Universiteit Utrecht

GREENING GREECE?

AN ANALYSIS OF PREREQUISITES FOR A SUSTAINABLE ENERGY SECTOR

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Abstract

Over the years, governments increasingly show interest on renewable energy sources and try to establish a switch from fossil fuel electricity production to green electricity production. Nevertheless, this process has been proved rather difficult and barriers impede the way towards renewable energy growth. This thesis explores the conditions that lead to successful implementation of energy policies for the development of wind and photovoltaic energy. The methodology that was employed in order to create a set of framework conditions is based on the theories of institutional capacity-building for renewable energy sources, the implementation capacity framework for renewable energy projects and an analysis of the barriers that might occur when implementing energy policies. The research also investigates the conditions that led to massive development of wind and photovoltaic energy in Denmark and Germany respectively. After having developed a final set of "success" conditions, the research focuses on Greece – a country of great potential in solar and wind energy but rather low in effectively implementing policies. The Greek case is analyzed in order to investigate if "success" conditions are present in the energy market. The thesis concludes by presenting recommendations to address the weaknesses of the Greek energy policies and create opportunities for the "success" conditions to appear so as to develop solar photovoltaic and wind energy in Greece.

Preface

My reasons for taking the decision to focus on this research projects were mainly driven by my willingness to gain insight on analysing energy policies and making it possible for renewable energy sources to further develop and appear as a real alternative to what already exists. However during this process I realised how many people would eventually become involved and help me accomplish this important task.

Firstly, I would like to thank my supervisor Carel Dieperink for his continuous support, encouragement and valuable advice. I am extremely grateful for his guidance and I hope that he enjoyed working with me as much as I enjoyed it.

Furthermore, I would like to express my gratitude to the people in Greece who gladly accepted to help me and dedicate some of their time in order to enlighten me with their knowledge and information during the interviews that I conducted. Our discussions were of major importance for writing this thesis.

Lastly, I am very grateful to my family, Vassilis, Giannis, Stavros, Amalia, Suzette, Agis, Vangelis, Angeliki and other friends for being by my side and helping me in conducting this research. I am very happy to have you all!

During this research I learnt a lot and I can only hope that whoever reads this report will get as inspired as I was during this process.

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1. Introduction

1.1. Green Energy on the European Agenda

Energy is a crucial component for the social and economic development of Europe. As a response to the awareness of the environmental consequences resulting from the current energy regime based on fossil fuels, the demand for sustainable energy keeps growing. Sustainable energy sources are indigenous and can help reducing the dependency on fossil fuels, improving energy security while also reducing greenhouse gas emissions (Herbert et al., 2007).

As a matter of fact, energy consumption is increasing by 1-2% each year in all EU member states (Technical University of Crete, 2007). Moreover, a recent publication on renewable electricity in Europe by Jäger-Waldau et al (2011) states that "the energy dependence of the European Union (EU) on energy imports has increased to 54.8% of energy imports in 2008, because the Union's own indigenous energy production is insufficient for the Union's energy requirements. The declining fossil energy production in the Union implies that the EU's import dependency will further increase if no countermeasures are taken." Moreover, renewable energy sources such as solar energy, wind, geothermal, biomass small-hydro and wave energy may reduce conflicts regarding energy reserves, facilitate or necessitate the development of new technologies or improve existing ones and reduce air, water and land pollution (Kothari et al,2010).

As a reaction to the demand for more sustainable energy and less use of fossil fuels, the European Commission released the Directive 2009/28/EC (RES) on the promotion of the use of energy from renewable sources in order to boost the use of renewable of energy sources. Consequently, the member states introduced policies and legislations so as to ensure that the share of energy from renewable sources is consistent with the target of at least 20% share of energy produced by renewables in the Community's final consumption of energy in 2020 (van Koten et al, 2008).

1.2. The situation of Greece

As shown by IEA's statistics (2009), in Greece the most developed renewable sources in producing electricity are hydro power (5645 TWh), wind power (2543 TWh) and solar PV (50 TWh) in 2009. Nevertheless, hydro power has not increased substantially during the last decade therefore, potential can be seen in both solar and wind power. Consequently, the energy policies considering these two renewable energy sources will be investigated in the study as the ones with greatest potential in Greece.

Greece is obliged to implement the RES Directive but in reality the implementation stage is still in infant stage. In Greece, the electricity industry is dominated by the vertically integrated, state-owned Public Power Corporation (PPC). According to Regulatory Authority of Electricity in Greece, in 2010 the PPC generated and supplied 93% of the country's electricity, owned the transmissions network; and owned and operated the distribution network and supply. The main fuel for electricity generation is lignite and the mines are operated and owned by PPC. The share of renewable energy sources in electricity production is still low but gradually it gains more support.

Moreover, Greece has a significant number of islands that are not connected to the main electricity system and their energy supply is mainly covered by oil. These islands account for approximately 8% of total electricity demand (IEA,2006).

1.3. Knowledge Gap

Greece as a member state of the EU is influenced by the Directive 2009/28/EC for the promotion of renewable energy sources (RES Directive) hence, it must be implemented. Greece aims to achieve the binding target of 20% for the share of renewables in gross final consumption of energy by 2020 according to the RES directive with wind power contributing with 7.5 GW and solar PV power with 2.2 GW (NREAP, 2011). However, the current energy system encourages the use of non-sustainable energy sources which further burden the environment and impede the implementation of the RES Directive in Greece. Moreover, Greece is far from realising a liberalized electricity market. Even though, legislation was formed already in 1999, successful implementation has not yet occurred.

It is assumed that the adopted policies or legislations have faced barriers which hinder a full and complete implementation of the abovementioned directive. Therefore, the study aims to identify the conditions that contribute to the promotion of solar PV and wind power and result to a higher penetration in the share of electricity production.

The case of Greece provides us with an example in which the institutional, political and economic context is in favour of the incumbent utility PPC which discourages the development of fair competition in the electricity market as well as the development of a green electricity market. Therefore, there is a strong need to identify which are these barriers and how they can be tackled in order to create the appropriate conditions for boosting the production and consumption of green electricity.

1.4. Research Aim and Methodology

The research is focused on two Directives, namely the Directive on the promotion of the use of energy from renewable sources and the Directive concerning common rules for the internal market in electricity. The aim of this research is to explore the conditions which will lead to wind and solar PV development in Greece and provide with **recommendations for improvement** towards a sustainable energy sector. This is done by:

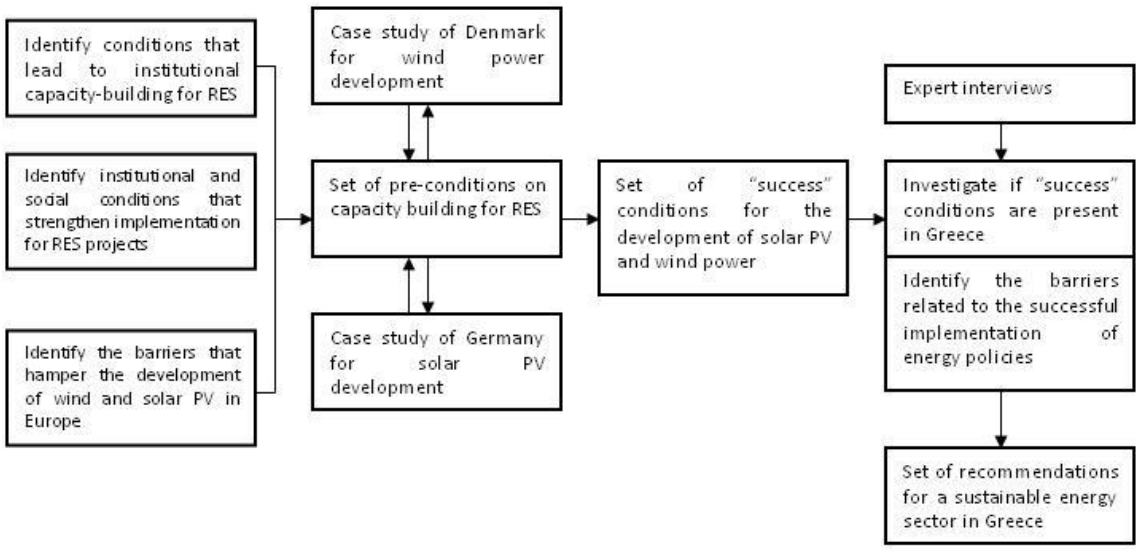
- Developing a set of conditions on the basis of institutional capacities, implementation capacities and barrier analysis for RES projects;
- Describing the case studies of Denmark and Germany in order to construct a picture of best practices in Europe and design a set of “success” conditions;
- Investigating if the “success” conditions are present in the Greek energy market
- Provide with recommendations so as to introduce “success” conditions for a sustainable energy sector

The ***research question*** to be answered in this study is:

To what extent are conditions favorable to the development of wind and solar PV power, present in the Greek electricity market?

The figure below outlines the research framework which will be used in order to successfully answer the research question.

Research Framework



In order to effectively answer this question, the following **sub-questions** have been devised:

1. What institutional conditions lead to capacity-building in order to enhance the production of green electricity?
2. What institutional and social conditions improve the implementation capacity of RES projects?
3. Which are the barriers hampering the renewable energy growth in the European market?
4. What can be learnt from the frontrunner cases regarding the conditions that should be present in order to promote wind and solar PV power?
5. Which "success" conditions are present in the Greek energy sector?
6. Which are the barriers that hamper the implementation of energy policies in Greece?

The theoretical background of the study consists of three types of literature: institutional capacity-building for the promotion of renewable energy sources, the concept of implementation capacity for RES projects and the barriers which impede the successful implementation of energy policies. From this literature a list of conditions is derived which is to be used for the case studies of Denmark and Germany. The cases studies will result to the most important conditions that are present in the Danish and German energy sector and are the most important ones for achieving a sustainable energy sector.

The next part of the study is focused on the situation of Greece. An analysis of the current electricity system and the legal framework regarding the promotion of solar PV and wind power is conducted. Moreover, interviews with the most relevant stakeholders were conducted in order to identify which "success" conditions are present and what are the barriers that hamper solar PV and wind power implementation.

Finally, the study concludes with a discussion concerning the Greek situation and provides with some general recommendations so as to create a favourable environment for solar PV and wind power in the future.

1.5. Data Collection

In order to achieve the objective of this study, information was gathered from different sources. The first sub-question is answered by conducting literature overview as to identify the conditions which contribute to institutional capacity-building for the promotion of RES. Moreover, in order to answer the second question, the implementation capacity framework introduced by Suzanne Agterbosch (2006) is analyzed so as to identify the conditions for implementing RES projects. The third question (regarding the barriers to renewable energy growth) is answered by gathering material from EU reports and industry associations' reports.

Moreover, the case studies on Germany and Denmark (question 4) were conducted by gathering information from governmental websites, policy reports, EU reports, publications from RES industry associations, academic journals and presentations on international conferences for the promotion of RES and support mechanisms.

Finally, in the last part of the study is focused on (question 5 and 6) an analysis of the legislation the electricity market and the development of solar PV and wind power of Greece .In this attempt to describe the Greek energy status, policy reports and legislative journals were reviewed.

Expert interviews hold an important role in this part. Scientific literature and policy reports cannot provide with sufficient information in regards to the conditions which are present of non present in the Greece energy sector. Therefore, key people in the energy sector such as government actors, energy consultants, wind and solar PV industry association members of boards and people from research institutes were interviewed. The following actors were contacted:

- ◊ **Tselikis Ioannis and Sofianopoulos Dimitri**s, Department of customer service for RES investors of the Ministry of Environment, Energy and Climate Change
- ◊ **Rossis Kyriakos**, Wind power department of CRES Centre of Renewable Energy Sources
- ◊ **Kapsalis Georgios**, PPC Renewables, Department of administrative procedures
- ◊ **Papachristou Dionysis, Electric Engineer,** RAE (Regulatory Authority of Electricity) – the main permitting body;
- ◊ **Lampaditou Eyterpi and Manou Eleftheria**, LAGIE (TSO)
- ◊ **Psomas Stelios**, Helapco – Hellenic Association of Photovoltaics
- ◊ **Papastamatiou Panagiotis**, President of ELETAEN- Hellenic Wind Energy Association,
- ◊ **Papastamatiou Panagiotis,** TERNA- Private investment company for wind and PV projects
- ◊ **Aggelopoulou** - SPEF , President of the board of Photovoltaic Producers Association
- ◊ **Kalogerakis Nikos**, PASYF- Greek Association of Photovoltaic Producers
- ◊ **Seimanidis Savvas**, Network Consulting Group- Consultancy company for energy issues

1.6. Outline of the thesis

The below table shows for each of the following chapters what will be discussed and to which research question the discussion relates.

Chapter	Aim	Addressed research question
2.	**To develop a set of conditions for strengthening institutional capacity building for renewable energy sources**	**Sub-question 1**

3.	**To provide insight into the conditions which strengthen implementation capacity for RES projects**	**Sub-question 2**
4.	**To investigate the barriers that appear when implementing energy policies in all EU member states and hamper the promotion of renewable energy sources**	**Sub-question 3**
6.	**To present the case of Denmark and learn lessons for promoting wind power** **To present the case of Germany and learn lessons for promoting solar PV power** **To draw a final set of conditions that need to be present in order to develop wind and solar PV power**	**Sub-question 4**
7.	**To analyze the Greek electricity market and investigate whether the identified conditions are present**	**Sub-question 5** **Sub-question 6**
8.	**To present the conclusions;** **To present recommendations for introducing the conditions which do not exist**	**Central research question**

2. Institutional capacity-building for renewable energy sources

2.1. Introduction

This chapter aims to provide the answer of the first question of what institutional conditions influence the capacity-building in order to promote the renewable energy sources and consequently, the production of green electricity. Section 2.2 defines the concept of capacity for energy policy. Section 2.3 analyzes the framework conditions which strengthen the institutional capacity-building for renewables as shown by literature overview. Section 2.4 gathers all framework conditions in a table which will be used in upcoming chapters for developing the set of the final conditions necessary for developing solar PV and wind power.

2.2. The concept of capacity: Capacity for energy policy

A broad definition by OECD defines capacity as "the society's ability to identify and solve environmental problems" (OECD, 1994). Therefore, problems regarding energy such as security of energy supply or the availability of fossil fuels lead actors to make decisions and develop strategies which will result to the elimination of energy problems. Janicke et al (1997) define strategies as "the purposeful use of instruments, capacities and situative opportunities to achieve long term goals". Moreover, scholars state that decisions made by the governments or private sector should aim at creating long term strategies which improve the conditions of environmental action and that brings us again to the notion of capacity-building.

In this study, institutional capacity[1] is considered as a factor contributing to capacity-building for successful implementation of energy policies. Institutions here are defined as the prescriptions that humans use to organize all forms of repetitive structured interactions including those within organizations, private associations and governments at all scales (Ostrom, 2005). Legal and governmental institution building is a basic precondition for effective public policy. It institutionalizes vested interests in the politico-administrative system as well as responsibilities and accountability and increases the opportunity for civil society players to exert influence (Weaver & Rockman, 1993).

The institutional setting of a country enables innovation and diffusion of green technologies, defines property rights, introduces the terms of electricity production and more importantly, defines the rules of the "game" in the renewable energy arena (Wangler, 2009). As mentioned by North (1991), institutions reduce uncertainty in human interaction through their stabilizing role therefore they are closely related to information flows- an element with major importance when dealing with the energy sector.

Nevertheless, according to Breukers and Wolsink (2007), the design of institutions may encourage the shift from fossil fuels to renewables or raise barriers. For instance, in the competition between renewable energy sources and fossil fuel energy source, the latter is supported by a whole set of institutions favouring it (Jacobson et al, 2000). The key issue here is to what degree the existing

[1] The concept of institutional capacity is defined as the necessary structural conditions for successful policy as well as the strength of civil society and the presence of a common purpose to form coalitions to form that purpose (Healey et al, 1997).

institutions are blocking the emergence of new technologies and how the process of institutional change can be aligned to the needs of renewable energy sources.

