD in Italy, see Forni et al. (2025a).

least efficient energy class (from 32.8% in 2019 to 22.7% in 2024). However, there is evidence that part of the expenditure was a deadweight loss, as the renovation work would have occurred even without the incentives (Accetturo et al., 2024).

Environmental policies are often evaluated based on three key elements: economic efficiency, environmental effectiveness, and political and social acceptability (IEA, 2024). Therefore, for a policy to be effective, it must be well designed from an economic point of view, it must succeed in reaching the environmental targets and align with the interests and attitudes of the targeted parties—in the case of residential buildings, households—since their decisions on energy retrofit investments and home heating methods can have a substantial impact on the environment. In the literature, there is evidence that household behaviours and preferences for energy choices vary significantly across countries and that households'choices in low-emissions technologies are influenced by a mix of socioeconomic, attitudinal, and contextual factors, which suggests that policies should be tailored to national and local contexts (Hassett et al., 2024). Overlooking the behavioural aspects of household decision-making may result in inaccurate predictions about the effectiveness of government policies, such as financial grants to sustain investments in energy-efficient technology (Lades et al., 2021).

The objective of this paper is to analyse various dimensions of Italian households'attitudes towards energy efficiency measures, focusing on their awareness of the EPBD, their participation in initiatives such as the "Superbonus 110%" and the "Ecobonus 2020", their perspectives on government intervention, the motivations behind their renovation activities, and their overall environmental awareness. Additionally, this study examines whether demographic and socioeconomic characteristics influence the formation of these attitudes and behaviours. Given that existing evidence for Italy on these topics is limited and partially outdated, this analysis aims to make a valuable contribution to the related literature since understanding how households engage with energy efficiency policies is essential for designing effective and equitable interventions.

To this end we employ the newly released Italian Survey of Consumer Expectations (ISCE), a representative sample of around 5,000 Italian households (for details, see Guiso and Jappelli, 2024a).[2] Wave 5 of October 2024 collects information on households'behaviours and attitudes

[2] The survey is conducted quarterly within the GRINS (Growing Resilient INclusive and Sustainable) partnership.

towards dwellings'energy efficiency measures, in addition to the standard demographic and socioeconomic households'characteristics. The empirical strategy involves conducting descriptive analyses of energy-related variables and their interaction with socioeconomic factors, complemented by the estimation of a series of probit models. Specifically, we estimate probit models on whether households are informed about the EPBD, on the adoption of the Superbonus or Ecobonus schemes, on the perceived appropriateness of government intervention, on the influence of financial incentives on the decision to renovate, and on the role of information in shaping households'decisions to undertake energy efficiency improvements. In addition, we estimate a multinomial logit model for a three-category variable capturing the primary motives for renovation works—whether economic, environmental, or comfort-related.

Our analysis reveals several key findings with important policy implications. Knowledge of the directive is higher among older, more educated, and higher-income individuals, but lower among renters, women, and residents of Southern Italy—pointing to the need for more targeted communication strategies. Access to Superbonus and Ecobonus benefits has largely favoured wealthier households in Northern Italy, raising concerns about equity, especially as exposure to information strongly influences participation. Support for public renovation policies is higher among those who have already undertaken such works, suggesting that perceived personal benefit drives public endorsement and underscoring the need for fair and inclusive access. Motivation to retrofit due to financial support is more common among higher-income, better-educated households, indicating structural barriers. In contrast, motivation driven by expert advice or public campaigns is shaped by education but not income—further reflecting unequal access to available resources. Lastly, while economic motives outweigh environmental ones, neither appears strongly tied to socioeconomic status, although information access rises with education.

The structure of the paper is as follows. Section 2 reviews the relevant literature, Section 3 introduces and describes the data, Section 4 outlines the econometric framework, Section 5 presents the empirical findings and discusses some policy implications, and finally Section 6 concludes with a summary of the key results.

2 Literature review

This section reviews the literature on households'environmental behaviour, their environmental awareness, and their decisions to invest in energy efficiency. Households can

take two main types of energy conservation actions, monetary and non-monetary: efficiency investment (e.g. acquisition of new technologies, low-energy appliances, or energy efficient systems) and curtailments (e.g. turning off lights, cutting down on heating or air conditioning and switching off standby mode) (Jansson et al. 2009). However, Hesselink and Chappin (2019), by reviewing agent-based modelling studies, identified four clusters of barriers (structural, economic, behaviour, and social barriers) to the adoption of energy efficiency by households. There is evidence of a positive and significant influence of pro-environmental motivation on both monetary and non-monetary energy efficiency investments across multiple countries (Urban and Ščasný, 2018). Their analysis draws on the OECD's Environmental Policy and Individual Behaviour Change (EPIC) Survey, alongside that of Hassett et al. (2024), who show that energy conservation is primarily hindered by behavioural and attitudinal barriers—such as low environmental concern or lack of motivation—whereas investment in low-emissions technologies (e.g. heat pumps, solar panels) is more affected by structural constraints and financial limitations. Using the same dataset, Ameli and Brandt (2015) show that household investment in energy efficiency and renewables is shaped by ownership status, income, and environmental attitudes and that pro-environmental behaviours and energy awareness also play a key role. There is also evidence that household decisions to invest in energy efficiency and adopt renewable energy are positively linked, mainly due to unobserved factors like pro-environmental motivation (Dato, 2018).

Effectiveness of household energy efficiency interventions (Russell-Bennett et al., 2019), as well as energy efficiency interventions and adoption of energy-saving technologies **(**Canepa et al., 2023), vary by country mainly due to climatic, social, cultural, political, and technological factors. There is also evidence of a positive link between household energy consumption expenditure and subjective well-being: higher spending on energy is associated with a greater likelihood of life satisfaction in 27 out of the 37 countries surveyed (Piao and Managi, 2023). Based on an on-line survey conducted in eight European Union countries, Schleich (2019) finds that higher income groups tend to have higher retrofit adoption shares especially in Italy, Spain and Sweden. Verachtert (2022) highlights the importance of both individual attitudes and structural conditions in shaping household energy choices and contributes to understanding the attitude–behaviour gap in the context of climate change in 23 European countries.

Evidence on behavioural attitudes towards energy saving is provided by Belaïd and Joumni (2020) for France and by Brown et al. (2023) for Ireland. In both studies, climate change

concern, awareness, and responsibility are significant predictors of energy-saving behaviour and income, education, and gender shape energy behaviour. Procrastination–driven by uncertainty, expected hassle, and complexity of offers–is found to be one of the main reasons for non-adoption of energy efficiency renovation projects among a sample of Duch homeowners (Mogensen and Thøgersen, 2024). In the UK, households adopt both energy efficiency measures and renewable technologies primarily to save energy, reduce fuel bills and help the environment (Caird et al., 2008). However, Chapman et al. (2021) reveal a significant value–action gap: although consumers express concern for the future of the planet, their domestic behaviour often fails to reflect this concern. By using a machine learning method, Satre-Meloy and Hampton (2024) find that physical characteristics (e.g. number of bedrooms, heating type) and household size are the strongest predictors of energy use. In the UK case study of Pelenur (2018) households, despite expressing a strong pro-environmental orientation, do not always adopt energy-saving behaviours or technologies. Trotta (2018) employs an interdisciplinary approach to investigate the wide range of socio-demographic, environmental, and housing-related factors that influence energy-saving behaviours and energy efficiency investment decisions among British households.

US households exhibit significantly lower adoption rates compared to German households for all three decisions of purchasing energy-efficient appliances, adopting energy-saving practices, and buying fuel-efficient vehicles (Long, 2018). In Australia, financial barriers have the most significant impact on the adoption of energy-efficiency measures by low-income households, followed by split incentive barriers, while the provision of information appears to play no substantial role (Azimi et al., 2024). Other studies cover countries such as Lithuania on the adoption of renewable energy (Štreimikiene et al. 2022) and China on the motivations behind individuals'energy efficiency investments (Perret et al., 2022). In Iowa, adoption of energy-efficient and renewable technologies is motivated by cost savings, local availability, and environmental concerns, while barriers include high costs, limited information, and access issues (Gravert, 2024).

As far as Italy is concerned, there is limited and partially outdated information on households'environmental awareness and behaviour and their decisions regarding the adoption of environmentally friendly energy systems and energy-efficient retrofit investments. An exception is Crispino and Loberto (2024), who use a novel Twitter-based indicator of attention to climate change over the period 2016-2022 and find that high temperature anomalies (heatwaves) are the only weather-related factor significantly

associated with increased attention. Urban and Ščasný (2012) find that in Italy (as well as in Spain and Poland) financial constraints and bureaucratic issues slow adoption despite environmental concern. In addition, Italian households are found to face financial barriers despite environmental concern (Canepa et al., 2023) and lowest-income homeowners are significantly less likely to adopt retrofit measures than those in the highest income quartile, with the probability of adoption about 11 percentage points lower for the former (Schleich, 2019). Benedetti and Laureti (2021) investigate the choice of using renewable energies for space heating and the decision to invest in energy efficient retrofits on 2013 data. They show that educational level, previous investment experience, heating system use intensity, and its maintenance are key drivers of switching to a renewable energy-based heating system. Energy-related persuasive communication also plays a significant role and has been shown to reduce electricity consumption in dwellings by between 18% and 57% (D'Oca et al., 2014). Finally, Salvalai et al. (2017) present a pilot renovation project carried out on a social housing building, which used innovative prefabricated multilayer panels for external retrofitting. The results point to a drop in measured heating consumption of 36%, reaching 69% if combined with window replacement.

3 Data and descriptive statistics

3.1 The Italian Survey of Consumer Expectations

The Italian Survey of Consumer Expectations (ISCE) collects comprehensive information from a representative cross-section of Italian households, focusing on aspects such as demographics, income, wealth, consumption habits, and economic expectations. The sample includes individuals aged 18 to 75 who are household heads, selected from a national pool of 120,000 registered panel members. To mirror the demographic and socioeconomic composition of Italy's population, the survey employs stratified sampling based on variables such as geographic location, age, gender, education, employment status, and municipality size. Each participant is assigned a weight to ensure that aggregated responses align with national population distributions. The survey is administered online through a Computer-Assisted Web Interviewing (CAWI) system.

ISCE is conducted quarterly, with data collection occurring in October, January, April, and July, starting from October 2023. Each wave of the survey includes two major components: a consistent core section and rotating special sections. The core section, subdivided into five parts labelled A through E, remains stable across waves and gathers data on individual and

household demographics, financial and real assets, income, and monthly spending, including utility costs. It concludes with questions about respondents'outlooks on macroeconomic trends and personal financial prospects, such as future income and plans for major purchases. For a more detailed discussion of the survey's design and methodology, see Guiso and Jappelli (2024a).

