

STUDY ON WORLDWIDE RENEWABLE ENERGY EXPLOITATION

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Abstract: This paper presents in an original manner, gradually, the current market issues and factors that determine electricity use and large scale integration of renewable energy sources. We carried out a systematic bibliographical study on the current state of the global use of renewable energy sources and highlighted the main issues that define the wind as the main source of renewable energy in terms of investment and integration in the electricity.

Keywords:renewable energy sources, wind, solar

Introduction. To get a clear image on the share of electricity produced from worldwide renewable energy sources and its trend, we have analyzed the status of electricity net production as well the consumption for the entire world.

Looking back and analyzing the evolution since 2006, the situation would be as in the figure below [6]:

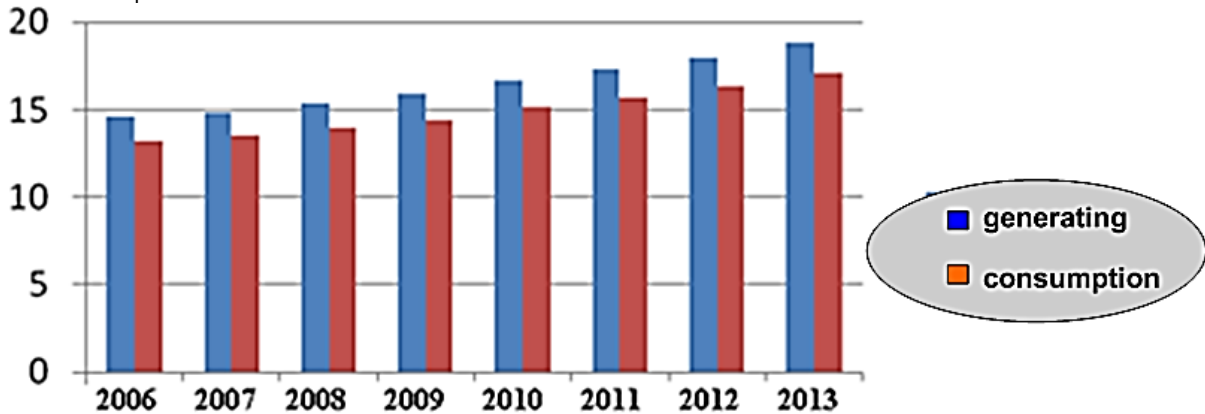


Fig. 1.The worldwide electricity net production and consumption [TWh]

Obviously, the both components: the energy production and consumption are growing. Since 1990, increased electricity exceeded the electricity consumed (2.9% vs. 1.9%). According to the values of IEO2009 study [3], the projected growth for the period 2006-2030 is 2.4% per year (Figure 2). Therefore in the year 2030, the amount of energy produced will be 31.8 TWh. However, this value is expected to be lower, but not very much, because of economic crisis. The value is influenced only by demand from the industrial sector. In the domestic consumption, the values does not change regardless of the economic situation.

As regards, the situation in Europe, predicted by VGB Power Tech [11], until 2020, the gap between electricity demand and its production capacity in Europe will reach 300,000 MW, as increasing demand for electricity as well installed capacity decommissioning, due to the age. The mix of primary energy used for electric power generation was changed significantly in recent decades. Even the coal is the main fuel used for electricity generation, in recent years a rapid growth was observed in the use of natural gas and nuclear fuel.

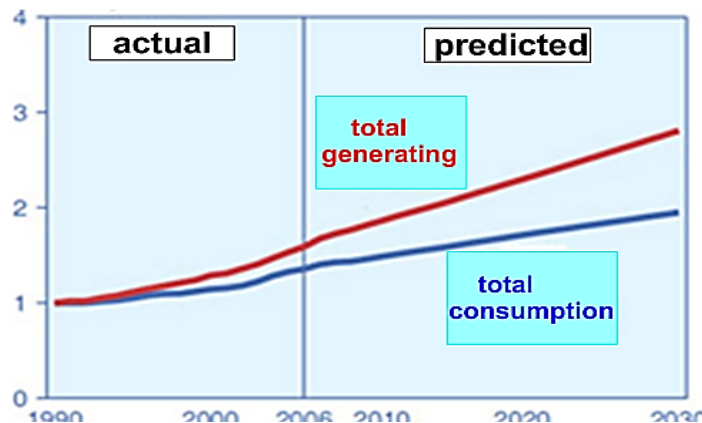


Fig. 2Worldwide electric power generation and consumption 1990-2006-2030 [6]

Moreover, oil use is decreasing due its price instability (especially in periods 2003-2008 and 2014-2015). Figure 3 shows the primary energy balance forecast for 2030 in the EU [6].

