"Can the sunshine be enough? An evaluation of the Greek Photovoltaic Rooftop Program according to sustainability science"

A Master Thesis

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Abstract

Climate change is one of the most challenging issues humanity has been called to battle. The European Union has already voted for a specific energy scheme to reduce its carbon dioxide emissions. The scheme targets into a 20% reduction in its greenhouse gas emissions by the year 2020. One of the steps Greece has taken to promote this effort and reach the goals set by the European Union, is to bring about the use of photovoltaic systems by initiating various policies and incentives. One of the strategies that the Greek government has put forward is the FO.S program that started in June 2009. The program is following the example set by similar projects in Germany, Spain and Italy and it focuses on the integration of photovoltaic panels on household and small businesses rooftops.This research makes an attempt to identify the challenges the particular program has been facing during its short term implementation, assess how it has been working until now, answer whether and how it reaches out to the public and to which extend it accomplishes its initial goals. The analysis of the findings is performed firstly in relation to the basic criteria for the evaluation of an environmental policy. The second part of the analysis gives an overview of the Greek Solar Thermal Market development, a story of an innovative, friendly to the environment technology, that the last 30 years has had a rather succesful turnout. In the following part the FO.S program is compared to the solar thermal market case. The comparison provides a useful insight of what could be done better in order for the program to achive better results. The last part of the analysis section focuses on relating the program in evaluation to sustainability science.

Key words: photovoltaics, rooftop program, evaluation, sustainability, transition theory

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SECTION A

INTRODUCTION

The European Union is committed to increasing the use of renewable energy across Europe. One of the ways this is to be done is through the promotion of solar Photovoltaics (PV), a technology that converts directly solar energy into electricity thus a method with significant environmental benefits (Spratley: 1998). Greece is among the European countries with the higher solar irradiation ratios throughout the year; annually an average of 4.4 kWh/m² (Celik: 2009) reaches the country's surface. The generation of electricity from solar Photovoltaics can add significantly to the country's effort to reduce its carbon emissions. Therefore the development of PV installations could contribute positively to the battle against climate change. Additionally the production of electricity from such a source facilitates the country to reach the goals that are set by the European Union for a 20 % reduction of its carbon emissions and a 20% ratio of Renewable Sources of Energy penetration in Europe's energy mix until the year 2020 (EU, Impact assessment: 2008).

To promote this effort, the Greek government has been trying to bring forward the use of PV systems by initiating various policies and incentives. Despite the promotion the sector has gained the last years the market has not yet found its pace towards a steady growth. Policies as said exist but they do not function. One of the major drawbacks identified by the stakeholders involved in the PV sector is the long bureaucratic procedure than an interested party has to pass through to finalise a project.

Despite this common knowledge on the gaps that Greek policies suffer in general, authoritative researches on the discovering the reasons the policies malfunction rarely take place. In Greece policy evaluation is almost non-existent (Spyropoulos: 2010). The necessity therefore for concrete evaluation strategies that would depict the faults in the public policy sector and the administrative forces that realize them seems more urgent now than ever. Environmental policy is a relatively new area of policy in Greece[1] hence environmental policy evaluation. One of the strategies that the Greek

[1] The Greek Ministry for the Environment, Energy and Climate Change was formed in October 2009. Environmental policies before the formation of the specified Ministry were carried out from the

government has put forward is the "FO.S"[2] program that started in June 2009. The program is following the example set by similar projects in Germany, Spain and Italy and it focuses on the integration of photovoltaic panels on the rooftops of households and small businesses.

This research attempts to use an evaluation framework as a means to identify the challenges the particular program has been facing during its short term implementation, assess how it has been working until now, answer whether and how it reaches out to the public and to which extend it accomplishes its initial goals.

SCOPE

The initial intention starting this project was to present a holistic analysis of the barriers that the Greek Photovoltaic market was facing towards its development. After the first attempts to go through the legislative and financial schemes that rule the market and the first interviews with the different stakeholders and policy makers the author came to the conclusion that the market involved many different programs that aimed at different scales of PV installations that it was impossible to cover all of the varying aspects into the limited space of the particular master thesis. Therefore instead of analyzing the barriers and challenges that the whole Greek PV policy and industry framework is currently facing the author decided to narrow down the scope of the thesis to the detection of the challenges that a specific PV program, the FO.S program, which is part of the Greek PV policy context, could encounter during its implementation.

OBJECTIVE

This thesis research seeks centrally to reveal the challenges, the obstacles, the missing points that the Greek Program FO.S has been encountering throughout its short period of implementation. Furthermore the target of the research is to come upon knowledge on how information about the project is diffused and whether the results the project has brought on can be considered positive or negative.

Ministry of Development and the Ministry of Physical Planning and Public Works. Policies were in place but they lacked of substantial implementation.

[2] The word FOS in Greek means light and the program's name is an abbreviation for the words "fotovoltaica" and "steges" which mean accordingly "photovoltaics" and "rooftops".

A side effect objective of the thesis is to examine whether the policy can be placed within the conceptual frameworks that are mentioned in the section below. In other words this thesis seeks to identify whether the paradigms outlined can find a useful application in this particular policy context. An attempt to number some recommendations on how the program can be improved, using this theoretical background will also be made in the final stage of the thesis. The report could be used by the stakeholders in the sector and the administrative forces involved in the design and the implementation of the policy.

The two following sections outline the research questions that needed to be formulated to support the research design made based on the central thesis objective.

1. Main research question

"Which are the challenges that the Greek FOS program has been facing during its implementation?"

2. Additional research questions

1. *Does the program accomplish at any rate its initial goals?*
2. *Can the policy application be regarded as successful?*
3. *How does the information about the program reach the public?*
4. *How could the program be improved to achieve better results?*

RESEARCH DESIGN

1. CONCEPTUAL FRAMEWORK

The syllogism behind the selection of the project design is based on some core hypotheses. The diffusion of the PV technology in Greece is not great. Only 0.2 % of the Europe's installed capacity is represented by the Greek market (PPC: 2009). The contradicting fact is that already from 1999 there have been policies in place in order to promote the diffusion, usage and installation of the particular technology in order for the country to meet its sustainability goals. The legislative and financial schemes, the contracts signed with the government and the main electricity supplier, the Public Power Corporation (PPC), seem extremely favorable- especially in comparison to other European countries that have already developed a flourishing photovoltaic market. A possible and simplified explanation would be the fact that bureaucracy strolls the implementation of the policies in Greece; indeed during the beginning of

the research the author realized that one, a company for instance or a natural person, has to go through a long and burdensome bureaucratic procedure to install a PV station of more than 10kW. What if there was a policy that the individual did not have to go through a long bureaucratic process?

The Greek policy makers realizing the essentiality to reduce it designed the FO.S. program bearing this obstacle in mind. Their consideration seems to have resulted in a relatively concrete policy with a less bureaucratic procedure. However an early research on the program indicated a slow development of the sector despite the apparent favorable conditions. Consequently one could argue that there is a problem in implementing the policies appropriately. There must be some gaps, mishaps, lack of knowledge and information diffusion, lack of different kind of incentives or variables that have not been taken into consideration and the policy does not function the way it was expected to do so.

It is very important to state at this point that the FO.S program is seen in this conceptual framework as part of a wider environmental policy effort that its ultimate goal is to limit the effects that global warming causes. How could someone identify the challenges and barriers that an environmental policy as the FO.S program, might encounter during the effort of its implementation? Which are the frameworks that need to be used to provide a spherical analysis and pinpoint the specifications that are not taken into account?

The sections below provide the theoretical background that ought, according to the premises of this Master on Environmental Studies and Sustainability Science, to be utilized.

1.1. The environmental evaluation as a means to investigate a policy outcome

Scientists working within the research fields of environmental economics, environmental politics and environmental studies in general, often stress the need and argue for the importance of the evaluation of environmental policies (Mickwitz: 2003). The 6th Environmental Action Program for the European Union (1600/2002/EC), which was adopted in June 2002, defines the task of evaluating policies. Paragraph c in Article 10 affirms that “the objectives shall be pursued by improvement of the process of policy making through:

- ex ante evaluations of the possible impacts, in particular the environmental impacts, of new policies including the alternative of no action and the proposal for legislation and publication of the results;

- ex post evaluation of the effectiveness of existing measures in meeting their environmental objectives. (European Parliament and the Council of the European Union, 2002)

Evert Vedung (1997) defined evaluation as '*careful retrospective assessment of the merit, worth and value of administration, output and outcome of government interventions, which is intended to play a role in future, practical action situations.'*

A certain type of evaluation that has become popular during the last years is the evaluation of Recently Introduced Policy Instruments (RIPI). The particular evaluation frame is different from the typical ex post evaluation due to the fact that conclusions and expected effects are usually unavailable during the short time of the policy's implementation (Kautto and Similä, 2002). The RIPI evaluation is also different from an ex ante evaluation. The difference lies on the fact that an ex ante evaluation strives usually to foresee the possible outcomes of a policy while RIPI often incorporates implementation practices and hypotheses that can be tested based on already existing experiences. Therefore RIPI evaluations can be used effectively to promote a change in a strategy that has not been implemented for a long time and alter a negative outcome the time that the policy instrument is realized to malfunction (Mickwitz: 2003).

A parameter that needs to be addressed at this point is the complexity that an environmental problem and consequently an environmental policy that aims at reducing its impacts might entail. The issue of climate change that is addressed with the policy in question is a rather multifaceted problem. It encloses uncertainty; its time frame is rather long, its effects concern geographically remote areas and both its causes and consequences are unequally distributed. Its complexity increases if the complex human, social, technical and economic interactions involved are taken into account (Mickwitz: 2003). Thus some basic criteria are necessary to be numbered in order for the evaluation to remain focused. Table 1 summarizes the most basic criteria that need to be considered during the evaluation of an environmental policy.

Criteria	*Related questions*
Relevance	Do the goals of the instruments cover key environmental problems? On a general level this criterion is trivial, but specific norms or rules can be questioned using this criterion.
Impact	Is it possible to identify impacts that are clearly due to the policy instruments and their implementation? All impacts may be considered in the light of this criterion, irrespective of their occurrence inside or outside the target area.
Effectiveness	To what degree do the achieved outcomes correspond to the intended goals of the policy instrument? Similarly, the effectiveness of reaching other public goals can also be assessed as long as these are first identified.
Persistence	Are the effects persistent in such a way that they have a lasting effect on the state of the environment? The effects outside the target area and the unintended effects that may create new problems can also be considered via this criterion.
Flexibility	Can the policy instrument cope with changing conditions?
Predictability	Is it possible to foresee the administration, outputs and outcomes of the policy instrument? Is it thus possible for those regulated, as well as others, to prepare and take into account the policy instrument and its implications?

Table 1. The basic criteria for the evaluation of an environmental policy
Source: Mickwitz, 2003

This thesis research is conducted baring in mind the positive outcomes that a goal free RIPI evaluation could offer since the FO.S program is a newly introduced policy and its full effects cannot be criticized or foreseen with either an ex ante or an ex post evaluation. The hypotheses outlined in the previous section form a conceptual framework that goes through a reality investigation in order to determine either their validity or their falsification. A comparison with a successful case of innovative and environmental friendly technology in Greece such as development of the solar thermal market, which has similar characteristics to the program in exploration, will provide in the analysis section an additional constructive insight of what could be improved in order for the instrument to achieve better results and

1.2. Sustainability Science

Sustainability science is a problem driven science. It can be broadly defined as a trans-disciplinary framework that seeks to reveal the relations between nature and the interaction it has with people (Kates et al: 2001). It is a paradigm that supports the integration of multiple aspects of a society in order to effectively tackle a challenge. The progress that is driven by the interaction between human society and the natural

environment is called sustainable development. It becomes clear that sustainability science offers the theoretical frame and sustainable development becomes its actual application.

Despite the fact that the field has been facing severe and continuous criticism for the vagueness of its core definition, the sustainability science framework proffers the opportunity to the researcher to combine knowledge from all relevant disciplines that can be encountered during the analysis of a particular problem. Therefore the field can progress a holistic approach to a problem that is being investigated. Its concept allows the scientist in research to focus on a particular problem and look at the very many different angles and point of views that exist and propose a multilevel analysis that reaches the values of participatory communication encountered in Habermas' sociological theorems (Farej: 2009).

