SCHOOL OF ECONOMICS, BUSINESS ADMINISTRATION & LEGAL STUDIES

Strategic management of renewable energy sources in Greece:

Benefits arising from their implementation

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Abstract

This project investigates the merits that will occur from the development of renewables, by studying the current situation, and the actions and legal framework that promote this development. More analytical, the austerity measures imposed in Greece and also the EU 2020 targets for the protection of the environment, oblige Greece to find a solution in order to both ensure the safety of the environment and the restart of its economy. The answer to this issue seems to be the development of Renewable Energy Sources (RES). Greece aiming on its energy safety and to a series of benefits that can assist the country to deal with financial crisis, it has to develop renewables, such as wind, solar, hydroelectricity, geothermal and biomass. RES development in Greece faces current technical, political, social and financial challenges, but it is high necessity to succeed, since this accomplishment will benefit the country to a wide spectrum. The merits of this deployment can be detected on many different categories, such as financial sector, energy security, protection of the environment and generation of new job positions. Consequently, it becomes clear by this project that Greece, even though it has to face many obstacles towards the deployment of RES, it needs to “invest” on them since it does not have just the potential, but also it would benefit from them.

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1. Introduction

In our days, the rapid development of the global economy as well as the sharp increase of the earth's population, have resulted on a remarkable increase of the word's energy requirements. Despite the fact that the developed OECD countries have almost stabilized their energy demands, the financial development of emergent countries such as China and India, result on a soaring increase of their energy needs. As the International Outlook of 2013 presents, it is expected for Non-OECD countries to almost double their current energy consumption by 2040 (figure 1). On the other hand, the scientific community has reached to the conclusion that conventional fuels, such as oil and gas, are near depletion in the following decades. Consequently, it is easy to figure out that it is required to be found and adopted new energy sources that it will cover this excessive demand. Failing to do so, it implies that countries with no or limited energy sources, they will suffer from energy resources shortage and in order to cover their basic energy needs, they will have to spend a fortune. Thus, it is easily comprehensible that clean energy is no longer just a simple environmental strategy, but it is also a required move towards energy security. For this reason Greece, aiming on the energy safety of its citizens, it focuses on the development of the Renewable Energy sector.

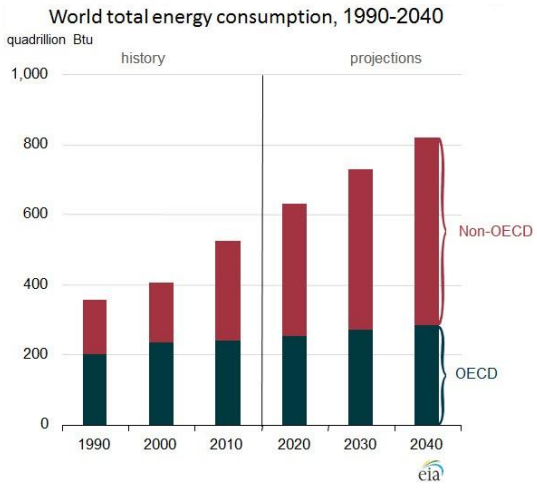

Figure 1 - World energy consumption by country grouping, 2010-2040 (Quadrillion Btu) (Source: [1])

Today, the Greek energy sector is heavily depended on fossil fuels, such as lignite, gasoline, oil and natural gas. According to International Energy Agency (IEA), these fossil fuels are accounted for a total of 91% of the total primary energy supply [2]. In addition to that based on studies of Independent Power Transmission Operator (IPTO), it becomes clear that approximately 70% of the total generated electricity in Greece, is product of the extensive use of fossil fuels such as lignite and natural gas. Taking into account that fuels such as oil and natural gas, do not exist on the Greek territory or that their quantities are not adequate for coverage of the Greek energy market's needs, it becomes obvious that there is a need for imports of these goods. This use of both imported and harmful for the environment resources, it appoints as imperative need for the Greek state to find alternatives. The sources that are able to achieve both energy sufficiency and environmental protection, in the same time, are two: Renewable Energy Sources (RES) and nuclear power. In the case of Greece because of various reasons such as seismicity, absence of financial resources and neighbouring countries, the installation of a nuclear plant is a very difficult, if not a visionary

project. Thus, the only alternative solution, which can be implemented by Greek state, is the development of RES. As a consequence of this, the Greek government in coordination with the Greek energy sector have pinpointed RES as the future energy resource that it will deal with the coverage of the country's energy needs. Despite of these logical assumptions, Greece is also obliged to promote and adopt RES due to its European's Union (EU) commitments and its agreement to Kyoto protocol. These EU commitments dictate the development of RES that will cover a 20% of the energy sector of the country, as well as 10% of the energy demand in the transport sector by 2020. Except from these, they also oblige Greece to increase its share of renewables for heating and cooling by 20%, while on the same time acquiring a 40% share of RES participation on total electricity generation.

In this dissertation, it is intended to present to the reader the merits that will arise from the development of RES in Greece. More specific, in the difficult times that Greece faces due to its financial problems, the development of Renewable energy systems can help on the reversal of the negative climate. At first, on this project, there is a reference on the Greek legislation and the actions taken by the Greek government, in order to promote RES. All these laws and actions are based on the European directives and the international commitments of the Greek state. Furthermore, there is an analysis of the current situation in Greece that aims to inform the reader for both Greek energy market and the energy mixture of the country. Moreover, this dissertation presents the benefits that Greece would obtain from the installation Renewable energy systems. The advantages of RES that are studied on this project, are their contribution on the job market, their social impact and their assistance on the energy safety of a country. All of these merits are essential for the reversion of the Greek country's negative climate and its confrontation with the problems caused by the economic crisis.

2. Description of National Renewable Action Plan, EU policies and Greek legal framework

Greece as a modern country and sensible regarding environmental challenges, has adopted ambitious policies, measures and strategies for the increase of the use of renewable energy. More specific, after the election of 2009, the Greek Government proceeded to an institutional reform and policy measures that promised a "green" sustainable development for the country. More analytical, one of its first steps, was the establishment of a new Ministry for the Environment, Energy and Climate Change (MEECC) targeting this way, to reduce the involved bodies in the licensing process for construction of power plants. Another, initiative of the contemporary Government was the formal acknowledgment of the targets set by Directive 2009/28/EC and the international commitments (Kyoto protocol), as first priority for the energy policy of the country. Additional to this acknowledgment, the Greek Parliament voted and adopted the Law L3851/2010 which came into effect on 4th June 2010 and it poses that Greece has as obligation to have a 20% of its final energy consumption from RES by 2020. This target is 2% above the mandatory level of 18% that European Commission set by the Directive 2009/28/EC, underlying this way, that the Greek Government does not consider the 20-20-20 package as a strict obligation but more like an opportunity. This view is based on the beliefs that RES are able to ensure at the same time, energy security, reduction of national GHG emissions , to boost the economy and to attract investment capitals and technical knowhow. [3]

The Greek Government aiming to create a detailed framework that it will promote the electrical energy production from RES and it will not leave space for misinterpretation, on Law L3851/2010, it states specific targets that should be delivered by 2020. More analytical, it states that RES electricity share must be 40% and it even analyses in more depth the

allocation of the RE installations by source. From this analysis, it becomes clear that Greece bases its renewable energy policies mostly on the wind energy plants, since it aims on installation of 7.5 GW of wind energy plants. Regarding the solar energy which is reckoned as another important resource for Greece, the targets posed include the installation of 2.2 GW of PVs and 120 MW of CSP plants. On the other hand, hydro plants which hold over 14.3% of total electricity production are planned to increase its plants by 250 MW for small hydro plants and by 350 MW for large hydro plants, while the pumped storage plants are going to increase by 880 MW. Finally, two prosperous sources of energy such as geothermal and bio-energy (biogas and solid biomass), it seems that are not evaluated and exploited correctly, since the 120 MW of geothermal energy and the 250 MW of bio-energy installations are not considered as major exploitation of their true capabilities. [3]

In the following table (figure 2), there is a graphical representation of the estimates of the required installed capacity for coverage of electricity consumption per year until 2020. In this figure, it can become clear the proportion of the shares of RES compared to the exploited fossil fuels and also, it can be noticed that the Governments targets is not to diminish the conventional fuels but to preserve them at their current level, while it will cover the excess demand by RE technologies.

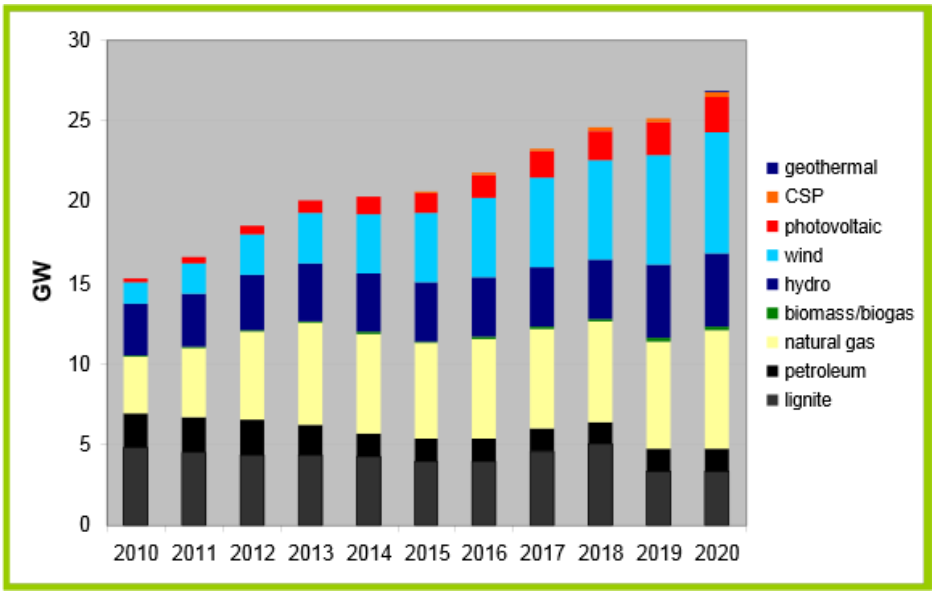

Figure 2 - Estimated installed capacity of the different RES technologies for electricity (Source: [3])

Furthermore, the law sets as target the exploitation of RES for heating and cooling. The suggested share of RES is 20% and as it is showed on the figure 3 the required contribution can be achieved relatively easy, since the Greek target is to reach from 1000 ktoe the 1200 ktoe.

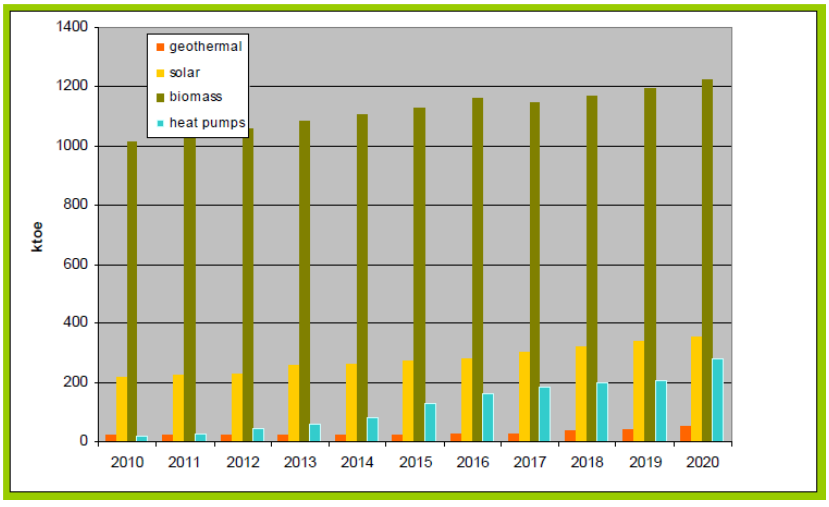

Figure 3 - Estimated contribution of the different RES technologies for heating and cooling to 2020 (Source: [3])

Another national target is the contribution of RES to transport sector by 10%. This measure has been taken mainly, in order to reduce the 27% contribution that transport sector had on the total greenhouse gas emissions in 2010 (33.08 Mt CO_2 from the 122.5 Mt CO_2). [4] Although, the environmental challenge is an important motive for this measure, the dependence of Greece to imported fossil fuels is another key factor. This happens because due to this dependence on oil and gas, Greece is unable to ensure security of supply to its citizens and also, it is constrained to spent huge amounts of money for the coverage of these needs. A representative example of this imperative need was the increasing annual consumption of gasoline from Greece at a rate of 3-4% p.a. up to 2006, which continued to rise at a lower rate until 2010 (peak at 4.06 Mt) were the austerity measures were taken and they reduced the consumption by 15% to 3.4 Mt. But this reduction is reckoned as transient, since the prospective market increase, will result on increased fuel consumption, too. Consequently, it becomes clear that Greece has to take some measures towards conventional fuels in order to deal both with the environmental challenges and energy security issues. A solution to these problems could be the domestic biodiesel production based on the 700,000 t/yr capacity that is enough to not just cover the Greek needs but also it can be exported. [4]

