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# Awareness and Utilization of Incentive Programs for Household Energy-Saving Renovations: Empirical Findings from Greece

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**Abstract:** The Greek policy targeting residential energy efficiency has launched the "Residential Energy Saving" financial incentives program to assist in achieving the goals related to reducing energy use and GHG emissions. Considering the research gaps of previous work, the present study examines the sociodemographic, dwelling, and geographical characteristics, and the environmental awareness and behavior that affect individuals' (a) actual decision to perform an energy-saving renovation of their dwelling; this has been previously examined, but not in the Greek context, (b) awareness of the incentives program; this has not been addressed in previous research, and (c) utilization of the program; this has not been addressed in previous research. Accordingly, we performed a questionnaire-based survey in Greece in 2019 (n = 451). Based on the development of three binary logistic regression models, it is indicated that the decision to perform an energy-saving renovation is affected by ownership status, year of construction, income, and environmental behavior; awareness is affected by education level, environmental awareness, and residence location; use of the incentives program is affected by residence ownership and year of construction, presence of senior citizens and education level. The study's results, indicating the determinants of energy-saving renovation decisions and awareness and utilization of financial incentives programs, can assist policymakers in planning financial incentives adapted to different characteristics, thus achieving improved awareness and utilization of such tools.

**Keywords:** energy efficiency; residential sector; household; financial incentives; awareness; energy-saving renovation



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## 1. Introduction

The industrial, transportation, residential, and commercial sectors add to global energy use. Specifically, the residential sector is responsible for about 21% of global energy consumption, or 17% of $CO_2$ emissions [1]. The corresponding European Union (EU) share is around 27% [2], whereas for Greece, it is approximately 26% [3]. Moreover, the IEA [4] predicts that between 2018 and 2050, building sector energy consumption, incorporating both residential and commercial structures, will rise by 65% due to urbanization and increased income and access to electricity.

Increased energy consumption poses substantial risks to public health and the natural environment [5]. Therefore, more efficient energy consumption across the entire energy chain can assist in environmental protection, climate change mitigation, and quality-of-life improvement, combined with money savings and increased national energy security [6]. Undoubtedly, the energy conservation gains have to exceed the potential costs (e.g., the performance of a renovation), meaning that measures should concentrate on areas with high potential savings, such as the building sector [6]. Regarding the building sector, energy efficiency solutions include active/passive space heating and cooling technologies, utilization of innovative materials, active service systems, Renewable Energy Sources

(RES), and advanced controls [7]. Taking into consideration precisely the case of the Greek building sector, Gaglia et al. [8] indicated that the application of RES, such as solar thermal and photovoltaics, is the most efficient option in energy and financial terms, while space heating measures have a low potential of energy conservation due to low actual thermal energy consumption.

In this sense, in 2007, EU leaders agreed on three key targets, i.e., the 2020 targets. These are a 20% reduction in GHG emissions compared to the 1990 level, 20% of the energy produced by RES, and a 20% improvement in energy efficiency. Directive 2012/27/EU ratified the latter in 2012. In 2018, an amendment [Directive 2018/2002] to the previous directive set the EU's 2030 energy efficiency target at a minimum of 32.5% in relation to 2030's business-as-usual projections. Against this background, each member state has developed for the years 2021 to 2030 a National Energy and Climate Plan (NECP), describing how it will contribute towards this target and to the GHG emissions and RES targets [6]. Referring specifically to Greece, the target is to have lower final energy consumption in 2030 in comparison to that recorded in 2017, or in other words, a 38% energy efficiency improvement relative to the foreseen evolution of 2030's final energy consumption [9]. In the context of the residential sector, according to the NECP, the goal is to replace or renovate an average of 60,000 residential buildings or building units each year with new, more energy-efficient ones [9].

Thus far, a substantial number of energy regulations and standards adopted by the EU have assisted Greece in carrying out the appropriate levels of energy efficiency measures in new building construction (e.g., [10–13]). Specifically, Greek Law 4122/2013 [13], along with all the subsequent updates (e.g., [14]), determines the requirements for the thermal envelope, the electromechanical facilities, and the design of existing or new (>50 $m^2$) structures that will be extensively renovated, based on specifically set parameters (e.g., local climate) [15]. Nevertheless, when referring to the current building stock, which is viewed as a challenge to the environment [8], Greek policies center on financial incentives to lift economic barriers and increase cost efficiency.

In this context, the «Residential Energy Saving" ("Εξοικονόμηση κατ'οίκον" in Greek) financial incentives scheme was launched in 2011 [16]. The program incentivized homeowners to implement energy-saving actions in existing residential buildings (detached houses, apartments, and shared spaces/facilities of apartment buildings). The incentives included granting low-interest loans and subsidizing interest rates, capital grants, and covering the costs of energy inspections. The eligible categories of energy efficiency interventions included the replacement of frames (casings/windowpanes); installment of shading components; installment of thermal protection to the building's exterior, including the rooftop structure and the pilotis; and upgrade of heating and domestic hot water supply system. The program closed at the end of 2017. In 2018, the government set in motion the "Residential Energy Saving II" ("Εξοικονόμηση κατ'οίκον ΙΙ") incentives program, a follow-up program that will end in 2023 [17]. In brief, the main differences between the two programs are the property value limits, property use, family income limits, energy-saving targets, application procedures, eligible budget, eligible expenses, and project implementation (e.g., payments, timeframe) [18]. The energy-saving results deriving from the specific programs are noteworthy; according to statistics from the Ministry of the Environment and Energy [19], energy savings range from 50% (residences upgrading from energy efficiency class D to class B) up to 87–95% [residences upgrading from the lowest energy efficiency class (H) to the highest one (A+)].

### *1.1. Contribution to Knowledge and Novelty of the Study*

In light of this, the current study seeks to contribute to the evaluation of the applicability of the above incentive programs by performing an investigation concerning the effect of (a) sociodemographic, dwelling, and geographical characteristics and (b) levels of environmental awareness and behavior on:

1. Homeowners'/occupants' decision to perform an energy-saving renovation of their residence; as presented in Section 2.1, this is a thematic examined in previous works; however, it is the first time that empirical results will be provided for Greece, thus complementing earlier research;
2. The public's awareness of the energy efficiency incentive programs; as presented in Section 2.2—and as far as the authors are aware—this theme has not been examined in previous research;
3. Use of the energy efficiency incentive programs by individuals who were both aware of the program and renovated their residences in the 2010–2019 decade; no relevant literature was identified on this subject, meaning that—as far as the authors are aware—this topic is investigated for the first time.

### *1.2. Study Structure*

Section 2 presents previous research on the factors affecting residential energy-saving renovation decisions and investment in energy efficiency measures, as well as research related to awareness of energy efficiency incentive programs; however, as mentioned in the above paragraph, there was no previous literature identified, concerning the factors influencing the use of energy efficiency incentives programs. Section 3 presents the study's materials and methods, including the survey's development and implementation and the data's treatment and analysis. Section 4 provides the statistical analysis results consisting of descriptive statistics and three binary logistic regression models. Section 5 discusses the study's results, while Section 6 provides the study's conclusions and respective policy implications.