This thesis focuses on a particular problem; the challenges that the Greek rooftop photovoltaic project faces its last year of implementation. The program appears to involve an interesting interaction of all three aspects sustainable development entails; it combines an economic activity that reaches the very basis of society and targets to the production of electricity from a renewable source of energy to curve the consequences climate change causes to the natural environment, by reducing Greece's carbon dioxide emissions. As phrased in the resolution that was published by the Ministry of Development, the decision to form the FO.S. program was derived by the fact that the "*the placement of very small photovoltaic systems on buildings would contribute to the realization of the goal of penetration of renewable sources of energy in the energy mix with the active participation of the citizens..*"(JMD: 2009). This thesis research will make an attempt to identify the connection the FO.S program has with sustainable development.

2. METHODOLOGY

The thesis report is based on a qualitative social research outline (Bryman: 2004). Qualitative research can be defined as a broad approach to the study of social phenomena .Despite the fact that qualitative research genres are numerous and the methodological means used by the researcher in each case are different, there are some common considerations and procedures for its conduct. *"A qualitative research*

is inspired by the complexity of social interactions in the daily life and by the meaning that the participants themselves attribute to these interactions" (Marshall& Rossman: 2006). Qualitative researches are carried out in natural settings rather than in a scientific laboratory and attempt to promote pragmatism in using multiple methods for exploring a topic. Therefore they are practical, interpretive and grounded in the experiences people have in their daily lives (Rossman &Rallis: 2003). This thesis research design utilizes the framework of a qualitative study to explore the case of the FO.S program. It tries to depict the complexities that are encountered in the policy by focusing in the attributes made by the various stakeholders involved in it.

During the collection of evidence the method of triangulation was used. According to Bryman (2004) this method "*refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings"*. An additional purpose of the method is to increase the credibility and validity of the results (Silverman: 2003). Denzin (1970) distinguished four different types of triangulation:

1. ***Data triangulation****, which entails gathering data through several sampling strategies, so that slices of data at different times and social situations, as well as on a variety of people, are gathered.*
2. ***Investigator triangulation****, which refers to the use of more than one researcher in the field to gather and interpret data.*
3. ***Theoretical triangulation****, which refers to the use of more than one theoretical position in interpreting data.*
4. ***Methodological triangulation****, which refers to the use of more than one method for gathering data.*

Three of these four types of triangulation are used in this research.

Data triangulation refers to the compilation of data from a variety of sources. According to Yin (2003) six sources of evidence can be the focus of data collection: documentation, archival records, interviews, direct observations, participant-observation and physical artifacts. Apart from the participant observation and the gather of physical artifacts the rest of the sources of evidence outlined were utilized.

Official documents, archival records, books, scientific articles as well as reports retrieved from the eligible electronic sites of the Greek government, the European

Union, the International Energy Agency (IEA) and the European Photovoltaic Industry Association (EPIA) were used to outline the literature review.

To seek answers to the main and the additional research questions the author used the method of interview. In order to obtain a wide spectrum of perspectives on which are the challenges that the FO.S program is currently facing, 30 interviews with the relevant stakeholders were conducted. Almost all of the interviews were completed by meeting the respondent in person. There were only two interviews performed on the telephone.

Firstly 10 interviews with key stakeholders were conducted. The respondents were picked according to the judgment of the author and their relation to the program. The type of semi structured, open-ended interview (Yin: 2003) was utilized. During these interviews the same open-ended questions were asked to all the interviewees; the respondents were free to choose how to answer the questions. This approach according to Yin (2003) facilitates faster interviews that can be more easily analyzed and compared. The author kept notes on what was discussed after the end each interview.

Secondly a questionnaire with the form of an electronic mail was sent out to the 50 registered companies to the Hellenic Association of Photovoltaic Companies (HELAPCO). The purpose was to gather a number of perspectives from the stakeholders mostly involved with the program, in order to attain additional information to answer the research questions and complete the evaluation of the FO.S program. Due to the very limited responses that were received-only three of the companies answered the questionnaire- the author decided to conduct interviews with the sector's companies in person. 20 interviews were carried out with PV company representatives in the cities of Athens and Thessaloniki. At this point the author needs to stress the fact that the interviews were conducted using two different methodologies. In a first phase all interviewees were asked the same set of questions and were free to elaborate on the subject discussed according to their point of views and experiences. Therefore the interviews in the beginning had the form of a semi structured open-ended interview (Mikkelsen: 2005) In the second phase of the interview the respondents were asked to fill in a small questionnaire of 9 questions, they were thus asked to choose answers from among the same set of alternatives (Yin:

2003). Hence the interviews took the form of a structured, closed-ended type. The questions for the questionnaire were picked after the conduction of the first interviews, the time that the author started forming a view of the implementation obstacles that the FO.S program deals with. Questionnaires are usually classified as a quantitative method. However the design and purpose of the specific questionnaires was to serve as a means to enhance the findings from the semi structured, open ended interviews. The questionnaire in this case was used as a complementary method to cross examine the results retrieved.

The fact that two different types of interview were used allows the author to state that this research uses also the **methodological type of triangulation.** As seen in the previous section this research will make use of two different theoretical frameworks to interpret the findings from the interviews, something that constitutes per se **theoretical triangulation.**

3. LIMITATIONS

The limited free time the researcher had due to working responsibilities in a company outside the field of Photovoltaics did not allow her to conduct interviews with people that have installed PV systems on the rooftop of their houses or business. The fact that interviews with the immediately benefited from the program do not comprise part of this thesis research limits its analysis. However, during the interviews with the companies, who are the ones closer in contact with the individuals who want to make use of the program the author tried to acquaint information on the central motive the interested individuals had in installing PV panels.

Regarding the spacial limitations that need to drawn what needs to be stated is the fact that the interviews were carried out in the cities of Thessaloniki and Athens

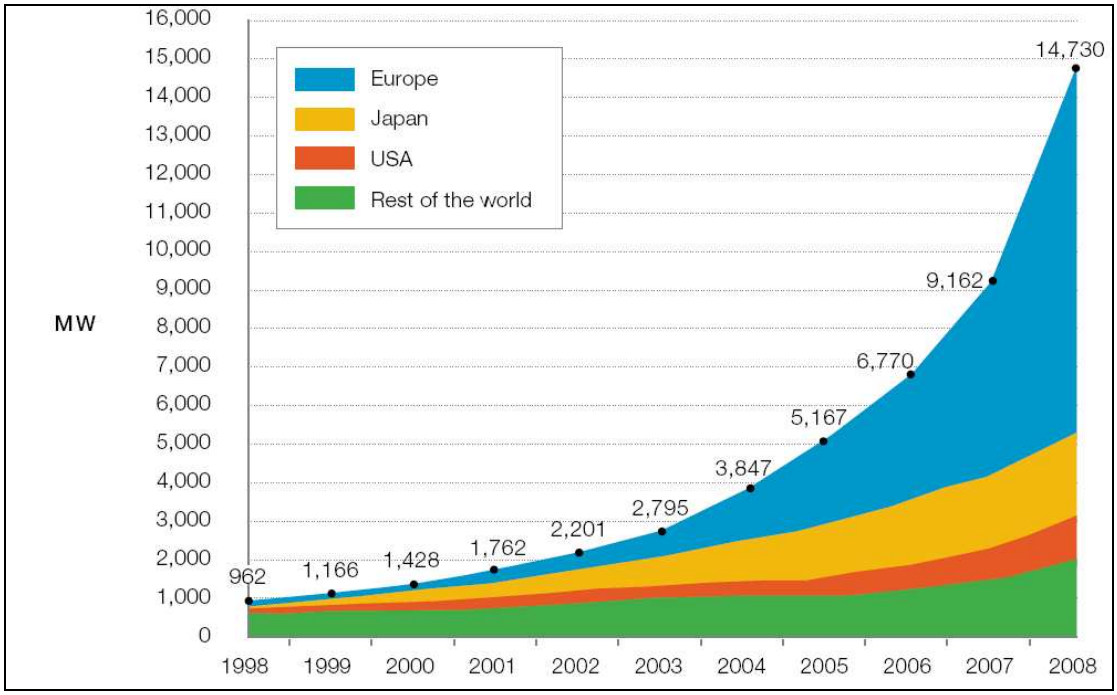
SECTION B

BACKGROUND

1. THE GLOBAL PHOTOVOLTAIC MARKET

The solar PV market has been booming over the last decade and this trend is expected to be confirmed in the coming years. By the end of 2008 the Global cumulative capacity was reaching 15 GW. Today Europe is the leading actor in the market. Its overall cumulative PV installed capacity surpasses the 9 GW which represents more than 65% of the Global cumulative PV installed capacity. Japan with a cumulative PV installed capacity of 2.1 GW and the USA with 1.2 GW are following behind, representing accordingly 15% and 8% of the Global cumulative PV power installed (EPIA: 2009).

Figure1. Historical development of the Global cumulative PV power installed per region



Source: Global market outlook for Photovoltaics until 2013(EPIA: 2009)

2. THE EUROPEAN PHOTOVOLTAIC MARKET

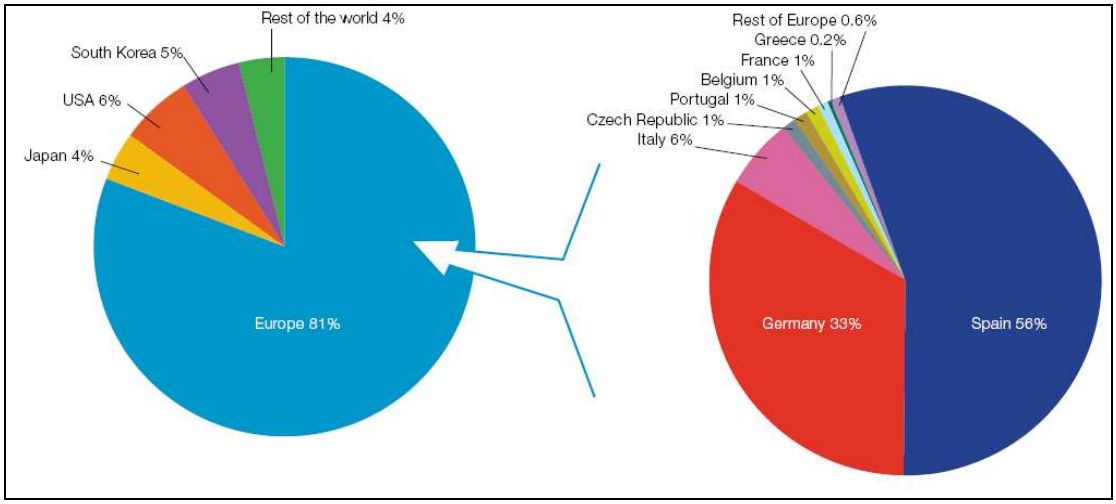
On 17 December 2008, the European Parliament and the Council of the European Union agreed on a package of measures on climate and energy with the aim to reduce the EU greenhouse gas emissions by at least 20 % and to increase the share of renewable energy to 20 % of total consumption by the year 2020 (EC, Impact Assessment: 2008). The climate energy package, recognizes that the increased use of energy from renewable sources, together with energy savings and energy efficiency, constitute important steps to promote security of the energy supply, technological development and innovation, providing opportunities for employment and development, and reducing, at the same time, greenhouse gas emissions (IEA: 2008). It is considered to be one of the most far-reaching reforms ever done on the European energy policy. Along with the aims aforementioned it aims to make Europe the world leader in renewable energy and low-carbon technologies. If the measures of the package are finally implemented Europe's dependence on imports of gas and oil will be reduced and the European economy will be protected from unstable energy prices and uncertain supplies (Fouquet & Johansson: 2008).

Since 2004, Europe has been leading the global PV market. The European Photovoltaic market is very heterogeneous despite the fact that Germany has been dominating for several years. In 2007, the German PV industry had a turnover of about 5, 7 billion euros and employed 42. 600 people while the employment figure for the whole of Europe is about 70.000.

Spain took over in 2008 the number 1 position worldwide with around 45% of the Global market and 56% of the EU market but now faces serious issues because of its government's inability to pay tariffs. . In order to promote the application of PV systems the Spanish government proposed as an upper limit for the installation a cap of 400MW for 2010. However when the installation size exceeded the cap already in 2009 even before the Royal Decree was passed the problems for the industry started to show off. As the installation demand increased, the costs started to fall rapidly allowing even poorly designed systems to make a profit. Feed-in payments to the PV industry reached €2.5 billion and the government was unable to repay the FiT (Cameron: 2010).