In general, the development of RES in Greece, in order to accomplish its European targets as it is stated above, must reach the 18% in gross final consumption of energy by 2020. Mathematically, this means that Greece has to reach a renewable energy final consumption of 4341 ktoe based on the estimations that the total energy consumption is 24114 ktoe. Consequently, we can figure out that the primary energy produced from RES which is around 1640 ktoe must increase by 2.6 times for the accomplishment of EU targets and triple for the accomplishment of the Greek Governments aims (20% of RES in gross final energy

consumption by 2020). The required sharp increase of the contribution of RES in the gross final energy consumption in a period of less than ten years, it appoints the Greek targets as ambitious. In figure 4, there is a bar chart of the aims that Greek Government has for each year until 2020. The green bars represent the European targets while the blue represent the government aims for RE surplus. [3]

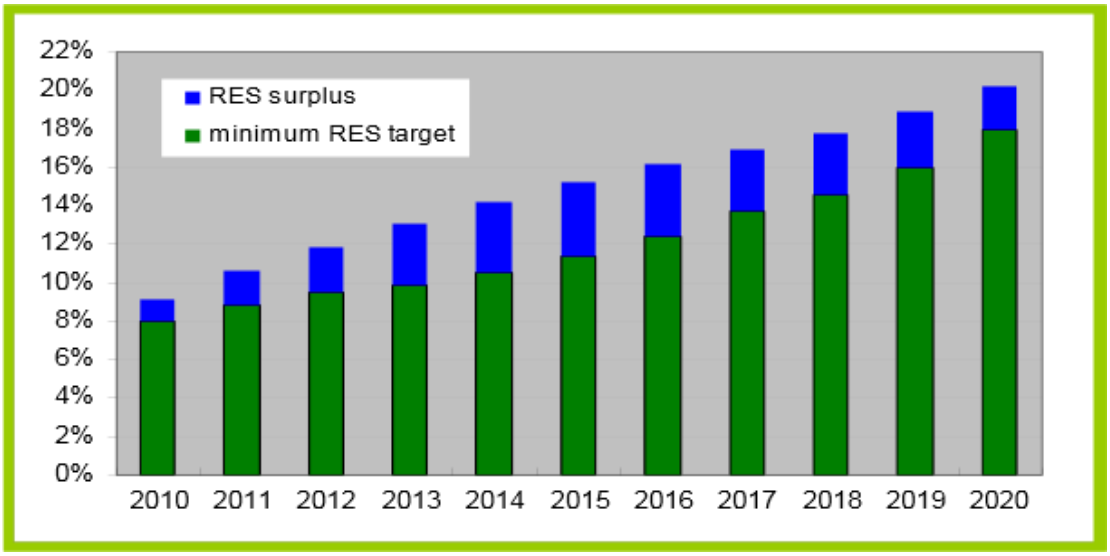

Figure 4 - Trajectory of RES in gross final energy consumption until 2020

(Source: [3])

3. Analysis of the situation in Greece

From 1950, the control of Greek electricity market is at the hands of the state, directly or indirectly. The company that has been responsible for this control is Public Power Corporation (PPC) which used to have a monopoly on the electricity production, until 1994. This monopoly was supported by the Greek state with laws that forbade the establishment of any private energy enterprise. Finally, at 1994, the Greek state allowed the production of energy from private companies, but constraining them to either use the produced energy for themselves, or to cogenerate with PPC or to produce renewable energy. Nowadays, there are legal efforts, aiming on the alignment of the Greek energy market with the EU legislations that promote liberalisation of energy markets. Despite all these efforts, the possession of almost the entire market of energy production and supply remain at the hand of PPC, which is still under public control. [5]

All these years, PPC and in general Greece, in order to cover the country's energy demand, they were based primarily on lignite, oil and gas usage. These sources that are fossil fuels and consequently, they harm the environment, they account more than 90% of the Greek total primary energy supply (TPES), resulting on a great number of carbon emissions. On the first graph (figure 5), it is easy to notice the quite high share of fossil fuels on the Greek TPES, compared to other IEA member countries. While on the second one (figure 6), it can be comprehensible the quite high amount of carbon emissions, since the Greek carbon emissions per capita are compared and are on the same level with countries like UK and Germany that have both greater industry and also extreme climate conditions compared to Greece.

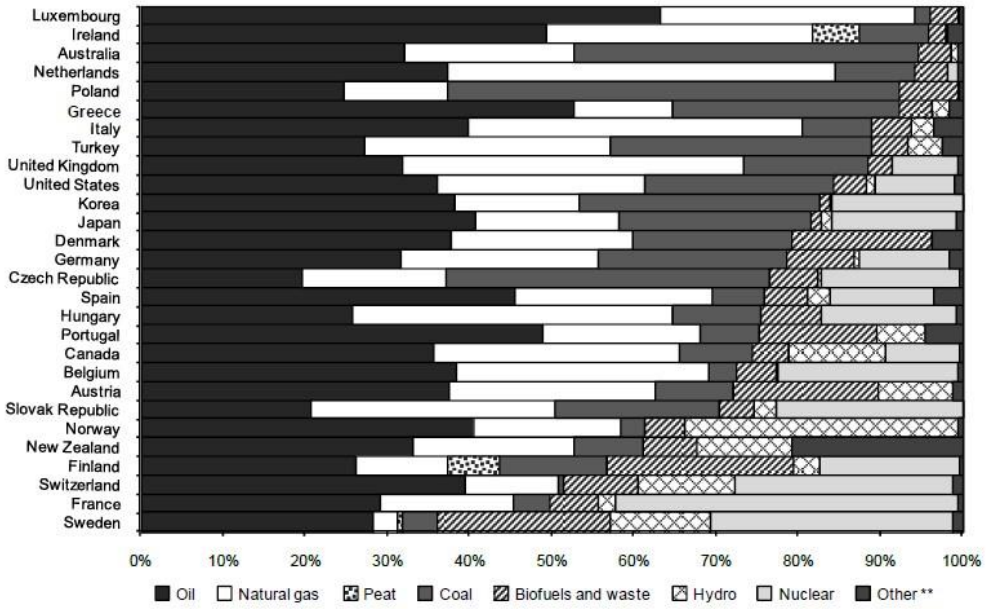

Figure 5 - Breakdown of total primary energy supply in IEA member countries, 2010 (Source: [2])

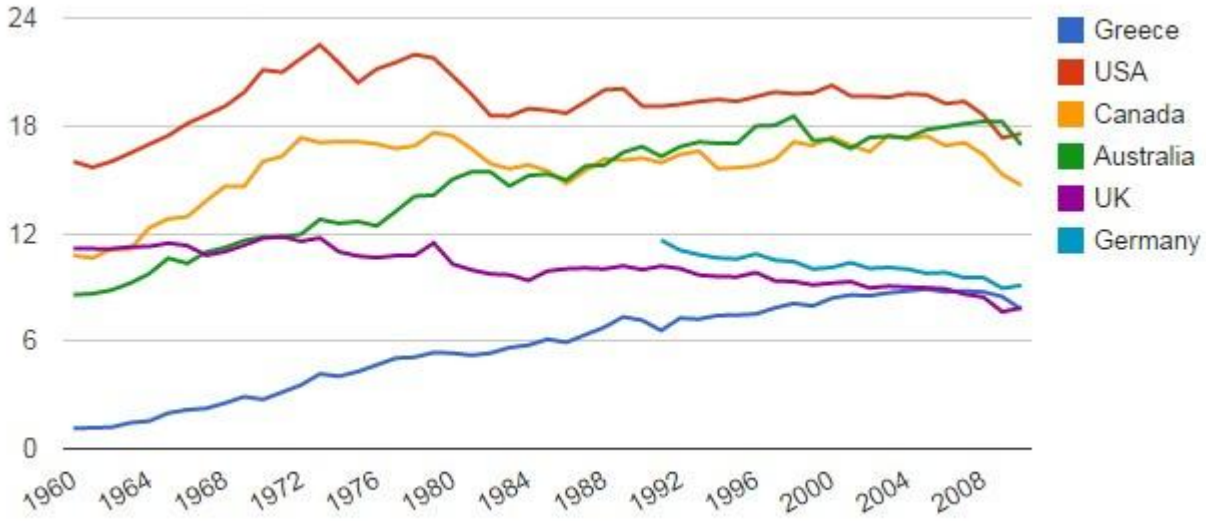

Figure 6 - Greek carbon emissions per capita compared with developed countries, 1960 to 2008

Although, environmental reasons are very important and are responsible for the commitment of Greek government to the EU directives and the Kyoto protocol, they are not the only factor for the alteration of energy mixture. This change is essential because of the country's great dependency on oil and gas which are two energy supplies that are imported, resulting on great expenses and on reliance to other countries for the coverage of its energy needs. These two fossil fuels, according to IEA studies, they have a share of almost two-thirds on the total primary energy supply (figure 7).

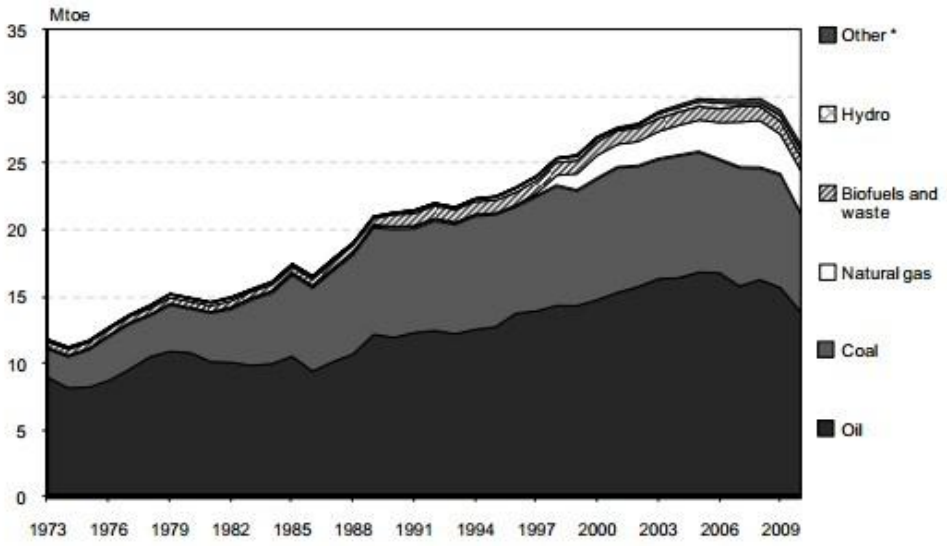

Figure 7 - Total primary energy supply 1973 to 2010 (Source: [2])

Concerning the mixture of the total final consumption (TFC), it is obvious that oil is going to have the lion's share on the final consumption, since it is the primary energy supply. This high share (65% in 2009) that reached after the rapid increase of TFC from 1990 to 2009, it is

based mainly on the transport, industry and building sector, were the oil is the dominant fuel. [2]

Despite the fact that oil is a key fuel for the Greek energy consumption, it is omission not to mention the importance of electricity, too. Electricity, as the second largest energy source, it accounted 23% on the TFC in 2009. Moreover, as it posed on the 2011 review of IEA, electricity supplies energy to important sectors, possessing more than 30% to each one's TFC. These sectors are the service, residential and industrial with electricity's share being 41%, 33% and 26%, respectively. [2]

Last but not least, other energy sources are natural gas, coal, biofuels and renewables with their contribution to the TFC, being limited and bounded to few industrial and household applications.

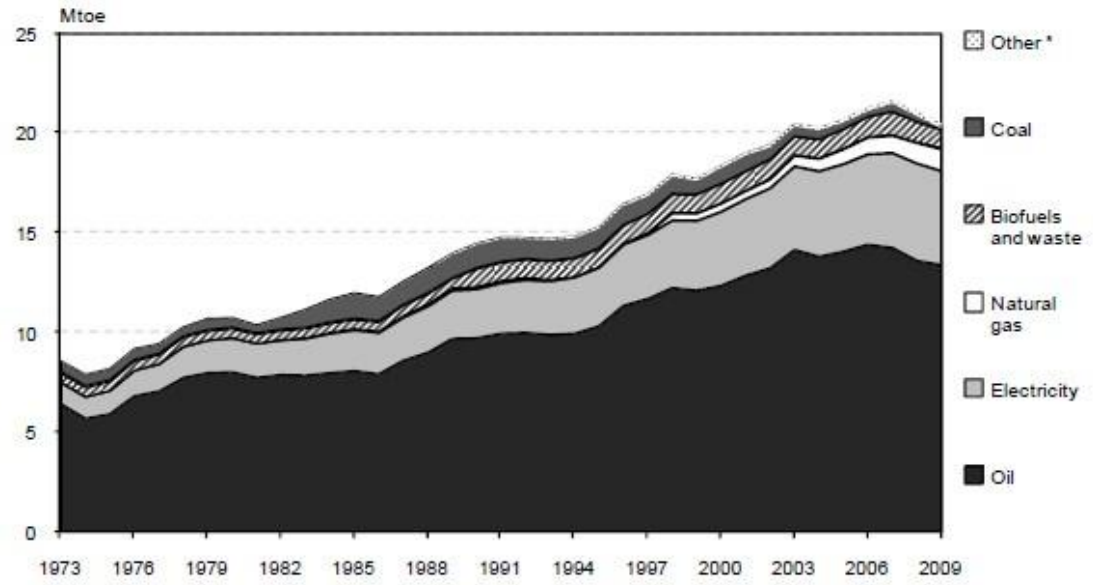

Figure 8 - Energy production by source, 1973 to 2010 (Source: [2])

Electricity, as it is mentioned earlier, plays an important role on the final Greek energy consumption and thus, it is also a major factor of the greenhouse gas emissions. Consequently, Greece in order to reduce its emissions, it needs to take some measures regarding this energy supply, too. The solution to this problem seems to be the installation of RES. Furthermore, another reason for turning into this direction is the European policies and directives that promote the installation of RES.