The special sections vary from one wave to another and address topical issues.[3] In wave 5, conducted in October 2024 to collect responses from 5,012 individuals, the focus is on energy efficiency in housing.[4] This wave's special module contains 12 questions examining whether respondents have taken steps to enhance their home's energy efficiency, what kinds of upgrades were made, how much was spent, and what portion of costs—if any—was subsidized through public funding. The module also explores public awareness and opinions of the Energy Performance of Buildings Directive (EPBD), motivations and barriers to improving energy efficiency, and perceptions of government efforts to support such initiatives. A complete list of the questions can be found in Appendix A.

3.2 Outcome variables

Herein we describe the construction of the outcome variables employed in the econometric models of Section 4 based on the questions listed in Appendix A. First, to investigate whether households are perceptive to environmental issues, we focus on the question of their knowledge of the EPBD labelled "Green buildings directive" (question L14): we build a dichotomic variable that takes value 0 if the respondent has never heard about the directive and value 1 if he/she has ("outcome variable 1").

Second, we aim to empirically evaluate whether retrofit measures such as the Superbonus and the Ecobonus have been adopted by wealthier households and whether other socioeconomic characteristics influence this choice. We combine answers 1 and 3 of question L13 to create a 0/1 variable, where 1 identifies who benefitted from either measure and 0 who did not undertake any retrofit ("outcome variable 2").

Third, given the burden borne by the government to finance the two aforementioned fiscal measures, we aim to investigate the appropriateness of the government intervention from the

[3] See Guiso and Jappelli (2024b) for an empirical application on the willingness to pay to prevent natural disasters.

[4] Of the 5,012 households interviewed in wave 5, 2,979 participate since wave 1, 422 since wave 2, 416 since wave 3, 635 since wave 4, and 560 are interviewed for the first time in wave 5.

perspective of households by using responses to question L18 to generate a binary variable, where 1 denotes support for public involvement ("outcome variable 3").

Fourth, we build a binary variable to estimate the influence of financial incentives on the decision to carry out interventions, based on question L17. This question allows for multiple answers and therefore is split into seven sub questions (from L17_1 to L17_7), one for each possible answer. Our variable equals 1 if the respondent choses a positive answer to questions L17_1 (Financial aid from the state, such as subsidies, tax credits, etc.) and L17_2 (Possibility of obtaining soft loans from the banking sector), and 0 otherwise ("outcome variable 4").

In addition, to investigate whether access to information plays a role in shaping households'decisions to undertake energy efficiency improvements, we focus again on question L17 and construct a binary variable that takes value 1 if the respondent selects a positive answer to questions L17_3 (Information and explanations from experts in the field), L17_4 (State information campaign) and L17_5 (Recommendations obtained from relatives/friends)—all related to information sources—and 0 otherwise ("outcome variable 5").

Finally, to explore whether households'socioeconomic factors influence environmental awareness, we recode question L16 as follows ("outcome variable 6"): value 1 identifies those who undertook retrofits to help protect the environment and/or combat climate change, value 2 identifies those who had in mind economic motives (Increase the economic value of housing or Reduce the cost of energy), value 3 identifies home comfort and other motives.[5]

3.3 Descriptive statistics

After dropping the observations for which income is not available—since income is one of the regressors of our models—we are left with 4,545 data points. Descriptive statistics of the outcome variables and the regressors used in the empirical analysis are reported in Table 1, while the variables not employed in this analysis but included in the special section on energy efficiency are described in Appendix B. [6]

[5] There is extensive literature on the positive relationship between dwellings'energy efficiency and their prices. For evidence for Italy, see, among others, Giarda and Panarello (2025).

[6] We dropped answer "Don't know" to all questions from the sample, which reduces to 4,091 observations for outcome variable 3 and 4,108 observations for outcome variable 6. For outcome variable 2, the sample drops to 3,477 observations because only homeowners were asked to answer question L13.

In our sample, 68.7% of respondents are informed about the Green Buildings Directive (outcome variable 1) and, among homeowners, 18.9% report having carried out renovation works between 2020 and 2024 benefiting from fiscal measures such as the Superbonus or the Ecobonus (outcome variable 2).[7] Overall, 89.6% of respondents are in favour of government interventions to help households bear the burden of energy-efficiency retrofits (outcome variable 3). Financial support from the government is the main motivation (66.4%) for carrying out renovation work or that would incentivise carrying them out (outcome variable 4), while having received information, or potentially receiving it, has helped making up respondents'mind to intervene in the 31.7% of cases (outcome variable 5). Finally, economic motives are the most common reason (62.5%) when asked what prompted (or would prompt) renovations, followed by the desire to increase the comfort of their homes (or other reasons), and then environmental motives (15.5%) (outcome variable 6).

The most frequent age class is that of household heads with more than 54 years (38.2%) and average age is 48.6, from a higher secondary school while average household size is 2.8. The majority (52.3%) declares a diploma, with 20.5% of the sample having obtained at least a lower secondary level of education, and 27.2% a tertiary degree. The sample is almost evenly distributed in terms of gender, with a slight majority of males (50.9%). In terms of monthly net household income, the range €2,000-€3,000 is the most frequent (29.8%), while incomes above €3,000 are the least frequent. In terms of occupational status, respondents out of the labour force are the majority of the sample (48.2%), followed by employees (44.3%). 55.1% of the sample lives in a municipality with less than 30,000 inhabitants, and 45.5% of the respondents reside in Northern Italy, 34.2% in the Southern regions or the main islands (Sardinia and Sicily), with the remaining 20.3% living in the Centre. As for housing tenure status, 76.5% are homeowners and finally, those who have renovated their homes are 26.4%.

TABLE 1 ABOUT HERE

3.4 Interrelations between variables

Figure 1 depicts the distribution of the respondents who are aware of the EPBD by three socioeconomic variables: level of education in Panel (a), monthly household net income in Panel (b) and age in Panel (c). In all three cases, higher values of the socioeconomic variable are associated with greater knowledge. The increase is more pronounced for income and

[7] The microdata of the Survey of Household Income and Wealth (SHIW) of the Bank of Italy show that as of 2022, 10.9% of homeowner households had benefitted from support measures to renovate their homes.

especially education—where the lowest level of education corresponds to the lowest level of knowledge (51.4%) and, similarly, the highest level of education corresponds to the highest level of knowledge (74%)—, while it is more gradual across age groups.

FIGURE 1 ABOUT HERE

Figure 2 shows the distribution of respondents who have used public funds to finance, either partially or in full, their work on improving the energy efficiency of their homes. From inspection of Panel (a), we observe a positive association between income and the percentage of households expressing a positive response, which increases from 12.5% in the lowest income class to 25.5% in the highest one. This finding is consistent with earlier research on the topic for Italy (UPB, 2023).

Panel (b) in Figure 2 provides insights into the geographical distribution of respondents who fully or partially financed their interventions through public subsidies. Specifically, the data suggest that public support—whether partial or full—is more concentrated in the Northern regions (55.7% of respondents), followed by the South and Islands (25.4%) and the Centre (18.9%). Notably, this pattern aligns with ENEA (2024), which reports that the share of subsidised investments under the Superbonus is 51% in the North, 26% in the South and Islands, and 23% in the Centre. Although the distribution remains tilted towards the North, evidence from UPB (2023) shows that the Superbonus contributed to a more balanced territorial distribution compared to earlier schemes, such as the Ecobonus, which were even more concentrated in the Northern regions.[8]

FIGURE 2 ABOUT HERE

In Panel (a) of Figure 3, we investigate the relationship between income and the question on whether the survey's participant is in favour of government's intervention to incentivise households'investments in energy efficient retrofits. Herein we detect a weaker but still positive relationship between affirmative answers and income. Indeed, the respondents with a household monthly income below €1,500 have the lowest percentage of answers in favour (76.1%), while the highest percentage (84.7%) is reached in the highest income interval.

[8] UPB (2023) highlights that the "Ecobonus 2020" resulted in a geographically unbalanced distribution, with 73% of incentives concentrated in the North and only 11% in the South and Islands. While we cannot verify whether partial funding in our data derives specifically from the Ecobonus, a similar territorial gap emerges: respondents with full public coverage (presumably from the Superbonus) are more evenly distributed (50% North, 33% South and Islands), whereas those with partial subsidies are more concentrated in the North (59%) and less present in the South and Islands (22%).

As shown in Panel (b), respondents who support government intervention are more evenly distributed across regions, yet they mirror the pattern observed among those who have used public funds for energy efficiency upgrades. The majority (45.4%) reside in the North, followed by 34.3% in the South and Islands and 20.4% in the Centre. This suggests that individuals who have benefited from public incentives are, unsurprisingly, more likely to support such government initiatives.

FIGURE 3 ABOUT HERE

Figure 4 depicts the distribution of respondents who identified the possibility of obtaining public funds and/or from credit institutions as motivating factor across the income, education and age dimensions. We observe significant differences across education levels, with the percentage of respondents indicating an affirmative answer reaching only 36% among those who attended only primary school. This percentage increases significantly for the other education levels and reaches its maximum value for those who attained tertiary education (71.4%). A similar positive relationship is noticeable for income, although it is less pronounced. Indeed, while 58.3% of the respondents with an income level below €1,500 responded affirmatively, the percentage increases to 76.6% among respondents in the top income bracket. On the contrary, the relationship between the answer and age appears weaker, with the values ranging from 62.2% for the 35-44 age interval to 67.7% for the over 54.

FIGURE 4 ABOUT HERE

Figure 5 shows how information on energy efficiency interventions shapes households'decision to undertake renovation works decisions, broken down by income, education, and age. Differences across education levels are noticeable in Panel (a), with the share increasing from 29% among those with primary education to 34.7% among those with tertiary education. A similar, although less marked, gradient is observed in Panel (b) with respect to income. This may reflect greater familiarity with technical content, a better ability to evaluate long-term benefits or higher exposure to information campaigns. They may also lead respondents with such features to perceive themselves as more capable of acting on the information received. In contrast, the relevance attributed to information tends to decline with age as shown in Panel (c), suggesting that younger individuals may be more responsive to awareness campaigns. This pattern may reflect a lower propensity among older respondents

to consider or engage in renovation works, possibly due to shorter investment horizons or lower expected personal returns.

FIGURE 5 ABOUT HERE

Figure 6 represents the distribution of answers to the question about the reasons to undertake energy efficiency works. In Panel (a) the percentage of respondents indicating environmental as the main reason behind energy efficiency renovation works does not fluctuate significantly across education levels, although it reaches its peak among respondents with tertiary education (16.6%). On the contrary, the option "Comfort & Other" presents a more pronounced negative relationship with education, ranging from 27.2% for primary education to 20.8% for respondents with higher secondary and tertiary education.