Therefore, the degree of the success of energy policy implementation is related to the degree of institutionalization of a country but also, the policy instruments that are enforced to promote renewables play an important role.

Policy instruments, whether they are market-based or command and control create the incentive structure in order to support technology diffusion and industry development but also stimulate investments on green electricity production (Agnolucci, 2009). Therefore, they are also important factors facilitating policy implementation.

2.3. Framework conditions strengthening institutional capacity-building for renewables

Janicke (1997) suggests certain framework conditions which may influence the successful implementation of energy and environmental policies. These conditions define the quality of institutional capacity of a state in order to create a favorable institutional environment for promoting renewable energy sources. The conditions are divided in: the cognitive-informational framework conditions, the political-institutional framework conditions and the economic-technological framework conditions.

2.3.1. Cognitive-Informational framework conditions

According to Janicke et al (1997), it is of major importance that the public is well-informed regarding environmental and energy issues. In order to achieve high levels of public awareness and environmental knowledge the media play an essential role and should be independent, critical and not-biased. Moreover, the existence of a strong epistemic community is rather important and also, influences the levels of public environmental knowledge. Knowledge for environmental dangers is a necessary condition for public awareness and the scientific community is the one to present new problems, solutions or paradigms regarding environmental policy.

Apart from that, a long-term strategy should be oriented towards a general paradigm which points to an overall goal. Therefore, it is important that the policy actors and relevant stakeholders structure their thinking towards the paradigm of "sustainable development of energy supply". If policy makers, civil society and governments are committed to environmental progress and develop capacities to address energy challenges, a transition toward more sustainable energy portfolios may be more likely (Carley, 2009).

2.3.2. Political-Institutional framework conditions

Healey's (1997) concept regarding institutional capacity refers mostly to the capacity to facilitate open-policy processes. Janicke (1997) defines this dimension of institutional capacity, participative capacity, in which policy processes should be characterized by openness but also by decentralization. The ability of citizens, groups and associations to make their voice heard, monitor government's actions and participate in the decision making process is increasingly seen as essential in institutional capacity building.

Another condition which increases the institutional capacity of a state is the extent to which all actors with a stake in decisions about energy strategies are involved in the relevant processes and the extent that national policy makers are able to include all relevant stakeholders (Wolsink et al,

2007) in these procedures. This condition would refer to the integrative capacity (Janicke et al., 1997) of an institutional framework and emphasizes how important it is that public and private entities are integrated during policy making procedures.
Integrative capacities may take place in different levels. A policy can possibly affect many policy fields. In our case, the implementation of a policy regarding the deployment of RES projects in a region has economic, social and environmental consequences which might affect other policy initiatives with similar consequences in the same region. Therefore, intra-policy coordination (i.e. the internal integration of the policy field) and inter-policy coordination (i.e the cross-sectoral integration of conflicting policies) are both necessary for building institutional capacity.

Moreover, the external integration of environmental policy institutions and non-governmental actors, organizations or individuals is another factor which strengthens institutional capacity (Janicke et al, 1997). Co-operation of many organizations, authorities, utilities and individuals is essential for the development of institutional capacity but is also considered as a difficult task to be fulfilled. Thus, it requires good networking skills. The ability to cooperate requires the ability to manage issues "horizontally" across organizations and not "vertically" within organizations (OECD, 2003). There are many critical factors influencing the performance of a network such as: the availability of rules and financial provisions for the network itself, the clear allocation of responsibilities; sufficient authority of the organizations in charge regarding taking action as well as the stability of the institutional arrangements that have been set up for this purpose. The efficiency of such networks may depend on the organizational skills of individuals or organizations but still, the institutional arrangements can be more efficient if the public sector[2] has developed specific processes to manage horizontal issues based on policy integration and public participation.

Therefore, in order to achieve good institutional capacity, good networking capacities are important as well as a monitoring system able to ensure good organizational and coordinative skills among all parties involved.

Another condition which influences the capacity for the deployment renewables is the quality of civil services and their ability to implement sound and coherent policies (OECD,2003). Well-structured civil services with clear allocation of responsibilities reduce bureaucratic problems and save time and money for the investors. For instance, energy projects such as the creation of a wind park or installation of solar panels need the issuing of permits which usually takes a long time and eventually hampers the procedures for the realization of the projects. When civil services have developed good coordination skills, bureaucracy problems are decreased and projects are easily realized.

More important though is the ability of a government to pass policies and regulations which are accepted by citizens, NGOs, and businesses. Political instability and weak governments or political institutions make it very difficult for a country to implement policies including energy policies preventing the creating of an "enabling environment" towards sustainable development (OECD,2003).

At this point of the discussion, it is essential to mention the stakeholders or groups whose interests shouldn't be neglected in the decision-making procedure, thus their existence in the policy arena is important and constitute necessary conditions for the realization of renewable energy projects. A country with high capacity of environmental and energy policy and management should have, for example, many well-organized environmental player groups such us NGOs and politically active ecologists (Weidner, 2002) which are able to influence political decisions and are strong enough to put pressure on policy actors. Most times, environmental groups play a consultative role in

[2] Public sector is defined as the actions of individuals, organisations, or networks of organisations embedded in a wider institutional context (OECD,2003)

governments and increasingly in enterprises decisions too (Janicke, 1997). The existence of such groups increases the "voice" of civil society and strengthens the ability of society to actively participate in decision-making processes. It is also important that these groups have comprehensive and accessible monitoring and reporting systems so as to increase transparency regarding their actions.

Moreover, a flourishing and innovative environmental business sector is an essential factor for the capacity of a country. A "green" business sector is formed by consultancy firms with green views, eco-industry, insurance companies and ecological enterprises which present environmental interests in the society but also, have an impact on the whole economy system. Initiatives coming from green businesses affect the market and develop an environmental spirit within the market which is beneficial regarding public awareness.

All the above mentioned conditions are taking place in the national level. However, the political capacity of a country regarding the deployment of renewables can be increased if this country is a member of an international organization or if it is committed to international treaties. Policies for the promotion of renewable energies have been influenced more and more by international obligations (Reiche et al., 2004). In the European level, there is the EU-directive regarding the production of electricity by renewable energy that gives all Member states motivations for the development of renewable energies until 2020. Furthermore, in the global level, the Kyoto protocol sets obligations regarding the reduction of CO2 emissions and makes it urgent to make transition from fossil fuels energy systems to renewable energy systems. Therefore, obligations by international agreements influence governments towards faster implementation of policies including energy policies.

Concluding, if the aforementioned conditions are met, along with a sound level of social welfare, good economic prospects and a culture supporting the deployment of renewables and sustainable development in general, successful implementation of energy policies is inevitable.

2.3.3. Economic-Technological framework conditions

States with greater wealth, other things equal, will have a higher percentage of renewable energy (RE) because they have the ability to invest more heavily in RE deployment or other green energy opportunities. States with larger growth rates will likely build more power capacity to satisfy growing state demand for electricity therefore, renewable energy deployment may be a viable option for satisfying rising demand (Carley, 2009). A high degree of economic development will spur development in other sectors too such as industry, businesses, utilities but more importantly, it will create the necessary investments and funds for the promotion of renewable energy projects.

The industrial level of a country plays an important role in capacity-building. A strong local industry can have beneficial effects on the local rate of diffusion by being in the position to satisfy the specific demands of the local market. A country with a modern industrial structure is able to create the infrastructure and technology needed in order to realize sustainable energy projects. More important though is the fact that a developed supplier industry can by force of its economic importance more easily influence the institutional set-up and create the institutional conditions in favour of renewable energy sources and technologies (Jacobsson et al, 2000). Apart from that, the existence of strong green industry may contribute to technological innovation and knowledge; a necessary condition for the development and diffusion of green technologies.
Furthermore, good economic conditions and a stable economic system of a state may influence positively investors to invest on green technologies if the financial incentives and the planning system permit such endeavour. . Also, project developers and plant suppliers are highly dependent

on the economic conditions of a state since financial measures and incentives may determine their future business plans (Enzensberger et al, 2002).
The support schemes and policy instruments that are enforced in order to attract investors are very dependent on the economic performance of a country and also may influence the implementation of energy policies as it will be explained in the next chapter

In conclusion, the good economic performance of a state might lead to high capacity building levels but still is a difficult issue to discuss. This is because it has a contradictory impact on environmental and energy issues by influencing both the problems and their solutions (Janicke, 2007). Nevertheless, economic performance is related to research, educational, communicational and administrative capacities which are all important to renewable energy capacity building as mentioned above.

2.4. Conclusions

In this chapter, the first sub-question was answered by describing the concept of institutional capacity and the possible institutional factors that influence energy policies. Institutional capacity-building for renewables has been made operational by describing seventeen conditions necessary for creating a strong institutional framework for promoting renewable energy sources. The framework conditions can be classified in cognitive-informational conditions, political-institutional conditions and economic-technological conditions. The table below shows the above-mentioned framework conditions.

Table 1: Framework conditions strengthening capacity building for the development of renewables.

❖	**Cognitive-informational framework conditions**
1.	High level of public awareness
2.	The existence of unbiased media
3.	The existence of an epistemic community
4.	A general paradigm towards “Sustainable development of energy supply”
❖	**Political-Institutional framework conditions**
5.	Open-policy processes
6.	Integration of all relative stakeholders during policy making procedures
7.	Good intra-policy coordination
8.	Good inter-policy coordination
9.	Good networking skills in organizational and national level
10.	Ability of civil services to implement policies
11.	Cooperation between authorities and all parties involved
12.	Political and institutional stability
13.	The existence of environmental groups and “green” business sector
14.	Membership in an international institution (i.e European Union)
❖	**Economic- Technological framework conditions**
15.	Good economic performance
16.	Existence of strong local industry
17.	Existence of financial and support schemes

3. Implementation capacity concept

3.1 Introduction

In this chapter, the second sub-question will be answered concerning the social and institutional conditions necessary for realizing wind power projects using the framework of implementation capacity. Section 3.2 introduces the concept of implementation capacity concept and describes the actors that the implementation capacity mostly affects. Section 3.3 describes the institutional conditions and section 3.4 describes the social conditions. The last section presents a list of the conditions in a table and conclusions are drawn.

3.2 Introduction to the implementation capacity concept

In order to structure the findings of this research, a framework introduced by Suzanne Agterbosch (2006) is employed. In her research, Agterbosch introduced a framework which groups the conditions for realizing wind power projects[3] in the Netherlands using the implementation capacity concept. According to Agterbosch, Vermeulen and Glasbergen (2007) "Implementation capacity is defined as the total of relevant systemic conditions and mutual interdependencies, and indicates the feasibility for wind power entrepreneurs to adopt a technology. It makes possible to explain, in comparative terms, the changing possibilities over time for different categories of entrepreneurs."

The conditions are divided in four groups; technical conditions, economic conditions, institutional conditions and social conditions. In this research as well as in Agterbosch's research the institutional and social conditions are discussed since these conditions mostly affect the decisions made by relevant stakeholders about investments and determine the opportunities which influence the realization of green energy projects (Agterbosch et al, 2004). Institutional conditions are humanly devised sets of institutions which reduce uncertainties by specifying the rules, facilitate or constrain the actions of the actors involved, define right and obligations and consequently, facilitate the implementation of the legislation (ibid). Respectively, social conditions are actions of the stakeholders (such as government authorities, environmental organizations, landowners etc) involved whether they cooperate or they compete.

3.2.1. Actors

In her research, Agterbosch analyzed four entrepreneurial groups and how the institutional and social conditions along with their interdependencies affected their investments, decisions and implementation capacity. These four groups are the energy distributors, small private investors, wind cooperatives and new commercial independent wind power producers.

The first group, the **energy distributors** represent the former monopolistic sector of the Netherlands and have been the original market players on the RES electricity market, Before the liberalization of electricity market they were obliged to purchase electricity from the (wind) power producers and

[3] Even though the conditions drawn by the implementation capacity framework is referring only to wind power projects, it is believed that these conditions can be also applied to other kinds of renewables hence, they can be operational in the present study which refers to wind and solar PV projects.

had to pay the "most stimulating compensation" [4]for renewable electricity. However, the energy distributors' role changed after the emergence of several Electricity acts, legislations and the liberalization of electricity market. From the end of the 1990s, small private investors dominated the wind market in the Netherlands in terms of number of projects, number of turbines and total installed capacity. **Small private investors** mainly consist of farmers and wind power exploitation is a supplementary income for this group. The third group which is discussed are the **wind cooperatives**. For this group, wind power exploitation is not the means to make income but a way to promote a green, sustainable society based on renewable energy sources. Their contribution to the total capacity installed over the years is of minor importance but their actions are mostly important for raising public awareness, lobbying in favour of wind power and other forms of renewable energy; and consulting wind power investors. The last group is the **new commercial independent wind power producers**. The importance of independent producers increased in the late 90's, after the liberalization of electricity market. This group can be divided in different types of entrepreneurs such and were engaged as consultants for third parties like landowners, utility companies or government authorities.

3.3 Institutional conditions

3.3.1 Rules that determine positions of actors on the electricity market or the market structure

In a monopolistic system private RES producers are obliged to sell their electricity to the regional energy distributor. The energy distributors are obliged to purchase all the electricity which is generated by the producers located in the area in which they have the monopoly.
However, that changed with the publication of the Directive 96/92/EC concerning common rules for the internal market of electricity which introduced liberalization of the electricity market and consequently disintegrated the monopolistic behaviour of the energy distributors. From 1998 (when the Electricity Act was introduced) and on private wind producers were not obliged to sell their electricity to the regional energy distributors and there were regulations which guaranteed access to the grid for private producers. These institutional changes strengthened the implementation capacity of private investors. As of 2001 consumers were free to choose their green electricity company and the demand for green electricity was increased dramatically which further contributed to strengthening the implementation capacity of all entrepreneurial groups for the following years.

3.3.2. Financial preconditions

The availability of financial incentive schemes are of major importance when developing a RES supply market. In the Netherlands, the Standard Arrangement of Redeliveries (1989) and the MAP levy[5] were important institutional conditions which increased the financial feasibility of wind projects. Both conditions gave energy distributors the power to decide on the distribution of MAP subsidies and the conditions for the payback tariffs which had to be agreed by a regional energy distributor and a potential wind power generator on a case by case basis.

Moreover, in 1996 subsidies switched to a green fiscal system in terms of fiscal instruments which were gradually introduced after the investment subsidies proved to be unfeasible under a free market. These fiscal instruments created a favourable to green investments climate and supported the emergence of the new independent wind power producers. A green certificate system came

[4] The methods for calculating the tariffs were set out in the "Standard Arrangements for Redeliveries" which was introduces by the 1989 Electricity Act and were revised annually.

[5] The Milieu Actie Plan- MAP was adopted in 1991 and introduced voluntary agreements that were made between the government and the energy distributors in which distributors committed themselves to a target that renewable electricity would account for 3,2% of electricity sales in 2000.

into effect the same period as the liberalization of the green electricity consumer market which automatically implicated that energy distributors lost their position in financial support of wind power. As a result, the implementation capacity of energy distributors was decreased and the implementation capacity of the private producers was increased.

3.3.3. Preconditions for implementation or planning and permitting procedures.

In order to accomplish a RES project there are several planning and permitting procedures (such as acquiring land ownership, spatial planning, and securing permits) that should be taken into account. Those procedures are not parts of energy policies and are not determined by financial instruments but instead concern policies in other fields such as land use, the environment and nature conservation. Various competing authorities at different levels of government and involved in order for all permits to be issued which is considered to be a rather complex and fragmented procedure.

Planning and permitting procedures differ for each country and type of renewable energy source Therefore; the final conditions suggested by Agterbosch (2006) are not relevant at this point. However, some recommendations can be used which are more general.