In our days, based on the studies of the Independent Power Transmission Operator (IPTO), lignite contributes to the total generated electricity energy which is connected to the grid (total 29.42 TWh), by 43.9%. Besides that the contribution of natural gas comprise almost the one-fourth (23.3%) of the total generated electricity, resulting on a mixture of 67.2% from conventional fuels. Nevertheless fossil fuels are the key source for electricity production, as the RES contribution is growing from 6% to 15.2%, it can be described as a small first step towards the accomplishment of EU targets. The fact that RES usage is growing during the most severe economic crisis can only be described as positive for Greece. For instance, from the figure 10, we can easily understand that despite the stagnation that is observed due to the financial crisis, there are alterations of 36 MW on the installed capacity of RES, just in the period of May to June 2013.

Last but not least, the rise (from 7.6% to 14.3%) of hydroelectric contribution to electricity generation is another prominent fact. This happens because hydroelectric installations are also considered as RES, thus the general share of renewables is reaching approximately 30% (29.5%) of total electricity generation, enhancing this way the optimistic sentiment regarding the accomplishment of 40% of total electricity production from RES, by 2020.

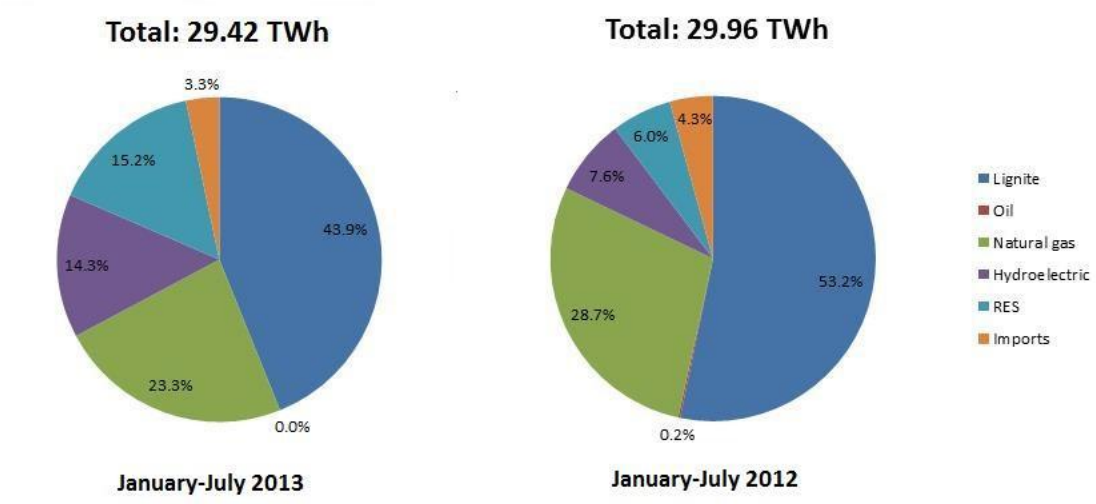

Figure 9 - Total electricity production from RES connected to the grid

(Source: Independent Power Transmission Operator)

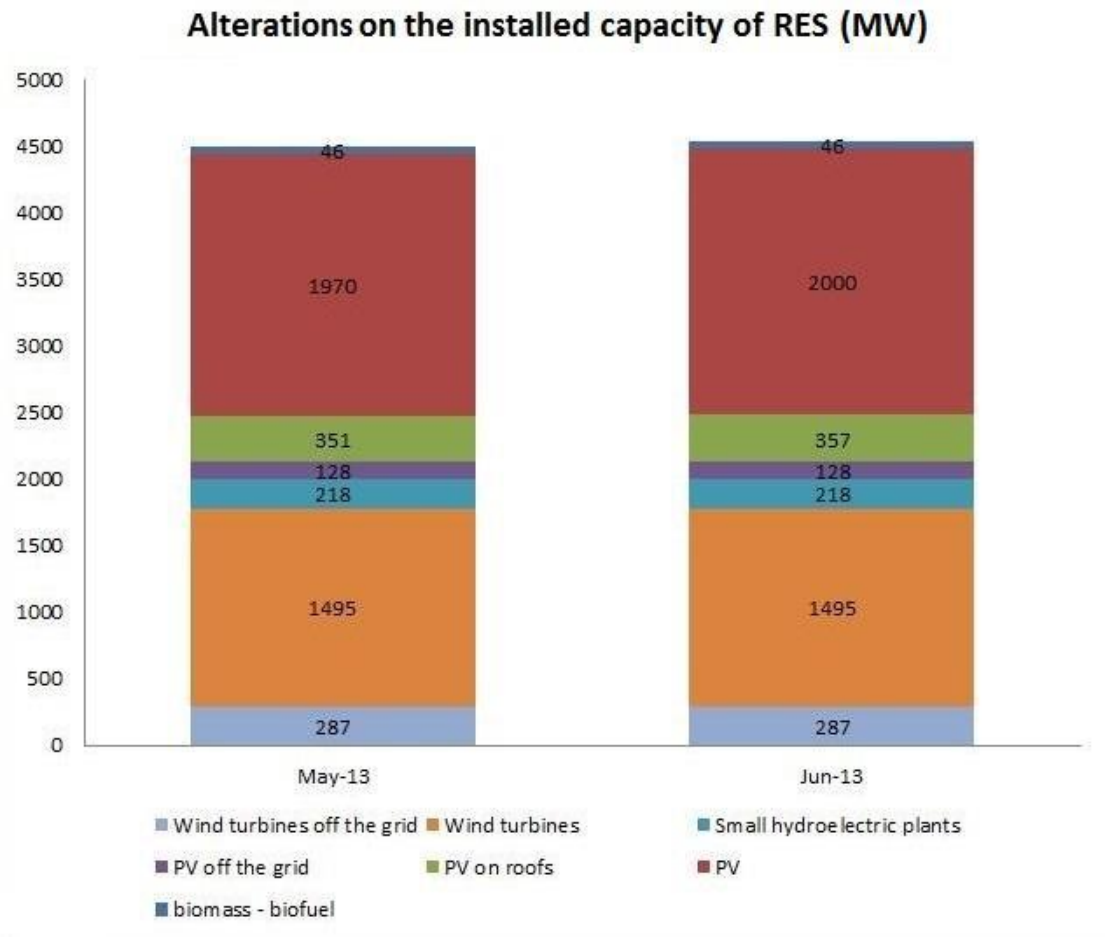

Figure 10 - Alterations on the installed capacity of RES (MW)

(Source: Hellenic Petroleum)

Furthermore, the optimistic sentiment for the successful implementation of Greek targets can also be supported by the 4531 MW of total installed capacity of RES, in June 2013 (figure 10), as well as from the rapid increase (51%) that it was observed in RES installation capacity from 2140 MW in 2011 to 3237 MW in 2012 (figure 11). [6]

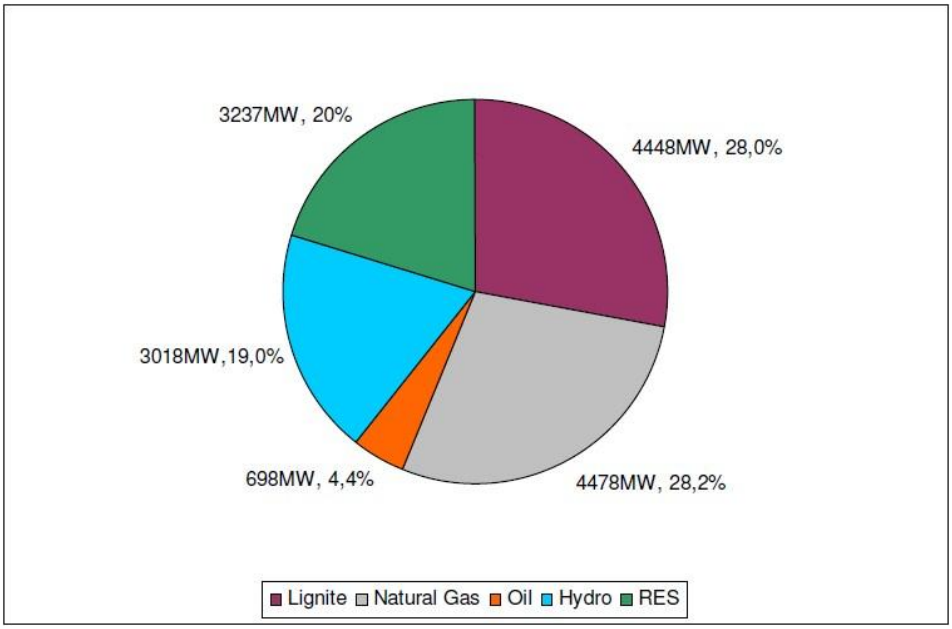

Figure 11 - Installed capacity per fuel type in the interconnected system, at the end of 2012 (Source: [6])

In general, the Greek Renewable energy market seems very prosperous even today, attracting in these difficult times, the interest of many investment companies that want to invest on RES installations. For instance, there are companies such as the French EDF, the Spanish Iberdrola, the Italian TERNA and the German Conergy that are investing on Greek RES. This positive evaluation of the Greek Renewable energy market can also be supported by the great number of applications for installation of RES, equal to 24.902 MW. Besides that, the 29,914 MW of prospective installations which are at the stage of production licensing as shown on the following table (figure 12), they highlight this potential, too.

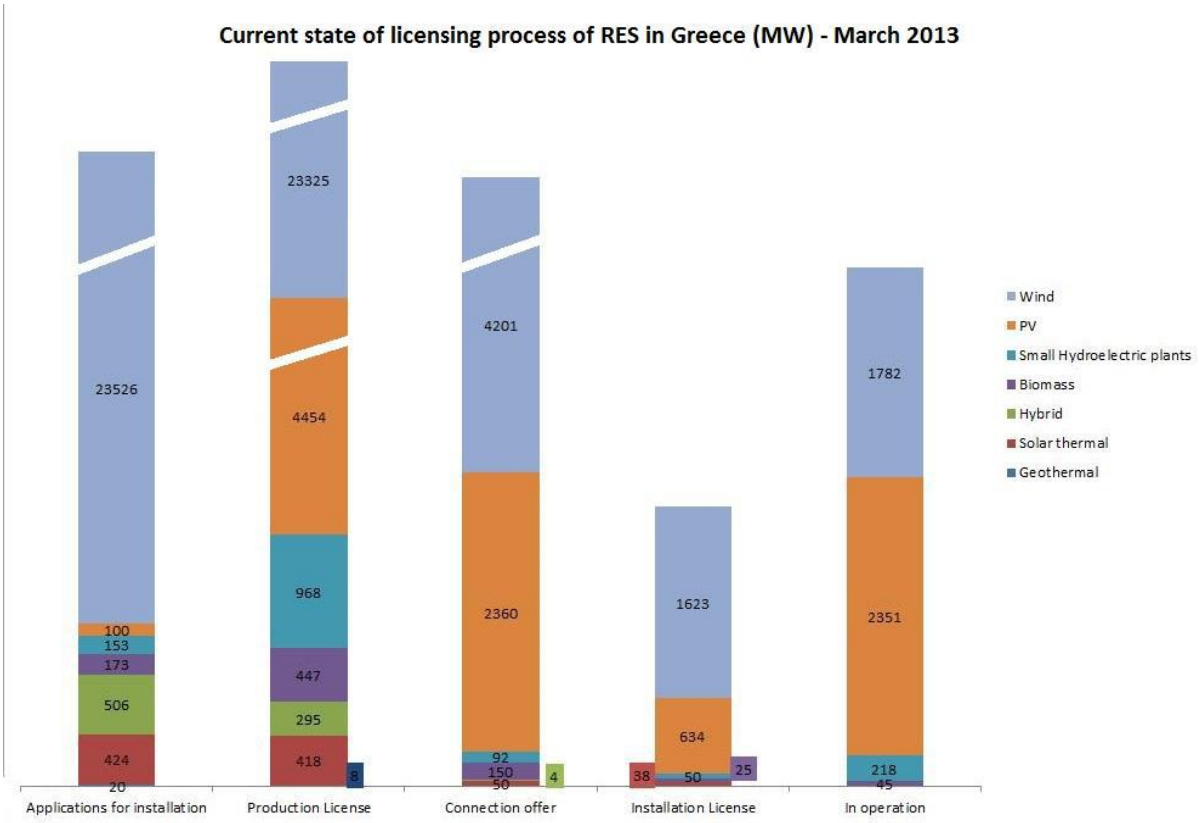

Figure 12 - Current state of licensing process of RES in Greece - March 2013

(Source: Hellenic Petroleum)

4. Importance of Renewable Energy Sources in Greece

In our days, that Renewable Energy Sources are increasing in a steady and continuous way, Greece as a part of the worldwide society, it follows these rapid developments by adopting and promoting the use of renewable energy technologies. The reasons that turned the worldwide society towards the Renewable energy sector are the projected shortage of conventional power sources, such as oil and gas, as well as the environmental challenges that we are facing today. Nevertheless, the justification for turning to RES is based on the aforementioned reasons; there is also a strong belief that this practise has its political causes, too. More analytical, the discrepancy of the scientists regarding the magnitude of the damage caused by conventional fossil fuels to the environment, as well as their disagreements about their depletion date, reinforce the opinion that there are political incentives. These motives are believed to be, the alternative, to the Western countries' dependency on politically unstable countries. Although, diachronically the reasons behind the increase of installed renewable capacity were the aforementioned, there is a recent cause for this turn. This reason is the revulsion of the public opinion against the other technologies. This aversion is based on the accidents that occurred during the last years, such as Fukushima accident and the Gulf of Mexico oil spill.