The distribution of the outcome variable 6 conditional on the respondents'income, shown in Panel (b), does not indicate a particular relationship with any of the three responses. When looking at the interrelation of the outcome variable with age, we notice how the two age categories with the highest percentage of respondents indicating an environmental motivation are the youngest and the oldest members of the sample.

FIGURE 6 ABOUT HERE

4 Methodology

In this paper, we aim to examine whether demographic and socioeconomic characteristics influence the environmental attitudes and awareness of Italian households, using a subset of questions from the special section on energy efficiency in wave 5 of the ISCE (the questions are reported in Table A.1). To this end, we estimate a set of probit models and a multinomial logit model on the discrete variables described in Section 3.3, as a function of demographic and socioeconomic regressors.

To model each of the binary outcome variables, i.e. whether households are informed about the Green buildings directive (outcome variable 1), whether they adopted the Superbonus or Ecobonus schemes (outcome variable 2), whether they are in favour of the government intervention (outcome variable 3), the role of financial incentives on the decision to carry out interventions (outcome variable 4) and the role of information in shaping households'decisions to undertake energy efficiency improvements (outcome variable 5), we employ the following model:

$$y_i = 1\ if\ \left(y_i^* = x_i'\beta + \varepsilon_i\right) > 0; 0\ otherwise \quad (1)$$

where y_i^* is the latent variable underlying the observable y_i, x_i contains the explanatory variables, β is the vector of coefficients to be estimated, and $\varepsilon_i \approx N(0,1)$ is the error term. The probability that y_i equals 1 given x_i is Pr $Pr\left(x_i\right) = F(x_i'\beta)$. We assume that F(.) follows a $N(0,1)$ distribution and we estimate equation (1) via maximum likelihood by using a probit model.

The set of regressors x_i is the following:

1. Household head characteristics: age classes (under 34, 35-44, 45-54, over 54, with under 34 as the reference category), gender (male or female, with male as the reference category), employment status (employee, self-employed, out of the labour force, with employee as the reference category), and educational level (up to lower secondary, upper secondary and tertiary, with up to lower secondary as the reference category).
2. Household level characteristics: monthly household net income in class intervals (less than €1,500, €1,500-€2,000, €2,000-€3,000 and above €3,000, with less than €1,000 as the reference category), housing tenure status (homeownership, rent, and other, with homeownership as the reference category), and number of household components.
3. Location features: municipality size (less than 30,000 inhabitants, 30,000-100,000 inhabitants, and above 100,000 inhabitants, with the first as the reference category) and geographical area (North, Centre, and South and Islands, with North as the reference category).
4. Motivation- and information-related variables: whether the household has carried out renovation works, whether the respondent is motivated to carry out retrofits based on the information (private or public) received and whether the respondent is motivated by having received or by the prospect of receiving financial support.

To model environmental awareness that takes three values ("outcome variable 6"), we use a multinomial logit model. This approach is appropriate for modelling choices among multiple categorical outcomes, in this case reflecting households' levels of awareness. The basic form of the multinomial logit model can be expressed as follows:

$$P\left(y_i = j\right) = \frac{e^{x_i'\beta}}{\sum_{k=1}^{K} e^{x_i'\beta_k}} \quad (2)$$

where $P\left(y_i = j\right)$ is the probability that household *i* chooses alternative *j* (in our case, from 1 to 3), x_i contains the explanatory variables listed above, and β_j is the vector of parameters for alternative *j*. The denominator is the sum of the exponentials for all possible alternatives, to ensure the probabilities across all choices sum to 1. The parameters β_j are estimated using maximum likelihood.

5 Results and discussion

Column 1 of Table 2 reports the estimated marginal effects from the probit model of equation (1) for outcome variable 1, namely whether the respondent has knowledge of the EPBD. The results indicate a positive association with income, with marginal effects increasing across income classes, ranging from 0.056 in the lowest class to 0.114 in the highest. Consistently, we find a similar pattern by education level, with higher education associated with a greater likelihood of being aware of the EU directive; the marginal effect is 0.152 for individuals with tertiary education. A positive correlation between attention to climate change and various socioeconomic indicators such as income and education was also found in the study of Crispino and Loberto (2024). Age is another variable found to be positively associated with the knowledge of the EPBD directive. On the contrary, the two variables negatively associated with the outcome variable are gender and homeownership: being female lowers the probability of having knowledge of the directive by 4.2pp and being a renter by 7.8pp. These results suggest the existence of informational gaps, which can be filled by adopting targeted and context-specific outreach strategies. Lastly, respondents who have been (or might be) motivated to undertake renovations by private information are 6.3pp more likely to be aware of the directive. In contrast, motivation stemming from public information campaigns is not statistically significant: this highlights the need to strengthen public communication efforts by improving their credibility, relevance, and alignment with the needs of specific target audiences.

When examining the factors behind undertaking energy efficiency works using partially or fully public funds (outcome variable 2), as shown in column 2 of Table 2, we observe only a partial overlap with the determinants of outcome variable 1. Indeed, we find that income

remains positively associated with the probability of having benefitted from the Superbonus and Ecobonus, with marginal effects increasing from 0.039 in the €1,500-€2,000 class to 0.115 for monthly income above €3,000. In line with the findings discussed in Section 3.4, we also find a negative association for residents of the Centre and South and Islands compared to those living in Northern Italy, with marginal effects of -0.056 and -0.078, respectively. In addition, being a female household head displays a negative marginal effect (-0.036). Finally, we find evidence that being exposed to information campaigns increases the likelihood of adopting retrofit measures such as the Superbonus or Ecobonus by 6.0pp. Although not directly aligned with our analytical framework, communication strategies were also found to be effective in reducing electricity consumption in the study by D'Oca et al. (2014).

In column 3 of Table 2, we suggest an alternative model specification in which the sample is restricted to respondents who have carried out renovation works, regardless of whether these were financed through personal resources or supported by public incentive schemes. In the baseline specification, households who benefited from public incentives are compared to those who did not undertake any interventions either due to a lack of need or limited financial means. The observed positive association between income and the uptake of financial incentives may partly reflect the fact that higher-income households are more likely to have undertaken renovations in the first place. By narrowing down the analysis to renovators, we are able to compare households with similar propensities to undertake energy efficiency improvements. In this context, the outcome variable takes the value 1 for those who renovated using public funds and 0 for those who employed their own resources. Interestingly, we continue to observe a positive association with income: the probability of having benefited from the Superbonus or Ecobonus increases in the second and third income classes, with marginal effects equal to 0.103 and 0.129, respectively. Geographical disparities also persist, with households in the Centre and in the South and Islands showing significantly lower uptake rates (-7.85pp and -8.34pp, respectively), underscoring the regressive nature of these fiscal policies in both economic and territorial terms. The results of both specifications (columns 2 and 3) indicate that current support measures tend to benefit wealthier households and those residing in the North of the country, resulting in regressive distributional effects. These findings are consistent with those of Del Ciello and Palmisano (2025) and Forni et al.

(2025b).[9] They are also coherent with the lower adoption rates of energy-efficient technologies among lower-income households documented by Schleich (2019). To promote a fairer and more inclusive access to energy efficiency incentives, future policies should adopt equity-enhancing criteria, such as means-tested schemes and targeted regional outreach.[10] Simplifying access procedures and strengthening information campaigns can further help reduce existing socio-economic and territorial disparities.

Turning to respondents'attitude towards hypothetical government intervention to promote energy efficiency works (outcome variable 3), column 4 of Table 2 shows a positive relationship with age; conversely, household size is negatively correlated. More importantly, and in line with expectations, those who have undertaken renovation works show a higher likelihood of supporting public measures with a marginal effect of 0.025, likely due to the tangible and perceived advantages gained from existing initiatives, while being motivated to retrofit by having received (or potentially receiving) financial incentives stands out as the most influential factor (with an estimated marginal effect of 0.171), strongly increasing the probability of endorsing government intervention. Therefore, the design of renovation policies should be aligned with efforts to broaden public support for government intervention. To maintain policy legitimacy and long-term engagement, it is essential that both the perceived and actual benefits of renovation policies are fairly distributed across all segments of the population, rather than being seen as benefiting only those who carried out renovations using public funds.

Column 5 and 6 of Table 2 report the estimated marginal effects of the probit model for outcome variables 4 and 5, respectively, reflecting the role of financial incentives and of information on the decision to undertake interventions, respectively. As for outcome variable 4, estimated marginal effects show that there is a positive association with income: the higher the income, the higher the outcome (the marginal effect ranges between 0.039 and 0.157). In a sense, this is a counterintuitive result, as one might expect lower-income households to be more likely to be motivated to retrofit by financial support or easier access to credit, even though it was higher-income households who ultimately benefitted the most from subsidised renovations. The result points to the existence of access barriers for low-income households, suggesting they may feel discouraged or excluded from pursuing energy-efficient home

[9] Forni et al. (2025b) also find that restricting the analysis to those who accessed public money to retrofit their homes, public support was distributed more evenly, suggesting a mildly progressive pattern among actual beneficiaries.
[10] For a discussion of this point, see De Blasio et al. (2024) and Forni et al. (2025a).

renovations. Given the well-established positive correlation between income and education, the higher the education level, the greater the probability that financial incentives may prompt renovation works (the estimated marginal effect is 0.113 for the highest education level). Municipality size has the opposite effect, with households living in larger municipalities exhibiting a lower probability of being convinced by financial motives. Age is only mildly significant, with older household heads showing positive marginal effects. Being a renter does not significantly affect the outcome variable, as well as having carried out renovation works. These findings highlight limited responsiveness among low-income and less educated households, who appear less able or willing to take advantage of financial incentives despite potentially greater need. This underscores the need to address underlying access barriers—such as upfront costs, complex procedures, or lack of tailored financial products—that may inhibit participation.

The estimated marginal effects of the determinants of being motivated to renovate thanks to the information gained from experts, public campaigns or relatives/friends (outcome variable 5) are reported in column 6. In this circumstance, income does not play a role (its marginal effects are not statistically significant), while education does: upper secondary education and tertiary education display positive, and increasing, marginal effects (0.044 and 0.062, respectively). The marginal effects for age decrease as age increases, suggesting that, compared to younger households, older ones are less influenced by background information in making their decisions. This is true also for female-headed households. Household size displays a positive marginal effect as well as large municipalities and having carried out renovation works (this variable shows a marginal effect equal to 0.095), while the housing tenure status does not play a significant role. To maximize the impact of information on households, policymakers should develop targeted communication strategies aimed at less-educated, older, and female-headed households—groups that appear less responsive to standard information channels. This could include the use of more accessible language, diverse outreach platforms, and personalised support, ensuring that information about renovation opportunities effectively reaches and engages all segments of the population.

