# DEPICTION AND ANALYSIS OF INDIVIDUAL BEHAVIOR RELATED TO ENERGY SAVING AND RENEWABLE SOURCES: A CASE STUDYFOR ATHENS, GREECE.

**HATZIGEORGIOU E.[1], STEFANOU J. and VLONDAKIS G.**

EXERGIA, Energy and Environment Consultants S.A.,
Omirou Str & Vissarionos 1, 106 72 Athens-Greece

## ABSTRACT

The paper develops and applies a methodological framework for the depiction of individual behavior for energy saving and renewable energy sources (RES) using a questionnaire. Initially, a literature review is realized through scientific papers and other sources. The findings of recent surveys suggest that public support for RES projects and energy saving attitudes is general high.

Subsequently, the methodological framework is presented and the proposed procedure is analyzed. The questionnaire is formulated and distributed in the Greek city of Athens, both to local people and particular decision makers. Each questionnaire has twenty nine (29) closed-type or multiple choice questions, divided into three groups: 1. Energy saving and rational use of energy, 2. Public acceptance of RES and 3. General information. The questionnaires were, initially, orientated to evaluate the level of information of local residents about energy saving, rational use of energy and renewable energy technologies. The number of distributed questionnaires was 85.

Then, the questionnaires were gathered and analyzed statistically, using the software tools SPSS and EXCEL. The results of the descriptive statistics show high levels of acceptability (60%) for Photovoltaic (PV) applications, concerned with energy production in the domestic sector. It is noteworthy, that only a small minority (1%) of participants expressed negative opinion towards PV systems. In addition, the improvements of energy performance in buildings are suggested as the most effective factor for energy saving. Following, a regression analysis of selected variables is carried out via chi-square test. The obtained results reveal that the sample opinion towards to the energy production from PVs is statistically independent with the average annual income of participants. Finally, the conclusions are presented together with relevant proposals for further investigation.

**Keywords**: Energy Saving, Renewable Energy Sources, Individual Behavior, Statistical Independence Analysis, Greece

## 1. Introduction

In case of Greece several studies, in recent years, have analyzed the public attitudes towards existing or new energy projects in different areas. A typical example of such a research is the study of Kaldellis *et al*, (2013), which was carried out in Northern Greece. According to the results of this study, the 85% of respondents express a positive attitude towards applications of photovoltaic systems, both on domestic and on industrial scale. Other researchers examined factors that form public attitudes regarding to new renewable energy sources' (RES) projects, focusing on the reduction of the land value, the amount of the offsets for local communities, and the type of investor (Malesios and Arabatzis, 2010; Oikonomou *et al*, 2013).

The academic literature on what drives household's energy- saving behavior has increased significantly over the past years. Recent studies, along with the usual variables which are related to demographics factors and characteristics of the dwelling, (Sardianou and Genoudi, 2013), are

[1]Tel: 210-6996185, Email: office@exergia.gr

trying to incorporate in their analysis the role of information (Ek and Soederholm, 2010), the overall friendly behavior to the environment (Martinsson *et al*, 2011) and a number of psychological factors (Botetzagias *et al*, 2014; Webb *et al*, 2013).

More recently, Hatzigeorgiou *et al*, (2014) developed a methodological framework for the analysis of the individual behavior towards energy saving projects and renewable energy technologies by using a questionnaire. The authors implemented their framework in the case-study of the island of Lesvos, Greece.

Our paper develops as follows. In the next section the proposed methodological framework is presented and then the results of the study are depicted in Section 3. In the concluding Section 4 we discuss the findings, that emerged from this study and we make recommendations for further research.

## 2. Methodological framework

The data for this study were collected in the municipality of Athens, during the period between January and March 2014, based on a representative sample of one hundred (100) local habitants. The proposed methodology is based on the development of an integrated and coherent set of questions which will provide a holistic depiction of individual behavior on energy saving and rational use of energy, in the residential sector. Individual preference on RES technologies was examined. Each questionnaire has twenty nine (29) closed-type or multiple choice questions, divided into three groups: 1. Energy saving and rational use of energy, 2. Public acceptance of RES and 3. General information.

The results were analyzed via the SPSS and the EXCEL software tools to export descriptive statistics related to the people attitude towards RES applications and the reduction of $CO_2$ emissions by adopting energy saving techniques in both domestic and local level. Moreover, a combinatorial analysis of selected variables is carried out through the $X^2$statistical independence test.

## 3. Results

### 3.1. Energy saving and rational use of energy

Some of the results that are relevant to public attitudes towards energy saving and rational use of energy are presented in Figures1, 2, 3.

According to the obtained results:

- 25% of the households are using heating system that is older than 10 years.
- 32% of the sample considers the price as the main criterion for the selection of a domestic electrical device.
- The interventions in buildings are the most decisive factor for energy saving.

