Dipartimento di Economia e Finanza

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ASSESSMENT OF THE ITALIAN CONDITION: FOCUS ON RES – E

Relatore: Prof. Carlo Viviani

Candidato: Alessandro Michelangelo Castiello D'Antonio

Matricola: 157801

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Abstract

The aim of this work is to analyze the state of art and the future potential of the development of renewable energy sources for electricity in Italy. The theoretical analysis is enriched through two interviews with representatives of two significant companies operating on the Italian territory. The research covers a cost-benefit analysis of the various renewable energy sources, to highlight the pros and cons stemming from the use of renewable sources that affect European economic policies, both at a supranational and national level. The fight against climate change, other than being a moral duty, is a logic act from an economic viewpoint. Europe demonstrated a strong commitment in this struggle by enacting in 2007 the climate change package 20-20-20, which aims at the achievement of three different but integrated targets. The electricity sector is where major improvements in efficiency, reduction of CO_2 emissions and increase in the use of renewable energies may and must take place, in a world where the demand for electricity grows from year to year. Each member state has reacted differently to the accomplishment of the three European objectives, due to the conditions peculiar to each nation. Italy has demonstrated having fair premises in reaching its proper objectives, however, shows at the same time a strong unexploited potential. Thanks to generous incentive policies of the recent years the electric capacity from renewable sources has boomed, together with its production, especially for what regards wind and solar power. Despite this, the present time has required tighter policies, due to the harshness of the economic condition and to the need of the renewable market to become unbiased from public incentives. Nonetheless, still eight years shall come, and the Italian condition allows for an optimistic expectation regarding the fulfillment of the 20-20-20 objectives.

1. Introduction

The fight against climate change, other than being a moral duty, is a logic act from an economic viewpoint. As the Stern review pointed out for the first time in 2006, ignoring such a process in the present would just bring to a future increase of the costs of climate change, when tackling it will become mandatory. Future costs may be described as ranging from 5% to 20% of world GDP if nothing is done in the present, and are estimated to decrease to 1% of GDP if the world starts bearing its responsibilities and aims at finding a solution. In fact, climate change isn't caused by some strange whim of nature, but by mankind, due to the continuous use of polluting products and industrial processes, which polluting externalities were not known at the time of invention. In 1992, just 20 years ago, the human population accounted for 5.5 billion, while today it reached 7 billion; the impact of such growth on the ecosystem is significant, as in only two decades the growth of the worldwide population came at the expense of 300 million acres of forests, equivalent to 25% of the Amazon forest. While the quantity of CO_2 found in the atmosphere was nearly 280ppm before the industrial revolution, a continuous increase started in the XVIIIth century led this amount to reach 380ppm at the time the Stern review was written, with a growth rate of 2ppm per year. On September 5, 2012, CO_2 found in the atmosphere touched 392ppm; risks deriving from greenhouse gases increase, which involve significant climate change, stemming from i.e. increase of earth's temperature, increase of sea level, may be limited if CO_2 emission are stabilized between 450 and 550ppm.

The excuse still used by some, among whom also the physicist Richard Muller was convinced, is that climate change is just an invention of scientists. Muller sustained that scientists had carried out biased researches by selecting data near population centers, hence obviously founding the presence of higher temperatures due to the urban heat island effect. Despite this, he actually ran a new research following the most appropriate principles from his point of view, collecting temperature data from 1750 and eliminating any influence stemming from population centers. He found that during the past years, the temperature has actually risen by 1,5°C. Muller then tried to find a correlation between the increase of temperature and natural phenomena, such as volcanic eruptions, ocean currents and solar activity, but discovered that only human activity revealed to be the cause for such increase, due to the increase in CO_2 emissions, and with dignity admitted his past error. As a matter of fact, on one hand volcanic eruptions and ocean currents have a temporary effect on earth’s temperature that last for a couple of years - and actually the former decrease earth’s temperature, while the solar activity, being constant, has no effect on temperature. He also discovered that the temporary temperature decrease of the most recent years is only an effect of ocean currents, hence the commitment in the fight against climate change shall not diminish.

The European Union, acknowledging the importance of such issue, felt the call for duty and drew up in 2007 the climate change package 20-20-20, a plan to which all member states have to comply, aimed at keeping the increase of world’s temperature up to 2° Celsius, with respect to the preindustrial period. Such objective is to be reached by 2020 through three different targets: the decrease by 20% of CO_2 emissions, the increase by 20% of energy efficiency, and the increase by 20% of renewable energies. Such project has been drawn to foster the commitment undertook through the adoption of the Kyoto protocol, ending in 2012, which objective for the EU was to decrease CO_2 emissions by 8%, with respect to 1990s levels.

The present year is full of symbolic significance for the European Union, as while the Kyoto protocol was a worldwide challenge, the 20-20-20 package is valid only for its member states, and hence with the setting of a communitarian target going beyond the global objective, the EU is trying to take the worldwide lead in the fight against climate change.

The 20% target involving renewables splits differently with respect to each member state, on the basis of a fixed and a variable amount. The EU indicated that each member state had to increase the share of renewables in energy consumption by 5.5%, plus a certain percentage to be calculated on the basis of the country's GDP per capita. Hence, while Italy had to aim to an increase of 17%, Denmark for instance had to reach a share of 30%. To reach such targets it is possible for the member states to undertake cooperation agreements in order to import the remaining share of electricity from foreign countries; for instance, Italy is expected to import 1.1 Mtep to reach its objective (Viviani, 2010).

Italy has welcomed the compulsory targets of the 20-20-20 package with strong commitment. In the previous years, the coupling of significant and generous incentives, especially to photovoltaic technologies, has favored the growth of renewable energies on the Italian territory. As a matter of fact, for the time being, 95% of Italian municipalities have installed at least a photovoltaic panel. This came at the expense of Italian consumers, which saw their electricity bills increase by an important share due to the incentives for renewables. Although renewables bear an important share of responsibility for the increase in prices, such event is also due to the conversion of a large part of plants involved in electricity generation to combined cycle plants based on natural gas. This has allowed significant increases in efficiency and decreases in GHG emissions, but a large part of the cost has been bear by Italian consumers who saw their bill increase by 30% with respect to the European average, due to the high price of natural gas.

The years 2011 and 2012 are to be considered crucial for renewables, as public incentives have are progressively diminishing, to allow the market go by itself, starting a direct competitive struggle against coal and fossil fuels. Section 2 and 3 will contain a brief overview and analysis of two European targets for 2020, respectively the 20% reduction in greenhouse gas emissions and the 20% increase in energy efficiency. Section 4 examines the 20% increase in renewable energy target, focusing on renewable energy sources for electricity generation, offering cost-benefit analyses of renewable sources and related technologies and an in-depth exploration of the Italian condition. Sections 2, 3 and 4 are structured in the following way: the reader is first offered a general view concerning the state of art and potential developments of the subject treated at the European level; then, in such framework, the reader is introduced to a focus on Italy's present situation and future expectations. The latter segment is analyzed in depth especially in Section 4, core of the thesis, when considering the renewable energy sources that produce electricity. Section 5 explores the point of view of firms by reporting two interviews with two managers of Edison and Snam, companies operating on the Italian territory, in order to gain an inner perspective of the issues treated. Section 6 will cover the conclusions concerning the achievement of the European objectives, on the basis of the framework depicted throughout the whole thesis.

2. - 20% Greenhouse Gas Emission s

First objective of the European Union for 2020 is the reduction by 20% of greenhouse gas emission, with respect to 1990 levels. Such objective differs between different member states, as each is obliged to reduce by a certain percentage its emissions or allowed to increase them to a certain limit: the average of these movements will result in a 20% decrease in overall EU GHG emissions (see Figure 1). GHG includes a cluster of polluting gases such as carbon dioxide, which accounts for more than 60% of emissions, methane, and nitrous oxide, which altogether negatively influence the cycle of solar radiations. Solar radiations, in presence of a small quantitative of greenhouse gases, go through the atmosphere are in part absorbed by the earth. A share of 50% of radiations is absorbed: some is reflected back first by the earth and then by the atmosphere, other is converted into heat, hence into infrared radiation and goes back into space passing through the atmosphere.

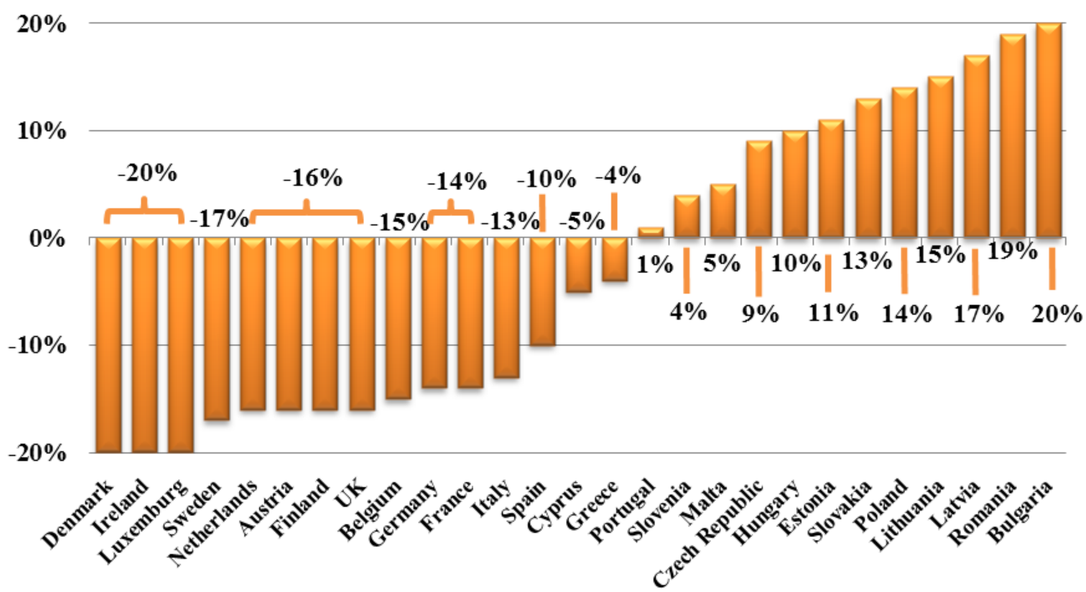

Figure 1. CO_2 Objective per Member State – 2020

Source: Personal Elaboration of data from European Parliament (2009)

From the start of the industrial revolution, greenhouse gases have continuously increased, mainly due to the burning of fossil fuels. This has caused these gases to concentrate between earth and the atmosphere, causing the GHG effect: a large part of infrared radiations are absorbed and reflected back to earth by GHG gases, instead of going in outer space, producing in turn an increase of earth's temperature.

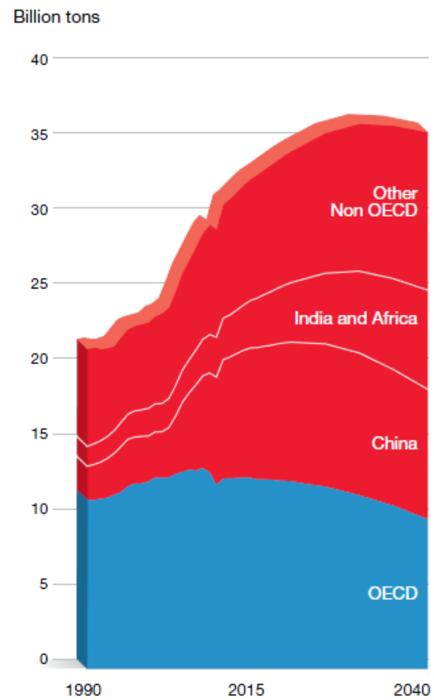

Figure 2. Energy CO_2 emissions by region

Source: ExxonMobil, (2012)

The European objective for 2020 represents a complicated task for Europe, as there are a set of issues to be taken into account; as if this were not enough, the fulfillment of such objective goes against a worldwide trend that includes all developing countries. While Europe and the US put effort to force a decreasing trend in CO_2 emissions, the most important developing countries, who experienced low levels of emission in the past, are actually observing an increase in GHG due to their sudden growth, as shown by Figure 2 and Figure 3.

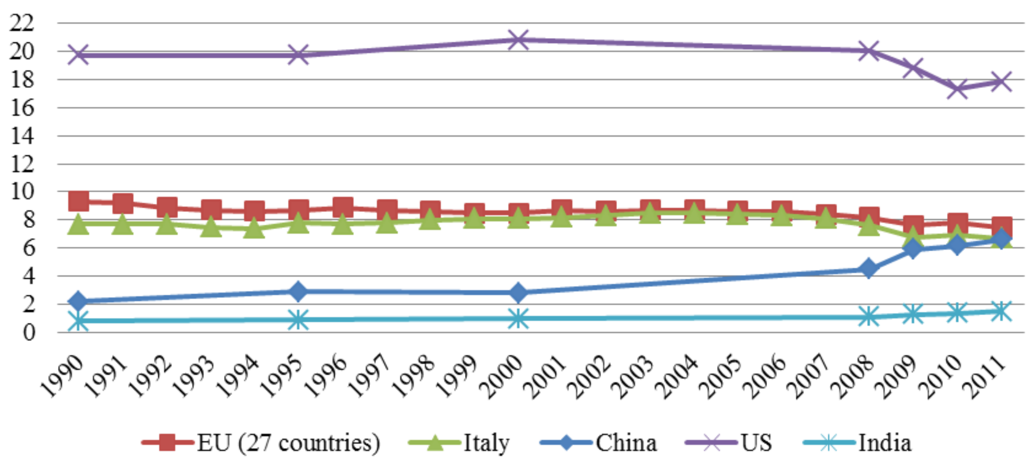

Figure 3. CO_2 per capita Emission (CO_2ton/ capita)

Source: Personal Elaboration of data from Eurostat (2011)

China's CO_2 emissions in 2011 have increased by 9.3% with respect to the previous year, and could have increased by 1.5 billion tons more if this country hadn't implemented policies favoring the use of renewables and an increase in energy efficiency. India became the fourth country in CO_2 emissions in 2011, by emitting 8.7% CO_2 more with respect to 2010. Not by chance, the outlook for 2040 of ExxonMobil estimates worldwide CO_2 emissions to reach a peak in 2030, and then finally start diminishing. By 2040, 70% of CO_2 emissions will be produced by non-OECD countries (see Figure 2): these results must be taken as stimulus for EU to foster the achievement of its objective for 2020, and engaging in similar policies for the future.