During her research Agterbosch noticed that administrative procedures like licensing, permits etc were highly time consuming and costly. Moreover, she mentions that during the trajectory of these procedures there were internal fragmentation or dispersed decision making powers, limited knowledge base of civil servants concerning projects or RES legislation, incorrect implementation of legal norms by the different authorities as well as inconsistency in planning on provincial and municipal level. As a result, relevant stakeholders might have hesitated to make investments or start a project due to insecurity because of the abovementioned reasons as well as changing legislation and deviation from institutional conditions.

3.4. Social Conditions

3.4.1. Characteristics of the entrepreneurial groups

The most important distinctive characteristics of the four entrepreneurial groups are the motivation to invest in wind energy, the degree of professionalism and the position of wind energy as investment option.

Energy distributors had limited motivation in 1990's to invest in renewables since the electricity sector was not in favour of decentralized generation and concerns about environmental degradation were of minor importance at this point. Therefore, the wind energy was not a priority and the implementation capacity of energy distributors was limited and weak.

New independent wind power producers are the only market players that the exploitation of wind power is their core-business. They were the latest group to emerge since for them the market had to be more attractive to invest; and that happened when the market was liberalized. On the contrary, the motivation behind wind cooperatives was ideological arguments and not profits. Finally, for small private investors (mostly farmers) wind power exploitation is an additional income and their biggest asset is that they own land so they could install turbines since the legislation was favourable to this kind of projects. As a result of a series of legislations, implementation capacity for energy distributors was decreased in comparison to the implementation capacity of private power investors.

The differences among the entrepreneurial characteristics partly explain the differences in performance. Therefore, in order to boost RES investments there should be high motivation to invest, high degree of professionalism among the stakeholders and the climate for RES should offer investment options.

3.4.2. The social constellation of stakeholders and their perceptions

It was mentioned before that in order for a wind power project to be developed there were several players that had to be involved (from government authorities at different levels to land owners, environmental organizations and local residents). The local political debate about wind energy showed that there are important social conditions at the operation level of implementation. It was observed that there was a confrontation of ideas about wind energy and questions such as the contribution of wind power to climate change or the necessity and importance of wind power in relation to the costs. Questions like these affected negatively political decisions, the public opinion and entrepreneurs; and showed that stakeholders with different interests might easily turn the public opinion against renewable energy sources.

3.4.3. The interaction between wind power entrepreneurs and other stakeholders

Interaction between wind power entrepreneurs and other stakeholders involved in local or national level might determine their opportunities[6]. Collaborative arrangements between local entrepreneurs and local authorities or the residents of a region are important social conditions for the implementation capacity.

3.5. Conclusions

In this chapter, the second sub-question was answered by describing the implementation capacity framework and the social and institutional conditions which strengthen the capacity of investors to realize/implement RES projects. The conditions are presented in the table (3.1). Table (3.2) presents the conditions deriving from both the institutional capacity-building framework and implementation capacity framework so as to indicate a set of preconditions for effective implementation of energy policies and projects.

Table 3.1: Framework conditions increasing implementation capacity for RES stakeholders

❖ **Institutional conditions**
1. Transition from a monopolistic system to a liberalised market structures 2. Development of green fiscal instruments and incentives favourable to independent power producers 3. Limited internal fragmentation and dispersed decision making powers 4. Increased knowledge base about RES projects and RES legislation 5. Decreased incorrect implementation of legal norms by different authorities 6. Decreased inconsistency in planning on provincial and municipal level
❖ **Social conditions**

[6] A good example is the collaboration between the energy distributors and the Ministry of Economic Affairs in order to introduce the voluntary agreements at the beginning of the 1990's. The collaborative policymaking created a good opportunity for this group, stimulated large-scale initiatives and increased the implementation capacity for energy distributors.

7. High motivations to invest in RES
8. High degree of professionalism among the stakeholders
9. RES in position to offer investment options
10. Harmonisation of stakeholders' perceptions about RES projects
11. Collaboration between authorities and entrepreneurs groups.

Conditions that are discussed in both frameworks and overlap will be integrated into one condition. In order to approach a more realistic set of conditions, some conditions which appear to be rather abstract will be excluded from the final table. These conditions are: open policy processes; political and institutional stability; membership in an international institution (all 3 states analyzed in this study are members of the European Union hence they are obliged to implement all Directives proposed by EU); high degree of professionalism among the stakeholders; the existence of unbiased media; the existence of an epistemic community and a general paradigm towards "Sustainable development of energy supply".

Table 3.2: Synthesis of conditions of institutional capacity-building and implementation capacity framework

❖ **Political-institutional Conditions**
1. Integration of all relative stakeholders during policy making procedures 2. Ability of civil services to implement policies (Decreased incorrect implementation of legal norms by different authorities) 3. Good networking skills in organizational and national level 4. Cooperation between authorities and parties involved (Good inter- and intra-policy coordination; collaboration between authorities and entrepreneurial groups) 5. The existence of environmental groups and "green" business sector 6. Transition from a monopolistic system to a liberalized market structure 7. Limited internal fragmentation and dispersed decision making powers 8. Increased knowledge base (of civil servants) about RES projects and RES legislation 9. Decreased inconsistency in planning on provincial and municipal level
❖ **Social conditions**
10. High motivations to invest in RES 11. RES in position to offer investment options
❖ **Economic conditions**
12. Good economic performance 13. Existence of strong local industry 14. Existence of financial support schemes (Development of green fiscal instruments and incentives favorable to independent power producers)
Cognitive- Informational conditions
15. High level of public awareness

4. Barriers to renewable energy growth

4.1. Introduction

In this paragraph, insight on barriers[7] regarding the integration of renewable electricity in the market will be given so as to answer the third sub-question. The following sections analyze the most important barriers which were detected during the implementation phase of energy policies in EU member states. Information was gathered from reports[8] which assess how different EU countries are reacting to the changes that the new setting caused in terms of adaptation of the grid and the market to the rapid increase of RES electricity. Section 4.3 describes the most severe barriers and section 4.4 describes less severe barriers hampering the development of wind and solar PV power. Section 4.5 provides with some conclusive remarks.

4.2. Barriers when implementing energy policies

The European electricity system has shifted from a monopoly system with a small number of stakeholders, large generating facilities and public-owned companies to a liberalized setting in which the number of stakeholders is growing exponentially, generating facilities are decreased in size and the electricity sector is being unbundled. It is therefore crucial to shed light on the barriers that the policies and legislations have created concerning the integration of RES electricity and technologies in the market.

According to the AEON report (2010), there are three types of barriers: barriers considered having a severe impact, barriers imposing a medium to severe impact and those having a minor impact. The first group includes barriers such as lengthy administrative procedures, grid connection and access, and information and awareness issues. In the second group barriers such as: the absence of renewable obligations for the sector, the barriers of qualification and the lack of reliable certification schemes for installers are mentioned. Finally, the last group concerns barriers such as lacking

[7] Barriers can be intentional or non intentional. Intentional barriers always have a motivation which can be sound or less sound arguments and legitimated interests in the society which are in favor of maintaining these barriers (AEON report, 2010).
A good example of an intentional barrier is the Environmental Impact Assessment (EIA). In order to start constructing a RES project an EIA is required which determines if such a project will/will not have a negative impact in the area (such as pollution, bad labour conditions, smell, excessive noise). From this perspective the EIA is a necessity because it confirms that RES projects protect (or at least do not harm) the natural environment and local habitat but, this process can also be lengthy and costly for the developer or the applicant. In this case, the legislator should be in position to weigh the importance of arguments and interests in comparison with the importance of promoting the deployment of renewable energy sources.
On the other hand, a non intentional barrier may be the absence of legislation for the construction of certain RES projects. For instance, in Belgium (region Bruxelles Capitale) until recently there was no administrative procedure in place for permitting the drilling of geothermal resources. The absence of legislation was not due to negative attitude towards geothermal energy but simply because of the fact that such a project had never taken place before therefore there was no demand for introducing legislation. Consequently, administrative lack of clarity may discourage project developers who most likely will not choose to invest in construction works if legislation gaps as such exist.

[8] These reports have been written on behalf of the DG Energy and Transport (European Commission) and have been the result of joint cooperation of several research institutes and consulting companies such as Eclareon, Oko-Institut e.V., Ecorys Nederland BV, EREC and Golder Associates

measures for promoting energy efficient equipment. In this study, the first two types of barriers are discussed as the most indicative ones for resulting to the final set of conditions.

4.3. Most severe types of barriers

4.3.1. Administrative procedures

Barriers in administrative procedures include all necessary processes in order to authorize the construction of RES projects. Examples of these processes are obtaining a building permit, grid connection permit, an electricity production permit and an environmental impact assessment (PV Legal, 2012).

The barriers concerning administrative procedures are divided to those that affect all kinds of renewable energy systems, barriers affecting large scale systems and barriers affecting small/scale building integrated systems.

4.2.1.1. Lengthy procedures

Stakeholders in the majority of EU countries have mentioned lengthy and complicated procedures as the most severe obstacle which impedes RES growth. Long lead times to obtain all necessary permits are a key problem which causes risk and uncertainty to stakeholders who might after all hesitate to make an investment. According to national reports best practices are UK and Sweden for obtaining permits for wind turbines up to 2MW. In these countries the estimated time for issuing permits can range from 10-18 months whereas in most countries the estimated time can range from 30 to 60 months.

For the PV sector, the PV legal report reveals that the best performing country is Germany where authorisation procedures require less than 40% of the time needed to realise a RES project(from 5 to 68 weeks according to the size of the project). In the rest of the countries, the required time may range from 70% to 90% (AEON report, 2010).

4.2.1.2. High permitting fees

In many EU member states, administrative authorities charge fees for permitting procedures but in many cases the costs may vary greatly in different regions or municipalities and consequently constitute an additional planning barrier for the procedures (PV Legal, 2012). Furthermore, when the administrative framework is not tailored to the needs of each energy system's authorisation it is possible that high authorisation efforts will occur along with excessive permitting fees. Hence, if fees need to be collected (i.e for larger projects), they must be transparent, proportionate and published on the Internet.

4.2.1.3. High number of authorities involved in permitting

In most of the countries, stakeholders mentioned as an obstacle the excessive number of authorities involved in permitting procedures. The main problem in high number of authorities involved is that the different public authorities do not communicate or co-ordinate sufficiently with each other leading to waiting times of several years and causing unproductive periods and loss of money for the investors (AEON report, 2010, PV Legal report, 2012). A solution to this obstacle can be given by introducing a one-stop shop, thus assigning one central agency with the task of co-ordinating the authorisation procedures and providing assistance to the applicants (AEON, 2010). This system is

considered as very effective from countries which have already introduced it (Denmark, Finland, Germany, Sweden and UK).

4.2.1.4. Lack of experience of civil servants or insufficient preparation of public administrators

Another identified barrier is that in several countries the civil servants dealing with permits for renewable energy projects are not familiar with renewables. This leads to confusion, delay and even unmotivated denials of authorisations. At this point it should be mentioned that this barrier may differ from country to country and from technology to technology; for instance, technologies that are not that popular. Technologies which are more likely to be affected are small-hydro, unusual biomass or biogas installations, nevertheless even wind power can be an unusual power for some regions in Europe.

4.2.1.5. Inhomogeneous application of laws and unclear legal framework

Stakeholders from several Member states complain about unpredictable and inhomogeneous application of laws depending on the region or municipality. Depending on random factors or the responsible civil servant, the same legal provisions are applied differently which leads to higher costs of compliance and legal uncertainty. This is also a barrier due to lack of transparency (AEON report, 2010).

Furthermore, problems such as legal uncertainty, contradicting legal provisions and excessive discretionary powers of the administration were reported by stakeholders. Barriers of this kind may be created because of lots of different interpretation of laws or blurred legal framework and may cause high rates of unfounded refusals of projects.

4.2.1.6. Environmental requirements (especially EIA)

In many Member, stakeholders complained about the environmental requirements and especially the Environmental Impact Assessment. As mentioned above, EIA is considered as an intentional barrier but stakeholders report that EIAs are not conducted in a uniform way due to lack of clear guidelines about how to conduct EIAs.

4.2.1.7. Local administration

Local administration might be in position to oppose the deployment of certain renewable energy sources as stated by. Reasons for their opposition can be: influence of conventional energy pressure groups, opposition of the local population and fear of negative impact on tourism (AEON report, 2010). It is also mentioned that when there is such a deliberate opposition of the local authorities, it is considered as a very difficult barrier to overcome.

4.2.1.8. Permitting for building integrated technologies (roof-top PV)

In half of the member states (Austria, Belgium, Czech Republic, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Slovenia and UK), it was stated that small building integrated solar energy systems do not require any authorization. However, there was also information confirming that some countries require permitting for small residential systems and some times procedures for small systems are the same procedures as for large systems (stakeholders from nine countries confirmed this information). This can have a severe impact on the

development of building integrated systems due to the small volume of the investment and the relatively high effort to obtain authorisation (PV Legal, 2012). Therefore, legal-administrative barriers may discourage potential investors (AEON, 2010) so instead, lighter procedures for small energy systems should be introduced.

4.2.1.9. Areas under monument protection

In many countries, public authorities responsible for authorizing modifications of buildings under monument protection refuse any renewable installation that may be visible from outside. A prejudice spread in many countries supports the principle that historical buildings under monument protection should not be equipped with renewable energy systems for the generation of the energy they consume. This prejudice is highly supported by policies which exclude historical buildings from installing renewables. Additional to this, in Greece there is a law which forbids renewable energy systems to be seen from historical places or monuments under protection therefore, permits are not given to these projects.

Nevertheless, the same historical buildings in most cases already use central heating (or even cooling), ventilation electricity and telecommunication networks (if not they would have been unusable). Therefore, it is considered that policies that exempt renewable energy installations from historical buildings and surroundings support old, legitimated technologies and are hostile to the promotion of renewables. Of course, there is no doubt that historical monuments should remain intact or at least as close to their original phase but on the other hand there could be created nice demonstration projects which could contribute to a positive image of renewables.

4.2.2. Grid Connection and Access

Grid connection seems to be quite a critical phase for the market integration of RES- Electricity (RES-E). Connection to the grid is the phase in which RES-E producers, grip operators and other stakeholders come in contact (Eclareon, 2012). In order for renewable energy systems to be allowed to connect to the electricity transmission or distribution grid, project developers must firstly verify if a grid connection is available in the premises where the project is to be developed. The grid connection process consists of a grid connection permit phase during which a request for connection is sent to the distribution grid operator or to the transmission system operator (in case of large projects). Afterwards, the grid operator will in most cases reply to the system developer confirming the access point and presenting an offer for the connection works. In case of refusal, the grid operator should provide an alternative access point and then, connection works offer. Once, there is an agreement between the grid operator and the system developer, the two parties may sign a provisional connection contract, a deposit is paid to the operator (from the project developer, depending on how big is the project) and works can be started. Once the construction and installation works are finished, the project developer should inform the grid operator and request for the connection works to start. Finally, the energy system can be connected to the grid and feed electricity into it (PV Legal, 2012).

While this is the general flow for the grid connection phase, variations may appear which can result to great obstacles for the development of renewable energy technologies. The barriers that are encountered during the period of grid connection as shown by the Eclareon report (2012) and PV Legal report (2012) are: lengthy procedures, insufficient clarity of procedures, excessive grid connection costs, lack of grid capacity and virtual saturation of the grid capacity. It is also important to mention that these issues are considered as the second most sever barrier and although they have been clearly reported in the affected Member States, only few national action plans recognize them as serious obstacles and address them accordingly (ibid).