## 2. Literature Review

### *2.1. Previous Work on Factors Affecting Residential Energy-Saving Renovation Decisions and Investment in Energy Efficiency Measures*

Over the past few years, a considerable—and ever-increasing—amount of research has been dedicated to the factors that affect the decision to renovate a dwelling and invest in residential energy efficiency measures. In this context, Kastner and Stern [20] reviewed empirical studies to detect the determinants of residential energy-relevant investment decisions. Their work classifies the determinants into six categories, namely (a) demographic, residence, and spatial characteristics, (b) decision-maker dispositions, (c) views concerning household consequences, (d) views concerning consequences outside the household, (e) social effects, and (f) policy actions. We can cluster previous works into three groups; the first group of research assesses the impact of both socioeconomic/residence characteristics (see category "a" above) and contextual determinants (see categories "b" to "f" above); the second group focuses specifically on the effect of socioeconomic and residence characteristics; and the third group emphasizes the contextual determinants.

#### 2.1.1. Research on Socioeconomic/Residence Characteristics and Contextual Determinants

In the sense of works focusing on both socioeconomic/residence and contextual determinants, Jakob [21] worked on the identification of the determinants of Swiss single-family homeowners' renovation choices; he concludes that technical criteria and housing activities like building extensions and incentives influence the renovation of buildings' envelopes, as opposed to socioeconomic factors, including age, education, and income. Nair et al. [22] investigated the determinants of energy efficiency investment implementation in Swedish detached houses; the findings indicate that socioeconomic/residence (income, education, age, house age) and contextual (thermal comfort, previous investments, perceived energy costs) aspects affect homeowners' preferences for specific energy efficiency measures. Hrovatin and Zorić [23] worked on the factors influencing household energy-efficient retrofit decisions in Slovenia; they detected that an estimated potential for energy savings, household income, and obtaining expert guidance are all substantially correlated with a holistic retrofit approach. Wilson et al. [24] worked on the understanding of British

owner-occupied households' renovation decisions; their analysis indicates that particular "home-life" settings (i.e., harmonizing competing space uses, creation of identification based on household functions, handling physical disadvantages of the people in the household) influence decisions, which also explain the effect of residence and household attributes.

#### 2.1.2. Research on Socioeconomic and Residence Characteristics

As previously noted, a second group of studies focused on the socioeconomic and dwelling characteristics' impact on the decision to renovate the dwelling and invest in residential energy efficiency measures. Plaut and Plaut [25] studied the financial, household, and geographic factors that affect American (U.S.A.) households' decisions to renovate; their analysis indicates that income, education level, age, race, household size, residence size, property value, location, and proximity to green or commercial areas are factors significantly associated with the performance of renovations. Mortensen et al. [26] worked on the socioeconomic parameters that affect the motivational factors related to private energy renovations of Danish homeowners, including age, income, family structure, years of ownership, and occupation; they conclude that younger individuals are more likely to perform a renovation, while the use of the right policy tools could assist older people. Das et al. [27] examined the demographic factors that affect taking on residential energy efficiency measures in Canada, concluding that not all demographic groups participate equally in the adoption process; age has a negative impact, education and income have a positive effect, while available financial incentives—namely government grants—are even more impactful than income when referring to the adoption of efficiency measures. Trotta [28] studied the demographic and residence characteristics affecting energy-efficient retrofit investments in English households; he concludes that (a) the number of residents, (b) the existence of children, (c) dwelling type, ownership status (i.e., the landlord–tenant problem), year of construction and location, and (d) length of residing in the specific household are factors determining such investments.

#### 2.1.3. Research on Motivational Factors

The third group of research focuses on the influence of motivational factors. Nair et al. [29] focused on the perceptions of Swedish homeowners relative to the adoption of measures for energy efficiency for building envelopes; the results indicate that contextual factors such as physical state, thermal performance, aesthetics, and economic factors affect their decision in regard to taking on such energy efficiency measures. Gamtessa [30] investigated the factors underlying retrofit decisions in Canadian households, finding that cost savings, economic incentives, and retrofit cost significantly affect this type of decision. Stieß and Dunkelberg [31] investigated the effect of German homeowners' expectations and attitudes towards energy-efficient refurbishments; their results indicate that a mixture of individual and contextual elements, comprising comfort, convenience, social position and sense of belonging, concern for the environment, and economic aspects influence decisions on these issues. Achtnicht and Madlener [32] focus on building energy retrofits' adoption drivers and barriers in German detached and semidetached dwellings; their findings suggest that homeowners who can financially afford it, find it profitable, and find a favorable opportunity are more likely to carry out energy retrofit activities. Alberini and Bigano [33] investigated the incentives that affect household energy upgrades, namely heating system replacements, in Italian households, finding that monetary incentives (energy bills savings and provided rebates) have a significant effect, unlike non-monetary incentives ($CO_2$ emissions reductions in particular). Aravena et al. [34] investigated the determinants of investments and implementation of energy efficiency measures in Irish residences; their results offer evidence that monetary or economic elements (e.g., energy-saving gains and cost of the measures) primarily lead the decision to adopt such measures, followed by comfort gains, with environmental benefits not being essential.

Likewise, Klöckner and Nayum [35] worked on the structural psychological factors influencing energy efficiency improvements in Norwegian homes with a private ownership

status; they concluded that the most critical drivers include improved living arrangements, increased anticipated comfort levels, anticipated energy cost reductions, easily accessible information, and a reasonable payback period. Conversely, they identified believing that the right moment had not yet arrived, being unable to decide, not owning the property, and time demands for supervising contractors as the most significant barriers. Further work by the abovementioned researchers [36] examined the mental and structural factors affecting the choice to perform an energy-related upgrade of Norwegian privately owned domestic buildings. They indicated that willingness to incorporate energy efficiency improvements in a restoration project is affected by ethical responsibility, perspectives, and confidence in one's abilities, linked to mental factors such as creativeness, identified consumer efficiency, societal patterns, recognition of problems, and leading values. Moreover, based on their results, relevant barriers consist of the uncertainty regarding the potential for financial savings and the belief that the right time to begin the rehabilitation has not yet arrived. Conversely, motivators include improved living settings and increased anticipated comfort, lower energy costs, a rise in the house's market value, and the perception that the present building standard wastes energy.

