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Renewable Energy Investments of the European Union: Opportunities and Constraints

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Abstract

EU (European Union) currently faces some important challenges in terms of energy policies such as reduction of greenhouse gas emissions to control climate change, increasing energy demand, providing energy security and easy access to energy, and difficulties to finance internal and external investments on renewable energy. It is important to point out that the challenges of energy issues and climate change are related to each other because almost 80% of the total greenhouse gas emissions in the EU is due to energy-related emissions. Therefore, it is certain that the energy consumption has great influences on climate change. Renewable energy stands as a great solution to overcome all these challenges. However, EU needs to overcome constraints on the renewable energy investments. To find out which policies EU implement in economic, social and political areas to manage these constraints, we apply descriptive research method in this study. We firstly examine the current challenges in EU's energy policies, the EU's energy strategies, and the rapid growth of renewable energy in the world. Secondly, we evaluate data and statistics of global trends in investing on renewable energy within the power sector since 10 years by mainly focusing on European countries. Thirdly, we review the possible solutions to overcome constraints on renewable energy investments to achieve 100% renewable energy target of the EU. Our evaluation suggests that renewable energy has great opportunities to tackle challenges in the energy policies if the constraints on renewable energy investments are resolved.

Keywords: Renewable energy investments, climate change, energy strategies, EU.

1. Introduction

In this study, we discuss energy policies of the European Union (EU) in the light of renewable energy investments and its opportunities to overcome challenges such as reduction of greenhouse gas emissions to control climate change, increasing energy demand, providing energy security and easy access to energy, and difficulties to finance internal and external investments on renewable energy. To this end, we analyze which political, economic and social actions are needed to be taken in order to increase European Union's current renewable energy capacity in next three or four decades in order to cope with greenhouse gas emissions and energy related issues. To find out solutions for these challenges, we assert that it is not enough only to reduce greenhouse gas emissions but also a complete cut off fossil energy sources by shifting to renewable energy sources within three or four decades is needed. Depending on EU's 100%

renewable energy target, we suggest that renewable energy has great opportunities to tackle challenges in the energy policies if the constraints on renewable energy investments are resolved.

In the first part, we firstly examine the current challenges within EU's energy policies, EU's energy strategies, and the rapid growth of renewable energy in the world. We point out that EU's renewable energy targets have many opportunities to overcome challenges in energy policies. In the second part, we evaluate data and statistics of global trends in investing on renewable energy within the electricity sector since 10 years by mainly focusing on European countries. Therefore, we firstly overview the renewable energy developments within the EU borders, and then we evaluate EU's regional investments on the solar and wind power installation projects such as Medgrid (TransGreen) and Desertec (DII). In the third part of the study, we evaluate solutions to overcome constraints against the renewable energy investments to achieve 100% renewable energy target of the EU. These solutions are: a new market structure, investments on renewable energy technology, a well-planned infrastructure for renewable energy across the EU countries, and political leadership enforcing a shift from traditional energy resources to renewable energy resources. Finally, the last part will end up with general conclusions about the all discussions and opinions within the paper.

2. Is Renewable Energy Necessary for the EU?

There are some essential challenges that EU faces today: reduction of greenhouse gas emissions to control climate change, increasing energy demand, providing energy security and easy access to energy, and difficulties to finance internal and external investments on renewable energy. In addition, energy is a very essential issue providing social stability, economic growth and environmental protection so it has an important place in sustainable development agenda in European countries (Azman et.al. 2015). Renewable energy stands as a great solution to challenges caused by greenhouse gas emissions and other energy related issues.

2.1 Increasing Energy Demand and Climate Change

It is essential to point out the relation between greenhouse gas emissions and energy factors. According to statistics, almost 80% of the total greenhouse gas emissions in the EU is due to energy consumption. Energy Outlook 2035 of the BP – British Petroleum in 2015 asserts that *"total carbon emissions from energy consumption increase by 25% between 2013 and 2035 (1% per annum), with the rate of growth declining from 2.5% over the past decade to 0.7% in the final decade of the Outlook. Even so, the profile for emissions is well above that recommended by the scientific community"* (FS-UNEP Centre 2015: 33). Furthermore, Bloomberg New Energy Finance projection also estimates that CO2 emission caused by power sector in China may increase within next 15 years while in the EU and US may decline modestly (FS-UNEP Centre 2015). It is mostly known that *"if the Earth and atmosphere did not emit radiation but only absorbed radiation, the Earth and the atmosphere would continue to heat hotter and hotter until it would be uninhabitable"* (NSTA 2007: 9). Moreover, UNFCCC (2007) report claims that *"Greenhouse gases include carbon dioxide (CO2), methane (CH4) and nitrogen dioxide (N2O), and a rise in these gases has caused a rise in amount of heat from Sun which would normally be radiated back into space"* (UNFCCC 2007: 8). Therefore it is clearly known that greenhouse gas emissions are man-made. Finally, the IPCC 2001 and 2007 reports list the following impacts of climate change: sea-level rise 5-8 inches during the 20th century, melting arctic sea ice causing global changes in water circulation, warmer oceans causing serious ecological damage, floods

