Renewable Energy Assessment in Italy and Brazil: An economic and Political Comparison

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Abstract

The aim of this study is a comparison among Italian and Brazilian electrical energy system with a particular focus on renewable energy sources. The energy sector has a key role in the sustainable development of a country, so it influences economic and political choices. The work would underline differences, common point among two country, specially, in this particular socio-economic period and it should emphasize that green economy could be a possible answer to financial crisis. The main purpose of this study is a presentation of Italian and Brazilian energy system with a particular focus on renewable sources. The energy sector has a key role in the sustainable development of these countries and it could influence economic and political choices or their economic climb. The work will be divided into four sections: Section I will introduce all details of the question; Section II will explain the renewable assessments or the countries, Section III will talk how renewable energy investment could be for economic crisis and the last section will show final conclusions.

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Keywords: energy policy, renewable energy, solar, economic, sustainable.

1. Introduction

The idea of economic growth has dominated politics and policies since 1945. Environmental concerns and sustainable development were introduced at a later time. Expectations of win–win, sustainable growth through technological(Schneider et al. 2010) and efficiency improvements, have not been fulfilled. The present economic crisis opens up a social opportunity to ask fundamental questions.

The energy assumed a central role in human life since the ancient time because the economic progress developed thanks to an idea of deranged use of available resources like water, energy or land (Mathiesen et al. 2011).

An immediate consequence of the financial crisis that shook the large majority of countries is the reduction of economic activity and increased unemployment. Since economic activity is closely linked to energy consumption, it is expected that the quantity of energy consumed will also decrease. At first glance this seems to be good news: with lower demand, prices should fall, as occurs when stores offer sales.

The Paris Agreement on climate change, which entered into force in November 2016, is at its most recent heart an agreement about energy (IEA - International Energy Agency 2011). Anyway, political and economic crisis influenced the global energy markets, so the aim of this paper is a presentation how their knowledge is essential to define a future energy programs. The description is based on the study of two different Country: Italy and Brazil, as far for their geographical but so close for many common points.

As regards climate change and environmental-energy programs, Italy as a member of the European Union was a signatory to the United Nations Framework Convention on Climate Change (International Energy Agency 2010) (UNFCCC) and to the Kyoto Protocol and on October of 2016 Italy ratified the Paris Agreement. In fact, already in the past, Italy has implemented a number of sectoral and cross-sectoral policies to have a direct or indirect effect on the reduction of greenhouse gas emissions. Legislation introduced to improve the energy performance of buildings, strengthening their thermal demand requirements. These include compulsory standards for new buildings and renovation of older buildings.

After less than a year since its signing, Brazil has officially validated the Paris Agreement at the national level. This was

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an essential step because Brazil, one of the world's biggest greenhouse gas emissions (GHG) emitters, has a fundamental role in this scenario. The INDCs (Intended Nationally Determined Contributions) submitted by the country set an absolute emission reduction of 37% until 2025 and 43% until 2030, having as base 2005 levels. Figure 1 shows a comparison between Italian and Brazilian CO_2 emissions' trend.