At the European energy policy level, the major objectives consist in secure supply of electricity, competitive energy

systems and environmental protection. Increasing dependence the EU's on foreign sources of energy, climate change and liberalization of energy markets, emphasized the importance of secure supply of electricity.

For these reasons, at European level and worldwide, the competent bodies presents renewable energy as having a leading role on energy security.

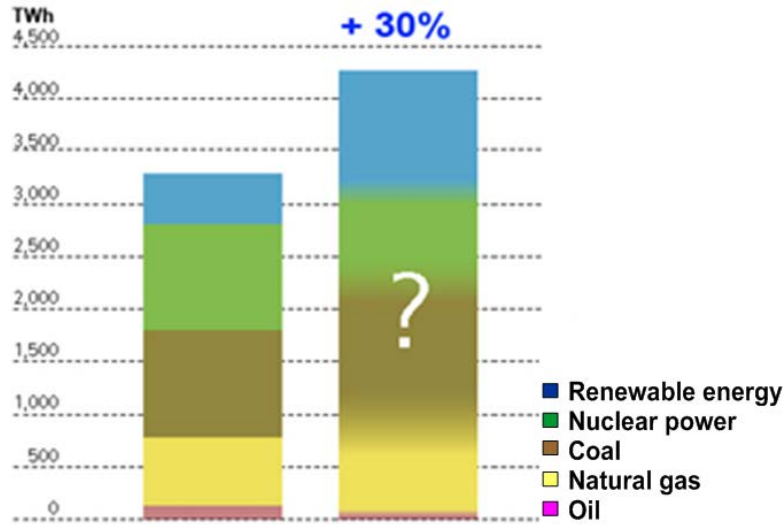


Fig. 3 The primary energy mix in the EU (2006-2030) [6]

The values of electricity produced from renewable sources are still small, but in an accelerated increase. One remarkable thing is that, in 2008, the installed capacity in new plants using renewable sources (US and EU) exceeds the conventional power plants (with fuel as coal, oil or nuclear).

Table 1 shows that, over a few years, renewable energy sources, excluding large hydropower plants, have doubled their contribution to electricity. [6]

Table1. Evolution of global electricity produced from renewable energy sources

| Year | Renewable energy with large hydropower plants [TWh] | Renewable energy without large hydropower plants [TWh] |
|------|---|--|
| 2006 | 2.86 | 0.24 |
| 2007 | 2.81 | 0.25 |
| 2008 | 2.88 | 0.28 |
| 2009 | 2.91 | 0.30 |
| 2010 | 3.11 | 0.33 |
| 2011 | 3.26 | 0.37 |
| 2012 | 3.41 | 0.41 |
| 2013 | 3.47 | 0.47 |

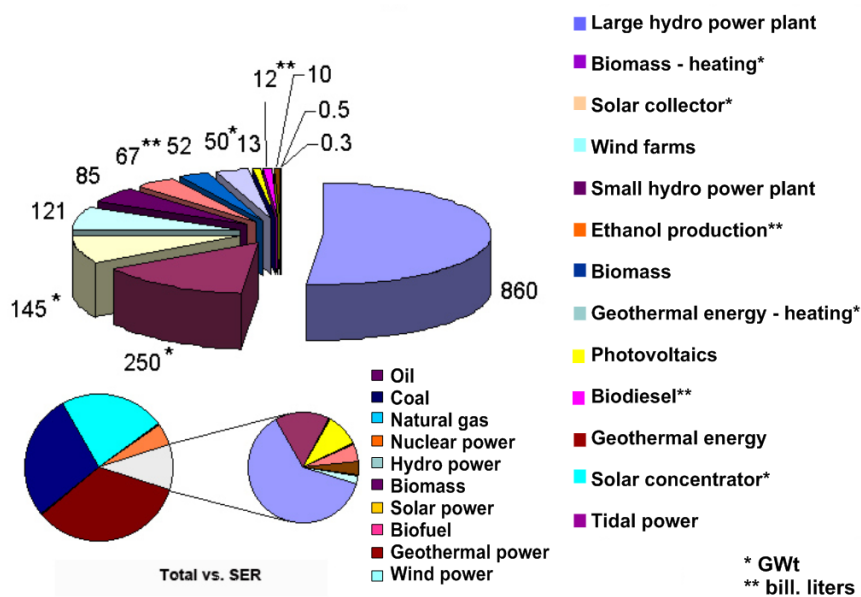


Fig. 4. The weights of worldwide installed power

Figure 4 shows the distribution of installed capacity by source of energy used (in the year 2013). The market for renewable energy sources has increased in recent years. In particular, this increase was due of more wind

farms and photovoltaic cells and, of course, the large and small hydroelectric plants.
The renewable energy exploitation.