Concerning Greece, the RES except from the preservation of its energy security, it is believed that they can contribute to the country's development and welfare. These expectations are based on the social benefits that emanate from RES. More analytical, RES are capable to ensure the social welfare of a country due to their contribution at the same time on both the financial and environmental sectors. Besides that and based on the difficult economic times

that we are living, where the unemployment rates are rapidly increasing, Renewable technologies are able to create new job positions that can assist the country to deal with this infliction.

4.1 Social welfare

The social welfare for a country can be divided into two pillars; the financial and the environmental. The meaning of financial welfare for a country has to do with the benefits of its economy that are succeeded through the investments. On the other hand, the environmental welfare is about the protection of the environment, the preservation of the natural resources that belong to the country, and the secureness of satisfactory standards of living.

4.1.1 Financial welfare

The financial benefits that arise from the growth of RES can be divided into three categories of benefits; benefits for the companies, for the country's economy and for the citizens.

The advantages of RES to the country's economy have to do with their contribution into two factors that affect the financial and social welfare of a country. First of all, the RES are able to contribute on the GDP of a country, due to the attraction of investments that are both used on the country's financial market and also they are obliged to contribute on its tax system. Justifying the need for development of RES, in order to ensure the financial welfare and the maintenance or increase of the GDP of a country, Lord Nicholas Stern, professor at the London School of Economics, states that ignoring climate change could result on reduction of global GDP by 20%, by the end of the century. Adding to the above, he

underlined that this reduction could only be faced, by spending 1% of the global GDP per year, on clean energy production technologies. [7, 8]

Concerning Greece, the implementation of the reference scenario, will result on the expenditure of 0.7% of the GDP in order to fulfil the targets of 2050. These measures are necessary due to the need to reduce greenhouse gas emission by 67% in 2050, something that means an average cost of 20 €/ tonne CO_2, which is equal to an annual cost of approximately 4 billion €. [9]

From the size of the required investments, it is reasonable to come to the conclusion that a country, itself is not able to cover these targets without the help of private sector. Thus, it is essential for a country to attract investments that they will assist it to the efforts towards clean energy that has as subsidy financial benefits, too.

In Greece, the RES investments started with few hundred millions in 2006, but as time passes the amount of investments has risen to several billions. From the following table (figure 13), it is easy to figure out that each year there are investments of an average 30% increase (31.5% from 2006 until 2012). This rate of investment increase, it is quite high and it is easy to conclude that from this continuous rise of investments the Greek state is benefited, concerning its financial welfare. [10]

	RES investments in Greece				
	Total Capacity installed at the end of the year	Annual Capacity installed		Annual Investments	
	MW	MW		mil. €	%
2006	906	203		319	
2007	1.037	131	15%	208	31%
2008	1.271	234	23%	396	15%
2009	1.527	256	20%	440	25%
2010	1.800	273	18%	558	22%
2011	2.414	614	34%	1.154	39%
2012	3.634	1.220	51%	2.360	57%

Figure 13 - RES investments in Greece from 2006 until 2012 (Source: [10])

To analyse these investments in more depth, it is required to evaluate the contribution of each RES on its own.

In European level, according to Observ'ER, the RES which contribute more on the investment processes are wind, solar and biomass energy. More analytical, wind energy in 2011, had an asset finance of 16.5 billion € and in 2012, a finance of 11.8 billion €. Also, the invested amount on venture capital and private equities on this sector, was the higher among RES, with 1.5 billion € in 2011 and almost 1 billion € (978 million) in 2012. [11]

Regarding solar photovoltaic, the financing of new assets were 9.8 billion € in 2011, while in 2012, it reached 6.4 billion €. This reduction is based on the limited number of projects, since in 2012, there was a decrease of approximately 100 projects from the 392 projects, in 2011. About the venture capital and private equity investments, the expenditure of almost 1 billion € in 2011, was reduced to 57 million €, in 2012. [11]

Geothermal energy faced also a reduction on its investments. More analytical, the 187 million € for asset finance in 2011, they fell to 124 million €, in 2012, following the general fall of investments in European countries. This abandonment of the geothermal energy investments, it becomes easily comprehensible by the fact that the investments of 2011 (13.67 million €), in 2012, they "vanished". [11]

Following the general trends, biogas investments limited to 42 million € in 2012, from the 57.76 million in 2011. Besides that the venture capital and private equity investments decreased from the 333.64 million € to 186.11 million € in 2012.

In contrast with the general fall in every RES investment, biofuels recorded a 3 times increase from their asset financing in 2011 (from 147.7 million € to 491.22 million €). Despite this success, they were not on the plans of venture capitalists and private equities, since their participation in biofuel projects was null. [11]

The asset financing of the renewable technology that transforms urban waste into energy, decreased by a small proportion in 2012. More analytical, the 1 billion € of asset financing, became 705 million € in 2012. This decrease was a result of the absence of investments on all the EU countries, except from UK, where the amount of investments almost doubled.

Last but not least, the financing of new assets that are related with solid biomass fell from 3 billion € to 1 billion €, during the period 2011-2012. However of this fact, these technologies managed to attract the interest of private funds and in contrast to other RE technologies that faced major reductions, they increased their venture capital and private equity investments by 14 times (from 58.12 million € to 817.95 million €). [11]

	2011		2012	
	Venture Capital / Private Equity (in mln. €)	Number of Projects	Venture Capital / Private Equity (in mln. €)	Number of Projects
Wind power	1514.76	14	978.65	15
Biomass & Waste	58.12	7	817.95	7
Biogas	333.64	2	186.11	9
Solar photovoltaic	1044.09	19	56.73	9
Small hydropower	3.16	1	25.84	3
CSP	16.20	1	4.41	1
Geothermal	13.67	2	0	0
Biofuels	8.48	1	0	0
Total EU	2992.11	47	2069.69	44

Source: EurObserv'ER 2013

Figure 14 -Venture capital and private equity investments in renewable energy per technology in the EU in 2011 and 2012. (Source: [11])

Concerning Greece, the investments on new assets of RES are made mainly for wind energy and solar photovoltaic. In numbers, these investments according to Observ'ER were 93.58 million € for wind energy and 65.19 million € for solar photovoltaic, in 2011. Especially, the solar photovoltaic investments increased in 2012 by 3 times, reaching 193.52 million €. [11]

All, these investments, show that Greece has the ability to increase its revenues from the development of RES, since these technologies are able to attract the interest of private funds. Despite the current downward trends due to the financial crisis and the general reduction of investments, the invested capitals are reckoned as important aid for the accomplishment of social welfare.

Furthermore, the development of RES needed by a country is based also on the international and in the case of Greece, on the European treaties, too, since otherwise the country is obliged to pay the agreed financial penalties.

More specific, if Greece is not capable of implementing the agreed treaties, it will have to face the non-compliance consequences. For the Kyoto protocol, these consequences [12, 13] are translated into:

a) Commitments for the reduction of the next period emissions targets, by adding the amount not implemented multiplied by a factor of 1.3 times

b) Commitment to produce an action plan that will justify the reason behind the non-compliance, as well as the further measures that it would take

c) Forbiddance to transfer units to other Parties, using the emissions trading processes, until its total compliance to the action plans

For the EU policies, these consequences are not fully clarified due to the fact that its country is the legal entity of its territory, however, the Commission in order to transpose a directive; it has the right to ask the Court of Justice to rule against a Member State. [14, 15]

All, these measures drive us to the conclusion that the non- compliance of Greece to the agreed Kyoto and European policies, it worsens its financial welfare, since in order to comply with the rules and the penalties, it would have to spend vast amounts of money.

The benefits of RES to the citizens and industrial sector of a country are related to the energy pricing. According to the article of A. Mansson et al. [16], the high prices of oil as well as its volatility, affect the potential welfare of a country. This happens because due to the volatility of energy and prices, it cannot be done a rational planning and also, the potential danger of an outage, it results on energy insecurity. On the example of Praktiknjo et al., it is estimated that an outage can cost from 0.48 to 68 €/ kWh [16]. Consequently, this dependency on imported sources, results on high expenses. These expenses are either due to the need to pre-purchase the required amount of resources or due to the rise of prices, because of the high global demand for these resources. All these charges directly or indirectly, they affect the final consumers (citizens or industries), resulting on "reductions" of their purse. In addition to these high expenditures, the emission taxes that are added to the final cost of energy, generated from these resources, they increase the total cost excessively.

4.1.2 Environmental welfare

A basic factor that contributes to the social welfare of a country is the secureness of its environmental welfare. More analytical, the damage of the environment results on both social and financial problems.

The reasons of the environmental destruction that are linked to energy production are mainly, two: climate change and air pollution. Climate change is believed to be caused mainly by the greenhouse gas effect. As it is presented by the figure 15, the solar radiation, when it comes in contact with the earth's surface, some of it, it is absorbed by the earth's surface in order to warm it, while the rest of it, it is reflected. This natural process, due to the greenhouse emissions, it is degraded, because the greenhouse gas molecules and clouds that are created on the atmosphere, they absorb and reemit the reflected solar radiation. This reemission of solar radiation towards earth's surface has as result the rise of earth's temperature. The expected consequences of Global warming are; melting of the ice on poles which will raise the sea level and may cause floods, reduction of the agricultural production due to extended periods of draught and endangered species, since 15- 40% of animals are expected to become extinct by just a $2^{o}C$ increase in the average global temperature. [9]

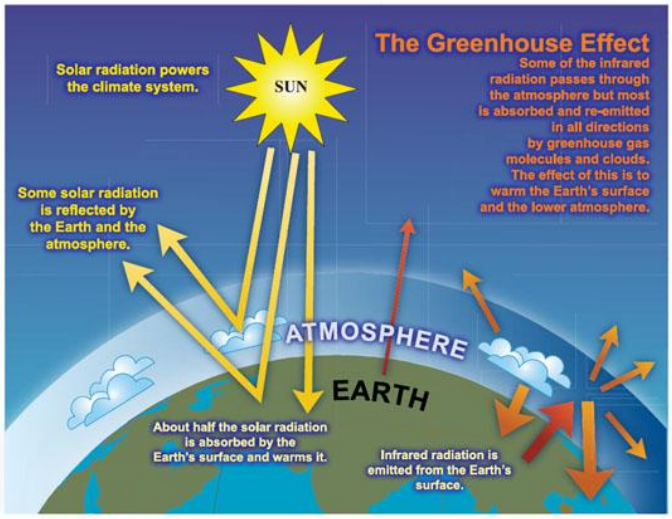

Figure 15 - The Greenhouse Effect (Source: [17])

Greenhouse gas emissions are mostly attributed to burning fossil fuels which emit large quantities of CO_2 as well as deforestation, chlorofluorocarbons (CFCs) used in refrigerators and fertilizers used in agricultural activities. According to the National Bank of Greece, it highlights that studies have shown that carbon dioxide was always between 180 and 300 ppm during the last 800,000 years. Thus, the deviation of our era's emissions (390 ppm) from these natural range, in a small period of time, it can only have negative impact to the environment. [18]

Methods that can be employed to reduce the GHG concentration include energy savings, increased efficiency, protection of forests and replacing conventional power sources with renewable for power generation, heat and transportation. The following figure, illustrates the share of each sector to GHG emissions of European countries. As, it is shown Energy production is the main reason of greenhouse gas emissions, thus it becomes clear that the change of the energy mixture is a required measure.