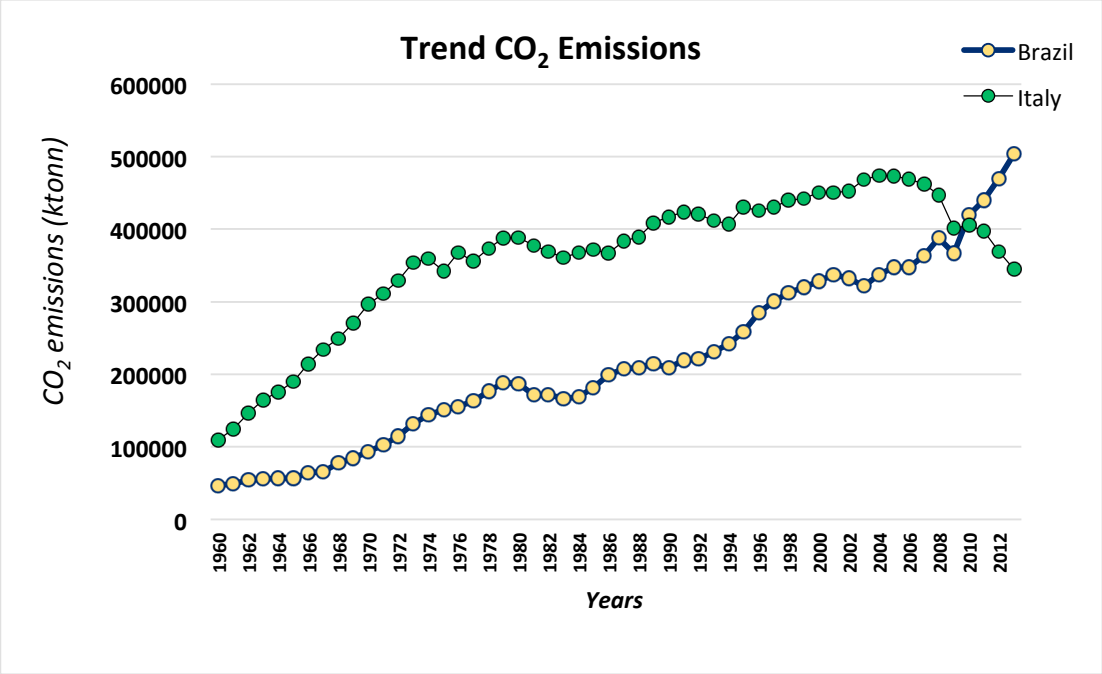

Fig. 1: Comparison of CO_2 emissions (period 1960-2012) (Data from http://resourceirena.irena.org)

Remark that figure 1 represents data until 2011, year that signs economic slowdown for Italy but growth for Brazil.. Connected to CO_2 emissions and political actions to fight global warming, it is interesting to evaluate climate variation in the time, considering actual and past data.

The monthly mean historical rainfall and temperature data show the baseline climate and seasonality by month, for specific years, and for rainfall and temperature.

Figures 1a and 2b display mean historical monthly temperature and rainfall for Brazil and Italy during the period 1900-2012. The dataset was produced by the Climatic Research Unit (CRU) of University of East Anglia (UEA).

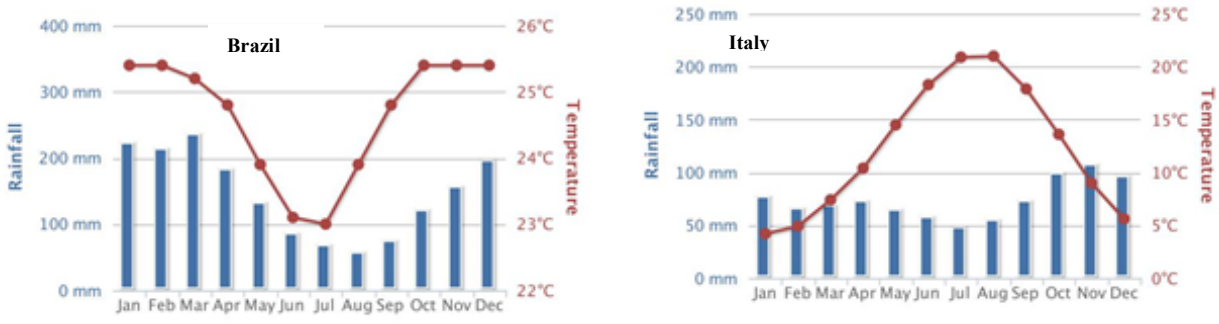

Fig. 1:Mean historical monthly temperature and rainfall (1900-2012) a) Brazil and b) Italy (Data from http://sdwebx.worldbank.org/climateportal/)

According these data, a significant amount of rainfall characterized Brazilian climate and influenced hydropower generation in Country. The next sections will explain all renewable energy sources available in the two countries and the financial effects that turned out.

2. Renewable energy study in Italy

Italy is a large mountainous country and runs from Alps to Mediterranean Sea. Its surface is 300.000 km^2 and we find some islands like Sicily, Sardinia and other small islands. Italy has almost 59 million inhabitants of whom 22 million are in active employment. The country is divide into 20 independent regions and all of which are part of the constitutional structure of State. Italy was a founding member of the European Union and is part of the G8 group of countries. It enjoys a GDP per capita just above the European average. It has developed a framework to implement an energy market policy that is consistent with European requirements. The Table 1.1 recaps all principal information(GSE 2016.).