Baumhof et al. [37] worked on identifying the determinants of the behavior of Germans older than 50 years, that are owner-occupants of single- or two-family residences, concerning energy-saving renovation solutions; by comparing house owners (a) intending to refurbish, (b) not intending to refurbish, and (c) that have already refurbished, the study concludes that the motivational trigger for refurbishment is indoor comfort, while barriers include financial aspects, time limitations and the ability of the homeowners to complete the renovations. Another study from the same team [38], based on the Motivation–Opportunity–Ability framework, investigated factors affecting the scale of energy renovation initiatives carried out by owners of single- and two-family homes; their results indicate that ambition to improve the dwelling, building maintenance requirements, pre-existing relevant experience, a supportive social setting and readiness to get a loan support the completion of more extensive energy-related renovation projects. März [39] studied the decision processes of German small property owners on energy renovations; the results indicate that the decision-making process is significantly influenced by (a) economic elements, (b) values, beliefs, norms, and routines, (c) personal skills and abilities, and (d) contextual elements. Ebrahimigharehbaghi et al. [40] studied Dutch house owners' barriers and drivers toward renovations that use less energy; their analysis reveals that the main driver is quality-of-life improvement rather than financial benefits, while the main barriers include renovation costs, process complexities, information barriers, and difficulty of finding reliable experts and information. Gamtessa and Guliani [41] researched the association between energy efficiency auditing procedures and family engagement in environmentally friendly initiatives in Canada; they concluded that environmentally friendly behaviors—led by environmental awareness—are positively related to engagement in energy efficiency audit programs. De Wilde [42] examined the importance of trust during the decision process concerning implementing a retrofit in the context of Dutch householders that adopted a low-carbon renovation scheme; the analysis indicates three types of trust: interpersonal, impersonal, and professional.

### *2.2. Previous Work on Factors Affecting Awareness of Energy Efficiency Incentive Programs*

We conducted a literature review to reveal research concerning the factors that affect individuals' awareness/information/knowledge of incentive programs dedicated to energy efficiency measures and renovations. However, we did not identify any previous works on this specific subject; the only connection between information and energy efficiency incentive programs was related to the significance of information throughout the decision-making process or the evaluation of the most significant information sources. For example, referring to the first theme, Matschoss et al. [43] mentioned that a critical barrier to energy refurbishment projects in the case of owner-occupied multifamily buildings is the shortage

of information, while Ramos et al. [44] highlighted the importance of the informational failure barrier in relevance to increasing energy efficiency in the domestic sector.

Concerning the information sources, Nair et al. [29] focused on Swedish homeowners' perceptions of adopting energy efficiency measures for building envelopes, identifying that personal contacts, construction firms, installers, and energy advisors were valuable information sources on this subject. Hrovatin and Zorić [23] noted that apart from professional energy audits, other formal and informal information sources and recommendations are also crucial concerning the information of homeowners and the promotion of decisions on energy-efficient retrofits. Ebrahimigharehbaghi et al. [45], based on a survey of Dutch households, identify (a) maintenance/installation companies, (b) family/friends, and (c) the internet as the primary information sources for (potential) renovators.

## 3. Materials and Methods

### *3.1. Survey Design and Implementation*

We developed a questionnaire with five groups of questions to conduct the web-based survey. The translated—from Greek—questionnaire is available in Appendix A of the present paper. Specifically, the questionnaire contained questions on (a) dwelling characteristics (house size and type, ownership, construction year, number and type of residents) (Appendix A—Coding A1–A7), (b) questions on environmental awareness and behavior (Appendix A—Coding B1), (c) actual and suppositional choices on the installment of household microgeneration systems (Appendix A—Coding C1; we did not use these questions in this study), (d) viewpoints on microgeneration-system-related factors (Appendix A—Coding D1; we did not use these questions in this study) and (e) sociodemographic attributes (age, gender, marital status, level of education, occupation, yearly family income, location of residence) (Appendix A—Coding E1–E8). Table 1 presents the variable types corresponding to each question/set of questions.

**Table 1.** Types of variables corresponding to the survey's questions.

| Coding | Question/Set of Questions | Variable Type |
|---|---|---|
| A1 | Type of residence | Nominal |
| A2 | Ownership status of the residence | Nominal |
| A3 | Year of construction of the residence | Continuous |
| A4 | Energy-saving renovation or refurbishment of the residence within the last ten (10) years | Binary |
| A4 | Use of the "Residential Energy Saving" incentives program | Binary |
| A5 | Number of bedrooms | Continuous |
| A6 | Number of residents | Continuous |
| A7 | Children residing in the residence | Binary |
| A7 | Senior citizens residing in the residence | Binary |
| B1 | Environmental awareness and behavior statements | Binary |
| C1 | Actual and suppositional choices on the installation of residential microgeneration systems | Binary |
| D1 | Perceptions of factors related to microgeneration systems | Ordinal |
| E1 | Gender | Nominal |
| E2 | Age | Continuous |
| E3 | Marital status | Nominal |
| E4 | Education level | Ordinal |
| E5 | Occupation | Nominal |
| E6 | Annual family income | Ordinal |
| E7 | Regional unit of residence | Nominal |
| E8 | Municipality of residence | Nominal |

The study's target demographic group was Greek adults (i.e., >18 years old). We applied Yamane's [46] simplified formula to calculate the required size of the sample:

$$n = N/[1 + N \times (e)^2] \quad (1)$$

where n is the requested sample size, N is the study's population, and e is the degree of expected error. Assuming an e of 0.05 and a Greek adult population of approximately 8.93 million [47], a sample of roughly 400 respondents is estimated to be adequate for the proposed analysis.

A non-probability purposive sampling method was applied to collect the sample, considering the research's constraints (sampling frame, time, budget). In non-probability sampling methods, some participants have a higher—but unknown—chance to be selected compared to others, while the character of the purposive sampling method is that the survey takes into account a variety of individuals who eventually represent at least the extremes of specific factors under examination [48]. The main difference between a probability and a non-probability sample is that the former requires a sample frame, i.e., a complete and updated directory of all the members of the examined population [48]; this was not possible in the context of the present research. At the same time, we should note that the collected sample does not represent the general Greek population, a study limitation discussed in Section 5.4.

Finally, we collected the sample through an online questionnaire during January and February 2019. The questionnaire was distributed to approximately 5000 individuals. A total of 541 completed questionnaires were collected, corresponding to a survey response rate of around 11%. Online surveys frequently have lower response rates than conventional methods [49,50]. A non-response bias analysis was conducted because of the survey's relatively low response rate. Since there was no information on the non-respondents—due to the survey's anonymity—we could not test for bias by comparing respondents and non-respondents. Instead, the sample was divided into two groups—early and late respondents—and tests were run on each group. Using chi-square tests on the study's dependent variables, we determined that there were no differences between the two groups on a statistically significant level, demonstrating that non-response bias is not a problem in this study.

### *3.2. Data Treatment and Analysis*

We created a dataset based on the collected data. To create the final dataset, we identified and removed the respondents who had not answered all the questions. On this basis, we should note that the question with the highest rate of missing answers was "year of construction" of the residence. As mentioned in Section 3.1, the final database included 451 responses; this dataset, including the complete responses, will be called "Total_Sample". Furthermore, to properly examine the subject of the use of the public incentives program, a subsample was created, including only the respondents who stated that:

- their residence had been refurbished or renovated during the past ten years (i.e., between 2010 and 2019) and
- were aware of the "Residential Energy Saving" public incentives program, bearing in mind that these two elements are necessary conditions for someone who has used the specific incentives program. We will refer to this subsample as "RR10&Awar_Sample". The above procedure for creating the subsample is diagrammatically depicted in Figure 1.

We performed the statistical analyses using the SPSS 20 statistics software. The first step consisted of the descriptive statistics analysis, which included the creation of the environmental awareness and behavior indexes using the questions in part B of the questionnaire (Appendix A—Coding B1). The descriptive results of both Total_Sample and RR10&Awar_Sample are available in Section 4.1.

