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Public attitudes towards photovoltaic developments: Case study from Greece

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HIGHLIGHTS

- The circumstances for RES are favorable both in the EU and in Greece.
- The growth of renewable energy sources, particularly photovoltaic systems, is provenly following an upward trend.
- The photovoltaic electricity production is an environmentally-friendly, sustainable and socially acceptable answer to the future energy requirements of society.
- The Greek citizens state that they are adequately informed and sufficiently willing to invest in photovoltaic systems either residentially or in a plot of land.

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ABSTRACT

The present decade is considered to be vitally important both as regards addressing energy requirements and for environmental protection purposes. The decisions taken, both on an individual and a collective level, will have a decisive impact on the environment, and primarily on climate change, due to the increased energy demands and the need to reduce carbon use in energy generation.

The present study was designed and carried out while an extensive debate was ongoing in Greece regarding changes to the legislative framework that would specifically disallow new applications for the installation of photovoltaic systems; its aim is to depict the attitude of Greek citizens, through the completion of 1068 questionnaires. The research results show that over half the respondents are informed about the use of photovoltaic systems for electricity generation. Furthermore, almost half are willing to invest in such systems, either at home or on a plot of land. The factors contributing to the installation of photovoltaic systems are mainly "environmental", "financial" and "social". Finally, the citizens who are most willing to invest in residential photovoltaic systems are mainly university or technical school graduates; they would rather take such a decision after being motivated by institutional bodies and would do so for reasons of recognition.

1. Introduction

Until the last few decades, fossil fuels have played a major role in global energy demand. However, both the increase in carbon dioxide and the geographical distribution of fossil resources necessitate a search for alternative energy sources on a global level (De Vries et al., 2007; Wolsink, 2007; Labis et al., 2011; Tampakis et al., 2013). In addition, as the increase in population numbers signifies higher energy use due to new consumer demands, a shift to alternative forms of energy is deemed imperative, and can also be viewed as an answer that could minimize several environmental problems, including climate change (Schiermeier et al., 2008; Von Borgstede et al., 2013) and the rising needs for energy, along with the self-sufficiency of insular regions. Insular energy systems are essential when an area is unable to connect to existing electricity generators and consumers through a transmission grid that is situated in another area, due to its small size and/or remote location. As a result, such areas do not have electricity networks in their proximity that they can use to their advantage, that could provide increased efficiency (Fokaides and Kylili, 2014).

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Out of the various renewable energy sources available, photovoltaic electricity production constitutes an environmentally-friendly, sustainable and socially acceptable answer to the future energy requirements of society (Pearce, 2002). Although investments in RES technologies are viewed as an effective measure to accelerate growth in view of the recent economic crisis, nevertheless the dissemination of RES projects still lies below expectations, despite the policies implemented for their promotion (Masini and Menichetti, 2012).

There are many cases where the availability of suitable sites for the installation of such applications is frequently questioned, since society sets additional barriers in numerous high-capacity areas suitable for RES use (Kaldellis et al., 2012a). It is a common conviction that the views and attitudes of stakeholders need to be modified, in order to ensure a sustainable energy future, in accordance with the global scientific community that is systematically promoting the use of RES (Kaldellis, 2005; Liu et al., 2013).

In the case of investments in renewable energy sources, circumstances are favourable both in the EU and in Greece. More specifically, an EU survey regarding the acceptance of various energy sources has shown that European citizens are extremely positive towards renewable energy sources. In fact, 80% support the use of solar power, 71% wind power, 65% hydroelectric power, 60% ocean energy (waves, tides etc) and 55% promote the use of biomass. The relevant rates are greatly reduced regarding the acceptance of conventional fuels, with nuclear power coming out last, with an acceptance rate of only 20% (EC, 2006). In the case of Greece, after a relevant study carried out in six Greek cities, it was found that society views renewable energy sources in a positive light, but the main obstacle is the cost of the relevant technology, since people are not well-informed in making the distinction between low-cost and high-cost technologies. They expect to obtain this information from the Media and the state, along with funding and subsidies that will promote the said technologies (Kaldellis, 2005; Tzanakaki and Mavrogiorgou, 2005; Kaldellis et al., 2013).

Despite the fact that governments and research institutes take an overall positive stand towards renewable energy sources, it has been observed that certain renewable energy source projects face a reaction from the local population (Upreti and Horst, 2004; Kaldellis, 2005). This information from public opinion surveys is a significant tool for planning energy policies and instituting effective measures for the promotion of renewable energy sources (Kontogianni et al., 2013).

In Greece, the first incentives for photovoltaic systems were introduced in 2006 through law No 3468/2006. The response from the Greek market was practically immediate, and took less than 2 years. Two successive laws provided the opportunity for an even more attractive investment and licensing climate for the sector of building installations, through the introduction of additional guarantees for improved procedures regarding grid connections. However, the unexpectedly large number of applications submitted by 2011, with a total photovoltaic capacity which exceeded the national goals for 2020, led to huge delays in the grid connection procedures (Karteris and Papadopoulos, 2013). This was the scenario up to 2012. In August 2012, the Ministry of the Environment, Energy and Climate Change announced the temporary suspension of the licensing procedures for certain photovoltaic categories. More specifically, it decided to suspend the submission of new applications for production licenses and grid connection quotations and also to suspend the assessment of pending applications for production licenses and grid connection quotations (JMD B 2317/2012).

The purpose of this study is to outline the views of Greek citizens on a series of issues related to investments in photovoltaic systems. The data, collected through a structured questionnaire, are important due to the fact that they depict the attitude of Greek citizens before governmental decisions were taken to suspend applications for new licenses. The evaluation of the citizens' views at this crucial point in time, could serve as a starting point and a tool for changes to be made to the government's decisions, in line with the current situation.

2. Literature review

The views of society on issues related to the environment largely affect environmental actions carried out among the population. In other words, citizen attitudes have a major impact on energy policy planning (Viklund, 2004). In a study conducted in Australia, citizens who were environmentally-aware were willing to proceed with the adoption of green technologies in order to turn their convictions into practice. Furthermore, according to Islam (2014), households do not only take into account the particular features of the relevant technology but are also affected by psychological, social and institutional factors. Another equally important parameter is the Feed-In Tariff (FiT) scheme, according to which owners are paid for the electricity they generate in kilowatt-hour (kW h) over a contract period of 20 years, as a rule. The aim of such incentives is to encourage an increase in the use of renewable energy sources, especially in the case of low-level electricity generation (Muhammad-Sukki et al., 2011).

On the other hand, citizens who are opposed to such types of action can create a considerable barrier against the implementation of RES projects. In addition, the environmental behaviour of members of a society cannot be easily influenced by state policies and incentives, however much one might expect a different outcome (Gadenne et al., 2011). In order to minimize the problems and maximize the expected results, and prior to the strategic plans being drawn up and governmental decisions taken, it is imperative to research public opinion. In this way, the possibility of failed governmental decisions is minimized (Tampakis et al., 2013).