Finally, Table 3 reports the marginal effects of the multinomial logit model in which the outcome variable 6 (what reasons prompted renovation works) takes on three values: 1 for environmental awareness, 2 for economic motives and 3 for home comfort or other reasons. The results are quite surprising—negatively—due to their poor statistical significance. This highlights the small correlation between environmental awareness or economic motives and

households'demographic and socioeconomic characteristics. These findings contrast with previous literature, such as Urban and Ščasný (2018), Canepa et al. (2023) and Piao and Managi (2023), where especially age and education are statistically significant predictors of strong environmental attitudes and lower energy consumption expenditure. However, there are some exceptions. In the "environmental motives" equation, female-headed households display a higher environmental awareness, while households in the 35-44 age group and renters show lower awareness for no apparent reason. Interestingly, the variable capturing being motivated to undertake energy-efficient retrofits based on the information received increases the probability of retrofitting for environmental concerns, suggesting that those who would renovate if better informed are more likely to do so moved by their environmental awareness. This underscores the importance of information in raising environmental awareness and influencing action, suggesting that targeted and customised communication strategies could help foster greater environmental consciousness across all population groups. In the "economic motives" equation, the marginal effects for the "over 54" age group and the "South and Islands" dummy variable are significant and negative, as is the marginal effect of renters—a reasonable result. As expected, being motivated by financial support to renovate shows a significant and positive marginal effect (0.043) on the probability of retrofitting for economic motives, suggesting that those who would renovate if offered financial incentives tend to do so to reduce energy bills and increase their home's value. By contrast, the negative sign associated with being motivated by the information received (marginal effect -0.043) is plausibly linked to environmental awareness. Indeed, individuals who are—or would be—prompted to renovate because of information campaigns are less likely to act moved by economic considerations, and more likely to be driven by environmental concerns, as previously discussed. In this sense, among those who could be persuaded by informational initiatives, environmental awareness and economic motives appear to operate as substitutes. We notice once again that the reasons prompting households to undertake renovation works are strongly linked to the ultimate goals they wish to achieve. For this reason, it is essential, from a policy perspective, to enhance individuals'sensitivity to environmental issues through well-designed communication strategies, thereby fostering greater interest in social and collective benefits rather than exclusively in private financial gains. Finally, households'socioeconomic characteristics appear to have greater statistical relevance in the "home comfort and other motives" equation, suggesting that older household heads and those residing in medium-sized and large municipalities are likely to prioritise comfort-related considerations. Overall, while economic motivations remain the primary driver of renovation

decisions, they appear to be relatively uniform across income, age, and education groups. This indicates a broad-based potential for leveraging financial incentives. However, environmental motivations remain secondary. Strengthening the link between climate awareness and pro-environmental behaviour could foster more sustained public commitment to renovation efforts.

6 Conclusions

This paper aims to provide an overview of Italian households'environmental attitudes and awareness, and to assess the extent to which demographic and socioeconomic factors influence them. To do so, we draw on data from a special module on energy efficiency included in the October 2024 wave of the Italian Survey of Consumer Expectations (ISCE).

The main messages emerging from our analysis can be summarized as follows. First, households are aware of environmental issues, and the knowledge of the EPBD is positively correlated with income, education and age, while it is negatively correlated with being a renter, being female and living in the South of the country. Second, the Superbonus and Ecobonus schemes have been more likely to benefit higher-income households, particularly those in Northern Italy, and having been exposed to either public or private information appears to have significantly influenced uptake. Third, respondents who undertook renovation work are more inclined to support public measures in that area, indicating that support for such initiatives is closely tied to experiencing direct benefits from government intervention. Fourth, the likelihood of being motivated to undertake renovation works by having received—or expecting to receive—financial support rises with both income and education levels, while the likelihood of being motivated by having received—or potentially receiving—information from various sources increases with educational attainment but not income. Finally, economic motives for undertaking renovation works are more widespread than environmental ones; however, somewhat surprisingly, neither of them is associated with households'socioeconomic characteristics such as age, education or income.

Our findings suggest several directions for policy design. Knowledge of the EPBD is uneven, with lower levels among renters, women, and residents in Southern Italy, underscoring the need for more targeted outreach. Both private information sources and public information campaigns increase the likelihood of adopting retrofit measures, however public information is not effective in shaping environmental awareness captured by the knowledge of the EPBD, pointing to the need for improved communication strategies. Access to financial incentives

benefits higher-income households and those residing in the North of the country, highlighting equity concerns in both uptake and information access. Finally, while economic motives drive renovation decisions across the board, environmental motivations remain limited.

Bibliography

Accetturo, A., Olivieri, E., Renzi, F. (2024), "Incentives for dwelling renovations: Evidence from a large fiscal programme", Bank of Italy Occasional Papers No. 860

Ameli, N., and Brandt, N. (2015), "Determinants of households'investment in energy efficiency and renewables: evidence from the OECD survey on household environmental behaviour and attitudes", *Environmental Research Letters*, Vol. 10

Azimi, S., Hon, C.K.H., Tyvimaa, T., Skitmore, M. (2024), "Adoption of energy‐efficiency measures by Australian low‐income households", *Journal of Housing and the Built Environment*, Vol. 39, pp. 909-936

Belaïd, F., and Joumni, H. (2020), "Behavioral attitudes towards energy saving: Empirical evidence from France", *Energy Policy*, Vol. 140

Benedetti, I., and Laureti, T. (2021), "Analysing Energy-Saving Behaviours in Italian Households", *Studies of Applied Economics*, Vol. 29(3)

Brown, A., Hampton, H., Foley, A., Del Rio, D.F., Lowans, C., Caulfield, B. (2023), "Understanding domestic consumer attitude and behaviour towards energy: A study on the Island of Ireland", *Energy Policy*, Vol. 181

Caird, S., Roy, R., Herring, H. (2008), "Improving the energy performance of UK households: Results from surveys of consumer adoption and use of low- and zero carbon technologies", *Energy Efficiency*, Vol. 1(2), pp. 149-166

Canepa, A., Chersoni, G., Fontana, M. (2023), "The role of environmental and financial motivations in the adoption of energy-saving technologies: Evidence from European Union data", *Quarterly Review of Economics and Finance*, Vol. 91, pp. 1-14

Chapman, O., Kapetaniou, C., Gabriel, M. (2021), "Decarbonising homes: Consumer attitudes towards energy efficiency and green heating in the UK", https://media.nesta.org.uk/documents/decarbonisinghomes.pdf, accessed on 24/03/2025

Crispino, M. and Loberto, M. (2024), "Do people pay attention to climate change? Evidence from Italy", *Journal of Economic Behavior and Organization*, Vol. 219, pp. 434-449

Dato, P. (2018), "Investment in Energy Efficiency, Adoption of Renewable Energy and Household Behavior: Evidence from OECD Countries", *The Energy Journal*, Vol. 39(3), pp. 213-244

D'Oca, S., Corgnati, S.P., Buso, T. (2014), "Smart meters and energy savings in Italy: Determining the effectiveness of persuasive communication in dwellings", *Energy Research & Social Science*, Vol. 3, pp. 131-142

Del Ciello, S. and Palmisano, F. (2025), "Edifici in transizione: alcune riflessioni sugli effetti distributivi dei bonus per l'efficienza energetica", Menabò di Etica ed Economia, April 2025, available at: https://eticaeconomia.it/edifici-in-transizionealcune-riflessioni-sugli-effetti-distributivi-dei-bonus-per-lefficienza-energetica/, accessed on 20/03/2025

De Blasio, G., Fiori, R., Lavecchia, L., Loberto, M., Michelangeli, V., Padovani, E., Pisano, E., Rodano, M.L., Roma, G., Rosolin, T., Tommasino, P. (2024), "Il miglioramento dell'efficienza energetica delle abitazioni in Italia: lo stato dell'arte e alcune considerazioni per gli interventi pubblici", Bank of Italy Occasional Papers No. 845

EC (2024), "Shedding light on energy in Europe – 2024 edition", available at: https://ec.europa.eu/eurostat/web/interactive-publications/energy-2024, accessed on 20/03/2025

ENEA (2024), "Report dati mensili al 31.12.2024", available at: https://www.efficienzaenergetica.enea.it/images/detrazioni/Avvisi/Report_31_12_2024.pdf, accessed on 20/03/2025

Forni, L., Fortuna, F., Giarda, E., Giovanardi, F., Panarello, D. (2025a), "The Green Buildings Directive: A quantification of its costs and benefits in two Italian regions", *Journal of Housing Economics*, Vol. 68

Forni, L., Giarda, E., Sommer Stephan (2025b), "Are Incentives for Energy Retrofitting Regressive? Evidence from the Italian Superbonus", *SSRN paper*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5292174

Giarda, E., and Panarello, D. (2025), "The energy efficiency price premium of residential buildings in three Italian regions", *Energy Research & Social Science*, Vol. 121

Gravert, K., Poleacovschi, C., Ballesteros, L., Cetin, K., Passe, U., Kimber, A., Koupaei, D.M., Douglass, F. (2024), "Homeowners'Motivations to Invest in Energy-Efficient and Renewable Energy Technologies in Rural Iowa", *ASCE OPEN: Multidisciplinary Journal of Civil Engineering*, Vol. 2(1)

Guiso, L., and Jappelli, T. (2024a), "The Italian Survey of Consumer Expectations: Statistical Bulletin", CSEF (Centre for Studies in Economics and Finance) Working Paper No. 722

Guiso, L., and Jappelli, T. (2024b), "Are people willing to pay to prevent natural disasters?", CSEF (Centre for Studies in Economics and Finance) Working Paper No. 723

Hassett, K., Mebiame, R.M., Mortha, A., Nakai, M., Ahlborg, H., Kavya Michael, Ozdemir, U., Tikoudis, I., Lamhauge, N., Osunmuyiwa, O., Arimura, T., Johnstone, N. (2024), "Household energy choices: New empirical evidence and policy implications for sustainable behaviour", OECD Environment Working Papers No. 247

Hesselink, L.X.W., and Chappin, E.J.L. (2019), "Adoption of energy efficient technologies by households – Barriers, policies and agent-based modelling studies", *Renewable and Sustainable Energy Reviews*, Vol. 99, pp. 29-41

IEA (2023), CO2 emissions by sector, Europe, 1990-2022, in: Energy Statistics Data Browser, available at: https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser?country=WEOEUR&fuel=CO2%20emissions&indicator=CO2BySector, accessed on 20/03/2025

IEA (2024), "The importance of attitudes in support for different policy measures", available at: https://www.iea.org/commentaries/the-importance-of-attitudes-in-support-for-different-policy-measures, accessed on 20/03/2025

Jansson, J., Marell, A., Nordlund, A. (2009), "Elucidating green consumers: A cluster analytic approach on proenvironmental purchase and curtailment behaviors", *Journal of Euromarketing*, Vol. 18(4), pp. 245-267.