The following step consisted of developing three regression models to identify the statistically significant determinants of the topics under investigation. The three dependent variables have a binary coding (true/false); hence, we developed binary regression models. This type of regression is suitable when the dependent variable is dichotomous [51]. The first two models are based on the "Total_Sample" dataset (n = 451) and deal with the factors that affect respondents' (a) decision to refurbish or renovate their residence (results presented in Section 4.2) and (b) awareness of the "Residential Energy Saving" public

incentives program (results presented in Section 4.3). The third model, based on the "RR10&Awar_Sample" subsample (n = 123), examines the elements affecting the use of the "Residential Energy Saving" incentives program (results presented in Section 4.4). In all three models, explanatory factors considered include sociodemographic (Table 2), dwelling, and geographical characteristics (Table 3), as well as the two environmental indexes (Table 2).

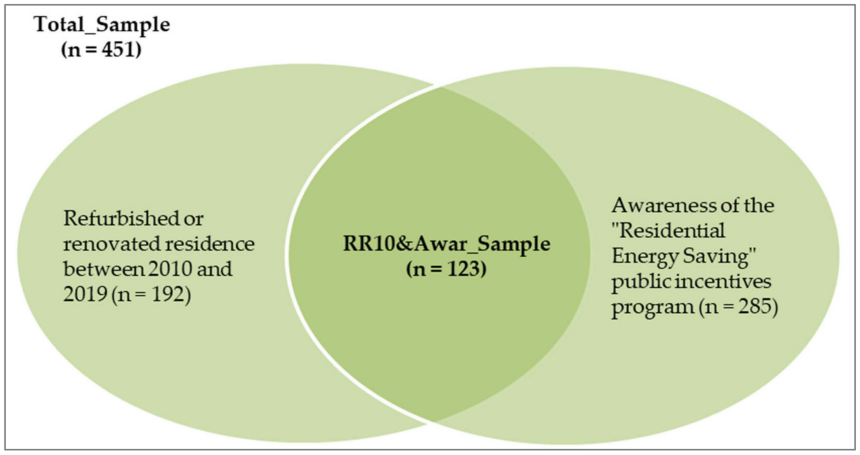


**Figure 1.** Creation of the "RR10&Awar_Sample" subsample.

**Table 2.** Sociodemographic characteristics.

| Sample | | Total Sample [a] | RR10&Awar Sample [b] |
|---|---|---|---|
| Gender | Male | 43.5 | 46.3 |
| | Female | 56.5 | 53.7 |
| Age | mean (SD) | 39.56 (10.80) | 40.36 (9.89) |
| Education level | High school degree | 10.0 | 8.1 |
| | Vocational training | 10.0 | 6.5 |
| | University degree | 33.0 | 36.6 |
| | Master degree | 38.8 | 43.1 |
| | Doctorate | 8.2 | 5.7 |
| Occupation | Public or privately employed | 60.3 | 63.4 |
| | Self-employed | 22.4 | 25.2 |
| | Retired | 2.9 | 1.6 |
| | Student | 8.2 | 5.7 |
| | Homemaker | 0.9 | 0.0 |
| | Unemployed | 5.3 | 4.1 |
| Annual family income | EUR 0–6000 | 12.6 | 8.1 |
| | EUR 6000–12,000 | 18.2 | 19.5 |
| | EUR 12,000–18,000 | 23.9 | 26.0 |
| | EUR 18,000–24,000 | 20.0 | 26.8 |
| | >EUR 24,000 | 25.3 | 19.5 |
| Environmental awareness scale (maximum value = 5) | mean (SD) | 3.32 (1.15) | 3.79 (0.82) |
| Environmental behavior scale (maximum value = 10) | mean (SD) | 5.65 (1.59) | 6.12 (1.67) |
| Awareness of the "Residential Energy Saving" incentives program | Yes | 63.2 | 100.0 |
| | No | 36.8 | 0.0 |

[a] n = 451, [b] n = 123.

**Table 3.** Dwelling and geographical characteristics.

| Sample | | Total_Sample [a] | RR10&Awar_Sample [b] |
|---|---|---|---|
| Year of construction | mean (SD) | 1988 (17.89) | 1982 (15.20) |
| Type of housing | Detached house | 25.5 | 25.2 |
| | Apartment house | 74.5 | 74.8 |
| Property ownership | Privately owned | 76.7 | 82.9 |
| | Rented | 23.3 | 17.1 |
| Number of bedrooms | mean (SD) | 2.45 (0.832) | 2.47 (0.813) |
| Location density (population/km$^2$) | mean (SD) | 10,921.71 (7226.28) | 9932.79 (7393.46) |
| Number of residents | mean (SD) | 2.96 (1.33) | 3.02 (1.42) |
| Minor(s) residing (age < 18) | Yes | 37.9 | 39.0 |
| | No | 62.1 | 61.0 |
| Senior citizens residing (age > 65) | Yes | 14.4 | 16.3 |
| | No | 85.6 | 83.7 |
| Energy-saving refurbishment or renovation of the residence during the 2010–2019 decade | Yes | 42.6 | 100.0 |
| | No | 57.4 | 0.0 |
| Use of the "Residential Energy Saving" incentives program | Yes | 5.1 | 17.9 |
| | No | 94.9 | 82.1 |

[a] n = 451, [b] n = 123.

We ran a multicollinearity test on the model's explanatory variables for each binary logistic regression model. We confirmed no multicollinearity issues in all three models, as tolerance values were higher than 0.93 in the first two models and higher than 0.96 in the third. In addition, Variance Inflation Factor (VIF) values were lower than 1.08 in the first two models and lower than 1.04 in the third [52–54]. Moreover, and in the context of shaping the best-fitted regression model, we took into consideration the following metrics: (i) -2Log likelihood (-2LL), with lower values signifying a better model fit to the sample [55]; (ii) the Cox and Snell pseudo-$R^2$ goodness of fit test, equivalent to the linear regression's $R^2$; the specific measure used in logistic regression tends to have values lower than the values of linear regression, meaning that 0.2 to 0.4 values signify an excellent adaptation when referring to logistic regression models (equivalent to linear regression $R^2$ between 0.4 and 0.9) [56,57]; (iii) the Hosmer–Lemeshow (HL) goodness of fit test, with a *p*-value > 0.05 signifying a fitting model [58]; (iv) the Classification Table providing the proportion of the correctly classified cases [59]. The associated values of each model are shown in Tables 4–6. The logistic model with the best fit was elaborated in each case, considering the abovementioned methodology and metrics. The presented models consist only of statistically significant variables on a 1%, 5%, or 10% level.