and droughts all over the world, warmer winters harming the seasons' length and in turn natural balance, agricultural disasters due to drought effecting (IPCC 2001 & 2007).

EU countries supply their energy demand from different energy sources. In 2011, the average energy production in the EU was from the following sources: 35% oil, 24% gas, 17% solid fuels such as coal, 14% nuclear power, and 10% renewable sources such as hydropower or wind energy (European Commission 2013). These rates vary across different countries depending on different conditions such as access to energy sources, policy choices, and financial situations. Most of the EU countries are producing electricity by fossils and nuclear sources. For instance, Poland generates 95% of its electricity by coal plants (Wallace 2008: 375). On the other side, *"nearly 45% of European electricity generation is based on low-carbon energy sources, mainly nuclear and hydropower…some parts of the EU could lose more than a third of their generation capacity by 2020 because of the limited life time of these installations"* (European Commission 2010: 5). Moreover, EU has directly been affected by the increasing energy demand in the emerging economies such as China, India and the Middle East where the energy demand is estimated to increase 60%. For instance, Japan and Korea now have to pay 60% higher prices to the Liquefied Natural Gas (LNG); therefore, the import rate of LNG fell by 30% in 2013 compared to the 2011 (European Commission 2013: 3). In addition, US started to export its coal sources to EU countries because industrial energy prices decreased due to indigenous shale gas sources in the US. As a result, the coal consumption rates increased in 2012 by 28% (hard coal and lignite) in the UK and Spain, 16% in France, 3% in Germany, and 38% in Portugal (European Commission 2013). However, this dependence on coal threatens the environmental targets of the EU.

Today, EU should not only fight with climate change itself by reducing greenhouse gas emissions, but also with increasing energy demand. In order to manage these challenges, EU has recently been active to take its responsibility through some strategies and policy adjustments. Until 2006, EU has become part of more than 40 multilateral environmental agreements, and EU implements environmental standards in its bilateral agreements in international negotiation.[1] In 2007, the European Council announced energy and climate change policies for 2020: reducing greenhouse emissions by 20%, increasing the share of renewable energy to 20%, and achieving 20% energy efficiency which were all strongly supported by European Parliament. European Council also announced a long-term target in order to decrease 80-95% emissions reductions in industrialized countries by 2050 (European Commission, 2010: 4). Moreover, it is necessary to invest almost 1 trillion Euros on new energy infrastructures and technologies to ensure energy security, reduction of energy related greenhouse gas emissions, and competitiveness of EU's energy prices within the energy market (European Commission 2013).

2.2. Access to Energy and Energy Security

Today, the oil and gas production from indigenous sources is far from supplying the EU's energy demand. On the other hand, dependence on imported energy sources such as oil and gas has increased in the last 20 years and this dependence is estimated to increase more than 80% by 2035 (European Commission 2013). In addition, EU's access to energy and energy security is threatened by "*the turmoil in North Africa, Middle East and Ukraine; threatening oil and gas production or suppliers; the surge of unconventional oil and gas production in North America;*

[1]A complete list can be found on the commission homepage, dated 27 October 2006.
Available: http://ec.europa.eu/environment/international_issues/pdf/agreements_en.pdf [accessed 10 Oct 2015]

ample and low-cost international coal suppliers; and the nuclear accident in Fukushima Daiichi, bringing back concerns about the use of nuclear power…" (International Energy Agency 2014: 5). For instance, US has become a net exporter today by its electricity production capacity from indigenous energy sources, particularly shale gas, so the industrial energy prices are now four times lower in the US than the prices in the EU (European Commission 2013). This threatens the competitiveness of the EU's energy market because the price of industrial energy prices in EU increased 37% between 2005 and 2012 while the prices declined by 4% in the US (European Commission 2013).

