

## **ANALYSIS OF THE RENEWABLE ENERGY POTENTIAL IN ROMANIA AND ENVIRONMENTAL IMPACT MANAGEMENT**

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### **ABSTRACT**

*This paper stresses the necessity and possibility of using renewable energy because fossil fuel reserves are expensive and depleting. The ultimate goal is to reduce pollution and ensure some energy independence. It also presents the current situation and development of this sector in our country.*

*Renewable resources are a clean and sustainable alternative to obtain energy. In times of rising prices of fossil fuels and the increased efforts to reduce the dependence of imported natural gas, electricity production based on renewable energy is an important option.*

*Renewable resource management is very important because their use can influence the environment and it reduces the land used for agriculture.*

**KEYWORDS:** *Keywords: renewable energy, wind power, solar energy, biomass, fossil fuels*

**JEL CLASSIFICATION:** Q42

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### **1. INTRODUCTION**

In the current context of depletion of fossil fuel reserves, their rising prices and the EU requirements on reducing emissions, the development and use of alternative energy sources has become a priority in Romania.

The use and promotion of renewable energy sources is essential. Their exploitation contributes to environmental protection and sustainable development. According to Directive 2009/28 / EC of the European Parliament and Council to promote electricity generation based on renewable energy sources by the year 2020, Romania will have to produce 20% of all electricity from renewable sources. (Directive 2009/28/EC)

Renewable energy sources in Romania have important theoretical potential. The utilizable potential of these sources are much lower, due to technological limitations, economic efficiency and environmental restrictions. In the table below are shown the main renewable energy sources in Romania.

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**Table 1: The energy potential of renewable energy in Romania**

Energy renewable Source	The potential annual energy	Economic equivalent energy (thousand tep)	Application
<b>Solar energy</b>			
- thermal	60x10 <sup>6</sup> GJ	1433,0	thermal energy
- fotovoltaic	1.200 GWh	103,2	electrical energy
<b>Wind energy</b>	23.000 GWh	1.978,0	electrical energy
<b>Hydropower, of which:</b>	40.000 GWh	3440,0	electrical energy
<b>below 10 MW</b>	6.000 GWh	516,0	
<b>Biomass</b>	318x10 <sup>6</sup> GJ	7.597,0	thermal energy
<b>Geothermal energy</b>	7x10 <sup>6</sup> GJ	167,0	thermal energy

Source: Planul Național de Acțiune în Domeniul Energiei din Surse Regenerabile (PNAER)-2010, www.minind.ro

Regarding the distribution of renewable energy in the figure below describes this potential.



**Fig.1 Map available renewable resources, by region**

Source: Strategia energetica a Romaniei in perioada 2007 – 2020

Legend:

- I. The Danube Delta (solar energy);
- II. Dobrogea (solar and wind);
- III. Moldavia (plains and plateaus - micro hydro, wind and biomass);
- IV. Carpathian Mountains (IV1 - Eastern Carpathians, IV2 - South Carpathians, IV3 - Western Carpathians (biomass, micro hydro);
- V. Transylvania (micro hydro);
- VI. Western Plain (geothermal energy);

- VII. Subcarpathians (VIII - Getici Subcarpathians; VII2 - Curvature Sub-Carpathians, VII3 - Subcarpathians Moldavia: Biomass, micro-hydro);  
VIII. South Plain (biomass, geothermal and solar).

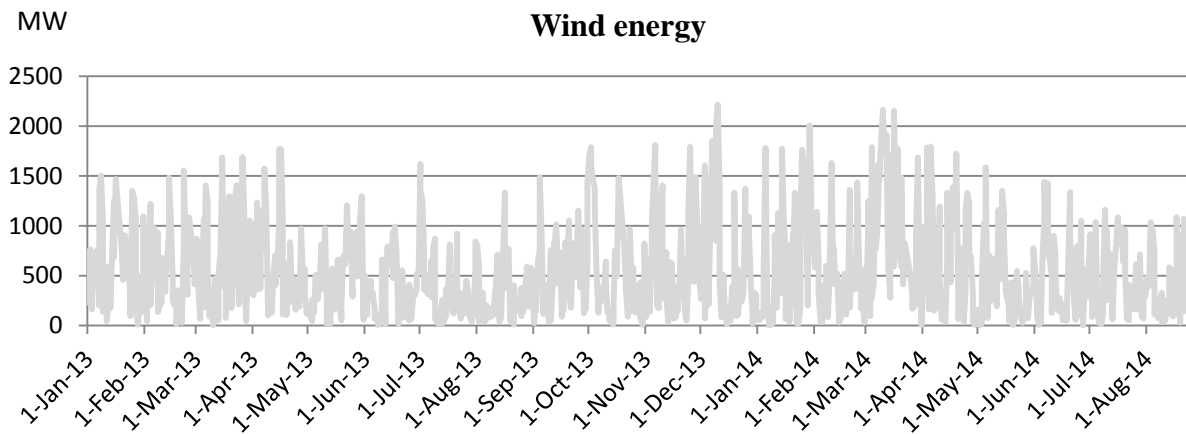
To stimulate the production of renewable energy, Romania has introduced in 2004 a system based on green certificates. Green certificate is a document that certifies renewable energy production of a quantity of electricity. Renewable energy sources eligible for green certificates are wind, solar, biomass, hydro (hydro power plants with a capacity equal to or less than 10 MW), geothermal, wave, and hydrogen produced from renewable energy sources. (Plumb & Zamfir 2009)