**Table 4.** Logistic regression model on refurbishment or renovation of the residence during the 2010–2019 decade (Total_Sample).

| Explanatory Variables | B [a] | S.E. [b] | Wald [c] | Sig. [d] | Exp(B) [e] | 95% C.I. for Exp(B) [f] | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Privately owned property | 0.748 | 0.265 | 7.941 | 0.005 | 2.112 | 1.256 | 3.552 |
| Year of construction | −0.047 | 0.007 | 48.549 | 0.000 | 0.954 | 0.941 | 0.966 |
| Annual family income: >EUR 24,000 | −0.634 | 0.256 | 6.133 | 0.013 | 0.530 | 0.321 | 0.876 |
| Environmental behavior | 0.165 | 0.069 | 5.806 | 0.016 | 1.180 | 1.031 | 1.350 |
| Constant | 92.651 | 13.450 | 47.453 | 0.000 | | | |

**Table 4.** *Cont.*

| Explanatory Variables | B [a] | S.E. [b] | Wald [c] | Sig. [d] | Exp(B) [e] | 95% C.I. for Exp(B) [f] Lower | Upper |
|---|---|---|---|---|---|---|---|
| -2LL = 534.018<br>$R^2$ = 22.1%<br>HL $\chi^2(8)$ = 11.603<br>Accuracy = 68.7% | | | | | | | |

[a] The value (in log-odds units) that predicts the dependent variable from the explanatory variable. [b] The standard error linked to the coefficient. [c] The Wald chi-square value tests whether the coefficient is zero. [d] The 2-tailed *p*-value tests whether the coefficient is zero. [e] The explanatory variable's odds ratios are estimated as the coefficient's exponentiation. [f] The 95% confidence interval for the coefficient.

**Table 5.** Logistic regression model on awareness of the "Residential Energy Saving" incentives program (Total_Sample).

| Explanatory Variables | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I. for Exp(B) Lower | Upper |
|---|---|---|---|---|---|---|---|
| Education level | 0.311 | 0.120 | 6.659 | 0.010 | 1.365 | 1.078 | 1.728 |
| Environmental awareness | 1.743 | 0.171 | 103.627 | 0.000 | 5.712 | 4.084 | 7.989 |
| Location density | −0.703 | 0.263 | 7.161 | 0.007 | 0.495 | 0.296 | 0.829 |
| Constant | −6.221 | 0.814 | 58.383 | 0.000 | 0.002 | | |
| -2LL = 371.743<br>$R^2$ = 53.1%<br>HL $\chi^2(8)$ = 12.444<br>Accuracy = 77.2% | | | | | | | |

**Table 6.** Logistic regression model on using the "Residential Energy Saving" incentives program (RR10&Awar_Sample).

| Explanatory Variables | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I. for Exp(B) Lower | Upper |
|---|---|---|---|---|---|---|---|
| Privately owned property | 1.858 | 1.093 | 2.889 | 0.089 | 6.408 | 0.752 | 54.577 |
| Year of construction | 0.056 | 0.020 | 7.651 | 0.006 | 1.058 | 1.017 | 1.101 |
| Senior citizens residing | −2.078 | 1.116 | 3.467 | 0.063 | 0.125 | 0.014 | 1.116 |
| Education level | −0.602 | 0.269 | 5.014 | 0.025 | 0.547 | 0.323 | 0.928 |
| Constant | −111.557 | 40.441 | 7.610 | 0.006 | 0.000 | | |
| -2LL = 92.404<br>$R^2$ = 28.1%<br>HL $\chi^2(8)$ = 12.014<br>Accuracy = 87.8% | | | | | | | |

## 4. Results

### *4.1. Descriptive Statistics*

Table 2 illustrates the sociodemographic characteristics of both the total sample (Total_Sample) and the subsample (RR10&Awar_Sample), including age, gender, education, occupation, yearly family income, environmental awareness, environmental behavior, and knowledge of the "Residential Energy Saving" incentives program. Two separate indexes represent environmental awareness and behavior. We created the environmental awareness index based on five questions about awareness and perceptions of energy and environment-related subjects. We developed the environmental behavior index based on 10 questions about environmentally friendly activities, such as buying "green" products, energy saving, and recycling.

Regarding the total sample (Total_Sample), most respondents (56.5%) are women, while the average age is around 40. The largest share (80%) is university-educated and

works as a public or private employee (60%). Concerning annual family income, a little less than half (45.5%) of the respondents reported an income above EUR 18,000. Relating to the environmental indexes, the mean value for the awareness-related index is 3.32 out of 5, and for the behavior-related index, 5.65 out of 10, indicating that respondents are more environmentally aware than having an environmentally friendly behavior. Finally, most (63%) respondents know about the "Residential Energy Saving" public incentives program.

Furthermore, Table 3 presents the dwelling and geographical characteristics concerning the house size and type, ownership, construction year, number and type of residents, location density, refurbishment/renovation of the residence during the 2010–2019 decade, as well as the use of the "Residential Energy Saving" incentives program. The majority of the total sample resides in privately held apartments built roughly 30 years ago (on average in 1988), with an average of two or three roommates (and two or three bedrooms as well), with the minority of these being minors (38%) or senior citizens (14.5%); the average population density of residencies' locations is 10,920 persons per $km^2$ (corresponding to the population density of an urban municipality). Around 40% of the respondents stated that their residence was refurbished or renovated during the past 10 years (i.e., between 2010 and 2019), while 5% reported using the "Residential Energy Saving" public incentives program.

The subsample (RR10&Awar_Sample) of the respondents stating that (a) their residence has been refurbished or renovated during the past 10 years and (b) they are aware of the "Residential Energy Saving" program presents some differences compared to the total sample. The most interesting differences are highlighted below. First, over 85% of the subsample are university-educated, compared to 80% of the total sample. As to annual family income, the category scoring the highest percentage is EUR 18,000–24,000 (26.8%), an increase of 6.8 percentage points compared to the total sample's corresponding value; conversely, the >EUR 24,000 category presents a decrease of almost six percentage points when comparing the subsample to the total sample. The environmental awareness and environmental behavior indexes present higher average values for the subsample than the total sample. Concerning the dwelling and geographical characteristics, the houses included in the subsample are older by an average of 6 years, as their average year of construction is 1982, while the population density for the subsample is almost 1000 people per $km^2$ less, than that of the total sample. The percentage of respondents using the "Residential Energy Saving" incentives program is three times larger than the corresponding total sample percentage—17.9%, compared to 5.1%. As expected, the awareness rate of the "Residential Energy Saving" incentives program and the refurbishment/renovation of the residence during the 2010–2019 decade is 100.0% since these are prerequisites to include a respondent in the subsample (RR10&Awar_Sample).

### *4.2. Binary Logistic Regression: Energy-Saving Refurbishment or Renovation of the Residence during the 2010–2019 Decade (Total_Sample)*

The first regression model examines the statistically significant factors affecting residents' decision to refurbish or renovate their dwellings during the 2010–2019 decade. Based on the metrics presented in Section 3.2, the best-fitting regression model includes four explanatory variables affecting the decision to refurbish or renovate a residence: two residence-related characteristics, a sociodemographic factor, and an environmental-related index (Table 4). The analysis reveals that compared to tenants, individuals owning the properties are more likely to have performed a refurbishment or renovation. In addition, the older the residence (in terms of year of construction), the more probable it is to have been refurbished/renovated. The only sociodemographic factor found to have a significant impact is the yearly income; specifically, respondents with an income >EUR 24,000 are less likely to have performed a refurbishment or renovation. Further, we identified that individuals with better environmental behavior are likelier to have undertaken a refurbishment or renovation. We can express the logistic regression equation as:

$$\log(p_1/1 - p_1) = 92.651 + 0.748 \times (\text{privately owned property}) - 0.047 \times (\text{year of construction}) - 0.634 \times (\text{annual family income: >EUR 24,000}) + 0.165 \times (\text{environmental behavior}) \quad (2)$$

where $p_1$ is the probability of refurbishing or renovating the dwelling during the 2010–2019 decade.