Access to energy is an essential challenge that EU needs to overcome because it is not possible to transfer produced renewable energy in some member states across the other EU countries because of the insufficient infrastructure. It is estimated by the European Commission that "*there is a need for new investment (of about EUR 200 billion) in transmission lines, interconnectors, storage facilities etc. by 2020"* (European Commission 2013:4). Increasing investments on renewable energy provide chances to use EU's internal energy potentials so access to energy becomes easier. In addition, EU has chance to decrease dependence on imported energy sources from the North Africa, Middle East and Russia by using its own energy sources. Moreover, technological developments in renewable energy offer cheap energy production so this attracts attention of energy producers from both public and private sectors.

2.3. Energy and the Economic Crises

During crisis times, it is hard to follow climate change policies and energy agendas due to some EU politicians who are lack of long-term perspective to establish green economies by environmental and energy policies, because short-term policies can only postpone the existing risks and problems (Wallace 2008: 500). For instance, *"total investment across Europe in clean energy fell from $48.4bn in 2008 to $43.7bn in 2009"*; however, since 2010 "even countries that have been hit hardest by the financial-debt crisis (Spain, Portugal, Ireland; and Greece) have looked possible to try and protect their green growth industries from the impact of the more extreme austerity measures as other sectors suffered funding cuts" (Schellekens et.al. 2010: 21). Although there are some interruptions on renewable energy investments between 2011 and 2013, these investments are increasing rapidly since 2014. This creates a positive perspective that there is still hope to achieve renewable energy goals, because renewable energy costs are decreasing due to new technologies and investments are increasing rapidly all over the world.

2.4. The Rapid Growth of Renewable Energy

The development of renewable energy has increased rapidly since 2000s. This development surpassed the expectations about renewable energy evolution because investments, capacity and integration of the renewable energy increased over the past decade. According to 10 years report of REN21 - Renewable Energy Policy Network for the 21st Century (2014), there are some factors behind this dramatic growth: economic and energy crises since 1970s, renewable energy policies of some pioneering countries, and energy-related greenhouse gas emissions. As a result, the usage of renewable energy crossed many sectors like heating, power production and transportation all over the world.

Some countries like Germany, Denmark, Spain, Canada and the United States established the necessary market structure for the renewable energy, and they pioneered first technological advances for the renewable energy. In Europe, for example, EU's 20% renewable energy target by 2020 binds the member states, and this target forces them to establish strong renewable energy

industries and to implement support policies like feed-in-tariffs. The share of renewable energy in energy consumption increased dramatically over the past decade in European countries by 2013 because it reached 51% in Sweden, 26% in Denmark, 32.1% in Austria, 15.1% in Greece, and 13.5% in Italy (REN21 2014: 27-28). It is important to note that Germany is the pioneering country in shifting to renewable energy in the Europe because German society voted to cut off nuclear power by 2020. Moreover, Germany is now using renewable energy in different sectors by 2013 such as electricity consumption (25.4%), heating (10.2%), and transportation (5.9%) (REN21 2014: 28). In addition to these country specific examples, EU's Energy Security Strategy of 2014/2015 and 2020/50 Energy Strategies aim to increase the share of renewable energy in energy production and consumption. We can make a better judgment about the feasibility of these strategies until we see more outcomes but still we can argue that these strategies and energy policies of EU provided a leadership in renewable energy for EU because many countries have inspired from these strategies and policies. In the United States and Canada, on the other hand, the share of renewable energy in energy consumption has also increased over the past decade. This share in electricity is 53% in Canada and 13% in the United States by 2012, and renewable energy production by wind has reached to 61.1.GW by 2013 in the United States (REN21 2014: 34).

Negotiations on the effects of greenhouse gas emissions on climate change also contributed to the developments on renewable energy all over the world. According to a proposal of GLCA – Global Leadership for Climate Action (2009), "*without urgent and concerted action, climate change will damage fragile ecosystems, impede development efforts, increase risks to public health, frustrate poverty alleviation programs, and force large-scale migration from water or food-scarce regions."* In order to understand what causes these results, we need to go into scientific details. It is scientifically proved that world climate balance depends on the interaction between the solar energy coming from the Sun to the Earth's surface (land &water), and the release of this solar energy back to the atmosphere and space (NSTA 2007: 7). Considering this balance, the greenhouse gas emissions take an important place on climate change negotiations since they heavily affect the absorption and transparency capacity of our atmosphere which is a protector of living creatures on Earth by welcoming necessary solar energy while blocking the harmful ones.