Europe has actually observed an increase in GHG emissions from 2009 to 2010: such inversion of trend in one year was caused by a set of special factors: on one hand, winter temperatures were lower in 2010 than in the year before, hence provoking an increase in electricity demand, generating higher emissions. On the other hand, increases in emissions were caused by manufacturing industries, which recovered from the economic crisis of 2009 increasing their production, and by a three percentage growth in fossil fuel combustion and nuclear power. However, the latter emissions where slightly offset by the increase in the use of renewable energies. Despite this temporary trend reversal, the International Energy Agency is expecting Europe to fulfill the target for 2020, although estimating an increase in worldwide CO_2 emissions; IEA calculated that renewable energies will contribute to emission abatement by 21%, while energy efficiency by 44%.

The importance of renewables in GHG decline is crucial, as their implementation affects all the sectors involved in GHG emission, as shown in Figure 4.

Considering that by 2040 worldwide demand for electricity is expected to increase by 80% with respect to the actual demand, the use of renewable energies as mean to reduce GHG emission is fundamental.

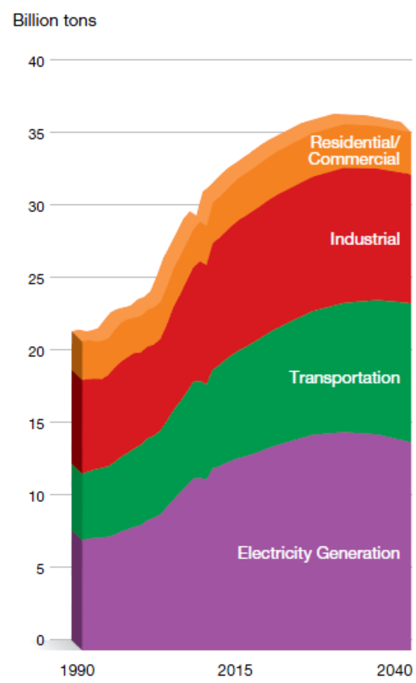

Figure 4. Energy CO_2 emissions by sector

Source: ExxonMobil, (2012)

In the European Union, thanks to the implementation of the National Renewable Energy Action Plans (NREAPs), from 2010 to 2020 renewable energy sources will be responsible of 40% reduction in emissions. Renewable energies are in fact characterized by a very low environmental impact for what concerns pollution, at least with respect to conventional sources of energy. Renewables emit less than 100 gCO_2/KWh of GHG, while carbon ranges between 300 gCO_2/KWh and 600 gCO_2/KWh. Wind power actually has GHG impact almost equal to zero, and may contribute with a share of 31% to the European target for emission reduction. For instance, in 2007, 57 GW of wind power capacity saved 91 Mt of CO_2 emissions, and avoided the expenditure of billions in fuel costs.

To be more precise, one must analyze the GHG emissions created during the stages of production, transport, building, maintenance and deployment of a plant – the Life Cycle Assessment (LCA), and consider the time it takes to balance the quantity of energy used during the previous stages with respect to the energy actually produced by the plant – the energy payback time (EPBT).

A wind power plant presents an optimal outcome of the two analyses, as most of the materials used to produce and build a plant may be totally recycled; moreover, the EPBT for a medium wind turbine is only 9 months. The scale changes from months to years when analyzing an EPBT of a medium photovoltaic installation, which, considered the costs of production that also involve important CO_2 emissions (from 20 to 40 gCO_2/KWh), equals 6 or 7 years. Much of photovoltaic carbon footprint is generated during its production process because silicon, required for PV modules, is extracted at high temperatures from quartz sand. Improvements in photovoltaic technology, such as the use of thinner silicon layers, will contribute in diminishing the carbon footprint of this technology.

Ocean energy is instead much cleaner, as for each KWh produced, 430 grams of CO_2 are avoided. By 2020, it is estimated that the growth of ocean energy capacity will grow to 5,000 MW, avoiding almost 7 $MtCO_2$ per year (Carbon Trust, 2006). Geothermal is responsible for a quite high carbon footprint with respect to other renewables, amounting to 82 gCO_2/KWh; despite this, it is one of the most spread sources, so its exploitation may be carried on without significant obstacles. Only on the Italian territory, the exploitation of geothermal could produce electricity up to 7 TWh per year in 2020, leading to an abatement of CO_2 emissions of 4,140 Mt per year. Biomass has always been defined as ‘carbon neutral’, as the CO_2 released when it is burned is balanced by the CO_2 which is absorbed by the plants during their growth. However, as explained more in depth in Section 4.1.2, the life cycle assessment of biomass doesn’t deliver a desirable result: during the production and maintenance of crops used for biomass, much more CO_2 emissions are released due to factors such as use of fertilizers, harvesting and transportation. Emissions may vary on the basis of the kind of biomass used, and go from 25gCO_2/KWh to

93gCO_2/KWh; the use of conventional fire plants, plants working both through biomass and fuel, may actually decrease the overall carbon footprint. On the other hand, hydropower is characterized by low carbon emissions, which go from 5 to 10gCO_2/KWh in case of larger plants; similarly to wind power, when a hydropower plant is operating it doesn't generate any emission. However, it must be taken into account that the overall impact of hydropower plants on the near environment may have negative externalities, which will be further analyzed in Section 4.1.1.

As the Italian overall target reduction of 18% is divided in a decrease by 21% for ETS sectors and by 13% in non-ETS sectors, a significant instrument in the struggle against CO_2 emissions is the European Union Emission Trading Scheme. This mechanism involves the creation of a market for emissions: a fixed number of emission quotas per ETS different sectors have been made available and sold to firms, which in this way buy the right to pollute to the extent permitted by the quotas, and at the end of the year re-sell the unused quotas to the government, if remaining. In such a way, the European Union tries to keep under control part of the total emissions of member states, and tries to set a specific cost for CO_2, to be bear by polluters. This mechanism should incentivize the decarbonisation of the various sectors, but has observed different downturns throughout its life: from oversupply, to price volatility and crime issues. While in 2008 the price of CO_2 touched €0,01 per ton, in 2009 the economic crisis had again significantly contributed in slashing the prices of emission quotas, due to an oversupply caused by a slowdown of the economy. The condition concerning a low price level is expected to continue until 2014 (WWF, 2012).

A negative externality of emission policy comes into place if a firm were not able to maintain under control its CO_2 emissions through ETS. Hence, expecting to see the production cost increase to compel with the national target, it might delocalize its production in countries offering a less severe control on emissions, incurring in what is called *carbon leakage*. In fact, CO_2 emissions would leak from countries which emission target is 'too' severe to countries observing a lower degree of policy tightness. Despite this, it is expected that some nations, including Italy, are going to resort to the instrument of ETS in order to reach their national target.

Even if Italy is expected to reach the 2020 emission reduction target, and perhaps to achieve -30% in an optimistic scenario, the main obstacle is represented by the end of the crisis. In fact, after such an economic downturn, the recovery of industrial activity would provoke a significant increase in GHG emissions, if not properly tackled by effective policies.

The set of measures imposed by the European Union aim towards the same objective, Europe's decarbonisation, thereby their correct integration will result in an easier achievement of the target. As previously described, the use of renewables contributes significantly to the decrease of GHG emissions; the same does the increase of energy efficiency. In 2009, even due to the crisis, an increase in both energy efficiency and renewables led to a decrease of 36.3 Mt of CO_2 emissions: GHG emissions decreased by 3% (Sustainable Development Foundation, 2010). Actually, by achieving both targets regarding renewables and efficiency, the future panorama seems much brighter, as if those measures are correctly implemented, CO_2 emissions are estimated to decrease by 30% by 2020 (Ecofys, 2011). On the basis of the national energetic action plan, a decrease in energy consumption thanks to the enactment of policies aimed to efficiency will result in avoiding 45 Mton of CO_2 emissions by 2020, only in Italy (ENEA, 2011). In fact, following a similar trend would mean decreasing emissions from 400gCO_2/KWh in 2010 to 270 gCO_2/KWh in 2020, even if electricity production would inevitably observe a continuous increase.

3. + 20% Energy Efficiency

The objective regarding energy efficiency has been set to be considered more a trend than an actual achievement, but actually plays a crucial role in reaching the two European targets concerning emissions and renewables. In fact, it has been estimated that an increase in energy efficiency by the magnitude imposed from the EU could avoid more than 780 Mt of CO_2 emissions. Progress towards energy efficiency throughout member states has been very slow, due to lack of supportive action. Member states have not succeeded in creating policies and incentives for efficiency: the European Commission has hence estimated in 2011 that the actual increase in efficiency by 2020 will be by 9%, instead than 20%. The improvement in efficiency has to be addressed to such sectors that observe energy wasting, going from transport, to buildings, products, electricity generation and distribution. It is estimated that in the latter case, inefficiencies reach 40% in case of generation and 10% in case of distribution. Energy efficiency is called to play a crucial role due to the continuous increase in electricity production and demand that will characterize the years yet to come (see Figure 5), even thanks to the slowrecovery after the economic crisis. By using energy in a more cost-effective way, it is possible to partly offset the increase in electricity demand: an increase energy savings corresponds to a reduction in electricity consumption.

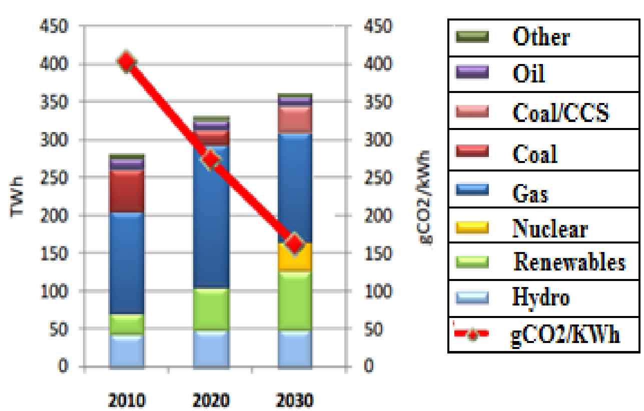

Figure 5. Electricity generation and CO_2 emissions

Source: ENEA (2009)

Moreover, the scarcity of oil reserves, which have been estimated to extinguish in 40 years, calls for action.

A narrow view on this topic might foster the conclusion that energy efficiency, resulting in use of less energy, and hence to a decrease in demand of energy generation, could diminish job opportunities: however it has been estimated that each Mt avoided through measures supporting energy efficiency creates more than 2,000 full time jobs (European Commission, 2005). Actually, the number of jobs may be much more, as the calculations have considered the job losses due to a decrease in energy demand, but not the jobs created by the export of European more efficient technologies. Fulfilling the European target by 2020 requires the implementation of a set of cost-effective measures for end-use consumers in the EU which on one hand would produce an annual saving of $78 billion, and on the other hand would contribute in decreasing energy import dependency from foreign countries. In fact, it has been demonstrated that the implementation of a cluster of policies, encompassing broad sectors, has a positive impact on the level of European energy security. Unfortunately, coordination of policies, even between member states, has lacked in the past years, mainly due to the non-binding characteristic of the 2020 efficiency target. Single efficiency policies has hence been less effective than broad cross-cutting policies, as the former are directed to sectors which still count for the major part on oil products, and are therefore dependent on oil imports (Fondazione Eni Enrico Mattei, 2010).

Energy efficiency has been demonstrated to bring a significant set of direct cost savings, in terms of decreased energy dependence, job creation and consumer cost savings. The implementation of efficiency policies and the achievement of the

2020 objective would also create other indirect positive externalities on energy prices. On one hand, an increase in energy efficiency would bring to a reduction of energy demand. In turn, such reduction will negatively affect the oil price: in fact, decrease of energy demand brings a decrease of oil demand, and hence to relevant cost savings stemming from the reduction of oil price. In fact, economic theory teaches that less oil will be bought at less cost due to a decrease in demand: for each 1% increase in energy savings there will be almost a 1% decrease in fuel price (Ecofys, 2012). On the other hand, energy efficiency has a positive impact, from consumers' point of view, on electricity prices. This happens due to the fact that in order to match high peak-demand during the day, more expensive generators are put in place, as they work at a higher marginal cost: hence, by limiting energy demand, the use of this kind of generators would be avoided, and the use of lower-cost generators would keep electricity price down. Last but not least, by decreasing energy demand, the need for additional power generation capacity, together with all the set of energy infrastructure involved, is reduced, hence avoiding significant investments. From 2010 to 2035, energy consumption is expected to increase by 8%, implying a boost in energy infrastructure that would generate infrastructure investments of more than $130 billion per year. If the European energy efficiency target is achieved by 2020, energy consumption would actually decrease by 10% in 2020, leading to a decrease of $30 billion per year in infrastructure investment by 2035 (Ecofys, 2012).

Italian energy consumption is estimated in 130 Mtep at 2010, having observed during that year a decrease of 4.1 Mtep thanks to efficiency measures with respect to the previous year. The use of energy efficiency allows creating a diminishing trend in consumption that could range from 2 Mtep, scenario in which there is a high economic growth coupled with supporting policies for energy efficiency, to 8 Mtep in 2020 in case of low economic growth but still in presence of supporting policies (ENEA, 2009). If such supporting policies weren't enacted, it is estimated that consumption will instead follow an increasing trend for the years to come. Energy saving in 2016 is expected to grow by 60% with respect to 2010, reaching a total of 126,540 GWh per year saved, which correspond to a total of 37 Mt of CO_2 emissions avoided. Half of the energy savings would come from the residential sector, accounting for more than 60,000 GWh/year.

The year 2016 is an important date for what regards the path of energy efficiency, as each member of the European Union is required to fulfill an intermediate national objective of 9% increase in energy efficiency with respect to the average energy consumption per year between 2001 and 2005, as described in the European Directive 2006/32/CE. For the time being, in 2010 Italy managed to increase energy efficiency by 3.6%, hence the objective for 2016 doesn't seem too utopian (PAE, 2011). To achieve the 2020 objective however, it is important to implement more effective policies and to foster the ones already put in place to secure the achievement of the 9% objective by 2016.

Italy, for once, should try to anticipate the European trend and enact policies aimed at the experimenting and introducing efficiency mechanisms that will impact on the final energy demand. As recommended by Ecofys (2012), in order to be more effective, this should imply implementing a cluster of policies aiming at the achievement of efficiency standards in various sectors, also in the public sector. The Italian environment is not very fertile for this kind of innovations: the prohibition of selling incandescent bulbs was implemented way after other countries, only thanks to the urgency coming from the EU, and this delay resulted in high inefficient costs.