Wind power comes from wind energetic potential converted by wind turbines in electric power. Technological developments in this field determined the appearance and use on market of increased power turbines. If the usual values of rated power for a turbine is between 1-2 MW, today's most advanced can generate 5-6 MW.

The installed capacity in wind farms has increased by nearly 30% over 2013, reaching 121 GW, practically, doubled compared to 2008. The most important countries in terms of installed wind power are shown in Figure 5 [10].

While in some countries this growing trend of using wind to produce electricity was common, however, are noted some countries that have managed to double its installed capacity for the fifth consecutive year and short of its target at two years (China) or other (less developed) which came into force on market: Mongolia, Pakistan, Kenya etc. Regarding offshore wind farms (located offshore), installed capacity was 1.5 GW at the end of 2008, most of these plants being present in Europe. Leader in this regard remains the UK.

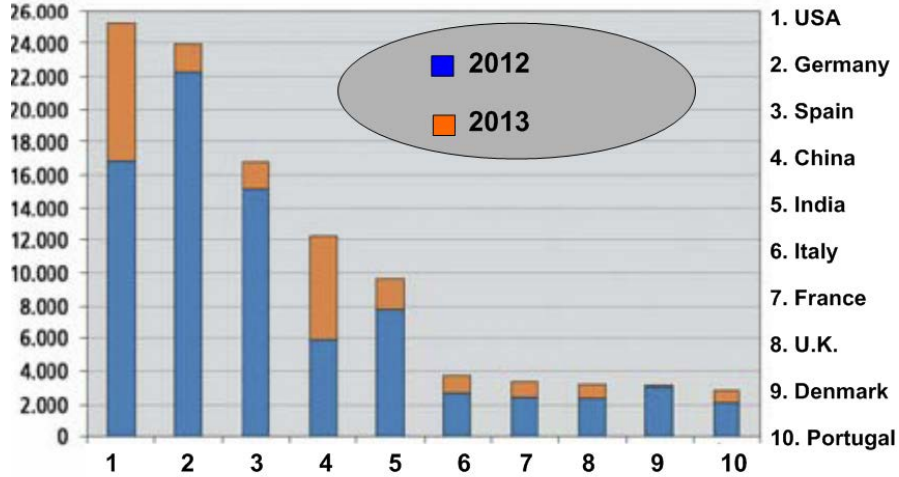


Fig. 5 Top10 installed wind power countries[MW]

Across the globe, 1.5% of consumption is ensured by energy produced from wind power. However, there are countries with a significant level of penetration for wind energy, example Denmark, where a fifth of the electricity comes from wind turbines.

High power wind turbines are connected to the transmission network, with equipment and control systems to fulfill the technical standards imposed by the system operator and to ensure network stability. The largest installed capacity in are found in the US plants (500 MW / plant). Smaller wind farms are connected to the system, providing excess energy on the market or disconnected, producing energy only for the owner.

Hydropower remains the main component of renewable energy. The plants that are using this type of energy are grouped into two categories depending on the

installed power: mini and small hydro (less than 10 MW, in US under 30 MW) and large hydropower plants (over 10 MW). Worldwide, the installed capacity exceeds 850 GW, producing 3,000 TWh. This amount represents 20% of global electricity and 88% of all renewable energy sources.

Three Gorges Dam complex in China remains the largest hydroelectric plant in the world as installed capacity (over 21,000 MW) and the energy produced (about 100 TWh). Although the number of large hydroelectric world is very high, the trend of investment in this segment is declining, the market focus moving to mini and micro grids, as an important part of Distributed Generation – DG. Small hydropower grids reached an installed capacity of 85 GW, with substantial development especially in Asia and Africa.