4.2.2.1. Lengthy procedures, insufficient clarity of procedures

Long lead times are mostly connected with procedural aspects as already mentioned in barrier 1. Barriers in grid connection processes are those concerning the initial grid connection and the final grid connection phases. When these procedures are lengthy, complicated or differ from region to region, they can result to excessive delays and consequently have a significant impact on the economic returns of energy systems. Two are the identified causes for this: too many authorities are involved in the processes (beyond the grid operator) and deadlines are not respected. Furthermore, insufficient clarity and standardisation of grid connection procedures worsen the problem since there are situations (Italy, Poland, Portugal, Slovenia) in which the actual processes are not adequately defined and differ from grid operator to grid operator.

4.2.2.2. Excessive grid connection costs

As evidenced in the RES integration report (Eclaeron, 2012) and PV Legal report (2012), high costs exist also in grid connection procedures. This barrier arises from producers and grid operators sharing the grid connection costs. There are two sharing regimes available: deep costs and shallow costs. In the first approach, the project developer has to bear several grid infrastructure related costs when requesting for connection. In a shallow cost approach, the project developer bears the cost of grid connection but not the cost of reinforcement and extension.

In general, the barrier arises in the deep cost approach which creates high costs for the RES developer and consequently, it is really complex for developers to undertake such a risk and start an investment.

4.2.2.3. Lack of grid capacity

This barrier is related to the impossibility to connect to the grid due to insufficient grid infrastructure which does not allow connection of new plants. The main causes of this barrier are complex and insufficient procedures as well as insufficient planning for developing more RES projects. However, this is often a temporal problem but nevertheless deployment and integration of RES-E are slowed down. It should be also taken into account that the insufficient adjustment of the grid planning process to the growth of RES-E is a strong indicator that the legal framework has not been effectively adapted to the transition of the energy system (Eclareon, 2012).

4.2.2.4. Virtual saturation of the grip capacity

Virtual saturation of the grid may arise at a time when the entire grid (in a region or even in a whole country) is reserved by projects that have requested and secured access to the grid. In this case, further requests are not accepted until the security of the grid infrastructure is ensured. A negative effect that appears from virtual saturation of the grid is the emergence of secondary speculative market of authorised grid access points and other administrative permits. This speculative phenomenon leads to increased costs and flood of grid connection requests which further increase the virtual saturation.

4.2.2.5. Insufficient spatial planning

In several cases spatial planning has been named as a great barrier since it can be insufficient or even hostile for RES projects. Especially for wind power, which is more affected than other

technologies (because of large turbines or huge wind parks), insufficient spatial planning can be an important issue for the long-term development.

If spatial planning is not undertaken as a priority when designing strategy for grid development, it is possible that uncertainty and the risk of finding no available place for large new energy installations will affect negatively future project developers. It is also a fact that renewables in several countries[9] are ignored during spatial planning processes which undoubtedly is a factor which creates a hostile environment against renewable energy installations.

4.2.3. Information and awareness issues

In most Member States, the efforts to communicate information about renewables are not satisfactory. Issues related to limited information include lack of general knowledge on RES benefits, poor dissemination of support measures and insufficient funding for "raising awareness" campaigns. Information issues are considered to be important because cultural acceptance and a positive image of RES are on the base of policies designed for renewables or relevant issues (AEON final report, 2012).

4.2.3.1. Availability of information on support measures

Public authorities are responsible for informing the public about the support measures such as financial incentive schemes and subsidies when installing renewable energy technologies. Often though, this is not the case mainly because of general lack of transparency (AEON report, 2010). The information provided is not clear, not updated and difficult to understand. It was also reported that different websites or civil servants contradict each other and the available legal texts do not have a clear guidance for the users. Moreover, in case that there are questions, public authorities do not respond (by telephone or emails) leading to lack of support for users.

4.2.3.2. "Raising awareness" campaigns

"Raising awareness" campaigns are designed to inform and create a positive image about renewable energy sources as well as give information and motivation to the most important professional groups concerned (investors, banks). The most frequent remarks in this field are the following.
Lack of independent and comprehensive information, especially for building integrated technologies. In many cases, ordinary citizens do not have access to reliable, independent information and neutral support in the choice of products. Furthermore, representatives of companies or associations active in renewable energy markets, state that **campaigns are underfunded.** It was observed that in many countries, campaigns started but did not last long enough in order to have a real impact due to lack of funds. Another important issue is that campaigns play a crucial role for preparing the public opinion to accept the impact of large scale RES projects (such as wind parks). However, in some cases the campaigns did not address adequately the relevant target groups and uncoordinated information offered from various stakeholders did not lead to the expected results.

4.2.3.3. NIMBY attitude

The Not in My Back Yard syndrome has been mentioned as a severe barrier by stakeholders in countries such as Belgium, Denmark, Estonia, Finland, Germany, Hungary, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Poland, Romania, Spain, Sweden and the UK. Social opposition that ranges from spontaneous neighbourhood protests to professional campaigns against RES projects

[9] Austria, Belgium, Denmark, France, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovenia, Spain and Sweden

creates big risks for stakeholders and investors since this kind of reactions may cancel the construction of a whole project. However, it should be mentioned that the most effective way to oppose the realisation of a project is to slow down the administrative procedures and this is how NIMBY groups legally act against large RES installations (AEON report, 2012).

4.3. Medium to severe barriers

4.3.1. Insufficient renewable obligations for buildings

Renewable obligations are the obligations for the constructor or the owner of a building to produce a certain share of the energy production by renewable energy sources. Many stakeholders confirm that the absence or the insufficient design of renewable obligations is a barrier to the deployment of renewable energy generation in the building sector (AEON report, 2010). For many, this is a consequence of not introducing specific energy obligations in the Energy Performance of Buildings Directive. According to this Directive, the implementation of some kinds of renewable energy obligation by the Me mber states will not be obligatory (art.13(4)).

4.3.2. Exemplary role of public buildings

In some Member states, public buildings are demonstrating energy projects so as to directly and visually communicate information about renewable energy sources. However, in most of the Member States, there are "virtually no examples" of renewables demonstration projects in public buildings which decreases the importance of the exemplary role of public buildings for renewables.

4.3.3. Certification of installers

Lack of qualification and reliable certification schemes for installers (mostly for cooling and heating) are considered to be an important barrier for many countries. Stakeholders complain about the absence of a certification body, absence of guidelines for planners and architects; and lack of general training, especially in Eastern European countries. The benefits of certification are important for both installers and consumers. For the installers, certification identifies them as professionals and increases consumer confidence in their work; it allows installers to distinguish their skills and experience in the field and it validates extra resources spent on training and gaining experience. For the consumers, the existence of certification schemes provides a mean to identify qualified installer and increases the quality level of installed equipment. Therefore, when certification bodies in national or even European level do not exist the above-mentioned benefits are ensured.

4.4. Conclusions

In this chapter, the barriers that occur when implementing European and national energy policies were described. In order to effectively answer the third sub-question, the following table presents the most important barriers which should be avoided or diminished so as to successfully implement energy policies and promote wind and solar PV power in the European Electricity market.

Table 4.1: Barriers to renewable energy growth in Europe

Most severe barriers:
❖ **Administrative procedures** 1. Lengthy procedures 2. High permitting fees 3. High number of authorities involved in permitting 4. Lack of experience of civil servants

5. Inhomogeneous application of laws and unclear legal framework 6. Environmental requirements 7. Permitting for building integrated technologies 8. Local administration opposition] 9. Areas under monument protection ❖ **Grid connection and access** 10. Lengthy procedures 11. Excessive grid connection costs 12. Lack of grid capacity 13. Virtual saturation of the grid capacity 14. Insufficient spatial planning ❖ **Information and awareness issues** 15. Availability of information of support measures 16. Absence of "raising awareness" campaigns 17. NIMBY attitude
Medium to severe barriers:
18. Insufficient renewable obligations for buildings 19. The exemplary role of public buildings 20. Certification of installers

5. Case studies on Frontrunner Countries: The cases of Germany and Denmark

6.1. Introduction

In order to provide with recommendations for creating a sustainable energy sector in Greece, it is essential to identify which countries have developed the most effective energy policies so as to create a green electricity market. Answering the forth sub-question concerning the lessons which can be learnt from frontrunner cases in promoting wind and solar PV power, the cases of Denmark and Germany will be analyzed and conclusions will be drawn in accordance with the conditions which must be present in order to promote these two kinds of renewables.

6.2. Criteria for choosing Germany and Denmark as frontrunner cases

Based on the procedure which was followed in order to conduct the AEON report (2010) and investigate all possible barriers hampering the promotion of renewable energy sources in all EU member states, six groups of countries were established. The degree of barriers identified in the study (ibid) is lowest for group 1 and highest for group 6. Denmark, Germany Finland and Sweden belong to the group 1; Bulgaria, Greece, Poland, Portugal and Spain belong to group 6.
Therefore, there is a strong indicator which suggests the Germany and Denmark are best practice examples for energy policies.

The primary production of renewable energy within the EU-27 in 2009 was 148.4 million tones of oil equivalent (toe) – an 18.3 % share of total primary energy production. The volume of renewable energy produced within the EU-27 increased overall by 60.2 % between 1999 and 2009, equivalent to an average increase of 4.8 % per annum (Eurostat, 2011).

The largest producer of renewable energy within the EU in 2009 was Germany, with an 18.7 % share of the EU-27 total. Germany has seen a tremendous development in electricity production from renewables and therefore, can be considered as a frontrunner case from which lessons can be learned so as to design effective energy policies for the case of Greece.

Germany is a pioneer in solar PV power and a leader in European and global level (EPIA market report, 2011). Even though in 2011 Italy became for the first time the top PV market in Europe with 9GW of newly connected PV systems, Germany remains the largest producer of the last decade with 24.700 MW of cumulative installed capacity (ibid).

As for the share of wind power, it was particularly high in Ireland (41.4 %) and also accounted for more than one fifth of renewable energy production in Spain (27.3 %) and Denmark (21.0 %) (Eurostat, 2011). Nevertheless, the case of Denmark is the most interesting since it has a long history of energy policies (since 1974) and also its energy market operates in a liberalized market since 1999 which has affected considerably the development of wind power. Therefore, the lessons drawn by Denmark are indicative for what should be done and what should be avoided in order to create a green electricity sector in Greece.

6.3. Structure of the case studies

The case studies will be conducted taking into account the conditions and barriers described in earlier stages of this thesis. In order to investigate whether the conditions exist in the German and Danish electricity market the case studies are structured as follows:

1. Policies in place
2. Targets
3. Policy instruments –support schemes
4. The degree of liberalization of electricity market
5. Existence of "green" business sector, environmental groups, green energy associations
6. Administrative procedures
7. Grid connection and access
8. Public awareness
9. The role of public buildings
10. Certification of installers

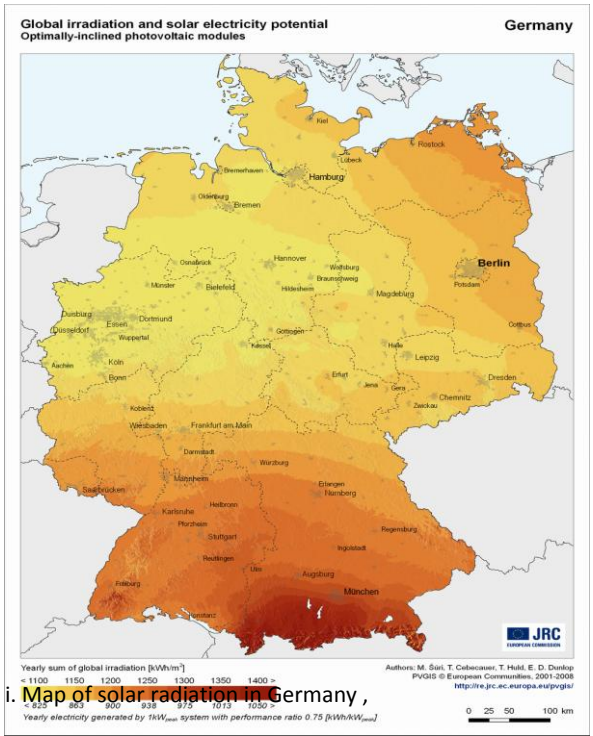
The abovementioned structure is based on a selection of barriers which Denmark and Germany have diminished and a selection of conditions.

The policies which are in place will provide with insight regarding the measures and actions that the countries have set in order to implement national or European energy policies. The policy instruments- support schemes will be presented in order to show whether the development of fiscal instruments and incentives create a favorable environment for investments in both countries. The degree of liberalization of electricity market will show whether "success" cases fulfill the condition of the transition from a monopolistic system into a liberalized market structure. Moreover, the existence of "green" business sector shows to what extent RES can be represented in policy-making procedures and if they are involved in it. The section of administrative procedures will investigate if civil services are able to implement policies; if their cooperative and organizational skills are sufficient; if their knowledge regarding RES projects and RES legislation is high; and if the administrative framework is attractive for RES investments. The section regarding grid connection and access will show what procedures led to diminishing these severe barriers to solar PV and wind power development. The section referring to public awareness will provide with insight regarding to informational conditions such as public acceptance of RES as well as sufficient knowledge related to support schemes and incentives. The last two sections show how medium barriers have been treated.

6.4. Case study: Germany

6.4.1. Introduction

Germany represents more than 50% of the European PV capacity it with 7,408 MW installed in 2010 and 24.700 MW of total cumulative installed capacity. Germany is fairly the world's leader in PV market. Its economy is also the largest in Europe and the 5th largest in the world (IEA, Germany report 2007). Germany has a long history regarding the use of renewables. It started back in 1974 after the oil crisis and it is still going on proving that Germany can successfully implement energy policies. PV industry is among the biggest in the world with more than 10.000 companies producing or installing solar panels and approximately 63.000 created jobs (BSW,



i. Map of solar radiation in Germany ,

2010). In Germany, political parties and coalitions are strongly involved in the creation and implementation of renewable energy policies which is seen as the key driving force behind successful practices (Gan et al, 2007).

Therefore it is interesting to investigate the initiatives, legislation and policy instruments used in order to achieve such a massive deployment of solar PV.

6.4.2. Policies in place

The first "feed-in" law was adopted in 1990. Under the provisions of this law, the system guaranteed fixed tariffs for long term with a purchase obligation which minimized the risks for project developers (Gan et al, 2007). To a large extent this law caused the tremendous development of renewables and production of green electricity (National Action Plan, Germany, 2009). Eventually, that law led to the adoption of Renewable Energy Source Act in 2000 which resulted to further improvements regarding the electricity feed-in and introduced favorable political framework conditions for the deployment of solar PV.

Furthermore, the EEG/2000 set the provisions giving priority to electricity produced by renewables, feed-in and compensatory payments (ibid). The principles of EEG are the following. Both private and institutional investors in PV systems receive a feed-in-tariff for solar electricity fed into the grid. Grid operators are obliged to buy solar electricity and pay producers a fixed remuneration. The tariffs vary depending on the size of the system and type of installation (i.e roof-top or ground-mounted). The FiT is guaranteed for 20 years and it is subject to a regression rate which means that payments decline as technology matures.

After the EEG entered into force, the share of renewables in total gross electricity generation doubled (from 6, 3 in 2000 to 11,7 in 2006) (Busgen et al, 2009). EEG was amended in 2004 and 2009. The 2009 EEG, considerably improved the conditions for further deployment of renewables. It aimed at increasing the renewables share of Germany's electricity consumption at 30% by 2020.