The incorporation of RES is an essential requirement for the European Union (EU) in order to fulfill its objectives for 2020 (when 20% of the gross national energy consumption and 40% of the gross national electricity consumption must be covered by RES). In view of this challenge, many countries are in the course of preparing ambitious plans. One such example is Scotland, which has set its goals far above EU requirements, and where energy production from renewable sources by 2020 is expected to reach 50% (Warren and McFadyen, 2010). Nevertheless, there are many cases where studies have highlighted a contradiction between high-level objectives and limited acceptance by society, mainly related to social recognition issues and income (Batley, et al., 2001). More specifically, the gap between national goals and the increased share of renewable energy sources and social acceptance has been discussed by several researchers, who have come to the conclusion that social disapproval can function as a restricting factor in achieving a government's ambitious objectives (Wóstenhagen et al., 2007). The behaviour displayed by citizens vis-à-vis public support of an environmental decision is related to social psychological constructs (Kaldellis, 2005; Barr and Gilg, 2006; Poortinga et al., 2006; Jobert et al., 2007; Schultz et al., 2007). Studies have indicated there is a medium to strong overall public support for renewable energy sources, such as wind power (Krohn and Damborg, 1999; Wolsink, 2007). Other studies conclude that the social acceptance of renewable energy sources tends to vary and views differ depending on the size of the project. The majority of studies which attempt to analyze public opinion are quantitative and view the public as a homogeneous whole. On the contrary, others use qualitative research to try and put together issues related to the acceptance of renewable energy sources, and specifically discuss the provision of economic incentives, the information available regarding climate change, the energy behaviour of citizens and aesthetic issues linked to the landscape (West et al., 2010).

As mentioned above, there is a positive attitude towards RES in general, both on an EU level and in Greece. In the case of Sweden and in relation to “green” energy, it was observed that 88% of those interviewed believe that wind power is an environmentally-friendly source of electricity, while the relevant figure for solar and hydroelectric power is 93%. Another important fact is that Swedish people consider environmental issues to be vitally important for their society, followed by unemployment, health and education. They also appear willing to change their current way of life, since they are fully aware of how they can thus contribute to a mitigation of climate change. Consequently, they support the development of new renewable energy technologies, that will also help resolve the problem of climate change (Ek, 2005; Von Borgstede et al., 2013). A recent survey undertaken in Malaysia, which aimed to record the public's understanding and views on renewable energy sources and solar photovoltaic installations in conjunction with the FiT scheme, has shown that the public have a limited knowledge of the range of altenative methods available and do not seem keen to invest in such photovoltaic energy plans (Muhammad-Sukki et al., 2011).

In Greece, a public opinion survey regarding renewable energy sources in island regions and on the mainland has indicated that views are stronger in the area of central Peloponnese (61%) than in the Greek islands (51%) (Kaldellis, 2005). This may be due to the fact that the long-term operation of the thermo-electric plant at Megalopolis has had a negative environmental impact (Kaldellis et al., 2004), which has increased the public reaction against it and the public interest in finding an alternative solution (Kaldellis et al., 2012b). It may also be related to the fact that the local economy of island regions is based on tourism, and residents are concerned that the installation of RES may spoil the landscape. A more recent study conducted in Greece actually reveals a greater acceptance of RES, with 85% positive views on photovoltaic systems and 80% on hydroelectric power and wind power. Any objections to the use of these systems can either be attributed to ignorance of their environmental, social and economic benefits, or to their visual or noise impact (Kaldellis et al., 2013). In the case of wind parks, Kontogianni et al. (2014) studied the views of the local population whose houses were closely situated to an existing wind farm and found that they fully supported both the wind farm and the use of wind energy as a whole.

The growth of renewable energy sources, particularly photovoltaic systems, is provenly following an upward trend, with continuous technical improvements being made along with the provision of subsidies. The best way to facilitate the development of photovoltaic systems is through the creation of an institutional framework with the participation of all stakeholders in decision-making processes. The need for cooperation regarding renewable energy sources has been perceived by the broader public, in order to examine the process of project implementation. Lack of communication can only lead to problems, both pertaining to the public and also to local authorities, that often result in delays or even cancelled investments in certain cases. What frequently occurs, on behalf of the institutional bodies, is that they seek public participation only after a particular project has been announced (Tampakis et al., 2013).

In Greece various incentives have been provided since 2006 for renewable energy sources, such as tax deductions, while licensing has also been facilitated to a great extent, thus resulting in a large number of applications. In 2012, Greece was the fourth country in Europe and the seventh worldwide, as regards new installed photovoltaic capacity. More specifically, 912 new photovoltaic MW were installed in 2012, which equaled 88% of the total new RES capacity installed in the previous year. Photovoltaic systems covered over 3% of the country's electricity requirements, producing 1.7 TW h, amounting to 30% of the total green energy in 2012. In 2012, the use of photovoltaics prevented the emission of 1.12 mil tones of carbon dioxide into the atmosphere (Hellenic Association of Photovoltaic Companies—HELAPCO, 2013). In total, RES capacity in the interconnected system amounts to 3972 MW, of which 1495 MW come from wind farms, 1944 MW from photovoltaics, 218 from small hydroelectric stations, 45 MW from biomass and 90 MW from the Cogeneration of High Performance Heat-Power (CHP). In due course however, a governmental decision changed the legislative framework and no individual applications are now being accepted. Nevertheless, licensing continues for large-scale photovoltaic projects that have already been included in the Fast Track process, and for photovoltaic systems with a capacity of up to 10 kWp in buildings. The photovoltaic projects that have already been given a production license or a binding connection quotation continue with the licensing procedure unhindered (http://www.investingreece.gov.gr/default.asp?pid=36&sectorID=49&la=2). Until 2011, Greece had achieved a major increase in its share of Renewable Energy Sources. More specifically, in 2011, according to Eurostat, the percentage increased to 11.6% from 9.2% in 2010, 8% in 2008, 7.2% in 2006 and 7.1% in 2004. For the 27 countries of the EU, the rate of RES penetration was 13% in 2011, compared to 12.1% in 2010. The goal for 2020 is 20%. In time, and due to the economic crisis and the suspension in granting new licenses, Greece found itself in the final position in the ranking of countries according to the attractiveness of investing in the field of RES, according to a report by Ernst and Young. As noted in the report, strong markets of the past, such as Spain and Greece, continue to “drop down” the ranking scale, as a result of the harsh measures taken in order to combat their subsidy-related deficits. More specifically, although Greece was in the 22nd position in the final report of February 2012, it dropped down by almost twenty places in May 2012, coming out 40th. On the other hand, the number of solar installations doubled in Greece in 2012, despite the various reductions in the special selling price of solar produced kW h and the tax increase last year; however, as the report mentions, “financing continues to form a major obstacle”. For this reason, Greece is also ranked last regarding the possibility of financing RES projects, with only 30.7 points (To Vima, 2013). All these problems have led the photovoltaic electricity market to the brink of collapse. The above problems could be resolved through a change to the legislative framework, that will focus both on environmental and developmental issues. Moreover, the dependency of island regions on oil for energy purposes is a prohibiting factor for the development of tourism and for the quality of life of the local population.

3. Research methodology

3.1. Research area

The research area included all the households of Greece. Greece is a country located in the SE corner of Europe. It belongs to and forms the point of the Balkan Peninsula. It covers a surface area of 131,957 km^2, which consists of the mainland (106,778 km^2) and thousands of small and large islands (total area—25,179 km^2).

3.2. Sampling method

The sampling method used was simple random sampling, due to its simplicity and the fact that it requires the least possible knowledge of the population compared to any other method (Damianou, 1999; Kalamatianou, 2000; Matis, 2001). The “population” under study is the total number of households in Greece. Using households is a classic case of using a group of people as a sampling unit, instead of individuals. This method is chosen because in certain cases it is more convenient and less costly (Matis, 2001). In fact, the member selection process (from the randomly selected household) was organized in such a way that the same member was not always chosen (i.e. the head of the family or the wife etc) (Filias et al., 2000).