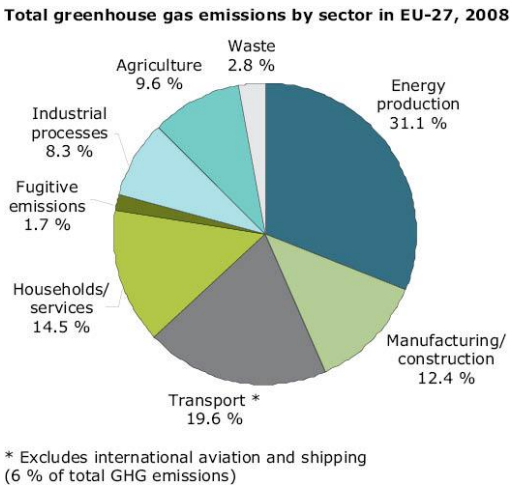

Figure 16 - Total greenhouse gas emissions by sector in EU-27, 2008 (Source: [19])

Furthermore, from the Synthesis report of Intergovernmental Panel on Climate change, it is highlighted that detrimental sources of GHG emissions are fossil fuels, deforestation and agriculture. More analytical as it is presented on the following table (figure 17), the fossil fuel use reached 56.6% in 2004, while its GHG emissions contribution increases steadily from 1970. [20]

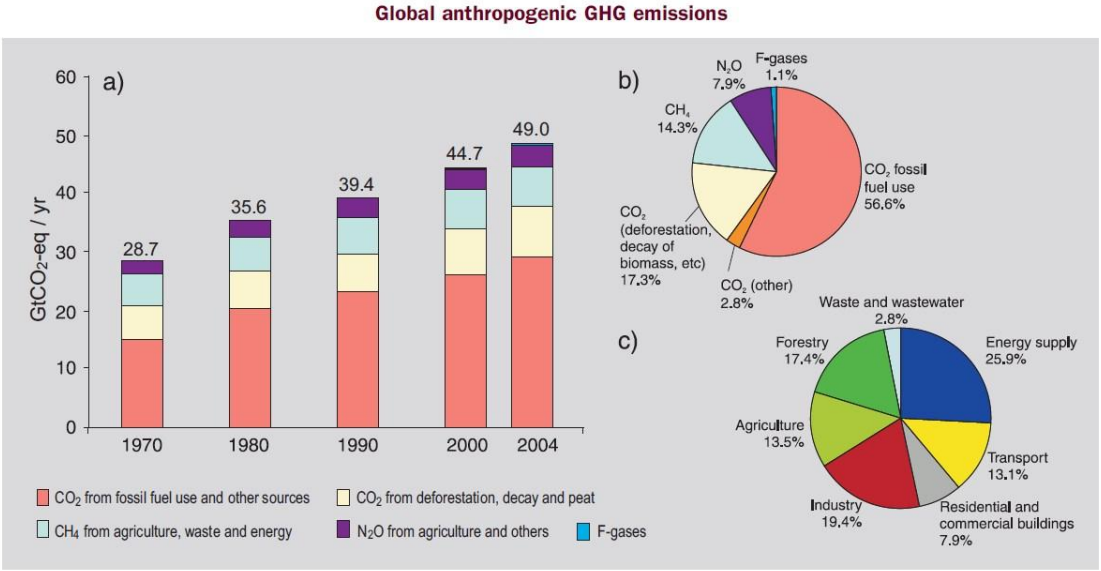

Figure 17 - (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004, (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO2, (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO2 (Source: [20])

Studying in more depth, the connection of each energy source with GHG emissions, from the Life Cycle Assessment of Electricity Generation report, it becomes clear that all electricity generation technologies emit greenhouse gases during their life cycle, even renewables. However, as it is illustrated by the figure 18, their contribution to gas emissions is vestigial, since the greenhouse gas emissions of RES are less than 10% of the coal's corresponding. In addition to this, it is stated that the most emissions are caused indirectly, for example during the construction phases of RES. [21]

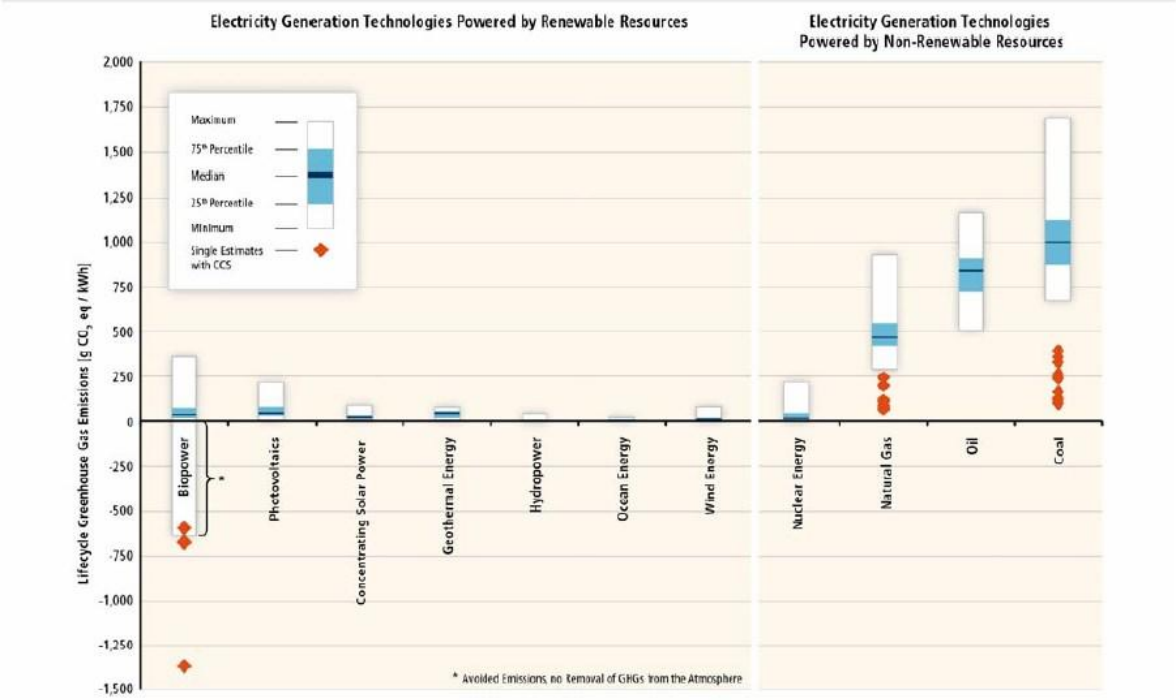

Figure 18 - Estimates of life cycle GHG emissions for categories of electricity generation technologies, including some technologies integrated with CCS (Source: [21])

Concerning, the air pollution, the major human activities that result on air pollution are power generation and transportation. The air pollutants that emanate from these activities have impacts both on human health and environmental welfare. The leading sector which is responsible for GHG emissions is the generation sector of Electricity and heat, followed by the transportation and industrial sector. In EU as the Union of the Electricity Industry (EURELECTRIC) presents the level of emissions from the power sector has consistently decreased, having in some cases, even minor contribution compared to other sectors such as transport. [21]

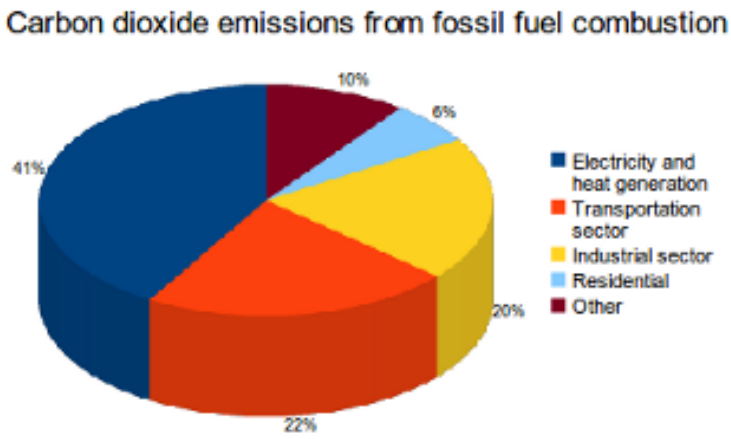

Figure 19 - CO2 emissions from Fuel Combustion, 2012 (Source: [22])

Targeting to deal with the issue of air pollution, the European Commission is making efforts towards the adoption of RES on both energy and transport sector of a share of 20% and 10%, respectively. The support to RES is based on their capability to produce energy without emitting any air pollutants that harm the environment. This opinion is also highlighted by the EURELECTRIC report [21], which presents studies that show that non-combustion RES and nuclear energy emit quite few air pollutants compared to fossil fuels. According to the same source, even the combustion process of biomass for the generation of electricity, it

emits less than half of the corresponding emissions of hard coal, lignite and oil. Based on these facts, it is easy to figure out that the replacement of conventional fuels from RES is beneficiary to the air pollution, too.

The environmental welfare must be high in the Greek agenda, since it is directly linked with its social welfare. More specific, despite of the general living standards and the environmental impact of the climate change, there are also consequences that they will harm the Greek state's structure and prosperity. More analytical, the consequences of the climate change are summarized by the Bank of Greece [18] as:

Water supply

- The water supplies of Greece will be reduced due to the reduction of rainfall levels
- The Greek wetlands will dry and pollute
- The phenomenon of desertification will rise Increase of the sea level

Studies have shown that the level of sea will rise between 0.2 to 2 meters until 2100. This increase would have both financial and residential damages.

Fishery

Because of the climate change, a significant amount of fishes will be decreased, resulting this way the fish market. The estimations are presenting reductions of 2.5% of the average total fish catch. However, there are optimistic scientists who believe that the amount of fishes will remain stable due to the increase of the warmer-water species.

Agriculture

On the agricultural sector, the consequences of climate change are related with the type of cultivation. Some farms that are thermophile are expected to grow, while other farms will reduce. According to the study, the consequences of climate change and desertification would fluctuate between profits 3.31% of the GDP to deficits of 14.84% of GDP.

Forests

The impact on forests will be changes on the type of forest, something that is going to affect the logging. Thus, there would be reductions on the biomass produced by logging. The estimations of this reduction are between 529.9 k cm^2 to 686 k cm^2.

Tourism

It is estimated that the arrivals will increase by 25% but despite this increase, the financial benefits will remain the same. This occurs because there will be needed to develop new touristic areas and public infrastructure, while other areas will lose their share and will be abandoned.

Transports

The consequences on the transport sector will be:

- To the infrastructure, due to the necessity for reconstruction and repairs because of the new climate conditions
- To the maintenance of the transport infrastructure
- To the operation of transport system (changes on the routes and services will be required)

To conclude, it becomes easy to figure out that the consequences of the climate change can harm the Greek state in every sector. For this reason, Greece in order to ensure the safety and future of its citizens, it needs to take the necessary measures to avoid the climate change. These measures according to scientists are two; either the development of RES or the development of nuclear power. Because of the neighbouring countries of Greece, as well as its high seismicity, it is preferred the solution of RES.

4.2 Employment

Among the benefits that RES include, there is their capability to produce an abundance of job positions. More specific, RES compared to fossil fuel technologies that are the current primary sources of energy, they are capable to produce more job positions than them for the same power output. This occurs because fossil fuel power plants are heavily mechanized, resulting on a lack of need for human factor. More analytical, according to the United Nations Department of Economic and Social Affairs researches, it is presented that renewable energy produces two to three times more job positions than fossil fuel energy. [23] This fact can be supported by the studies of the University of Massachusetts-Amherst, which states that in an expenditure of $ 100 billion for development of renewable energy, the direct and indirect jobs created are approximately 1.5 million, while taking account the induced effects (spending of the earned money), they reach almost 2 million jobs. This number compared to the 542.000 jobs that are created by the same spending for Oil Industry, results on the conclusion that green development can help on the reduction of unemployment rates by 3 times more than the conventional. [24]

TOTAL JOB CREATION THROUGH $100 BILLION GREEN STIMULUS PROGRAM	
Direct jobs	935,200
Indirect jobs	586,000
Induced job	496,000
Total job creation	1,999,200

Source: U.S. Bureau of Economic Analysis and authors' calculations.