Interesting policies that may be applied in Italy could be built on the English example of the Green Deal. Such deal allows the private consumer to pay interventions aimed at improving energy efficiency, previously financed by the electricity supplier, through the electricity bill. In this way, the consumer gains a direct and immediate access to the financing and the electricity supplier is directly involved in the development of efficiency measures. Another way to incentivize energy efficiency would also be that of switching the payment of the vehicle tax with respect to the amount of CO_2 emissions, and not on the basis of the vehicle's KW.

It is important to stress the relevant contribution that renewable energies may give to energy efficiency, both by only increasing their utilization and by improving their transmission infrastructure. In fact, if the 20% renewable energy target is met, renewables may be responsible for up to 40% of total energy savings needed by 2020. As Figure 6 below shows, renewables' efficiency widely ranges between different percentages. Most efficient sources are hydro, ocean and wind, while at the other end we find geothermal and photovoltaic which still do not enjoy high efficiency degrees. Despite this, improvements in efficiency of renewables are frequent, and constitute a future constant trend as these technologies are object of high amounts of R&D investments, due to the binding target of 2020.

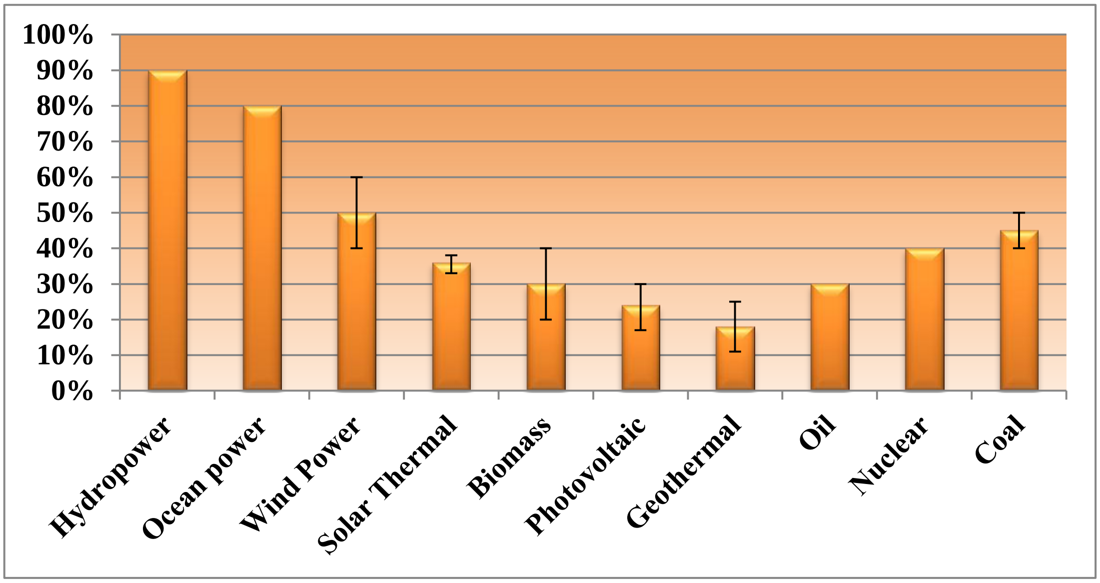

Figure 6. Efficiency by Source in Electricity Generation

Source: Personal Elaboration

As depicted in Figure 6, conventional sources are actually characterized by higher efficiency with respect to some renewable sources: however, by taking into account the whole European portfolio regarding the climate change package of 2020, trying to fulfill one objective though the use of means that provoke negative externalities on the other targets is an unconceivable practice. Hence, it is unthinkable to increase energy efficiency by fostering the use of conventional sources: some kinds of renewables may even need more energy to produce a certain amount of electricity, but at least such energy is produced in a cleaner way, with respect both to the same production process and to the deployment one. Having cleared this, the obstacle to be analyzed is whether to foster the increase of renewables capacity, potentially even passing the 2020 target, or to maintain it stable and focus on the increase of efficiency of renewable technology. As a matter of fact, perhaps it would be more effective focusing on increasing the efficiency of installed renewable capacity than increasing the capacity itself, as the latter action might actually incur in higher useless costs.

4. + 20% Renewable Energy Sources

Sources of renewable energies involve a number of different technologies which contribute to electricity generation and will be analyzed throughout this section. These sources may be divided in two different clusters, traditional renewable energies and new renewable energies. Hydropower and biomass sources are part of the former cluster, while there are different sorts of new renewable sources: wind energy, solar energy (which is transformed in electricity through photovoltaic and solar thermal technologies), geothermal energy, and ocean energy. The importance of renewable energy sources has continuously increased in recent years, being source of the production for more than 20% of Europe's electricity consumption in 2010 (European Commission, 2012).

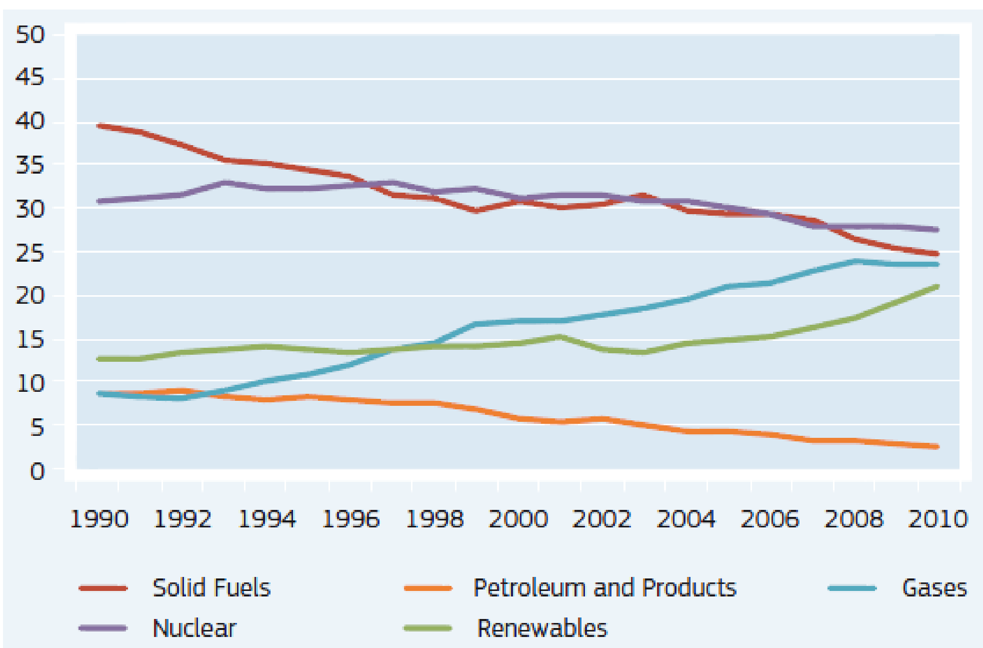

Figure 7. EU-27 Sources of Electricity Generation (%)

Source: European Commission (2012)

Figure 7 above displays the sources of electricity generation in Europe in percentages, and their trend during a time lapse of ten years, from 1990 to 2010. Different trends regarding the electricity sources may be identified: while the gases, and most importantly the renewable sources have experienced a continuously increasing trend from the 1990s, all the other sources have experienced a decreasing movement. In such panorama, Figure 8 below splits the 20% European electricity generation from renewable energies to highlight in detail the contribution of the different renewable energy sources, not in percentage but in TWh.

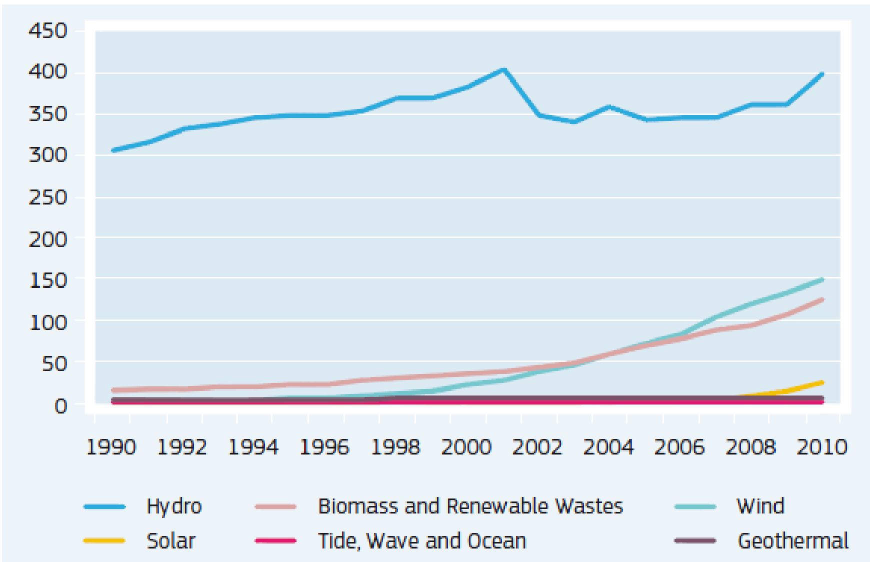

Figure 8. Contribution of RES to electricity generation (TWh)

Source: European Commission (2012)

Hydropower sources of electricity have long taken the lead on the other technologies, while the tidal, wave and ocean technologies together with the geothermal aren't yet well developed. On the other hand, wind and biomass sources have experienced a steady increase from the start of the new millennium, and are followed by the solar technology which has started to contribute significantly only during recent years, mainly thanks to technological innovations and supportive policies.

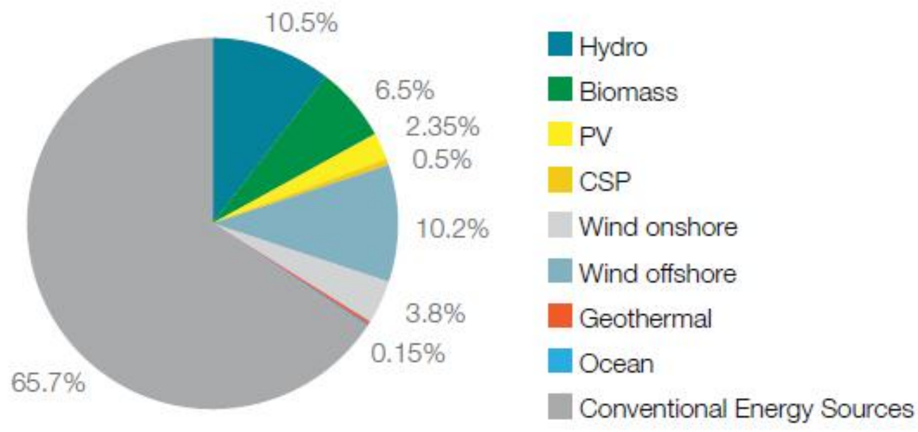

Figure 9. RES in electricity mix of 2020

Source: EREC

According to the National Renewable Action Plans (NREAPs) of the different European member states, by 2020 almost 34% of electricity consumption in Europe will be provided by renewable energy sources. The cause of such significant increase of renewable sources is to be identified in a set of support mechanisms that member states will – and have – put in place to the benefit of the cluster of renewable energy technologies. These mechanisms go from the feed-in-tariffs (FITs), to premium tariffs, green certificates and tenders. NREAPs are full of evidence of such measures, but their modes of implementation vary from one member state to another. In fact, many actually lack of details regarding the real execution of such instruments, from the duration to the structure, such as in Italy. The lack of relevant information significantly influences the implementation of NREAPs in a negative way, as investors will try to avoid capitalizing projects characterized by some degree of uncertainty, stemming from an uncertain policy framework. The Italian environment, similarly to the one found in other countries, observes a high degree of bureaucracy, representing a severe bottleneck for the investments; while some member states have actually implemented, or have the intention to implement, simplification procedures, it is unknown whether Italy is truly intending to tackle such obstacle. Last but not least is the issue regarding the grid parity, which will play an extremely relevant role in the conflict between renewable energies and conventional energy sources.

The Italian environment is characterized by a fair development of renewable energies, which managed on April 16th, 2012 to contribute to electricity generation for 26% of the total share. The initial European objective has hence been passed successfully, as the increase by 17% of renewable energy sources entailed that renewables should account 26% in electricity production, 17.1% in heat and cooling and 10.1% in the transport. Following the words of the Minister of the Economic Development, Corrado Passera, Italy is actually aiming to reach 35% of electricity from renewables by 2020. Corrado Clini, Minister of the Environment, said that renewables "Represent a fundamental tool in decoupling economic growth from CO_2 emissions, and are the pivot of the energetic shift" (La Repubblica, 2012). Despite this, in general, but unfortunately especially in Italy, there has always been a great difference from what is said to what is actually done. In fact, notwithstanding the words of the ministers, Italy has observed both a reduction of incentives and an increase in bureaucracy in this area, also regarding smaller plants, conditions that may lead to a decreasing trend of international investments throughout the territory. The reductionist incentive policies, which outlines are found in the Fifth Conto Energia, are mainly due to the need of adjusting the tariffs to actual production prices, in order to allow the market to go on by itself, without the support of public incentives, and to a shrink of public financial capacity to sustain these technologies, as negative externality of the financial debt crisis. Hence, this leads to a high degree of uncertainty for what regards the future, even due to the many advantages that characterize the use and development of renewables for Italy, which now represent 1% of the Italian GDP: renewables will generate positive externalities that have been identified in the creation of 130.000 jobs by 2030, an increase in exports and decrease in energy dependence from foreign nations (Italy's energy dependence corresponded to 84% in 2010, while EU's average is 35%), together with the economic and environmental benefits brought by the reduction of greenhouse gases. In fact, reduction of CO_2 – which has a precise cost, €7,67 according to the European Emission Trading Scheme – and other polluting agents has a concrete effect on costs: their reduction would decrease health care costs and lost working hours. What will now follow is a deep analysis of the state of art and future development of the different renewable energy sources, with respect to their contribution to electricity generation.

4.1 Traditional Energy Sources

4.1.1 Hydropower

Hydropower, as Figure 8 clearly illustrates, covers the largest stake in the wide panorama of renewable energy sources at the European level, and accounted in 2010 for 57% in electricity generation by renewable technologies (European Commission, 2012). In Italy, it accounted during the same year for 67.8%, as share of gross electricity generation by renewables. It must be underlined that there exist three clusters of hydropower plants, the smaller ones with capacity up to 1 MW, the medium ones from 1 MW to 10 MW, and the larger ones with more than 10MW of electric capacity. The Italian environment in 2010 observed a very high number of small hydropower plants, accounting for 63.3% of the total, which however produced, together with the medium sized plants (25.6% of the total), only 15.2% of electricity produced by the whole set of hydro plants (GSE, 2010). The advantages of small hydropower stem from the fact that the energy produced may be easily used locally, eliminating part of inefficiencies that are due the transport of energy, regarding both costs and energy losses. Most of hydropower plants are installed in the northern regions of Italy; this is primarily due to the favorable environmental conditions for the exploitation of such technology found in the north.