### *4.3. Binary Logistic Regression: Awareness of the "Residential Energy Saving" Incentives Program (Total_Sample)*

The second regression model presents the statistically significant determinants of respondents' awareness of the "Residential Energy Saving" public incentives program. Based on the metrics presented in Section 3.2, the best-fitting model contains three statistically significant explanatory variables: a sociodemographic characteristic, a geographical element, and an environmental-related index (Table 5). The model demonstrates that higher-educated respondents are likelier to know about the public incentives program. Likewise, more environmentally aware respondents are more likely to know about the specific program. Additionally, the analysis shows that people residing in locations with a lower population density are more likely to know about the "Residential Energy Saving" program. We can express the logistic regression equation as:

$$\log(p_2/1 - p_2) = -6.221 + 0.311 \times (\text{education level}) + 1.743 \times (\text{environmental awareness}) - 0.703 \times (\text{location density}) \quad (3)$$

where $p_2$ is the probability of being aware of the "Residential Energy Saving" public incentives program.

### *4.4. Binary Logistic Regression: Use of the "Residential Energy Saving" Incentives Program (RR10&Awar_Sample)*

The third regression model investigates the explanatory variables impacting respondents' decision to use the "Residential Energy Saving" incentives program. According to the metrics presented in Section 3.2, the best-fitting model includes four independent variables, three residence-related variables, and a sociodemographic characteristic (Table 6). According to the analysis, property owners are more likely to have used the incentives program to refurbish or renovate the household than tenants. Additionally, we indicated that respondents living in newer residences in terms of the construction year are more likely to have used the incentives program. In households where senior citizens (>65 years) reside, respondents are less likely to use the incentives program. Moreover, the analysis shows that respondents with a lower education level are more likely to use the "Residential Energy Saving" program. We can express the logistic regression equation as:

$$\log(p_3/1 - p_3) = -111.557 + 1.858 \times (\text{privately owned property}) + 0.056 \times (\text{year of construction}) - 2.078 \times (\text{senior citizens residing in the household}) - 0.602 \times (\text{education level}) \quad (4)$$

where $p_3$ is the probability of using the "Residential Energy Saving" incentives program.

## 5. Discussion

### *5.1. Determinants of the Decision to Perform an Energy-Saving Renovation of the Residence*

The construction year of a building usually impacts its energy efficiency, with older dwellings having inadequate thermal insulation compared to modern houses [28]. The first Building Thermal Insulation Regulation was established in Greece in 1979 [60]. Prior constructions lacked minimum insulation standards, hence more considerable energy losses. The present analysis confirms this fact, as we have indicated that homeowners and occupants with older buildings are more likely to have renovated their residences.

This result follows previous studies, stating that renovation or implementation of energy efficiency measures is related to house age [22,24,61].

The results concerning the ownership status of the residence are not unexpected; the regression analysis shows that individuals owning the property are more likely to have renovated the dwelling compared to the tenants. This well-known issue is described as the "landlord–tenant problem", meaning that "landlords have little incentive to invest in the energy efficiency of their properties, given that it is the tenant who benefits from lower energy bills" [28], and has been addressed broadly in previous research (e.g., [62,63]).

The study's results concerning the effect of annual family income are not those expected. We have indicated that individuals with an income lower than EUR 24,000 are more likely to have renovated their dwelling. This finding comes in contrast to previous research, which has revealed either a positive effect [22,23,25–27] or no effect created by income [64–66]. However, this "opposite" result may have an explanation; the applicable provided public incentives take into account the level of annual family income, providing more significant financial motivations to lower-income homeowners. For example, when referring to the "Residential Energy Saving II" program, an applicant with an annual family income of EUR 25,000 is eligible for a capital grant of 50% (raised to up to 70%, depending on the number of children). In comparison, an applicant with an annual family income of EUR 45,000 is eligible for a 0% capital grant [17]. Thus, this result may offer further support to the finding of Das et al. [27] that "the driving force behind dwelling changes may not be income, but rather the provisioning of incentives", as well as to the proposition that non-socioeconomic factors may control homeowners' decisions [21].

Moreover, we found that pro-environmental behavior, including, among others, purchasing "green" products, recycling, and energy-saving activities within the household, is a positive predictor of renovated dwellings. This finding follows the results of previous studies (e.g., [41,67,68] while highlighting that in parallel to the financial incentives—as referred to in the previous paragraph—a holistic strategy focusing as well on individuals' environmental motivations is necessary.

### *5.2. Determinants of Awareness of Energy Efficiency Incentive Programs*

Education level has positively affected awareness of the "Residential Energy Saving" financial incentives program. As stated in Section 2.2, we did not identify any previous research concerning the determinants of incentive programs' awareness. However, work has been performed on the factors that affect awareness of comparatively relevant topics, such as the knowledge of renewable energy sources [69–71], microgeneration systems [72,73], and organic foods [74]. All these studies have revealed a positive relationship between education and awareness level; the current study supports their findings. In any case, this means that we should consider the effect of the level of education to achieve widespread applicability of the financial incentives program among homeowners of differing sociodemographic characteristics.

The analysis's result concerning the influence of environmental awareness is as anticipated: higher levels of environmental awareness (measured on a five-point scale) lead to a higher probability of an individual knowing about the "Residential Energy Saving" program. Although we did not identify any previous work concerning the determinants of incentive projects' awareness (see Section 2.2), we can refer to the research of Karytsas and Theodoropoulou [72]), which reports a positive effect of awareness of RES issues on knowledge of microgeneration systems, thus offering a similar finding to that of the present study. Regardless, this finding highlights the significant positive effect that environmental awareness can have in general, either on knowledge level or on various attitudinal/behavioral aspects (e.g., [75–77]).

According to available statistics [78], until July 2018, over 28,000 applications were approved within the "Residential Energy Saving II" program and 40% of the financial resources were committed to the Attica and Central Macedonia administrative Regions, where the two main urban centers, respectively, Athens and Thessaloniki, are located.

Hence, the remaining 60% applies to the remaining Greek Regions, characterized by lower population density. This allocation of financial resources is not in line with population distribution, as Attica and Central Macedonia are home to 53% of the permanent Greek population [79]). This discrepancy between population distribution and resource allocation may be a result of the differences in the demographic characteristics of Greek Regions that are used as eligibility criteria for the incentives program (i.e., annual income, dwelling energy efficiency characterization). In this context, and on the basis that people living in less densely populated areas may be more interested in the financial incentives program, the current study suggests—based on its analysis—that population density is a negative predictor of the knowledge of the incentives program, meaning that individuals residing in more scarcely populated locations are more likely to be aware of it.

