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Homeowners' Perceptions of Renewable Energy and Market Value of Sustainable Buildings

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Abstract: Growing concerns over environmental issues and sustainable living have resulted in increased interest in renewable energy and energy efficiency. The real estate market is no exception, with homeowners increasingly considering the market value of green and sustainable buildings, which can offer both energy efficiency and potential health benefits. This study investigates the level of interest among homeowners in investing in renewable energy sources and energy efficiency measures for their homes and how it relates to their perception of the market value of green or sustainable buildings in the real estate market. A survey was conducted in the Paphos urban complex in Cyprus, with 180 participants over the age of 18. The participants were selected through a random sampling method and were representative of the general population in terms of gender, age, and income. Data were collected on their attitudes towards renewable energy sources and energy efficiency, as well as their perceptions of the market value of green buildings. The data collected were analyzed using various statistical methods, including Cronbach's α coefficient, the non-parametric Friedman test, descriptive statistics, and factor analysis, with the Statistical Package for the Social Sciences (SPSS) being used for coding and analysis. Results indicate that 64% of the homeowners surveyed were interested in investing in renewable energy sources, and 72% were interested in energy efficiency measures. Additionally, findings suggest a moderate level of interest (58%) among homeowners in investing in renewable energy sources and that this is positively associated with their perception of the market value of green buildings. Furthermore, homeowners with higher income and education levels tend to be more interested in investing in renewable energy sources and energy efficiency measures and perceive green buildings as having higher market value. This study provides insights into the factors that drive homeowners' investment in renewable energy sources and energy efficiency measures, shedding light on the relationship between homeowners' perceptions of the market value of green buildings and their interest in such investments.

Keywords: green buildings; sustainable buildings; energy efficiency; residential sustainability; residential renewable energy; real estate; sustainable living; consumer behavior; environmental behavior

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1. Introduction

Climate change is at the forefront of discussions, with the built environment being one of the main contributors, as it is responsible for almost 25% of global carbon dioxide emissions [1,2]. However, in urban areas, this number rises to 70% [3,4]. On the other hand, in terms of energy demand, the building sector in Europe accounts for over 40% of the total primary energy demand in the world [5–7]. Thus, the building sector is considered one

of the major parameters for the prospective reduction of greenhouse gas emissions [1,8,9], bringing the energy renovation of buildings to the debate [6,10].

The interest in green buildings appears to be rapidly increasing during the past few decades, shifting away from the emphasis on conventional structures, aiming for sustainable development revolving around the reasonable use of energy and natural resources [3,11] and forcing the real estate housing market to face a paradigm shift [12,13]. Therefore, the real estate and the land development industry show an increasing recognition and interest in green and sustainable buildings [14,15]. This is supported by the World Green Building Council and its European network, which are actively funding efforts to inform investors of the benefits of purchasing green buildings [16], aiming to overcome the barrier of the high construction costs that underlie the diffusion of green buildings, despite that the high costs are offset by the green buildings' long-term economic benefits [12].

Based on the above, Cyprus governmental representatives have been pushing green and sustainable development through funding programs, subsidies, and new regulations and legislation, a common practice among European member states as well [17–19]. More specifically, the EU Directive (2010/31/EU), which has been included in the national law of Cyprus, has as a main aim the improvement of the energy performance of buildings and the thermal comfort of the users whilst considering the environmental conditions [20,21]. Additionally, in order to guarantee the sustainability of the economy, the EU has implemented the European Green Deal, which will be applied in all its member states [22,23], aiming to become the first climate-neutral continent by 2050 [24,25]. Cyprus has followed this path with the establishment of several new laws for the construction of new buildings and the energy refurbishment of existing ones, including on-site renewable energy production, regulation of buildings' energy efficiency, thermal insulation of buildings through low-interest loans, information campaigns on energy saving, etc. [26,27].

Even though governments tried to redirect the real estate market towards green and sustainable building development, investors seemed to demonstrate a lack of willingness to invest in green buildings due to the additional costs of construction [12,28]. According to the investors, real estate buyers have historically shown little interest in sustainable structures, and it seems that they are unwilling to spend more money on them [12,29]. However, 75% of the typical buildings in Europe are currently energy inefficient, and just 1% of them are being renovated annually [7]. These numbers suggest that the current building stock in Europe will need more than five decades to be carbon-neutral, exceeding by a few decades EU's climate-neutral goal by 2050 and making the needed changes imperative.

Yet, the interest in the climate crisis and sustainable development seems to have grown during the past few years [30–33]. The renovation of existing buildings and the construction of new buildings in accordance with the aforementioned sustainable building standards may be the ultimate solution for reducing carbon dioxide emissions and building energy demand [34–37]. This, along with the European Green Deal, has sparked a rise in real estate developers' interest in environmentally friendly and sustainable buildings.