In 2011, the EEG was amended again. The amendments introduced a number of approaches in order to further promote the market integration of RES-Electricity. Briefly, these are the most important approaches provided by the EEG 2011:

1. RES-E producers can optionally choose to benefit from a technology specific market premium on top of the revenues which they gain from direct marketing
2. Electricity suppliers that provide their customers with at least 50% of renewable energies which would be eligible for receiving FIT may be exempt from paying the EEG surcharge. According to the revised FIT the surcharge exemption will be replaced by a surcharge reduction by 2 ct/kWh, which applies only if 20% of the sales to final consumers from RES-E is based on intermittent energy sources
3. Finally the EEG gives an authorisation to the German Government for introducing financial incentives parallel to the feed-in tariffs and to change the preconditions for participation of RES-E in the balancing market (RES- Integration Germany Report, 2011)

In general, the German legal framework provides favorable conditions (table 6.1 shows the contribution of renewable energy sources to electricity supply in Germany from 1990-2009) for the connection of RES electricity plants. The EEG is considered as Germany's powerhouse for climate protection but also economic development. Following the track of EEG, the domestic turnover from the installation and operation of renewables increased from €12,3 billion in 2004 to €25 billion in 2007. Moreover, there was a considerable increase in employment in the renewables industry accompanied by an expansion of industry, especially PV industry (Busgen et al, 2009).

Approximately, 50 percent of the photovoltaic technology worldwide originates from Germany (BSW,2011).

The principles of EEG are the following. Both private and institutional investors in PV systems receive a feed-in-tariff for solar electricity fed into the grid. Grid operators are obliged to buy solar electricity and pay producers a fixed remuneration. The tariffs vary depending on the size of the system and type of installation (i.e roof-top or ground-mounted). The FiT is guaranteed for 20 years and it is subject to a regression rate which means that payments decline as technology matures (BSW, 2011).

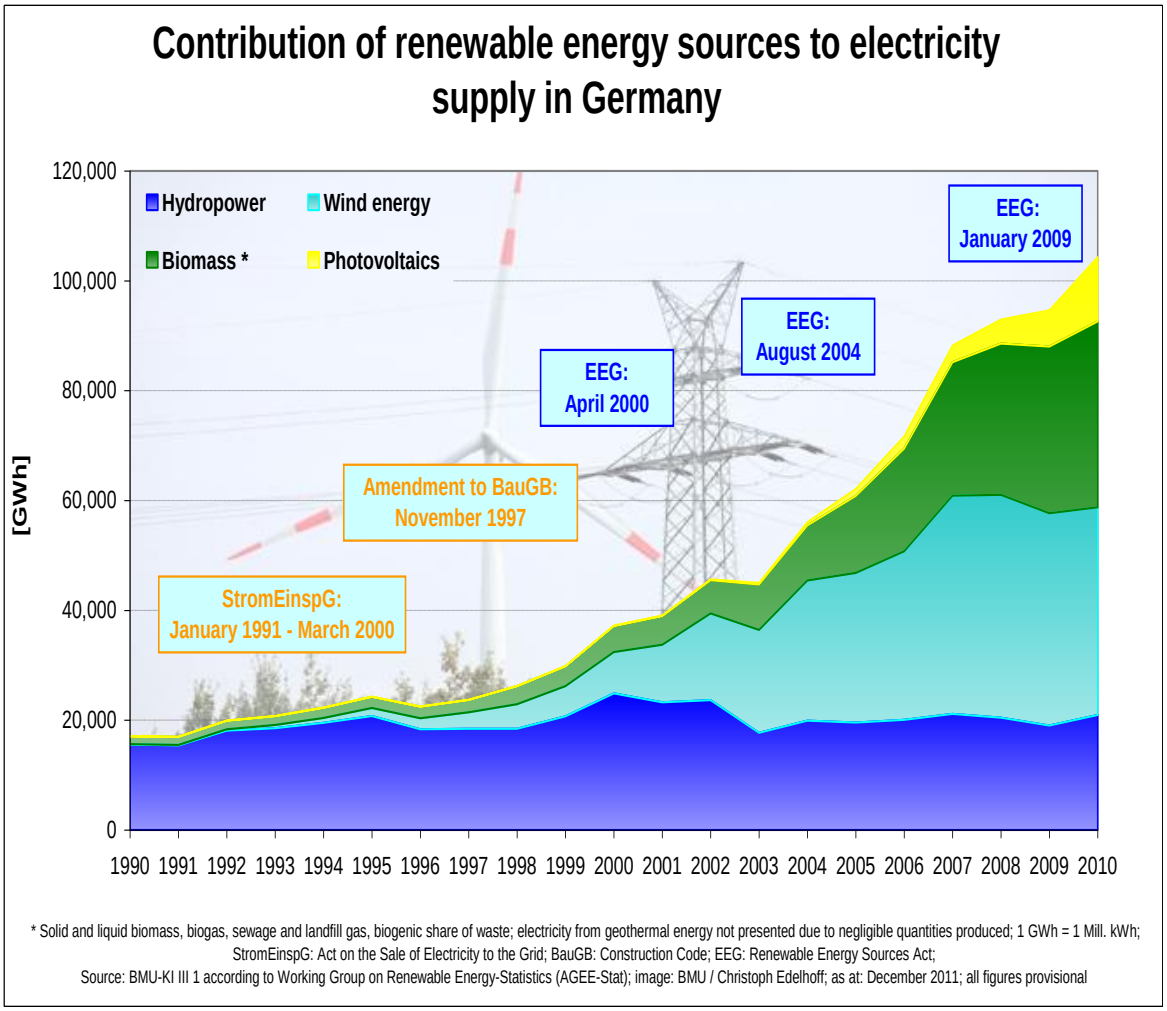


Table 6.1: Federal ministry for the Environment, Nature Conservation and Nuclear Safety, Presentation IFIC, 2012

6.4.3. Targets

According to Annex I of Directive 2009/28/EC, Germany is obliged to increase its share of energy from renewable sources by 2020 to at least 18.0 %. Based on an expected gross final consumption of energy, Germany assumes that the 2020 target of 18 % energy from renewable sources can be achieved with national measures only – i.e. without the benefit of surpluses from other Member States under the flexible cooperation mechanisms laid down in Directive 2009/28/EC. Instead, Germany expects to surpass the national target. (NREAP, Germany, 2011).

At this point, it is important to mention that in order to achieve the national target, many federal states and municipalities have set their own targets for the development of renewable energies. In Germany, the responsibility for achieving regional and local development of RES is undertaken by the federal states and municipalities. There fore, they design ambitious projects are regional and local level which are supported by the Federal Government. One example is the "Development prospects for sustainable 100% renewable-energy regions in Germany (*Entwicklungsperspektiven für nachhaltige100%-Erneuerbare-Energie-Regionen in Deutschlan)*" in which communities that wish to meet their energy needs through 100% renewable energy, have access to scientific research and support for activities aiming at full supply of RES. So far there are 82 regions reported in this project (NREAP, 2011).

6.4.4. Policy instruments-incentives

Over the years, a diverse range of instruments at federal and local level fostered growth in the renewables sector. FiT[10] is the main instrument used which requires electric utilities to connect renewables electricity generators to the grid and to buy electricity from producers (table 6.2 presents the prices of FiT after the latest amendment of the EEG). The costs of the support scheme (both feed-in tariff and optional market premium) in Germany are allocated to the end-consumers via the electricity suppliers. As of 1/7/2010 an amendment of the PV feed-in-tariff law changed the framework conditions for PV investments. The FiT were reduced by 8-13 percent (depending on the size) for newly commissioned PV systems in addition to a further reduction due to the degression rate at the beginning of 2010 (BSW, 2010). However, a major change by the revision of EEG in July 2011 coming into force 2012 will be the introduction of an optional market premium as alternative support besides the feed-in tariff.

Furthermore, the government further contributed to lower the costs of PV installations by providing tax incentives to the producers such as VAT exemptions for commercial systems, or beneficial credit terms such as covering a part of the investment for large installations (i.e 75 percent of the investment is covered for installations which cost up to €10 million, with up to 2 years free of redemption and interest rate of 4- 7,2 percent) (Germany fact sheets, EPIA, 2009).

Another essential financial measure that fosters green energy deployment in Germany is the funds invested on R&D. BSW's surveys showed that in 2004 PV industry received 30€ million in 2004 and 163€ millions in 2008. The investments derive both from suppliers and industry and are meant to develop further PV technology and boost innovation so as to reduce PV installation and production costs (BSW-Solar,2010).

Table 6.2. Feed- in Tariffs in Germany in 2012 (after the EEG amendment in 2011)

RES	2012 ct/kWh
Hydropower	3,40 – 12,70
Landfill gas, Sewage gas, Mine gas	3,98 – 8,60
Biomass	6,00 – 25,00

[10] FiT is a financial scheme which ensures that actors who produce green electricity get a premium for every KWh they provide to the grid. The advantages of this scheme is that it ensures long-term return for investors (depends on how long it is guaranteed by the government), it is simple to be implemented and it's quite flexible for different kinds of technologies or locations (Gan et al, 2007).

Geothermal	25,00 – 30,00
Wind energy (onshore)	8,93 (4,87)
Wind energy (offshore)	15,0 (19)
Solar energy	17,94 – 24,43

6.4.5. The degree of liberalization of electricity market

The short-term power markets in Germany encompass the day-ahead-market (functioning up to 24 hours before delivery) and the following intra-day-market (functioning within the day). The standardised products of the spot market can be traded over the power exchange (EPEX) or bilaterally over the counter.

In principle the power market has been open to all providers since the beginning of liberalisation in 1998. Many new suppliers tried to enter the market, but the number has declined again significantly over the past years. Despite numerous market players in the electricity market, the four largest electricity companies still hold a significant market share of about 80 % of the total generation capacity. The extent of vertical integration is decreasing as the ownership structure of three large electricity companies has recently changed by selling shares to third parties and the fourth TSO is undergoing a restructuring process into an independent transmission operator. However, full competitiveness in the wholesale market is still questionable. On the balancing market the four TSOs contract positive and negative balancing capacity for imbalances through a tendering procedure. They are responsible for the provision of balancing services in their respective control area. The reserve power consists of primary, secondary and tertiary reserve in the order of the time delay before the reserve capacity is available (RES integration, German Report, 2011).

6.4.6. Existence of "green" business sector, environmental groups, green energy associations

There is a variety of actors that contributed to Germany's endeavor to formulate the framework for introducing FiT in 1990. The most important help came from solar activists and municipal utilities which put pressure on local governments regarding the cost-covering contracts for electricity using renewable energy technologies (Lauber &Mez, 2004). Moreover, additional help came from municipalities which subsidized solar panel installations for special purposes such as schools (ibid).

Furthermore, the role of the Greenpeace Germany is substantial to solar PV development. They proposed several initiatives and gathered thousands of orders for solar cell rooftops as to boost the PV market and prevent a collapse.

The electric utilities are represented by associations such as BDEW Federation of Energy and Water Management in Berlin, the LDEW National Association of water and energy, the National Group of Northern Germany and the Regional Group of Central Germany. These associations represent the interests of their members to the politicians, authorities and public and try to influence political decisions. As a matter of fact, the amendment of EEG 2004 was strongly influenced by the industry and the general public. At that time the lobby of utilities and industry was much stronger than in the 90's and thus, they had a say in policy-making (Gan et al, 2004).

The solar industry is represented by BSW- the Federal Solar industry Association. BSW-solar's mission is to exert a decisive influence on creating a suitable policy framework for stable solar PV growth. It represents more than 800 members and acts as an intermediary between businesses and

public and political sectors (BSW,2011). BSW lobby is politically powerful and strongly influences the policy makers. Since PV industry in Germany is quite strong, their voice should be represented in decision-making and indeed, this is the reality in the policy arena.

Finally, the consumers are represented by the Energy Consumer Association. The mission of this association is to inform energy consumers regarding all the changes in electricity prices, changes in PV FiT and legislation. Often, they often disagree with the actions of electric utilities and present their cases to court. Consumers have the chance to express their "voice" regarding energy prices, environmental policies, energy supply etc. This association involves the civil society in policy making thus, its role is substantial in German society (Ebund der energie verbraucher, 2011, https://www.energienetz.de/).

6.4.7. Administrative procedures

General administrative principles

The German legal system provides for tools to increase the efficiency of administrative procedures:

- **The principle of expedition of proceedings:** This principle specifies that administrative proceedings should take place swift and without wilful delay;
- **The administrative inaction suit:** This legal remedy allows for legal actions at administrative courts if the administrations do not react to complaints in due time.
- **Bound decision:** During the authorization process, the administration authorities have no discretionary power. If the requirements for the building permission are met, the permit authority is obliged to grant the permission. In case of rejection, the German judicial system provides for a broad range of legal remedies and independent courts;
- **No authorisation is required** by the German building codes for small roof top PV systems. The project developer may notify (he is not obliged) the administration in order to obtain confirmation that his project does not infringe any building regulations;
- **One-stop shopping** is possible for some small PV systems if an authorisation is required at all. This procedure is considered as rather complex, but it has a so-called "concentration effect", which means that includes also most other necessary authorizations (except from planning decisions, permissions according to the mining law and water protection law requirements). It therewith allows one-stop shopping for large installations as well. This makes the procedure very effective and it does not necessarily lead to longer lead times;
- **Preclusion effect:** During the authorization process, everyone has the opportunity to file objections against the project within a defined period of time. If objections are raised after that time they have to be ignored by the permission authority and the courts. Consequently, the so called preclusion effect increases legal certainty for the project developer in a considerable way.

Regarding **small/medium scale PV installations** on buildings the procedures are very efficient. Authorisation by default is available for most small systems and for the rest; one-stop-shopping is possible. In general, the procedures are not considered lengthy or costly. The authorities coordinate with each other and civil servants are experienced and knowledgeable regarding solar PV installations and authorisation procedures (PV Legal,2012; RES integration Country Report, 2012).

Regarding **ground mounted PV installations**; it is observed that sometimes it is difficult to assess the eligibility of the system for FiT. The German Renewable Energy Act sets very rigid and distinct requirements that ground mounted PV installations must abide by in order to be eligible for the FiT. The criteria to be met for receiving the FiT payments are mainly depended on urban development plans and regulations and often, definitions are not clear regarding the areas where PV are eligible to receive FiT. Therefore, legal uncertainty exists and project developers often face the risk of not

eligible[11] for FiT PV installations hence, their investment is lost (PV Legal, 2010). However, as of July 2011 the revise of the EEG provided with clarifications about the restrictions on the eligibility for areas that fall under environmental protection laws (BSW, 2012)

6.4.8. Grid connection and access

6.4.8.1. Grid connection procedures

For **residential rooftop systems**, it is not always clear whether a planning permission is required. Nevertheless the application procedure is quick and without obstacles.
The **commercial rooftop systems** are the largest segment in Germany. For this segment, grid connection procedures are characterized by long waiting times and high connection fees. Moreover, these installations face difficulties when are located in monument protection areas.
Ground-mounted systems face serious obstacles since finding suitable areas appears to be difficult. Moreover grid connection is often very difficult and lengthy (PV Legal, 2012)

According to stakeholders, lack of clearly defined timelines and required information are the core of the grid connection obstacles. Nevertheless, in comparison to the rest of Europe, the German project development process for PV installations is quite short and only connection process is lengthy and constitutes one of the greatest problems.

6.4.8.2. Costs of grid connection

The connection charges are shallow meaning that the developer bears the costs of connection the system to the economically and technically most suitable connection point. Also, he is the one to pay for measuring devices necessary to record the electricity transmitted and received. The grid operator bears the costs for optimizing, reinforcing and expanding the grid.

6.4.8.3. Grid Capacity

The barrier of lack of grid capacity has not been detected in Germany. As mentioned above, RES electricity has priority to the electricity market. When a project developer applies for a connection permit to the grid operator is obliged by the EEG to boost and expand his grid with the best available technology in order to guarantee that electricity generated by RES has a priority over electricity from other sources when purchasing, transmitting, distributing and paying for it (RES integration German report, 2011).

Furthermore, there are available two grid development studies which calculate the need for additional grid capacity based on the scenarios of 20% RES electricity until 2020; and aim at providing a strategic concept for the development of the transmission grid. The studies take also into account storage capacities and interconnectors towards Denmark and Scandinavia. Therefore, there is enough information regarding grid capacity which is an indicator why lack of grid capacity has been avoided.