3. Renewable Energy Investments of the EU

Although there was a decline in renewable energy investments between 2011-2013 due to declining oil and gas prices, there has been a dramatic increase in renewable energy investments in power sector (hydropower, wind and solar energy) after 2014 in the world. The electricity production from renewable sources has reached 100GW of installations by investments on solar power in China and Japan while wind power in Europe (FS-UNEP Centre 2015). It is certain that renewable energy share in the power sector has an increasing tendency since 2000s despite to some interruptions due to some reasons like decrease in oil and gas prices. However, in order to provide sustainability in energy production, investments on renewable energy should be increased and energy efficiency must be achieved. The year 2014 proved that it is possible to achieve this, because energy-related greenhouse gas emissions remained the same in 2014 although the global economy grew and energy use increased (FS-UNEP Centre 2015).

Table 1: Global Renewable Energy Indicators between 2004 and 2014

		Start 2004(1)	2013	2014
Investment				
New Investment (annual) in renewable power and fuels(2)	**Billion USD**	45	232	270
Power				
Renewable power capacity (total, not including hydro)	GW	85	560	657
Renewable power capacity (total, including hydro)	GW	800	1,578	1,712
Hydropower capacity (total)(3)	GW	715	1,018	1,055
Bio-power capacity	GW	<36	88	93
Bio-power generation	TWh	227	396	433
Geothermal power capacity	GW	8.9	12.1	12.8
Solar PV capacity (total)	GW	2.6	138	177
Concentrating solar thermal power (total)	GW	0.4	3.4	4.4
Wind power capacity (total)	GW	48	319	370

Source: The table was taken from REN21's publication, namely "10 Years of Renewable Energy progress" (REN21 2014:9).

(1)Capacity data areas of the beginning of 2004; other data, such as investment and biofuels production, cover the full year. Numbers are estimates, based on best available information.

(2)Investment data are from Bloomberg New Energy finance and include all biomass, geothermal, and wind generation projects of more than 1MW; all hydro projects of between 1 and 50 MW; all solar power projects, with those less than 1 MW estimated separately and referred to as small-scale projects or small distributed capacity; all ocean energy projects; and all biofuel projects with an annual production capacity of 1 million liters or more.

(3)The GSR 2014 reported a global total of 1,000 GW of hydropower capacity at the end of 2013; this figure has been revised upwards. Hydropower data do not include pumped storage capacity.

Table 1 indicates 10 years of renewable energy progress in the world. The renewable energy investment increased from USD 45 billion in 2004 to USD 270 billion in 2014. Moreover, renewable power capacity (including hydro) increased from 800 GW to 1,712 GW in 10 years. The hydropower capacity share in total power capacity is the highest by 1,055 GW. Then comes wind power capacity (370 GW) and Solar PV capacity (177 GW) according to 2014 data. It is important to note the regional shares within the total global power capacity. According to REN21's 10 Years of Renewable Progress report, China holds the first place in hydro and wind power capacity while EU has highest share Solar PV capacity and holds second place in wind power capacity within the world's total power capacity (REN21 2014). Therefore, it is necessary to focus on renewable energy investments of the European Union in solar PV and wind energies.

3.1. Investments in the EU

Renewable energy provided almost 58.5% additional power capacity globally, and its share in world's power generating capacity reached to 27.7% which is sufficient to supply 22.8% of the world's electricity in 2014 (FS-UNEP Centre 2015: 6). Europe, Japan, China and USA are the pioneering countries in renewable energy because they increased renewable energy investments on their indigenous sources.

In 2008, the renewable energy share in the EU energy market has increased to 10% of gross final energy consumption and 62% of newly installed electricity generation capacity in the EU was produced from renewable sources such as wind and solar (European Commission, 2010: 6). After 2008, there has also been some major developments in renewable electricity generation; for instance, the creation of "The European Network of Transmission System Operators for Electricity" (ENTSO-E) by 34 states and "Regional Initiatives for ERGEG" by the reinforced cooperation of stake holders (European Commission 2009: 45).

The wind power capacity to produce green electricity had the highest share in total power capacity until 2004 within EU countries such as Germany, Spain and Denmark which implemented feed-in tariff systems encouraging electricity producers to invest on renewable energy by providing decreased prices and overcoming market barriers (TICAD 2004: 45). However, solar PV power capacity has the highest share in EU's total power generation today, because the growth in the solar thermal sector in the EU is remarkable because of the 17.5% annual growth rate since 2000 (European Commission, 2009: 70).

