



## Citizens' views on electricity use, savings and production from renewable energy sources: A case study from a Greek island



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### ABSTRACT

A country's economic growth is closely linked to the availability, generation, distribution and use of energy. At the same time, the increased rate of global energy consumption is a risk to development and to the efforts to safeguard people's living standards for the future. The production of electricity from RES substantially contributes to the energy security of states and to environmental protection. Greece has a valuable and exploitable potential in several RES and can significantly increase their use. However, various significant institutional changes have taken place in Greece over the last decades involving changes to the energy mix, the penetration of RES and attracting foreign investment.

The present research took place on the island of Andros, Greece, with the help of a questionnaire and face-to-face interviews. It is noted that the respondents agree with the need to save energy and to expand the use of green energy. They say they are slightly satisfied by the messages given through the Mass Media. They have insufficient information regarding RES systems that can be used in households and believe that a major subsidy from the state would lead to their purchase.

### 1. Introduction

Energy and more specifically the renewable energy sources play a key role in economic growth [1,2]. Energy consumption is vital for human survival and one of the basic indicators for economic development [3]. This fact is also compounded by the current rapid economic growth, which has led to a rise in energy requirements, and an increase in the use of fossil fuels and the level of CO<sub>2</sub> emissions [4]. With no mitigation policies for climate change, it is estimated that global greenhouse gas emissions will rise by 25–90% in comparison to the levels in 2000 [5].

It is estimated that, between 2010 and 2040, global energy consumption will increase by 56%, with a significant energy consumption increase (90%) expected in non-OECD countries; in OECD countries, the increase is expected to reach 17% [6].

The reduction in energy dependence through a change in energy supply sources and the use of suitable energy saving policies are part of the EU strategy. A major role to this end is played by RES, which can contribute to sustainable development and boost the economy [7]. More specifically, in recent years, the development of renewable energy sources has been more rapid in developing, non-OECD countries.

Between 2004 and 2014, global investments in renewable energy sources increased from 45 bn to 270 bn dollars, with China featuring the highest investments in 2014 (83.3 bn dollars) [8].

The establishment of a suitable investment climate, the development of know-how, and the lifting of economic and political barriers are some of the most important steps required for the development of renewable energy sources [9].

The benefits from the efficient use of energy do not only include a reduction in greenhouse gases on a local level but also a reduction of investments in energy infrastructure and in dependence on fossil fuels, along with increased competitiveness and prosperity for consumers [10].

Education can play a significant role in the formulation of an energy-related, environmental behavior [11]. More specifically, education plays an important role in energy savings and in the reduction of greenhouse gas emissions through the development of targeted educational activities that focus on the knowledge, attitudes and behavior of students, as regards shaping their energy awareness with sustainable development as the goal [12,13]. The public positively views the framework 'Energy Savings and Renewable Energy Sources' on an individual level, but do not have sufficient information on the topic.

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What is noted, is the fact that the public expects more interventions by the State and more information from the Mass Media, while expecting less from the local community; another important parameter is the cost and financing of technologies and investments [14].

The above observations point to the necessity of a national public awareness strategy, which will include campaigns from the mass media and the press, along with information on energy-saving techniques and RES technologies, that can be applied on an individual, local and national level. The present survey also has a similar focus, its aim being to present the views of the citizens of Andros, on a series of issues related to the use and saving of electricity, and the production of alternative forms of energy.

The conclusions of the survey will comprise an important tool both for its continuation and for policy-makers, in order for them to map out a more effective policy on a local and national level. The study of citizens' views both in the present survey and in a similar social survey conducted by Zografakis et al. [15] in Crete, at this critical period of the economic crisis in Greece, can constitute a starting point and an essential tool for authorities, so that they adapt their decisions to the new state of affairs in accordance with the protection and development of energy resources.

## 2. Literature review

The Renewable Energy Directive, officially coded as 2009/28/EC, defines an overall policy for energy production from RES within Europe. The guidelines forces European Member States to cover at least 20% of their total energy needs by renewables by 2020. Furthermore European countries recently agreed to a new 2030 framework on climate and energy, which imposes at least a 27% share of Renewable Energy consumption [16,17].

The most important energy strategies for sustainable development should not only include replacing fossil fuels with RES and a gradual incorporation of RES into the energy system but also energy savings and improvements to the energy production system [18–22].