The previously stressed relevance of hydropower in Italy founds justification in the history of electric energy production.

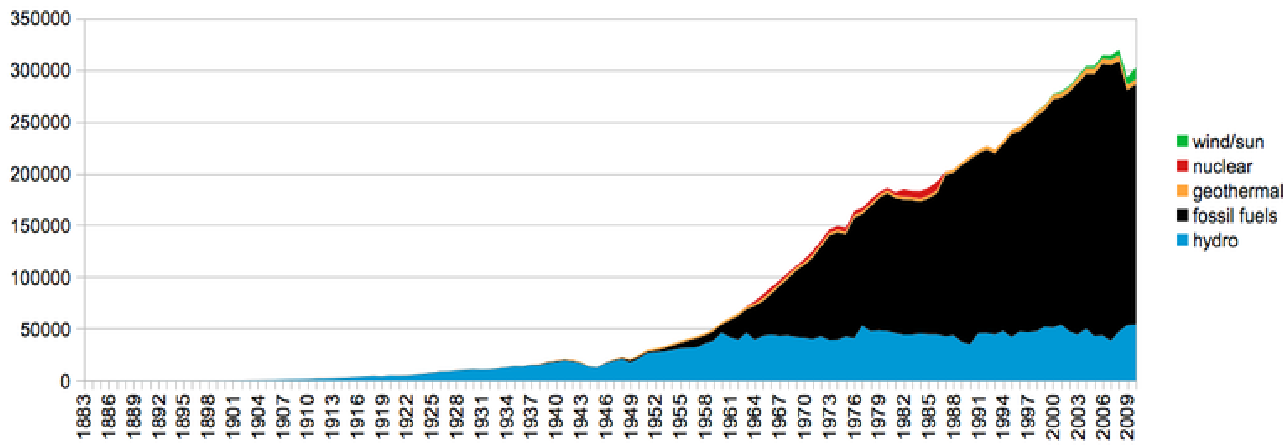

Figure 10. Electric Energy Production in Italy 1883 – 2010 (GWh)

Source: Terna (2010)

As Figure 10 depicts, hydropower has been used as source of electric energy since 1983, hence such historical tradition explains the widely spread use of this kind of technology throughout the Italian territory. Notwithstanding the upward and downward movements regarding the power of hydro plants, the recent trend is upward sloping, as between 2000 and 2010 the power of the plants has increased annually by 1% on average, while the number of plants has observed an annual average increase of 3%.

Following a scenario depicted by Arep (2010), in which the country exploits only its own present resources, hydropower is expected to continue growing by 1% per year on average. The growth increases by three basis points in the case in which the country enacts policies and strategies to support renewable energy's development. Hydropower's importance in the Italian panorama is reinforced by the job creation it represents: in 2010 this renewable source employed 40,000 persons, being the second most important source of labor after biomass.

The economic impact of such technology has been extremely relevant in the past, as hydropower provides low-cost energy: this is due to the fact that hydropower is not dependent on fuel, hence the operating cost of the activity of such plants isn't influenced by the frequent up and down swings of the fuel prices. Moreover, for what concerns in particular way the small and medium sized plants, which as previously highlighted are the most numerous on the Italian territory, these principally provide energy for local limited area, near the plant itself, and this allows avoiding energy transportation costs and inefficiencies. Notwithstanding this, hydroelectric production may easily adapt to changes in electricity demand, during the day or also during an economic cycle. The efficiencies of such technology regard also the production of electricity, process during which only 10% of the energy used is dispersed. To highlight the importance of such data, it is important to remind that fossil fuel plants are only 50% efficient, on average. The major production costs to be sustained in order to install hydropower plants regard only the infrastructure and its maintenance, and are estimated to go from 0.5 to 0.10 € per each KWh produced. While the amortization period goes from 8 to 10 years, and an hydropower plant usually has a life span of 30 years, profits may be accumulated both by selling electricity to the operator of the national electricity grid, and by selling green certificates on the market (if the plant is larger than 20 kW) or through spot trading (if the plant is smaller than 20kW).

The use of hydropower is also controversial when one considers its environmental impact. Other than the benefits, stemming principally from the absence of fuel usage and carbon burning, and in some cases from protection against floods through dams, the construction of a hydropower plant, especially of large dimensions, may negatively influence the rivers' ecosystem. Such negative impact may involve the life and the possible migration of local flora and fauna, as fishes, birds and other animals are victims of an invasive disruption of their natural habitat. This kind of energy source is surely better than fossil fuels, but being a renewable energy doesn't directly entail being a sustainable renewable energy. The lack of sustainability of hydropower founds reason in the potential, and real, disruption of the ecosystem that the construction of such plants may cause in the environment. For the future, sources of renewable energy should move towards aspects of sustainability; the small expected growth of hydropower in the following years must be hence welcomed, and the development of sustainable renewable energies should be fostered.

4.1.2 Biomass

Biomass ranks third, after hydropower and wind, in the sources of renewable energies in electricity production at the European level. There are four different types of biomasses that are used to produce electricity, here listed in descending order: solid biomass accounted in 2011 for 58% of electricity production from biomass sources, followed by biogas (23,4%), municipal waste (15.6%) and liquid biomass, accounting only for 3% of the total share (AEBIOM, 2011). Co-generation of heat and electricity is a spread technique put in place to increase the energy efficiency and reduce CO_2 emissions: in this way the same level of electricity demand is fulfilled with fewer inputs. The importance of such technology is underlined by the fact that 63% of bioenergy production from solid biomass comes from co-generation plants, producing both heat and electricity. Another source of electricity generation is biogas, which is mainly extracted in methanisation plants, landfills, and water treatment plants. At the European level, the use of biomass for electricity generation is estimated to observe a total growth rate of 78% between 2010 and 2015, and then to slow down to a total growth rate of 37% from 2015 to 2020. Such boom will bring the contribution of biomass energy to electricity generation at 14% according to the NREAPs or 11% (AEBIOM, 2011), as most of the energy extracted through this source will be used for heat and transport.

In Italy, bioelectricity has grown almost by an annual rate of 17% from 2005 to 2010, and is expected to observe an annual growth rate of almost 12% until 2020.

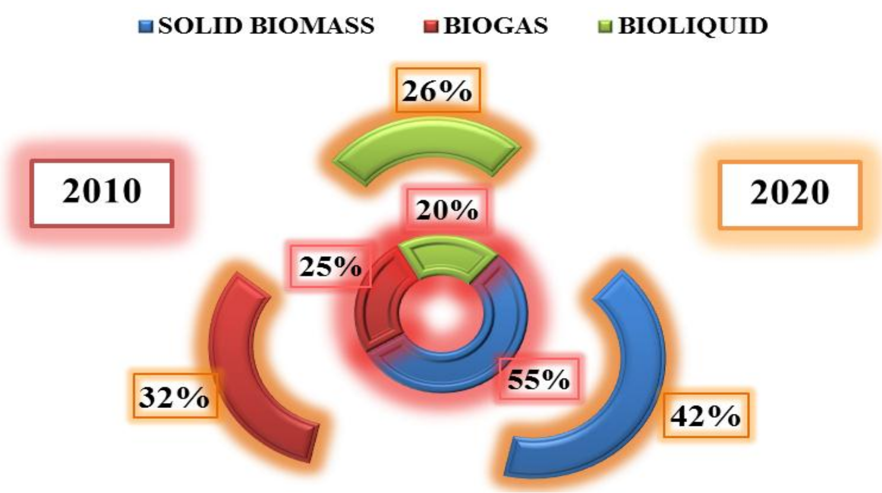

Figure 11. Contribution of Bioenergy Sources to Electricity Sector

Source: Personal Elaboration of data from Eurostat (2011)

As Figure 11 displays, the most important type of biomass source will remain the solid one, even if this kind of source will observe a decreasing trend of 13% in 10 years, from 2010 to 2020, benefiting the other two bioenergy sources. Within the latter cluster, biogas will increase by 7% its share in electricity generation, while bioliquid will observe a growth of 100 base points less.

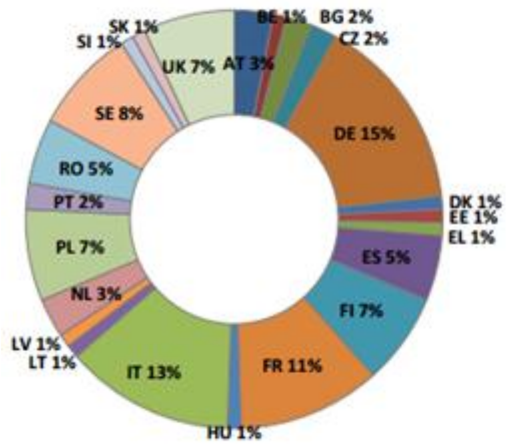

Figure 12. Total EU Potential by Country

Source: European Commission (2012)

Compared to the other European countries, Italy has a great potential for biomass growth for electricity generation. It actually classifies second, after Germany, in the European ranking for biomass potential as estimated by the European Commission (2012) and shown in Figure 12. Such result is extremely encouraging, being Germany the top leader in electricity production from biomass sources. Through the data contained in the ENEA Report (2009) it has been possible to extrapolate the future Italian potential of solid biomass and biogas, and to distinguish it by territorial region.

Figure 13. Italian Potential by Region and Source

	BIOGAS	SOLID BIOMASS
NORTH	58%	50%
CENTER	16%	17%
SOUTH	27%	30%

Source: Personal Elaboration of data from ENEA (2009)

Such figure reflects the long lasting tradition of the north region of Italy, which tends to pull the nation toward a certain trends. Reasons behind which such characteristic is peculiar of the northern region are found in the volumes of Italian history; these for instance regard the high concentration of Small and Medium Enterprises and the relative lower influence of criminal organizations. To support such thesis it is enough to report that in 2011 the Italian GDP grew by 0.4%: GDP growth in the north-east has been higher than the national average by 0.9%, and in the north-west by 0.6%. Such remarkable difference has been due to the important growth undergone by the industrial and service sector in the north, supported by a modest growth of agriculture, while the center and the south experienced growth only in the service sector, whilst agriculture and the industrial sector suffered an important contraction. Despite this, the southern region of Italy shows a significant potential regarding the growth of both biogas and solid biomass, as it is responsible for almost 1/3 of the national share. Moreover, in 2010, this same region was responsible for the production of 65% of the national share of bioliquids, and this is majorly due to only two regions, Apulia and Campania, that alone generated half of the total bioliquids. Bioliquid as source of electricity has yet to be developed both in the northern and central regions, while the latter has to implement relevant actions in order to allow the nation to wholly exploit its potential, for what concerns biogas, solid biomass and bioliquid. Such potential is expected to be exploited in the future, as the estimated growth of biomass electricity generation has been calculated to go from 8.5 TWh in 2010 to 14 TWh in 2015, culminating in 19 TWh in 2020 (Beurskens, Hekkenberg, & Vethman, 2011).

The production of electricity from bioenergy certainly involves a number of benefits, but is widely contested as such source also provides for a number of negative externalities. From an economic point of view, the production of bioenergy may be less costly with respect to fossil fuels, as the raw materials processed are responsible for a very low cost, also due to their abundance; for instance, their cost is on average half the one of fossil fuels when analyzing solid biomass. Despite this, the fixed cost of a biomass plant is actually quite high, but a mechanism similar to that of scale economies may be exploited. In fact, the cost of producing 1 TW decreases the more TWs are produced, hence larger plants will produce more electricity with the same quantity of inputs. Moreover, the payback time of such investment, or the time until which such investment is recovered, goes from 4 to 10 years. An investor may also take advantage of the Italian state incentives, which could accelerate the payback period; it is however difficult to rely on such policies as their implementation and regulation is not very clear. Bioenergy production also benefits the same nation in which it is generated, as it provides a constant energy supply, and avoids dependency from foreign sources of energy.

On the other hand, the present technologies used to extract power from biomass aren't very developed, and hence cause the process to be more expensive: to repair to this lack of innovation, investments in R&D should be put in place, at least to avoid this kind of costs. In fact, bioenergy production also entails relevant transport and collection expenses: at least for the time being, these may be minimized by rationally locating bioenergy plants near biomass sources: the study carried out by Romano et al. (2008) goes toward this direction, focusing on solid biomass. A higher investment rate in the future may be expected only through the minimization of such costs: in 2010 total financial investments for biomass in Italy corresponded to $0.8 billion, while the investment in wind and solar technologies was much more, respectively equal to $4.5 billion and $3.1 billion (Bloomberg, 2011).

A rather controversial issue involves the main characteristic of bioenergy production: its carbon neutrality. Such assumption has always been considered true, but is now strongly challenged at the European level. The assumption entailed that all of the sources of bioenergy are carbon neutral, meaning that the CO_2 released in the atmosphere during the production process is balanced by an equal or larger amount. When focusing on solid biomass, according to EU officials and a group of scientist, such balance is not reached, and the actual CO_2 produced is more when one considers all land use impacts of the production. Plus, when for instance, a tree is cut down, transported and combusted, a carbon debt is created, and the time lapse occurring to recover such debt, by planting a new tree which absorbs the CO_2 emitted, may extend to 35 – 50 years. The claim is that European policies have completely neglected such issues, regarding the age of the tree to be cut (the older, the more CO_2 it contains) and the real emissions released during such process: this would actually make European biomass policies go against the European target of 20% reduction of carbon emission by 2020. The fastest solution would be that of promoting the cascade use of biomass, meaning that biomass is first used for material purposes, and then recycled to produce energy; unfortunately, according to the head of EU policy for Birdlife, this is happening only in a partial way throughout the EU (Euractiv, 2012). It is important to address the production of electricity through bioenergy to efficient objectives, taking into account all of the potential externalities that such production may have, regarding environmental, economic and social perspectives. In fact, such source of electricity is too important to be considered in a trivial way, also for what concerns the two latter contexts: it must be underlined that biomass has a large supply chain, and is involved in a large number of sectors, hence being the technology that created most employment in the sphere of renewable energies. For instance, only in Italy it employed 56% of the workers having a job in the renewables sector.