It is very clear that few member states holds the major place in producing power from solar thermal sources by holding the cumulated capacities of thermal collectors installed in EU such as Germany accounts 39% while France, Greece, Spain and Italy account 45% of renewable electricity production in EU (European Commission 2009: 71). In addition, it is important to note that growth of investments on solar PV power capacity is the highest in the EU during the last decade, because EU's solar PV installations is about 70% of the world's total power capacity generated from solar PV (REN21 2014). China has the second place in generating power from solar PV and its investments on wind and solar PV installations grows rapidly.

According to data on Table 2, Europe's total renewable energy investment between 2004 and 2013 is the highest in the world by USD 648.5 billion, and China holds the second place by USD 301.1 billion. It is certain that EU is the pioneering region regarding renewable energy investment during the last decade but the amount of investment dramatically decreased from USD 115 billion in 2011 to USD 48.4 billion in 2013. There is a similar tendency in the USA because its renewable energy investment also decreased from USD 53.4 billion in 2011 to USD

35.8 billion in 2013. REN21 Report (2014) argues that this decline is due to uncertainty over support policies and actual retroactive reductions on support in these countries. However, cost reduction in renewable energy technology, particularly solar PV, balances this decline because new renewable energy installations increased by more than 32% despite the fact that global investment on solar PV decreased 22% in 2013 (REN21 2014: 15). On the other hand, the recent data shows that there has been a dramatic increase in renewable energy investments in power sector (hydropower, wind and solar energy) after 2014 in the world. For instance, the electricity production from renewable sources has reached 100GW of installations by investments on solar power in China and Japan while Europe invested on wind power to produce electricty (FS-UNEP Centre 2015).

Table 2: World's Renewable Energy Investments by Region

		2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
USA	billion USD	5.7	11.9	28.2	34.5	36.2	23.2	34.7	53.4	39.7	35.8	267.5
Brazil	billion USD	0.5	2.2	4.2	10.3	12.5	7.9	7.7	9.7	6.8	3.1	64.9
Middle East and Africa	billion USD	0.6	0.6	1.2	1.7	2.7	1.7	4.3	3.2	10.4	9.0	35.4
Europe	billion USD	19.6	29.4	38.4	61.7	72.9	74.7	102	115	86.4	48.4	648.5
India	billion USD	2.4	3.2	5.5	6.3	5.2	4.4	8.7	12.6	7.2	6.1	61.6
China	billion USD	2.6	5.8	10.2	15.8	25.0	37.2	36.7	51.9	59.6	56.3	301.1

Source: The data has been taken from the REN21's Report (10 Years of Renewable Energy Progress) (REN21 2014: 15).
Note: Data include government and corporate R&D.

3.2. Regional Investments of the EU

European Union is depended on imported energy; this is why its networks with neighboring countries are very essential in order to secure and stabilize its energy supply. There are some major internal and external projects planned mostly in the North Sea (wind power plants) and in North Africa regions (solar energy) in order to secure and stabilize EU`s energy resources. These projects are really appreciated by EU and single member states because at the end the projects, they will be beneficial for the whole EU and for the regions where the plants will be established. With reference to Energy 2020 target, the Commission announced that this kind of international projects (Desertec & Medgrid) must be supported by funding sources because the Commission

examines the developments on these projects and plans to increase the level of funding (European Commission, 2010: 18).

Medgrid (TransGreen) & Desertec (DII) Projects in North Africa

EU`s position in its external relations within third countries is very important because EU can not only enforce member states to take measures for efficient and low-carbon energy policy, but also convince its neighboring countries to follow parallel policies. Therefore, these projects should be taken into consideration in this direction. The reason why the projects were planned in North Africa is the discovery of high renewable energy potentials just next to EU, North African neighboring countries, and the possible positive effects of the projects within North Africa region that the energy supply and the living standards within the region will increase after the establishment of a secure energy production between EU and North Africa. It is pointed out that *"the solar energy potential is immense all across the Sahara Desert and there is a multitude of very good wind sites, for example along the Red Sea and the coast of Morocco"* (Bataglini 2010: 294). There are two major projects between EU and North Africa over the last years; which are 2010 Medgrid (originally named Trans Green), and 2009 Desertec Industrial Initiative (DII).