The estimation of the population proportion and the standard error of the population proportion s_p was carried out using the formulae of simple random sampling (without the finite population correction for s_p).

$$\overline{p} = \frac{\sum_{i=1}^{n}(p_i)}{n}$$

$$s_{\overline{p}} = \sqrt{\frac{\overline{p}(1-\overline{p})}{n-1}}$$

The size of the sample was estimated based on the formulae of simple random sampling (Kalamatianou, 2000; Matis, 2001). Although simple random sampling without replacement was used, the finite population correction can be ignored, since the sample size n is small compared to the size of the population N (Pagano and Gauvreau, 2000).

$$n = \frac{t^2 \times \overline{p} \times (1-\overline{p})}{e^2} = \frac{1.96^2 \times 0.50 \times (1-0.50)}{0.03^2} = 1067.111 \cong 1068$$

where t=the value of the Student distribution for probability $(1-\alpha)$=95% and $n-1$ degrees of freedom. Since the size of the conducted presampling is large (over 50), the value t is obtained from the probability matrices of the normal distribution for the desired probability. In practice, for a probability of 95%, the value is 1.96 (Matis, 2001). p is the proportion estimate, e is the maximum acceptable difference between the sampling mean and the unknown population mean. We accept that it is 0.03, i.e. 3%.

In order to calculate the size of the sample, a presampling was required on a sample size of 50 persons. Thus, the true population proportion was estimated for each variable.

The use of a questionnaire is not limited to the estimation of only one population variable, but more. Thus, we need to estimate the sample size for each variable. The variables that produced the largest sample size are 'Willingness to invest in residential photovoltaic systems (roofs, terraces etc)' and 'Degree of information regarding photovoltaic electricity production systems', which are also the most important variables in our study.

If the estimated sample sizes are similar and the sizes of them all lie within the financial capabilities of the sampling, then the maximum sample size is selected. In this way, the most varying variable is estimated with the desired accuracy and the rest with a higher accuracy than initially defined (Matis, 2001).

With the help of the CATI (Computer Aided Telephone Interviewing) programme, telephone interviews were carried out, using an automatic dialling system for random numbers per area. Furthermore, by using CATI it is possible to create and manage an unlimited number of questionnaires with an unlimited number of questions on each one. In addition, this particular programme is able to skip questions, and also has the advantage of recording the interviewees' answers in a simple and quick manner. It is also able to extract the survey results in Excel format, SPSS and other packages, and to be used simultaneously by a large number of users. In cases where people refused to answer the research, new telephone numbers were selected and when there was no one at home, two more tries were made to find the residents and record their views. If this was not feasible, we used the same process to select new sampling units. The data collection was conducted from December 2011 to February 2012.

3.3. The research questionnaire—Statistical processing

In order to structure the questionnaire, the relevant literature was taken into account that is related to photovoltaic systems, RES, environmental attitudes and behaviours (Roe et al., 2001; Upreti and Horst, 2004; Ek, 2005; Kaldellis et al., 2004, 2012a, 2012b, 2013; Kaldellis, 2005; Kaldellis et al., 2008; Tzanakaki and Mavrogiorgou, 2005; Barr and Gilg, 2006; Faiers and Neame, 2006; Poortinga et al., 2006; Jobert et al., 2007; Schultz et al., 2007; Malesios and Arabatzis, 2010; Zografakis et al., 2010; West et al., 2010; Arabatzis and Myronidis, 2011; Gadenne et al., 2011; Tsagarakis et al., 2011;Liu et al., 2013). Before the questionnaire distribution began, the necessary content validity test was carried out (Zikmund, 2003). The degree of understanding, "acceptance" and interpretation of the questionnaire were examined. Pre-testing was necessary in order to: avoid unsuitable, partial, vague and double questions, define the order of the questions to prevent any misunderstandings, reduce the extent of the questionnaire and address any indifference on the part of the interviewees.

Cronbach's α coefficient, descriptive statistics, Friedman's non-parametric test, categorical regression, factor analysis, cluster analysis and discriminant analysis were used from the SPSS statistical programme for the data processing.

Cronbach's α coefficient is used to identify the internal consistency of a questionnaire, i.e. whether the data have the tendency to measure the same fact. It expresses the squared correlation between the score (observed) that a person is assigned on the given scale and the score that they would have obtained (true) if they had been asked about all issues (Siardos, 1999).

The Friedman test is used to compare the values of three or more correlated groups of variables. The distribution of the Friedman test is a X^2 distribution with (df) $df=k-1$ degrees of freedom, where k is the number of groups or samples. This test classifies the values of variables for every subject separately and calculates the mean rank of classification values for each variable (Freund and Wilson, 2003; Ho, 2006). The non-parametric Friedman test was used in order to extract the main subject from the multidisciplinary variable 'Sources of information on photovoltaic systems'.

Categorical regression is an extension of the principles of classical linear regression and logarithmic analysis. Through scaling, it assigns values to each category of variables in such a way that they are optimum as concerns the regression, and reflect the characteristics of the original variables. Categorical regression scales the nominal, ordinal and numerical variables in an optimum manner, quantifying their categories, so that the squared correlation between the quantified dependent variable and the linear combination of the quantified independent variables is maximized. The interpretations are related to the transformed variables, but they are also related to the original variables, due to the relation that exists between the original variables and the transformed ones (Siardos, 2000). In this case, the dependent variables used with the categorical regression method were (i) degree of information on photovoltaic systems, (ii) willingness to invest in residential photovoltaic systems and (iii) willingness to invest in photovoltaic systems on a plot of land; the independent variables in all three cases were the sources of information.

Factor analysis is a statistical method that aims to examine the existence of common factors within a group of variables (Sharma, 1996). More specifically, principal component analysis was used here, which is based on the spectral analysis of the variance (correlation) matrix (Murtagh and Heck, 1987; Lupton, 1993; Siardos, 1999; Djoufras and Karlis 2001; Jolliffe, 2002). The criterion used for the significance of the principal components was the one recommended by Guttman and Kaiser (Cattell, 1978; Fragos, 2004), according to which, the limit for obtaining the required number of principal components is defined by the eigenvalues which are equal to or greater than one.

We concluded with a matrix rotation of the principal components using Kaiser's varimax rotation method (Harman, 1976) for better results. Factor analysis was used in order to extract the factors from the multidisciplinary variables 'bodies that can motivate citizens to install photovoltaic systems (Q1)', 'financial reasons (Q2)', 'reasons of recognition (Q3)', 'reasons of trust in the relevant stakeholders (Q4)', 'environmental protection reasons (Q5)', 'various other reasons (Q6)'. The loadings of the extracted factors from the previous factor analyses were applied anew in order to extract the factors that explain the reasons that would urge citizens to install photovoltaic systems. Cluster analysis was applied on the former loadings of the final factors in order to examine the potential existence of individual types of citizens from the factors arising from the last factor analysis. Finally, discriminant analysis was applied in order to estimate whether the citizen clusters, that emerged in relation to the original variables, were correctly ranked.