Despite this bad turnout for the Spanish PV industry many other countries are developing well designed support schemes for PV application. Italy and France are increasing their share in the PV market while Czech Republic, Bulgaria, Portugal, Belgium and Greece are ranked as high potential markets with promising support schemes. Despite the fact that productivity in the PV industry evolves with automated production and reduced unit and system costs, the fast market development is expected to advance the rate of employment in the sector (EPIA: 2008). Depending on the system size, the lowest price for photovoltaic systems connected to the grid recorded in 2007 ranged between 4,5 EUR/W and 5,5 EUR/W; much the same as the corresponding price in 2006 (IEA: 2008)

Figure 2. The regional distribution of Global annual PV market and the Regional distribution of European annual PV market in 2008



Source: Global market Outlook for Photovoltaics until 2013(EPIA: 2009)

Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market [3] and Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport[4] established definitions for different types of energy

[3] OJ L 283, 27.10.2001, p. 33
[4] OJ L 123, 17.5.2003, p. 42

from renewable sources. Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity[5] established definitions for the electricity sector in general. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources amends the aforementioned Directives and contains several elements which are important for the Photovoltaic sector: the reformation of administrative procedures, the contemplation of renewable energy use in local and regional planning, the introduction of minimum renewable requirements for building codes, the improvement of information and training requirements and the reinforcement of electricity grid access provisions. National Action Plans, which are to be adopted within the year 2010, will describe the Member State strategies that will need to be applied in order for them to reach the 202020 target of the European package on climate and energy. The National Plans will define the contribution that each sector-electricity, transport, heating and cooling- to the target (IEA: 2008).

3. THE GREEK ELECTRICITY MARKET

3.1. Legislative framework: history of development

Traditionally and internationally the field of electric energy is dominated by monopolies. In 1994, the Law N.2244 (GGN. A'168), allowed Greece to make the first step towards the production of electrical energy from third parties. Until that time the Public Power Corporation held the monopoly of power generation in the country. That first step led the way to the liberalization of the Greek electricity market. In simple terms this means that new producers could enter the market, PPC's monopoly could be broken and all customers could choose their electricity provider (HTSO: 2010). The particular law gave for the first time the opportunity to independent producers to penetrate the sector and especially the production of electricity from Renewable sources of Energy (RES).

In 1999 with the Law N. 2773 (GGN.A'286) the Greek institutional framework underwent a harmonization according to the Directive 96/92/EC, of the European Council. The transposition of the Directive helped the country lead the liberalization

[5] OJ L 176, 15.7.2003, p. 37

of the electricity market faster than before. The particular law created favorable conditions for the development of RES generation stations. It provided with priority the absorbing of electrical energy generated by the RES stations against the absorbing by conventional units (articles 35 to 37). It also defined a special way of pricing the energy produced by them (articles 38 to 39). Additionally, in 2006 with the Law N.3468 (GGN.A'129), Directive 2001/77/EC, was transmitted to the national law and promoted with priority, and with the use of rules, the production of electricity from RES units along with the Cogeneration Units.

In January 2009, the Law N.3734 (GGN. A'8) harmonized the Greek legislation with the Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market. The relevant legislative framework was attuned and the different prices for the absorption of energy generated from Photovoltaic stations were readjusted (HTSO: 2010)

3.2. The basic factors of the free electricity market in Greece

The deregulation of the energy market of Greece in February 2001 granted power generation licenses to other companies and private bodies than the PPC. The Law 2773/99 created two companies, the Regulatory Authority of Energy (RAE) and the Hellenic Transmission System Operator (HTSO).With the new legal framework the responsibility for the power transmission was taken over by HTSO SA. Similarly, the overall control of the Greek Power System (Power Generation, Transmission and Distribution) has been taken up by the Regulatory Authority for Energy (RAE). These two companies along with the Public Power Corporation (PPC) constitute the basic factors of the free electricity market.

4. THE GREEK PHOTOVOLTAIC MARKET

In Greece, there are several support schemes[6] currently in place promoting the development of the domestic PV market. The central policy to motivate the installation of PV systems is represented by the Feed-in Tariff (FiT), which in its current form, has been in force since January 2009. A combination of fiscal and financial incentives completes the picture of the PV market in Greece. Concerning the FiT, the first element that needs to be taken into account is the geographical distinction between the mainland territories and the islands with autonomous grids, where higher tariff levels are applied (EPIA: 2009). The second basic element that characterizes Greece's FiT is the relatively simple market separation. The market is divided into three segments:

- Residential and small rooftop applications under 10 kW
- Medium-sized applications comprised between 10 and 100 kW
- Large applications bigger than 100 kW

The duration is 20 years for the two larger segments without any geographical distinction, while the tariffs will be annually adjusted according to the inflation rate development -25% of last year's consumer price index- from August 2010 and on. This means the tariff will remain fixed until then. From 2015 the tariff will be modified according to the variation of the marginal cost of the system. Below are the details of the main national additional supports available:

- **Investment subsidies**: according to the National Development Law, commercial PV installations are eligible for a subsidy from 20% to 40%. Domestic applications are not eligible for any subsidy. In any case the minimum investment eligible for a grant is 100,000 €.

[6]According to the definitions provided in the text of the Directive 2009/28/EC of the European Parliament and the Council "*support scheme means any instrument, scheme or mechanism applied by a Member State or a group of Member States, that promotes the use of energy from renewable sources by reducing the cost of that energy, increasing the price at which it can be sold, or increasing, by means of a renewable energy obligation or otherwise, the volume of such energy purchased. This includes, but is not restricted to, investment aid, tax exemptions or reductions, tax refunds, renewable energy obligation support schemes including those using green certificates, and direct price support schemes including feed-in tariffs and premium payments"*

- **Tax rebate on profit taxes**: Small domestic systems are eligible for a 20% tax deduction capped at 700 € deducible income per system. Residential systems are also exempt from any income tax.

- **Value Added Tax (VAT) reduction**: Residential customers have to pay VAT while commercial and industrial customers may benefit from exemption (EPIA: 2010).

FiT						
Year	Month	Rooftop* systems < 10 kW (€/MWh)	Mainland grid (€/MWh)		Autonomous island grids (€/MWh)	
			≤100 kW	> 100 kW	≤100 kW	> 100 kW
2009	August	550	450	400	500	450
2010	February		450	400	500	450
2010	August		392.04	441.05	490.05	441.05
To be adjusted from August 2010 according to the consumer price index.						

Table 1. The FiT schemes for the different segments in Greece

Source: Overview of European PV Support Schemes (EPIA: 2010)

More than 8,000 applications with a cumulated capacity of 3.75 GW have already been filed by potential investors (RAE: 2010). Over the next 2 to 3 years the market is expected to be in the 100-150 MW range on an annual basis (Business-As-Usual scenario). Table 2 below shows the expected market development according to a BAU scenario and an accelerating scenario base on an estimation made by HELAPCO (2009)

Table 2. The expected PV market development

Source: HELAPCO: 2009

5. THE FO.S PROGRAM

A special program for the development of photovoltaic systems on household residents and buildings of very small businesses was composed with a Joint Ministerial Decision (GGN B'1079: 2009) which was issued under the authorization of the Law 3468/2006 (article 14) and the modification of the Law 3734/2009 (article 27A). The program covers PV systems up to 10 kW peak which are installed on rooftops, on small room residents on the last floor of a block of departments or on the terrace shelters. The systems are connected to the low voltage grid. With this Decision the license procedures, the pricing of the generated energy as well as the content of the sales contract of the produced energy with the PPC are defined. Currently, the program is only valid for the mainland grid areas. Islands with autonomous grids will enter the program in a second phase as soon as an extra rooftop solar capacity is set for each island.

The price of the generated energy form the photovoltaic system is set at 0.55 €/kWh for the agreements that will be signed during the years 2009-2011. It is guaranteed for 25 years, and is adjusted annually for inflation (25% of last year's Consumer Price Index). An annual regression of 5% is foreseen for newcomers as of 2012. No cap is set. The sales contract is signed with the utility, the main electricity company in Greece, the Public Power Corporation Company (PPC).

Apart from the feed-in-tariff, small residential applications are eligible for a 20% tax deduction capped at € 700 per system (articles 3 and 6 of the JMD). Residential users

do not have to be registered as "business" with the tax authorities and are exempted from any tax. The users need however to pay the 21% VAT paid for the initial investment. Small companies are also exempted from any tax as long as they keep the income from PV as untaxed reserves (HELAPCO: 2009)

Eligible for this program are natural persons non tradesmen[7] or legal persons tradesmen who are among the small businesses and have in their property the space where the installation will take place or they are the owners of a horizontal property[8] of the building and they have gotten the written authorization to use the particular space by the rest of the building owners (article 1 of the JMD).

There are some major preconditions for the subsumption in the program. First of all there has to be a signed contract with the PPC for consumption of electric energy in the name of the owner of the Photovoltaic, in the building where the system will be placed. Secondly, the residence has to cover part of its hot water supply by some other renewable source (e.g. solar thermal thermosyphon, biomass). Thirdly there has to be no funding from another program (HELAPCO: 2009)

a) Installation site

The installation is allowed on the terrace or rooftop of the building, including veranda covers, but installation is not allowed on facades and on superstructures on the roof. In the case of placement of PV on rooftops, this must occur within the volume of the roof, following its incline, and be at a distance of 0.50 m from its perimeter, in order to ensure an aesthetically pleasing image of the building. The PV must constitute a unified whole with the other constructions if there are any, in order not to harm the aesthetics of the building and the surroundings. The PV systems that are placed on the terrace of the building must be parametrically delimited with a compact parapet of greatest height 1.20 m for aesthetic reasons and for protection of the installation. The distance from the parapet of the terrace must be 1.00 m from the inside of this, for

[7] a merchant who owns or manages a shop and has opened books with the tax office.

[8] horizontal property laws state statutes that enable condominium (housing consisting of a complex of dwelling units, as an apartment house in which each unit is individually owned)ownership of property. Whereas property laws generally recognize ownership rights to all space from the center of the earth to some distance in the air, condominium laws allow individual ownership to be split on a horizontal plane that generally limits the unit owner's interest to the inside dimensions of the unit.(Kotsakis: 2003)

safety reasons. In the case of a penthouse, these installations will be limited to the perimeter of the roof (PV LEGAL: 2010).

b) Administrative procedure

A *"small-scale works permission"* from the local Urban Planning authority is required. For its issuance, a copy of the topographic for the exact orientation of the position of the real estate and the plan of the terrace or roof are required in order to show the exact position of placement of the PV system. The written permission of the co-owners of the building is a prerequisite (JMD: 2009).

The first step that needs to be taken to participate in the program is to fill in an application for grid connection to the local branch of the Public Power Corporation. The preconditions are that the interested party must already have chosen the type of equipment which will be installed and have carried out the relevant technical study. The Public Power Corporation examines the application and proceeds, within twenty days from receipt of the application, to written formulation of an Offer of Connection to the interested party, which includes the description and the investment in the connection work, and is valid for three months from its date of issue.

The second step requires the filing of an application for drawing up of a Connection Agreement with the regional branch of the Public Power Corporation. The application states that the Connection offer is accepted, and the Permission for small-scale works, which needs to be issued in the meanwhile from the responsible Urban Planning offices, is attached.

Thirdly the applicant needs to fill in an application for activation of the connection in the regional branch of the Public Power Corporation. The preconditions at this stage are the readiness of the installation and the completion of the connection works. If these are fulfilled the Public Power Corporation notifies the interested party by telephone and the determination of a date for performance of monitoring of the installation is set.

The fourth step of the administrative procedure the individual needs to go through is the signing of the Connection Agreement with simultaneous submission of the relevant fee to the regional branch of the Public Power Corporation. The Public Power

Corporation constructs the connection works within twenty days from the signing of the Connection Agreement, if new grid works are not required (beyond the installation of a new meter).

The fifth and final stage concerns the activation of the connection. This occurs immediately after the successful completion of the monitoring. If during performance of the monitoring, lacks or dysfunctions are ascertained in the installations of the interested party, the connection remains inactive until the interested party proceeds to the corrective actions which the Public Power Corporation will indicate to him/her (HTSO: 2010)

c) Funding the program

Public authorities are not involved in funding the program. A necessary precondition and term for the eligibility of a system to the FO.S program is the non-existence of public support. The owner has the ability to cover the initial investment capital either on his/her own or with a bank loan. The loan can cover up to 100% of the value of the investment, either with collateral, which is usually the mortgage of the owner's resident property either with the allocation of the Connection Agreement signed with the PPC to the bank that provides the loan. The loan can be up to the amount of 50,000 euro which is approximately the capital needed to install a PV system of 10Kw (Kourasi, Tetsis: 2010).

