

Factors affecting citizens' decision to invest in renewable energy

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Abstract. Renewable energy sources (RES) have been acknowledged as a feasible way to produce inexhaustible energy with significantly less harmful emissions compared to fossil fuels. RES investments could be the lever for increasing the deployment of RES and citizens could contribute significant capital. However, the understanding of their decision to invest is limited. Hence, the aim of this study is to understand the reasons for which citizens would invest in RES. To achieve this aim, a structured questionnaire was designed and 1,536 Greek citizens were recruited using simple random sampling. According to results, the examined economic, environmental and social reasons were evaluated highly. Regarding the economic reasons, citizens would mainly invest to reduce electricity bills and increase their income, while factor analysis showed that an economic and an investment dimension underlie economic motives to invest. In terms of environmental reasons, citizens seemed to acknowledge the ability of renewable systems to generate less harmful emissions and, through this effect, to protect fauna and air quality. As for social reasons, citizens regarded the investment as a way to adopt pro-environmental behavior. It is recommended to highlight appeals to economic, environmental and social benefits in campaigns addressed to citizens and aiming at promoting investments.

1 Introduction

In terms of its electricity system, Greece presents a distinctive case because the country relies on a twofold electricity system (i.e., interconnected mainland system and the non-interconnected island systems), but, at the same time, it has a significant renewable potential [1]. In line with EU's directives, Greece has achieved remarkable progress in deploying renewable energies and further deployment may be accomplished as the country offers excellent conditions for renewable energy production due to its geographic position [2]. That being said, the public sector on its own is not able to cover the required financial resources and, therefore, private financing is needed to achieve higher penetration of renewable energy into the energy mix [3]. Citizens could contribute significant capital for renewables and, in some countries, citizens own a significant share of renewable energy production and have supported technology transitions by participating in various feed-in-tariff schemes [4, 5, 6]. In this regard, citizens may provide financial resources for the deployment of renewable energy sources [7, 8].

Although there have been some notable research works on the subject, the understanding of the complex dynamics occurring in citizens' willingness-to-invest requires more extensive research. That is, the number of studies on the subject is still somewhat limited and, as a

result, it does not suffice to inform policymaking [9, 10]. So far, it has been indicated that citizens' investment decision is notably more complicated than it was initially thought while it is subject to various influences. To contribute to the literature that can inform policymaking, this study aims to identify the factors that affect citizens' decision to invest in renewable energy. Specific objectives are to examine the economic, environmental and social reasons that drive citizen investments in renewable energy. This study employs a questionnaire survey as this type has been proposed as an optimal way to collect information about citizens' views [11, 12]. To our knowledge, this is the first study that employs a representative citizen sample to examine views on renewable energy investments.

2 Methodology

Results presented in this paper consist part of a nationwide research that took place from May 2020 to May 2021 in Greece. For the purposes of this research, a structured questionnaire based on the findings of the relevant literature was designed and pilot-tested. The questionnaire contained 26 closed-ended items and most items used a five-point Likert scale. To be more exact, the questionnaire was structured in sections with each section examining various thematic areas related to

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renewable energy investments. In terms of sampling, the method of simple random sampling was followed and resulted in a representative random sample of 1,536 citizens. Questionnaires were then coded in Excel and inserted into the Statistical Package for the Social Sciences (SPSS) for statistical analysis. In order to discover relationships between variables in the dataset, factor analysis was performed.

3 Results

3.1. Respondents' sociodemographic profile

In the sample, women (51.6%) were slightly more than men and, regardless of gender, most respondents were aged between 41 to 50 years, while 43.1% of respondents graduated from university or upper secondary school. Over half were married and 28.3% had two children. Most respondents reported living in urban areas (64.1%) and 28.5% earned between 5,001 to 10,000 a year.

3.2 Economic reasons for investing in RES

Economic reasons were first examined and, in general, all economic reasons presented high agreement percentages. However, the highest percentage was recorded for the ability of renewable energy investments to reduce electricity costs (82.6%), followed by income increase through selling the produced energy (73.3%) and the low taxation on this kind of investment (70.8%). Before the application of factor analysis, certain tests were conducted in order to ensure that the data of Q7 were suitable for factor analysis. In specific, Cronbach's alpha value (0.883), Keiser-Meyer-Olkin index (0.888) and Bartlett's test of sphericity (Chi-Square= 5932.216) confirmed the suitability of the data. The non-parametric Friedman test was applied to detect statistical differences among responses. It was shown that the most important economic reason for investing in RES was the reduction in electricity costs (mean rank 6.05) followed by income increase through selling produced energy (mean rank 5.43) and low taxation on RES investments (mean rank 5.29). On the other hand, the lowest ranked economic reasons involved capital investment (mean rank 4.38) and the relatively low investment cost compared to other investment types (e.g. asset purchase) (mean rank 4.34).

Then, factor analysis with Varimax rotation was performed and two factors were extracted for the multivariate 'Economic reasons for investing in RES' (Table 1). The variables '*Income increase through selling produced energy*', '*High subsidies granted for RES investments*', '*Reduction in electricity costs*', '*Low taxation on RES investments*' and '*Acquisition of stable income*' fell under the first factor. Based on the content of these variables, the first factor can be named '*Subsidies, low investment taxation and improved income and electricity cost*'.

The second factor included the variables '*The relatively low investment cost compared to other investment types (e.g. asset purchase)*', '*Short*

depreciation time' '*Capital investment*' and '*Protection from oil price fluctuations due to geopolitical crises*'. Due to the content of these variables, this factor could be named '*Optimal investment opportunity and protection from oil price fluctuations*'.