All the above seem to have led to a growing interest in green buildings since future homeowners prioritize green buildings compared to other choices in the market [38]. Subsequently, green building technologies are being incorporated by real estate developers in order to gain strategic positioning in the housing market [39,40]. While it is true that green buildings require a higher upfront cost compared with conventional buildings [41–43], studies have shown that they offer long-term energy cost savings [31,44]. Additionally, research has shown that the perceived benefits of green buildings, including energy efficiency [45], improved air quality, and healthier living environments [46], can result in higher resale value and increased market demand [47,48]. These benefits may also outweigh the initial investment cost over the long term, making green building a viable option for investors [49].

The overarching aim of this research is to investigate the relationship between renewable energy sources, energy efficiency measures, and the market value of green or sustainable buildings in the real estate market from the perspective of homeowners. This

study seeks to contribute to the broader literature on sustainable development, energy efficiency, and real estate valuation by providing insights into the factors that influence the market value of sustainable and energy-efficient buildings and to inform policy and practice that promote the development of green and sustainable buildings.

2. Literature Review

Through the following literature review, the research on sustainable and green buildings is presented, starting from their definition and their interaction with the end-user. Subsequently, their connection to the green value is addressed, looking at works that analyze the added value of sustainable buildings, aiming to develop the needs of the current work and focusing on the specificity of the Cyprus situation.

A building can be generally identified as "sustainable" or "green" when it is designed, constructed, and operated in an environmentally friendly and resource-efficient manner, according to a philosophy that puts its main emphasis on the efficient use of energy, water, and material resources [50], aiming at a reduced environmental footprint. This is achieved through energy-efficient design (lighting and HVAC systems), water conservation measures, the use of renewable energy sources, the incorporation of sustainable building materials, sustainable construction methods, proper space arrangement, operation, maintenance, and subtraction (referring to the process of removing unnecessary features or elements from a building design in order to reduce the overall environmental impact and resource consumption) [51]. Additionally, a building is defined as "green" when it is designed, constructed, and functions in a way that reduces the general impact of the built environment, as well as when it minimizes the impact on people's health [52]. The positive influence of these buildings is widely supported by the published scholarly literature [53,54] in terms of air pollution reduction, which is directly related to human physical and psychological wellbeing, *inter alia*, cardiovascular diseases, asthma, respiratory allergies, depression, and stress [55–58].

All the above characteristics, and the needed high specification standards, differentiate green buildings from other buildings. This was investigated by Robinson and Sanderford (2016) [59], who applied a propensity scoring methodology in order to calculate the status of the buildings, aiming to determine whether green buildings are equivalent to other premium buildings offered in the real estate market. The results indicate that some building characteristics can be considered good predictors of whether a building will be certified as green. Additionally, their high market values were discussed, illustrating that those luxury and premium buildings which are not green can also gain high market value, even though they do not offer the benefits that green buildings do, thus, showing that people are willing to pay extra to prosper from luxurious properties that are not energy efficient.

The different approach to green building design has also been highlighted by researchers, with Chegut et al. (2014) [60] noticing that they tend to be higher and bigger compared to other buildings of their type; they tend to be built far from motorways and train stations. Kok and Jennen (2012) [61] highlighted their higher quality. Iwaro and Mwasha (2013) [62] asserted that there is a link between building sustainability and the building envelope because the building envelope creates indoor environments that are suitable for human activities and shields the building from unfavorable external and internal influences such as pollution, climate change, temperature, humidity, heating, ventilation, air conditioning (HVAC) load, and lighting load. According to this work, the building envelope, which is directly affected by several external and internal influences, materiality, and processes, and its design are among the most crucial elements that will define a building's greenness and sustainability. However, it is important to note that many other factors beyond the building envelope also contribute to a building's greenness, such as the use of sustainable materials or construction techniques, and conservation strategies, among others [63].

Even though green and sustainable buildings appear to have a number of benefits, according to researchers, green building technologies have, in some ways, disturbed the

real estate industry during the past years [64]. On the other hand, other researchers addressed [34] the interest of some real estate investors who invest in green buildings due to their higher returns. The increasing interest in green buildings led to responsible property investing (RPI), with which investors can demonstrate their commitment to sustainable and green development [65]. RPI is a component of responsible investment established by the UN Environment Programme Finance Initiative [66], which has as a main purpose of minimizing the impact of investment on society and the environment whilst guaranteeing financial profitability [67].

The above notes are supported by the fact that any building that has a LEED certification in the housing market can be sold at a 30% higher price, according to the research by Saeed and Mullahwaish (2020) [68], who also proved how a property's green certification can improve its appeal in the real estate market and even raise its level of desirability, raising its market value. This is also supported by the fact that green residential buildings attract advanced market value in the housing market, according to the United States Green Building Council; the same report by this group connects green buildings to higher rents for real estate investors [69]. Thus, the shift is now changing, despite the fact that there are also preferences and concerns to consider. Firstly, several studies highlight a positive public perception of renewable energy sources for buildings. For instance, Karasmanaki et al. (2021) [70] found that people in European Union countries tend to support renewable energy driven by environmental values and concerns. Abdelkader et al. (2020) [71] highlighted that the perception of green buildings has a significant impact on individuals' intentions and behavior toward sustainable energy practices. Additionally, Qazi et al. (2019) [72] emphasized that public awareness plays a crucial role in facilitating the development of renewable energy technologies. Zhang et al. (2019) [73] reviewed renewable energy assessment methods in green building and green neighbourhood rating systems and provided valuable insights for investors, users, and policymakers interested in promoting green buildings and neighbourhoods. Additionally, the majority of real estate investors are open to spending more on developing more environmentally friendly and energy-efficient real estate properties, despite the fact that the real estate industry is slow to change its business-as-usual approach and there is a need for more incentives and greater awareness to encourage mass deployment of sustainable real estate [38].