4.2 New Renewable Energy Sources

4.2.1 Wind Power

Wind power is the second most important renewable energy source for TWh produced in Europe, and observed in 2010 a growth of 12.4% with respect to 2009 for installed capacity (EWEA, 2012). Germany has installed on its territory more than 32% of the European capacity, whilst Italy ranks in fourth place accounting for 6.9%. The proof of the relevance of such sector comes from different perspectives. Wind power generates directly 0.3% of the European GDP, and this is due to the fact that a variety of actors play important roles in the development and functioning of this technology. The main actors are four: component manufactures, wind turbine manufacturers, developers and service providers. The former two account for 57% of the total sector employment, while the latter two are the ones who contribute more to GDP, accounting for 2/3^{rds} of the total contribution. These positive externalities come obviously at a cost: to support the wind power technology, and allow it to gain the relevant present position inside the energy industry, the R&D expenditure within this sector has been above 5% of European GDP since 2007. The sector is expected to continue growing at important rates, and it is estimated to contribute in 2020 with a share of 0.60% to the European GDP (see Figure 14).

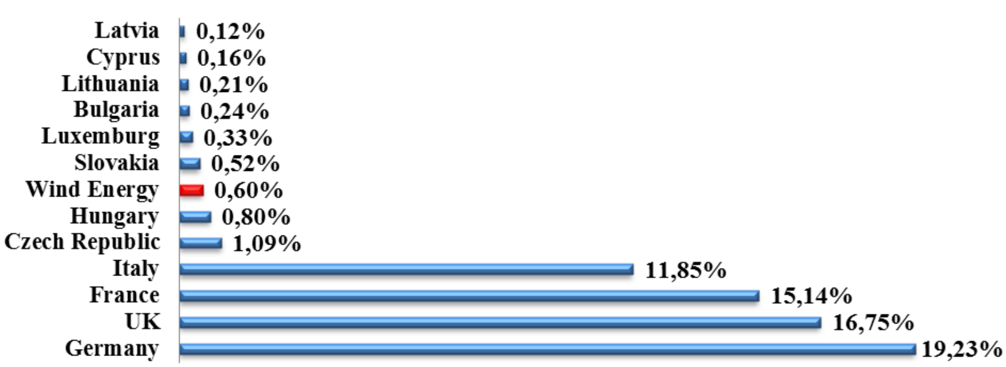

Figure 14.

Forecast of Wind Energy Sector's Contribution to EU GDP by Member State

Source: EWEA (2012)

On February 2012, wind power in Italy has been passed by the photovoltaic technology in the production of energy, holding a share of 3.4% of the national production against the 3.47% reached by the photovoltaic. The slowdown of wind power is due to a set of obstacles peculiar to the Italian environment, other than the tremendous uncertainty regarding state incentives both in the past years, and in the present. The costs to be held to install a wind power plant are 20% higher than the European average, due to the higher prices of terrains on which building the plant and to higher authorization expenses. The latter are both economical and physical, as obtaining an authorization in Italy might take up to 4 years, while in Germany the same process takes only 2 years. For this reason, when wind plants are finally installed, their technology is two years older, hence less efficient and more costly, than the one installed in other countries that benefit from a smoother process.

These characteristics regard the onshore installations, as projects regarding offshore wind plants are either awaiting authorization or were already rejected. The cost of offshore installations is higher, almost doubles, the one of the onshore, and even if it requires additional ad hoc electric infrastructure, it may deliver higher quantities of electricity. In fact, by installing offshore plants the investor may easily exploit a larger set of locations, as there are no obstacles, also avoiding any negative impact on the landscape, and may exploit higher air flows. It is estimated that the potential of the Italian offshore wind power corresponds to 10 GW on an area of 1600 km^2 (Politecnico di Milano, 2012). Despite this, the national action plan published in 2010 by the Minister of the Economic Development fixed offshore installations for 2020 to 600 MW, which are expected to produce more than 2 TWh.

Notwithstanding the obstacles previously described, the present condition at the start of 2012 is that 7% of the wind power plants installed on the European territory are located in Italy, and provide power for a total of 7,300 MW. For the end of 2012 it is expected that new installations will provide for 1 GW of power, and will be located mostly in the south region of Italy. This is due to the fact that such region is characterized by stronger winds, with respect to the north, which may flow from 5 to 8 m/s; almost 60% of wind power installations are located only in three regions, Sicily, Apulia and Campania.

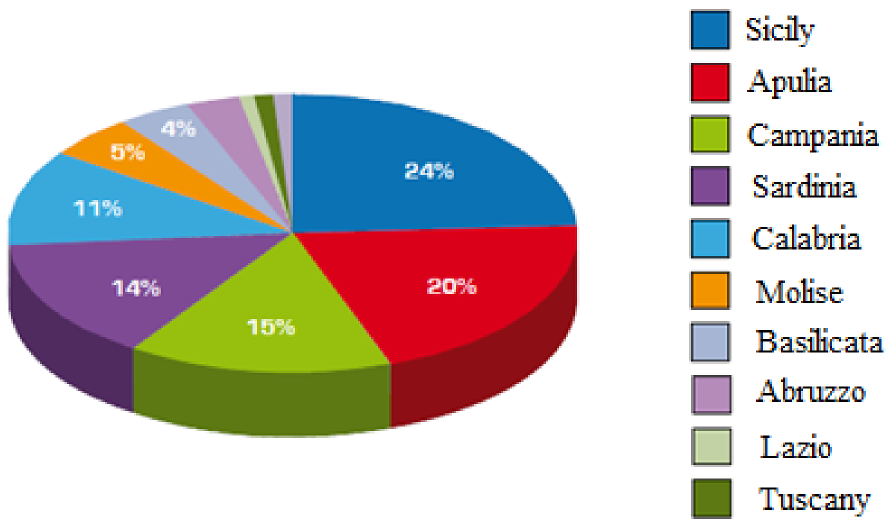

Figure 15. Wind Power Capacity by Italian Region

Source: Politecnico di Milano (2012).

A major obstacle running against a correct development of such technology is represented by criminal organizations. The installation of wind power plants is a highly bureaucratic procedure on one hand, and involves a large quantity of labor on the other hand, concerning the physical building of the plant. On these two areas, criminal organizations have always been strong, and by smoothing bureaucracy and providing labor for unemployed persons, found an optimal mean to create profits:

such actions are allowed by the exploitation of their profound rooting in the territory. A recent newspaper article provides the example of such developments in Calabria and Sicily, southern regions of Italy. In the former region, on July, 27th, 2012, the Guardia di Finanza seized a wind power plant on the Capo Rizzuto Island, valued €350 million. It was discovered, even thanks to wiretappings, that such plant, representing one of the largest in Europe both for size and for power supplied, had been built by a firm whose manager was a dummy behind whom was one of the most important bosses of a clan belonging to the calabrian mafia, n'drangheta. In Sicily instead, the investigations brought to the discovery and arrest of a group of managers which operated in the renewable sector thanks to bribes, illegal authorizations and unreasonable simplifications of the bureaucratic process for the installation of wind power plants (La Repubblica, 2012).

The exploitation of the Italian potential regarding wind power is uncertain for the future, due to the transition period by which the old incentive system is being replaced with a new one, which doesn't offer as favorable conditions as the former incentive system. It is true that incentives have to gradually decrease during the years to let the technology compete by itself against conventional energy sources, but such gradual shift is being accelerated from one year to another, penalizing investments and operators in the sector.

Two different scenarios have been identified by the Politecnico di Milano for what concerns the following years, from 2013 to 2015, on the basis of the incentive policies that will be implemented by the Italian government. If the future incentive policies will be implemented on the basis of the ones developed until 2012 (Scenario 1 in Figure 16 below), Italy would show a wind

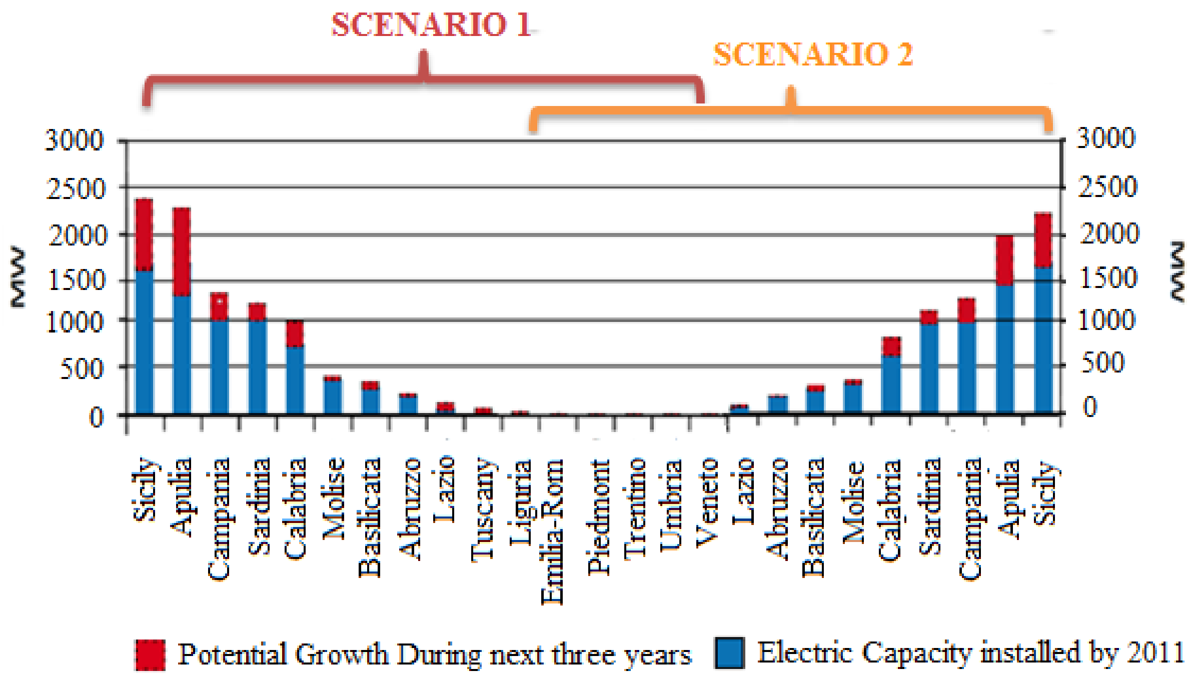

Figure 16. Two scenarios from 2013 to 2015 for Wind Power Capacity Growth

Source: Politecnico di Milano (2012).

power potential of 3 GW for the next three years. The new installations are expected to be concentrated in the same cluster of regions which hold at the present the major share of installed capacity. If incentive policies are instead going to be reduced from 2013 onwards (Scenario 2, Figure 16), as it is most likely to happen, the wind power production potential will decrease by 40% in three years. This is due to the new policy introducing low bid auctions through the Schema di Decreto Interministeriale (April 13th, 2012). Such new mechanism in fact, will add difficulties to the investment process of installations, adding extra-costs – to the already high expenses that an investor has to bear in Italy, with respect to other countries – lowering hence the profit margin of an already quite volatile project.

It is important to underline how the repowering interventions of old wind power plants would add a potential of 2.7 GW, if such repowering involves wind power installations built within 2005. Unfortunately such potential is going to be rather unexploited as the new incentive policies of the new Schema di Decreto are going to penalize this kind of investment by adding complexities to the already difficult bureaucratic process. Moreover, in such analysis the offshore installations haven't yet been considered, mainly because, actually, on the basis of bureaucratic complexities and absence of incentives policies going in this direction, there are very low probabilities for the said technology to be installed on the Italian maritime territory. This is a great opportunity being missed by the Italian government and by investors, as Europe is going towards a completely different trend: the investment in offshore plants will reach 50% of total investment in the wind power sector by 2020 (EWEA, 2012).

It has to be underlined that the installations of offshore wind power plants in Italy suffer from peculiar obstacles which are not faced by other countries. In fact, the windiest regions are located in the Tyrrhenian Sea, in deep water areas which are difficult to exploit through the technologies available at the present. Moreover, while on one hand the structural links needed to tie such plants to the national electric infrastructure face competition with onshore renewable sources, on the other hand the authorization procedures involve two different levels. An investor must first acquire the authorization from the Italian state, and then also from the local municipalities to which the sea area at stake belongs. The positive side of the coin is represented by a set of projects carried out by private companies, some of which are aimed at creating peculiar wind plants suitable to the deep water areas of the Mediterranean Sea (project GEOMA, led by Blue H R&D), while others focus on the study of wind flows on the seas to detect optimal locations for wind power installations.

In order to capitalize investment opportunities the Italian government should be the first to develop a better incentive system for the following years, or at least to severely simplify the bureaucratic procedures needed for the authorizations to build wind power plants.

New developments of the wind power technology concerning the near future regard the extraction of wind power through the use of kites. Such technology is composed by a kite, made of a material similar to that of a sail, 50 meters long and 10 wide, which is hooked to the ground through a cable made of synthetic fiber – ten times more resistant than steel. A 5 MW electric generator is used to transform wind power in electricity, while a sophisticated computer software manages the kites, aiming at obtaining the maximum performance from each kite. This technology allows extracting energy from more powerful winds located at high altitudes; the density of kites may not be more than 16 per square kilometer, hence 6 km^2 would provide the same electricity generated by a small nuclear plant. Another benefit of this technology concerns the fact that the land which the kites are installed on may be used for other purposes, while an important downturn is represented by the fact that the upward air portion covered goes up to one kilometer. The importance of the kite technology may support a set of different realities, as for instance the crisis suffered by Alcoa in Italy. KiteGen Research, an Italian firm working in the wind power sector since ten years, has offered to acquire an important production site of this firm (Portovesne), which risks to be closed down, and to power it exclusively through the wind power extracted by kites.

4.2.2 Solar Power

Solar power may be transformed into electricity through the use of two different technologies: solar photovoltaic and concentrating solar thermal power. The former technology has experienced outstanding rates of growth in the past years, principally due to a decrease in the cost of photovoltaic cells and to favorable incentive policies. In 2011, global installations increased by 25 GW, with the European Union being responsible of three quarters of such increase – only Germany and Italy accounted for 57% of new operating capacity. Much more generous feed-in tariffs during 2011 are the principal cause of the solar photovoltaic exploit on the Italian territory, which brought the total capacity to almost 13 GW. New photovoltaic technologies being explored and still representing niche markets are the building-integrated photovoltaic and concentrating photovoltaic. The former is growing on average by 56% per year, notwithstanding the economic crisis that dampened investments in the sector. The concentrating photovoltaic is gaining interest due to its higher efficiency, fact demonstrated by the large number of worldwide projects involving such technology, while for the time being only 33 MW were operating at the start of 2012.