Tab. 1: Italian General Information

General Data	
Inhabitants	60.6 [million]
Surface	301.340 [km^2]
Density	200 [ab/km^2]
Gross Domestic Product	30.527,27 mln $US

Italian energy sector is strong dependent on foreign energy markets and electricity generated from thermal generation. Specifically, Italy produces small volumes of natural gas and oil but most fossil fuels are imported and augmented by local production of energy from renewable sources.

European Government imposed that by 2020, the renewable energy should account for 20% of the EU's final energy consumption so to meet this shared target, each member state needs to increase its production and use of renewable energy in electricity, heating and cooling, and transport. In 2015 renewable energy production (only electrical) was been of 106.686 GWh thanks to a large contribution of hydropower and solar plant. Figure 3 shows an evolution of electricity generation from 2000-2014 years.

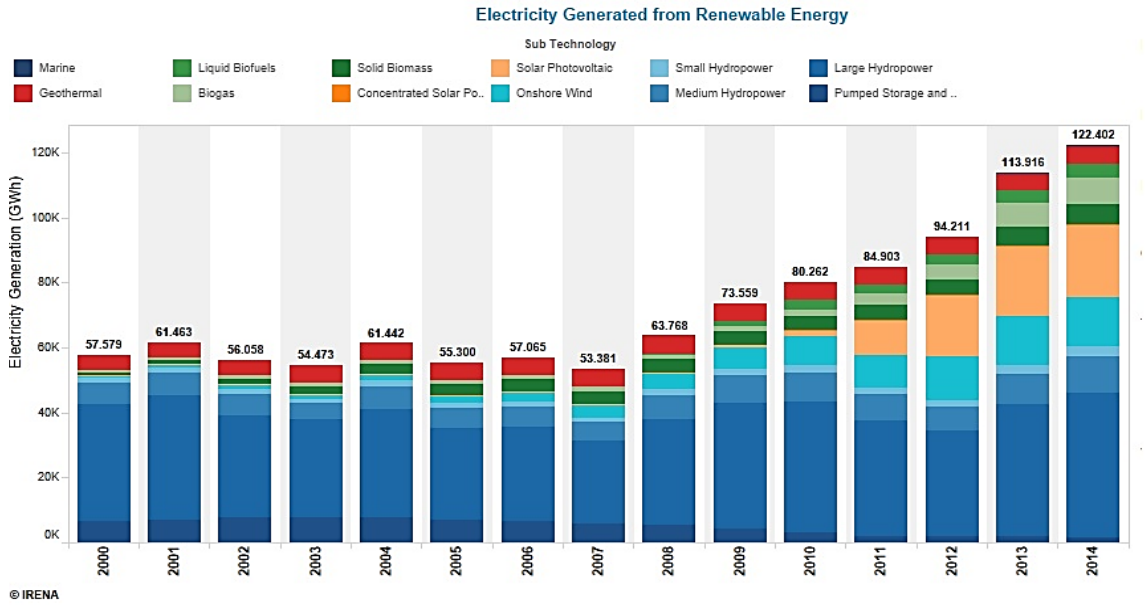

Fig. 3: Italian Electricity Generation from RES (renewable energy system) (Data from http://resourceirena.irena.org) (Data from http://resourceirena.irena.org)

The installed power at the end of 2015 is 51,475 MW and represents a little increase respect to the previous year thanks to the installation of new wind farms and photovoltaic plants. Between 2002 and 2015, the gross efficient power installed in Italy changed from 19,221 MW to 51,475 MW, an increase of 32,254 MW and an annual average growth rate of 7.9% overall power; The years 2011 and 2012 are characterized by higher power. Figure 4 shows RES plant installed between 2002-2015 (GSE 2016).