Nagrale and Sabihuddin (2020) [74] argue that green buildings can have a positive impact on real estate investments due to the variety of benefits they offer. These benefits include reduced water pollution and greenhouse gas emissions, as well as the ability for owners and tenants to reduce their energy demand, resulting in lower costs. Leskinen et al. (2020) [65] added the economic parameter, saying that sustainable buildings are often valued higher in the market, leading to higher returns on investment and rental incomes. Real estate investors can also benefit from energy and water savings, reduced operation and maintenance costs, improved indoor environmental quality, and the greater indoor comfort and productivity that green buildings offer [75]. According to the research by Oladokun et al. (2010) [76], these benefits are divided into three main pillars, the environmental benefits (e.g., the protection of ecosystems and biodiversity, the improvement of air and water quality, and the reduction in solid waste), the economic benefits (e.g., the reduction of operating costs and future liability, the enhancement of asset value and profits, the increase in retail sales, and the optimization of lifecycle economic performance), and the occupational benefits (e.g., the enhancement of occupant comfort and health, reductions in healthcare costs, and the improvement of employee satisfaction and morale and their increased productivity).

Current research [60,77–81] and data from the private sector [82] have shown that green buildings can be considered as "premium" in the global market since sustainability practices are followed during the design and construction phases, with an additional 8% to 18% increase in sales prices and 3% to 13% increase in rental prices. It is also noted that the higher a building's green rating, the greater the monetary benefits for the real estate developer. The final selling price of green properties seems to be influenced by both

rent and yield. In terms of the incentives that influence how income affects the price of a property, it has been observed that tenants tend to pay more for apartments that align with their "environmental" ethos, which emphasizes measures to improve the environment, mainly through minimizing the impact of humans on the earth.

The real estate market has been increasingly connected to the concept of sustainable buildings, and the term "green value" has emerged to refer to the sustainable value of a building, specifically its environmentally friendly features and energy efficiency. According to Hartenberger et al. (2017) [16], the quality of a building, starting from the design phase, followed by construction and operation, plays a significant role in the development of appropriate investment feedback, which is required to continue investing in buildings of the same category or greater quality [83]. Furthermore, owning a green building or property has been found to have benefits such as higher resale value, higher rental rates, increased occupancy rates, reduced operating rates, increased net operating income, and reduced capitalization rates [84]. To that effect, one important factor that affects the energy efficiency of buildings is the Energy Performance Certificate (EPC). Since 2010, European legislation has required all sellers to assess the energy performance of their properties in order to sell them, resulting in the development of the EPC, otherwise known as the 'Energy Passport'. The EPC collects data on a building's energy demands. It also provides information to future buyers at the time of sale in an accessible manner, allowing for easy comparison of the energy performance of different properties. It is essential to note that an energy-consuming dwelling will be worth less than a perfectly insulated one falling into the "low consumption" category with equal surfaces and characteristics. Thus, the EPC is an integral part of the data that buyers compare among properties. An unfavorable diagnosis will most likely be detrimental, leading to a downward revision of the price or renovation work to hope for a sale. As well as can be expected, the relationship between EPCs and the real estate market is a topic that has been explored in several papers [85–88]. However, the findings are still inconclusive. For example, Fregonara et al. (2014) [89] investigated the impact of the EPC level on listing prices and found that the EPC level has an impact on listing prices, while Olaussen et al. (2017) [90] found no evidence of a price premium associated with energy labels.

Although it is clear that energy efficiency has potential benefits for both the environment and the financial bottom line of real estate investors, there are also limitations to its implementation and impact on the real estate market. Christersson et al. (2015) [91] suggested that despite the financial advantages of energy efficiency investments at the building portfolio level, investors face challenges in realizing these advantages due to a lack of qualified service providers and a poor understanding of the overall value. Marmolejo-Duarte et al. (2019) [92] highlighted that while energy efficiency may not have a significant impact on the marketing of homes in Spain, companion policies such as subsidies and fiscal exceptions may be needed to increase the prominence of energy efficiency in the residential market. Duarte and Chen (2019) [93] found that although there is a positive correlation between residential prices and energy ranks, higher selling prices may not always compensate for the higher building costs associated with energy-efficient technologies. Encinas et al. (2018) [94] suggested that while some potential homebuyers are willing to pay for energy efficiency, willingness to pay is influenced by education level and a lack of understanding of the cost savings associated with energy-efficient modifications. Overall, the literature demonstrates that while there is potential for energy efficiency to have a positive impact on the real estate market, there are also significant limitations that must be addressed.