The residential small-scale producer of PV electricity is no longer considered to be a tradesman, in other words he/she does not have to open books with the tax office. As the Joint Ministerial Decision states *"there are no tax obligations for the owner of the PV system for the provision of this energy to the grid."*

SECTION C

1. RESULTS

This section presents briefly the findings derived from the 10 semi structured, open-ended interviews that were performed in the first phase of the interview process along with the findings from the 20 mixed methods type interviews (Bryman: 2006) with the PV companies that were performed in a second phase. Some statistical facts derived from the 20 mini questionnaires (see appendix) that were submitted to the company representatives are used in this section in order to increase the credibility

and validity of the qualitative findings. What needs to reminded is that the questions in the mini questionnaire were formed after the first interviews with the relevant stakeholders took place and after the realisation of the basic problems the program faces. The research questions of this thesis report are being briefly answered. The findings for the moment are summarized and a further elaboration on them will be made in the analysis section.

Almost all of the respondents (26 out of 30) rated bureaucracy as the major obstacle for the policy implementation. The need for raising further public awareness on the existence of the policy and the benefits the program offers was also among the most popular responses (24 out of 30). Furthermore the majority of respondents (19 out of 30) made critical points on the overall policy design. The discussions circled around the requirement for a longterm, more visionary policy design and the general lack of governance in Greece. Different set of targets and a more concrete strategy that reaches out to the public more effectively were among the suggestions that the interviewees made. The three issues are tied together and they are scaled almost at the same level of importance. The challenge of further communication of the program and an additional reduction of the bureaucratic procedure are bound to an enhanced policy design. Apart from the three major challenges identified the respondents often mentioned some other points that need to be adressed to increase the effectiveness of the program. Lack of trust to the institutions, the construction arbitrariness that rules the country as well as the challenge of dealing with the fact that more than two thirds of the Greek population is living in apartments in big blocks and not in houses were among the other specific topics the respondents highlighted.

Table 1 shows the most important statistical fact retrieved from the questionnaires and strenghtens the validity of the findings. This research is seeking to reveal which are the challenges the FO.S program has been facing during its implementation and the table represents the answers rather accuarately. In this particular question the respondents had to pick among 4 different answers/challenges; bureaucracy, public awareness, policy design and other. There was no restriction on the number of choices hence the respondents often picked more that one answers, usually according to which challenge they concidered most important. 50% of the company representives rated further reduction of the bureaucratic process as the first problem

that needs to be addresed for the policy to achieve better results. The second challenge, selected by 45% of the PV company representatives, that needs to be assessed is the overall policy design. Provisions for further public awareness were rated third in the row with a percentage of 40% of the pv company respondents arguing pro it. Finally 10% of the respondents highlighted other specific issues they thought were more important, like the Greece's building consrtuction characteristics.

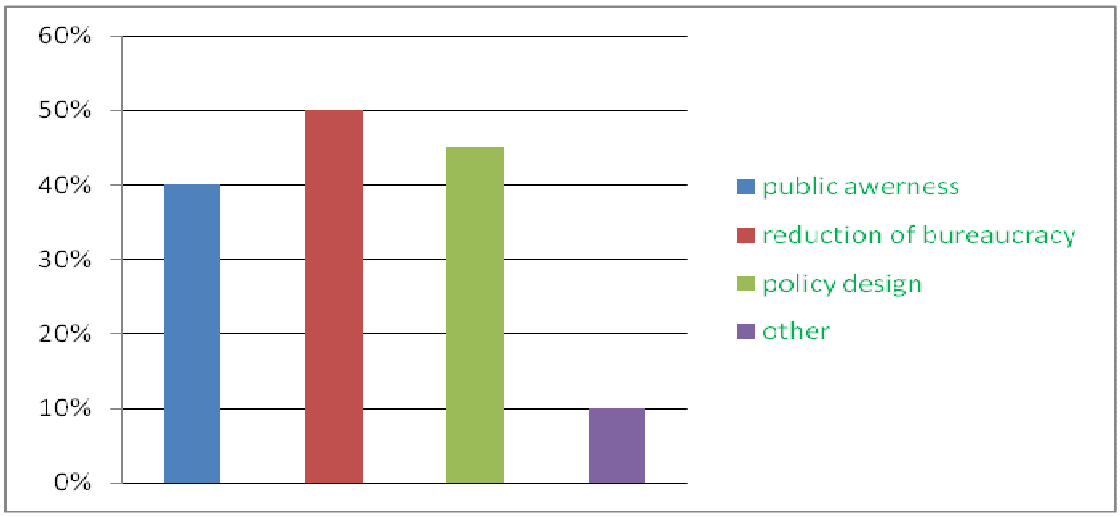


Table 1. The major identified challenges

Since one of the major issues that was brought was the need for public awareness the researcher wanted to identify whether the PV copmanies had taken any actions to advertise the FO.S program. Table 2 illustrates the rate of action taken by the companies to communicate the program to the public. More than half of the companies, notably 65% of the sample, have used advertising to raise public comprehension on the project and attract possible investors. Most of the companies that answered positively to the question in the questionnaire advertised the program by publishing articles on their electronic sites, by presenting case studies of already installed panels on residents rooftops as well as developing special brochures with the relevant information on the program.

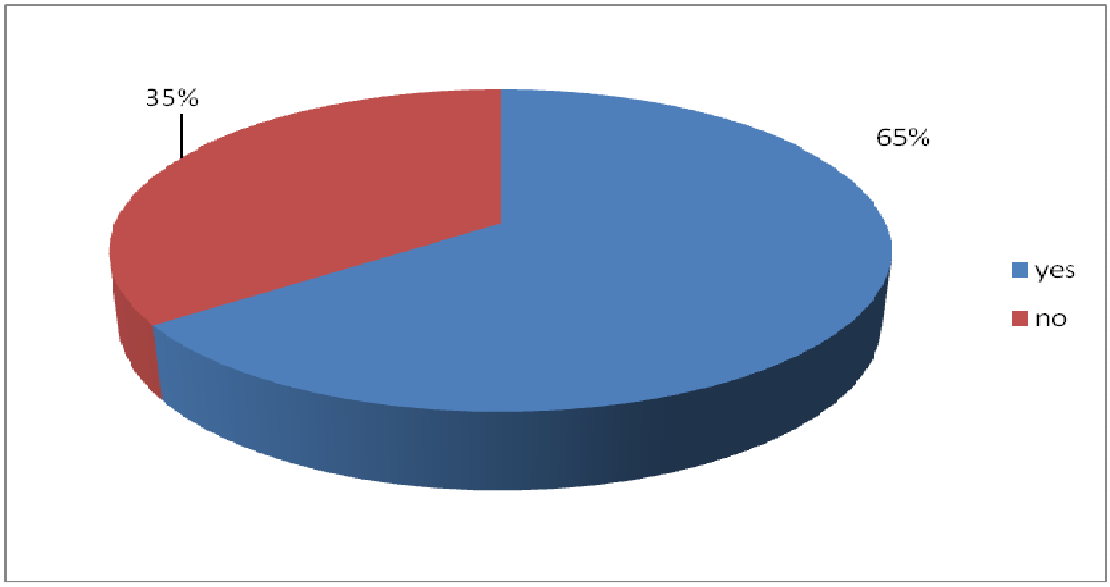


Table 2. The rate of action taken from the companies to advertise the program.

During the interviews two issues were further discussed. The interviewees were asked to form opinions on the financial and the legislative framework of the FO.S program. The financial scheme for the program basically refers to the FiT support scheme and its capability to promote the installation of PV systems on rooftops in Greece. As it was expected the crushing majority of the respondents (28 out of 30) thought that the price of the kWh that is sold to the PPC is sufficiently high and as specifically stated *"creates a rather logical investment opportunity"*(Kalapodas, Tsolakis, Drosos: 2010). Table 3 presents the opinions of the company representatives on the adequacy of this financial scheme. The question in the questionnaire was rather straightforward; the respondents were asked to pick between "adequate" and "inadequate". The Feed in Tariff scheme was characterized by 90% of the sample as adequate, meaning that the offer is sufficient enough to boost the policy. The remaining 10% of the PV company respondents that judged the project's financial scheme negatively, argued for the need of additional subsidies for the initial capital investment due to the current economic crisis (Bethanis, Chatzinikolaou: 2010).

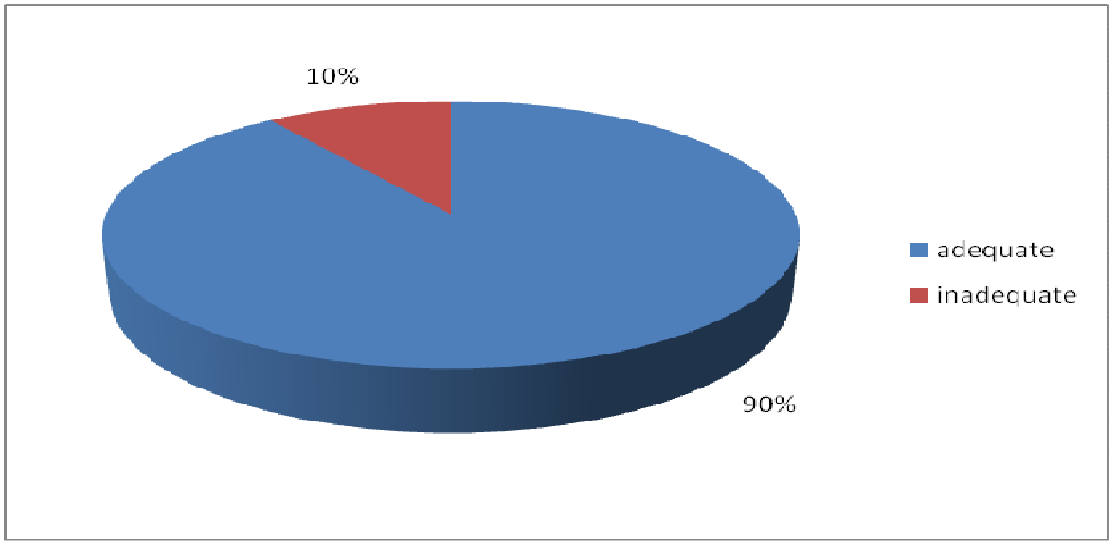


Table 3. The rate of adequacy of the financial support scheme of the program

On the other hand, the legal framework of the program refers to two things; the official documents of legislation that set the program in motion along with the different building code provisions that are as a prerequisite for the installation of a PV system on a rooftop. During the first interviews the stakeholders often elaborated on the existing gaps in the legal framework but almost always with special regard to the aspect that concerns the building code deficiency. More than half of the respondents (18 out of 30) stated that the construction provisions are unclear, messy and most of the times insufficient to cover all the varying cases of constructions. The problems in the building code were most of the times linked to the delaying bureaucratic procedure since the only permission required is a "small project permission" issued by the local building departments. Table 4 illustrates the rate of adequacy of the legal framework of the program according to the answers given by the PV company representatives in the mini questionnaire. The question followed the same format with the question for the adequacy of the financial framework. What has to be stated at this point is that often the company representatives hesitated to answer to this question due to its broad sense. The author provided with clarifications to facilitate a choice. As it can be seen, 55% of the sample found the legislative framework inadequate and 45% adequate.

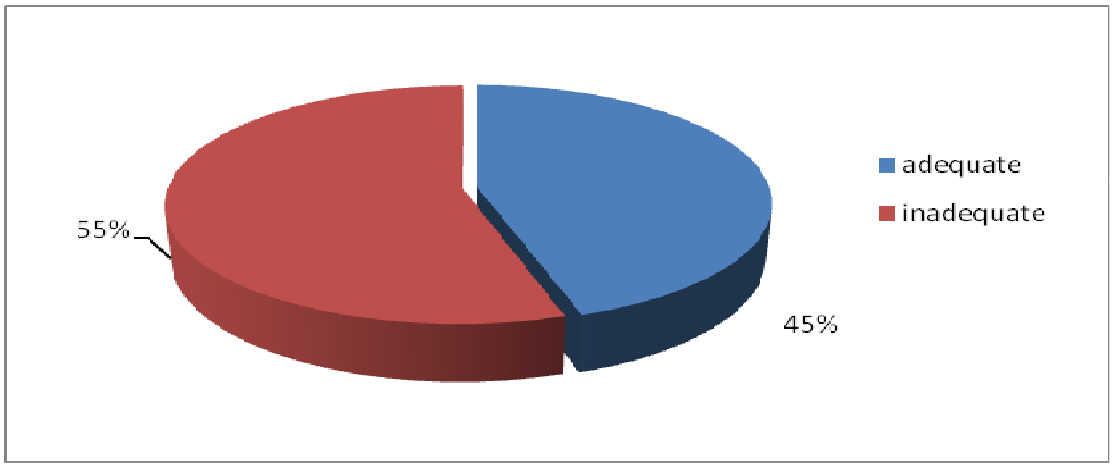


Table 4. The rate of adequacy of the legal framework of the program

Table 5 sums up the general perception of the sample on the program. As it can be seen the great majority of the sample thinks that the program is either very good or average. The fact that more than half the respondents evaluate the program as average clearly indicates the need for further development of the program and that there is still great room for improvement. The statistical results match with the views of the stakeholders that were interviewed first. Most of them found the initiative intriguing but its application problematic. As Mr. Plitharas humorously stated *"the initiative is great but its application sticks"*.