## **2. THE MAIN TYPES OF RENEWABLE ENERGY USED IN ROMANIA**

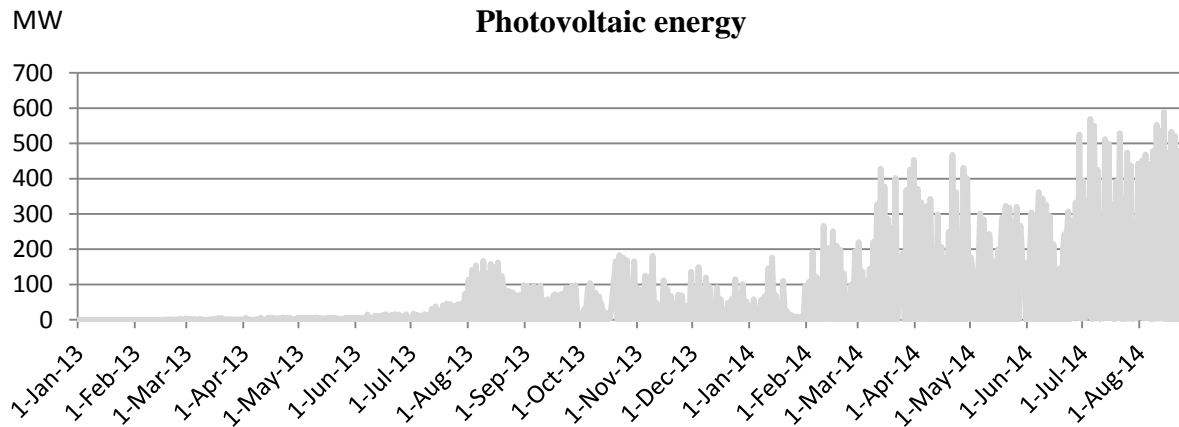
Besides hydropower, the most developed sector in the renewable energy in Romania is the wind. Wind power has greatly expanded in recent years, mainly in Dobrogea - the Black Sea coast, where average wind speed and the less populated areas allow the installation of wind turbines but also in Moldavia. 2012 was the year with the largest increase with an installed capacity of 923 MW, so 5% of all new EU wind energy sources were recorded in our country. The percentage is very high if we consider that at the end of 2009 approximately 0.1% of the energy demand was met from wind energy sources. And in 2013 there were increases in terms of wind energy, thus keeping upward trend of recent years. The main wind farms in our country are those of Fantanele-Cogealac-Gradina (Dobrogea) with a capacity of 600 MW, Pantelimon (Constanta) with a capacity of 123 MW and Targisor (Constanta) with a capacity of 120mW (TPA Horwath Romania, 2013)

In a large expansion is also the solar energy. It is used directly by converting light energy radiated by the sun into electricity or thermal energy. Solar installations are of two types: photovoltaic and thermal. The photovoltaic directly produce electricity from solar energy while the thermal convert solar energy into thermal energy and help other fuel saving of 75% per year and are used mainly for heating homes, greenhouses, swimming pools or hot water waste. Photovoltaic energy in Romania registered a spectacular growth in recent years, so at the end of 2013 were 395 functional photovoltaic. Two of the largest solar parks in our country are Bucsani (Giurgiu) with an area of 42 hectares and an installed capacity of 18.5 MW and Targu Carbunesti (Gorj) with an area of 50 hectares and an installed 20 MW/h. Besides these forms of renewable energy, globally is pretty much used to obtain energy from biomass. As with solar energy, also here you can get both electrical energy and thermal energy. Biomass is organic non-fossil material represented by all non-fossil organic matters (wood, oil, waste vegetable) from forestry, agriculture and industry, and as well as fruits and cereals which can make ethanol. Energy from biomass comes from solar energy accumulated by plants in photosynthesis and is intended to be an alternative to fossil fuels energy, which after all they come also from biomass. The difference is that biomass energy is renewable and can be used every year, while fossil fuels can be converted into usable energy after a long time. The potential for biomass in Romania is considerable high that our country has a large and fertile land. The energy market for biomass in Romania may exceed 210 MW in the next two years.