The literature also shows that the ownership status of green buildings (owner-occupied or tenant-occupied) provides different benefits for the users [95,96]. Owner-occupied green buildings have potential benefits for the owner, such as lower operating and maintenance expenses, higher efficiency, and higher reputation. On the other hand, tenant-occupied green buildings can benefit from rent premiums, higher revenues, lower vacancy rates, higher efficiency, lower operating expenses, and, again, higher reputation [84,97].

This research aims to enrich the current literature by examining the influence of renewable energy sources and energy efficiency measures on the market value of green or sustainable buildings in the real estate market, as perceived by homeowners in Cyprus. Specifically, this research paper will address the following research questions:

1. What is the level of interest among homeowners in investing in renewable energy sources for their homes, and how does this relate to their perception of the market value of green or sustainable buildings in the real estate market?
2. To what extent do homeowners believe that the adoption of energy efficiency measures and renewable energy sources increases the market value of green or sustainable buildings in the real estate market, and how does this perception differ by demographic and socioeconomic factors?
3. What are the most important factors that drive homeowners to invest in renewable energy sources and energy efficiency measures, and how do these factors influence the market value of green or sustainable buildings in the real estate market?

By addressing these research questions, this study aims to provide insights into the market value of green or sustainable buildings in the real estate market and to inform policies and practices that promote sustainable and energy-efficient buildings.

3. Methods

A survey was conducted to investigate the relationship between renewable energy sources, energy efficiency measures, and the market value of green or sustainable buildings in the real estate market from the perspective of homeowners. Surveys are considered the most effective methods to capture public opinion [98–100] and thus effectively contribute to the holistic understanding and awareness of the issues concerned in the current research.

The survey was structured with closed-ended multiple-choice or five-point Likert scale questions (see [101]). Care was taken when writing the questions to ensure that they provided the data needed by the research team and were governed by reliability so that all respondents received the same type of information. Fifteen questions were employed, covering concepts beyond socioeconomic and demographic characteristics, *inter alia*, citizens' views regarding the renewable energy sources' perceived importance, the importance of energy saving, the public's energy saving knowledge gaps and attitudes toward renewable energy sources, and the general desire to save energy and promote the expansion of renewable energy sources by funding them through personal income. The survey was anonymous, gathering no sensitive data, and the participants provided consent to use their answers for research.

To ensure the reliability and validity of the research, impartiality is required from both the researcher and the population being studied, with no confusion or prejudice. The method of simple random sampling was used to achieve an objective result and avoid wrong conclusions due to its simplicity and low requirement of knowledge about the population [102–104]. The survey was then sent via email to a list of potential participants generated by the authors, consisting of individuals residing in the study area. In addition, email recipients and/or participants were encouraged to forward the email/e-survey to their contacts, creating a snowball effect [17] that expanded the sample size beyond the authors' initial contacts. Each respondent was required to use their email address, thus preventing duplicate responses.

This study was conducted in the Pafos urban complex spanning from December 2021 to January 2022 and included 180 participants over the age of 18. Pafos, the fifth-largest city in Cyprus, named the European Capital of Culture in 2017, is a popular tourist destination [105] coastal city located in the southwestern part of Cyprus, a Mediterranean island country that has set ambitious targets for increasing the share of renewable energy in its energy mix [106,107]. Pafos has unique characteristics of interest to researchers in various fields [108–115], such as its coastal location, the growing tourism industry, and typically Mediterranean climate characterized by long, hot, and dry summers and mild winters with abundant sunshine, which makes it an attractive location for real estate development

and the use of renewable energy sources. In terms of building standards, the Cypriot government has introduced regulations to promote energy-efficient building design and construction, and the use of renewable energy sources, such as solar panels and geothermal energy, is becoming increasingly common. The typical energy demand for heating and cooling in Pafos is relatively high due to its warm climate, and studies note that climate change is expected to further increase cooling needs [116]. The most common HVAC technology used in buildings in Pafos is split air conditioning systems. Furthermore, the real estate market in Pafos has undergone significant changes in recent years [117], with an increased focus on energy efficiency and sustainability in building design and construction [118]. Additionally, Pafos is a relatively small and manageable urban complex, making it easier to collect data and conduct surveys. Thus, overall, the unique context of Pafos in Cyprus makes it a timely, relevant, and suitable location for investigating perceptions and attitudes towards renewable energy sources and energy efficiency measures and policies in the real estate market. Moreover, since the focus on energy efficiency and sustainability in the real estate market is a global trend that transcends geographical boundaries, the findings have the potential to inform policymakers and researchers in other regions of similar populations and characteristics facing similar challenges related to the use of renewable energy sources and the design and implementation of energy efficiency measures and policies in the real estate market. Nevertheless, the purpose of this study is clearly to provide insights specifically in the context of Pafos and not to make generalizations about the global population.