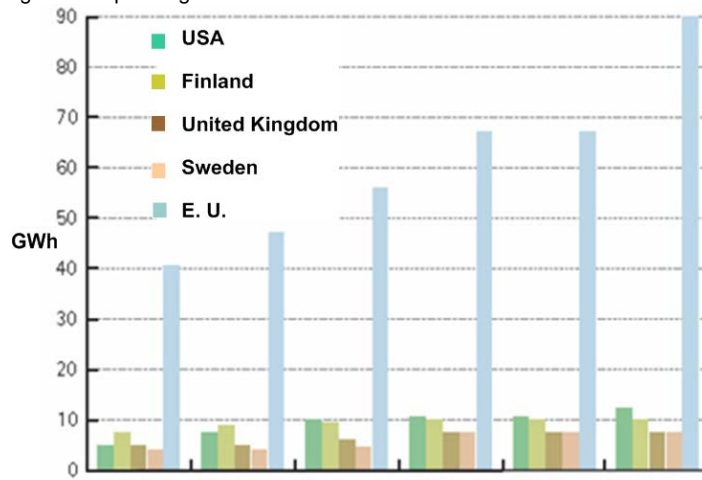


Fig. 6 The electricity generated using biomass

Large hydropower plants had an increase of about 30 GW, high values was recorded particularly in China and India. The use of **biomass** has a large spread in the world and is the main source of energy for cogeneration. It represents a biodegradable fraction of products, waste and residues from

agriculture, forestry and related industries as well as industrial and urbane wastes. The installed capacity worldwide has reached 52 GW value. Countries with the highest use of biomass are all in Europe: Finland, France, Germany, Italy, Poland etc. However, countries as: Brazil, Philippines,

Argentina, China, India are increasingly use more biomass and biogas together. Evolution of electricity generation from biomass is shown in Figure 6
 Solar energy from the solar radiation is mainly used for electricity production based on photovoltaic technology. Also,

using concentrators and other technologies, this energy can be used to obtain thermal energy.
 Connection of units that use photovoltaic panels is growing. Only in 2013, the increase was between 70% to 13 GW, which determined a six times value, higher than in 2008. In Figure 7 we present the evolution of installed PV power.

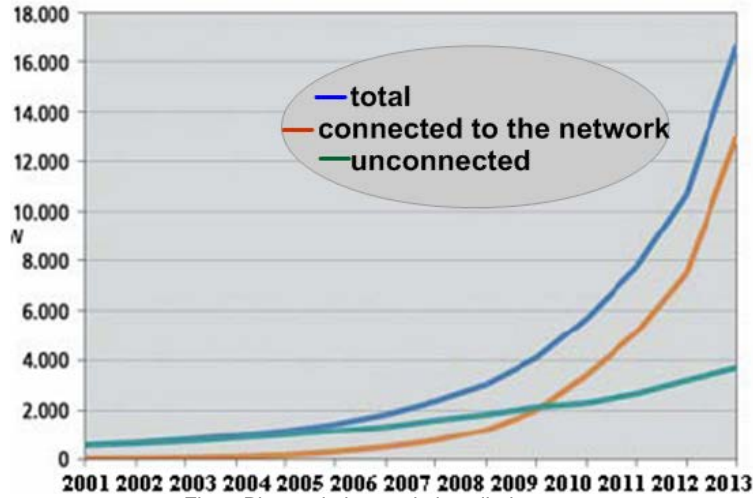


Fig. 7. Photovoltaic panels-installed power

Leader in terms of installed capacity and connected to the network is represented by Spain with 2.6 GW, followed by Germany and the USA. Also important increases are found in Australia, Japan, South Korea and France.

There are the three major directions of development on the use of photovoltaic panels. First of all, considering their integration into new built houses (BIPV - Building Integrated Photo Voltaics), installed capacity in Europe reached approximately 28 MW. A second direction is the increased level of thin-film photovoltaic panels made of semiconductor material, sprayed directly onto the glass, characterized by a very high efficiency at low cost.

One last important direction is the construction, on large-scale, of solar power plants greater than 200 kW, their number being about 1800. The installed capacity is about 3 GW, Spain is the undisputed leader with 1.9 GW, followed by France and Germany. Olmedilla de Alarcon plant in Spain with an installed capacity of 60 MW is the largest facility of its type in the world. The investment made in renewable energy in 2008, about 120 billion, is another evidence of increased interest in renewable energy. Divided by type of energy, most of the funds were used for plants using wind energy (42%) and PV (32%). Compared to other countries, the US is the leader (20% of total investments), followed by Spain, China, Germany and Brazil surprisingly or not. Much of the investment were due, also, by private investors. The banks have continued to support the advantageous loans for renewable energy projects. A leading position is occupied by European Investment Bank, with 2.2 billion [1].