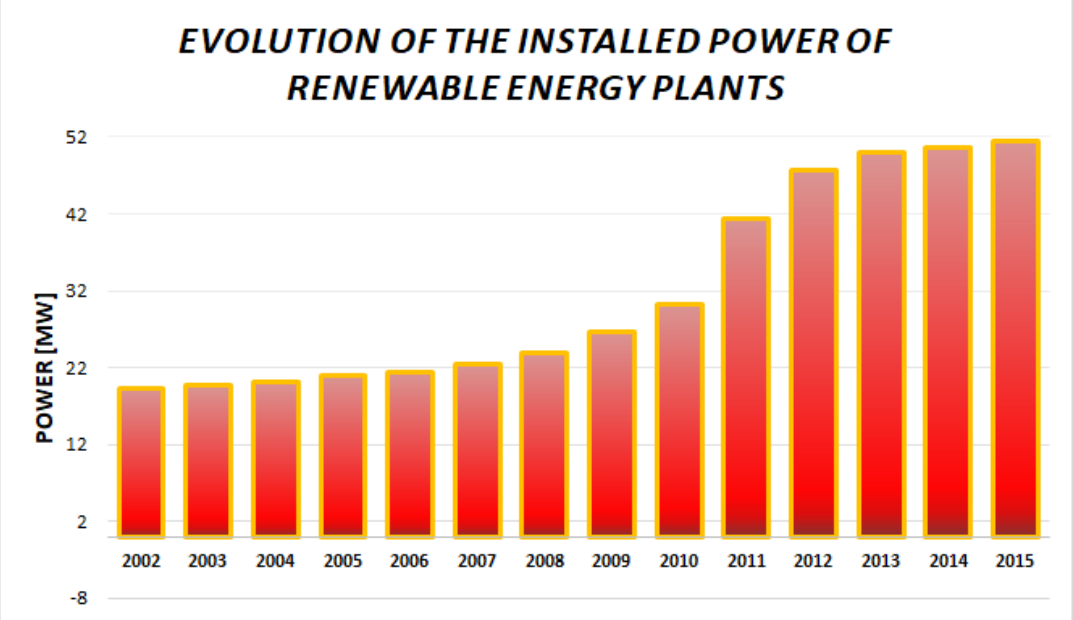

Fig. 4: Trend of the installed power of renewable energy plants.

Electricity demand 2016, equal to 314.3TWh (-0.8% by 2015), was met for 88.2% by national production (277.2TWh: + 2.5% by 2015) and for the remaining quota from net imports from abroad (37.0 TWh: -20.2% by 2015). National production recorded a substantial increase in the thermoelectric component and a substantial reduction in hydroelectric power. Renewable production is down due to the reduction in renewable hydroelectric production and, for the first time, of photovoltaic. Three counterproductive sources: wind, bioenergy and geothermal power generation.

Consumption is down 0.6% compared with 2015 and is 295.5TWh. The distribution by industry shows an increase in industry, a substantial stability of the attested service and a decline in both the domestic and the agricultural sectors. In terms of power installed, at December 31, 2016, the gross efficient generation power was 117.081MW, down 2,960MW (-2.5%) compared to 2015. This phenomenon is due to discharges in the thermoelectric park, increasing the capacity of renewable sources such as photovoltaics, wind and hydroelectric power (GSE 2016).

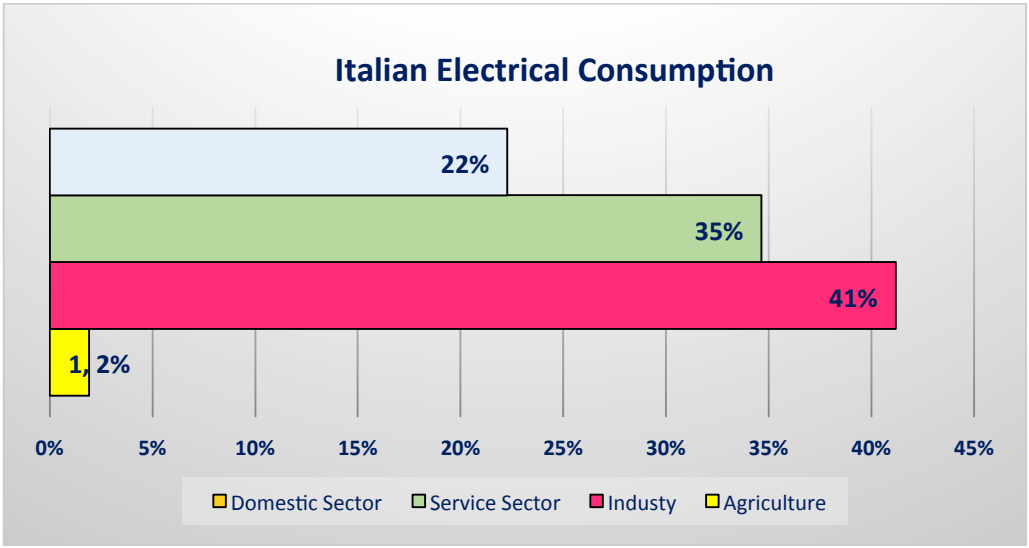

Fig. 5: Electrical consumption for year 2015.