Statistical methods utilized for data analysis included descriptive statistics, Cronbach's α coefficient, the non-parametric Friedman test, and factor analysis. Descriptive statistics were used to summarize and describe the main features of the data, such as means, standard deviations, and percentages. Cronbach's α coefficient is a measure of the internal consistency and reliability of a set of items that are intended to measure a single construct or variable [119]. For the scope of the current research, Cronbach's α coefficient was used to evaluate the reliability of the survey questions related to attitudes towards renewable energy sources and energy efficiency measures. A high Cronbach's α coefficient value indicates that the items in the survey are consistent and reliable in measuring the intended construct [120]. Friedman's non-parametric test (see also [121]) is a statistical test used to compare at least three associated groups of a variable. Friedman's non-parametric test was used to prioritize the most important factors influencing the perception and attitudes of respondents towards renewable energy sources and energy efficiency measures. The test ranks the values of the variables for each topic and calculates the mean of ranking the classified values. This test helped in identifying which factors were most important to respondents. The distribution of the Friedman criterion is χ^2, with a distribution with degrees of freedom BE = k − 1, (where k is the number of samples). This criterion sorts the values of the variables for each topic separately and calculates the means of ranking the classified values for each one of the variables. Factor analysis is a statistical method used to identify common factors among a group of variables [122]. This study used factor analysis to identify the underlying factors that influenced respondents' attitudes toward renewable energy sources and energy efficiency measures. A commonly used orthogonal rotation method (Varimax) was applied to simplify the factor structure and improve interpretability [123,124]. By using this rotation method, it was made possible to group together the survey questions into more meaningful and distinct factors and remove any redundancy or overlap between factors while interpreting the data and identifying the relationships between the different factors. The Kaiser–Meyer–Olkin index and Bartlett sphericity test were used to assess the appropriateness of the data for factor analysis [17,125,126]. This helped us to group the survey questions into distinct factors and to identify the relationships between these factors.

The SPSS statistical package (see also [127,128]) was used for coding and statistical processing towards analysing the research data and drawing significant quantitative conclusions.

4. Results

Out of the total 180 participants, 53.3% of participants were women, and the largest age group was 31–40 (30.5%), followed by 18–30, 41–50, 51–60, and those older than 60. A total of 65.7% have higher education, with 28.8% having a university degree. In terms of employment status, 30.7% are private employees, 20.5% are civil servants, and 12.6% are unemployed (Table 1).

Table 1. Demographics.

Gender	Male	53.3%
	Female	46.7%
Age	20–30	25%
	31–40	32.5%
	41–50	26.5%
	51–60	11.6%
	>60	4.4%
Education Level	High school degree or equivalent	8.5%
	Vocational training	34.5%
	University degree	44%
	Master's degree/doctorate	13%
Occupation	Farmer	4%
	Homemaker	2.4%
	Unemployed	12.6%
	Retired	2.6%
	State employed	20.5%
	Private employed	30.7%
	Student	11.7%
	Self-employed	15.5%

The response rate cannot be accurately calculated due to the limitations of the snowball sampling method. However, the sample was found to be consistent with the latest Cyprus Census (www.census2021.cystat.gov.cy/en/ (accessed on 8 May 2023)), except for the overrepresentation of females. This suggests that the sample is capable of offering valuable insights that can be used for further studies or debates.

Figure 1 illustrates that 80% of participants support renewable energy sources for economic growth, while only 13.9% oppose this. A majority hold positive attitudes towards transitioning to environmentally friendly energy sources, with 37.6% agreeing and 53.1% strongly agreeing. A total of 64.1% of citizens agree with using existing energy sources for a smooth transition to renewable energy sources. Overall, 86.2% are willing to adopt mild renewable energy sources technologies such as solar heating and geothermal energy, while only 8.3% oppose.

Table 2 illustrates the percentage ratios of energy production technologies in terms of the desire to develop them in Cyprus and shows that the largest percentage of citizens want to develop solar energy, followed closely by wind energy. Coal burning is the least preferred option.

The Cronbach's *a* coefficient (0.773) was calculated for the variable "Citizens' desire for the development of energy production technologies". The Friedman statistical test indicates solar energy as the most important variable, followed by wind and hydroelectric energy (Table 3). The Kaiser–Meyer–Olkin index is 0.775, and the Bartlett sphericity test gives results of χ^2 = 1981, 398, df = 36, p.