6.4.9. Public awareness

Germany has achieved high levels of public awareness and acceptance of energy policies. The consumers are well-informed and active regarding renewables and indeed the general paradigm is "sustainable development in energy supply" (Gan et al, 2007). Reducing the CO2 emissions, preventing climate change and protecting the environment concern German citizens and more importantly they are willing to take action.

[11] The decision upon the eligibility lies upon the grid operator who has to reimburse the owner of the plant. He has to take this decision once the project is realized.

Awareness raising measures with regard to renewables are widely available in Germany. Overall, the general public shows a very positive attitude towards solar PV power and RES. Considering the information on support measures in most cases is available online in a very comprehensive way ny public authorities or industry associations.

Moreover, campaigns for solar PV installations are very usual in Germany. Mostly, they are organized by public institutions such as the Federal Ministry for the Environment, the German Energy Agency and the Renewable Energy Agency. It is important to mention that also, regional and local authorities are active in organizing campaigns. Finally, the industry associations such as BSW (the PV industry association) collaborate with authorities and also initiate campaigns on their own.

6.4.10. The role of public buildings

In Germany there is a number of projects demonstrating PV panels on public buildings (i.e. "Solardachbörse", solar roof exchange) in Berlin as well as some other German cities. Renewable energy sources have been installed in many public buildings but still it is not a widely used weapon. For new constructions or renovations of existing public buildings, the use of RES is not required or implemented appropriately.

6.4.11. Certification of installers

In Germany, installers can be educated in the standard vocational education. This education is based on a dual system which consists of a theoretical training in a vocational school and practical education in a company. It lasts between 2 and 3.5 years and ends with a country-wide uniform examination, organized and executed by a chamber of crafts. Once the trainings are over and one passes the examination, he/she is a certified installer and does not need any additional certification for installing RES systems.
There are specific training programmes for electricians for power engineering and building systems during the education who concentrate the PV systems; and for roofers who wish to learn the installation of solar thermal and photovoltaic systems.

6.5. Case study: Denmark

6.5.1. Introduction

Denmark has a long tradition of implementing vigorous energy policies with broad political support and the commitment of a wide range of actors: energy companies, industry, grass roots, municipalities, research circles and consumers. Initially, Denmark showed interest and support for RES in 1973 after the oil crisis. Already, in the 70's, Denmark was one of the first countries to put on its policy agenda objectives like energy security, self-suffiency and efficiency throughout time (Lipp, 2007, Hvelplund, 2005).

Denmark was the world's first large-scale user of wind power as well as a world leader in manufacturing turbines(CEPOS, 2009).Moreover, Denmark used to be the third country dominating the wind power development in Europe (along with Germany and Spain) until recently that investments started to decline (Morthorst, 2003). As of 2010, Denmark has more than 5000 turbines installed with a capacity of 3545 MW (offshore wind power covers 505 MW) (Danish Energy Agency, 2012).

However, investments in new wind-power installations have declined dramatically after the Danish electricity market was liberalised in 1999. Therefore, it is interesting to investigate what conditions exist in Denmark, how wind power was developed over the last years and how liberalization affected further wind installations.

At this point, it is crucial to explain how the electricity market works in Denmark. First of all, Denmark belongs to the NordPool power exchange which is an electricity market established in 1991 among Norway, Sweden Finland, and Denmark. Denmark joined the market in 1999/2000. There are two market powers are of importance for wind power: the power spot market and the regulating (balancing) markets (Morthorst, 2003).

The spot market is the central energy market; the regulating market comes into force only if bids to the spot market are not fulfilled (ibid). The spot market is a daily market and the price of power is determined by supply and demand. In this market, producers and consumers give their bids 12-36 prior to the purchase, stating quantities of electricity supplied or demanded and their price. Afterwards, each hour that the price equalizes supply with demand is determined at the NordPool. Producers and consumers in principle can trade at the exchange but in reality only big consumers and generators participate in the market. The small ones form trading co-operatives or engage with bigger traders in order to act on their behalf.

Furthermore, the regulating market comes into force when the bits by generators and consumers are not fulfilled. The regulating market is very important for wind-based power producers. The bids in this market are given 1-2h prior to the actual production hour and power production from the bidding actors should be available within a notice of 15 minutes. Therefore, only fast responding power capacity will be able to deliver regulating power. If the wind power production is higher from the bid, the wind producer have to regulate down, thus they will get lower price for the excess electricity produced than the spot market price. Accordingly, if wind power production is lower than the bid, other producers have to regulate up to secure the power supply and these other producers will receive a prive above the spot market price for the extra electricity produced. This additional cost will have to be given by the wind producer.(Morthorst, 2003)

6.5.2. Policies in place and targets

Official energy plans were introduced in 1990 and 1996 by the Danish Ministry of Energy. Their goal was to create a sustainable energy system in which wind power was given a priority role among with the development of other RES. The targets of those plans where 12-14% of primary energy by 2005 and 35% coverage by 2030. Specifically for wind power, there was a roadmap with targets for installed capacity 1500 MW in 2005 and 5500 MW in 2010, covering 10% and up to 50% of Danish electricity consumption, respectively (Meyer, 2006). The target for 2005 was achieved already in 2003 with installed capacity of 3000MW. Nevertheless, since then, the growth has stagnated due to changes in energy policies and support schemes.

Installations for the generation, transmission and distribution of electricity are regulated by the Electricity Supply Act (Consolidation Act No. 1115 of 8 November 2006, with later amendments), the Promotion of Renewable Energy Act (Act No. 1392 of 27 December 2008, with later amendments) and the Act on Energinet.dk (Consolidation Act No. 224 of 16 March 2009 with later amendments) as well as Executive Orders issued in pursuance of these (NREAP Denmark, 2010)

Support measures were defined in the Electricity Supply Act. Since December 2008 the “Promotion of Renewable Energy Act” has been in force, which includes an increase of the level of the feed-in premiums.

Before the electricity reform in 1999 there was a support scheme in the form of FiT which was applied to wind power producers. The FiT was related to the price of electricity but also included a governmental subsidy. The prices were stable at that time because the market was not liberalized yet. The FiT were fixed and significantly higher than the FiT decided after the electricity reform.

Danish Electricity Reform

The Danish Electricity reform was decided in 1999. It implied a liberalisation of the Danish electricity market as from January 2000 as well as a redesign of the support to wind-power producers from a pre-reform high feed-in tariff uniform to all wind-power installations to different tariffs distinguishing between old/new and on land/off shore wind power installations (Meyer and Kofoed, 2003). The redesigned tariffs aim to eliminate or reduce the support to wind power over a transition period leading to a Nordpool electricity market scenario (Munksgaard et al., 2008). Nevertheless, it is believed that the Electricity Reform resulted to a recession of wind installations since the incentives were decreased because of it (ibid).

6.5.3. Policy instruments –support schemes

The Electricity reform introduced a support scheme other than FiT. The general promotion system as of 2000 is the Feed-in Premium. The FiP is a premium on top of the market price. The reform distinguishes between three categories of wind-power installations:

1. Old wind-power installations on land, i.e. installations connected to the grid before the electricity market was liberalised in January 2000.
2. New wind-power installations on land (connected to the grid after January 1, 2003).
3. New offshore wind power (Munksgaard et al. 2008)

Owners of **old wind-power installations** on land benefit from a transition programme as part of the electricity reform. The programme aims to soothe the transition to market liberalisation by maintaining a high feed-in tariff for a transition period of 10 years (ibid). Investors receive a high pay off from investments made before January 2000 (before the liberalization of electricity market). Differentiation was made by system size[12] in the sense that part of the subsidy is scaled to the installed capacity of the wind turbine (so that small and less efficient turbines received a higher subsidy than bigger and more efficient turbines).

Plants connected between 2000 and 2002 obtain a FiT for a production limit of 22.000 full-load hours; afterwards a premium (including a balancing reimbursement) is paid until the generation plant reaches 20 years. **New wind-power installations on land** connected to the grid after January 2003 have to sell electricity to the market price and on the top of the market price they receive a general subsidy offered for a 20-year period. There was a cap for the premium plus the market price which was removed in January 2005 (RES integration Danish report, 2010).

For **offshore installations**, there is a guaranteed feed-in tariff for up to a limit of 42.000 full-load hours. Additional electricity production is traded according to the market spot price plus a premium and a balancing compensation until the wind farm has reaches the age of 20 years (Munksgaard et al. 2008).

[12] A distinction is made between small (up to 200 kW capacity), medium (201–599kW) and big (more than 600 kW) wind turbines

Furthermore, the "Promotion of Renewable Energy Act" (1 September 2009) brought an increase of the premium so that plants which were connected after 21 February 2008, receive3.35€cent /kWh for 22.000 full-load hours. Additionally, they get a balancing reimbursement of 0.31€ cent /kWh for their balancing settlement. This balancing reimbursement is granted for the whole lifetime of the plant (ibid).

More over, there is a regulation on net-metering[13] for the Producers of Electricity for Own Needs which is based on the Act on Electricity Supply and authorises the exemption of certain system operators from Public Service Obligation (PSO). Electricity producers using all or part of the electricity produced for their own needs are exempt from paying Public Service Obligation on this electricity. The Public Service Obligation is a charge levied to support renewable energy. Wind energy systems are eligible to this incentive only if the systems are connected to a private supply system (RES-Legal, 2012).

According to the AEON Danish report (2010), a barrier regarding the incentives was detected which in principle was supposed to have a positive impact on wind energy but instead, it had the opposite effect. A raise in the size of the compensations to landowners who were affected by the erection of wind turbines was introduced. The compensation for wind energy was higher than any other compensation for other RES or other infrastructure projects (highways, railroads, etc). This measure was expected to promote wind energy installations but instead it became a barrier as the high compensations made wind turbines unattractive to investors.

6.5.4. Existence of "green" business sector, wind energy associations

Denmark is a global leader in wind turbines manufacturing with Siemens and Vestas dominating the national and global market. It is estimated that more than 240 manufacturing companies exist in Denmark with a great amount of exports globally. The Danish Wind Industry Association (DWIA) consist of wind turbine manufacturers, energy companies and a wide range of companies that provide with components, services and consultancy.

DWIA is responsible for managing the interests of the member; develop and exchange knowledge and experiences with players within and outside the industry. Moreover DWIA promotes member interests on nationally and internationally.

6.5.5. **Administrative procedures**

The general impression regarding administrative procedures in Denmark is positive and indicates a satisfaction comparing to other European Countries. Denmark has a very short average lead time for wind power installations in comparison with the rest of countries in Europe which is approximately 32 months (Wind barrier Report, 2010). The existence of one-stop shopping for permits is

[13] Net-metering is an instrument to promote small electricity production facilities. The net-metering mechanism charges the electricity that has been fed into the grid system against the electricity that has been drawn out of the grid. This model allows for promotion of energy from renewable sources, in the case where it is cheaper to generate the electricity instead of drawing it from the grid. The amount of electricity that has been fed into the grid by the system operator will be imputed to his energy bill for the regular market price. The financial benefit consists in so far of the difference between the costs of generation of the fed-in electricity into the grid and the electricity price that has been imputed to the energy bill. The second benefit may arise for the system operator, if more electricity is fed into the grid than the amount that can be drawn from it. In such case, the facility operator obtains an allowance for the surplus.(RES-Legal, 2012, http://res-legal.de/en/glossary.html?tx_sbakronymmanager_pi1%5Bpseudo%5D=true#sbakronymmanager139)

appreciated and it is believed that this tool makes procedures much easier and swift. Deadlines are respected and timetables are easily communicated to all interested parties. The amount of money to be invested in administrative procedures including costs of work and fees is trivial (AEON Danish report, 2010). The number of administrations that developers/investors should visit is only one administration (because of the existence of one-stop shopping). Stakeholders know exactly what is expected of each of them so they can be prepared in advance. During permitting procedures, transparency is high and authorities have a positive attitude towards wind power projects.
Therefore, administrative procedures in Denmark are considered very efficient.

6.5.6. Grid connection and access

There are several levels of electricity grid voltage in Denmark (e.g. 10 kV, 60 kV, 150 kV and 400 kV). Most RES-E generating plants are connected to the distribution grid, except for off-shore wind parks. The connection process depends on the type of plant and the voltage level of the grid which the plant will be connected to. As reported in RES integration country report (2010), the connection process is well defined and does not cause any problems. No delays have been reported and the lead time for obtaining connection permission is lowest among the EU countries. The access of electricity from RES into the grid has been under constant development and improvement in Denmark. The barriers related to the power grid issues are mainly transnational issues rather than domestic barriers. The power grid in Denmark is well developed and the main bottleneck for the expansion of RES is mainly outside Denmark.

Electricity produced by wind energy and other RES enjoys priority in use of the grid. If curtailment (so as to ensure grid stability) is necessary, only off-shore wind parks may be curtailed and only after non-renewable plants have been curtailed first. The operators of the wind parks receive a compensation payment when the output of their parks has to be reduced.

6.5.6.1. Costs of grid connection

The connection costs are well defined by law. They are so-called shallow costs, i.e. the developer only has to pay for the part of the connection up to the closest connection point. If such a development of the grid is necessary for the connection, the additional costs of a reinforcement of the grid are borne by the Danish TSO Energinet.dk. In the end, such investments are paid by every electricity user through the PSO-tariff (Public Service Obligation Tariff). Since all the consumers bear the costs of grid reinforcement, there is no need for rules for distributing them among previous and future producers of electricity (NREAP Denmark, 2010).

6.5.6.2. Grid capacity

Lack of grid capacity has not been detected in Denmark.

6.5.7. Public awareness

The levels of information and awareness about wind energy are sufficient in Denmark, In general, the public is informed and there is a positive opinion about wind and RES projects. The role of public funding is important for campaigns and relevant programmes. Public institutions are relatively active in initiatinf and funding campaigns so as to communicate information for RES.

Moreover, planners and architects are up to date regarding knowledge about RES technologies. RES technologies are part of their basic curriculum for engineers and architects. In general, there are

many trade magazines and other sources of information that demonstrate experience form RES projects as well as emerging technologies. Consultants and producers communicate and promote their know-how in order to remain competitive in Denmark as well as internationally.

Nevertheless, there is room for improvement in the banking sector. If people in the financial sector knew more about RES technologies, they could have been even better ambassadors in promoting RES investments to those who are seeking loans for renovation projects (AEON Danish report, 2010).

6.5.8. The role of public buildings

The exemplary role of public buildings is not relevant for wind turbines because only very small turbines are allowed to be installed in buildings, only in cases that electrification is not possible.

6.5.9. Certification of installers

The Danish Ministry of Education is the governing body that is overall responsible for the certification of installers. In practice it is the AMU (Adult vocational training programmes) that is responsible for certifying the installers. TEKNIQ (Danish Mechanical and Electrical Contractors' Association) provide courses to train and upgrade the knowledge of its members and they are also a main stakeholder in this respect. RES technologies are also basic part of the curriculum for vocational training of apprentices and it is therefore an integrated part of their education.

6.6. Conclusions

In this section two case studies were conducted in order to identify the success factors in Germany and Denmark which contributed to the development of solar PV and wind energy respectively.
The markets of Germany and Denmark are considered "developed" in solar PV and wind energy accordingly. The case studies showed that both countries have very efficient administrative and permitting procedures and both have designed a tool which facilitates investors and decreases lead times; the one-stop shopping. Moreover, in both cases the legal framework regarding administrative procedures is relatively clear and public authorities are able to enforce policies. The level of coordination between public authorities is high which is making administrative procedures even less time-consuming and less costly for the investors. Another important factor regarding administrative procedures is that civil servants appear to be well-informed about RES projects and show a positive attitude towards them; therefore, opposition from local administration is not an obstacle in Germany and Denmark.