3. Investigation on Brazilian energy sources

Brazil, officially the Federative Republic of Brazil, is the largest country in both South America and Latin America. As the world's fifth-largest country by area and sixth by population, it is the largest country to have Portuguese as an official language and the only one in the Americas. Brazil is one of the states with the best performance of economic development. It is part of the so-called BRICS (Brazil, Russia, India, China and South Africa) namely Countries that in recent years, and probably in the near future, recorded the highest rates of economic growth. The government plays a substantial role in the Brazilian electricity sector. Until the 1990s, the government controlled the electricity sector almost completely(Hira & de Oliveira 2009; Da Silva et al. 2005).

Tab. 2: Brazilian General Information

General Data	
Inhabitants	207.8 [million]
Surface	8 514 877 [km^2]
Density	23 [ab/km^2]

Fig. 6: Brazil GDP (2008-2016)

In 2004, the Brazilian government implemented a new model for the electricity sector. This hybrid approach to government involvement splits the sector into regulated and unregulated markets for different producers and consumers. This approach allows for both public and private investment in new generation and distribution projects.

As for conventional source, the thermoelectric generation, above all, coming from natural gas, and for oil reserve, EIA estimates that Brazil had 13.2 billion barrels of proved reserves, the second-largest level in South America after Venezuela. More than 94% of Brazil's reserves are located offshore, and 80% of all reserves are found offshore near the state of Rio de Janeiro.

Regarding renewable sources, Brazil is one of the countries with the highest contribution of renewable energy; in fact the main considerable are: water resources and biomass. The percentage of renewables in the energy mix has been increasing over time and is expected to increase further to rise from 42.4% to 47% of the domestic total Brazilian in 2030, as required by the National Energy Plan (PNE). The hydroelectric potential in Brazil is among the top five in the world: the country has nearly 20% of the planet and has approximately 11% of global hydropower production. The use

of hydraulic source comes from1883.

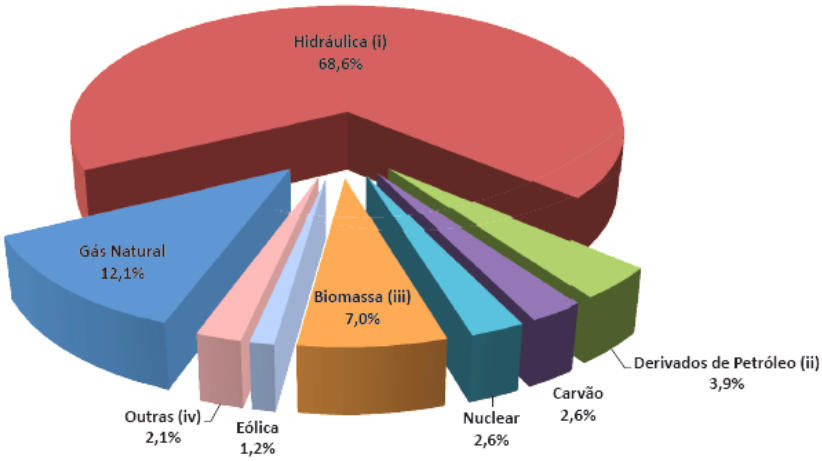

Fig. 7: Renewable and conventional sources

The exploitable hydropower potential is still estimated about 250 GW of installed power. Most of this potential is localized in the Amazon basin, while the north areas aren't still used. Hydroelectric plants are about 70% of the total electrical capacity installed in Brazil, amounting to 84 GW. Of these, approximately 14 GW are produced by Itaipù, built in Parana River on the border between Brazil and Paraguay; production values are split 50% between the two countries. Currently Itaipù hydroelectric plant produces about 90 to 100 TWh per year; the unused part of the production from Paraguay to Brazil is counted as the import of electricity. The Brazilian wind potential is estimated at about 350 GW14, concentrated mainly in northeast areas of country that is characterized by a high wind. There are 986 square kilometers of sand dunes with strong winds in the coast of Rio Grande do Sul. Another promising region is Minuano. A for solar energy, Brazil is a privileged country regarding solar irradiation.