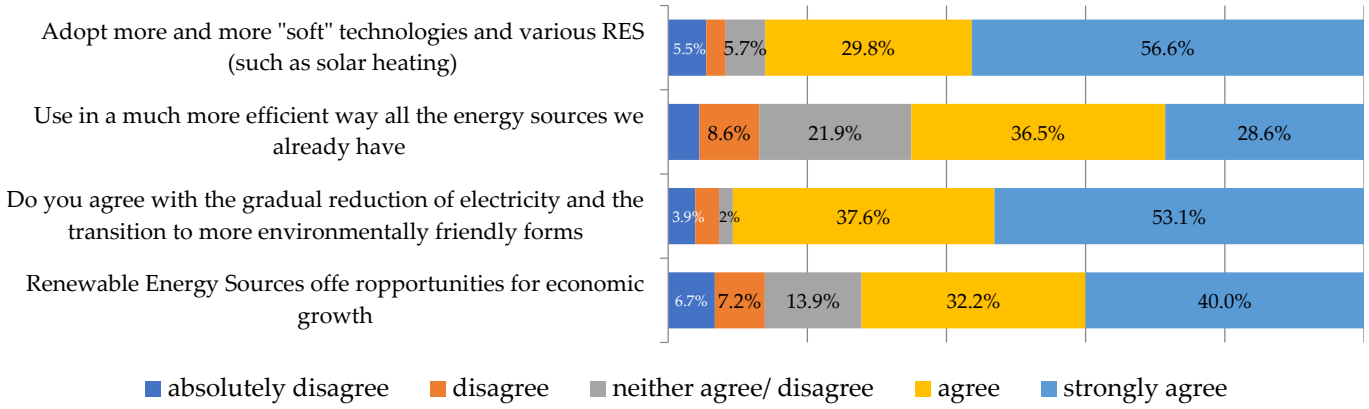

Figure 1. Public attitudes towards renewable energy sources.

Table 2. Citizens' desire for the development of energy production technologies (%).

Energy Production Technology	Desire for Development (1–10 Scale)									
	1. Do not Develop in the Future → 10. To Be Greatly Developed in the Future									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Fuel oil combustion	47.1	18.3	11.4	7.1	6.2	2.9	2.1	0.5	1.7	2.6
Combustion of natural gas	9.0	7.1	9.0	13.3	12.1	11.9	11.4	8.8	4.3	12.9
Hydropower	1.7	1.2	3.3	4.8	6.2	9.0	14.0	18.8	8.3	32.6
Wind power	1.9	1.4	2.1	3.1	5.0	6.0	10.5	21.9	8.6	39.5
Solar power	1.0	1.4	1.7	1.9	3.1	4.8	10.0	22.4	8.1	45.7
Nuclear fuel	62.1	7.4	5.2	5.7	4.5	5.0	3.3	2.6	1.9	2.1
Biofuels	5.2	5.0	6.0	7.9	9.5	7.9	14.5	12.9	9.5	21.7
Fuel oil combustion	47.1	18.3	11.4	7.1	6.2	2.9	2.1	0.5	1.7	2.6
Natural gas combustion	9.0	7.1	9.0	13.3	12.1	11.9	11.4	8.8	4.3	12.9

Table 3. Friedman test for the opinion of citizens regarding the development of energy production technologies in Pafos, Cyprus.

Energy Production Technology	Average Rank Score
Fuel oil combustion	3.12
Natural gas combustion	5.34
Hydropower	6.89
Wind power	7.29
Solar power	7.75
Nuclear fuel	2.89
Biofuels	6.26
$p < 0.001$	

Two factors were extracted for the variable "Citizens' desire for the development of energy production technologies". Factor one (PC1) includes "solar energy, wind energy, hydroelectric power and biofuels," while factor (PC2) two includes "burning coal, lignite, oil, nuclear fuel and gas combustion" (Table 4).

Figure 2 illustrates that the reason for installing photovoltaic systems or wind turbines is to improve the quality of the atmosphere, as well as to reduce pollution and increase the country's energy independence.

Table 4. Factors for citizens' desire for energy production technologies.

Variable	After the Rotation PC1	After the Rotation PC2
Fuel oil combustion	0.092	0.810
Natural gas combustion	0.460	0.517
Hydropower	0.874	0.135
Wind power	0.910	−0.001
Solar power	0.910	0.025
Nuclear fuel	0.076	0.568
Biofuels	0.612	0.004

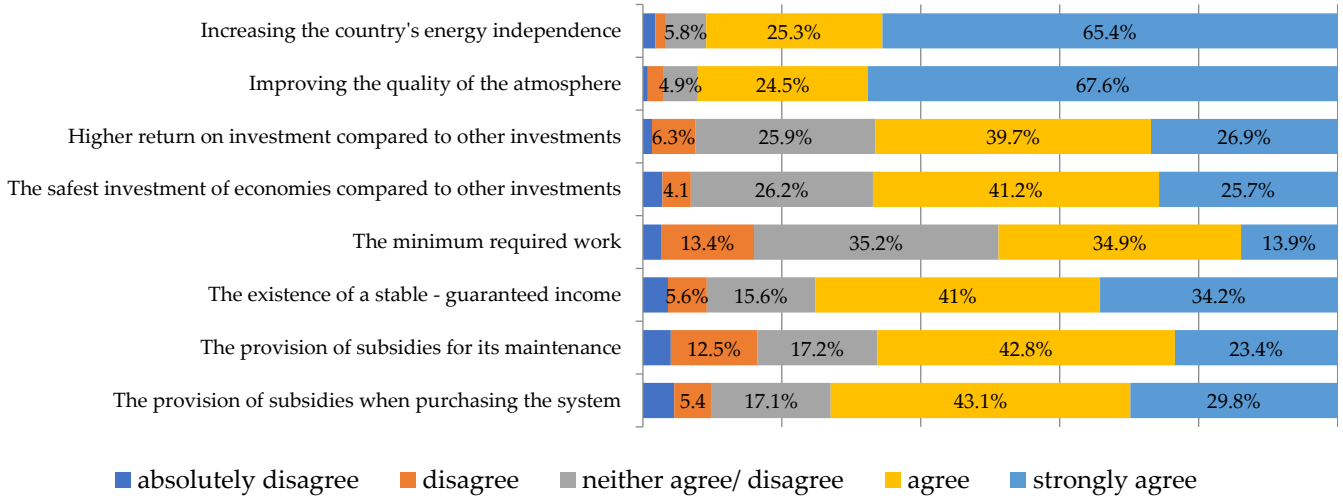

Figure 2. Reasons for installing photovoltaic systems or wind turbines (%).