The existence of well-designed and attractive to the investors support schemes is another condition favorable to the development of wind and solar PV power in Denmark and Germany. In both countries, there are very specific policies regarding the return of investments, subsidies and incentives which creates a favorable environment for renewables. Moreover, both countries have long-tern energy policies, energy targets and energy roadmaps which are believed to create a possible attitude to the public opinion and decrease uncertainty for the future.

The degree of liberalization of electricity market has not proved to be a "success" condition because in the case of Denmark there is evidence that the recession of wind installations started after the electricity reform which introduced the liberalization of electricity market (Munksgaard et al. 2008). As for Germany, the degree of liberalization is the least possible therefore, it is not considered as a fully liberalized market.

Access to the grid and grid connection procedures is a matter for which there is space for improvement. In Germany especially, solar PV installations can be seriously delayed because of barriers in this matter. Nevertheless, comparing to other European countries Germany and Denmark are less troubled with grid connection but still it is an important factor which should be taken into account when introducing and implementing energy policies.

In regards with public awareness and public acceptance, both countries have designed measures and campaigns which increase public acceptance for renewables. Campaigns related to the benefits or RES as well as support measures for RES are very often and the public opinion has a very positive attitude towards solar PV and wind power.

Moreover, the existence of strong industry and industry associations are crucial to the development of wind and solar PV sources. When "green" industry exists, their interests should not be neglected by policy makers and lobby activities should point to further development of RES. Therefore, it is crucial that an industry market is developed so as to further promote RES interests and contribute to more beneficial to wind and solar PV energy policies.

The existence of renewable obligations for public building is a visible way to communicate the benefits of using RES hence it is considered as means to inform citizens or possible investors.
Lastly, the certification of installers is crucial because it ensures the good quality of the installation and a long life-cycle of RES systems.

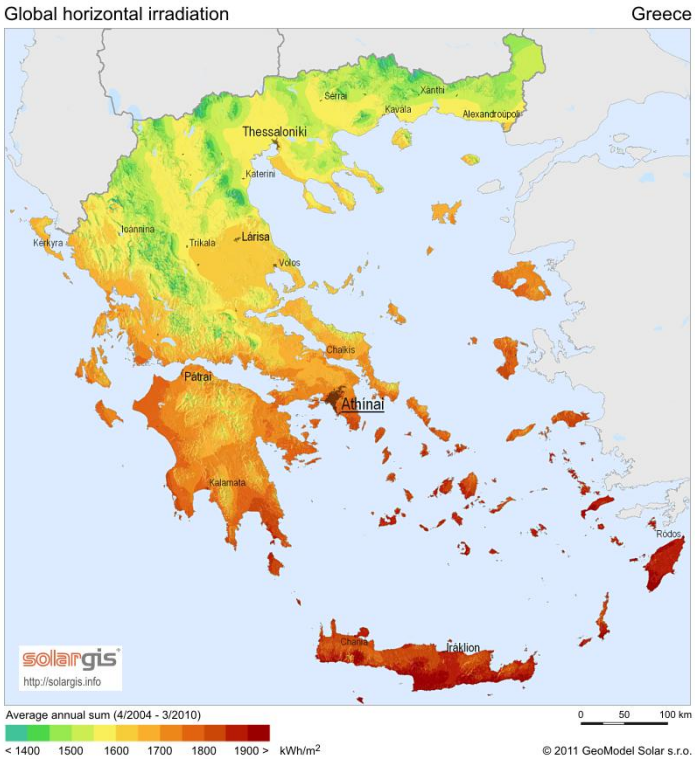
Therefore, answering the forth research question, the conditions that should be present in order to successfully promote wind and solar energy in a liberalized market are the following:

1. Efficient administrative procedures
    I. Existence of one-stop shopping
    II. Short waiting time for authorization and permitting procedures
    III. Low costs for administrative procedures
    IV. The existence of a clear and stable legal framework
    V. High levels of coordination among the authorities
    VI. Civil servants should be well-informed and experienced about authorization procedures and RES legal framework
2. The existence of beneficial support schemes for the investors
3. Clear energy policies and clear energy targets
4. Easy access to the grid
    I. Sufficient spatial planning
    II. Short lead times for grid connection procedures
    III. Low costs for connecting
5. High level of public acceptance/ knowledge for RES
    I. Campaigns for communicating the benefits of using RES and the support measures
    II. Campaigns for the financial sector
6. The existence of strong local industry and "green" business sector
7. The existence of renewable obligations for buildings (for solar PV)
8. The existence of a certification body for installers

7. The "test" on Greece

7.1. Introduction

In this section, the case of Greece and the characteristics of the electricity market for solar PV and wind power will be analyzed. The structure of the case study is based on the results of the literature overview of the conditions strengthening capacity building for RES, the implementation capacity framework, the barriers to renewable energy growth and "success" conditions derived from the case studies of Germany and Denmark. Answering the fifth and sixth sub-question, the presence of the identified conditions from the above-mentioned sources is to be investigated and the barriers that hamper solar PV and wind power development to be discussed.
In order to strengthen the reliability of the sources, 13 interviews were conducted with key actors from the electricity sector in Greece. The interviews were done face to face, by e-mail or by telephone. For the purposes of the case studies, the interviews were based on a questionnaire.



ii. Solar Radiation map of Greece (SolarGIS © 2012 GeoModel Solar s.r.o.)

The public authorities, industry associations and stakeholders involved with RES that were interviewed are the following:

- ◊ **Tselikis Ioannis and Sofianopoulos Dimitri**s, Department of customer service for RES investors of the Ministry of Environment, Energy and Climate Change
- ◊ **Rossis Kyriakos**, Wind power department of CRES Centre of Renewable Energy Sources
- ◊ **Kapsalis Georgios**, PPC Renewables, Department of administrative procedures
- ◊ **Papachristou Dionysis, Electric Engineer,** RAE (Regulatory Authority of Electricity) – the main permitting body;
- ◊ **Lampaditou Eyterpi and Manou Eleftheria**, LAGIE (TSO)
- ◊ **Psomas Stelios**, Helapco – Hellenic Association of Photovoltaics
- ◊ **Papastamatiou Panagiotis**, President of ELETAEN- Hellenic Wind Energy Association, and Director of TERNA- Private investment company for wind and PV projects
- ◊ **Aggelopoulou Olga**- SPEF , President of the board of Photovoltaic Producers Association
- ◊ **Kalogerakis Nikos**, PASYF- Greek Association of Photovoltaic Producers
- ◊ **Seimanidis Savvas**, Network Consulting Group- Consultancy company for energy issues

7.2. The Greek electricity market

The Greek electricity industry is dominated by the vertically integrated, majority state-owned Public Power Corporation (PPC). PPC controls 95% of the power generation and 100% of the supply market. In 2010, the power generation mix was dominated by lignite (57,3%), fuel oil, hydroelectric (15,6%) and natural gas power plants (21,6%), as well as by wind and solar energy parks (4,3%)(RAE National report, 2010). The market consists of a Day-ahead market, real time dispatch (intra-day dispatch scheduling and an Imbalance settlement (ibid).

The **Greek Transmission System Operator** (TSO) was known as DESMIE and it was established as a first step of the liberalization of electricity market in 2000. DESMIE was a public limited company which belonged to the Greek public sector and PPC. PPC is also the owner of the transmission grid.

In February 2012, DESMIE was divided into two entities; the Independent Power Transmission Operator (IPTO) and the Operator of the Electricity Market (LAGIE). Both entities started functioning in February 2012.
The duties of the IPTO are to undertake the role of DESMIE for the Hellenic Electricity Transmission System and as such it performs the system operation malignance and development so as to ensure a safe, efficient and reliable electricity supply. Nevertheless, it still is a wholly owned subsidiary of PPC. LAGIE is responsible for the operation of the electricity market therefore, it schedules electricity injections into the Transmission System and ensures the energy absorption by it (as provided in the Power Exchange Code); it calculates the System Marginal Price; it clears the transactions in the Daily Energy Planning; and it is responsible for paying the FiT to the RES electricity producers.

The **Distribution System Operator (DSO)** is still unbundled as its duties are undertaken by an organisational unit integrated in the PPC and the distribution grid belongs to the PPC.

The public authorities mainly involved with RES in Greece are:

- ◊ Ministry of Environment, Energy and Climate Change;
- ◊ CRES (Centre of Renewable Energy Sources) – national advisor on RES and research centre;
- ◊ RAE (Regulatory Authority of Electricity) – the main permitting body;
- ◊ IPTO(TSO) and LAGIE– responsible for the connected grid (excluding non- connected islands)
- ◊ PPC (main DSO) – the Public Electricity Company of Greece is the main DSO and the sole responsible for many of the non – connected to main grid islands;
- ◊ PPC – Public Power Corporation S.A.– PPC owns 93% of the installed power capacity in Greece, generated by lignite, fuel oil, hydroelectric and natural gas power plants, as well as by aeolic and solar energy parks.

7.3. History of RES legal framework

In Greece, the legal framework concerning RES is spanning through many different laws and ministry decisions in a period of approximately 20 years. A short description of the main laws for the promotion of wind and solar PV power is as follows:

Law 2244/1994; this law is considered as the starting point for the electricity production from RES by private investors. For the first time, that law obliged PPC to buy renewable energy with fixed sale rates from plants in the mainland and non-interconnected islands; it guaranteed operation times and introduced FiTs guaranteed for 10 years. This law remained in force until the end of 2000 when it was replaced by the law 2773/99.

The **Law 2773/99** introduced the key features of liberalization of electricity market. It ensured priority to the electricity produced from RES in order to cover demand of electricity; it maintained the 2244/1994 favourable feed-in regime but in addition established a ten-year contract to the RES producers at a price which was 90% of the existing medium voltage tariff for the energy produced.

The **Law 2941/2001** provided with a legal framework which simplified procedures for establishing companies (according to the previous law, RES producers should create a company in order to feed the grid with their electricity), licensing Renewable Energy Sources plants, etc.;

The **Law 3299/2004** on promotion of investments, introduced subsidies from 40- 55% of the capital costs according to region, and the type of the enterprise (in case of Small to Medium Enterprisess and specific regions they can reach up to 55%)

The **Law3468/2006** integrated the Directive 2001/77 on electricity from RES. According to this, the target of 20.1% RES contribution on electricity production in 2010 was set. The scope of the Law 3468/2006 was to simplify the permitting system for investments in RES projects in Greece. It continued and further fostered favourable FiTs. It introduced FiTs in favour (higher) of PV and wind power systems. Lastly, it proposed a methodology for remuneration of energy produced in hybrid station in non-interconnected islands and guaranteed FiTs for a 10 year-duration of the contract with an extension by 10 more years.

The **Law3734/2009** introduced new rationalised feed-in tariffs regime for energy produced by PV systems and a yearly decrease of around 11% for new installations

The **Law3851/2010** raised the target of the energy produced by res to the gross final energy consumption by 20%; It also raised the target for energy produced from RES by 40%; it further differentiated FITs for additional technologies (especially biomass, biogas); it proposed that FITs should increase by 15-20% in case no capital grants are received (PVs and solar thermalare excluded); FITs increase by up to 25% in case of plant subsea interconnection to the mainland and a possible FIT increase for wind power plants to be sited in low wind speed sites and a guaranteed level for wind energy curtailments.

7.4. The existence of “success” conditions

The table 7.1 below shows the existence or not of the “success” conditions in the Greek energy market. This section will provide with information collected during the interviews with key people in the energy sector.

Table 7.1 shows the presence or absence of conditions according to the interviewees. (-) indicates absence of the condition; (+) indicated presence of the condition; (NA) indicates not available information

	RAE	YPEKA	ELETAEN	SPEF	PASIF	PPC renewables	Network Consultancy Group	HELAPCO	CRES wind power
Efficient Administrative procedures	-	-	-	+	-	**+ for PV - for wind**	-	+	-
Existence of attractive support schemes	+	+	+	+	+	+	+	+	+
Easy access to the grid	-	-	-	-	-	-	-	-	-
Existence of energy policies and targets	+	+	+	+	+	+	+	+	+
Renewable obligations of buildings	**NA**	**NA**	-	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Public awareness/acceptance	+	+	-	+	+	+	+	+	-
Existence of green business sector/industry associations	+	+	+	+	+	+	+	+	+
Existence of certification body	-	-	-	-	-	-	-	-	-

7.5. Condition 1: Efficient administrative procedures

The permitting process is one of the biggest bottlenecks as regards to wind and solar PV development in Greece. The high number of authorities involved (around 20 different authorities) and the long lead times are the main obstacles. The 3 main permitting steps include:

- ◊ Production Permit;
- ◊ Installation Permit;
- ◊ Function Permit

In addition, mainly for applications of installations over 10 MW like for wind and PV parks there is a need for an Environmental Impact Assessment (EIA) report, connection to the grid, power purchase agreement (PPA), land acquisition permission, but also a building, installation and operation licenses are needed.

7.4.1. One-stop shopping

According to the interviewees, one-stop shop exists in Greece (since August 2011) but until now it is not working effectively. The agency responsible for providing this service is understaffed in comparison with the number of applications received every day, therefore, even if the agency exist they can do more than advice the investors.

Mr Papastamatiou mentioned that "One-stop shop exists in Greece but still, the agency is understaffed, the staff is not well-informed about administrative procedures and even worse, there is no willingness for hiring more employees."

7.4.2. Lead-times for authorisation and permitting procedures

For permitting wind power installations, the lead-times may take from 4 to 6 years. The long lead-times are caused by many reasons. Most times, waiting times are so lengthy because the planning of administrative procedures is insufficient. In other words, there are so many authorities involved in authorisation and permitting procedures that often, one authority contradicts with the other and they cancel or block the procedure until they find a solution. Of course, this barrier results from the unclear legal framework concerning administrative procedures. Furthermore, one problem mentioned by the interviewees is that there is not parallel processing during the permitting procedures. The investors/developers must wait until they obtain one permit in order to apply for the next one which makes the whole procedure very lengthy.

Moreover, another reason why permitting procedures are so time-consuming is because if someone appeals against a wind project (this happens very often), the case must go to the Council of State which might take at least 2 years until they reach a verdict. Afterwards, a new Ministerial decision or an improvement of the existing law must be published which might take 1 year more. Therefore the uncertainty regarding the waiting times is very high in Greece and this makes it really difficult for small investors to maintain their investments for so long.

For solar PV the lead times are shorter but still, it highly depends on the coordination of civil services. After the pass of the Law3851/2010, permitting procedures were simplified and the legal framework for PV installations became clearer. Residential rooftop systems (under 20kW) are entirely exempted from the production permit and for small and medium systems (20-50kW) an exemption from the production permit might be possible id requested to RAE. Commercial rooftop systems are still representing a small segment of the PV market but they are to gain more importance since authorisation processes have improved considerably. For ground-mounded systems the procedures have been simplified as well and it is expected that this segment will be developed in the future. Therefore, lead-times for PV are much shorter than wind power projects (for more information; Appendix 1).

Mr Seimanidis states that "Long lead times for permitting discourage most of the investors and make it impossible for small and medium investors to bear the costs of waiting. Only big investment companies can afford waiting for so long".

7.4.3. Costs for administrative procedures

Costs are unknown; it depends on the size of the installations. For the production permit for instance for wind power it is approximately 100€/MW. However, apart from that conducting an EIA might

cost 15.000€ so for wind power the costs might be high but not that high considering the total investment (which can be 1.000.000€).

7.4.4. Clear and stable legal framework

The relevant legal framework regarding the procedures and regulations is changing often resulting to confusion among the civil servants (they cannot implement the legislation) and the investors. The main problem as indicated by the interviewees is that the amendments of older laws often refer to even older laws which are not in force anymore, making the interpretation of the law almost impossible. Another reason why the legal framework is not clear and therefore it cannot be implemented is because there is not complete spatial planning and a detailed land use framework and a land registry program do not exist. Moreover, more barriers are created since there is not availability of maps of forests and woodlands nor detailed recording of important archaeological sites. Consequently, it is not known nor by public authorities or by investors where PV or wind systems can be installed.