However, exploitation of this resource is still insignificant because there are installed only 26 MW. The average energy conversion from photovoltaic systems is very interesting: the annual solar radiation is at its maximum value (approximately 2,300 kWh / m2) in the semi-arid northeast regions while the minimum (about 1,100 kWh / m2) in the northwest and southeast area. Figure 8 describes power installed in the period 2005-2016.

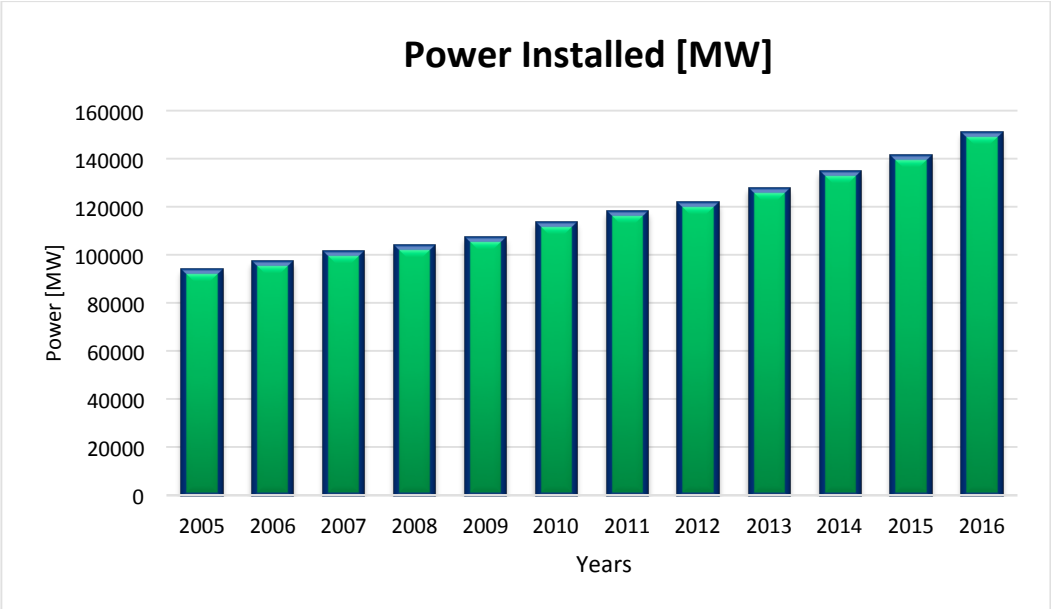

Fig. 8: Renewable energy plant installed in Brazil.

4. Economic impacts of renewable energy industry

In developing countries, where per capita consumption is relatively small, energy efficiency alone will not resolve the problem, because in many cases the final energy services (lighting, heating, cooking etc.) are still insufficiently available. Thus, global production and consumption of energy must increase to fulfill this repressed demand(IRENA 2017).

In this field, the renewable energies (such as wind, solar, biomass and small scale hydropower) will have a major role to play. Not only are these energy sources less polluting, but by their nature, are produced in small units. The decentralization of energy production leads to increased supply security and the creation of jobs. For example, this occurs in the production of ethanol from sugar cane in Brazil. The production of ethanol generates 4 – 21 times as many jobs as those needed to the produce the equivalent amount of energy from oil. For the same quantity of electricity, the number of jobs generated with wind energy is nearly 100 times greater than that generated by nuclear. The 120 GW of installed capacity in wind turbines throughout the world produce 260 TWh of electricity and avoid the emission of 158 million tons per year of CO2, which would occur if this energy was produced from fossil fuels. This is a market of about US $ 48 billion, which creates some 400,000 jobs (as shown in figure 8).

As for Europe, the wind industry remains one of the mainstays of the renewable energy sector in Europe. Employment declined slightly to 329,700 in 2015 (EurObserv'ER, 2017). Germany was the leader in wind jobs with 43% of the total in the European Union, followed by the United Kingdom, Denmark, Italy and France. The European solar PV industry continued to see a fall in employment in 2015. At 114,450, it has lost two thirds of jobs since 2011. Germany, the United Kingdom, France, and Italy are the leaders, with 67% of the European PV jobs in 2015. If we consider the huge potential of renewable energy sources for Brazil and Italy, more investments may cause an increase of the jobs in this sector.