Lades, L.K., Clinch, J.P., Kelly, J.A. (2021), "Maybe tomorrow: How burdens and biases impede energy-efficiency investments", *Energy Research & Social Science*, Vol. 78

Long, C., Mills, B.F., Schleich, J. (2018), "Characteristics or culture? Determinants of household energy use behavior in Germany and the USA", *Energy Efficiency*, Vol. 11, pp. 777-798

Mogensen, D., and Thøgersen, J. (2024), “Stop procrastinating, start renovating! Exploring the decision-making process for household energy efficiency renovations”, *Energy Research & Social Science*, Vol. 117

Pelenur, M. (2018), “Household energy use: a study investigating viewpoints towards energy efficiency technologies and behaviour”, *Energy Efficiency*, Vol. 11, pp. 1825-1846

Perret, J.K., Udalov, V., Fabisch, N. (2022), “Motivations behind individuals'energy efficiency investments and daily energy‑saving behavior: The case of China”, *International Economics and Economic Policy*, Vol. 19, pp. 129-155

Piao, X., and Managi, S. (2023), “Household energy‑saving behavior, its consumption, and life satisfaction in 37 countries”, *Scientific Reports*, Vol. 13(1382)

Russell-Bennett, R., McAndrew, R., Gordon, R., Mulcahy, R., Letheren, K. (2019), “Effectiveness of Household Energy Efficiency Interventions in Advanced Economies – what works and what doesn’t”, Final Report. Brisbane: Queensland University of Technology

Salvalai, G., Sesana, M.M, Iannaccone, G. (2017), “Deep renovation of multi-storey multi-owner existing residential buildings: A pilot case study in Italy”, *Energy and Buildings*, Vol. 148, pp. 23-36

Satre-Meloy, A., and Hampton, S. (2024), “Physical, socio‑psychological, and behavioural determinants of household energy consumption in the UK”, *Energy Efficiency*, Vol. 17(86)

Schleich, J. (2019), “Energy efficient technology adoption in low-income households in the European Union – What is the evidence?”, *Energy Policy*, 195, pp. 197-206

Štreimikiene, D., Lekavicius, V., Stankuniene, G., Pažeraite, A. (2022), “Renewable Energy Acceptance by Households: Evidence from Lithuania”, *Sustainability*, Vol. 14, 8370

Trotta, G. (2018), “Factors affecting energy-saving behaviors and energy efficiency investments in British households”, *Energy Policy*, Vol. 114, pp. 529-539

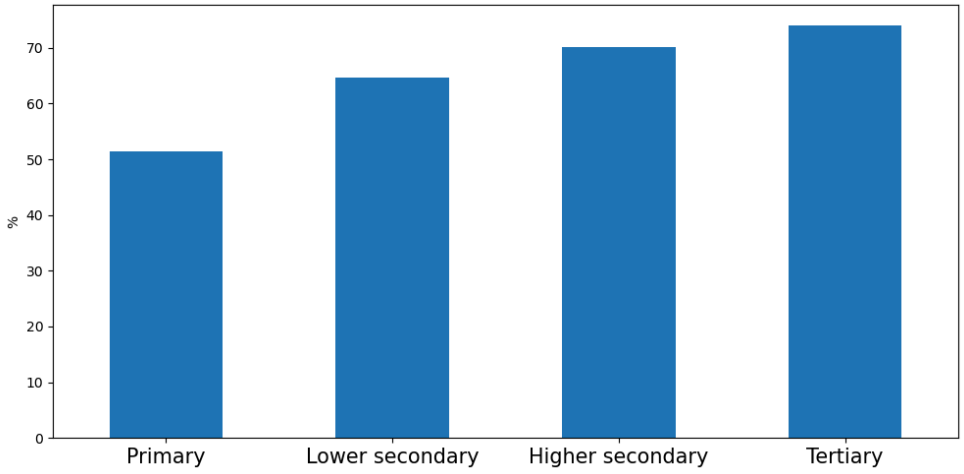
UPB (2023), “Audizione sugli strumenti di incentivazione fiscale con particolare riferimento ai crediti d’imposta”, available at: https://www.upbilancio.it/wp-content/uploads/2023/03/Audizione-crediti-dimposta.pdf, accessed on 20/03/2025

Urban, J., and Ščasný, M. (2012), “Exploring domestic energy saving: The role of environmental concern and background variables”, *Energy Policy*, Vol. 47, pp. 69-80

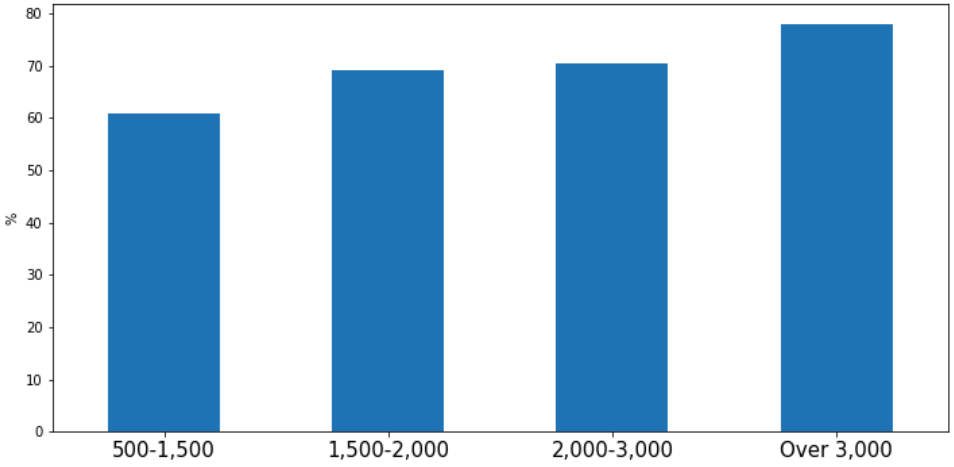
Verachtert, S. (2022), “The effects of attitudes on household energy behavior. A study of climate change concern, responsibility, and awareness in European societies”, *Social Science Quarterly*, Vol. 103, pp. 1221-1233

FIGURES

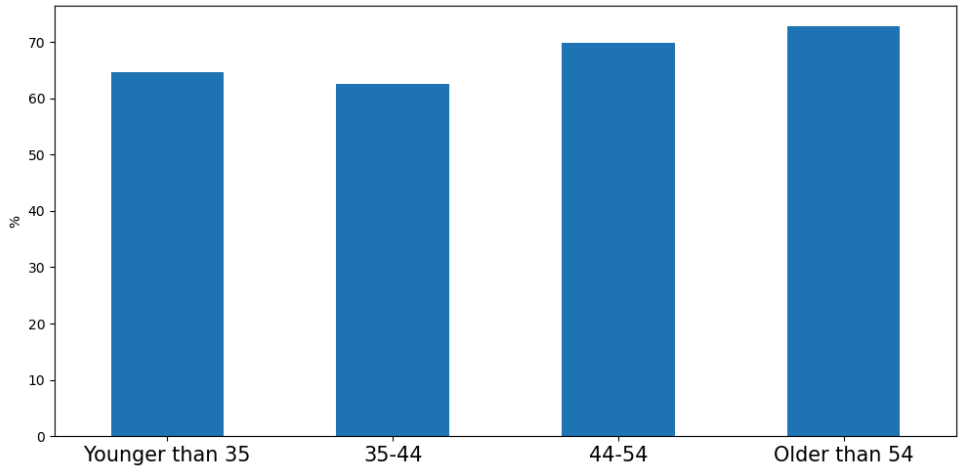
Figure 1 Knowledge of the EPBD (outcome variable 1)
%



Panel (a) – By level of education class



Panel (b) – By monthly household income class (€)

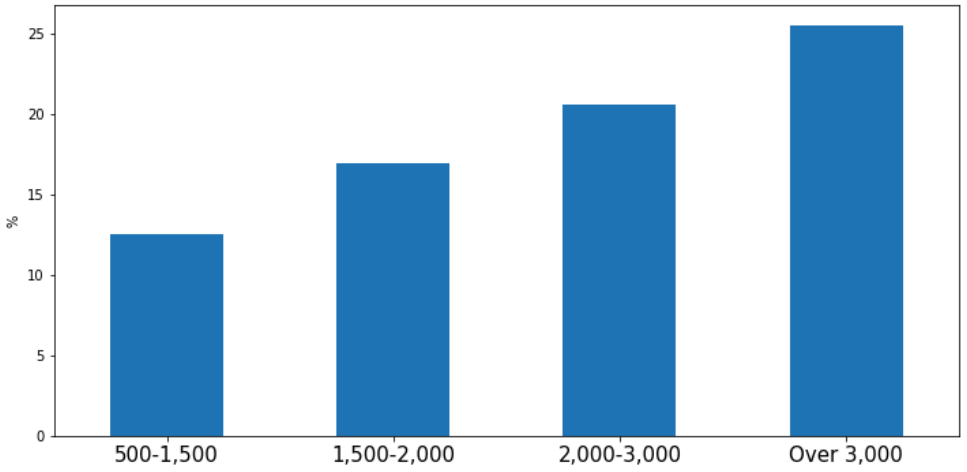


Panel (c) – By age class

Source: Authors'elaborations on ISCE data.

Figure 2 Uptake of Superbonus or Ecobonus (outcome variable 2)

%



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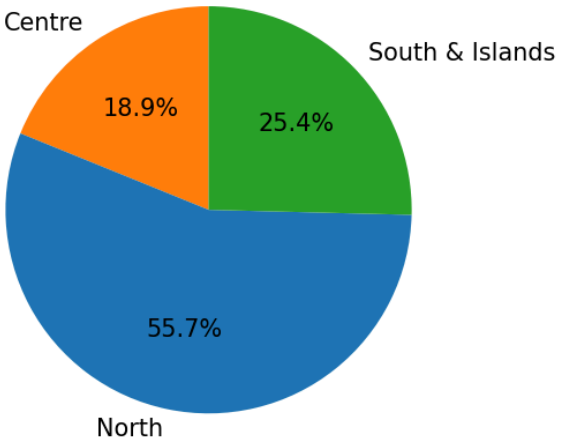

Panel (b) – By geographical distribution

Source: Authors'elaborations on ISCE data.