Table 1. Factor loadings for economic reasons for investing in RES

Variables	Component	
	PC1	PC2
Income increase through selling produced energy	0.772	0.280
High subsidies granted for RES investments	0.752	0.201
Reduction in electricity costs	0.737	0.238
Low taxation on RES investments	0.693	0.334
Acquisition of stable income	0.600	0.473
The relatively low investment cost compared to other investment types (e.g. asset purchase)	0.208	0.811
Short depreciation time	0.258	0.769
Capital investment	0.357	0.690
Protection from oil price fluctuations due to geopolitical crises	0.292	0.690

3.3 Environmental reasons for investing in RES

The environmental reasons for which citizens would invest in renewable energy were then examined. All environmental reasons presented remarkably high agreement percentages. In specific, the strong majority of respondents agreed or strongly agreed that investments in renewable energy contribute to the mitigation of air pollution (84.3%) as well as to the protection of fauna (83.5%) and flora (82.7%). The results of the non-parametric Friedman test confirmed that respondents attached high importance to these reasons with fauna protection (mean rank 2.54) receiving the highest ranking followed by the contribution to air pollution mitigation and flora protection (mean ranks 2.52).

Table 2. Factor loadings for environmental reasons for investing in RES

Variables	Component	
	PC1	PC2
Flora protection	0.940	0.285
Fauna protection	0.926	0.326
Contribution to the reduction of air pollution	0.290	0.891
Contribution to the mitigation of the depletion of natural resources	0.291	0.890

Cronbach's alpha value (0.877), Keiser-Meyer-Olkin index (0.678) and Bartlett's test of sphericity (Chi-Square= 5005.828, with df=6 and p=0.000) confirmed that the data of Q8 were suitable for factor analysis. As it can be seen in Table 2, the first factor included the

variables ‘*Flora protection*’ and ‘*Fauna protection*’ and thus could be named ‘*Flora and fauna protection*’ whereas the second factor involved the variables ‘*Contribution to the reduction of air pollution*’ and ‘*Contribution to the mitigation of the depletion of natural resources*’ and thus could be named ‘*Mitigation of air pollution and natural resources depletion*’.

3.4 Social reasons for investing in RES

Then, the social reasons that affect the decision to make investments in renewable energy were investigated. The reason with which the majority agreed or strongly agreed was that investments can be a means to adopt pro-environmental behavior (77.2%). Respondents were, however, somewhat divided about the ability of renewable investments to enhance their social profile through entrepreneurial activity (35.6%). According to the rankings of the non-parametric Friedman test, the desire to adopt environmentally friendly behavior (mean rank 3.86) was the most important social reason that would affect respondents’ decision to invest in renewables. This was followed by setting a good example for family (mean rank 3.25) and society (mean rank 3.15). Conversely, increasing respect from friends and acquaintances (2.12) was ranked in the last position. In addition, over half respondents considered that setting a good example for family (57.8%) and society (54.1%) would affect their investment decision. Increasing respect from friends and acquaintances due to investments was a reason that a considerable share of respondents (42.1%) disagreed with. Cronbach’s alpha value (0.802), Keiser-Meyer-Olkin index (0.712) and Bartlett’s test of sphericity (Chi-Square= 3283.840, with df=10 and p=0.000) confirmed that the data of Q9 were suitable for factor analysis.

Table 3. Factor loadings for social reasons for investing in RES

Variables	Component	
	PC1	PC2
Increasing respect from friends and acquaintances	0.895	0.130
Social prestige through entrepreneurial activity	0.885	0.205
The desire to adopt pro-environmental behavior	-0.058	0.817
The desire to set a good example for my family	0.397	0.785
The desire to set a good example for society	0.444	0.759

The variables ‘*Increasing respect from friends and acquaintances*’ and ‘*Social prestige through entrepreneurial activity*’ fell under the first factor which can be named ‘*Boosting social profile*’. The second factor included the variables ‘*The desire to adopt pro-environmental behavior*’, ‘*The desire to set a good example for my family*’ and ‘*The desire to set a good example for society*’. Based on the content of its

constituent variables, the second factor can be termed ‘*Pro-environmental behavior and setting an example*’ (Table 3).

4 Conclusions

The performance of this study was driven by the observation that the occurrence of a certain behavior is often reliant upon the strength of reasons that may evoke the behavior in question. If investments are approached as a behavioral outcome, insights into the reasons for investing in renewable energy are critical both in understanding what motivates investors, as well as in building the profile of investors. Such insights can, in turn, point to the steps that may be taken to promote investments or to improve policy areas that require attention.

This study provided evidence that economic, environmental and social reasons affect citizens’ decision to proceed to investments in renewable energy. The examined reasons of each category, however, seem to have a different level of effect on citizens’ decision to invest. For instance, citizens were driven to invest primarily by their intention to reduce electricity costs and obtain an income from selling electricity rather than by the investment cost. With its ability to enable a better interpretation of results, factor analysis showed that two dimensions underlie economic reasons with the first being related to economic motives and the second being related to investment motives. Hence, policies aiming at promoting citizen investments should address, inter alia, both dimensions as these two were found to correspond to citizens’ expectations. Moreover, since citizens seem to acknowledge that renewables have lower emissions and that investments consist a way for themselves to adopt pro-environmental behavior, it is recommended to stress these features in campaigns addressed to citizens. In other words, strategies that combine appeals to economic, environmental and social benefits are particularly promising and could perhaps unlock the potential of citizen investment. In general, it is highly recommended to consider the entire range of possible motives (economic, environmental and social) that may promote investments.

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