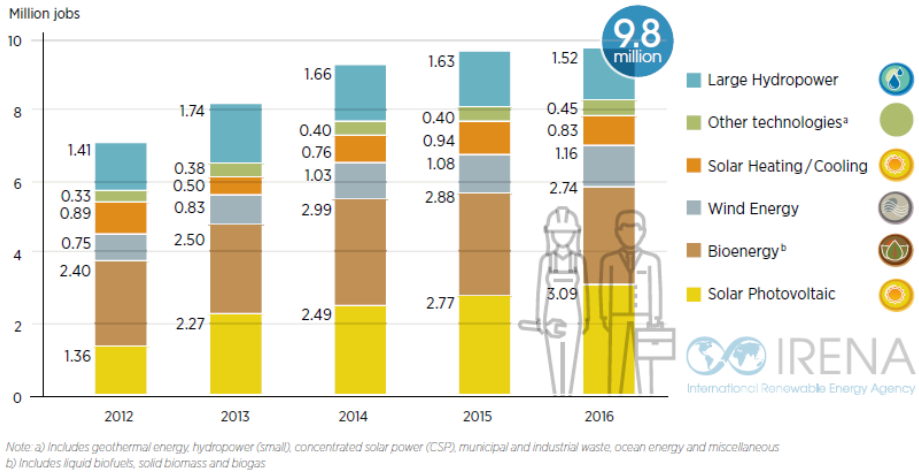

Fig.9: Global renewable energy employment

5. Conclusion

In conclusion, this paper gives information about energy supply in Italy and Brazil, focusing on the renewable energy sector.

The first part of the work describes a brief energy summary for Brazil and Italy in terms of capacity installed and electrical consumption. Furthermore, many international researches underline that the market for renewable sources grows and the financial crisis may be an opportunity. The presence of a stable, favourable policy framework continued to be a key factor for renewable energy job creation. New wind power installations in the United States, Germany, India and Brazil, meanwhile, contributed to the increase in global wind employment by 7%, to reach 1.2 million jobs.

Liquid biofuels (1.7 million jobs), solid biomass (0.7 million) and biogas (0.3 million) were also major employers, with jobs concentrated in feedstock supply. Brazil, China, the United States and India were key bioenergy job markets.

Jobs in solar heating and cooling declined 12% to 0.8 million amid an installation slowdown in major markets such as China, Brazil and the European Union. Large hydropower employed 1.5 million people (direct jobs), with around 60% of those in operation and maintenance. Key job markets were China, India, Brazil, the Russian Federation and Vietnam.

Differently for Italy, according to EurObserver data, employment in renewables in Italy has even declined from 121,850 occupied in 2011 to 97,100 in 2015, a less than 20%. A plausible explanation is that Italy's growth in renewables sector is reduced to minimum because in the electricity sector invested a significant share of incentives.

In conclusion, the investment in sustainable energy sector can be a correct politic choice to improve programs thus it may be an attractive opportunity and challenge for the future.

6. References

GSE, Energie rinnovabili al 2020 Scenari tendenziali.

GSE, 2016. La valutazione delle ricadute economiche e occupazionali dello sviluppo delle fonti energetiche rinnovabili in Italia. Gestore Servizi Elettrici - Unità Studi, Statistiche e Sostenibilità. , p.39.

Hira, A. & de Oliveira, L.G., 2009. No substitute for oil? How Brazil developed its ethanol industry. *Energy Policy*, 37(6), pp.2450–2456.

IEA - International Energy Agency, 2011. *Solar Energy Perspectives*, Paris: OECD Publishing.

IRENA, 2017. Renewable Energy and Jobs: Annual Review 2017. , p.16. +

Mathiesen, B.V., Lund, H. & Karlsson, K., 2011. 100% Renewable energy systems, climate mitigation and economic growth. *Applied Energy*, 88(2), pp.488–501.

Schneider, F., Kallis, G. & Martinez-Alier, J., 2010. Crisis or opportunity? Economic degrowth for social equity and ecological sustainability. Introduction to this special issue. *Journal of Cleaner Production*, 18(6), pp.511–518.

Da Silva, E.P. et al., 2005. Analysis of hydrogen production from combined photovoltaics, wind energy and secondary hydroelectricity supply in Brazil. *Solar Energy*, 78(5), pp.670–677.