Figure 20 - Total Job creation through $100 billion Green Stimulus Program (Source: [24])

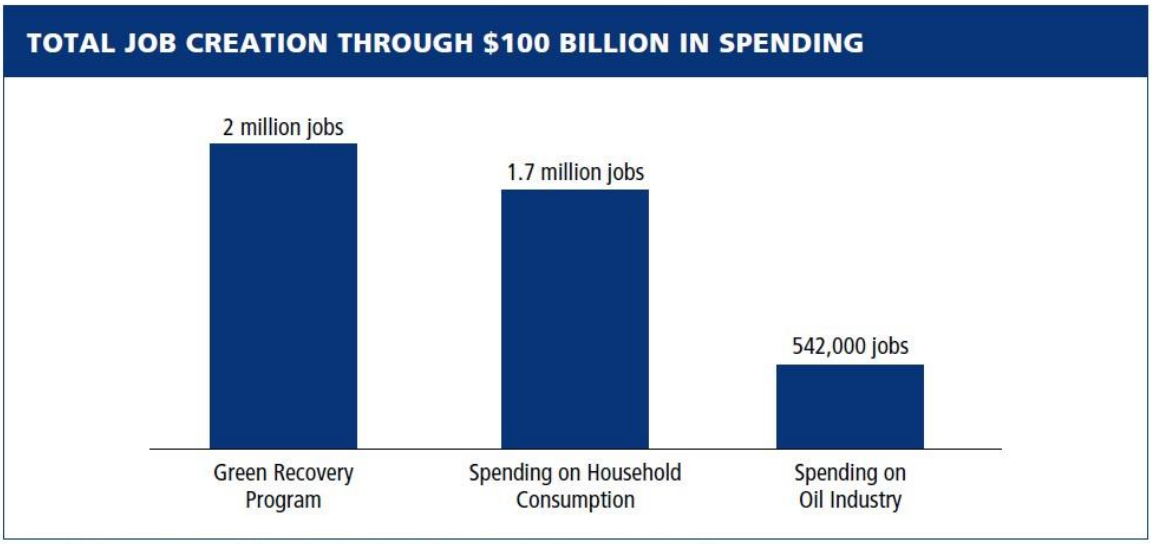

Figure 21 - Total Job creation through $100 Billion in spending (Source: [24])

Furthermore, based on the Greenpeace suggested programs for future development of a greener energy mixture in USA (Appendix 1), it is easy to figure out that the development of RES, results on the production of two to three times more job positions than the continuation of the current energy policy (figure 22). [25]

table 6.2: **employment & investment**

	REFERENCE			ENERGY [R]EVOLUTION			ADVANCED ENERGY [R]EVOLUTION		
	2015	2020	2030	2015	2020	2030	2015	2020	2030
Jobs									
Construction & installation	77,275	64,942	60,238	434,323	420,379	243,081	546,621	501,219	399,299
Manufacturing	60,255	41,933	35,079	330,750	270,940	143,907	487,420	327,949	180,877
Operations & maintenance	150,873	168,011	209,943	181,292	264,388	413,168	199,086	314,617	488,107
Fuel	181,332	186,004	202,736	204,582	213,436	233,260	210,632	196,220	201,204
Coal and gas export	763	878	1,401	416	218	19	361	121	11
Total Jobs	**470,498**	**461,767**	**509,396**	**1,151,363**	**1,169,361**	**1,033,434**	**1,444,121**	**1,340,126**	**1,269,497**
Coal	109,954	104,239	114,937	63,904	40,551	20,056	55,283	32,591	5,597
Gas, oil and diesel	118,234	119,625	122,193	185,298	172,467	177,478	172,422	143,192	133,852
Nuclear	33,940	36,904	41,097	18,470	12,024	1,712	18,470	12,024	1,712
Renewables	208,370	200,999	231,168	883,691	944,319	834,188	1,197,945	1,152,319	1,128,336
Total Jobs	**470,498**	**461,767**	**509,396**	**1,151,363**	**1,169,361**	**1,033,434**	**1,444,121**	**1,340,126**	**1,269,497**

Figure 22 - Total jobs generated by scenario and by energy resource (Source: [25])

However of these promising numbers that are the aggregation of both construction, manufacturing, operations and maintenance jobs, and they represent the quantity of the created jobs, an important factor for the evaluation of the created jobs is also their future prospects. As it is stated by James Conca on Forbes, the construction process for 1,000 MW of gas installed capacity requires the same amount of jobs (1,000 jobs) with wind power installations, while coal and nuclear installation require 1,500 and 5,000 jobs, respectively. Thus, these facts could drive us to the misconception that gas and wind produce the same amount of jobs. This is a wrong assumption because the operation process of the wind requires 90 jobs, a third more than gas. Also, in the same text, it is highlighted that solar energy installation in contrast to wind, it has even more construction job requirements. From the aforementioned facts, it is easy to come to the conclusion that RES have greater job opportunities from conventional fuels, such as oil and gas, while they are inferior to the job opportunities provided from fossil fuels, such as coal. [26]

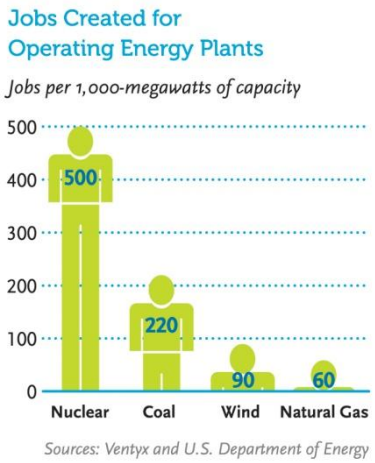

Figure 23 - Jobs created by operating energy plants (Source: [26])

Another factor that has an impact on the employment sector is the manufacturing process of the equipment required for the development of RES. This equipment includes among

others; solar panels, wind turbines and bio-fuels' machinery. The contribution of the manufactured equipment on the employment field, it does not concern just the professions related to the production of this equipment but also, the research and development job positions that are engaged with the design and the optimisation of the product. Regarding the manufacturing process, an inaccurate assumption based on the public opinion, would be that Asian countries are the leaders on the production of the necessary equipment. Nevertheless, according to United Nations Environment Programme, Europe accounts 80 percent of the wind turbine global market and also, it has taken the lead from Japan, which was the major producer of photovoltaic cells. Thus, Greece as European member, it could attract investments of industrial renewable equipment producers, aiming on the creation of new job positions. Despite this, Greece can invest on research and development programmes, too. The investment on R&D can produce a great amount of job positions, since there would be development of institutes, laboratories and research centres.

In order to study in more detail, the benefits that emanate from the development of RES, it is needed to evaluate separately the contribution of its renewable source. According to the International Renewable Energy Agency (IRENA), the contribution of RES on the job positions worldwide, in 2013, was around 6.5 million jobs. These professions, on the same report, they are separated into 9 categories of Renewable energy technologies. From this separation, it is easy to figure out that the leading technologies on the production of job positions in the RE sector, are Solar Photovoltaic, Liquid Biofuels and Wind power. Especially, if we add up these job positions by energy, solar energy comes first with 2819 thousand jobs, followed by Bio-energy that accounts 2499 thousand jobs and Wind energy with 834 thousand jobs. From the following table (figure 24), we can notice the contribution of its technology to the employment sector. [27]

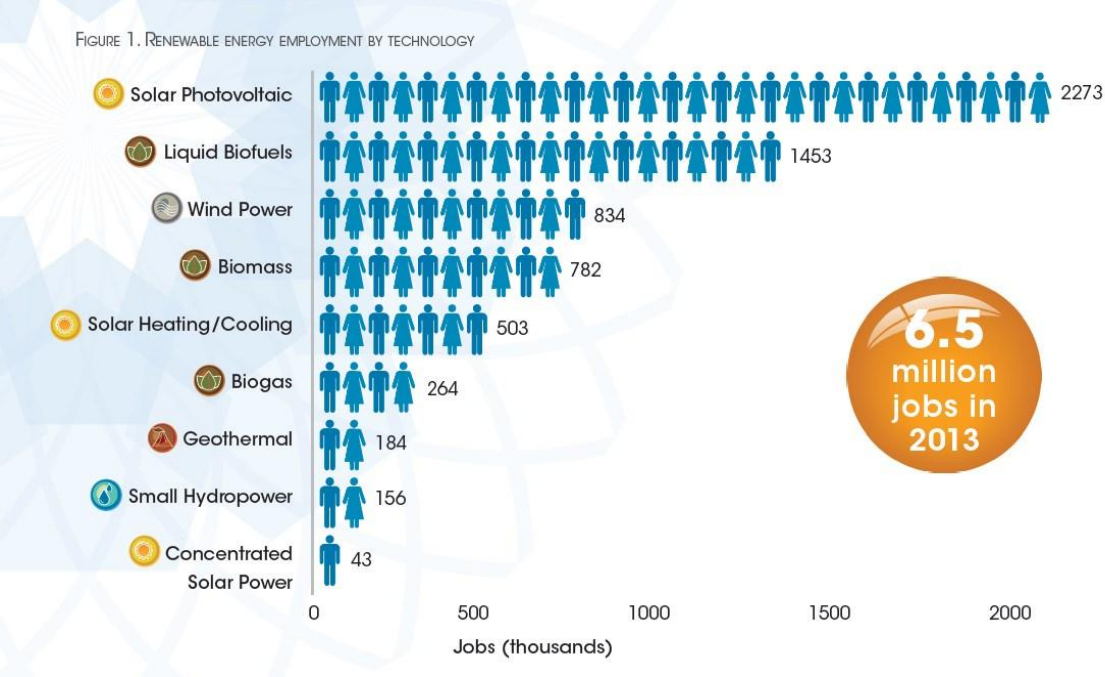

Figure 24 - Renewable Energy employment by technology (Source: [27])

The share of Solar PV in the employment sector of European Union and United States, it is declined to 14% in 2012 from the 43% that they accounted on 2007. This happened because of the rapid increase on the Asia's share, due to the low cost manpower. [27]

Concerning biofuels, their contribution to the European Union job positions was 108,000 jobs in 2012. The jobs related to this energy source, are mainly growing and harvesting jobs that require manual and physical work. However, there is also a smaller share of jobs that have as task the processing of feedstock into fuels. [27]

The contribution of wind energy to the employment of European citizens is 58,000 jobs, based on European Wind Energy Association (EWEA, in 2013). The global leaders in this category are UK and Germany, and especially the UK has made rapid steps towards the development of wind energy, something that can be noticed by the quick growth of the wind energy job positions, from 21,100 in 2010 to 34,400 in 2013. [27]

Regarding Greece, the contribution of renewable energy technologies to the employment sector was 33,005 jobs, in 2012. According to Observ'ER the distribution of these positions by sector, was as show on the following table (figure 25). [11]

	Country total	Wind power	Solide biomass	Photovoltaic	Biofuels	Heat pumps	Biogas	Solar thermal	Small hydro power	Wastes	Geothermal energy
Germany	368 400	117 000	50 200	87 800	22 700	12 500	51 000	12 700	7 200*	5 200	1 400
France	188 010	20 000	48 000	39 000	30 000	30 850	3 200	8 200	3 860	3 700	1 200
Italy	102 500	40 000	12 200	16 000	5 270	10 500	5 000	4 350	2 730	950	5 500
Spain	77 910	30 000	14 500	12 000	9 435	4 500	520	4 500	1 500	855	<100
Denmark	58 570	40 500	3 250	7 000	770	2 700	200	1 500	<50	2 500	<100
United Kingdom	53 520	20 500	7 050	12 500	4 420	1 600	3 500	900	1 000	2 000	<50
Sweden	50 610	5 100	28 350	600	4 140	8 500	250	150	520	2 900	<100
Belgium	39 850	4 000	3 300	20 500	9 920	600	300	600	400	180	<50
Austria	39 610	3 900	18 600	4 850	4 580	1 130	1 900	3 400	1 050	150	<50
Poland	33 835	2 815	20 500	420	5 480	560	320	2 540	950*	50	200
Greece	33 005	1 500	3 000	23 500	490	0	115	3 000	1 250	n.a	150
Finland	31 345	500	23 500	<50	1 540	5 000	80	<50	375	250	0
Netherlands	26 050	3 500	3 300	7 500	700	5 000	600	350	200	4 500	400
Portugal	19 125	2 700	7 025	3 500	1 830	700	120	1 100	1 750	300	<100
Bulgaria	17 565	830	2 925	10 000	790	2 400	<50	100	420	n.a	<50
Romania	17 285	5 000	10 410	<50	925	0	<50	200	450	n.a	200
Czech Republic	14 535	500	6 460	1 500	2 925	700	1 000	1 000	300	100	<50
Hungary	11 110	150	4 300	750	4 230	<50	130	200	400	50	850
Slovakia	7 920	<50	2 150	2 000	2 590	<50	60	500	300	<50	170
Latvia	6 430	100	5 200	<50	570	0	60	<50	350	<50	0
Slovenia	5 705	<50	1 760	2 400	200	480	130	150	385	<50	<100
Estonia	5 190	700	3 040	<50	<50	1 200	<50	<50	<50	n.a	0
Lithuania	4 715	400	2 975	100	840	<50	<50	<50	150	n.a	<100
Ireland	3 535	2 500	100	<50	310	100	110	200	115	<50	0
Cyprus	1 050	150	<50	250	<50	0	<50	500	0	n.a	0
Luxembourg	750	100	150	100	200	0	<50	<50	<50	<50	0
Malta	100	0	0	<50	0	0	0	<50	0	n.a	0
Total EU	1 218 230	303 445	282 095	252 570	114 955	89 170	68 895	46 440	25 805	23 935	10 920

** Small and large hydro, n.a.: non available. Source: EurObserv'ER 2013*

Figure 25 - Distribution of employment by sector, 2012 (Source: [11])

From this source, it becomes known that there was a decrease on the job position of wind power from 2,000 to 1,500 despite the fact that the installed capacity increased by 109 MW from the 1,640 in 2011.This reduction that does not have any connection with the wind power general trends (all the other countries stayed on the same levels or increased their job positions) was unexpected and its justification is based on the Greek need for reduction of the job positions, due to the financial crisis. An opinion that is based on the fact that the other two countries, which faced reductions on the job positions were Portugal and Ireland: two countries that are also affected by the financial crisis. [11]

On the other hand, in solar photovoltaic where Greece is among the first five countries for job opportunities, Greece managed to increase the 22,000 by 1,500. This development resulted on the conquest of the third place from Greece, surpassing this way, countries like Italy, Spain and United Kingdom. [11]

In solar thermal sector, Greece without significantly increasing its installed capacity (23 MW from the total 2,862 MW), it prosper to increase the number of the job positions by 500, reaching 3,000 jobs.

Concerning the small hydro power plants, the alteration of jobs was imperceptible. More specific, both the installed capacity and the job positions remained almost at the same levels as 2011, increasing by 12 MW and 10 jobs, respectively.