Medgrid (Trans Green), launched in 2010, is similar to Desertec because the enabler firms of the project seek to achieve a transmission grid to transform renewable electricity capacity from North Africa to Europe (Schellekens et.al. 2010: 35). Moreover, Desertec Industrial Initiatives is also an essential project which aims to establish a trans-continental Super Grid for Europe and North Africa, and its founder companies that are: ABB, ABENGOA Solar, Cevital, Deutsche Bank, E.ON, MtW Zander, RWE, SCHOTT solar and SIEMENS etc. which have the long term goal to supply the 15% of European electricity demand by solar power plants in the Sahara desert (DII 2009: 1). One can argue that Europe is already depended on energy import, so importing renewable electricity energy from North Africa is another dependency and the energy security within North Africa is discussible. On the contrary, imports of renewable electricity will be the only import in the long term, and the total import dependency will be lower than it is today because EU will not only import energy but also there will be high amount of renewable electricity generation within EU member states through well-planned transmission grids across the Europe (Bataglini 2010: 296). Since these projects will increase interdependency between Europe and North Africa after the establishment of inter-continental renewable electricity lines, the security of energy can be guaranteed by some significant policies:

→*For stable and long term cooperation, the energy demand and expectations of North African countries must be satisfied and guaranteed by EU.*

→*Although deserts are mostly thought to be empty and worthless, there are some Bedouin tribes whose rights should be included in the planning of CSP and wind capacities.*

→*In addition to rights of desert people, worries of local populations must be taken into consideration to guarantee the security of renewable electricity supply.*

→*The terrorist threat against energy installations will always be present and must be taken seriously in any location, but should not be exaggerated"* (Bataglini 2010: 297-298).

If these facts are well-planned by effective policies through a fair deal between EU and North Africa, it will establish a secure renewable electricity not only for the EU but also for the Africa region. Therefore, energy resources will be the source of corporations instead of being the source

of conflict. However, the future of these projects is questionable due to conflicts, civil wars and international struggles on the North Africa and Middle East.

4. Feasibility of 100% Renewable Energy Target of the European Union

In order to achieve 100% renewable energy targets, EU should firstly create a new market structure for renewable energy. EU`s common energy policy is affordable energy products and services under fair prices for all consumers (private & industrial) through EU`s social and climate goal, and if EU fails to establish a well-functioning energy market, the costs and competitiveness in Europe might be under risk (European Commission, 2010: 4). In order to secure its energy market, EU needs renewable energy installations which are long-term and sustainable solutions. To support investment on renewable energy, decreasing costs for renewable and increasing prices for carbon emitting resources have the paramount importance. For instance, *"in power generation sector, trading renewable energy resource power between member states could reduce the costs of support schemes by encouraging construction in low-cost locations"* (European Commission 2009: 82). It is claimed that the fragmentation of the European integral market, the unachieved transparency, accessibility and choice cause barriers against open and fair competition (European Commission 2010: 4). Therefore, it is very essential to avoid monopolies of the gas and power networks by the creation of open and non-discriminatory access for all third parties through smart-grids across Europe (Wallace 2008: 361). This can help EU internal market to be more secure by making energy sources easily reachable any time and to be more environment-friendly by increasing efficient energy use and decreasing greenhouse gas emissions.

Secondly, EU should increase investments on renewable energy technologies. It is estimated that around €1 trillion investment is need by 2020 for replacing the absolute capacity, increasing renewable energy installations, modernizing and the adaptation of infrastructures (European Commission 2010: 13). Although, investors are mostly private ones like energy companies, there is the need of state policies which create basis for a transparent and sustainable target for investment decisions. In addition, most investors in energy sector do not feel confident because they think that new investments on renewable technology will increase the prices for them and in turn for the consumers. However, it is mostly known that there are already increasing fossil-fuel prices due to energy crisis caused by unstable situation within exporter countries and current international financial crisis.