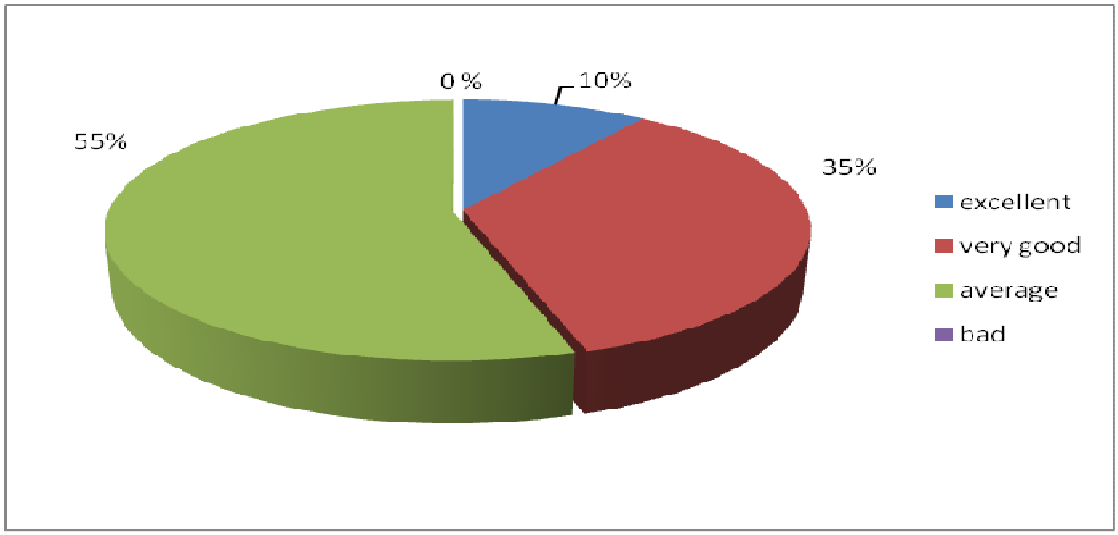


Table 5. The general perception on the program

2. ANALYSIS OF THE FINDINGS

This section attempts to present the findings of the interviews conducted in accordance to the main research questions and provide a multilevel, wide spectrum analysis of the phenomena and patterns observed. The analysis is performed firstly in relation to the basic criteria for the evaluation of an environmental policy. The second part of the analysis gives an overview of the Greek Solar Thermal Market development, a story of an innovative, friendly to the environment technology, that the last 30 years has had a rather succesful turnout. In the following part the FO.S program is compared to the solar thermal market case. The comparison provides a useful insight of what could be done better in order for the program to achive better results. The last part of the analysis section focuses on relating the program in evaluation to sustainability science.

2.1. A review of the FO.S program according to the evaluation criteria

The application of the instrument is judged in this section based on the core evaluation criteria that were presented in the introductory part of this thesis report. At this point therefore the policy is explored according to:

a. its relevance into covering key environmental issues,

b. its possible impact and contribution to the abatement of the negative effects of the environmental problem it addresses

c. its effectiveness in relation to its stated and intended goals

d. its persistence of effects in the long run

e. its flexibility in terms of dealing with altering socioeconomical conditions

f. its predictability in terms of ability to foresee some of the possible administrative outcomes and outputs and the way these interact with the individuals they refer to.

As stated in the beginning of this thesis report the basic intention for the formulation of the FO.S program would be that "*the placement of very small photovoltaic systems on buildings would contribute to the realization of the goal of penetration of*

renewable sources of energy in the country's energy mix with the active participation of the citizens."(JMD: 2009). This specific statement is the only written target of the policy. The General Secreteriat of Research and Technology[9] is the authority that brought on the policy context of the FO.S program. The interview conducted there with Mr. Spyropoulos, the line manager of the secreteriat, and the observations from the side of the author, were both enlighting. Apart from the documents posted on the site of the Ministry of Development, that is the Joint Ministerial Decision, texts on matters on the required building provisions and a file with questions and anwers for the public, no other document was available for the public or for a researcher. Despite this fact when Mr. Spyropoulos was asked to identify other goals that this policy instrument is addressing the conversation circled around the goals set by the European Package on Climate Change, the latest Directive 2009/28/EC that addresses "*the promotion of the use of energy form renewable sources"*and the country's National Strategy on Sustainable Development[10]. According to the aforementioned the policy is part of a wider spectrum of policies that have as their ultimate target the curve of the consequences caused by the generation of energy from conventional forms of fuels, like lignite and oil. Therefore the intrument's ***relevance*** to one of the most discussed environmental problems of the last twenty years, that of the issue of climate change and its effects on human and natural life, is at this point unquestionable.

The ***impact*** of the policy can be measured with the number of installed rooftop PV systems. The more systems installed with the diffusion of the policy is translated into less carbon dioxide emissios in the atmosphere. Therefore what needs to be stated at this point is that until February 2010 only 30 PV systems on rooftops with an functioning capacity of 213 kW were in place (Aslanoglou: 2010). The author cannot really state whether this development constitutes an achievement for the policy as there are no goals set for the number of expected installations, there is no written cap on desirable kilowatts or a certain timeframe. Nevertheless the acquired data were as stated until February and Mr Aslanoglou, the manager in the Management Directorate

[9] The responsibility for the program is soon going to be undertaken by a new agency, the Secretariat for Energy and Natural Resources which is going to operate under the newly constructed Ministry of Environment, Energy and Climate Change.

[10] At this point what needs to be stated is that Mr. Spyropoulos might have been influenced by the fact that he was having a discussion with a student who is involved with environmental studies and sustainability science and wanted to promote the instrument as part of a larger environmental policy context. Nevertheless his statements are taken into consideration in this analysis as said.

for the Grid, in PPC, estimated that with 298 applications -that account for 2.281kW- in process an acceleration is about to take place. If this trend is reassured in the coming months the development of the policy application could be regarded as positive. The environemntal benefit was not easy for the author to calculate as it was difficult to know which is the energy source, lignite, oil or natural gas, that the photovoltaic systems is replacing. Thus the exact amount of carbon dioxide savings could not be calculated.

The fact that the guarantee fot the the PV systems is 10 years and the contract signed with PPC is for 25 years, along with the high solar radiation in Greece througout the year, secure in a way the ***persistence*** of the instrument's effects on the long run inspite of the fact that the efficiency of the photovoltaic panels dicreases with the years (Zorbas: 2010). A common mention during the interviews was the economic crisis that Greece is going through the last months and the way the citizens are going to deal with it. As stated in the previous section two of the company representatives refered to the economic crisis and the need to subsidize the initial capital. On the other hand the fact that 268 applications were in process in February and Mr Aslanoglou expects an acceleration of this fraction of the PV market, indicates that people are still interested in starting a rather costly investment despite the crisis. So regarding the ***flexibility*** of the FO.S program to deal with altering economical conditions what can be stated is that the prospects for the progam could prove promising if the policy continuous to be implemented without any obstacles. The reason the author states this precondition is that there have been cases of policies that were withdrawn from the government regardles the positive premises given. A very indicative example is the fact that for all the PV applications smaller to 500kW-wih the exception of the FO.S program - the application procedure for new licenses has frozen despite the strong governmental statements for the promotion of "green" development and the existing programs that have until now promoted their application (HELAPCO: 2010).

"An implementation problem occurs when a political decision is not carried out in accordance with what the decision maker wants" (Lundin: 2007). The decisiosn makers in this case desire the placement of the PV systems on the rooftops in order to increase the ratio of RES in the country's energy mix. Despite the 30 PV systems installed the fact that so many applications are still in process demonstrates without

doubt a problem in the ***effectiveness*** of the administrative forces to carry out the specific political decision. Hence an implementation problem is identified. The fact that the Joint Ministerial Decision declares that the program will help the difussion of RES with the *"active participation of the citizens"* clearly allows the researcher to interpret the policy maker's will to incorporate this additional dimension in the target setting. Therefore the researcher is forced to investigate the ***effectiveness*** of the actions taken by the involved administrative forces to promote the program to the wide public as well.

As seen the majority of the respondents indicated bureaucracy as the main drawback for the policy's application. Furthermore the results from the interviews showed that there is a general defficiency in promoting the program to the public. The two challenges merit special analysis because they composed the core of the discussions performend with the respondents. The following parts are exploring in depth the initial findings and offer a more elaborated analysis in relation to other identified isues that are interlinked to them.

2.1.1. The ineffective Greek Bureaucracy

The FO.S program was picked by the author intinially because its framework seemed promising in comparison to other environmental and photovoltaic diffusion policies. The bureaucratic procedure especially in contrast to the process one has to go through to built a PV station larger than 10 kW gives the impression of a rather favoring one for the individual that wants to purchase such an investment. The licences one has to obtain to built a PV station are still numerous despite the significant steps taken to limit them to the absolutely necessary. Hence The fact that for the installation of a PV system the only licence needed is a "small works permit" by the local building authorities in relation to the fact that the rest of the application procedure has been according to the officials interviewed minimized (Tselepis, Spyropoulos, Papachristou: 2010) can support a hypothesis; there should be no delays for the interested investors to proceed to the installation of the systems.

However the assumption made in the beginning of this research was not verified. The bureaucratic procedure seems limited and simple but the actual process proves not to be. The Urban Planning Department and the local building authorities, according to the opinions formed by the crushing majority of the interviewees, are among the most

corrupted, disorganized and uninformed institutional organizations in Greece. The company representatives especially, who are the most involved parties as they often perform the study and the processing of the application procedures, have revealed to the author numerous cases of lack of basic information of the laws in place from the employees in the Urban Planning offices and the local building authorities. The stuff is often unaware of the specific requirements that need to be filled to acquaint the "small scale works permit with a result the issuance of the permission to take much longer than it should. The Joint Ministerial Decision clearly states that the "small scale works permit" ought to be issued within 20 working (article 17) days from the day the interested individual submits the topographic of the space on the rooftop where the PV system is going to be installed and -if needed- the written permission of the rest of the owners of the building. Many of the company representatives argued that the permission is rarely issued within the required time framework and that there have been cases in which their clients waited for 2 or 3 months. As many of the respondents stated some Urban Planning offices ask for a Committee on Urban Planning and Architectural Control permission even in cases where this is not stipulated by the legislation. Others ask for documentation which is either not predetermined by the legislation, or is completely absurd like for example "*a paper from the Forest Department for systems on roofs of existing buildings"* (Tsolakis: 2010). Hence permission for small-scale works is not issued as easily as the title implies, because of ignorance of the responsible Urban Planning offices. The fact that the employees in the Urban Planning offices often require other documents that are provided by other institutional organisations, often higher in the organisational structure, is also indicative of a serious problem of responsibility that runs the Greek institutional and sociological framework. This reassignment of responsibility is indicative of a reluctance that the whole institutional and sociological setting shows in front of a radical change (Fernandez: 2008) which is essential for the promotion not only of the FO.S program in particular but for the implementation of the policies in Greece in general.