### *5.3. Determinants of the Use of the Energy Efficiency Incentives Program*

The final step of the analysis involved investigating the factors affecting the use of the available financial incentives ("Residential Energy Saving I or II" programs), or in other words, if the homeowners/occupants that renovated their dwelling applied and received financial incentives to do so. Considering this, the individuals included in this analysis group had to meet two conditions: (a) to be aware of the financial incentives programs and (b) to have renovated their residences during the 2010–2019 decade. This means that the identified determinants concerning the "use of incentive program" theme target people with the abovementioned traits rather than the general population.

In this context, the first finding indicates that—within a group of people aware of the incentives and having renovated their dwelling—individuals owning the residence are more likely to have applied and utilized the financial incentives than those renting the property. This result offers a further dimension to the "landlord–tenant problem" [28], as tenants are not only less likely to have carried out a renovation (as presented in Section 5.1 above) but in cases where they have carried out a renovation, they are less likely to have used the financial incentives program, compared to dwelling owners. This discovery proves that overall planning, including measures facing the landlord–tenant issue, is necessary. Regardless, the specific finding could also be explained by the possibility that tenants perform smaller-scale interventions to the dwelling, compared to occupants, thus not being eligible for or needing financial incentives.

We also found that the construction age of the building affects the use of the financial incentives program among the individuals who were aware of the program and had performed a renovation. Specifically, the newer the building, the more likely it is to have taken advantage of the incentives program. This result contradicts the previous finding concerning the construction age, according to which homeowners and occupants with older dwellings are more likely to have renovated their residences (see Section 5.1 above). In any case, we can explain this "opposite" result by the fact that the buildings included in this subsample ("RR10&Awar_Sample") are older (mean year of construction: 1982) than the construction age of the buildings included in the overall sample (mean year of construction: 1988).

A further interesting finding has to do with the effect of the composition of the household; specifically, when older people (>65 years) reside in a house that has performed a renovation, the use of financial incentives is less probable. On the one hand, this may indicate that older people may lack information concerning such issues concerning younger people. On the other hand, this supplements the findings of previous research concerning the negative effect that age has on behaviors and attitudes on subjects such as the adoption of energy efficiency measures [26,27] or microgeneration technologies [80–82].

The final result is the effect of education on the utilization of the financial incentives program among the individuals who were both aware of the program and had renovated their residences. The analysis reveals that individuals with lower education are more likely to use the incentives program. This finding contradicts a relevant previous result (see Section 5.2 above) indicating that education positively affects knowledge of the incentives program. However, we should take into account the fact that we performed the analysis

within the subsample ("RR10&Awar_Sample"), whose members are in any case, highly educated (85% with at least a university degree; see Section 5.4 concerning study limitations). This means that the comparison is—for the most part—made between university graduates and postgraduates. In any case, there may be a relation between education's effect on using the incentives program and other socioeconomic effects—perhaps individuals with lower education may correspond to lower-income levels, meaning that it is easier to meet the income criteria set by the program.

Table 7 presents, in brief, the outcomes of the study's analysis, as discussed in Sections 5.1–5.3 above.

**Table 7.** Summary of the research outcomes.

| Dependent Variable | Explanatory Variable | Effect |
|---|---|---|
| The actual decision to perform an energy-saving refurbishment or renovation of the residence | Privately owned property | (+) |
| | Older constructions | (+) |
| | Annual family income | (−) |
| | Environmental behavior | (+) |
| Awareness of the "Residential Energy Saving" public incentives program | Education level | (+) |
| | Environmental awareness | (+) |
| | Location density | (−) |
| The actual decision to use the "Residential Energy Saving" incentives program | Privately owned property | (+) |
| | Newer constructions | (+) |
| | Elderly senior citizens residing in the household | (−) |
| | Education level | (−) |

### *5.4. Research Limitations*

The limitations that may have affected the present research results should be acknowledged. Firstly, we should highlight that the study does not represent the general Greek population. Specifically, and in line with the 2011 Greek National Census results [47], it is apparent that the collected sample includes a disproportionately high number of highly educated middle-aged individuals. Even so, the current work offers a consistent basis for concluding the determinants of (a) residential energy-saving renovation implementation, (b) awareness, and (c) utilization of incentive programs, which can be used for debate of further studies [70,83]. Nevertheless, we ought to note that we should not generalize the study's results to the overall population.

An additional limitation of the study that we should note is that we performed the survey in 2019. However, considering that we collected the data through a targeted survey and it is not collected periodically (e.g., annually) by specific organizations (e.g., Eurostat or the Hellenic Statistical Authority), it would not be possible to conduct the study based on more recent data. Thus, although we should acknowledge that an analysis applying a more recent dataset would perhaps present a more up-to-date illustration of the opinions of the respondents, the value of the present study in providing indications on the determinants of the themes under examination should not be overlooked, taking into account that more recent data—in comparison to that collected in 2019—is not available.

Furthermore, it is also noteworthy that the determinants taken into consideration within the specific study focus exclusively on sociodemographic, dwelling, and geographical characteristics, as well as on self-reported environmental awareness and behavior. Further research could examine the effect of contextual factors, especially on awareness and utilization of energy-saving incentive programs, as we did not identify any previous studies on these topics. The suggested research could support policymakers in recognizing the best policies regarding the applicability of financial incentive programs focusing on energy efficiency measures.

## 6. Conclusions

The study aimed to investigate the sociodemographic, dwelling, and geographical characteristics, as well as the self-reported environmental awareness and behavior that affect individuals' (a) actual decision to perform an energy-saving renovation of their residence, (b) awareness of the energy efficiency incentives programs, and (c) use of the energy efficiency incentives programs. Considering the previous research, topic (a) has been previously examined; however, this is the first time that empirical results have been provided for Greece, thus complementing earlier research. Concerning topics (b) and (c), based on our knowledge, this is the first study that investigates these themes.

In this regard, we conducted an online questionnaire survey in 2019 in Greece. The overall sample included 451 responses [corresponding to topics (a) and (b) presented above]. In addition, to examine the effects on utilization of the incentives programs [topic (c) above], a subsample including only respondents who were aware of the programs and who had renovated their dwelling during the 2010–2019 decade was created (123 respondents).

The performed statistical analysis indicates that individuals residing in older—self-owned—dwellings with an income lower than EUR 24,000 and above-average environmental behavior are more likely to have carried out a renovation. Furthermore, individuals living in more scarcely populated locations, with higher education and environmental awareness, are more likely to have been aware of the financial incentives program. When referring specifically to the respondents who were aware of the program and who renovated their residence, we find that those with a relevantly lower education level, living in newer self-owned dwellings where senior citizens individuals are not present are more likely to have made use of the incentives program.