Furthermore, solid biomass in Greece during 2011-2012 increased both the primary energy production and the employment positions by 0.060 ktoe and 200 positions, respectively (0.940 ktoe and 2,800 jobs in 2011). Resulting on the belief that supporting in a greater extends the biomass development, it could produce a great number of jobs. [11]

Finally, geothermal power, biogas and bio-fuels due to their underutilization for the production of renewable energy, they did not contribute enough to the generation of new job positions and they remained either constant or they slightly increased its shares. Analytically, geothermal continued to employ 150 people, biogas remained stable, too, to 115 workers and only bio-fuels had an increase of 10 jobs from 480. Thus, it becomes imperative need for Greek country, the further development of these technologies; since they are both environmental friendly and they are able to produce many job positions, proportionally to its energy contribution capabilities. [11]

4.3 Energy security

Greece because of the limited power resources that are found on its territory, it is obliged to import almost the two-thirds of the required resources for the coverage of its energy needs. This happens since; Greece is primarily based on oil and gas two power resources that do not exist in satisfactory and exploitable quantity in Greek territory. As a consequence of this shortage, Greece is required to import from countries that are favoured to have oil and gas deposits, such as Russia and Middle East countries. This dependency on either political unstable countries or on countries that covet the political manipulation of their trade partners, or on terrorist attacks on pipelines or tankers, is not an objective for a modern and civilized country, like Greece. Furthermore, the dependency of a country to its energy suppliers results on high expenses, since the oil and gas market is an oligopoly, there are quite high transport costs and the demand is increased due to the confrontation of energy as a staple commodity.

On the other hand, the lignite that is the main source of electricity generation and the most used Greek resource, according to studies, it has a limited sufficiency that is not able to cover the total energy demand, and even if it was able, its contribution to the pollution of the environment, it is enough to restrain its usage. More specific, according to IEA studies, Greece consumes lignite of 64 to 66 Mt [2], consumption that if it is held constant at current rates, it would be enough to supply Greece for several decades. However of this capability of lignite, since it is obvious that a country that aims on its development, it needs more energy consumption, another energy source must be found, because lignite would not be capable of covering this requirement by itself, without risking the rapid depletion of its reservoirs. Moreover, lignite is also ineligible because of its high emissions of CO_2 that are both harmful for the environment and the human. More analytical, as it is highlighted by the IEA data,

lignite's emissions are even higher than these of gas-fired plants and especially in Greece, they reach an average emission rate of 1 tonne of CO_2 per MWh generated compared to the 350 kg of CO_2 per MWh of the gas-fired plants (data of 2009). [2] As a consequence of these high emission rates and according to the EU directives for Large Combustion Plants, Greece has to advance on the energy field by closing down its old lignite units, if it aims to keep up with the European policies and to avoid the penalties by not following them. All of these reasons advocate to the need of finding an alternative source for the coverage of the Greek energy demands. The answer to this issue is twofold; either there will be development of RES or oil and gas imports must increase, affecting the country's energy security.

Consequently, all these facts in relation with the Greek capabilities for development of RES, drive us to the conclusion that Greece has to invest on the development of Renewables.

Furthermore, except from the imports of primary energy resources, Greece imports electricity, too. This happens because the generated electricity in Greece is not sufficient in order to cover its electricity demand. This happens, especially, during the summer months that there is greater demand from both industrial and residential sector.

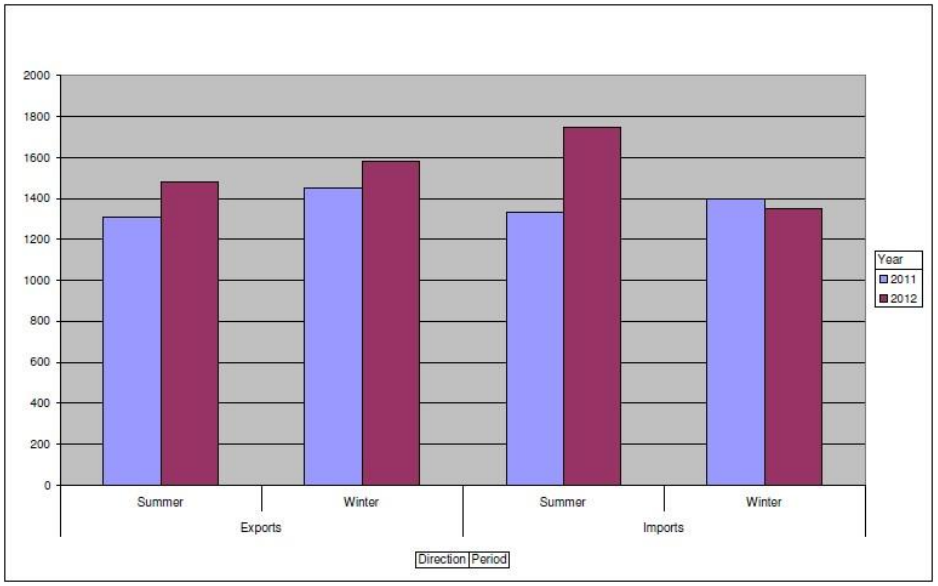

Figure 26 - Comparison of Summer and Winter Net Transfer Capacity (Source: [6])

Because of this inefficiency, Greece is obliged to import electricity from neighbouring countries, such as Italy, Bulgaria, F.Y.R.O.M. and Serbia. According to IEA report of 2011, the net imports of Greece during 2008-2010 are 5.6 TWh, 4.4 TWh and 5.7 TWh, respectively, resulting on an average net imported electricity of 5.25 TWh. Based on the fact that the total electricity, in 2010, was 66.5 TWh, it is easy to notice that the imports of 2010, accounted for more than 8.5% of the total electricity [2]. This quite high amount of imports, it is the result of the steady increase of imports from 2001. This increase was caused by two factors; the growing electricity demand as well as the efforts of the Greek Government to close down lignite-fired plants due to their harmful emissions and according to the EU directives. The following figure (figure 27), it presents the electricity imports of Greece by year and the engaged suppliers. From this figure and figure 9, it is easy to figure out that there is a small decline on the imported electricity, however this decrease is not the result of a successful policy, but it is caused because of the reduced electricity demand that was noticed during the Greek financial crisis.

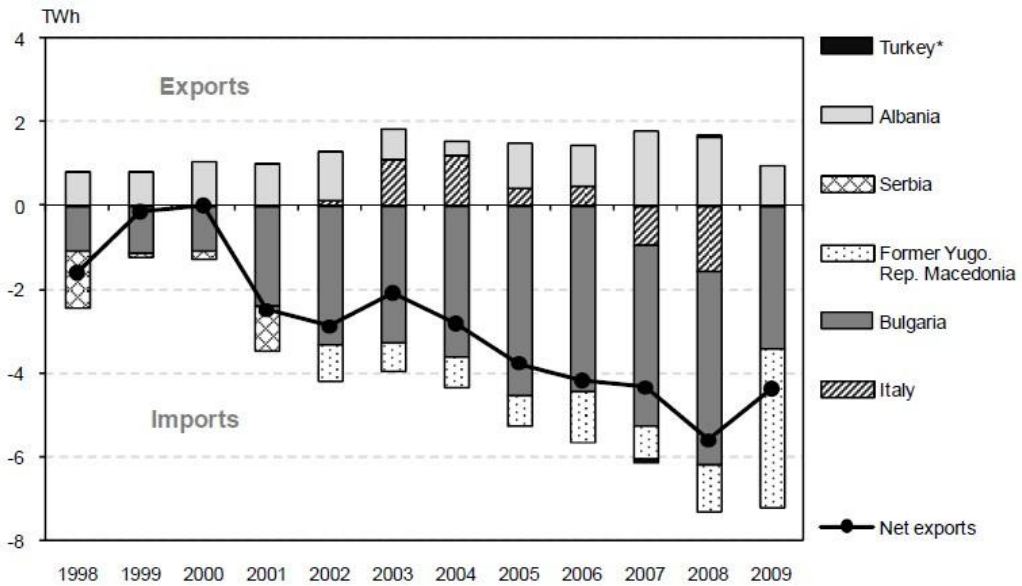

Figure 27 - Electricity imports and exports, 1998 to 2009 (Source: [2])

The need for imports that Greece faces, has a financial impact, too. More specific, in 2013, PPC was obliged in order to cover the markets' needs, to import electricity of 119 million Euros without taking into account the expenses for the interconnecting rights. This expense was increased by 6.8 million (6.1%), due to the inevitable increase of the energy imports by 161 GWh (8.1%) from 2012 to 2013. [28] Thus, it becomes obvious that except from the political affection to other countries, there are also economic factors that command the alteration of energy policy.

In contrast to these issues that emanate from the use of conventional energy sources, RES "promise" energy self-sufficiency. More analytical, their potential in Greece is reckoned as promising, since it is one of the highest in Europe, consequently their exploitation is viewed as an urgent need. This happens because this way, Greece will be able to deal with two problems at the same time, such as energy dependency and environmental disaster. However of these ambitions, today, RES in Greece are not capable to guarantee a reliable and continuous supply of energy to the Greek market. This occurs because of their limited energy capacity as well as their inability to store great amounts of energy for long periods of time.

These challenges may seem avertive for the installation of renewable plants, but still they remain the only eco-friendly and indigenous solution for the coverage of the energy demand. For this reason, it is necessary for the design of an energy mix that will ensure at the same time both energy reliability and security. To this context, the continuous increase of the contribution of RES in the energy system, abetted by the conventional fuels, can only described as a positive step towards the country's self-sufficiency. An example that shows Greek positive measures towards renewable is the increase by 41% of the total generated electricity from renewables during 2012-2013, as it is illustrated by the following chart (figure 28).

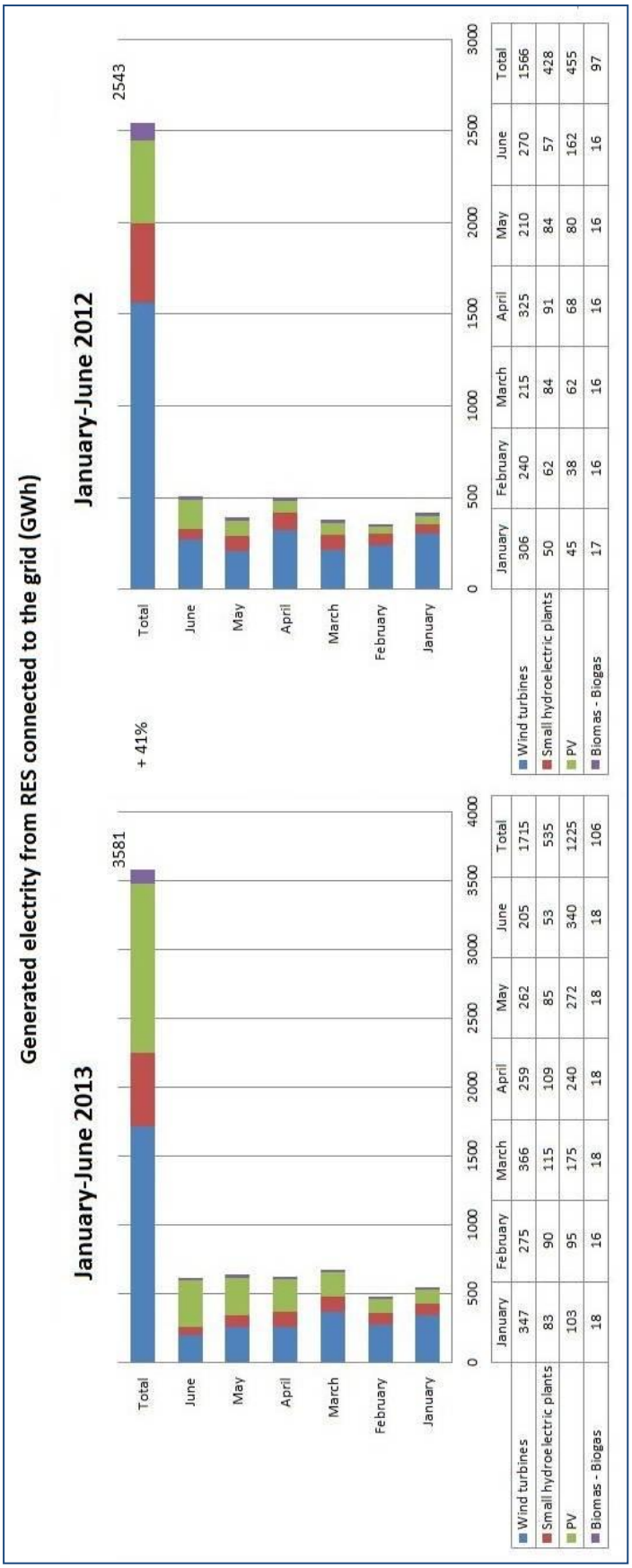

Figure 28 - Generated electricity from RES connected to the grid (GWh)

(Source: Hellenic Petroleum)

5. Discussion- Proposed intervention framework

In our days that the environment is in danger, it becomes easily comprehensible that all the countries must act in order to ensure its safety, which is related to the human's wellbeing. Although, this issue is by itself difficult to be solved, the current financial problems faced by every country due to the economic crisis, it enlarges the difficulty of finding a solution. One of the suggested solutions regarding the energy sector is the development of RES. This energy resource, it is believed that it can play a fundamental role in tackling climate change, energy demand coverage and energy security.