4. Results

The primary data collected and presented in this research relate to the socio-demographic characteristics of the respondents and their views and attitudes on the degree of information regarding photovoltaic systems for electricity production, willingness to invest in residential photovoltaic systems (roofs, terraces etc) and willingness to invest in photovoltaic systems on a plot of land, as well as the sources of information on photovoltaic systems. Finally, they include the reasons that could contribute to the installation of photovoltaic systems, such as 'bodies that may motivate citizens to install photovoltaic systems (Q1)', 'financial reasons (Q2)', 'reasons of recognition (Q3)', 'reasons of trust in the relevant stakeholders (Q4)', 'environmental protection reasons (Q5)' and 'various other reasons (Q6)', which could not be incorporated into the above categories.

4.1. Individual characteristics of the sample

As regards the socio-economic characteristics of the sample, it is observed that there is a differentiation as regards gender, over half the respondents are aged up to 40 years, and almost seven in ten have completed secondary school at least. One in four is a private employee, while about 20% are either unemployed or students. Finally, 32.8% did not answer on income and, of the rest, a large number (40.0%) earn over 10,000 euro (Table 1).

4.2. Sources of information and investments in photovoltaic systems

Next, we examined the characteristics related to the information provided to citizens on photovoltaic systems and their intention to proceed with a relevant investment. Their information on photovoltaic systems is considered quite satisfactory, since about half state that they have sufficient information on these systems and only 11% do not have any information, while 34% have little information (Fig., 1). Similar results were also obtained regarding the willingness of Greek citizens to invest in photovoltaic systems either residentially or on a plot of land. Most are interested in residential installations, either on the terrace or the roof, and lesser so on a plot of land. More specifically, 50% state they are quite willing to install them in their home (Fig., 2); when asked whether they wish to install them on a plot, the rate is reduced to 42% (Fig., 3). This attitude by citizens is partly justified, since they may not own a plot of land. However, they were given the opportunity by Greek legislation to lease a plot for an extended period and proceed with the above investment if they wished, since the leasing costs for plots of land are particularly low.

Regarding the evaluation of the sources of information on photovoltaic systems, citizens state that they are mainly informed by the Media. More specifically, they draw information from the Internet, TV, radio, newspapers, information leaflets and from their family and friends. They draw little or no information from educational establishments, NGOs and the banking system (Table 2). Beyond the ranking provided by the percentages for the sources of information, we also proceeded further to see whether there is a statistical difference between the evaluations.

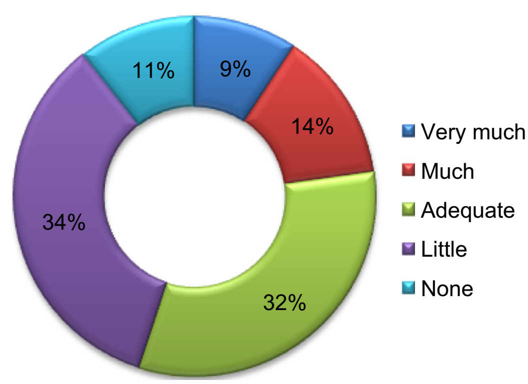

Fig. 1. Degree of information regarding photovoltaic systems for electricity Production.

Table 1
Socio-economic characteristics of the sample.

1. Gender					
Male	Female				
50.8	49.2				
2. Age					
18–30	31–40	41–50	> 50		
30.7	27.5	26.2	15.6		
3. Educational level					
None—Some grades of Primary School	Primary school	Lower secondary school	Technical school	Upper secondary school	University/TEI
1.5	4.0	7.1	14.3	26.4	46.6
4. Profession					
Unemployed/student	Farmer–fisherman–pensioner	Housework	Private employee	Civil servant	Self-employed
20.6	13.6	6.7	25.3	19.5	14.3
5. Annual income					
< 5000 euro	5000–10,000 euro	10,001–20,000 euro	20,001–30,000 euro	> 30,000 euro	No answer
11.0	16.5	21.6	10.6	7.5	32.8

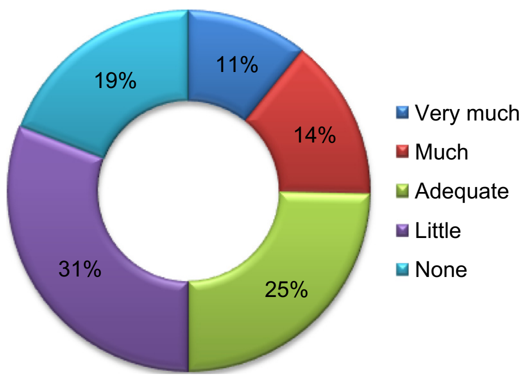

Fig. 2. Willingness to invest in residential photovoltaic systems (roof, terrace etc).

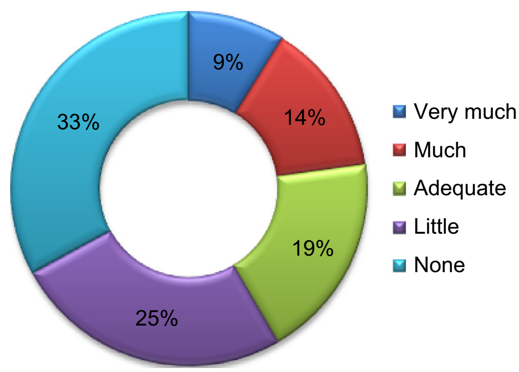

Fig. 3. Willingness to invest in photovoltaic systems in a plot of land.

Table 2
Sources of information on photovoltaic systems.

	Very much	Much	Adequate	Little	None
Family environment and friends	9.3	15.2	25.2	31.8	18.3
Education	4.7	9.3	14.3	26.1	45.6
TV–radio	6.3	14.1	24.2	37.8	17.5
Newspapers–magazines	5.9	15.4	25.5	31.6	21.6
Books–encyclopedias	5.5	8.8	14.6	23.1	47.9
Internet	20.5	21.0	22.7	16.8	19.0
Information leaflets	9.2	17.9	22.8	30.0	20.1
Environmental organisations	5.7	9.6	14.1	28.5	42.0
Banks	4.2	9.2	9.3	23.4	53.9

For this purpose, the Friedman test was applied, but prior to that, Cronbach's α coefficient was extracted that was equal to 0.826. Following the application of the Friedman test, it was observed that the source evaluated as being the most important is the ‘Internet’, with a mean rank of 6.40. It is worth noting that the next most important source of information is ‘family environment and friends’, with a mean rank of 5.76 (Table 3).

Next, in order to examine the contribution of each source of information to the degree of information on the installation of photovoltaic systems, categorical regression was applied. The results of the categorical regression, with the degree of information as the dependent variable, and the possible sources of information as the independent variables, are presented in Table 4. From the standardised regression coefficients of the independent variables, it is observed that the degree of information on photovoltaic systems is mostly affected by the variables ‘Internet’, ‘newspapers–magazines’, ‘family environment and friends’, ‘information leaflets’ and ‘banks’. Furthermore, and based on the *F* values for each independent variable, it is observed that the elimination of the variables presenting a high *F* value renders the model weak, while the elimination of the variable ‘education’ minimally affects the predictability of the model. Moreover, the relative significance measures of the independent variables state that the greatest contribution to the independent variable is made by the variable ‘Internet’ (29.3%), followed by ‘newspapers’ (16.9%), ‘information leaflets’ (14.1%) and ‘family environment and friends’(10.4%).

Table 3
The application of the Friedman test for sources of information on photovoltaic systems.