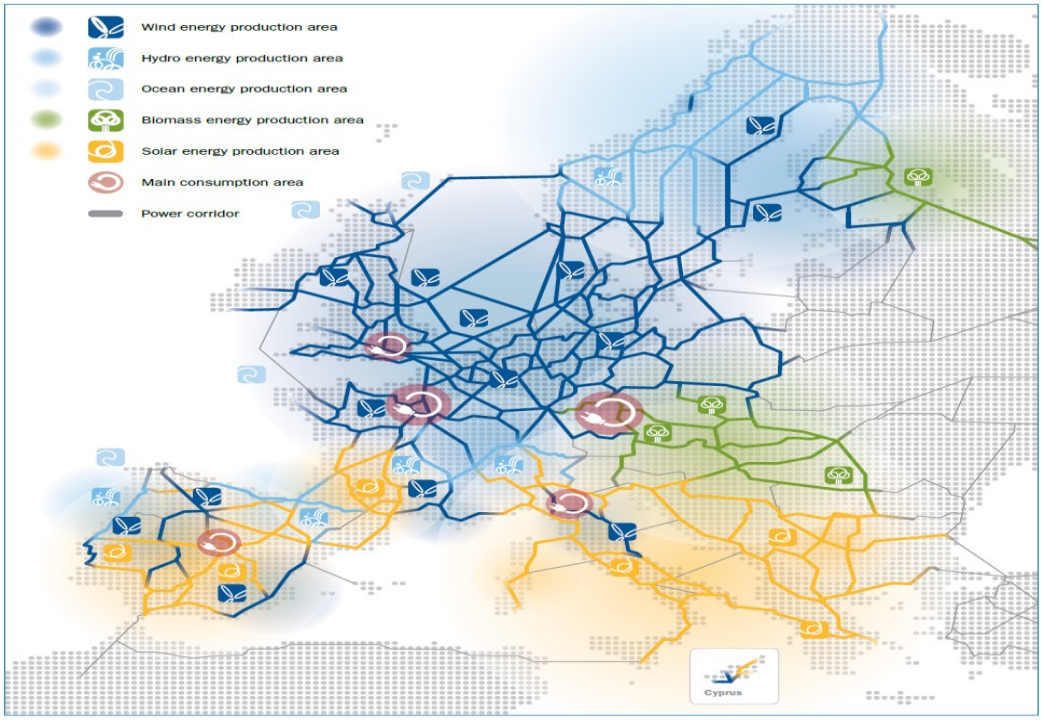
In order to guarantee security, sustainability and cost-effectiveness of energy for consumers and producers, investment on a sufficient transmission and storage infrastructure across EU internal market has the paramount importance (European Commission 2010: 15). Finally, the EU 2020 target created a confident condition for investors to invest on renewable energy technology by establishing binding regulations for member states, and it provided flexible obligations for member states which have to achieve their targets on time (European Commission 2009: 82). However, there must be more pressure on member states by EU in order to achieve these targets as soon as possible before it is too late.

Thirdly, EU should establish a well-planned infrastructure for renewable energy across the EU countries. Energy structures of EU members are adopting very slowly, whereas the scale of challenges are increasing, and the enlargement of EU by joining new members without strong infrastructure and competitive energy market makes EU energy adaptation even harder (European

Commission 2010: 4).The renewable energy potential is huge in Europe and it is sufficient to provide the current necessary electricity supply but resources are not efficiently distributed, because in some countries like Sweden and Spain the renewable energy potentials are high but in some it is not the same (Bataglini 2010: 294). In addition to this; in Energy 2020 report, European Commission claims that electricity and gas markets are still not integrated as one market and the current market is not completely connected due to barriers of national markets, because the monopoly position of nationally establishment of energy markets reduces competition within EU borders (European Commission 2010: 12). Contrary to all these pessimistic conditions there are still some studies on the future renewable energy infrastructure to be achieved in Europe for more secure, sustainable and efficient energy.

Depending on the **Figure 1** of European renewable energy grid by 2050, European Wind Energy Association estimates that *"In 2050 the system operates with 100% renewable, with the necessary grid infrastructure in place and full market integration…Photovoltaic and concentrated solar power will play a crucial role in the Southern European power market, and biomass generation in Central and Eastern European countries*" (EWEA 2011: 35).

Figure 1: European Renewable Energy Grid by 2050



Source: The figure was taken from the EWEA (European Wind Energy Association) report in 2011 (EWEA 2011: 35).

In order to achieve a well-integrated infrastructure, there is a need of collective action at EU level that all member states take responsibilities given by the Commission in order to eliminate anti-competitive situation within EU energy market by establishing a well-planned infrastructure distributing energy efficiently across the Europe. Before these infrastructures are constructed, it

firstly needs to be taken into consideration that there is the need of a market structure which is transparent and non-discriminatory, and the need of rules and procedures which establish a well adapted infrastructure providing efficient allocation of energy across the whole Europe (European Commission 2009: 82). Secondly, the development and coordination of infrastructures and market integration is very essential because an efficient transmission infrastructure for renewable energy and a well functioning integrated market in which everybody has easy access to energy can decrease the costs of renewable energy in the long-run. Thirdly, renewable energy resources such as wind energy and solar energy have the advantage of the low marginal costs and zero fuel and carbon price so well-planned infrastructure and an integrated market can create the necessary basis for renewable energy investments which in turn will not only secure the energy supply of EU but also will help to fight with global warming to protect our environment (EWEA 2011: 29).