The solar photovoltaic industry is characterized by harsh competition, due on one hand to continuous price reductions of raw materials and on the other hand to excess of supply. The latter condition was particularly suffered in China during the current year, where the growth of the photovoltaic market has quadrupled in 2011.

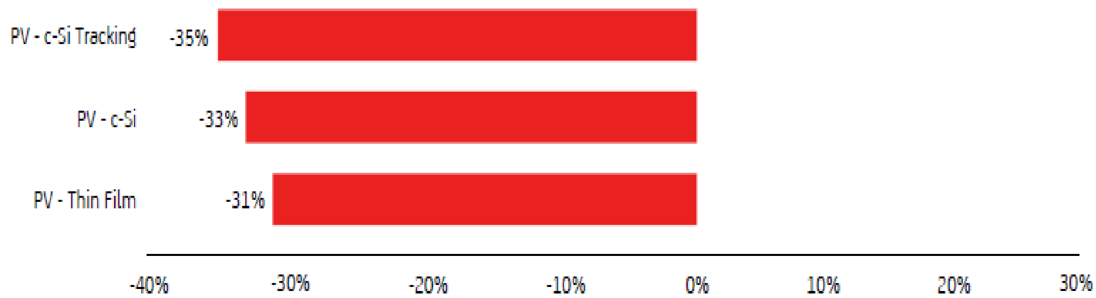

Figure 17. Levelised cost for Electricity Generation of Solar and Wind Technologies
(% change in terms of €/MWh)

Source: Politecnico di Milano (2012).

Figure 17 above shows the change in levelised cost between the first quarters of 2011 and 2012. The levelised cost of electricity is the total cost for the production of 1 KW during the whole life cycle of the plant; it takes into account any cost linked to the generation of one unit of energy, from fuel and CO_2 emission costs, to the ones related to a plant's decommissioning. Such cost decreased by a range that goes from 31% to 35% only in one year – for instance, the onshore wind power levelised cost observed only a 9% reduction.

The decrease in costs, other than benefiting consumers and the use of the same technology, negatively impacts on manufacturers. China is the main manufacturer of this solar technology, exporting it worldwide: Europe imports a share of 60% of China's production. Price reduction, together with excess of supply, forced relevant Chinese manufacturers of solar panels, going from Suntech to Trina Solar and LDK Solar, to close down part of the production and to fire or relocate more than 7,000 employees. Only LDK solar will have to cut more than 5,000 employees, accounting for 20% of its workforce (China Daily, 2012).

Also the concentrating solar thermal power is experiencing a steady growth, mostly in Spain, thanks to the particular national policies that in 2009 incentivized such technology at the expense of others. An important feature of this technology regards the fact that such installations may be integrated both with coal or gas-fired plants, but also with other renewable energies such as biomass. This characteristic, together with the capability of allowing thermal storage, are considered the two drivers for future investments and developments in concentrating solar thermal power technology. Moreover, its expansion is favored by specific policies that are going to allow the installation of larger sized plants, going from 150 to 250 MW, especially in the United States, hence permitting the exploitation of scale economies, which will significantly contribute to the reduction of the overall price.

In 2011, photovoltaic and solar thermal technologies contributed with a share of 2% to electricity consumption in the European Union, while for 2020 their impact is expected to grow, reaching 16% of produced electricity through solar power. The symbolic relevance of this technology is underlined by a singular event occurred during the last weekend of May, 2012. Germany produced an extraordinary amount of electricity from solar power, and was able to fulfill on Saturday 26th half of the total electricity consumption. According to Norbert Allnoch, the director of the institute of renewable energy industry (IWR), a similar event had never happened in the whole world, and for the first time such an objective was hit by Germany, which produced 22 GWh only by exploiting energy from the sun. On the day before, Friday 25th, electricity from solar power covered 30% of Germany’s consumption, but on Saturday the percentage increased due to a strong reduction in demand, caused by the closing of factories. Such a record had been possible thanks to the growth of this sector, which experienced an increase of 1.8 GW of power during the first months of 2012. A region of Italy, Sicily, managed to reach a similar but less important record on April 8th, when 60% of electricity production came only from renewable energy sources. Sicily constitutes a very fertile environment for the exploitation of solar power. For instance, by 2015, near Catania, Enel Green Power will install the first solar thermal power plant integrated with biomass that exploits the advantages of molten salt in Italy. Molten salt is able to keep the heat received during the day for long time after sunset, hence allowing electricity generation also during part of the night. Moreover, it is much more efficient and less polluting than the one based on oil heating. Such plant will have an electric capacity of 30 MW, and will be able to fulfill the electricity consumption of 40,000 families (La Repubblica, 2012).

To understand the contribution of solar power to the electricity mix, it is relevant to consider the growth in grid-connections, as the installation figures instead better describe demand for photovoltaic systems.

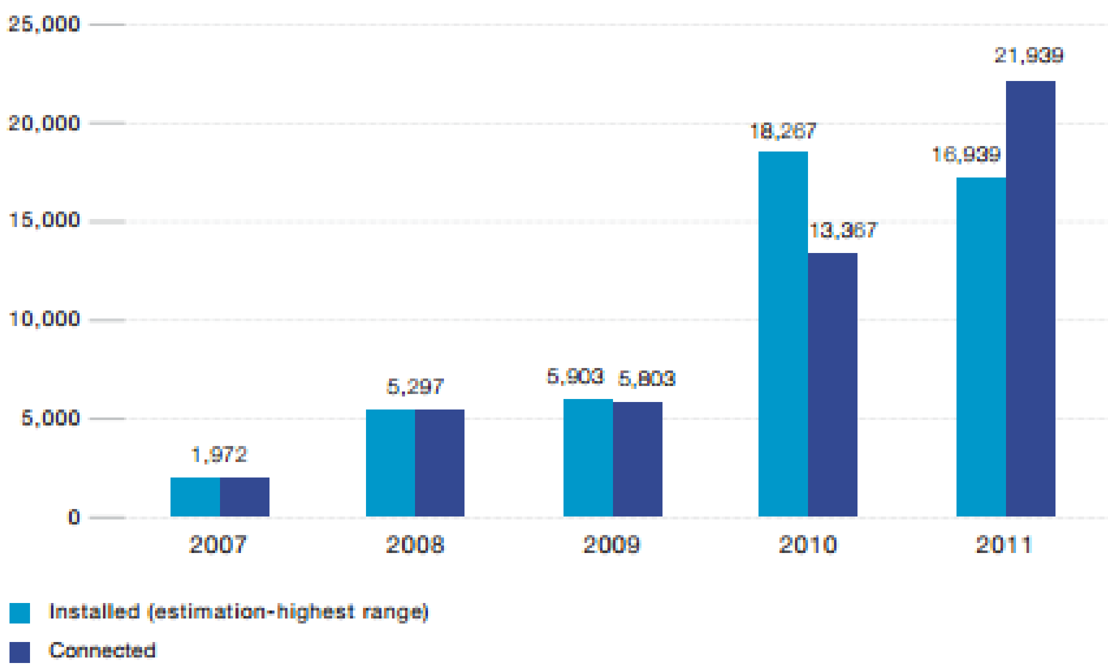

Figure 18. Annual difference between installations and grid-connections (MW)

Source: EPIA (2012)

As Figure 18 displays, the quantity of installed and connected plants has differed during some periods; this is principally due to the fact that incentives in the sector have led installations to be made during specific periods of time. For instance, in Italy during 2010 the law named “Salva Alcoa” – law made to save Alcoa, a multinational firm which risked to be closed down after public subsidies ended (see p.40) –, allowed solar incentives to be extended until the end of the year. This led to a strong increase of installations during the last months of 2010, and hence to a higher number of installations with respect to the number of grid connections, and contributed to the reversal of this trend in the following year.

The total number of installations on the Italian territory has grown by 53% between 2010 and the end of 2011, while their capacity has risen by 73%. The installed power has risen more than the number of installations because most of the plants set up during 2011 were larger than the previous ones.

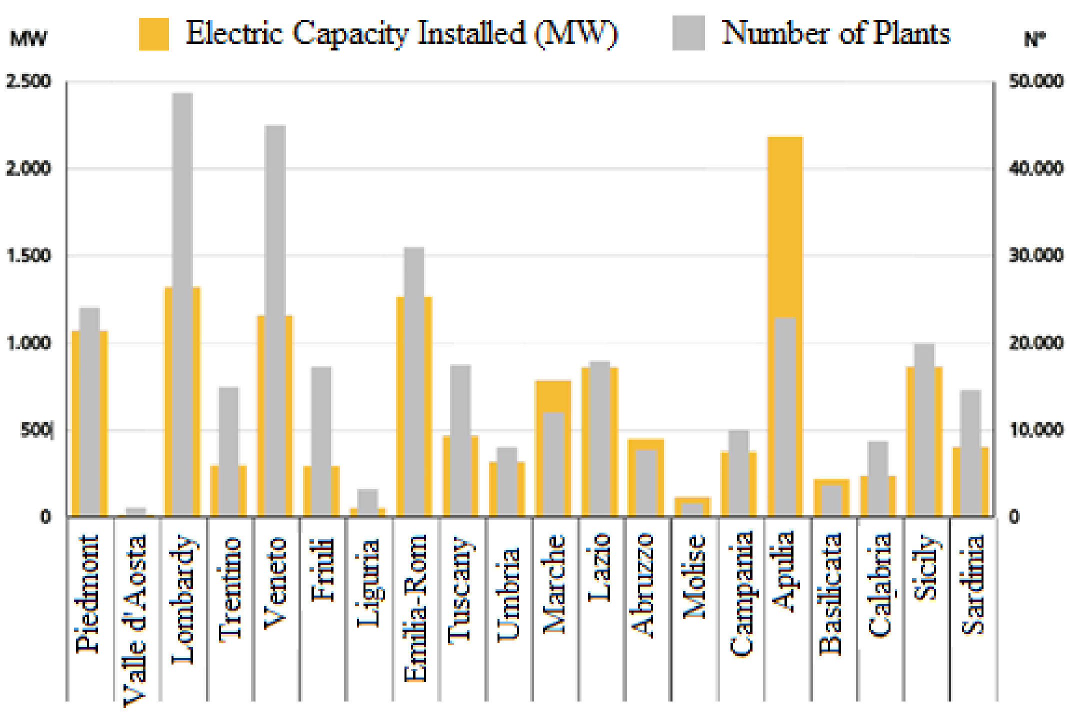

Figure 19. Number of plants and Electric Capacity Installed per Italian Region

Source: GSE (2011)

As shown in Figure 19, most of the plants are installed in the northern regions of Italy, and also produce the largest share of electricity. The case of Apulia, a southern region, is peculiar: with only 22.000 installed plants this region observes an amount of installed power of more than 2 MW alone. In such region in fact, the average size of installed solar power plants is 95.4 KW, while the average size of plants in the whole Italian territory corresponds to less than half, 40.6 KW. The combination of number of installed plants and their power allowed Italy to produce in the first six months of 2012, until June 30th, a total of 9.254 GWh, while during the whole 2011 the solar power generated 9.258 GWh in total. The growing trend is underlined by the fact that from January to June 2011, the electricity production from solar power reached 2.7 GWh, which nonetheless was considered a great result compared to the 1.6 GWh produced entirely during 2010 (La Repubblica, 2012). In September the capacity installed on the Italian territory reached 15 GW, but the sector is currently observing an abrupt slowdown. To stretch to such extent the installed capacity, GSE has estimated the annual cost to have touched 6.2 billion, and hence the budget limit imposed by the Fifth Conto Energia is getting extremely close. According in fact to the guidelines contained in such document, if the incentives exceed 6.7 billion, the photovoltaic sector in Italy will have to go on by itself; moreover, the Fifth Conto also expects to cut down incentives for photovoltaic installations by 35-50%. It is projected that the sector will observe, for the first time in many years, a relevant decrease in number and capacity installed, during the rest of 2012 and for the entire 2013.

An increase in technological efficiency and a correct policy for incentives are the main solutions to help the development of renewable energies, in particular that of solar power. Despite this, innovation and creativity form the basis for any discovery. Luca Paoletti has patented a revolutionary – and futuristic – idea: energetic motorways. By installing solar photovoltaic panels on the cement blocks that divide motorway lanes, it would be possible to exploit marginal territories that would remain unused. Such panels are made of innovative Cigs cells, which have a width measured in few microns, and can be stretched out as films on the upper part of the cement blocks. The use of this new technology allows avoiding any type of problems in case of accidents: in security terms, these cells are safe as are not made, like the old ones, by glass. In economic terms, by being installed as modules, the fact that one panel is damaged or is not working properly doesn't cause a failure of the whole system. The firm responsible of the motorway management may then exploit the electricity produced both by powering road signs and by selling the surplus of electricity not needed. The downturn of this idea is that the panels wouldn't always be installed in the most efficient way with respect to the angle of the solar rays. Such issue is overcome by installing panels on long distances, and by considering that Cigs cells are way more efficient than normal solar panels.

4.2.3 Ocean Power

Tidal, wave and ocean are considered rather news sources of renewable energy in the production of electricity. Installations based on the exploitation of this kind of source are still very low in number and accounted in the present year for the production of 0.53 TWh throughout the whole European Union: indeed, the only country that exploits this kind of energy is France, producing alone that amount of TWh with an installed electric capacity of 240 MW (European Commission, 2012). In 2020, the installed capacity is expected to increase to 2,543 MW, thanks to the

contribution of member states facing the Atlantic Ocean: France, Ireland, Portugal, Spain and the UK. Such capacity will bring this kind of energy to account for 0.15% of electricity generation for that same year. Despite the extremely low use of this source of energy, the NREAPs for 2020 of all EU member states show a deep commitment in investing in technologies to exploit ocean energy. The future perspective is rather harsh, because, due to a lack of efficient technologies, the cost of electricity from this type of source is experiencing an increasing trend. From 2011 to 2012 the levelised cost of electricity has increased by 23% in the case of tidal, and 8% for what concerns wave.
However, the high number of projects and prototypes being developed in the recent years will contribute to the inversion of such trend during the following years.