The construction arbitrariness in Greece

On the other hand, even in cases where the officials are aware of the provisions that needed to be taken into account to issue the "small scale works permission" the very

specific construction requirements for the installation site of the PV system create a great confusion however contradicting this might seem. The construction arbitrariness over the last 50 years and the numerous building constructions that were brought up illicitly constitute another predicament for the program's application. As some PV company representatives stated they came across cases of individuals that were mostly interested in placing a PV rooftop system but were afraid to proceed with the paper work due to the fact that the building they were residents of was not in the urban plan of the city because it was built illegally. There also some construction specificities like the

The problematic building code. Condominiums VS houses

A great challenge highlighted by a significant number of the respondents is the fact that Greece is a country that the vast majority of the population lives in blocks of apartments and not in houses. This constitutes a problem for the diffusion of the policy as immediately the available rooftop space for the installation PV systems is limited. Furthermore the rooftop is usually a site of common ownership in the building and it is utilized by all the residents of the condominium. Every block of apartments has a regulation which is defined and enclosed in the statute of horizontal ownerships of the building (Kotsakis: 2003). Despite that the regulation of the building does not describe the procedure that needs to be followed and the prerequisites that need to be applied when an owner desires to build any kind of construction or install a RES technology like a thermosyphon or a PV system. Hence it is left in the jurisdiction of the owners of the horizontal properties in the building to define the conditions for installing, in this particular case, a PV system on the rooftop. So despite the fact that the written authorization to use the rooftop space by the rest of the building owners (article 1 of the JMD) seems simple too in the end proves not be. As stated by Mr. Georgiou (2010) "*the rest of the owners in the building often seem reluctant to allocate their right in the use of the rooftop site even if this is for a good purpose".*

2.1.2. The need for raising public awareness

Knowledge can have a rather broad meaning. It can cover a wide range of the spectrum and in distinct cases can be defined as ideas, skills, innovations, existing policies and planned ones, but also scientific and academic knowledge per se. The

theory describes generally how this knowledge can move in a direction, among various stakeholders and contexts, to promote or realize an outcome; namely change (Ottoson: 2009). In this particular case knowledge refers to an existing policy, the FO.S Program, and the way this particular policy is communicated by the stakeholders involved to the wide public in order to modify the country's energy mix.

As seen in table 1 in the previous chapter, 40% of the company respondents argue for the essentiality of a more organized effort to communicate the project to the wide public. Their actions to promote the program legitimises in a sense their requirement for further advertisment form the side of the state. It is maybe very common to refer to the need of raising public awareness and identify this parameter as a usual challenge that a strategy comes across during its implementation. Nevertheless cases of successful policy outcomes due to strengthened advertisement offer good examples on what can be accomplished through a structured and widely promoted awareness campaign.

Lack of trust to the institutions

During the interviews some of the respondents mentioned as an obstacle for the diffusion of the policy the fact that citizens often do not trust the institutions and the governmental decisions. (Plitharas, Georgiou, Daskalakis, Kyriakides: 2010). As Mrs Kyriakides specifically said *"people often fear that the contract signed with the PPC is not legally binding that there is a gap in the law and therefore their contract will not last for 25 years."* This fear is not unjustifiable in the Greek policy context. There have been various cases of policies and governmental decisions that were launched and after some time canceled or withdrawn as seen previously.

To conclude this section of the analysis, as far as the ***predictability*** criterion is concerned and more specifically the ability of the evaluator to foresee some of the possible administrative outcomes and outputs and the way these interact with the individuals, only assumptions can be made. If the aforementioned barriers that are related to the effectiveness of the administrative forces that implement the program are removed then surely the policy will achieve better results and in a shorter timeframe.

2.2. A comparison to a succesful case of innovative technology diffusion

A comparison between the actions taken to promote the use of solar thermal collectors in Greece and the existing promotion on the FO.S program provides at this point of the report a useful insight of what constitutes a successful story of policy implementation. The development of the solar thermal industry is considered to be a rather successful case of innovative technology diffusion in Greece. The growth of the industry the last 30 years not only provided the country with a relatively high comparative advantage to other markets in the field, like the Austrian and the German, but brought upon significant environmental benefits and helped the country reduce its carbon dioxide emissions notably.

2.2.1. The Greek Solar Thermal Market. A story of successful strategic options.

Greece has been rather responsive to its natural solar income by developing its internal solar thermal market at a respectable level. The installation of domestic solar hot water systems (DSHWS) has been growing steadily over the past 35 years. The exports of DSHWS in Europe and in many developing countries are also increasing the last fifteen years. As a result the Hellenic solar thermal market is considered to be one of the most developed in the world. It is argued though that despite their successful commercial diffusion, solar thermal applications cover a limited percentage of the potential application (Argiriou: 2003).

The historical development of the industry

According to existing studies on the area (Tsilingiridis & Martinopoulos: 2010, Argiriou & Mirasgedis: 2003) the historical development of the industry could be summarized into 4 different phases.

The first phase includes the period between 1975 and 1984. Until the mid seventies the households were mainly using electric heaters for water. The oil crises and the increased prices in electricity boosted the market. This is the period most of the existing companies were founded (Tsoutsos: 2002).

The second phase took place between 1984 and 1986 when the Greek government decided to sponsor and launch two large advertising campaigns. More and more households decided in this period to install solar thermal systems in their rooftops because of the communication the field took. An additional reason to this development

was the application of the value added tax (VAT) for the first time in the Greek taxation system. The households started investing on durable products fearing that the consumer prices would rise (Argiriou: 2003).Other economic incentives were also in place that period. Loans with low interests helped the initial investment. And tax credits were also given to the households that purchased S/T systems. By the end of 1986 there had been installations of total surface of 185, 000 m² (Tsilingiridis: 2010).

From 1987 until 1993 the internal solar thermal market went through a slight downward. Financial constrains and the removal of the aforementioned incentives along with the fall of the electricity prices, due to the plummeted oil price, curved the industry's previous development. Despite the unfavorable conditions the earlier development of the industry and the communication that already existed allowed the sales to continue growing in a satisfactory pace. (Tsoutsos: 2002). The installed area of solar collectors increased constantly (GSIA: 1996)

Trying to recover from the descending phase the industry went through, the companies turned to exports as well as research and technology development (RTD) usually funded by EU programmes. Since 1993, which is the year that signifies the fourth phase of the historical development of the industry, Greek manufacturers have been among the main exporters of solar thermal collectors to Europe, especially Germany and Austria and many developing countries (Tsilingiridis: 2010). The installed solar collector area reached the 250.000m².

The environmental benefits

A very recent study revealed that the environmental benefits that the industry offers to Greece and the implementation of its action policies to battle climate change are high. The measurements showed that the use of DSHWS in Greece during the 1978–2007 period had as a result the conservation of electricity, as well as the abatement of air pollutant emissions. "CO2 reduction exceeded by 44.7% the objectives that were placed by the Greek program of ''Climatic Change'', as DSHWS penetration and technical characteristics changes exceeded the expectations" (Tsilingiridis: 2010) The avoided emissions of CO2 from the maximum feasible potential could be 5428 kt CO2, 5% of total CO2 emission in Greece for 2003, according to the latest study. This

number indicates the importance of the sector and its contribution to the country's effort to reduce its emissions and reach the goals it has set.

The reasons for success

Favorable circumstances along with important financial incentives, the low initial cost of the investment as well as the successful marketing strategies over the years have allowed the industry to boost. Solar collector diffusion, despite the fact that it has followed a market-driven mechanism, was revealed to be a multi-actor, multidimensional and multi-parametric phenomenon (Sidiras &Koukios: 2004). The early organization of the companies in one big association in 1978, the Greek Solar Industry Association (GSIA) helped a lot in promoting the industry's interest. The Association was the one to initiate the procedure of development of the first European Solar Thermal Association. The group of experts in place, the research funded from the industry and processed by universities and other Greek organizations like the Centre for Renewable Energy Sources (CRES) conduct surveys and studies that increase the information available for the field and help in the communication of the barriers that existed in the market.

The oil crises in 1973 started a period of extensive investment in solar thermal systems in Greece. As the oil prices reached a peak and the responsive electricity prices in Greece grew in accordance it seemed more cost effective for the Greek households at that particular period to invest in long lasting products such as thermosyphons. Moreover the fear of rising consumer prices because of the application for the first time of the value added tax in the Greek taxation system increased the purchases of DSHWS. Nevertheless, until today the main motivation to purchase a DSHWS is the economic savings. A study conducted by the Greek Solar Thermal Association shows that the payback period is estimated from 5 to 10 years. The low initial cost of the investment along with the financial incentives that the government offered during the decades of 1980 and 1990 boosted the demand. Low interest loans that existed that particular period in accordance with given tax credits to the households that would install the systems played an essential role to the diffusion of the systems in the local markets. An additional reason to the preference to solar collectors was and is until today the comfort that a DSHWS allows the owner. In the conventional case of the electrically heated hot water, the heater is turned on just before consumption is going

to take place in order to save energy losses, thus requiring a waiting time for the water to be heated up (GSIA: 2001). To buy a solar system in Greece is as easy as to buy an electric heater. As most roofs are flat, the installation is easy, too.

The special climatic conditions and the high level of solar radiation that the country is enjoying both play a significant, if not the most important reason for the industry's advance. Nevertheless the prospect for an even further development is high. It is estimated that only one third of the potential is advanced (Argiriou: 2003). Future perspectives are encouraging and DSHWS can play an important role in the energy and the environmental policy of the country.

2.2.2. A comparison to the FO.S program

Similarities

Both of the policies concern the diffusion of innovative technologies, friendly to the environment that make use of the high solar radiation ratio that Greece receives throughout the year in to produce energy. The DSHWS systems and the PV systems with their application reduce Greece's carbon footprint, help in the confrontation of climate change and facilitate the penetration of RES in the national energy mix.

Another important similarity of the two cases is the fact that the systems are placed on the available rooftop space of a building. However what needs to be noted is that different building provisions are employed as the relatively small size of a thermosyphon allows the placement on the rooftop site of more than one system. On the other hand 1kW of a PV application requires free space of around 10 to 12 m² (Georgiou: 2010) and the building code in this case allows the placement of only one system on each rooftop (JMD: 2009).

Furthermore the two cases represent economic environmental policy instruments. The economic instruments target at changing the benefits and/or the costs of the individual, groups of people or parties they refer to (OECD: 1994).The fact that tax exemptions, low rate loans in the case of the solar thermal market and the favorable FiT scheme for the case of the rooftop program, constitute a basic part of both of the policies immediately place them along the economic instruments the government has put forward to help in the development of a market segment.

Differences

The first element that someone could identify as a major difference is the relatively low amount of initial capital that needs to be invested to install a thermosyphon and the significantly high one that is a prerequisite to set up a PV system on a rooftop. The cost for a thermosyphon can vary from 500 to 1.500 euros according to size of the system. (GSIA: 2010). The low price provides the solar thermal application with a great advantage that needs to be acknowledged. On the other hand the initial investment capital for the installation of a PV system on a rooftop is around 5.000 for each kW. The company representatives stated that "*with a good investigation in the market and with the unit and panels costs falling constantly one could find the kW at 4.000 euros*" (Chatzinikolaou, Georgiou, Kefalas: 2010). Nevertheless the interested individual would have to invest 25.000 to 50.000 euros for an installation of 5 to 10 kW.

The timeframe for the two cases is as realized by the overview of the historical development of the solar thermal market, completely different. The solar thermal market has been growing for the last 35 years which is a rather significant period of time that allowed the gradual development of the market. On the other hand the FO.S program has only been implemented for a year. Nevertheless the parallel evaluation of the differences and the similarities between the two cases allows the researcher to identify and analyze the positive elements that facilitated the growth on the one hand, and on the other hand utilize them to outline, along the comparison, some suggestions for a better policy design for the FO.S program.

As stated in the previous sections one of the major reasons the solar thermal market development was boosted was the fact that the Greek government launched two big marketing campaigns to encourage the use of DSHWS. The campaigns promoted the policy through the means of the communication that were available at that time, the television and the radio. This element is lacking from the promotion that the current government is putting on the program. The only governmental promotion is done through the website of the Ministry of Development. HELAPCO also advertises the FO.S program through its electronic site. The rest of the advertisement is done as stated by the PV companies. Notably the use of computers and the internet altered the advertisement framework greatly the last two decades but some of the

respondents argued that television is still a more direct means of communication and refers to the wider range of population in Greece. It is therefore believed, however simple it might seem, that a broad state campaign on the FO.S program on the television, the radio in accordance to electronic advertisement will help in the diffusion of the PV systems.