Figure 3 Whether in favour of government's intervention (outcome variable 3)

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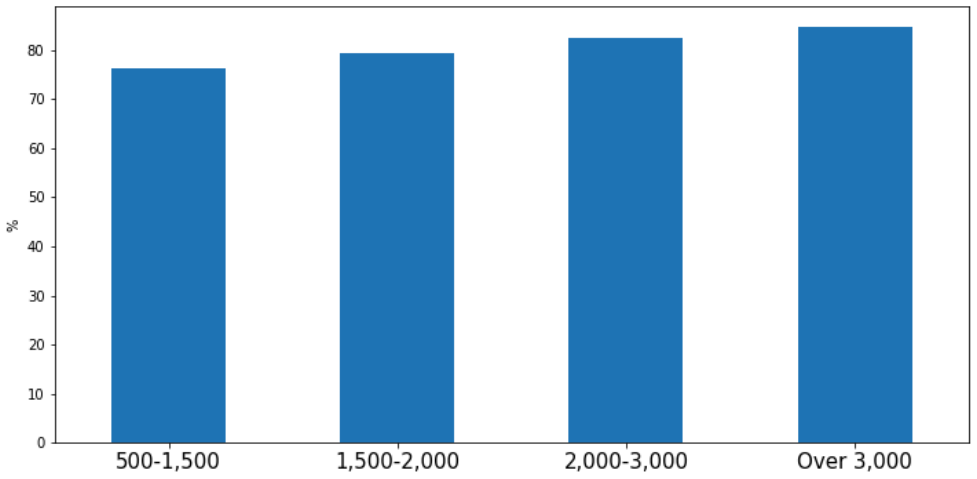
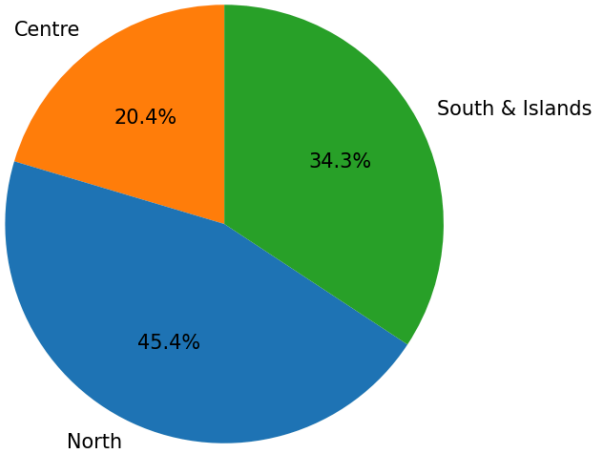


Panel (a) – By monthly household income class (€)



Panel (b) – By geographical distribution

Source: Authors'elaborations on ISCE data.

Figure 4 Whether financial incentives (public and/or private) have convinced or could convince respondents to undertake energy efficiency work (outcome variable 4)

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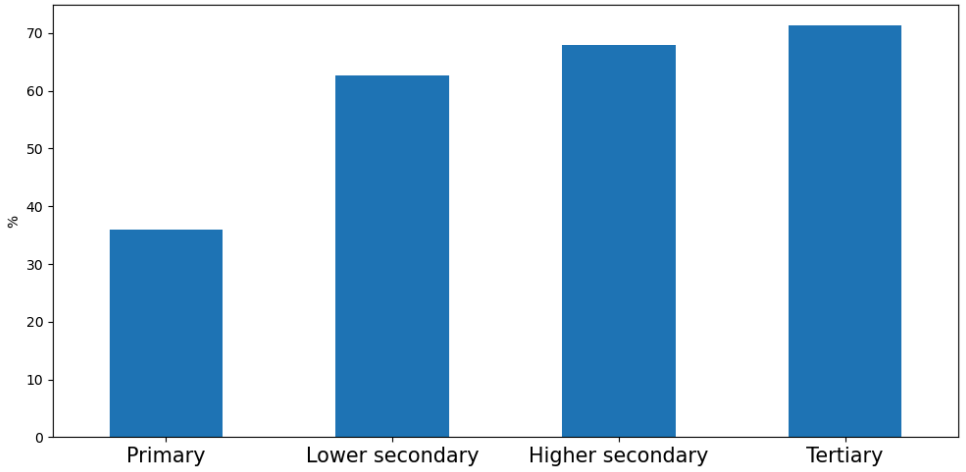
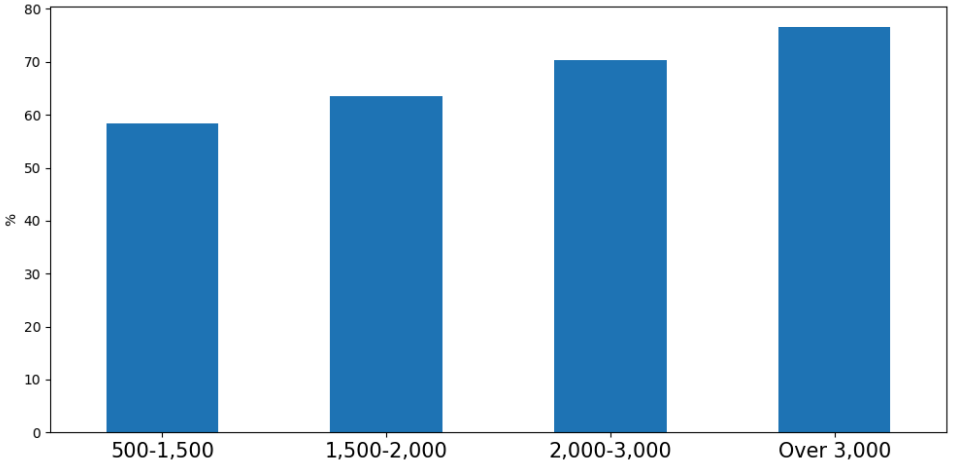
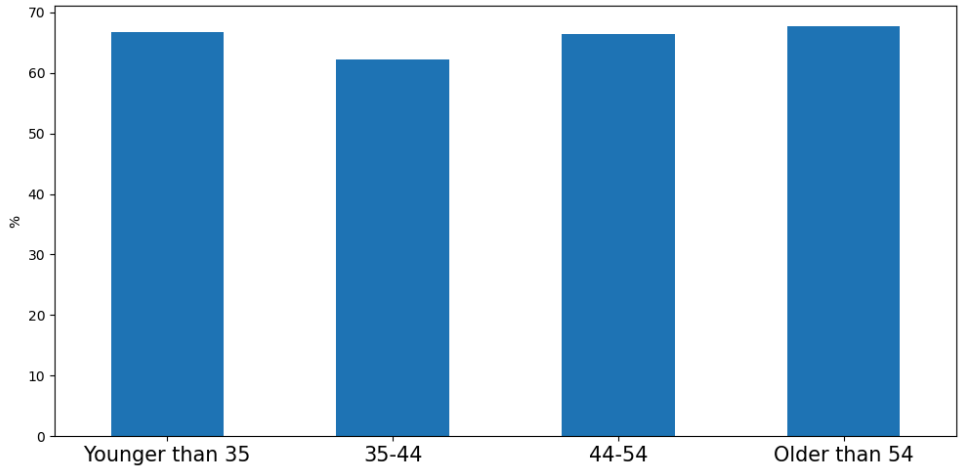


Panel (a) – By level of education



Panel (b) – By monthly household income class (€)



Panel (c) – By age class

Source: Authors'elaborations on ISCE data.

Figure 5 Whether information on energy efficiency interventions has convinced or could convince respondents to undertake energy efficiency work (outcome variable 5)

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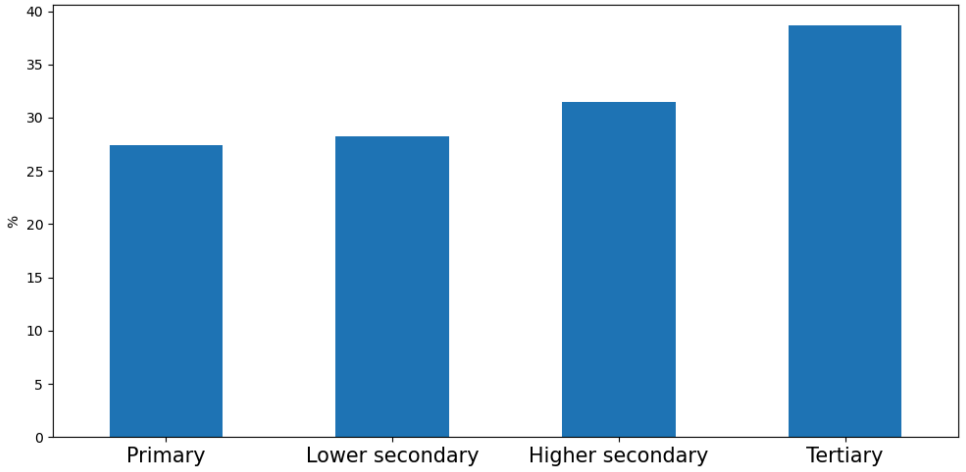
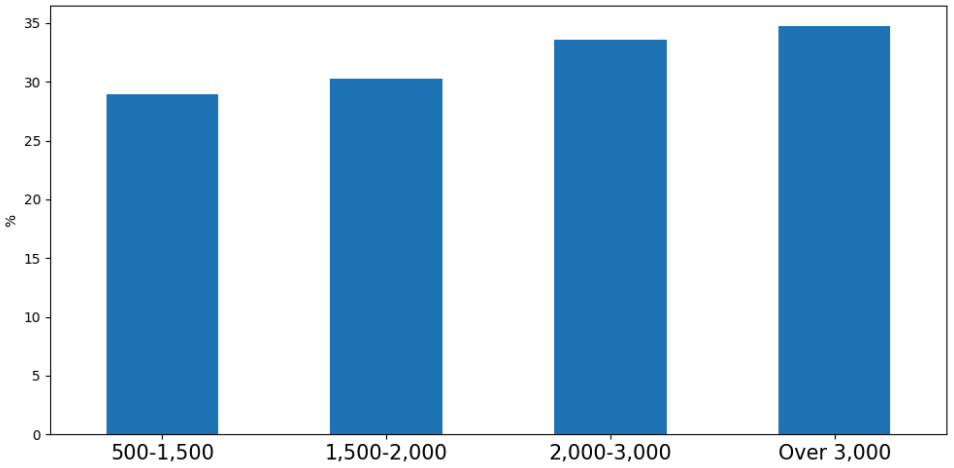
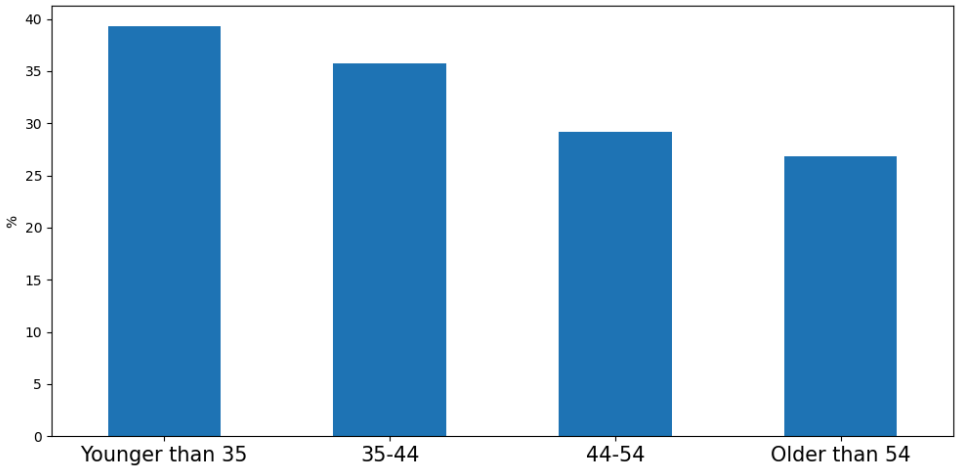


Panel (a) – By level of education



Panel (b) – By monthly household income class (€)



Panel (c) – By age class

Source: Authors'elaborations on ISCE data.