	Mean rank
Family environment and friends	5.76
Education	4.14
TV–radio	5.52
Newspapers–magazines	5.38
Books–encyclopedias	4.06
Internet	**6.40**
Information leaflets	5.70
Environmental organisations	4.29
Banks	3.75
$N=972$ Chi-Square $=1173.617$ *df* 8.000 Asymp. Sig <0.001	

In addition, categorical regression was applied in order to examine the contribution of each source of information to willingness to invest in residential photovoltaic systems. The results of the categorical regression with willingness to invest in residential photovoltaic systems as the dependent variable and the possible sources of information as the independent variables are presented in Table 5. From the standardised regression coefficients of the independent variables, it is observed that willingness to invest in residential photovoltaic systems is mainly affected by the variables ‘family environment and friends’, ‘information leaflets’ and the ‘Internet’. Furthermore, and based on the *F* values for each independent variable, it is observed that the elimination of the variables presenting a high *F* value renders the model weak, while the elimination of the variable ‘books–encyclopedias’ minimally affects the predictability of the model. Moreover, the relative significance measures of the independent variables state that the greatest contribution to the independent variable is made by the variables ‘family environment and friends’ (30.9%), ‘information leaflets’ (27.8%), the ‘Internet’ (21.3%) and ‘environmental organisations’ (10.0%).

Finally, categorical regression was applied in order to examine the contribution of each source of information to willingness to invest in photovoltaic systems on plots of land. The results of the categorical regression with willingness to invest in photovoltaic systems on plots of land as the dependent variable and the possible sources of information as the independent variables are presented in Table 6. From the standardised regression coefficients of the independent variables, it is observed that willingness to invest in photovoltaic systems on plots of land is mainly affected by the variables ‘family environment and friends’, ‘banks’ and ‘books–encyclopedias’. Furthermore, and based on the *F* values for each independent variable, it is observed that the elimination of the variables presenting a high *F* value renders the model weak, while the elimination of the variable ‘TV–radio’ minimally affects the predictability of the model. Moreover, the relative significance measures of the independent variables state that the greatest contribution to the independent variable is made by the variables ‘family environment and friends’ (25.3%), ‘banks’ (22.7%), ‘information leaflets (14.8%), ‘books–encyclopedias’ (15.2%), ‘newspapers– magazines’ (12.7%) and the ‘Internet’ (10.8%).

4.3. Factors that contribute to the installation of photovoltaic systems

Next, the structure of the citizens' views was examined regarding a range of reasons that would urge them to install photovoltaic systems.

Table 4
Categorical regression results: information on photovoltaic systems obtained or not, in relation to the source of information.

	Standardized coefficients		F	Sig.	Importance (pratt)
	Beta	Bootstrap (1000) estimate of std. error			
Family environment and friends	**0.141**	0.027	27.750	**0.000**	**0.104**
Education	0.079	0.029	7.314	**0.007**	0.063
TV–radio	0.031	0.028	1.232	0.267	0.016
Newspapers–magazines	**0.155**	0.032	24.110	**0.000**	**0.169**
Books–encyclopedias	0.090	0.029	9.307	**0.000**	0.080
Internet	**0.252**	0.029	73.322	**0.000**	**0.293**
Information leaflets	**0.129**	0.032	16.155	**0.000**	**0.141**
Environmental organisations	0.052	0.030	2.973	0.085	0.044
Banks	**0.111**	0.029	14.276	**0.000**	0.089

Table 5
Categorical regression results: investments in residential photovoltaic systems made or not, in relation to the source of information.

	Standardized coefficients		F	Sig.	Importance (pratt)
	Beta	Bootstrap (1000) estimate of std. error			
Family environment and friends	**0.229**	0.032	50.639	**0.000**	**0.309**
Education	−0.031	0.034	0.819	0.441	−0.024
TV–radio	−0.087	0.032	7.210	**0.000**	−0.042
Newspapers–magazines	0.075	0.037	4.196	**0.015**	0.090
Books–encyclopedias	0.040	0.035	1.332	0.265	0.039
Internet	**0.163**	0.032	25.571	**0.000**	**0.213**
Information leaflets	**0.185**	0.036	26.581	**0.000**	**0.278**
Environmental organisations	0.076	0.036	4.561	**0.011**	**0.100**
Banks	0.039	0.032	1.497	0.224	0.036

Table 6
Categorical regression results: investments in photovoltaic systems in plots of land made or not, in relation to the sources of information.

	Standardized coefficients		F	Sig.	Importance (pratt)
	Beta	Bootstrap (1000) estimate of std. error			
Family environment and friends	**0.177**	0.033	29.699	**0.000**	**0.253**
Education	−0.054	0.033	2.619	0.106	−0.030
TV–radio	−0.068	0.032	4.416	**0.036**	−0.037
Newspapers–magazines	0.099	0.033	9.070	**0.000**	**0.127**
Books–encyclopedias	**0.112**	0.034	10.857	**0.000**	**0.152**
Internet	0.089	0.034	6.748	**0.001**	**0.108**
Information leaflets	0.097	0.038	6.577	**0.000**	**0.148**
Environmental organisations	0.041	0.035	1.360	0.257	0.052
Banks	**0.153**	0.033	20.962	**0.000**	**0.227**

For this purpose, six multidisciplinary variables were used to examine a range of reasons, for example to evaluate 'bodies that may motivate citizens to install photovoltaic systems (Q1)', 'financial reasons (Q2)', 'reasons of recognition (Q3)', 'reasons of trust in the relevant stakeholders (Q4)', 'environmental protection reasons (Q5)' and 'various other reasons (Q6)', which could not be incorporated into the above categories, but were deemed necessary to examine according to the literature and the pilot questionnaire.

4.3.1. An evaluation of bodies that may motivate citizens to install photovoltaic systems (Q1)

In order to examine the structure of the respondents' views regarding bodies that may motivate citizens to install photovoltaic systems, Principal Component Analysis (PCA) was initially applied with varimax rotation of the factorial axes on the citizens' answers to the multidisciplinary variable Q1. The analysis highlighted two significant factors or factorial axes, which in total explain 61.04% of the total variance.

For the above multidisciplinary variable, Cronbach's α coefficient is 0.837; before we proceeded with the application of the factor analysis, the necessary tests were carried out. More specifically, the Keiser–Meyer–Olkin index has a value of 0.826 for 'bodies that may motivate citizens to install photovoltaic systems'. It is suggested that the KMO index should be greater than 0.80, however values over 0.60 are considered acceptable (Sharma, 1996). Also, Bartlett's sphericity test rejects the null hypothesis ($\chi^2=2961.352$, $df=28$, $p<0.001$).

Table 7 provides the loadings, which are the partial correlation coefficients of the eight variables, with each of the two factors that have emerged from the analysis prior to and following rotation. The higher the loading of a variable to a factor, the more that factor is responsible for the total variance of the degrees in the factor under consideration. The variables that "belong" to each factor are those for which the loading (columns 1 and 2) is close to or greater than 0.5.

Following the application of factor analysis in the case of 'bodies that may motivate citizens to install photovoltaic systems', two factors were identified (Table 7). The first factor (Q1A) comprises 'institutional bodies' and includes the variables 'State', 'Local Authorities', 'Media', 'Education'. Finally, the second factor (Q1B) comprises 'private bodies' and includes the variables 'p.s. representatives', 'special engineering consultants', 'others who have installed photovoltaic systems' and 'banks'.