Support from various governments and organizations in various projects was significant. Even in the economic crisis, the value of investments in this sector did not declined. In the last period of crisis, as a countermeasure and economic stimulus, but also to encourage the development of new jobs, many governments have announced the increase of public funding and financial support for projects that are using renewable energy and green technologies, ie low carbon emissions. For example, the US makes available to stakeholders USD 150 billion over 10 years, while neighboring country to the west, Hungary, offering 250 million euros for 7 years.

One of the industries with the highest rate of growth is the photovoltaic panels. The world leader is currently China (production of 1.8 GW), surpassing Japan, Taiwan also USA. Related to technology, the US is the world leader in the production of thin-film panels (270 MW) while the production of

such panels for one year increased by 120%. Even during the economic crisis at the end of 2008, the photovoltaic cell production totaled 8 GW, of which 1 GW represents thin film technology and investment value remains high despite of economic instability.

Wind turbine manufacturing industry has the most prominent representative in China, with around 70 manufacturers of turbines and other equipment. However, the main turbine manufacturers worldwide are Vestas (Denmark), GE Wind (USA) also Gamesa (Spain). The top 10 producers are responsible for about 80% of the turbines produced in the world.

The great interest on the use of renewable energy sources for electricity production was largely due to regulations on environmental protection, reduce carbon emissions and the use of renewable energy policies adopted both regionally and globally.

The first step to achieving the goals of limiting environmental pollution was made by signing the Kyoto Protocol in 1995 [7]. According to him, industrialized countries are required to limit or reduce emissions of greenhouse gases (CO₂, methane, industrial gases etc.). Reducing emissions must be made by 5% below the level of the base year (1990) during the first commitment period, i.e. 2008-2012.

The protocol entered into force until February 16, 2005, ratified by 187 countries, including EU members. By ratifying this treaty, the European Union proves the approach with maximum responsibility to environmental issues, becoming a world leader in promoting clean technologies.

One of the acts with great importance are represented by the European Directive 77/2001 / EC. "Promotion of electricity produced from renewable energy single market" [EC / 77/2001] provides doubling the contribution of renewables in total gross energy consumption in EU countries from 6% to 12%. by 2010. Another objective of the Directive is to increase the contribution of renewable energy from 14% to 22% of gross electricity consumption, all by 2010. The body for monitoring the implementation of the Directive is the European Commission.

In order to achieve these targets, governments should not remove any fuel source or technology option. Both nuclear power, hydropower also carbon capture and storage must remain in focus, with the available technologies for renewable energy.

For 2020 it is desirable that the contribution of renewables to the total energy consumption should be 20%. To do this,

electricity from renewable energy sources have to represent 34%.

To achieve these objectives, the Directive requires states member a series of measures to encourage the production of electricity from renewable energy sources and creating facilities for businesses that exploit such resources:

- setting a target for each country, for consumption of electricity produced from renewable energy sources;
- introduction of financial support schemes for renewable energy production;
- simplification of administrative procedures for projects that exploit renewable energy sources;

- guaranteed priority access to the transmission and distribution of electricity from renewable sources of energy;
- guarantee the origin of electricity produced from renewable energy sources. As mechanisms to promote renewable energy sources can be distinguished:
- aid for investment;
- direct support prices for each type of renewable energy sources;
- support for research and development;
- indirect help for differentiated develop, by type of renewable energy sources.

Conclusions

In the context of recent years, analyzing the evolution of energy markets and economic factors, political and environmental conditions that influence this evolution, the main requirements on energy can be summarized as: energy is clean, safe and available to all and the price be competitive.

Under these aspects, providing energy security also the development of society, shall involve two areas: increased efficiency in the use of fossil fuels (coal remains under the main fuel) and the extensive use of energy from renewable sources.

The widespread use of renewable energy represents the main direction that is followed since it determines increase of the energy security, for the present day and especially for the future.

From the multitude of renewable energy sources, even in fairly large initial costs, wind power presents the highest rate of integration and actual use in the electricity, following hydropower plants.

Systematic presentations of renewable energy sources comprised the definition of renewable energy, also, particular aspects that define each source, and the current state of their worldwide use. The particular aspects were presented for the use of renewable energy sources within distributed generation technologies, in distribution networks

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