Cronbach's coefficient *a* (0.885) was calculated for the multivariate variable "Reasons for installing photovoltaic systems or wind turbines". The participants considered the improvement of the air quality to be of primary importance, with a rating of 9.3, and more than 90% of citizens agreed with it. The Friedman criterion for evaluating the reasons for installing photovoltaic systems or wind turbines is presented in Table 5.

Table 5. The Friedman criterion for evaluating the reasons for installing photovoltaic systems or wind turbines.

	Instrument Ranking
The provision of subsidies when purchasing the system	6.36
The provision of subsidies for its maintenance	5.89
The existence of a stable, guaranteed income	6.76
The minimum required work	4.69
The safest investment of economies compared to other investments	6.14
Higher return on investment compared to other investments	6.22
Improving the quality of the atmosphere	9.30
Increasing the country's energy independence	9.12

Overall, 92% of participants are interested in investing in renewable energy sources as homeowners, while only 8% are not interested. The main reason (60%) for energy savings is to save money, followed by 52.7% of citizens who consider fighting climate change equally important. Daily habits and financial programs are also considered important for energy savings, with percentages of 40.4% and 36.7%, respectively (Table 6).

Table 6. Homeowners' interest and motivations for investing in renewable energy sources (%).

	Not at all	Rarely	Sometimes	Usually	Always
The daily habit *	1.9	4.8	15.7	38.4	41.2
The fight against climate change **	2.9	4.6	10.4	29.6	52.6
Saving money ***	1.2	1.7	5.7	30.9	60.5
Financial programs ****	5.4	6.5	21.4	30.2	36.5

* Refers to the willingness of homeowners to adopt environmentally conscious behaviors in their daily lives, such as reducing energy demand, using public transportation, and recycling. ** Refers to homeowners' motivation to reduce their carbon footprint and contribute to mitigating the effects of climate change by investing in renewable energy sources. *** Refers to homeowners' interest in reducing their energy bills and potentially generating income through the use of renewable energy sources, such as solar panels or wind turbines. **** Refers to government incentives, subsidies, and financing options available to homeowners who want to invest in renewable energy sources, such as solar panels, wind turbines, or geothermal systems.

Participants were asked about their willingness to pay an additional amount of money for the use of electricity from renewable energy sources. The results showed that a majority of respondents (33.3% and 27.7%) were either little or not at all willing to pay an extra amount. Only 25.5% were quite willing, while a smaller percentage (14%) were more or less willing to pay the extra amount (Table 7). This suggests that there may be some reluctance among consumers to pay a premium for renewable energy sources.

Table 7. Percentage as to the desire of consumers to pay an additional amount of money for the use of electricity from renewable energy sources.

Not at all	27.7
A little bit	33.3
Enough	25.2
Very	9.3
Very much	4.5

Table 8 indicates that 54.5% of citizens frequently use a solar water heater for water heating. In contrast, the use of natural gas is relatively low, with only 24.3% of citizens frequently using it for water heating, while 55.7% never use it.

Table 8. Percentage ratios on how participants heat the water in their houses (%).

	N/A	Never	Rarely	Often	Always
Electricity	4.5	26.7	24.3	16.8	27.7
Oil boiler	11.2	55.2	11.5	12.6	9.6
Solar water heater	8.1	32.2	5.2	15.3	39.2
Wood boiler	16.7	75.4	3.1	4.1	0.7
Pellet boiler	17.4	78.3	1.5	0.6	2.2
Natural gas	13.9	54.7	2.8	3.8	24.8

5. Discussion and Conclusions

The focus of the current research is to investigate the relationship between renewable energy sources, energy efficiency measures, and the market value of green or sustainable buildings in the real estate market from the perspective of homeowners in terms of specific research questions shaped by the analysis of the existing published scholarly literature.

The adoption of energy efficiency measures and renewable energy sources in residential buildings has become increasingly important in recent years [22,35]. Consistent with the wider literature, homeowners of the current study are also looking for ways to reduce their energy demand, lower their energy bills, and contribute to a more sustainable future [129]. One way to achieve these goals is to invest in renewable energy sources and energy efficiency measures [130]. However, it is not clear how homeowners perceive the market value of green or sustainable buildings in the real estate market and to what extent

the adoption of energy efficiency measures and renewable energy sources increases the market value of these buildings.