4.3.2. Financial reasons that contribute to the installation of photovoltaic systems (Q2)

Next, in order to examine the structure of the respondents' views regarding the financial reasons that would urge them to install photovoltaic systems, Principal Component Analysis (PCA) was applied with varimax rotation of the factorial axes on the citizens' answers to the multidisciplinary variable Q2. Cronbach's α coefficient is 0.837 for this question, the KMO index has a value of 0.913 and Bartlett's sphericity test rejects the null hypothesis ($\chi^2=6861.430$, $df=45$, $p<0.001$). The analysis highlighted one factor. More specifically, this factor consists of the variables 'provision of subsidies during the system's purchase', 'provision of subsidies for its maintenance', 'existence of a stable-guaranteed income', 'minimum labour required', 'reduction of your electricity costs', 'the safest investment for your savings compared to other investments', 'higher return on your investment compared to other investments', 'subtraction of installation costs from taxable income', 'subtraction of maintenance costs from taxable income' and 'creation of new jobs'.

Table 7
Table with the factor loadings of the data prior to and following rotation, for 'bodies that may motivate citizens to install photovoltaic systems (P.S) (Q1)'.

Factor loadings				
Variable	Prior to rotation		Following rotation	
	1	2	1	2
State	0.771	−0.457	**0.880**	0.170
Local authorities	0.792	−0.362	**0.833**	0.255
Media	0.639	−0.288	**0.669**	0.209
Education	0.672	−0.228	**0.654**	0.276
P.S. representatives	0.654	0.584	0.101	**0.872**
Special engineering consultants	0.720	0.454	0.236	**0.818**
Others who have installed p.s.	0.602	0.260	0.277	**0.594**
Banks	0.608	0.183	0.333	**0.540**

4.3.3. Recognition through the installation of photovoltaic systems (Q3)

To examine the structure of the respondents' views regarding the reasons of recognition that would urge them to install photovoltaic systems, Principal Component Analysis (PCA) was applied with varimax rotation of the factorial axes on the citizens' answers to the multidisciplinary variable Q3. Cronbach's α coefficient is 0.78 for this question, the KMO index has a value of 0.692 and Bartlett's sphericity test rejects the null hypothesis ($\chi^2=1200.452$, $df=6$, $p<0.001$). The analysis highlighted one factor. More specifically, this factor consists of the variables 'becoming an entrepreneur', 'having more free time-a better quality of life', 'I will be thought of more highly by my neighbours', 'I will be thought of more highly by my children'.

4.3.4. Trust in the relevant stakeholders and the installation of photovoltaic systems (Q4)

In order to examine the structure of the respondents' views regarding the reasons related to trust in the relevant stakeholders that would urge them to install photovoltaic systems, Principal Component Analysis (PCA) was applied with varimax rotation of the factorial axes on the citizens' answers to the multidisciplinary variable Q4. Cronbach's α coefficient is 0.88 for this question, the KMO index has a value of 0.807 and Bartlett's sphericity test rejects the null hypothesis ($\chi^2=3052.206$, $df=10$, $p<0.001$). The analysis highlighted one factor. More specifically, this factor consists of the variables 'banks', 'Public Power Corporation (PPC)', 'system installation companies', 'system maintenance companies' and the 'state' (existence of a stable institutional framework).

4.3.5. Environmental protection reasons and the installation of photovoltaic systems (Q5)

Next, in order to examine the structure of the respondents' views regarding the environmental protection reasons that would urge them to install photovoltaic systems, Principal Component Analysis (PCA) was applied with varimax rotation of the factorial axes on the citizens' answers to the multidisciplinary variable Q5. Cronbach's α coefficient is 0.905 for this question, the KMO index has a value of 0.795 and Bartlett's sphericity test rejects the null hypothesis ($\chi^2=2963.121$, $df=6$, $p<0.001$). The analysis highlighted one factor. More specifically, this factor consists of the variables 'reduction of pollution' (since this particular energy is generated by the sun), 'improved quality of atmosphere in the urban environment we live in', 'increased energy independence for the country' and 'sustainable management of natural resources'.

Table 8
Table with the factor loadings of the data prior to and following rotation, for various other reasons.

Factor loadings				
Variable	Prior to rotation		Following rotation	
	1	2	1	2
Contribution to the country's economic growth	0.752	0.332	**0.787**	0.240
Production of photovoltaic systems in my country	0.716	0.331	**0.759**	0.217
Use of photovoltaic energy by my fellow citizens	0.660	0.377	**0.747**	0.146
Contribution to the country's green development	0.732	0.248	**0.716**	0.291
Only choice for electricity provision to an illegal building	0.456	0.201	**0.477**	0.146
Great period of capital depreciation	0.644	−0.170	**0.477**	0.433
Notable increase in the price of oil and natural gas	0.705	−0.553	0.172	**0.879**
Notable increase in electricity cost	0.726	−0.494	0.227	**0.848**
Exemption from real estate tax	0.713	−0.353	0.309	**0.732**

4.3.6. Various other reasons that contribute to the installation of photovoltaic systems (Q6)

To examine the structure of the respondens' views regarding various other reasons that would urge them to install photovoltaic systems, Principal Component Analysis (PCA) was applied with varimax rotation of the factorial axes on the citizens' answers to the multidisciplinary variable Q6. The analysis highlighted two significant factors or factorial axes that in total explain 59.37% of the total variance.

For the above multidisciplinary variable, Cronbach's α coefficient is 0.805; before we proceeded with the application of the factor analysis, the necessary tests were carried out. More specifically, the Keiser–Meyer–Olkin index has a value of 0.847 for the motivating bodies. Also, Bartlett's sphericity test rejects the null hypothesis ($\chi^2=3663.791$, $df=36$, $p<0.001$).

Following the application of factor analysis in the case of various other reasons, two factors were identified (Table 8). The first factor (Q6A) comprises 'reasons of national interest' and includes the variables 'contribution to the country's economic growth', 'production of photovoltaic systems in my country', 'use of photovoltaic energy by my fellow citizens', 'contribution to the country's green development', 'only choice for electricity provision (illegal building)' and 'great period of capital depreciation'. Finally, the second factor (Q6B) comprises 'financial and tax-related reasons' and includes the variables 'great period of capital depreciation', 'notable increase in the price of oil and natural gas', 'notable increase in electricity cost', and 'exemption from real estate tax'.

4.3.7. Second-order factor analysis

In order to examine the structure of the respondents' views in total regarding the reasons affecting their decision to install photovoltaic systems, Principal Component Analysis (PCA) was applied with varimax rotation of the factorial axes on the factors that emerged from the applications of the factorial analyses to the above-mentioned multidisciplinary variables, and more specifically to the factors 'institutional bodies' (Q1A), 'private bodies' (Q1B), 'financial reasons' (Q2), 'reasons of recognition' (Q3), 'trust in the relevant stakeholders' (Q4), 'environmental protection reasons' (Q5), 'reasons of national interest' (Q6A) and 'financial and tax-related reasons' (Q6B). The analysis highlighted three significant factors or factorial axes that in total explain 66.81% of the total variance.

Before we proceeded with the application of the factor analysis, the necessary tests were carried out on the above multidisciplinary variable. The Keiser–Meyer–Olkin index has a value of 0.713 for the motivating bodies. Also, Bartlett's sphericity test rejects the null hypothesis ($\chi^2=2041.112$, $df=28$, $p<0.001$).

The application of factor analysis highlighted three factors (Table 9). The first factor (PC1) is 'environmental' and includes the variables 'reasons of national interest' (Q6A) and 'environmental protection reasons' (Q5). The second factor (PC2) is 'financial' and includes the variables 'financial and tax-related reasons' (Q6B), 'motivation by private bodies' (Q1B) and 'financial reasons' (Q2). Finally, the third factor (PC3) is 'social' and includes the variables 'motivation by institutional bodies' (Q1A), 'reasons of recognition' (Q3) and 'reasons of trust in the relevant stakeholders' (Q4).