Ocean energy represents a significant type of renewable source because of different characteristics: it is massively available, infinite and has a very low visual impact. Energy may be captured from the seas in three different ways: by exploiting waves, marine currents and tides. In certain environments it cannot be considered a source of constant flow of energy, as it strictly depends on the ocean conditions which at least vary from day to day. Notwithstanding this, the potential of ocean energy, especially for what concerns wave energy, is generally highest in winter months: this is a welcomed externality, as it allows producing more electricity during the winter, matching the higher demand which characterizes such season. Moreover, there is a certain degree of certainty regarding the quantity of electricity generated, as most of the times, thanks to technological instruments that the human being already possesses, or that may have in the future, it is possible to forecast to a certain degree the conditions that influence electricity generation from this source: for instance, the tide movement, the intensity of marine currents and the strength of waves. A project carried on by a team of English and Israeli researchers, respectively from the University of Exeter and the University of Tel Aviv, has allowed the development of a particular technology of floats, named point absorber, that is able to forecast the strength of each coming wave, and hence adjust and extract the maximum quantity of energy.

The relevance of ocean energy becomes clear by highlighting its potential, which has been estimated in 30,000 TWh worldwide (EREC, 2010). At 2011, total global capacity of ocean energy has reached 527 MW (REN21, 2012), mainly thanks to South Korea which accounts for 48% of global capacity. Important investors and developers in this area are also UK and Spain which are carrying on important projects for the development of new technologies. Despite this, investments in the previous year decreased by 5%, even due to the fact that the project carried out by South Korea was financed years ago.

There are also significant barriers to this technology: the most important ones concern first the lack of high voltage transmission lines infrastructure providing grid access in coastal communities; second, the regulatory framework of member states that may delay authorization procedures for the installation of such plants; third, the need for economic incentives, similar to the ones provided for other renewable energies, at least during the initial years during which this technology is introduced, in order to make it competitive; last, the lack of public awareness on the topic. A relevant obstacle to the development of technologies addressed to exploit ocean energy also regards the high costs that a company has to face during the R&D stage. This entails that smaller companies have a great number of financial problems in sustaining these costs: to remedy, at least in part, to such difficulties, Oregon State University and US Energy Department have installed in the Pacific Ocean a floating platform that allows small companies to experiment the technologies developed. The installation of similar platforms should be incentivized in order to foster innovation in this sector: there is a large set of small and medium enterprises that would greatly benefit from such move.

The Italian development of such sources of renewable energy was inexistent in the past, and is still inexistent, at least for the time being. The national industry roadmap (Arep, 2010) had estimated a growth of this sector from 2011 to 2015, by which the electric capacity should have increased by 72%, from 3 MW to 13 MW. Already in 2011 such expectations were not fulfilled, as the electric capacity is still nil. It is now expected to observe a growth in the Italian ocean energy sector from 2015 to 2020, corresponding to an installed electric capacity of 3 MW and 5 GWh (in 2020) of electricity generation. As shown in Figure 20, the Italian potential of ocean energy is relatively small compared to the one of other European countries facing the Atlantic Ocean. This is due to the fact that the Mediterranean Sea is not very large in size and almost landlocked, as its only connection with the ocean is Gibraltar Strait. Hence, waves are not characterized by a great amount of strength. Figure 20 displays the average annual energy available on the

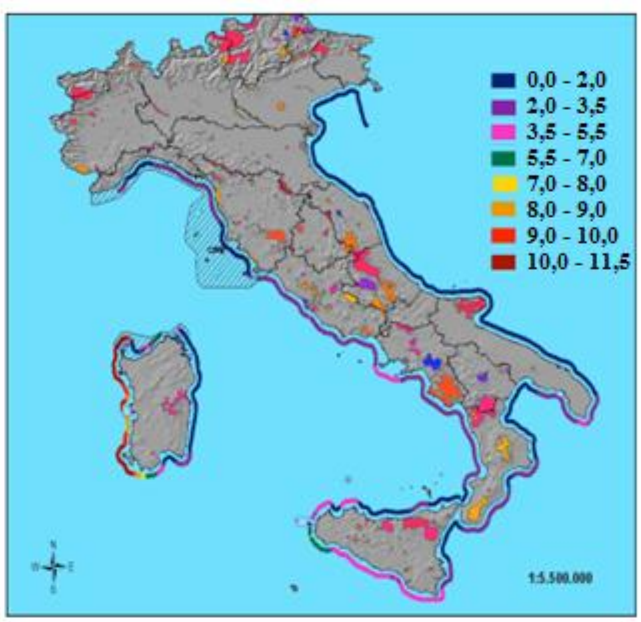

Figure 20. Average annual ocean energy (KW/m)

Source: ENEA (2011)

Italian coasts. Most of the coasts observe a low energy potential, even due to the fact that 50% of them face the Adriatic Sea, which is characterized by an even higher degree of closure, with respect to the Mediterranean; the regions that observe a higher potential are instead the two islands, Sicily and Sardinia. The technology to be used in such conditions must hence maximize the efficiency: different Italian projects in fact, are centered on increasing this characteristic – KOBOLD, REWEC and ISWEC (ENEA, 2011). By finding an optimal positioning of ocean energy plants and using highly efficient technologies even Italy might succeed in exploiting this infinite source of energy.

Other important regions with a fairly high potential are the Messina Strait and the Lagoon of Venice. Exactly in this Lagoon and in the near sea three prototypes have been installed during the current year. One prototype, GIANT, is able to produce 12 MWh per year, while a second one produces electricity up to 35 MWh per year. These prototypes are also able to collect relevant data regarding wave and tidal conditions peculiar to that area, and have no impact on the near ecosystem: the only visible object will be a cable transferring electricity to land.

4.2.4 Geothermal Power

Geothermal is a renewable energy source that is characterized by a high potential and a low degree of exploitation. Worldwide capacity has increased by 18%, reaching 11 GW in May 2012, with Europe accounting for 1.6 GW in 2011 (GEA, 2012). The major European producers of geothermal electricity are Italy, responsible for more than 50% of the total production and Iceland (40%).

As Figure 21 displays, expectations for the future years estimate a growth of this sector of 40% within 2015, reaching almost 3.5 GW of installed capacity in 2018. Growth will be greatly due by technological innovations that have finalized the enhanced geothermal systems (EGS) plants. This technology revolutionizes the potential of exploitation of geothermal energy, as it allows capturing electricity from this renewable source almost in any territory; the older technology in fact was used only in locations where hydrothermal resources where present. This is due to the fact that EGS permits to reach significant distances within earth's crust (5.5 km), where temperatures, all over the world, are found to be around 170°C. EGS installations aren't yet competitive, hence it is expected that European projects exploiting this technology will be carried out in the following years. There is in fact growing awareness on the extraordinary potential of geothermal electricity, which however isn't still correctly supported in financial

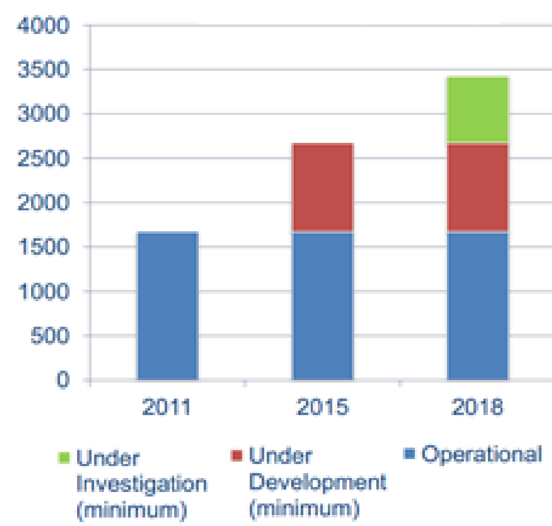

Figure 21. Installed Capacity and potential growth of Geothermal Electricity in Europe (MWe)

Source: EGEC (2011)

terms. Surprisingly, in the forecasts for 2050, the European Commission has excluded geothermal energy from the renewable technologies needing further investments; probably this is due to the fact that the Commission has greatly underestimated the potential of geothermal energy, expecting electricity production to range only from 12 TWh to 26 TWh in 2050.

This evidence is puzzling when going over geothermal energy advantages. First of all, it is a constant source of energy, not influenced by atmospheric and seasonal conditions, and reaches a capacity factor of 85%, more than nuclear plants (EGEC, 2012). It may easily provide base-load generation, and hence be considered as an effective substitute of coal or nuclear plants, also due to the fact that its integration in the existing power infrastructure doesn’t present severe obstacles – unlike the case of other renewable energy sources, which need considerable additional infrastructure. The only downturn of geothermal may be environmental pollution, not due to greenhouse emissions but to elements that are found in geothermal fluids, such as sulfur, mercury and arsenic. However by running environmental controls this negative externality may be minimized. Germany has probably positively considered the characteristics of geothermal energy, as it has increased financial and policy support, and expects to reach a target of 0.6 GW of capacity installed in 2020.

The present development of this technology in Italy is rather slow, but its history dates back to the start of 1900s. From that time onwards Italy has developed and used geothermal energy to produce electricity: the productive capacity is entirely located in Tuscany, the most relevant plants being the ones in Larderello and Montieri, and accounts for 20% of the electric consumption of the region.

Thanks to this long lasting capacity Italy is the first producer of electricity from geothermal sources, which accounts for 3% in the panorama of electricity generated by renewable energies. The electric capacity in the following years is expected to grow by 50% in 2020, from 800 MW to 1.9 GW, given that Italy implements aggressive policies for renewable energies, or by a moderate 34%, if instead the country only manages to fully use its present resources (Arep, 2010). There is a strong need for R&D and, most importantly, for government intervention to create policies going in that direction in order to reach such objectives; an investment of €0.4 billion would pave the way for a source of energy of this importance (Arep, 2010).

The potential of the Italian territory is rather high, as it has been estimated in 500 MTEP, two-thirds of which observe a temperature ranging from 80° to 150°C, allowing a competitive potential production of electricity. Figure 22 virtually displays such potential through the Italian territory. The potential exploitation of areas in which the temperature is lower than 80°C is considered of equal importance, as it is distributed on the majority of the Italian territory. For the time being, the fact that Italy is observing relevant development in projects exploiting geothermal is supported by evidence: the public venue of the Lombardy region and the IKEA

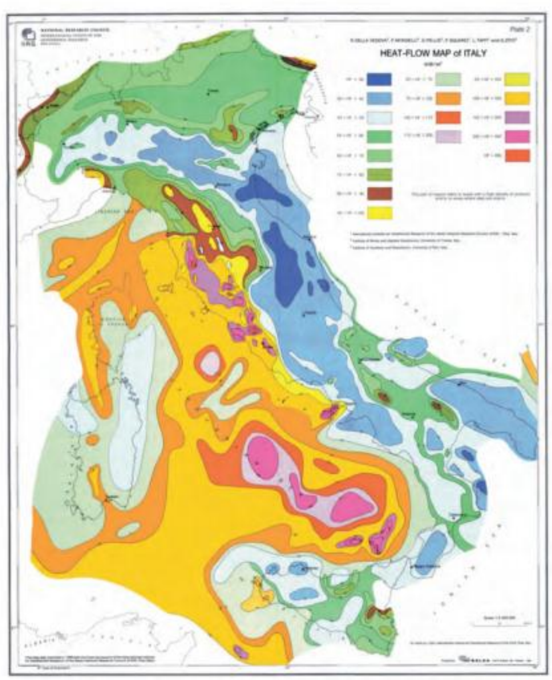

Figure 22. Conductive Heat Flow in Italy

Source: UGI (2011)

factory near Parma are powered only through geothermal. There's also a significant project that may deliver 200 MW of electricity by 2020, by exploiting the heat generated by the underwater volcano Marsili, near Sicily. Italy is located on a thin section of the earth crust, where the Ionian plate is pushed down by the African one. This provokes very hot regions to be exploited through geothermal, other than Tuscany and Sicily, which can be found in Campania and on the south part of the Tyrrhenian Sea.

4.2.5 Policies & Incentives

Incentives in the Italian environment have been distributed mainly through two different instruments, green certificates and the so-called Conto Energia. The first, takes into account all plants operating by the end of 2012, and involves the creation of a market in which such certificates are traded. The supply is constituted by those firms that produce electricity from renewable energy sources, which are given a green certificate for each MW produced, except from photovoltaic. The demand is made by those firms that are obliged to supply a certain amount of energy from renewables. In 2011, a large part of green certificates involved wind power electricity production (41.1%), while hydro accounted for 28.2%. Conto Energia is instead a form of public incentive for photovoltaic, by which the installment of photovoltaic plants is financed for a certain period of time and the production of electricity is rewarded through feed-in-tariffs. The system involving tax exemptions has never been adopted in Italy, while is present in many countries such as UK, Germany and France. There is also an inclusive tariff which incentivizes all kinds of renewables excluding photovoltaic, and comprehends both an incentivizing and rewarding component, the latter based on the quantity of electricity produced.

Production by this mean has increased since 2010 by 95%, benefiting mostly the bioenergy sector. Other mechanisms include the spot exchange for plants up to 200 KW, and the dedicated collection of energy by the national energy manager (GSE).

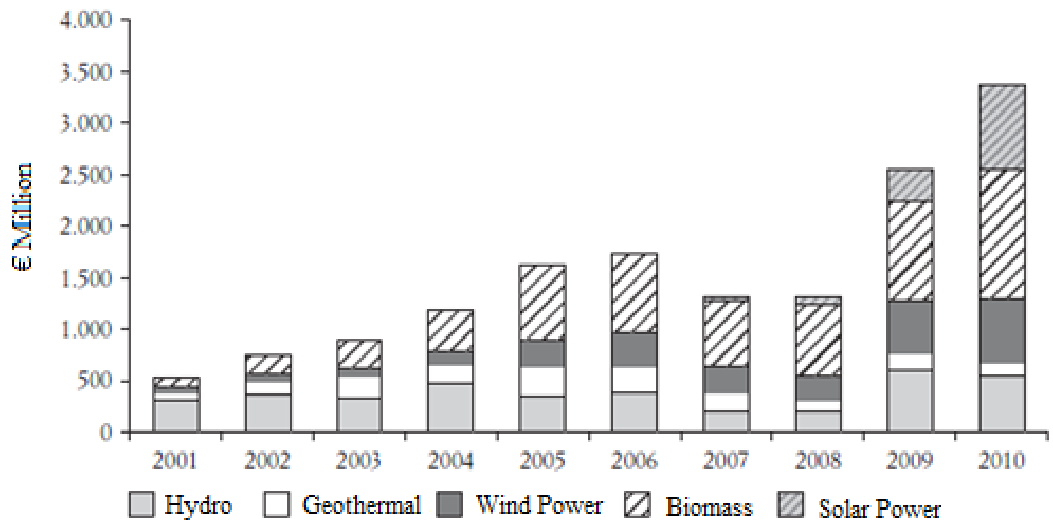

Figure 23. Division of incentives per renewable source

Source: Cassetta & Surdi (2011)

As Figure 23 shows, the incentives in Italy have always observed a significant growth rate, and except for the harsher years of the economic crisis, 2007 and 2008, have always been quite generous with respect to other countries, both in terms of economic value and of average duration of the incentive; this also allowed for speculations. As a matter of fact, Italy attracted many foreign investors who benefited by Italian policies, and significantly contributed to the growth of renewables.