The early foundation of the Greek Solar Industry Association constitutes an additional factor that facilitated the steady development of the solar thermal market. The per se existence of a forum where the companies could express themselves and promote their concerns and ideas on how to take the sector a step further helped along with the two major advertising campaigns that were sponsored by the Greek government to build up a continuous growth rate. (Karagiorgas et al: 2001). Accordingly the Hellenic Association of Photovoltaic Companies was founded in 2002, during the early years of development of the Greek PV market. In spite the fact that HELAPCO is making a significant effort to inform the PV companies and the public with constant news bulletins published in its website, almost half of the company representatives, when they were asked to judge the work that HELAPCO is putting forward to communicate and lobby the sector's interests reacted rather negatively and stated that the association remains rather inactive towards this direction. On the contrary GSIA is lobbying strongly the sector's interests something that can be even detected from the preconditions that need to be filled for the entrance to the program. Article 3 specifically states that someone in order to be suitable for the FO.S program needs to cover part of his/her hot water needs from a renewable source namely a solar thermal system (JMD: 2009)

A final remark can be made on the fact that the solar thermal industry participated actively in Research and Development Programs (RDP), usually funded by the European Union. The participation in the programs enhanced the industry's forces to bring about innovative solutions in the construction of DSHWS with a result the transformation of the industry into a great power of exports of solar thermal collectors (Tsilingiridis: 2010). A review of the most recent EU report on RTD projects on solar energy and Photovoltaics (EU: 2009) is indicative of the very small rate of participation of the Greek PV companies in such projects. On the contrary the participation of Greek solar thermal companies in many of the projects outlined in the

report illustrates the difference among the development of the solar thermal industry and the overall Greek PV industry that seems to move in a rather slow pace.

2.3. An conceptualization based on sustainability science

Greece drafted in 2002 its National Strategy for Sustaible Development (NSSD). The strategy considers the abatement of climate change as one of its central environmental objectives because it is seen *"as one of the major environmental hazards, since the pressures of desertification, water scarcity and temperature rise are already clear in Greece"* (NSSD: 2002). According to the strategy there are four main sectors of action for the confrontation of Climate Change. These are:

- *Reform and diversification of energy offer*
- *Rational use and conservation of energy*
- *Measures for the reduction of other greenhouse gases*
- *Institutional measures*

The process of reframing offers the researcher the opportunity to view the same issue but under a different context, a different frame. (Olsson: 2008). Up until now this thesis report has concentrated on depicting the implementation flaws of the FO.S. program according to the existing policy design. What if the central problem was not anymore the ineffective application of the policy but the problem of a monodimensional policy design that addresses only one of the aspects that should have been addressing to tackle the problem it proclaims it does? Keeping in mind the fact that the policy in question is part of a larger set of policies that tackle Climate Change in accordance to the fact that the abatement of Climate Change is one of the main objectives outlined in Greece's National Strategy on Sustainable Development allows the author to claim that it is a matter that relates to sustainable development. The focus is therefore transferred to the wider spectrum of policies that the program is part of and can also be examined by the optical corner of sustainability science.

The results from the interviews that were conducted indicated a need for change in the goals of the policy. The discussions around the policy design concentrated on the need for a more long-term strategy. Despite the fact that the initial intention to structure a

strategy that addresses such a great challenge like climate change is hopeful and relatively new for the Greek environmental policy context, it does not correspond to the attention that needs to be put in order for it to achieve its best results according to sustainable development. In other words the policy is considered to be incomplete and monodimensional.

The policy makers and the respective factors that are responsible for carrying the program out are only viewing one of the aspects, that of the economic investment. The promotion done until now on the project focuses only on the logical investment characteristic of the program, the high price of the kWh and the favorable contract signed with the PPC. Such kind of promotion of the policy is of course desired but still needs to be extended. The immediate involved parties such as the PV compnanies, PPC, RAE, CRES and the bankers argued vigorously for a better policy design but they concentrated on the aspect of the limitation of bureaucracy regarding the building code deficiencies that put obstacles to the diffusion of the policy. On the other hand the research that was conducted gave the author the opportunity to come across opinions that do not concentrate only on the design of the policy regarding its financial investment aspect but also in its societal and environmental. The views formed by the academia (Tsialtas: 2010) and the Non Governenmental Organisations representatives (Plitharas, Ibrahim: 2010) highlighted the importance for a more concrete multidimensional strategy, closer to the paradigm of sustainability, that has a substancial impact on the behavior Greek citizens adopt towards the conservation of the natural environment. Indicative of this environmental behavior deficit is the fact that the only motive that drives the individuals to participate in the FO.S program is the economic, according to all of the company representatives.

SECTION D

POINTS FOR DISCUSSION

During the interviews with the various stakeholders a particular issue was often brought up. Stakeholders often expressed their fear that the Greek Photovoltaic market will follow the example of Spain if the market does not grow in a healthy pace. As seen, the Spanish PV market after experiencing a tremendous growth the last years faces now serious problems because of the government's incapability to pay off the FiT. A comparison of the Greek PV market with the Spanish one and the

identification of the challenges the last one is facing could offer some important policy insights for the steady development the PV sector in Greece.

A recent study in the UK (Keirstead: 2007) indicated that with the appropriate information, photovoltaic systems integrated in the domestic sector can encourage a conservation in the energy that the households consume. A similar study in Greece is now rather difficult to be conducted due to the very limited time the FO.S program has been in place. Nevertheless the idea for a research that would attempt to connect technology diffusion with behavioral response could create the ground for the research that is related field to take a step forward.

OUTLINE

This thesis research concentrates on the evaluation of the recently introduced Greek Rooftop Photovoltaic program, namely the FO.S program. After a conduction of a series of interviews with the main stakeholders of the PV sector in Greece the researcher was able to discover the major challenges that the FO.S program has been facing during its implementation. The bureaucratic procedure despite the fact that seems simple from a first sight proves not to be especially due to the ignorance and reluctance towards change that the employees in the responsible Urban Planning Offices often show. The need for a government awareness campaign that reaches out to the public more effectively is stressed. The problems identified indicate a deficiency in the overall policy design and the ability of the relevant administrative forces to implement it. However, the policy encloses all three dimensions that sustainable development addresses; that is the environmental benefit which is translated into carbon dioxide savings, the economic investment the program offers as well as the societal factor expressed in the active participation of simple citizens. A need to address the policy in relation to sustainability therefore is highlighted.

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LIST OF REFERENCES

Argiriou, A. & Mirasgedis, S., (2003) The solar thermal market in Greece-review and perspectives, Renewable and Sustainable Reviews, 7, 397-418

Bryman, Alan (2004) *Social Research Methods*, Oxford: Oxford University Press

Bryman, A., (2006) Integrating quantitative and qualitative research: how is it done?, *Qualitative Research, 6*, 97–113.

Cameron, A., (2010) Spanish PV after the Crash. While PV is not booming in Spain anymore, it is still a 600 MW market, 29.04.2009 Retrieved from http://www.renewableenergyworld.com/rea/news/article/2010/04/spanish-pv-after-the-crash

Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., Jager, J., Mitchell, R. B. (2003). Science and Technology for Sustainable Development Special Feature: Knowledge systems for sustainable development, *14.* 100: 8086-8091

Celik, A., Muneer, T., Clarke, P., (2009) A review of installed solar photovoltaic and thermal collector capacities in relation to solar potential for the EU-15, Renewable Energy, 34, 849-856

CRES [Centre for Renewable Energy Sources] (2009) *Energy Outlook of Greece*, February 2009, Retrieved from http://www.cres.gr/kape/publications/download.htm

Commission of the European Communities (2008) Commission stuff working document, Impact Assessment , 'Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020', SEC,85/3

Denzin, N., (1970) *The research act in sociology: A theoretical introduction to sociological methods*, London: Butterworths

European Parliament and the Council of the European Union (1996) 'Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity' *Official Journal of the European Communities L 27*

European Parliament and the Council of the European Union (2001) 'Directive 2001/77/EC of European Parliament and the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market', *Official Journal of the European Communities* L 283/33

European Parliament and the Council of the European Union (2003) 'Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport', *Official Journal of the European Communities* L 123

European Parliament and the Council of the European Union (2003). 'Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity' *Official Journal of the European Communities* L179

European Parliament and the Council of the European Union (2009) 'Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources' *Official Journal of the European Communities* L179

European Parliament and the Council of the European Union (2002) 'Decision No1600/2002/EC of the European Parliament and of the Council of 22 July 2002 Laying Down the Sixth Community Environment Action Programme', *Official Journal of the European Communities* L242(45): 1–15.

European Commission (2009) *Photovoltaic solar energy — Development and current research*, Luxemburg: Official Publications of the European Union

EPIA [European Photovoltaic Industry Association] (2009) Global Market Outlook for Photovoltaics Until 2013, Retrieved from http://www.epia.org/publications/epia-publications.html

EPIA [European Photovoltaic Industry Association] (2009) Annual Report 2009, Retrieved from http://www.epia.org/publications/epia-publications.html

EPIA [European Photovoltaic Industry Association] (2010*) Overview of European PV Support Schemes*, Retrieved from http://www.epia.org/policy/national-policies.html

Farej, T., (2009) Sustainability and Development, Lecture notes, LUMES

Fernandez-Alles M. (2008) The Neoinstitutional Analysis of Change in Public Services, *Journal of Change Management ,8*, 3-20

Fouquet, D. & Johansson, T., (2008) European renewable energy policy at crossroads—Focus on electricity support mechanisms ,*Energy Policy, 36,* 4079–4092

GSIA [Greek Solar Industry Association] (2001) "*The Greek Solar Thermal Market. Overview of the market situation"*, Retrieved from http://www.ebhe.gr/pages/english/solarmarket.htm

HELAPCO [Hellenic Association of Photovoltaic Companies] (2009) *New Incentives for rooftop PV in Greece,* Retrieved from http://www.helapco.gr/index_en.html

HELAPCO [Hellenic Association of Photovoltaic Companies] (2009) *SOLAR ROOFTOPS: a practical guidance for the installation of photovoltaic systems on the residential sector,* (in Greek) Retrieved from http://www.helapco.gr/index.html

HELAPCO [Hellenic Association of Photovoltaic Companies] (2010), *Law for the Renewable Sources of Energy: Frozen of the license procedure*, (in Greek) Retrieved from http://www.helapco.gr/pages/greek/nea.html

HTSO [Hellenic Transmission System Operator] (2010*), An introduction to the market of Renewable Sources of Energy in Greece: the legislation* , (in Greek), Retrieved from

http://www.desmie.gr/content/index.asp?parent_id=44&cat_id=1403&page_id=2340&lang=1

HTSO [Hellenic Transmission System Operator] (2010), *The company profile*, (in Greek) Retrieved from http://www.desmie.gr/content/index.asp?parent_id=21&lang=1

HTSO [Hellenic Transmission System Operator] (2010) *Photovoltaic systems on buildings in the mainland of the Greece, the licensing procedure, (in Greek),*

Retrieved from *http://www.desmie.gr/content/index.asp?parent_id=44&cat_id=1403&page_id=2350&lang=1*

IEA [International Energy Agency] Photovoltaic Systems Programme, Annual Report 2008, *"Implementing agreement on Photovoltaic Power Systems"*, Retrieved from http://www.iea-pvps.org/

Karagiorgas, M., Botzios, A., Tsoutsos, T., (2001) Industrial thermal solar application Greece. Economic evaluation, quality requirements and case studies, *Renewable and Sustainable Energy Reviews ,5*, 157-173

Kates, R. W., Clark, W. C., Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., McCarthy, J. J., Schellnhuber, H. J., Bolin, B., Dickson, N. M., et al. (2001)Environement and Development: Sustainability Science ,Science 292, 641-642.

Kautto, P. and J. Similä (2002) 'Recently Introduced Policy Instruments and Intervention Theories', paper presented at the 5th Conference of the European Evaluation Society, Seville, 10–12 October.