4.4. Description of citizen clusters

Following the application of Factor Analysis in order to extract the factors and examine the potential existence of individual citizen types in the original sample, Cluster Analysis was used. The application of cluster analysis provided two citizen types regarding the total number of reasons affecting citizens in proceeding with the installation of photovoltaic systems (Table 10). The solution with the above number of clusters was chosen as the best to describe installation of photovoltaic systems with the largest number of statistically significant differences. Table 10 provides the participation rate of each factor in the corresponding cluster. More specifically, the persons in CL1 present a strong environmental influence and a weak financial one, while the persons in CL2 present a weak social influence regarding the reasons that could motivate them to install photovoltaic systems.

The ANOVA table indicates which variables contribute the most to your cluster solution. Variables with large mean square errors provide the least help in differentiating between clusters. For example, the financial factor PC2 has the highest mean square error and the lowest *F* statistically. Therefore, this factor is not as significant as the other two factors in the formulation and differentiation of the clusters (Table 11).

In order to assess whether the citizen clusters have been ranked correctly in relation to the original variables, discriminant analysis was applied. Following the application of this method on the citizen clusters regarding the reasons that may affect them in installing photovoltaic systems, the analysis showed that the results are correctly ranked in 99.8% of the observations (Wilks' Lambda$=0.302$, $X^2=1121.35$, $df=3$, $p<0.001$).

Table 10
Mean factor loadings for each cluster in the case of expanding the total number of reasons that contribute to investments in photovoltaic systems.

	Environmental PC1	Financial PC 2	Social PC3
CL1 (38.5%)	1.014	0.200	−0.218
CL2 (61.5%)	−0.634	−0.12566	0.133

Table 9
Table with the factor loadings of the data prior to and following rotation, for all the reasons that contribute to investments in photovoltaic systems.

Variable	Factor loadings					
	Prior to rotation			Following rotation		
	1	2	3	1	2	3
Reasons of national interest (Q6A)	0.670	0.219	−0.556	**0.862**	−0.005	0.251
Environmental protection reasons (Q5)	0.692	−0.154	−0.527	**0.838**	0.278	0.007
Financial and tax-related reasons Q6B)	0.477	−0.586	0.343	0.011	**0.830**	−0.018
Motivation by private bodies (Q1B)	0.597	−0.319	0.213	0.197	**0.658**	0.178
Financial reasons (Q2)	0.816	−0.226	−0.024	0.523	**0.618**	0.249
Motivation by institutional bodies (Q1A)	0.388	0.681	0.133	0.169	−0.189	**0.754**
Reasons of recognition (Q3)	0.515	0.333	0.451	−0.012	0.262	**0.714**
Reasons of trust in the relevant stakeholders (Q4)	0.716	0.250	0.254	0.263	0.351	**0.668**

Table 11
Analysis of variance.

	Cluster		Error			
	Mean square	*df*	Mean square	*df*	*F*	Sig.
Environmental (PC1)	605.345	1	0.356	939	1698.525	0.000
Financial (PC 2)	23.765	1	0.976	939	24.356	0.000
Social (PC 3)	26.662	1	0.973	939	27.411	0.000

Table 12
Statistically significant differences of the two citizen clusters, in relation to the most significant research variables.

Variable	Scale	CL1 (38.5%)	CL2 (61.5%)
1. Willingness to invest in residential photovoltaic systems	Very much	6.6%	12.8%
	Much	10.5%	17.3%
	Adequate	21.5%	26.5%
	Little	36.7%	26.5%
	None	24.6%	16.8
2. Willingness to invest in photovoltaic systems in a plot of land	Very much	5.8%	9.4%
	Much	10.8%	16.7%
	Adequate	21.1%	17.8%
	Little	28.6%	23.3%
	None	33.6%	32.8%
3. Income	$<5{,}000$	10.2%	12.3%
	5,000–10,000	19.6%	15.5%
	10,001–20,000	14.4%	25.2%
	20,001–30,000	9.4%	8.8%
	$>30{,}000$	5.0%	8.8%
	No answer	41.4%	29.4%
4. Family status	Single	43.2%	39.3%
	Married	49.7%	53.7%
	Divorced (separated)	3.1%	5.1%
	Widow/er	4.0%	1.9%
5. Number of children	0	56.1%	48.0%
	1	11.9%	12.6%
	2	20.2%	27.3%
	3	7.7%	9.5%
	4 or more	4.2%	2.6%
6. Profession	Unemployed/Student	24.1%	21.1%
	Farmer–Fisherman–Pensioner	18.2%	10.8%
	Housework	8.4%	5.7%
	Private Employee	22.2%	27.6%
	Civil Servant	16.2%	19.7%
	Self-employed	10.9%	15.1%
7. Educational level	None—Some grades of Primary School	4.0%	0.3%
	Primary School	6.3%	3.1%
	Lower Secondary School	9.4%	6.1%
	Technical School	16.2%	13.3%
	Upper secondary School	19.9%	28.6%
	University/TEI	44.2%	49.1%
Total		100	100

The two citizen clusters provided statistically significant differences, after the X^2 test of independence was applied in relation to the variables: 'willingness to invest in residential photovoltaic systems and on a plot of land', 'income', 'family status', 'number of children', 'educational level' and 'profession', as regards the reasons that may affect them in installing photovoltaic systems (Table 12).

Regarding the socio-demographic characteristics of the two citizen clusters, and their relation to environmental issues and information-awareness (Table 12), the following conclusions were reached:

- The members of Cl1, which is the smallest cluster (38.5%), are relatively unwilling to invest both residentially and on a plot of land, and the reasons that make them sceptical about investing are mainly national and environmental. Most have a low income, many are single and those who are married have few children, almost one in three is either unemployed, a student or does housework, and they have a medium educational level.
- The members of Cl2, the largest cluster (61.5%), are more willing to invest in photovoltaics, mainly residentially. They seek motivation by institutional bodies, feel trust in the relevant stakeholders and would invest for reasons of recognition. One in four has an income of 10,000–20,000 euro, quite a few are married, half have 1–3 children, approximately half are private or public employees, and they are university or technical school graduates.

5. Discussion

This particular paper aims to depict the attitudes of Greek citizens on a series of issues related to investments in photovoltaic systems both residentially and on plots of land.

What the present research shows is that there is notable optimism and sufficient interest in investments in photovoltaic systems. The fact that there is such a widespread level of acceptance serves to indicate that Greek citizens either have a raised awareness on environmental protection issues or they consider the said investments to be profitable or both. The public's high level of awareness of RES applications is also confirmed by other studies (Kaldellis, 2005; Zografakis et al., 2010).

Other researchers state that solar power is attractive on a national policy level, since it can reduce national carbon dioxide emissions and contribute to GDP growth, by creating jobs and increasing people's income (Timilsina et al., 2000). This is particularly the case for Greece, which on the one hand offers solar power of approximately 1900 kW h per square metre (Kaldellis, 2008) and has several island regions with a high wind capacity (Tampakis et al., 2013); on the other hand, Greece also presents the highest rate of unemployment in Europe.