Figure 6 Motives for carrying out energy efficiency renovation works (outcome variable 6)

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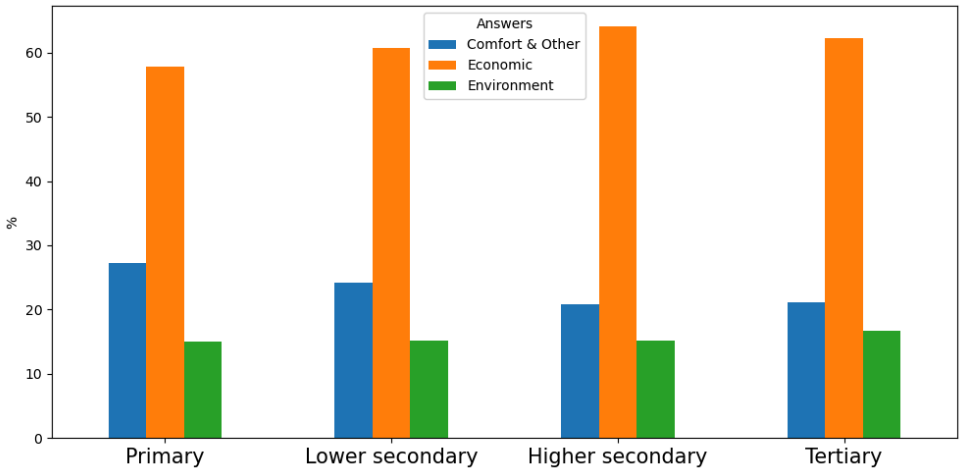
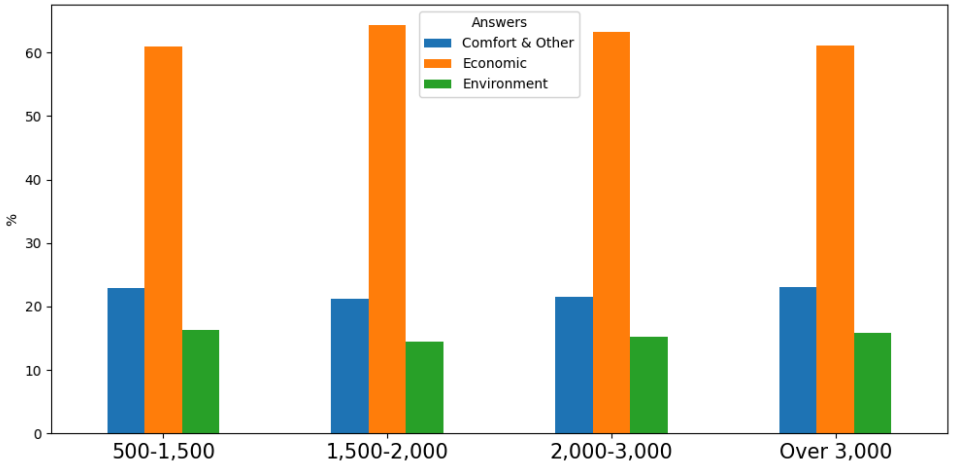
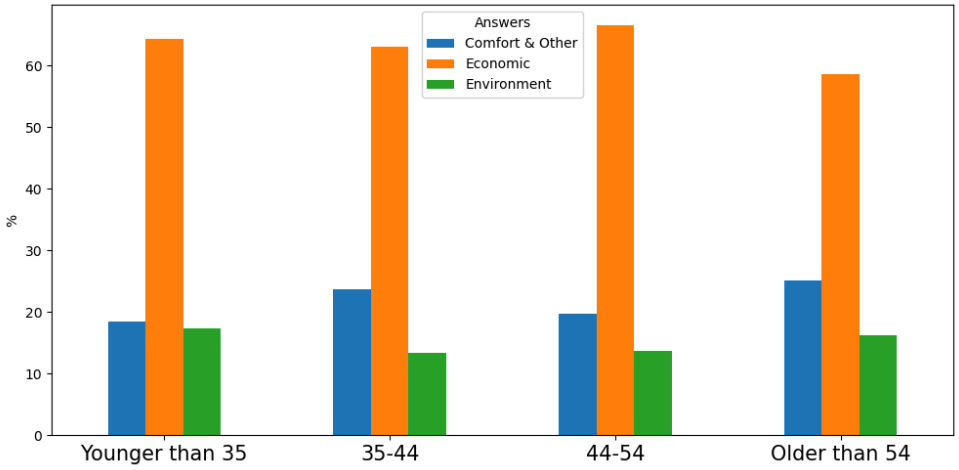


Panel (a) – By level of education



Panel (b) – By monthly household income class (€)



Panel (c) – By age class

Source: Authors'elaborations on ISCE data.

TABLES

Table 1 Descriptive statistics

	Mean	*p50*	*sd*	*N*
Outcome variables				
Knowledge of EPBD (outcome variable 1)	0.6868	1	0.4639	4,545
Superbonus/Ecobonus (outcome variable 2)	0.1888	0	0.3914	3,477
In favour of government intervention (outcome variable 3)	0.8956	1	0.3058	4,091
Role of financial incentives (outcome variable 4)	0.6635	1	0.4726	4,545
Role of information (outcome variable 5)	0.3167	0	0.4652	4,545
		Values	*%*	*N*
Environmental awareness (outcome variable 6)		Environmental motives	15.46	
		Economic motives	62.45	
		Comfort and other	22.09	
			100.0	4,108
Regressors				
Age class		Below 35	23.32	
		35-44	15.29	
		45-54	23.20	
		Above 54	38.19	
			100.0	4,545
Income class		Below €1,500	29.50	
		€1,500-€2,000	22.98	
		€2,000-€3,000	29.75	
		Above €3,000	17.77	
			100.0	4,545
Economic status		Employee	44.28	
		Self-employed	7.50	
		Not in employment	48.22	
			100.0	4,545
Education		Up to lower secondary	20.49	
		Upper secondary	52.32	
		Tertiary	27.19	
			100.0	4,545
Municipality size		Below 30,000 inhabitants	55.09	
		30,000-100,000	21.71	
		Above 100,000	23.20	
			100.0	4,545
Geographical area		North	45.52	
		Centre	20.31	
		South and Islands	34.17	
			100.0	4,545
Housing tenure		Homeowner	76.5	
		Renter	18.42	
		Other	5.08	

			100.0	4,545
Has renovated		Yes	26.41	
		No	73.59	
			100.0	4,545
	Mean	*p50*	*sd*	*N*
Age	48.5511	49	14.2823	4,545
Gender (males)	0.5099	1	0.5000	4,545
No. of household components	2.7928	3	1.1356	4545

Note: statistics, with the exception of the sample size, are computed with sample weights.

Table 2 Probit models: Estimated marginal effects

	Outcome variable 1	Outcome variable 2		Outcome variable 3	Outcome variable 4	Outcome variable 5
	Knowledge of EPBD	Has received public support vs has not renovated	Has received public support vs has paid with own money	In favour of government intervention	Motivated by financial support	Motivated by information received
	(1)	(2)	(3)	(4)	(5)	(6)
Age: 35-44	0.0222	0.0235	0.0334	-0.0133	-0.0116	-0.0213
	(2.41e-02)	(2.48e-02)	(5.03e-02)	(1.73e-02)	(2.41e-02)	(2.37e-02)
Age: 45-54	0.1051***	-0.0238	-0.0408	0.0390***	0.0354	-0.0754***
	(2.20e-02)	(2.26e-02)	(4.88e-02)	(1.51e-02)	(2.24e-02)	(2.19e-02)
Age: over 54	0.1224***	0.0370	-0.0266	0.0591***	0.0433*	-0.0862***
	(2.17e-02)	(2.31e-02)	(4.77e-02)	(1.43e-02)	(2.21e-02)	(2.17e-02)
Monthly income: 1,500€-2,000€	0.0561***	0.0394*	0.0603	0.0023	0.0388*	-0.0020
	(2.03e-02)	(2.15e-02)	(4.99e-02)	(1.38e-02)	(2.14e-02)	(2.02e-02)
Monthly income: 2,000€-3,000€	0.0484**	0.0663***	0.1034**	0.0173	0.0990***	0.0218
	(2.01e-02)	(2.05e-02)	(4.64e-02)	(1.30e-02)	(2.06e-02)	(1.98e-02)
Monthly income: above 3,000€	0.1136***	0.1150***	0.1288**	0.0216	0.1572***	0.0136
	(2.27e-02)	(2.49e-02)	(5.01e-02)	(1.52e-02)	(2.31e-02)	(2.33e-02)
Gender: female	-0.0415***	-0.0359**	-0.0393	0.0315***	-0.0161	-0.0587***
	(1.45e-02)	(1.53e-02)	(3.12e-02)	(9.48e-03)	(1.47e-02)	(1.45e-02)
Economic status: self-employed	-0.0156	-0.0201	-0.0435	-0.0015	-0.0304	-0.0361
	(2.72e-02)	(2.71e-02)	(5.65e-02)	(1.89e-02)	(2.79e-02)	(2.61e-02)
Economic status: not employed	0.0156	-0.0078	0.0149	0.0260**	0.0033	-0.0214
	(1.66e-02)	(1.81e-02)	(3.81e-02)	(1.10e-02)	(1.71e-02)	(1.70e-02)
Education: upper secondary	0.0892***	0.0131	0.0177	0.0012	0.0648***	0.0442**
	(2.07e-02)	(2.12e-02)	(4.59e-02)	(1.36e-02)	(2.09e-02)	(1.97e-02)
Education: tertiary	0.1523***	0.0366	0.0227	0.0058	0.1134***	0.0616***
	(2.35e-02)	(2.52e-02)	(5.20e-02)	(1.56e-02)	(2.42e-02)	(2.32e-02)
No. of household members	-0.0065	0.0005	0.0073	-0.0074*	-0.0090	0.0151**
	(6.59e-03)	(7.35e-03)	(1.47e-02)	(4.41e-03)	(6.70e-03)	(6.55e-03)