Nevertheless, citizens' attitudes and perceptions are the key to achieving the energy objectives set on each occasion. More specifically, at times of economic, energy and environmental crisis, energy savings and the efficient use of energy comprise a major policy choice in order to achieve socio-economic and environmental goals [23,24]. Such policies should be viewed as a means towards a better distribution of obsolete resources, for improving the environment or reducing energy dependence, and not as an end in itself. Thus, if the main objective is to improve the environment, then priority should be given to policies that directly aim at reducing environmental impact, such as environmental taxes [25]. In order for such policies and energy planning to succeed, it is essential to replace the current economic model with a public participatory system, since people play a fundamental role both in addressing climate change and in the development and inclusion of RES in modern societies [26,27].

Nevertheless, Katsaprakakis and Christakis [28] have stated that the example of Greece should be viewed as a cautionary tale due to the unregulated policy followed by investors regarding the construction of electricity production projects using RES; the latter exhibit a low level of maturity characterized by violation constraints, the disapproval of local communities and a lack of RES.

The study of energy use by households and consumers has been a great challenge and opportunity in recent years for researchers, professionals active in the energy sector and policy makers [29].

Therefore, energy demand continues to increase and the need arises to re-evaluate energy-saving methods, on a level of political action [30] and through rational use. The latter will lead to a consumption of only the required amounts of energy, a reduction in losses and wastage, and therefore energy savings. In this way, less energy can be produced and subsequently fewer energy resources will be consumed and smaller quantities of pollutants emitted [31].

Reducing energy consumption can be achieved through a programme aiming at energy-efficient behavior. Such a programme is usually related to the energy behavior of people living in buildings, i.e. involving the energy that is consumed internally and externally in buildings, for the production of which solar and thermal energy is used. Whenever energy is consumed, a percentage of the provided energy is used for the required purpose, but a large amount is lost. Reducing these losses would mean more usable energy and therefore less consumed energy [32]. The transition to a sustainable future requires major behavioral changes, which could affect almost all aspects of human activity. A lot of research had been done all over the world on this topic [33–35], especially in Europe [15,28,36,37]. There is a great variety of incentive policies used for energy-saving purposes among countries [38].

In a study by Thøgersen [39], that was carried out in 10 European countries, it was found that there are differences from country to country, as regards their citizens' everyday behavior in relation to energy-saving objectives. Furthermore, the same study observed that housing-related lifestyle (HRL) segmentation can be a useful tool for the creation of more targeted and effective energy-saving campaigns.

Several studies have also explained the energy behavior of humans using models borrowed from the field of psychology which focus on individual behavior [40].

Energy saving and its rational use equal a reduction in energy wastage, without however limiting the constantly increasing human needs and comforts. A characteristic example is that in Greece in 1950, the annual energy consumption was 70 kWh per person, and 53 years later, it was estimated at 4000 kWh per person. The household sector is known to be one of the most important energy consumers and is directly accountable for approximately 30% of total carbon dioxide emissions. Any efforts to reduce energy wastage at home can be reinforced through education addressed to adolescents within a school environment, since they are members of a family which consumes energy for its various activities.

Several factors influence energy saving on a household level. The first factor is knowledge of the possible ways to reduce energy consumption, the second are energy-saving incentives, and the third is the adoption of energy-efficient behavior [41]. Environmental information, knowledge, feedback and energy awareness also comprise important factors regarding consumer behavior in relation to energy savings [42]. Citizen behavior regarding energy savings can be divided into two major categories according to a relevant study: habitual actions (e.g. adapted behavior, change in energy use habits) and purchase-consumption behavior (e.g. use of energy efficient technologies) [43,44].

New, high, energy-efficient technologies do not effectively resolve the problem of energy savings, but changes in consumer behavior do contribute towards environmental protection and a reduction in greenhouse gases [45]. Energy efficiency is quite a broad term. The Green Paper defines two sectors: better use of energy through improved energy-efficient technologies and energy savings through changes in consumer awareness and behavior. Until recently, it was believed that energy efficiency was mainly related to technology, i.e. using optimum technology that will consume less energy, as regards supply or demand. Relevant examples include changing an old household boiler for a new one that consumes a third less energy, using low-energy light bulbs and not leaving household appliances on standby. The increased use of standby for electrical appliances actually increases energy bills in households by up to 10%. Changes to consumer behavior should be driven by increasing public awareness about the benefits of energy savings, both for the individual and for society.

Improving energy efficiency does not only reduce costs and improve sustainability, but is also an opportunity to support economic development and create jobs [46]. In addition, it does not imply that citizens must give up or limit activities in order to save energy. On the contrary, new technologies and a more targeted behavior will actually allow

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