Keirstead, J., (2007) Behavioural responses to photovoltaic systems in the UK domestic sector, *Energy Policy, 35*, 4128–4141

Kotsakis, E., (2003) Matters of horizontal and vertical property, *Digesta, A*, 97-118 (in Greek)

Lundin, M. (2007) When Does Cooperation Improve Public Policy Implementation?, *The Policy Studies Journal, 35,* 629-652

Marshall, K., & Rossman, G., (2006). Designing Qualitative Research. Thousands Oaks: Sage Publication

Mickwitz, P., (2003) A Framework for Evaluating Environmental Policy Instruments: Context and Key Concepts*, Evaluation, 9,* 415-436

Mikkelsen, B., (2005) *Methods for Development Work and Research: A new guide for practitioners*, London: Sage

Ministry for the Environment, Physical Planning and Public Works (2002) *National Strategy for Sustainable Development*, Greece, (Executive summary) Retrieved from www.minenv.gr/4/41/000/nssd-english-final.pdf

Ministry of Development (1994) Law 2244 '*Regulation on issues related to the production of energy from renewable sources of energy and conventional fuels and other provisions'*, 07.10.1994, Government Gazette Vol. 168 (in Greek) Retrieved from

http://www.desmie.gr/content/index.asp?parent_id=44&cat_id=1403&page_id=2340&lang=1

Ministry of Development (1999) Law 2773 'Liberalization of the electricity market. Regulation of matters of the energy policies and other provisions', 22.12.1999, Governmental Gazette Vol.286 (in Greek) Retrieved from http://www.desmie.gr/content/index.asp?parent_id=44&cat_id=1403&page_id=2340&lang=1

Ministry of Development (2006) Law 3468 'Production of electric energy from renewable sources of energy and cogeneration of electricity and thermical energy of high efficiency', 27.06.2006, Government Gazette Vol.129 (in Greek) Retrieved from http://www.desmie.gr/content/index.asp?parent_id=44&cat_id=1403&page_id=2340&lang=1

Ministry of Development (2009) Law 3734 'Promotion of the cogeneration of two useful sources of energy, regulation of matters related to the hydroelectric plant of Mesochora and other provisions', 28.01.2009, Government Gazette Vol.8 (in Greek) Retrieved from http://www.desmie.gr/content/index.asp?parent_id=44&cat_id=1403&page_id=2340&lang=1

Ministry of Development (2009) Joint Ministerial Decision 12323 *"Special program of development of photovoltaics on buildings and especially on the rooftop of*

residential units", 04.06.2009, Government Gazette Vol.1079, (in Greek), Retrieved from http://www.ypan.gr/5526_cms.htm

Ministry of Development (2009) *"Building provisions for the installation of photovoltaic systems until 10 kW on the rooftops of buildings"*, 20.07.2009, Government Gazette Vol.344, (in Greek). Retrieved from http://www.ypan.gr/5526_cms.htm

OECD [Organisation of Economic Cooperation and Development] (1994) *Managing the Environment: The Role of Economic Instruments*. Paris: OECD.

Olsson, L., (2008), Sustainability Science , lecture notes, LUMES

Ottoson, J. M. (2009). "Knowledge-for-action theories in evaluation: Knowledge utilization, diffusion, implementation, transfer, and translation", *New Directions for Evaluation, 124,* 7–20

PPC [Public Power Corporation] (2009) *Annual Report 2008*. Retrieved from http://www.dei.gr/Default.aspx?id=5714&nt=18&lang=2

PV LEGAL (2010), Segment A: a small scale installation on residential buildings Retrieved from http://www.pvlegal.eu/en/database.html?tx_sbpvlegaldb_pi1[selCountry]=1&tx_sbpvlegaldb_pi1[browseCountry]=49&tx_sbpvlegaldb_pi1[lifecycle]=862&cHash=ecb4b63ff4

Rossman, G.B., & Rallis, S.F., (2003). *Learning in the field: an introduction to qualitative research*, Thousand Oaks, CA: Sage

Sidiras, D., & Koukios, E., (2004) Solar systems diffusion in local markets, Energy Policy, 34, 2007-2018

Silverman, David (2005) *Doing Qualitative Research*, Los Angeles: Sage.

Spratley, W., (1998) Solar rooftops as distributed resources, *The Electricity Journal*, 40-52

Theocharis, T., Papadopoulou, E., Katsiric, A., Papadopoulo, A. (2008) Supporting schemes for renewable energy sources and their impact on reducing the emissions of greenhouse gases in Greece, , *Renewable and Sustainable Energy Reviews ,12,* 1767–1788

Tsilingiridis, G., & Martinopoulos, G., (2010) Thirty years of domestic solar hot water systems use in Greece-energy and environmental benefits-future perspectives, *Renewable Energy*, 35, 490-497

Vedung, E. (1997) *Public Policy and Program Evaluation*. New Brunswick, NJ: Transaction Publishers.

Yin, Robert (2003) *Case Study Research: Design and Methods*, London: Sage.

APPENDIX

A. Example of questionnaire

1. Which is the sector in the photovoltaic market that your company is involved in?

☐ Study and process of applications ☐ Trade of Photovoltaic Systems ☐ Installation of Photovoltaic Systems ☐ Manufacture of Photovoltaic Systems

2. Do you know about the existence of the FO.S program?

☐ Yes ☐ No

3. How were you informed about its existence?

☐ Press(newspapers, magazines) ☐ Internet

4. How do you judge the legal framework of the program?

☐ adequate ☐ inadequate

5. How do you judge the financial framework (FiT) of the program?

☐ adequate ☐ inadequate

6. Which are, according to your opinion, the challenges that the FO.S program has been facing during its implementation?

☐ public awareness ☐ bureaucratic procedure ☐ policy design

Other (please specify)

7. Has your company received any measures of advertisement to promote the program?

☐ Yes ☐ No

8. How do you judge the FO.S program in general?

☐ excellent ☐ very good ☐ average ☐ bad

9. Notes

B. Type of questions asked during the semi structured open-ended interviews

1. Which are the challenges that you think the FO.S program has been facing during its short period of implementation?
2. Do you believe that the program accomplishes at any rate its initial goals?
3. Do you think that the overall policy design and application can be regarded as successful?
4. How does the information about the program reach the wide public?
5. How do you think the program could be improved in order to achieve better results?
6. How do you judge the legislative framework of the program?
7. How do you judge the financial scheme that supports the FO.S program?
8. How do you judge the program in general
9. Do you think that the actions taken by HELAPCO are promoting the interests of the PV sector? If not why? (Particular question asked to the company representatives)
10. Which is the motive for an individual to participate in the FO.S program according to your experience? (Particular question asked to the company representatives)

C. List of respondents

Respective Stakeholders

1. Mr. Kostas Spyropoulos , Chief Director, Secretariat of Energy and Natural Resources, Ministry of Development
2. Mr. Tselepis, Executive Manager, Centre for Renewable Sources of Energy
3. Mr. Papachristou, Executive Manager, Regulatory Authority of Energy

4. Mr. Kiriakos Aslanoglou, Executive Manager, Management Directorate for the Grid, Public Power Corporation
5. Mrs. Maria Georgiadou, Communications Manager, Hellenic Association of Photovoltaic Companies
6. Mr. Dimitirs Ibrahim, Energy Campaign Coordinator, Greenpeace
7. Mr. Achilleas Plitharas, Climate Change Campaign Coordinator, World Wide Fund
8. Mr. Grigoris Tsialtas, European Centre for Environmental Research and Proficiency, Panteion University of Athens of Social and Political Sciences
9. Mrs. Chrisa Kourasi, Customer Service supervisor, Eurobank
10. Mr. Panagiotis Fetsis, Customer Service supervisor, Green Banking Branch, Bank of Piraeus

PV Company Representatives

1. Mr. George Georgiou, Engineering and Installations Department, HELIOSRES, Renewable Energy Sources
2. Mrs. Asimina Gortza, Production and Management Engineer, Sales Department, HelioMechanics S.A., Renewable Energy Systems
3. Mr. Vasilis Zorbas, Mechanical Engineer, Division of PV Power Plants, Wurth Solar Gmhb & Co. KG
4. Mr. Stavros Tsakiris, Mechanical Engineer, Area Sales Manager, R.E.S. Department, KLT Energy
5. Mr. Manthos Moutsios, Financial Director, Mantos Moutsios and Associates, Renewable Sources of Energy
6. Mr. Nick Andriopoulos, Financial Director, Q-pv, Quality Photovoltaics, Technical Studies and Installations
7. Mr. George Drosos, Mechanical Engineer, Sales Manager, SUNLIGHT, creating energy
8. Mr. Nikos Chatzinikolaou, Marketing Manager, ExelGroup, Green Technologies
9. Mr. Dimitris Chalkias, Civil Engineer, Sun Value Technologies
10. Mr. Giannis Kalapodas, Sales Department, Photovoltaic Systems, SunRise PV

11. Mr. Yiannis Daskalakis, Commercial Director, Renelux, Renewable Energy Systems
12. Mr. Alexandros Kagioglou, Sales Engineer, Enolia Solar Systems S.A.
13. Mrs. Katrina Kyriakides, Executive Manager, Global-Energy solutions ltd, Renewable Energy applications
14. Mr. Alexandros Barouxakis, Mechanical Engineer, Sales Manager, Procom Energy
15. Mrs. Sofia Papalexiou, Executive Manager, Ptolemeo S.A.
16. Mr. Konstantinos Bethanis, Project Development, ACTIVUS, Engineering, Procurement & Construction
17. Mr. Apostolis Tsolakis, Mechanical Engineer, Engaia
18. Mr. Antonis Rountas, Technical Support, Aresti Power, Renewable Energy applications
19. Mr. Georgios Kefalas, Electrical Engineer, Perseus Electronics
20. Mr. Petros Krontiras, Mechanical Engineer, Sales Manager, K&M Energy

D. The rest of the statistical data retrieved from the questionnaires

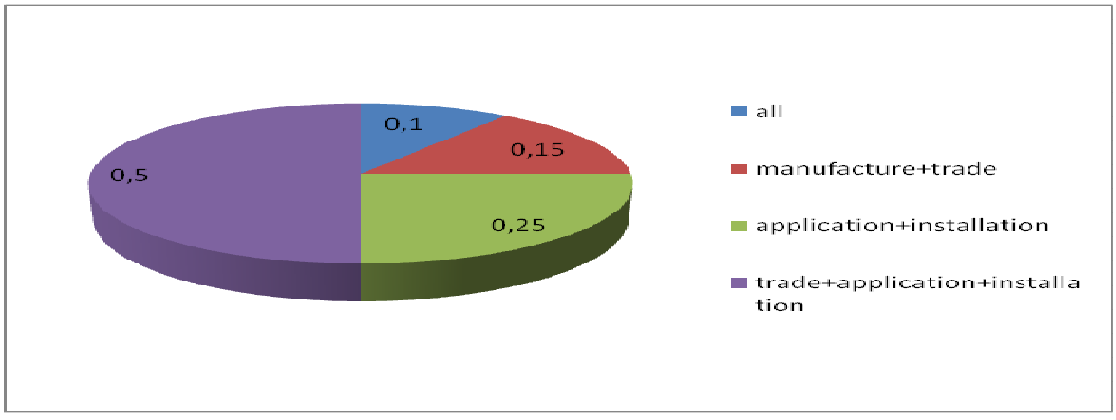

Table 1. The sectors of occupation of the PV companies interviewed

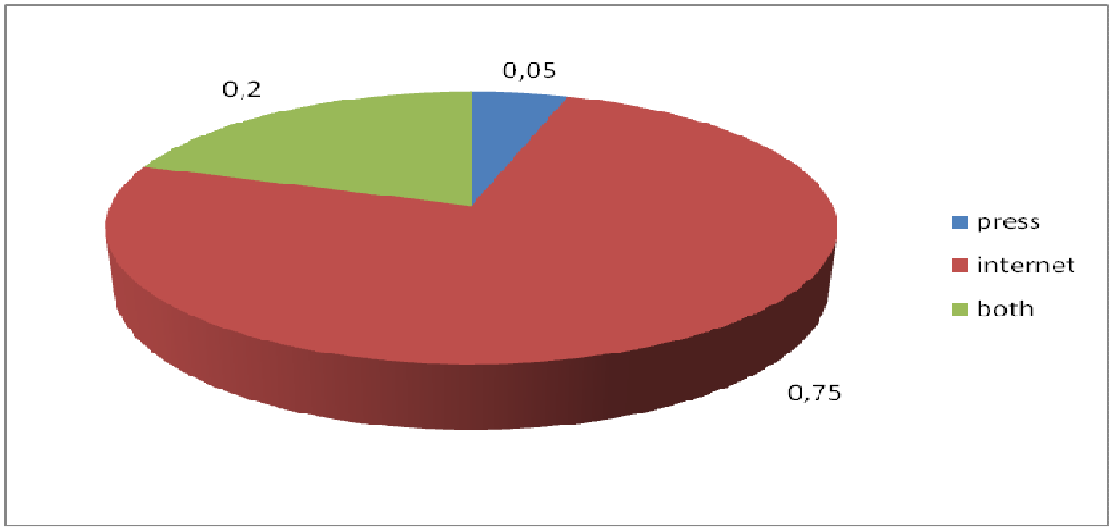

Table 2. The distribution on the way companies were informed on the existence of the program