Municipality size: medium	-0.0078	-0.0253	-0.0327	-0.0038	-0.0404**	0.0249
	(1.77e-02)	(1.93e-02)	(3.99e-02)	(1.18e-02)	(1.83e-02)	(1.80e-02)
Municipality size: large	-0.0164	-0.0333*	-0.0274	-0.0181	-0.0464***	0.0367**
	(1.75e-02)	(1.84e-02)	(3.87e-02)	(1.22e-02)	(1.79e-02)	(1.75e-02)
Area: Centre	-0.0283	-0.0559***	-0.0785*	0.0012	0.0432**	-0.0129
	(1.91e-02)	(2.02e-02)	(4.11e-02)	(1.32e-02)	(1.90e-02)	(1.88e-02)
Area: South & Islands	-0.0292*	-0.0782***	-0.0843**	0.0282**	-0.0184	0.0310*
	(1.68e-02)	(1.77e-02)	(3.82e-02)	(1.12e-02)	(1.75e-02)	(1.70e-02)
Housing tenure: rent	-0.0781***			-0.0186	0.0060	0.0243
	(1.92e-02)			(1.28e-02)	(1.88e-02)	(1.93e-02)
Housing tenure: other	-0.0506			-0.0290	-0.0593*	-0.0133
	(3.25e-02)			(2.16e-02)	(3.38e-02)	(3.18e-02)
Has renovated	0.0257			0.0246**	-0.0139	0.0952***
	(1.60e-02)			(1.02e-02)	(1.65e-02)	(1.67e-02)
Information campaign	0.0174	0.0599**	0.0707	-0.0089		
	(2.28e-02)	(2.63e-02)	(4.53e-02)	(1.50e-02)		
Private information	0.0632***	0.0565***	-0.0295	0.0105		
	(1.56e-02)	(1.84e-02)	(3.29e-02)	(1.02e-02)		
Motivated by financial support				0.1711***		
				(1.37e-02)		
Observations	4,545	3,085	1,054	4,091	4,545	4,545

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 Multinomial logit models: Estimated marginal effects

	Outcome variable 6		
	Environmental motives (1)	Economic motives (2)	Comfort and other (3)
Age: 35-44	-0.0317*	-0.0100	0.0417*
	(1.89e-02)	(2.57e-02)	(2.21e-02)
Age: 45-54	-0.0205	0.0186	0.0018
	(1.86e-02)	(2.41e-02)	(2.00e-02)
Age: over 54	-0.0016	-0.0541**	0.0557***
	(1.95e-02)	(2.43e-02)	(2.04e-02)
Monthly income: 1,500€-2,000€	-0.0083	0.0175	-0.0092
	(1.64e-02)	(2.23e-02)	(1.89e-02)
Monthly income: 2,000€-3,000€	0.0027	-0.0058	0.0031
	(1.65e-02)	(2.19e-02)	(1.85e-02)
Monthly income: above 3,000€	0.0110	-0.0405	0.0295
	(1.97e-02)	(2.58e-02)	(2.23e-02)
Gender: female	0.0211*	-0.0006	-0.0205
	(1.18e-02)	(1.61e-02)	(1.39e-02)
Economic status: self-employed	-0.0135	0.0231	-0.0096
	(2.09e-02)	(2.94e-02)	(2.54e-02)
Economic status: not employed	0.0160	-0.0265	0.0105
	(1.44e-02)	(1.88e-02)	(1.59e-02)
Education: upper secondary	0.0004	0.0312	-0.0316
	(1.64e-02)	(2.25e-02)	(1.97e-02)
Education: tertiary	0.0096	0.0265	-0.0360
	(1.94e-02)	(2.64e-02)	(2.30e-02)
No. of household members	-0.0045	0.0030	0.0015
	(5.40e-03)	(7.39e-03)	(6.43e-03)
Municipality size: medium	0.0120	0.0169	-0.0289*
	(1.51e-02)	(1.99e-02)	(1.68e-02)
Municipality size: large	0.0065	0.0298	-0.0363**
	(1.43e-02)	(1.91e-02)	(1.62e-02)
Area: Centre	-0.0009	-0.0249	0.0258
	(1.53e-02)	(2.09e-02)	(1.82e-02)
Area: South & Islands	0.0209	-0.0560***	0.0351**
	(1.44e-02)	(1.88e-02)	(1.61e-02)
Housing tenure: rent	0.0274*	-0.0352*	0.0078
	(1.63e-02)	(2.13e-02)	(1.82e-02)
Housing tenure: other	0.0096	-0.0235	0.0139
	(2.80e-02)	(3.69e-02)	(3.21e-02)
Motivated by financial support	0.0159	0.0426**	-0.0586***
	(1.29e-02)	(1.85e-02)	(1.67e-02)
Motivated by information received	0.0720***	-0.0431**	-0.0289*
	(1.34e-02)	(1.76e-02)	(1.51e-02)
Observations	4,108	4,108	4,108

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix A - Special section survey questions

Table A.1 - Survey questions on dwellings'energy efficiency

Number	Question	Answer	
L11	Has energy efficiency work been carried out in the house you live in since 2020 (inclusive), either by you or by the owner?	1.	Yes
		2.	No
		3.	Don't know / don't remember
L12	If energy efficiency works have been carried out, what are they?	1.	External thermal insulation
		2.	Window frames
		3.	Boiler
		4.	Heat pump for cooling
		5.	Solar panels
		6.	Other
		7.	Don't know [exclusive answer]
L13	If you are the owner of the house you live in, how did you pay the expenses for energy efficiency measures?	1.	I used 100% public subsidies (e.g. Superbonus)
		2.	I used 100% family resources
		3.	I used partial public contributions (e.g. Ecobonus or other)
L13_1	Having set your total expenses for energy efficiency measures at 100%, can you indicate what percentage of these were covered by public subsidies?	1.	Indicates % from 1 to 100
		99.	Does not indicate
L13_2	Can you indicate what was the total cost of the energy efficiency intervention you carried out? Take into account both the costs you incurred and any public contributions you benefited from.	1.	Indicates amount _____
		99.	Does not indicate
L14	Are you aware of the existence of European directives on improving the energy efficiency of residential buildings, such as the "Green Buildings" Directive?	1.	Yes
		2.	No
L15	In your opinion, what are the reasons that discourage households from carrying out efficiency works?	1.	Costs too high
		2.	Benefits too low
		3.	Retrofit times too long
		4.	Interventions too invasive

		5. Too much bureaucracy 6. Other (specify) 7. Don't know
L16	What is the main reason that prompted you or could prompt you to carry out energy efficiency work? If you are renting, imagine you are an owner.	1. Helping to protect the environment and/or combat climate change 2. Increase the economic value of housing 3. Reduce the cost of energy 4. Make the home more comfortable 5. Other (specify) 6. Don't know
L17	Which of the following aspects have convinced you or could convince you to undertake energy efficiency work? If you are renting, imagine you were an owner.	1. Financial support from the state (subsidies, tax credits, etc.) 2. Possibility of obtaining soft loans from the banking sector 3. Information and explanations from experts in the field (administrator, energy certifier, company representative, etc.). 4. State information campaign (social media/journals/web/TV/flyers, etc.) 5. Recommendations obtained from relatives/friends 6. Other (specify) 7. Don't know
L18	Do you think that government intervention is needed to incentivise investments by households to make their homes more efficient?	1. Yes 2. No 3. Don’t know
L18_1	What percentage should the government contribute?	1. 0%-20% 2. 20%-40% 3. 40%-60% 4. 60%-80% 5. 80%-100% 6. Don’t know
L18_2	Why do you think the government should not intervene?	1. Not a priority 2. There are other, more appropriate instruments 3. I am against government intervention in the housing sector 4. I am concerned about the impact of these new measures on public finances 5. The measures already taken are sufficient 6. Other (please specify)

Appendix B – Additional variables of the special section on energy efficiency

Herein, we briefly describe the questions from the special section on energy efficiency that are not within the scope of the present analysis. Among those who carried out energy efficiency interventions, the questionnaire asks which type of retrofit they had chosen (question L12). The most frequently selected options are boiler upgrades (52%) and window frame replacement (50%), while other measures—external insulation, heat pumps, and solar panels—are chosen by approximately 25% of respondents.[11]

Participants who indicated in question L13 that they used partial public are also asked to indicate the percentage of total costs covered by public subsidies. In general, the share of public contribution is limited, with two-thirds of the sample indicating a percentage between 26% and 50% of the retrofit cost, although a consistent minority (22%) reports a public contribution ranging from 51% to 80%.

When asked about the total cost of the energy efficiency intervention, 43% of respondents report expenses below €5,000, while 26% indicate costs between €5,000 and €15,000, with the remaining 30% reporting higher costs. These results are consistent with the responses to question L12, which highlighted a prevalence of low-cost types of interventions.

Regarding question L15 on the main discouraging factors for not undertaking energy efficiency works, 77% cite excessively high costs.[12] The second most common reason is excessive bureaucratic burden, selected by 43% of the sample, followed by concerns about the excessive length of the retrofit works (24%), insufficient benefits (21%), and overly invasive interventions (19%).

After question L18 on respondents'opinions about government interventions, a follow-up question is asked to those in favour (L18_1) and those against (L18_2) public policies. For L18_1, respondents are asked about the envisaged percentage of public contribution to the costs of a hypothetical energy efficiency project. Most prefer a high level of contribution: 45% of respondents indicate a preference for more than 60%, while 35% select a value between 40% and 60%. For those who opposed government intervention, the follow-up question explores the reasons for their opposition. The responses are relatively balanced, with the most common reason being “Not a priority” (25%), followed by “I am against

[11] Respondents can select more than one option.

[12] Respondents can select more than one option.

government intervention in the housing sector" (22%), and "I am concerned about the impact of these new measures on public finances" (19%).