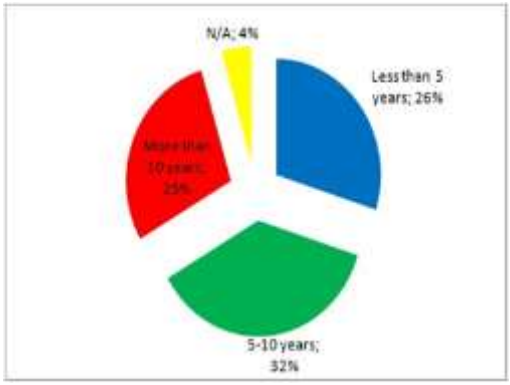


**Figure 1:** Age of the heating system used in resident.

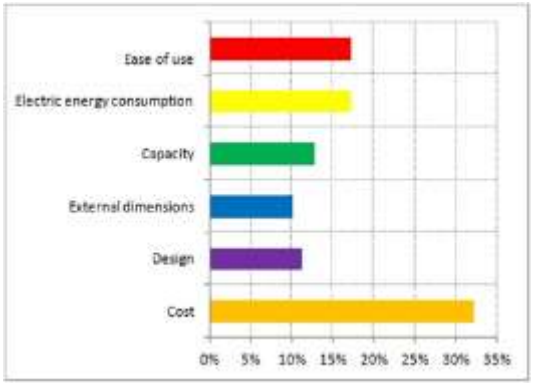


**Figure 2:** Criteria for selecting a domestic electrical device.

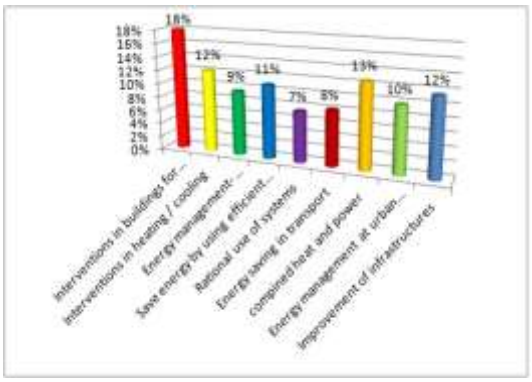


**Figure 3:** The most important technologies considered for energy saving and rational use of energy.

### 3.2. Individual preference on RES technologies

The public attitude towards RES applications is depicted in Figures 4, 5, 6.

According to the Figures 4, 5, 6:

- Public attitude towards PV applications is quite supportive (60%).
- 23% of the respondents expressed that the high cost and the inadequate financing of RES investments are the main obstacles for new projects.
- 58% of people participating in the survey have positive attitude towards the prospect of installation of new RES projects in the form of public investment.

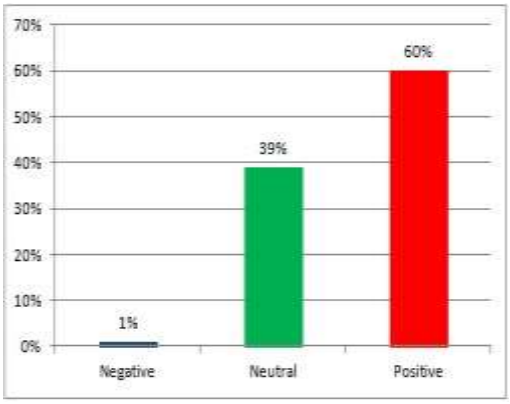


**Figure 4:** Attitude of the sample towards the electricity

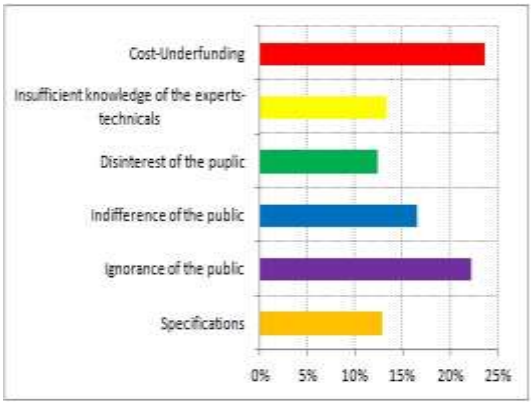


**Figure 5**: Obstacles to implementing RES systems production from PV systems in resident.

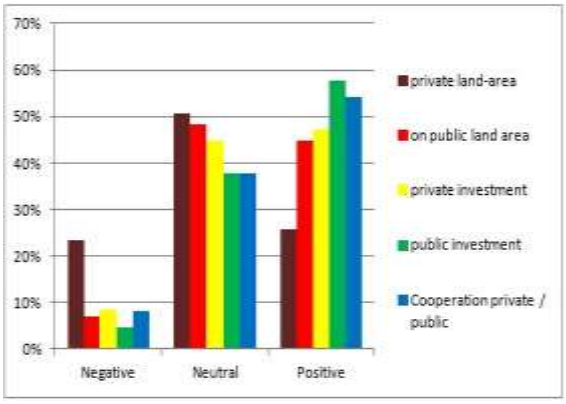


**Figure 6:** Public opinion towards new RES projects in different areas.

### 3.3. Statistical independence of selected variables

The following Tables 1, 2 present the results of statistical independence, using the $X^2$test.

**Table 1:** Statistical independence between the age of the heating system and the average annual income.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 2,017 | 6 | 0,918 |
| LikelihoodRatio | 2,394 | 6 | 0,880 |
| N of Valid Cases | 85 | | |

**Table 2:** Statistical independence between perception for energy production from PV systems and the average annual income

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 3,993 | 4 | 0,407 |
| LikelihoodRatio | 4,399 | 4 | 0,355 |
| N of Valid Cases | 85 | | |

According to Tables 1 and 2 the sample opinion towards to energy production from PVs and the age of the heating system are statistically independent with the average annual income of participants. This means that the households which have a high annual income do not present the necessary need for implementation of alternative heating systems on their residents or PV systems for the electricity production.

## 4. Conclusions

The present paper develops and applies a questionnaire survey for the depiction of individual behavior for energy saving and renewable energy sources (RES). Initially, a literature review is realized through scientific papers and other sources. The findings of recent surveys suggest that public support for RES projects and energy saving attitudes is general high.

Although the sample used in this article is relatively low, the initial assessment arising from the present study, is that the majority of the sample recognizes the positive impacts of energy saving and rational use of energy. Moreover, high levels of acceptability for existing and new RES projects have been recorded. The authors suggest for further analysis the comparative evaluation of different case studies in Greece, by employing larger sample –to-population ratio and integrated statistical models. These models could incorporate useful economic and environmental parameters for interpretation of household energy-saving behaviors.

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