The results showed that homeowners in Pafos, Cyprus, have positive attitudes towards environmentally friendly practices. They believe renewable energy sources are a necessary solution, can improve the environment and standard of living, and provide economic growth opportunities. However, only a small percentage is willing to pay more to strengthen renewable energy sources. Companies and industries are held responsible for environmental problems, and citizens lack knowledge and education. They are well-informed through websites, news, and social media. Daily habits include reducing home heating and unnecessary waste of water and electricity, using public transport or walking for shorter routes, and recycling. Photovoltaics are highly efficient in Pafos, but the public is largely unaware of their wider benefits. Media should raise awareness of energy alternatives. Social acceptance of renewable energy sources is low due to land commitment, high cost, and legal framework complexity. The public is optimistic about the benefits of photovoltaics for future use and saving money.

Particularly, regarding the first research question set, survey results show that a significant proportion of homeowners (72%) are interested in investing in renewable energy sources for their homes, such as solar panels and wind turbines. Moreover, it is found that homeowners who are interested in investing in renewable energy sources are more likely to perceive green or sustainable buildings as having a higher market value compared to those who are not interested in investing in renewable energy sources. This suggests that there is a positive relationship between homeowners' interest in renewable energy sources and their perception of the market value of green or sustainable buildings. As far as the second research question, survey results indicate that a majority of homeowners (59%) believe that the adoption of energy efficiency measures and policies and renewable energy sources increases the market value of green or sustainable buildings. It is also argued that this perception varies by demographic and socioeconomic factors, considering that these homeowners also have a greater understanding and appreciation for the benefits of green buildings, including their potential to increase market value. Specifically, homeowners who have higher levels of education and income are more likely to believe that the adoption of energy efficiency measures and policies and renewable energy sources increases the market value of green or sustainable buildings compared to those who have lower levels of education and income. While there is no such direct correlation mentioned in the results, it is reasonable to speculate that there may be some relationship between education/income and belief in the market value of green buildings based on these findings. Finally, concerning the third research question, the survey results show that the most important factors that drive homeowners to invest in renewable energy sources and energy efficiency measures are financial savings, environmental concerns, and the desire for energy independence. Furthermore, it is argued that homeowners perceive that energy efficiency measures and renewable energy sources could potentially increase the market value of green or sustainable buildings, although further research and analysis would be needed to determine whether this perception is accurate and to what extent.

Overall, this study provides important insights into homeowners' attitudes toward renewable energy sources, energy efficiency measures, and green buildings. These findings have important implications for policymakers, real estate developers, and homeowners who are interested in promoting a more sustainable future.

The research encountered limitations. The calculation of the response rate faced limitations due to the use of snowball sampling, which made it impossible to estimate the total number of people who received the questionnaire link or those who refused to participate. Additionally, it was impossible to determine the number of email addresses that did not receive the questionnaire due to being blocked as spam emails. These limitations make it difficult to generalize the findings of this study to the wider population. Furthermore, the research had limitations regarding the confirmation or rejection of research hypotheses through advanced statistical models and a small, non-representative sample size. A larger

sample size and the use of advanced statistical models would have provided a more precise estimate of the relationship between various factors and attitudes toward green buildings. In future studies, alternative methods of data collection that overcome the limitations of snowball sampling should be considered to obtain a more representative sample. For instance, probability sampling methods such as random sampling or stratified sampling could be used to ensure that the sample is representative of the target population. Additionally, the use of email filters and other means, such as offering incentives or following up with non-respondents to ensure that they received the questionnaire link, could be explored. To the same end, regular surveys should be conducted on the subject of renewable energy sources and energy efficiency measures and policies to form a more concrete picture of the issues. Research could also be conducted in a rural area to gather residents' views on renewable energy sources and energy efficiency measures and policies. Furthermore, further studies could be conducted on citizens' views on specific sources of energy production, such as geothermal energy or biomass for electricity generation. Last but not least, education can play an important role in shaping energetic environmental behavior. Courses on environmental education, renewable energy sources, and energy conservation should be introduced in academic programs and textbooks. Lessons that offer environmental knowledge and mobilize sensitivities should be included, and interdisciplinarity should be promoted through creative work, visits to nature, and informative seminars. It is important to note that education is not a panacea to all issues related to sustainability, and other interventions, such as economic incentives, regulatory frameworks, and technological innovations, should also be explored.

Author Contributions: The research project presented in this article was a collaborative effort, with each author contributing in various ways, including but not limited to providing unique perspectives, insights, feedback, and guidance that may not necessarily be captured by quantitative measures or categorized in a clear-cut manner. Be that as it may, in an attempt to grasp the authors' contributions, it can be stated that I.V. (Ioannis Vannas) and I.V. (Ioannis Vardopoulos) conceptualized the project and designed the methodology. I.V. (Ioannis Vannas) also performed the formal analysis while also contributing to the investigation, resource gathering, and data curation. I.V. (Ioannis Vardopoulos), C.V. and G.X. were responsible for the validation, writing, and visualization aspects of the project, with I.V. (Ioannis Vardopoulos) providing additional supervision and project administration. The funding for the article-processing charges related to the publication of the project was acquired by C.V. All authors have read and agreed to the published version of the manuscript.

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