Fourthly, political leadership for renewable energy is maybe the most important dimension seeking some policies such as state subsidies, feed-in tariffs and cost penalties against carbon emissions in order to increase renewable energy share by lowering prices and enforcing new investments on renewable energy infrastructure and creating a new well integrated market. It is clear that some actors and interest groups holding the larger shares of electricity market based on non-renewable sources would like to protect their *status quo*, but state needs to take some sanctions to convince these actors and groups to shift from old type of electricity generation to a renewable type of electricity generation.

It is important to note that these policies must be at EU level, not at the single-state level since a policy of one member state has effects on other members; therefore, EU must establish a well-integrated energy sector through common policies at EU level. A significant problem for EU during the 2008 Kyoto negotiations was the cost for climate change and renewable energy agreements which could badly affect different economy scales of member states, this is why the Commission had to propose three policies for central and eastern European Members (Wallace 2008: 375-376):

a) Less demanding targets for increases in renewable with several concessions

b) Permissions to increase emissions in sectors outside the ETS (mainly transport, building, agriculture, and services), in contrast to emission cuts to richer, older member states

c) A slightly larger share of ETS allowances to auction that their share of economic output would warrant

However, after rejections to these policies, some EU members organized within the Council by French Presidency and got two more exceptions for themselves by the concessions of increasing in ETS auction revenue and transitional free allowances in order to protect their energy sectors (Wallace 2008: 376). It can be seen that the differences between energy sectors of member states is a big problem standing in front of renewable electricity generation across the EU. In order to solve the problems of differences between different energy sectors, there is a need of clear political leadership of European Union, and then the composition of different states into one direction can be established very easily. The current 2020/50 strategies of European Commission provides essential targets for member states but the flexibility of the obligations for member states to achieve the targets on time creates ineffectiveness since some member states wants to protect their current energy sectors due to lack of vision of the politicians. Therefore, a strong monitoring role of European Commission is needed to pressure member states in order to

shift from generating power from fossils to renewable resources. This will also avoid the bilateral and multilateral actions at member state level, so one single leadership of EU can be achieved.

5. Conclusion

The discussions about energy policies of the European Union (EU) indicates that renewable energy investments has many opportunities to overcome challenges such as reduction of greenhouse gas emissions to control climate change, increasing energy demand, providing energy security and easy access to energy, and difficulties to finance internal and external investments on renewable energy. In addition, the analysis of political, economic and social actions shows that EU needs to increase its actions in order to increase current renewable energy capacity in next three or four decades so coping with greenhouse gas emissions and energy related issues becomes easier. In this direction, we assert that it is not enough only to reduce greenhouse gas emissions but also a complete cut off fossil energy sources by shifting to renewable energy sources within three or four decades is needed. Depending on EU's 100% renewable energy target, we suggest that renewable energy has great opportunities to tackle challenges in the energy policies if the following constraints are resolved: a new market structure, investments on renewable energy technology, a well-planned infrastructure for renewable energy across the EU countries, and political leadership enforcing a shift from traditional energy resources to renewable energy resources

The current situation about renewable energy investments in the world draws a positive framework since 2000s. European region is at the fore due to highest amount of renewable energy investment in the world between 2004 and 2014. Although there are few EU member states pioneering to invest and to establish policies on renewable energy, the current developments of power sector in the majority of EU countries, and regional investments and projects of the EU - such as solar power installations which are Medgrid (TransGreen) and Desertec (DII) - proves that there is an increasing tendency on renewable energy in general. These developments are consequence of a vision aiming to solve today`s and future`s problems in the long. However, this kind of efforts in the EU must be flagged by European Commission as the only leader enforcing all 28 member states to follow similar policies because some member countries are reluctant to follow policies in increasing renewable energy investment due to different reasons. To sum up, the 100% renewable target is not a hard duty for the EU and the world. There is a need of politicians with long-term vision in which they take responsibility of climate change and energy related issues by enforcing renewable energy developments.

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RECOMMENDED WEBSITES:

Energy Sector Management Assistance Program (ESMAP)
www.giz.de

Eurosolar
www.eurosolar.de/en/

Energy Information Administration
www.eia.gov/

Global Wind Energy Council
www.gwec.net/

Renewable Energy Policy Network for the 21st Century
http://www.ren21.net/

World Energy Outlook
http://www.worldenergyoutlook.org/

World Council for renewable energy
www.wcre.org/