A substantial decrease in the support of incentives came first in 2011, when public incentives started to be reduced, and the trend continued in 2012 with the introduction of the Fifth Conto Energia, which announced a decrease by 35% and 50% of the tariffs for photovoltaic. This was mainly due on one hand to the high costs of electricity production, and on the other hand to the near achievement of the

European target for 2020 and to encourage a real renewable market, not anymore biased by public incentives altering demand and supply dynamics. For the time being, due to the incentives' reduction brought by the Fifth Conto Energia and to the biased Italian political condition, the future of incentives experiences a high degree of uncertainty. Uncertainty stemming from the Fifth Conto Energia is due to the fact that the guidelines for receiving incentives have not been outlined clearly, and to the short life that such policy enjoys: in fact, enacted on July 5th, 2012, it provides for a maximum of €6.7 billion of expenditure, while today the amount has already reached €6.4 billion. Despite this, the Fifth Conto Energia has also represented a market failure as, for the first time since 2005, there has been less demand for incentives than the quantity supplied: €50 million remained unused. The main objective of such instrument was to create competition in the market to incentivize only the best projects, but the evidence of such surplus doesn't assure the selection of the most efficient projects. The demand of smaller photovoltaic plants has observed a significant contraction due to numerous obstacles regarding the rules for admission to the incentives: as a matter of fact, 50% of the power financed by the Fifth Conto is absorbed by only 10% of the projects presented. Such discrimination was exactly what this Conto Energia tried to avoid, clearly without success. The main reason for which such incentive mechanism has observed such failure is identified in its timing and speed of implementation: the market hadn't had the time to metabolize the new measures and hence to create adequate projects. The outlook is already toward the Sixth Conto Energia, which is expected to exclusively focus on incentivizing smaller plants and on building integrated plants. Moreover, through the new version of this instrument, the spot exchange is expected to be allowed even for plants up to 10 MW.

The model on which future incentives should be based is depicted in Figure 24. While hydro can be considered a mature technology, the future incentives should be set to provide an important shift of the different technologies throughout this virtual curve. Starting from onshore wind installations and biomass plants, both should have the capacity to move towards the area of mature technologies thanks to technological development, with a gradual need for lower incentives.

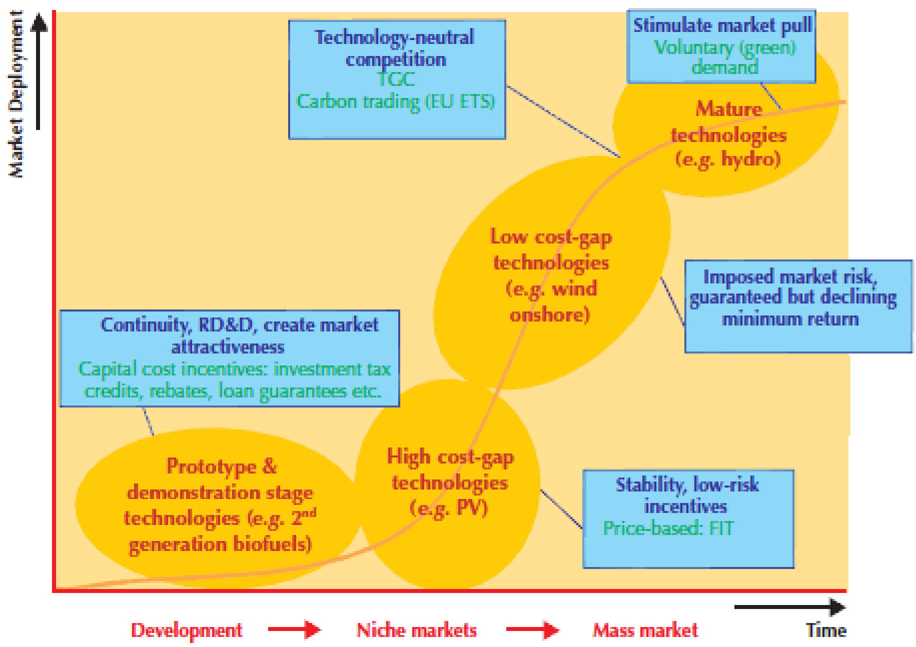

Figure 24. Framework of policy incentives and technology maturity

Source: IEA (2008)

Offshore plants, together with ocean power technologies, are instead found at the other end of the curve, as are now being experimented and will gradually be installed in the following years. Incentives for offshore and ocean power should enhance innovation in the sector, to foster technological development and achieve more efficient technologies. On the other hand, geothermal should still be supported by incentives due to the poor development of this renewable source, which is still observing a high-cost gap. Also photovoltaic should be supported by incentives in order to take the virtual place in the graph of onshore wind, hence locating in the low-cost gap technology area. This should bring such technology to be introduced in mass markets: policies should foster such introduction, for instance with measures aiming to reward the installation of photovoltaic in exchange of the elimination of asbestos, which is extremely polluting and, despite this, considerably spread throughout the Italian territory, especially in apartment buildings.

This kind of policy would allow photovoltaic to finally reach mass market.

5. Companies' Contribution to Italian Target

The prime movers in the achievement of the 20-20-20 objectives are without any doubt companies. Firms are the ones who have to integrate policies and technological development in order to create the physical conditions for the targets to be met. This is done through a long process of project management, where the state of art of the external condition and of the assets possessed is assessed and possibilities of development and profit are examined. Other than supporting the member states in fulfilling the European objectives, a sustainable strategy brings also significant profits. In 2008, in the middle of the economic crisis, firms which had focused on a sustainable development observed better performance in the exchange markets with respect to the sector average. This evidence is supported by the trends of the Corporate Sustainability Index of Dow Jones.

In order to move towards a sustainable strategy a firm may choose between four different moves. According to Stuart Hart, a short term strategy focused on the internal processes of the firm aims at pollution prevention by minimizing the wastes and CO_2 emissions of the operations. This also involves implying wastes as new inputs, protecting the biodiversity and concentrating on energy efficiency. A good example for such strategy can be found in P&G, which has long been focusing on such tactics, and has also centered marketing campaigns on it. Another short term strategy takes place by involving stakeholders to concentrate on enhancing firm's reputation and transparency, focusing on management ethics both on horizontal and vertical levels. This is also done by assessing the development and implication of a product's life cycle and design. A long term strategy with an internal focus concerns the assessment of the production process, in order on one hand to implement a better use of raw materials to protect both the human being and the natural resources, and on the other hand to reduce the emissions generated. Last but not least is the so called ‘base of the pyramid’ strategy, which takes care of the social and environmental impacts of the corporate vision and actions. Such strategy fosters social equity and local development, trying to increase the quality of life of those countries characterized by scarcity of water, poor health conditions, and social inequalities. In other words such strategy tries to assess whether the firm is able to fulfill the unmet needs found at the basis of the pyramid.

The major part of the firms involved supporting Italy in achieving the European targets by 2020 are Small and Medium Enterprises. However the contribution of larger firms, many of which were previously, or still are, state-owned, is extremely significant. What are going to follow are two interviews to managers of two Italian firms, Edison and Snam. Marisa Martano is responsible for energy efficiency and sustainable development in Edison, while Stefania Serina is responsible for environment and prevention of accidents in Snam. The former is a multinational firm counting in Italy 7.5 GW of electric capacity, producing 10 TW through a diversified set of installations, involving all kinds of renewables. Founded in 1884, Edison is the oldest European company in the energy sector; in 2012 it gained the title of Most Admired Italian Company for its reputation at international level. Snam is the leading company in transport and distribution of natural gas in Italy, accounting for almost 32.000 km of pipeline infrastructure on the Italian territory. Its commitment to sustainability stems from actions such as 25 km of reforestation and the restoration of land affected by the laying of more than 170 km of pipelines. During this period Snam is involved in an unbundling process, which will end in the last months of 2012. Such process entails the separation of ownership from Eni, and will allow Snam to be stronger and enjoy a higher degree of independence. Here follow the interviews received by both companies.

5.1 Interviews to Edison and Snam

1) What's your company's contribution to the achievement of the European targets for Italy, regarding the increase in energy efficiency, the use of renewable energies and the reduction of CO_2 by 2020?

EDISON: Historically Edison has considered the development of renewable energies as fundamental: the first hydropower plants in Italy have been installed by Edison (Bertini, Esterle, and Semenza along the Adda river). Since then, the effort has been consolidated with investments made in recent years, in the construction of wind power plants and photovoltaic.

Moreover, three years ago, with the establishment of a Business Unit entirely dedicated at Energy Efficiency and Sustainable Development, it has strengthened the commitment that has been sustained for years in this field. The business model, involving direct investments by Edison, confirms the strong desire to spread the culture of efficiency in industrial and service sectors, whenever there are proper conditions and a return on investment based on the sharing of the benefit received, in terms of reduction of the electricity bill.

SNAM: From a perspective of sustainable development, all of the companies of the Snam Group aim at protecting the environment and fighting the effects of climate change. All the companies also have the goal of reducing energy consumption and consequently also the related CO_2 emissions.
In fact, the company makes significant investments in order to adopt the best available technologies, such as high efficiency and low emission gas turbines.
The distribution sector is currently engaged in obtaining a certification following the UNI EN ISO 50001 norm for energy management.
The Snam Group has also chosen to enter two contracts for the supply of electricity entirely generated by renewable sources in two sites that have the highest electricity consumption: the GNL Italy regasification plant and the storage plant of Brugherio.

2) From your point of view, and from that of your company, which problems or difficulties do you encounter in pursuing this goal?

EDISON: The main problem involves the lack of transparency of renewable regulations: the incentivizing policy has revealed to be inconsistent with respect to progressive growth and to long-term perspective, also because it has not led to a consequential adjustment of the electric grid. For instance, in the field of photovoltaic, such policy has created a bubble that unfortunately has had a strong impact on the whole system, also on the electric bill.
Whatever the policy to be adopted, there is need for policy certainty to give operators the ability to plan their investments, creating at least a return in the medium-long term.

SNAM: The main obstacles encountered by our company in implementing these objectives are due to the difficulty of combining the demands of a complex market, such as the market of natural gas in which Snam Group operates, and the need for reduction in energy consumption and for the protection of the environment.

3) In your experience, how may the development of renewable energies help Italy in recovering from the crisis?

EDISON: Renewable energies, power-generating plants as well as interventions aimed at optimizing electricity consumption, may lead to significant benefits for the year-end financial statements of companies. Edison's approach, which does not involve deducting financial resources or human resources from the company, allows the company to fully focus on its core business. Hence, the positive effect is doubled and competitive advantage becomes significant.

SNAM: The development of renewable energies may contribute to the recovery from the crisis if such development is coupled with a reduction of energy prices, which have an increasingly strong weight for private consumers and companies. Being [Snam] a company operating in the energy sector by transporting and distributing the fossil fuel with the lowest environmental impact, it is in the interest of our company to promote the development of natural gas, together with the development of renewable energy sources.

The two companies are actually involved in different markets, but still, the importance of integration between the two areas appears clear from the interview. In fact, on one hand Edison directly contributes to the European targets of 2020 through its commitment in producing electricity from renewable energy sources. On the other hand, Snam actually supports the achievement of the objectives in different ways, among which purchasing electricity for consumption produced by external companies from renewable sources.

The obstacles found by the two companies in the achievement of the European targets are different, due to the different nature of their operations, but actually recall the ones already analyzed throughout the thesis. Policy uncertainty, generous incentives and increase demand of electricity are issues that have to be strongly tackled by regulators in order to be resolved. Despite this, the future perspective is synthesized in a common point of view among the two managers.

The development of renewables is in fact seen as a crucial step for the Italian nation to recover from the crisis, as it represents a significant source of profits for companies and of work opportunities for employees.

6. Conclusion

The path towards Europe's decarbonisation is still long and full of obstacles. One of the fundamental issues deals with the want of the majority of member states to avoid losing the sovereignty on important matters that directly involve and influence a nation's economy, wealth and power. Despite this, as history teaches, the choice, and more importantly the benefits, of being member of a community comes at the cost of losing independence to certain extents: in the past this involved national currencies, in the present this involves the struggle against climate change, and perhaps in the future might involve up to a certain point the political authority. In this panorama Italy is adequately contributing in fulfilling the European objectives. The target of renewable energy sources will probably be achieved by 2020, driven by the development of renewables from electricity generation, which aim at contributing by more than the initial objective of 26,4%, reaching a share of 30% in electricity production, at least to what the Italian minister of the environment Corrado Clini declares. Actually, the draft of the National Energetic Strategy published on Quotidiano Energia on September 7th, 2012, estimates renewable electricity to reach a share of 38% by 2020, becoming the first source of electricity, and reducing by 10% the use of fossil fuels.

The fulfillment of the European targets must not be viewed as a sterile duty, but as a great chance to recover from the economic crisis from a 21st century perspective, and not with a 19th century mentality. Renewables have created 120 thousand jobs in 2011, and the trend is increasing. They represent a significant instrument to reduce energy dependence from foreign countries: the achievement of European objectives would decrease Italian energy dependence by 17%.

Once the grid parity with respect to conventional energy sources will be met, renewable sources will ramp up. Obviously, in order to create the conditions for a green revolution, policy makers must offer their support, both at national and European level. Relevant obstacles for the development of renewable sources are present and significant, and the challenge is to find innovative solutions to fix them, not to give up at the first hurdle. The present society demands for a high quantitative of energy to be available for use everywhere and anytime, and surely some renewable sources aren't still able to fulfill such need. Moreover, some of these sources have still a relevant impact on the environment; hence the focus must be that of minimizing renewable energy sources to render them sustainable.
The future seems greener for Italy, and perhaps it's not by chance that the color *green*, according to Greek mythology, represents hope.

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