Greece as an environmental sensitive country and not sufficient in term of energy resources, decided to deal with the aforementioned problems by adopting RES. Important role to the formation of this decision was also played by the European Union, which has made great efforts regarding the promotion and adoption of RES during the last years. Through the directives policy, EU accomplished to imply various targets for the development of RES in every country by 2020.

Concerning Greece, from many studies, it becomes clear that there is high potential for development of RES. Especially, the wind, solar and biomass power generation, which considered the most favourable energy sources in Greece, they are accounted as some of the most prominent in Europe. More specific, according to J. Deb Mondol and N. Koumpetsos [29], the wind energy's potential in Greece and in particular in islands, it is enormous, since there are many locations with average wind speed of 66-88 km/h. Besides that as it is stated on the same report, the available biomass resources are equivalent to 30-

40% of the total oil consumption, thus it is easy to figure out that biomass can be an integral part of the Renewable policies, too. Last but not least, solar energy can also play a role on the country's energy production. This opinion can be supported by the fact that there are estimations, which pose that the average annual solar radiation of Greece is 1570 kWh/m^2, with some areas even having 7.5 h/ day of sunshine hours.

Despite these high prospects of RES in Greece, there are many obstacles and scepticism hindering their development. The challenges that emanate from the Greek pathogeneses have to do with various sectors of the Greek society. More specific, the barriers that are usually faced by Renewable energy investors are political, legal, bureaucratic, financial and social. [30] Consequently, it is easily comprehensible that RES development is highly dependent on pathogeneses that are able to halt the program for a long period of time or even permanently.

Furthermore, in our days, the development of Renewable energy systems is also halted due to the scepticism and the controversy of the merits that emanate from RES. More analytical, RES are questioned about their reliability at providing energy at large scale, as well as about their costs that are reckoned as too high, especially in an economic crisis period. Except from that, the superannuated and complex legal framework of Greece, it turns out the foreign investors.

From the aforementioned malaises of the Greek state, it is to understand that without any change on the current policies, RES will not reach the targets implied by the EU directives and the Greek government. Consequently, Greece has to take some measures in order to assist the adoption of RES. Firstly; Greece must give incentives for installation of RES, in order to attract the interest of both native and foreign investors. Also, it needs to reduce the

labyrinthine bureaucracy that halts the installation of RES, by involving too many regulatory authorities. Besides that, another necessary measure is informing Greek citizens about RES. This is essential, because today, there are people that are either not familiar with RES or they are mislead due to the great variety of information resources, and consequently, they develop a not in my backyard (NIMBY) stance.

Aiming on the information of the Greek citizens, a strategy that can highlight the necessity of RES development is the presentation of RES benefits. From the above analysis of the dissertation, it becomes clear that RES play an important role on the social structure. More analytical, they are able to contribute at the same time on both the financial and the environmental welfare. Regarding financial benefits, the attraction of investments from RES can result on revenues for the Greek country, from the imposed taxes, as well as from the capital movements. Except from these, also the citizens are benefited from the indigenous assessment of the energy prices. About the climate change, the extremely catastrophic events (draughts, floods, etc) that are reckoned as results of it, in case of not dealing with it now, drive us to the conclusion that it is better to anticipate the problem now, rather than trying to reverse it at a later stage.

Another reason for the promotion of RES development is their contribution to the job market. As it is posed from the preceding analysis, the number of renewable jobs offered, compared to this of the conventional power plants is greater. For this reason, it is necessary for a country that is tantalized by high unemployment rate, due to the financial crisis, to promote technologies such as RES, which deal with this issue, too. Finally, the contribution of RES can be major for the Greek state, also due to its energy resources shortage. More

analytical, the only fossil fuel that exists on the Greek territory is lignite, which can hold up to several decades. Thus, Greece is obliged to import energy sources, paying vast amounts and depending on other countries. A solution to this problem is the development of RES, since they ensure its energy sufficiency and security.

6. Conclusion

Nowadays, despite the estimations about the depletion of major fossil fuels (such as oil and natural gas) in the next hundred years, they continue to play an integral part on the global power generation, accounting more than two thirds of the total global energy consumption. Except from these ominous estimations, studies have also shown that more than 40% of global energy related CO_2 emissions are based on this energy source. The aforementioned reasons, combined with the fact that these sources are not equally spread on each country, result on the conclusion that it is required the development of alternative energy sources. As a solution to this problem that it is more than certain that it will arise during the next years, it is suggested the adoption of RES. These energy sources are proposed, due to the many benefits that they include such as environmental safety, social benefits and sustainability. Moreover, these advantages are also responsible for the promotion of RES from the European Union, with the form of directives that define the specific targets of each country member, by 2020.

Based on the EU targets, as well as on its environmental friendly beliefs, Greece decided to participate on these efforts, promoting and adopting RES. This movement is not just reliant on the European framework and the eco-friendly attitude, since Greek government believes that the development of RES will contribute to the country's financial and social wellbeing. This belief is also justified by the government's opinion that this way, it will both ensure the country's energy security and it will reduce the expenses of fossil fuel imports.

This project's main objective is to demonstrate the merits that emanate from the development of RES. From the first chapter, it becomes clear that Greece as a modern and conscientious country, has agreed on both International and European commitments towards the development of clean energy, and even it has altered its targets, aiming on more ambitious. In addition to that, the Greek efforts that are presented on the analysis of the current situation of the Greek energy market, show that Greece despite its intentions, it has to work harder in order to comply with the posed targets for 2020. To this extend, it is important for the Greek citizens and business sector to understand the generated benefits from the development of RES. These merits can be divided into three basic pylons; the social, the employment benefits and the energy security. As it is stated on the project, the social benefits could be both financial and environmental. More analytical, the financial are based on the attraction of investments that assist the country on the acquirement of the necessary money for implementing its missions and providing social safety. About the environmental, it is known that the human wellbeing as well as the flora and fauna, are in danger when there are environmental calamities. Aiming on the assurance of our health and safety, the development of RES "promises" the production of clean energy that does not have any impact on the environment. Regarding job positions, studies have shown that RES assist on the development of new job positions. Especially for Greece that it is stroked by the financial crisis, technologies that promise new jobs are more than welcome. Last but not least, the energy security is another issue of great importance for Greece. This happens because it is a country with no sufficient energy resources, which needs to import almost everything.

Although, the RES in Greece are far from their final target, we can hope that Greek government with the help of other European countries will manage to reach the aims posed for 2020. Besides that, nowadays, RES seem as one of the few solutions that Greece has in order to both fulfil its environmental safety, its energy supply safety and its economic progress.

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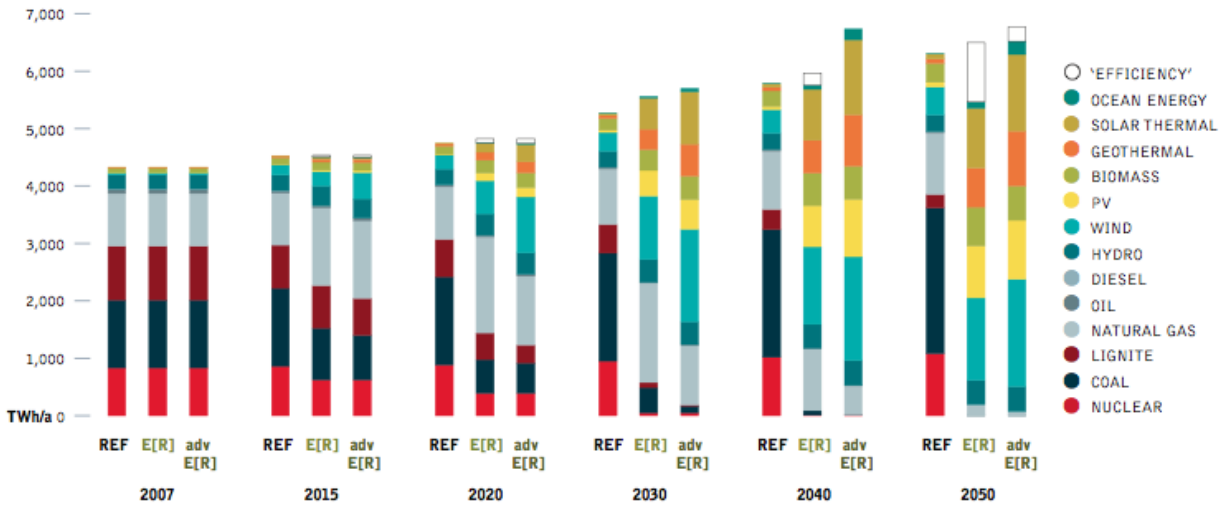
Appendices

Appendix 1

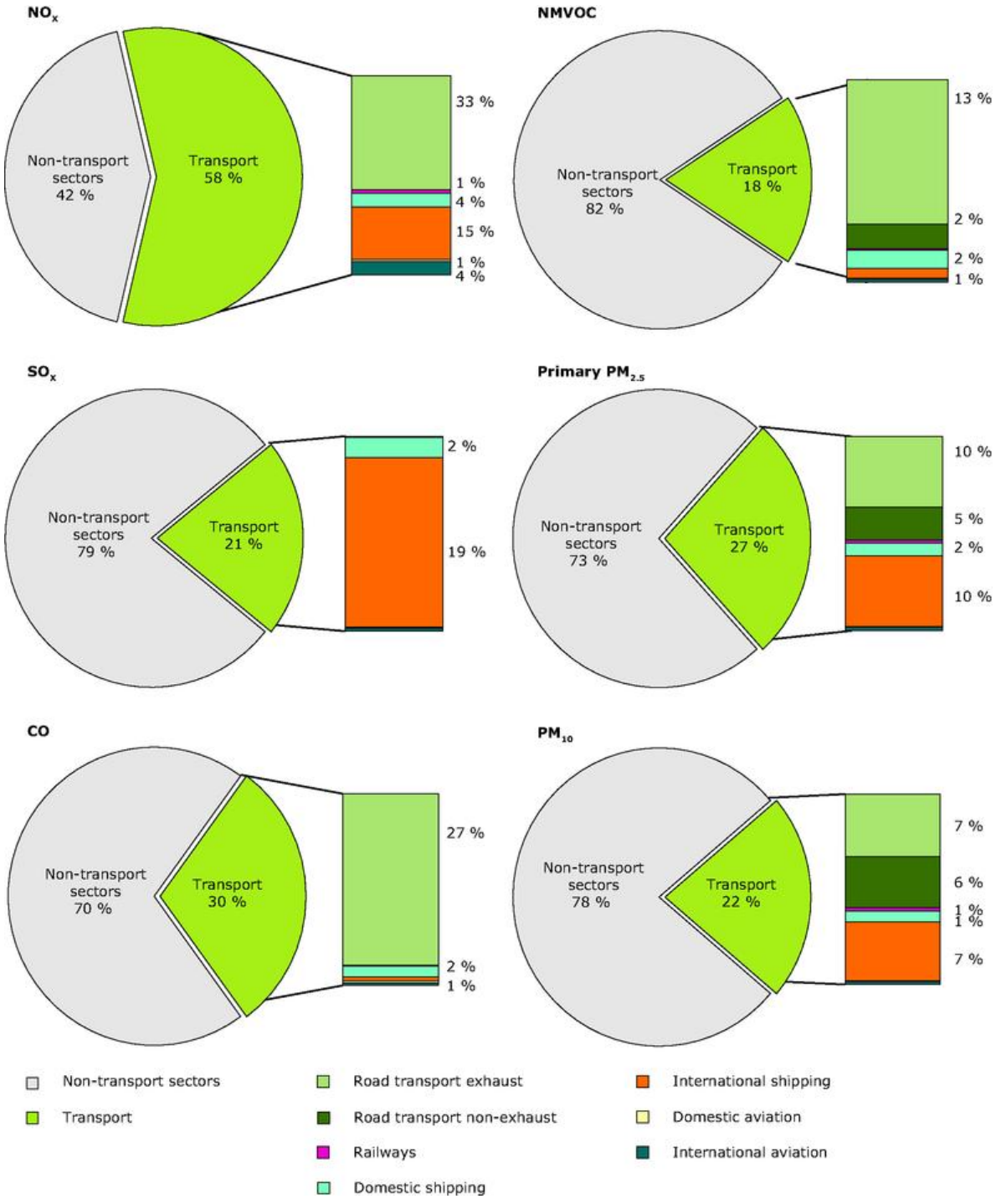
figure 6.5: **development of electricity generation structure under 3 scenarios**

(REFERENCE, ENERGY (R)EVOLUTION AND ADVANCED ENERGY (R)EVOLUTION) ("EFFICIENCY" = REDUCTION COMPARED TO THE REFERENCE SCENARIO)



Development of electricity generation structure under 3 scenarios from 2007 until 2050 (Source: [25])

Appendix 2



The contribution of the transport sector to total emissions of the main air pollutants in 2009 [31]