Mr Rossis states: "Laws are not specific and in most cases one law fills in the gaps of another law; at the end the whole legal framework looks like a puzzle." Mr Papastamatiou adds that in Greece, authorities tend to ask for unnecessary documentation while at the same time the legislative framework does not provide with clear instructions leaving the developers with high risks and uncertainty.

7.4.5. Good coordination among the authorities

The coordination among the permitting authorities is very low resulting to confusion, uncertainty and lengthy lead-times. The inability of public authorities to enforce the law derives mostly from the unclear and not stable legal framework. Moreover, because of different interpretations of the legislation authorities contradict each other in their decisions which may cause great delays to the procedures.

Mrs Angelopoulou mentioned that the reason why lead times are so lengthy is because when a developer has obtained a permit and contacts the next authority for obtaining another permit, the authority doubts the decision of the previous authority to issue the permit and the developer has to step back again and start the procedures. It is a vicious cycle.

7.4.6. Well-informed and experienced civil servants

In most cases, civil servants are not updated regarding the changes of laws or ministerial decisions and it was mentioned that often they prolong procedures because they are afraid of taking responsibility of their actions.

Moreover, the authorities often express a negative attitude towards wind power as well as a low level of transparency (Rossis).

7.5. Condition 2: Support schemes and financial incentives

According to the interviewees, the existing support schemes (FiT) create a safe investment environment which attracted a lot of investors (see table 7.2 and 7.3) and hence, there is increased penetration of RES in the Greek electricity production system. The favourable environment that the support schemes have created is mostly because:

- There is a twenty- year power purchase agreement between the Producer and the Operator (System or Grid). Also, the purchase of electricity produced is guaranteed as well.
- All the producers of electricity from RES are paying the special tax that goes to the Local Authority (municipality – 3% of the total gross revenue, not for PV).
- All RES electricity producers are exempted from paying the charges for using the System or Grid.
- There are grants for the capital investment (subsidy for covering a part of the capital costs) up to 20-30$% of the installation

Despite the optimistic climate regarding the FiT, payments to RES producers are delayed since November 2011. According to LAGIE, the special tax paid by consumers is not calculated correctly as to cover the expenses and payments to RES producers and there is a huge deficit which cannot be eliminated by the current calculation of the tax.

Table 7.2: Pricing – Feed-in Tariff for PV systems
Source: HELAPCO, 2012

	Ground Mounted Systems and Rooftops >10kWp (€/kWh)		Rooftop Systems <10 kWp (€/kWh)
Year/Month	> 100 kWp	≤100 kWp	
2012 February	0.292	0.328	0.495
2012 August	0.272	0.305	0.470
2013 February	0.252	0.284	0.447
2013 August	0.235	0.264	0.424
2014 February	0.218	0.246	0.403
2014 August	0.203	0.229	0.383
Tariff Payment		20 years	25 years

Table7.3 :Pricing- Feed in Tariffs for wind power

Year 2012	Price of Energy (euro / MWh)	
	Mainland	Non Interconnected Islands
Wind energy exploited through land facilities with capacity greater than 50 kW	87,85	99,45
Wind energy exploited through facilities with capacity smaller than or equal to 50 kW	250	250

7.6. Condition 3: Easy access to the grid

Both PV and wind power installations are put "on hold" because of the insufficient grid capacity. The lead times are quite high for wind power especially (it may take 58 weeks). For PV systems,

procedures have been simplified and problems have slightly decreased. Nevertheless, there is still room for improvement.

7.6.1. Priority for solar and wind power when applying for grid connection

In Greece there is a main grid connection procedure for both the transmission and distribution grid. This is due to the fact that PPC, the Greek Public Power Corporation, remains the owner of both systems. The main differentiation with respect to the grid connection procedure, although not large, is between the interconnected system, namely continental Greece, and the non-interconnected islands. Apart from that, a less complicated grid connection procedure is foreseen as far as small RES-Electricity plants are concerned and as regards some special cases such as offshore wind farms, installation of PV by professional farmers and very small PV on rooftops.

7.6.2. Sufficient spatial planning

All the interviewees agreed that there is no sufficient spatial planning. Most of them mentioned that grip development is driven by the amount of applications whereas it should be planned in advance so as to avoid problems such as virtual saturation of the grid. As a result, in areas that there is a lot of applications for systems to connect to the grid there is congestion of the grid and all application process have to be blocked.

A significant example is the opening of the market for photovoltaic systems to connect to the electricity grid in 2007. The government had just announced very high FiT and capital costs subsidies therefore investors immediately applied for connection permits. Around 6.500 applications for permits had been submitted to RAE, the Regulatory Authority of Electricity in Greece. Since this was far too many applications that the grid could was capable of absorb, RAE put the applications on hold. That led to a considerable delay of PV development in Greece, were license applications were not evaluated even 3 years later.

7.6.3. Costs for connecting

The grid connection costs are amongst the highest of Europe and the reason why they are so high is because of the poor grid infrastructure, especially in windy areas. The project developer bears the costs of connecting the system to the transmission grid and distribution grid. The transmission grid operator bears the costs of expanding the grid when needed.

7.7. Condition 4: Clear energy policies and energy targets

According to the interviewees, energy policies and energy targets exist but due to inabilities to enforce the laws, policies cannot be implemented.

7.8. Condition 5: Renewable obligations for buildings

Most interviewees were not aware of the existence of renewable obligations for buildings. Considering the exemplary role of public buildings, public authorities do not know or do not care about the implementation of RES in their buildings.

7.9. Condition 6: Public awareness/ acceptance

According to the interviews, the public is sufficiently aware of the benefits of using solar and wind power. Concerning wind power, all interviewees mentioned that the public opinion go against installing wind turbines close to their properties/ houses. Even though there are regulations which put distance limits for wind parks so that they cannot affect residence areas, residents still complain and appeal against the projects. Also, wind power face protests from the Bird Association and as matter of fact many projects have been delayed or even cancelled because of it.

In contrast to wind, solar PV systems rarely face protests from local communities and NGOs. The public opinion is more favourable for solar power than it is for wind power mostly because installing PV systems is an economically feasible option for citizens and it has tangible benefits (since the upfront costs are not as high as they are for wind power) so they opt for it. In contrast, wind power installations require high upfront costs therefore mostly investment companies install wind turbines or construct wind parks.

7.9.1. Campaigns for communicating the benefits of using wind and solar PV power and the support measures

The frequency of "raising awareness" campaigns for renewables and support measures is very low. The Centre of Renewable Energy Sources organizes campaigns in schools but in general campaigns do now exist in Greece mostly because of the financial crisis.

7.9.2. Campaigns for the financial sector

Campaigns for the financial sector are not available.

7.10. Condition 7: The existence of a certification body

There is no certification body in Greece for installers or for the products themselves. Installers are hired by the installing company so this is the only quality assurance that is offered to the investors. However, for wind turbines, CRES is responsible for ensuring that wind turbines were constructed according to the international standards and certifying their reliability before they are installed.

7.11. Condition 8: Existence "green" business sector/industry associations

In Greece there are only 5 companies producing PV panels and trackers. Their production though is very small and cannot be competitive in the European market. As for wind power, there is only one company which produces turbines.

Nevertheless, there are many associations which represent the interests of wind and PV electricity producers (HELAPCO, SPEF, PASIF, ELETAEN). Their involvement during policy making is very active and they admit that they are able to attend meetings with the Minister so as to express their interests. Nevertheless, their efforts to represent their interests most of the times are neglected by the legislators and their suggestions are not taken into account and new laws are not aligned with the needs of wind and solar PV development.

Mr Psomas: “It is really frustrating to spend endless hours consulting and discussing with legislators and politicians and when we believe that truly something is about to change, the release of new legislations turn down our hopes.”

7.12. Conclusions

Despite its favourable conditions, Greece one of the sunniest and with great potential for wind power in Europe, the Greek market has not achieved its actual potential. According to the results of the interviews only three out of eight “success” conditions exist in the Greek energy market for wind and PV power. The four conditions which are present are: 1) the existence of attractive support schemes and incentives, 2) the existence of clear policies and targets and 3) Public awareness for renewables and support measures 4) the existence of wind and solar PV associations. Nevertheless, even if these conditions exist, there is still room for improvement since according to the interviewees the FiTs are not paid monthly to the producers, public acceptance is not high for wind power projects, energy policies even if they exist in theory they cannot be implemented in reality and the voice of industry associations often is not taken into account by the politicians.

The biggest barriers for this failure of the Greek government to develop “success” conditions in the market is due to inefficient administrative procedures, difficult financing environment which is worsened every day due to the economic crisis, absence of clear and stable legislations and frameworks, lack of coordination between the responsible authorities and lack of grid infrastructure. Nevertheless, the situation could rapidly evolve positively if the existing barriers were removed and instead, the way to create the “success” conditions starts to be paved.

8. Conclusions and Recommendations

8.1. Limitations of the research design

Before drawing a set for recommendations for improving the energy sector of Greece and introducing the "success" conditions, the limitations of this study are discussed.

Firstly, the research design was based on a literature overview on institutional capacity building for environmental policies and the implementation capacity framework for wind projects. In order to operationalize the findings of this overview and create conditions for the purposes of this research, some abstract conditions even though mentioned in the theoretical part of the research, they were excluded from the case studies and the "test" on Greece. It was assumed that for these abstract conditions (such as the availability of unbiased media, the existence of strong epidemic community, the professionalism of stakeholders, the economic performance of the countries and the harmonization of stakeholders' perceptions about RES projects), the availability of reliable sources was limited therefore they were not investigated in depth. Nevertheless, this does not implies by any means that these conditions are not equally important for successfully implementing energy policies.

Secondly, the analysis of barriers was based on three EU and country reports which discussed barriers throughout Europe and for all kinds of renewables. For the purposes of this research, only barriers considering solar PV and wind power were presented. Moreover, these EU reports addressed a long list of barriers including power grid development and grid infrastructure which were not analyzed in this research since its scope was limited into social and institutional conditions.

Thirdly, the case studies on Germany and Denmark were conducted by gathering information from websites, scientific papers, presentations of International energy conferences and EU data. The limitations of this method are that the data may not be updated or filtered.

Forthly, the case study on Greece was mainly based on information deriving from interviews with key actors in the energy sector. At this point is should be mentioned that associations for photovoltaic producers are much stronger in Greece. Consequently, this means that information was more easily available (considering the administrative procedures, the prices of FiTs, barriers or opportunities) and this is probably reflected in this research as well. The solar PV power and its development in Greece is described in details in comparison with the wind development.

Finally, due to time constraints interviews with the people from the financial sector (such as banks), small RES producers and NGOs for renewables (such as Greenpeace) were not conducted. Nevertheless, it is believed that the material from the interviews is sufficient for the purposes of this study although a holistic approach would be also appreciated.

8.2. Conclusions and recommendations for improvement

The aim of this research was to investigate to what extent conditions favourable to the development of solar PV and wind power are present in the Greek energy sector and provide with recommendations for introducing these conditions in the future.

Recommendations for more efficient administrative procedures

In order to create less burdensome administrative procedures it is essential to strengthen the service of "one stop-shopping" for at least the necessary permits (such as production permit). In order to do so, it is recommended to train and allocate enough staff to handle the number of applications as well as provide with correct and transparent information to investors.

It is necessary to establish a robust legal and regulatory framework which must not be subjected to constant changes or misinterpretations of the public authorities in order to enhance investor's security and minimise actions towards annulment of permits.

Moreover, it is essential to minimise the number of authorities involved in permitting as well as the level ensure effective co-ordination between authorities at all levels. Timetables and strict deadlines should be introduced which will be respected by both parts (public authorities and investors). Furthermore, it is essential to produce a complete land registry program, establish a detailed land use framework and publish which areas are under monument protection so as to avoid misunderstandings by both investors and civil servants.

The informative capacities of civil servants as regards to RES legislative framework and RES projects should be improved. This can be done by organizing seminars between authorities, politicians and investors.

Finally, the permitting costs should be defined and made available to investors in advance.

In addition, the role of industry associations and their active involvement during decision – making and policy-making procedures is very important when designing a legal framework. Therefore, it is suggested that the associations and the government find solutions so as to better legislative and regulatory frameworks which will affect both administrative procedures and support schemes.

Recommendations for support schemes

As shown by the results, support schemes are quite beneficial and attractive for investors. Nevertheless, lately the producers do not receive their payments regularly therefore it is essential to recalculate the special tax for renewables paid by consumers so as to minimize the deficit and make it possible for LAGIE to pay the FiTs in time.

Recommendations for grid connection

In order to improve the grid connection procedures for both solar PV and wind power it is essential to reduce the average grid connection lead time and introduce strict deadlines. Moreover, it is important to improve the grid infrastructure by private or foreign investments so as to avoid lack of grid capacity. By improving the grid infrastructure, costs for grid connection will be significantly reduced and the projects will not be that costly for the investors.

Recommendations for higher levels of public acceptance/awareness for wind power

Local protest against wind power projects can be eliminated by organizing information campaigns demonstrating to the local people the benefits of using renewable energy sources. Another way to increase public acceptance or awareness for wind power is to organize pilot

projects in public buildings so as to provide with information visually and communicate the benefits of RES.

Recommendations for introducing a certification body of installers

Since a certification body of installers is not available in Greece, industry associations should take action and convince the government to ensure the creation of such a body and ensuring the good quality of wind and solar PV installations.

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Appendix 1

The authorisation process step by step for solar PV systems

1. Rooftop PV systems <10 kWp
1 step
1. Apply to the local utility office for grid connection and sign a contract for selling electricity to the grid → Install PV system

Rooftop PV systems 10-100 kWp
2 steps
1. Apply to the local utility office for grid connection
2. Sign a contract with the Electricity Market Operator (LAGIE) for selling electricity to the Grid →Install PV system

Rooftop PV systems 100-1000 kWp
3 steps
1. Get a small works permit from the local Urban Planning office
2. Apply to the regional utility office for grid connection
3. Sign a contract with the Electricity Market Operator (LAGIE) for selling electricity to the grid → Install PV system

Rooftop PV systems >1000 kWp
6 steps
1. Apply to the Regulatory Authority for Energy (RAE) for a Production License
2. Once Production License is acquired, apply to the Region for an Installation License
3. Get a small works permit from the local Urban Planning office
4. Apply to the Power Transmission Operator (ADMIE) for grid connection
5. Sign a contract with the Electricity Market Operator (LAGIE) for selling electricity to the Grid → Install PV system
6. Apply to the Region for an Operation License

2. Ground-mounted PV systems

Ground-mounted PV systems <500 kWp
4 steps
1. Apply to the Region for an exemption from environmental permitting (or apply for an Environmental permit if needed – usually only for protected areas)
2. Get a small works permit from the local Urban Planning office
3. Apply to the local (<100 kWp) or regional (>100 kWp) utility office for grid connection
4. Sign a contract with the Electricity Market Operator (LAGIE) for selling electricity to the Grid →Install PV system

Ground-mounted PV systems 500-1000 kWp
4 steps
1. Apply to the Region for an environmental permit
2. Get a small works permit from the local Urban Planning office
3. Apply to the regional utility office for grid connection
4. Sign a contract with the Electricity Market Operator (LAGIE) for selling electricity to the Grid → Install PV system

Ground-mounted PV systems >1000 kWp
6 steps
1. Apply to the Regulatory Authority for Energy (RAE) for a Production License
2. Once Production License is acquired, apply to the Region for an Installation License (includes environmental permitting)
3. Get a small works permit from the local Urban Planning office

4. Apply to the Power Transmission Operator (ADMIE) for grid connection
5. Sign a contract with the Electricity Market Operator (LAGIE) for selling electricity to the Grid →stall PV system
6. Apply to the Region for an Operation License