Based on these findings, and following the outcomes of the discussion (Section 5), we should highlight the following policy implications:

- Mitigation of the adverse effects of the "landlord–tenant problem" should be given great attention; specific measures that offer incentives to dwellings' tenants to perform energy efficiency measures should be introduced;
- Modifications should be introduced to the available incentive programs toward the incentivization of higher-income families to become engaged in energy efficiency renovations;
- Environmental education programs and strategies, which will assist the improvement of environmental awareness and behavior—with an emphasis on senior citizens (>65 years old)—are measures that can have a far-reaching effect on achieving energy efficiency advancements in the domestic sector;
- An overall improvement in education can contribute to awareness levels, leading to energy efficiency advances in the household building stock;
- The results of this research can assist policy- and decision-makers in planning effective financial incentives adapted to the different demographic, dwelling, and environmental characteristics, thus achieving improved awareness and utilization of such tools.

**Author Contributions:** Conceptualization, S.K. and E.T.; methodology, S.K.; software, S.K.; validation, E.T.; formal analysis, S.K.; investigation, S.K.; resources, E.T.; data curation, S.K.; writing—original draft preparation, S.K.; writing—review and editing, S.K. and E.T.; visualization, S.K.; supervision, E.T.; project administration, E.T. All authors have read and agreed to the published version of the manuscript.

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## Nomenclature

| | |
|---|---|
| -2LL | -2Log likelihood |
| B | Coefficient for the constant |
| C.I. | Confidence Interval |
| $CO_2$ | Carbon Dioxide |
| EC | European Commission |
| EU | European Union |
| Exp(B) | Exponentiation of the B coefficient |
| GHG | Greenhouse Gases |
| HL | Hosmer–Lemeshow |
| IEA | International Energy Agency |
| NECP | National Energy and Climate Plan |
| $R^2$ | R-squared |
| RES | Renewable Energy Sources |
| S.E. | Standard Error |
| SD | Standard Deviation |
| Sig. | Significance |
| SPSS | Statistical Package for the Social Sciences |
| VIF | Variance Inflation Factor |

## Appendix A. Survey Questionnaire

**RESIDENTIAL RENOVATIONS & MICROGENERATION SYSTEM APPLICATIONS**

The present questionnaire is part of a study on the socioeconomic aspects related to residential renovations and the application of microgeneration systems.
The questionnaire is anonymous. The results will be used specifically for educational and scientific purposes. Your honest participation is valuable for the survey.
Thank you in advance for your participation.

**A. RESIDENCE CHARACTERISTICS**

A.1. Please define the type of your residence.

- ☐ Detached house
- ☐ Apartment Building
- ☐ Other (please define)

A.2. Please define the ownership status of your residence.

- ☐ Privately owned
- ☐ Rented
- ☐ Other (please define)

A.3. Please fill in the year of construction of your residence.

A.4. Please select any of the following sentences that apply to your residence.

- ☐ I have performed an energy-saving renovation or refurbishment of my residence in the last ten (10) years.
- ☐ I have benefited from the "Residential Energy Saving" incentives program.

A.5. Please fill in the number of bedrooms of your residence.

A.6. Please fill in the number of people that live in your residence (include yourself in the counting).

A.7. Please note if among the people living in your residence, there are any:

- ☐ Children
- ☐ People older than 65 years

**B. ENVIRONMENTAL AWARENESS & BEHAVIOR**

B.1 Please select with which statements you agree.

- ☐ My work, education, or interests are related to subjects relevant to the environment.
- ☐ I know the "Residential Energy Saving" incentives program launched by the Ministry of Environment and Energy.
- ☐ Climate change is merely a natural process of the earth's climate and not the result of artificial environmental pollution.
- ☐ I believe that companies should be obliged to contribute to solving environmental problems.
- ☐ I have rejected the purchase/consumption of a product on the grounds of its non-environmental sensitivity.
- ☐ Due to the current financial conditions, my priorities do not allow me to deal with environmental issues and energy-saving efforts.
- ☐ I am willing to completely change my daily habits to contribute to the protection of the environment.
- ☐ I need to have some financial benefits to have more environmentally friendly behavior.
- ☐ I prefer environmentally friendly products, organic food, and energy-efficient home appliances.
- ☐ I usually separate and place in particular collection bins the packaging of products (plastic, paper, glass, aluminum), used batteries, printing inks, cooking oils, and non-functional electrical appliances.
- ☐ I turn off the lights when I leave a room.
- ☐ I turn off home appliances (e.g., TV, computer) instead of leaving them in standby mode when not used.
- ☐ The thermostat in my home heating system is set to a temperature between about 20 (±2) degrees Celsius.
- ☐ I use a smart home energy-saving system
- ☐ I have upgraded or intend to upgrade my home's energy efficiency soon

**C. ACTUAL AND SUPPOSITIONAL CHOICES ON THE INSTALLATION OF RESIDENTIAL MICROGENERATION SYSTEMS**

C.1. Have you installed or do you plan to install a microgeneration system in your residence in the future? If yes, please define.

| | Already installed | Plan to install in the future |
|---|---|---|
| Photovoltaic system | □ | □ |
| Ground source heat pump | □ | □ |

[redacted]

**D. PERCEPTIONS ON FACTORS RELATED TO MICROGENERATION SYSTEMS**

D.1 If you decided to install a microgeneration system, to what extent would each of the following factors affect your choice?

| | Not at all | A little | Enough | Much | Very Much |
|---|---|---|---|---|---|
| Equipment & installation cost | □ | □ | □ | □ | □ |
| Operating & maintenance cost | □ | □ | □ | □ | □ |
| Increase in house market value | □ | □ | □ | □ | □ |
| Available capital | □ | □ | □ | □ | □ |
| Functional reliability | □ | □ | □ | □ | □ |
| Equipment guarantee period | □ | □ | □ | □ | □ |
| Systems lifetime | □ | □ | □ | □ | □ |
| Ease of installation | □ | □ | □ | □ | □ |
| Ease of use | □ | □ | □ | □ | □ |
| Equipment & storage space | □ | □ | □ | □ | □ |
| Compatibility with lifestyle | □ | □ | □ | □ | □ |
| Secure equipment, installation & operation | □ | □ | □ | □ | □ |
| Relative advantages over other systems | □ | □ | □ | □ | □ |
| Widespread technology | □ | □ | □ | □ | □ |
| Observability & triability | □ | □ | □ | □ | □ |
| Government subsidies/tax exemptions | □ | □ | □ | □ | □ |
| Expectations on fuel prices | □ | □ | □ | □ | □ |
| Legislation on the installation process | □ | □ | □ | □ | □ |
| Aesthetic result | □ | □ | □ | □ | □ |

**E. DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS**

E.1. Please define your gender.

- ☐ Male
- ☐ Female

E.2. Please fill in your age.

E.3 Please define your marital status.

- ☐ Married
- ☐ Not married
- ☐ Other (Please define)

[redacted]

- ☐ University degree
- ☐ Master degree
- ☐ Doctorate

E.5. Please define your primary occupation.

- ☐ Public or privately employed
- ☐ Self-employed
- ☐ Retired
- ☐ Student
- ☐ Homemaker
- ☐ Unemployed

E.6. Please define your annual family income.

- ☐ 0–6.000€
- ☐ 6.001€– 12.000€
- ☐ 12.001€–18.000€
- ☐ 18.001€–24.000€
- ☐ 24.001€+

E.7. Please define the regional unit in which you reside.

E.8. Please define the municipality in which you reside.

*Thank you for your time!*

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