Until 2012, the wishes of Greek citizens fully corresponded with the country's goals for the development of renewable energy sources. The mass development of renewable energy sources was a top priority for Greece in order for it to comply with directive 2009/28/EC regarding the promotion of energy use from renewable sources by 2020. However, changes to the Greek legislative framework have meant that it no longer complies with the wishes of Greek citizens, who are interested in investing in photovoltaic systems. This is mainly due to the fact that the special RES account of LAGIE (Operator of the Greek Energy Market) presents a very large deficit. The Greek government only permits fast track investments by large multinational groups, and does not allow individual citizens to invest in electricity production from photovoltaic systems; it has also implemented a drastic reduction of the guaranteed prices and imposed additional taxation measures.

The financial deficit of LAGIE constitutes a major barrier for investments in renewable energy. According to figures presented by the former, the deficit of the RES account in April 2013 reached 380.56 mil euro and 336.65 mil euro in the previous month. In order to cover this deficit in the special RES account of LAGIE, and given the fact that the use of RES technologies has a beneficial effect on the whole Greek Electricity System, it has been proposed that the deficit be covered by all producers (conventional and RES). More specifically, according to a study by the Technical University of Crete, various alternative scenarios have been put forward in order to tackle the accumulating deficit more fairly: depending on the energy generated by each plant or the installed capacity of each plant, (a) to charge 30% of the accumulated deficit to RES and the remaining 70% to thermal power plants or (b) to charge 40% of the accumulated deficit to RES and the remaining 60% to thermal power plants or (c) to charge 50% of the accumulated deficit to RES and 50% to thermal power plants (http://www.energypress.gr/news/Analogistikh-meleth-gia-to-elleimma-toy-LAGHE-apo-to-Polytehneio-Krhths).

One tax measure that could potentially provide a financial incentive for small-scale technologies is linked to the elimination of taxes related to the sale of energy. In the case of the UK, for example, most technologies involved in the generation of energy on a limited level are not charged the full VAT rate of 17.5% but only 5% (West et al., 2010).

Moreover, along with the above-mentioned alternative proposals, efforts should also be made to extend the validity period of RES station operating licenses, and of the relevant sales contracts for the energy generated by at least 5 years, i.e. from 25 to 30 years for photovoltaic stations, and from 20 to 25 years for other RES. At the same time, the State should take action to successfully intervene with Banks so that they provide investors with the possibility to accordingly extend the duration of bank loans for RES investments-projects (http://www.energypress.gr/news/Analogistikh-meleth-gia-to-elleimma-toy-LAGHE-apo-to-Polytehneio-Krhths). If the above-mentioned measures are implemented, then the deficit will be addressed and will no longer act as a barrier to RES investments.

There are of course some people (20%) who oppose investments in photovoltaics residentially or on plots of land (33%). The reasons that possibly discourage them are related to landscape aesthetics (Tsoutsos et al., 2005), ownership of a plot and the financing of their project. The family environment is a major source of information and decisions, both for those who want to invest on plots of land and for those who want to invest residentially. Thus, bodies related to energy should pay particular attention to their communication with the public; they should also take the family environment seriously into account, since it significantly affects energy investments. The next most important way to obtain information is through the Internet and through information leaflets from companies, for those who want to invest residentially, and through banks and books, for those who want to invest on plots of land. Recent papers also highlight the need for broader consultations and improved communication practices among decision-making bodies, technical experts, other stakeholders and the public (Owens and Driffill, 2008). In addition, Islam (2014) has pointed out that the relevant awareness-raising efforts should not only focus on technological data but also provide information to the public concerning investment requirements, feed-in tariffs and the impact on the environment.

A major sector that needs to be examined mainly in the case of Greece is the attitude of tourists visiting the country, since Greek governments attach great importance to the development of tourism. The latter is the main driving engine for the country, and there is also a desire to attract high-income tourists to Greece. Tourists from countries where there is raised awareness on energy issues are the most willing to select and pay for hotels using RES. A significant proposal for hotels that have invested in the energy sector is for them to promote their energy-related advantages, in order to attract high-income tourists, and also to influence tour operators, who evaluate and rank hotels that have invested in renewable energy sources and energy efficiency measures (Tsagarakis et al., 2011).

Finally, the development of renewable energy sources can be promoted as a very promising method for resolving rural energy-related issues and for improving the living conditions of the rural population. More specifically, if agricultural investments are to be made in such areas, and it is not possible or economical for the public grid to reach them, then RES can provide a very good alternative. In no case, however, should these installations take place on fertile, arable soil, which means that governments need to pay attention to the siting of RES.

6. Conclusions

This particular research aimed to examine the attitudes and views of citizens regarding their willingness to install photovoltaic systems; it was conducted all over Greece from December 2011 to February 2012. It is considered a particularly significant study, due to the remarkable advantages solar energy production presents for Greece. The latter is the most affordable technology that can exploit sunshine for the production of electricity. Its affordable cost may also improve the price of electricity from the grid (Tian et al., 2007). From the research results, we observe that Greek citizens state that they are adequately informed and sufficiently willing to invest in photovoltaic systems either residentially or on a plot of land. They obtain information on photovoltaic systems mainly from the Internet and their family environment and friends. The Internet and their family environment are the means that mostly affect their decision to invest in residential photovoltaic systems, and the family environment and mainly banks are the means that mostly affect their decision, when they intend to invest in photovoltaic systems on plots of land.

One of the most important objectives of this study was to provide a link between the reasons that may influence citizens regarding the installation of photovoltaic systems. The emerging factors combine reasons of national interest with environmental protection. Citizens who are relatively unwilling to invest either residentially or on a plot of land, mainly have a low income, are unemployed, students or do housework, and have a medium educational level. Those who seek motivation by private bodies to install photovoltaics would make the investment for financial reasons. Finally, those who seek motivation by institutional bodies, show trust in the relevant stakeholders and would make the investment for reasons of recognition. Those citizens who are more willing to invest in photovoltaics have a mid-level income, are either private or public employees, and approximately half are university or technical school graduates.

For the above reasons, these conclusions are very useful both for the scientific community for a further review and continuation of the research, and for those who are involved in energy planning. The emerging results reflect the reality that pervades Greek society and at the same time provide the Greek state with the opportunity to make decisions both in relation to policy planning in the field of energy, and to environmental protection. Great importance should be given to the communication strategies used, due to the differentiations that exist between the characteristics of those citizens who wish to invest. Furthermore, the Greek state should seriously consider the positive interest of citizens to invest in photovoltaic systems and suitably adapt the relevant legislative framework. First, the state should proceed with lifting the ban regarding the issuance of new licenses for photovoltaic systems, and take relevant measures to restore interest in the marketplace. Such measures could include a rationalized approach towards feed-in tariffs (Danchev et al.,2010; Karteris and Papadopoulos, 2013; Islam, 2014) through the elaboration of actuarial studies, and offsetting the energy generated against the energy consumed, using household energy as a pilot project. Furthermore, although the targets set for solar power for 2020 have already been reached, other RES continue to present a delay, which means that in order to achieve the required energy mix, a larger share could be attributed to photovoltaic systems. The success of these objectives is motivated by the strong interest of Greek investors and the potential of each technology. The state should also modify the

Special Spatial Planning and Sustainable Development Framework for RES of 2008 rather than suspend new licenses. To conclude, due to the obvious desire for investments, the state could reconstruct the electricity transmission system in downgraded, barren regions, in order to be able to transfer RES loads and avoid any problems affecting the ADMIE SA-Independent Power Transmission Operator (ADMIE) SA (2013)—http://www.admie.gr/nc/en/home/).

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