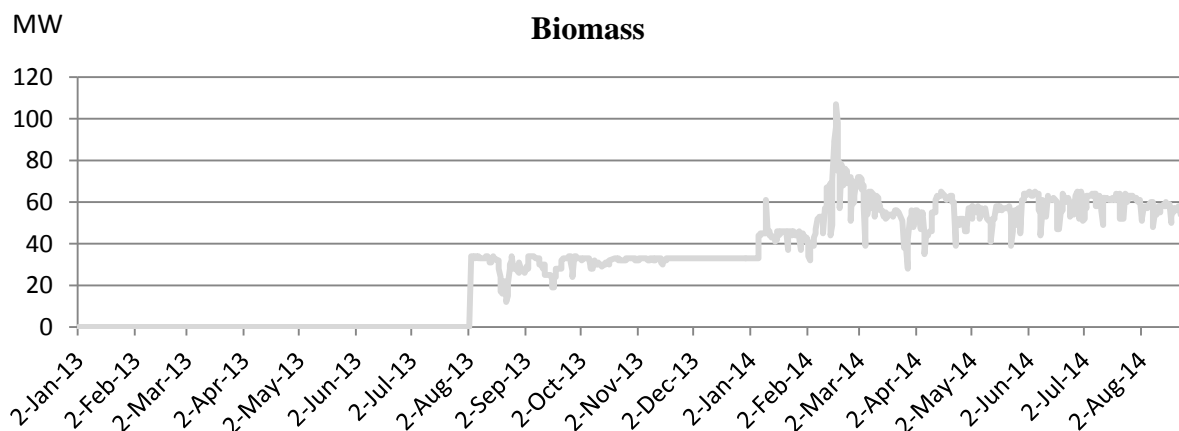
In Figures 2, 3 and 4 is seen the increasing energy production from wind, photovoltaic and biomass between January 2013 - August 2014.



**Fig.2 Wind energy production in Romania: January 2013 - August 2014.**



**Fig.3 Photovoltaic energy production in Romania : January 2013 - August 2014.**



**Fig.4 Biomass production in Romania: January 2013 - August 2014.**

(Sours: [www.sistemulenergetic.com](http://www.sistemulenergetic.com))

It can be noticed that wind energy production is fairly constant over the period analyzed, while photovoltaic and biomass energy have a considerable increase in the second half of 2013.

### 3. ADVANTAGES AND DISADVANTAGES OF RENEWABLE ENERGY SOURCES

Renewable energy sources are very attractive, with an unlimited potential in time, but must be taken into account and some disadvantages they have to manage them properly. The following are detailed the main advantages and disadvantages of the renewable energy:

- The biggest advantage is that renewables are durable and thus they are not exhausted.
- Renewable energy is non-polluting, having in this perspective a minimal impact on the environment.
- Most projects on renewable sources of energy are produced outside major cities, contributing to economic growth in less-favored areas.
- A disadvantage is that it is difficult to obtain large amounts of energy similar to those obtained using traditional fuels.
- Another disadvantage is that the production of energy from renewable sources is dependent on environmental conditions and they are not constantly in time and are not very well predictable. Thus, wind turbines need to blow the wind; the solar panels need sunshine and blue sky. Because of this, it is quite difficult for now to give up all the fossil fuels, because they are offering to us a constant and predictable amount of energy and they are needed to regulate the national energy system by balancing production with consumption of electricity instantly. Thus, in periods when it is not windy or it is cloudy it is increased the amount of electricity produced from fossil fuels. Without this control lever the energy system may fall resulting in interruption of electricity supply for population and economic agents and can generate huge damages.

In financial terms, the initial investment in renewable energy is much higher than investment in traditional energy production, but then the maintenance costs of renewable energy systems are smaller than coal or gas power plant.

### 4. IMPACT ON ENVIRONMENT AND AGRICULTURE

It is known that energy sources have a certain impact on the environment. Though conventional energy sources are cleaner, with harmful effects on the environment, it is important to understand the renewable energy effects on the environment. Depending on the technology used and geographical location we have to try to minimize the negative effects as much as we can.

#### **Wind Energy**

Harnessing this energy is one of the most sustainable forms of energy. This resource is abundant, inexhaustible and totally clean. Though wind turbine production technology is well developed and constantly improved, we should mention that there is a negative impact on the environment, wind turbines are making noise. For this reason it is necessary for them to be located in a reasonable distance from inhabited areas not to pollute the sound. Another signal is the discomfort caused by moving shadows caused by propellers. They also may adversely affect the natural habitat of birds. They can be killed by turbine blades when flying near windmills. Although they found evidence in this regard, a study by the National Coordinating Committee of the Wind (NWCC) has shown that the effects are small and they do not represent a real threat. (National Wind Coordinating Committee, Wind turbine

interactions with birds, bats, and their habitats: A summary of research results and priority questions, [https://www.nationalwind.org/assets/publications/Birds\\_and\\_Bats\\_Fact\\_Sheet\\_.pdf](https://www.nationalwind.org/assets/publications/Birds_and_Bats_Fact_Sheet_.pdf).

In the areas of hill and mountain wind farms would destroy the natural beauty of places. On the other hand placing turbines in the plains uses more land than in hilly or mountain ridges. Hence the questions arise regarding the use of land for the construction of wind farms. According to studies done in the United States National Renewable Energy Laboratory, found that large wind farms using between 12 and 60 ha / MW production capacity. But less than 0.4 ha / MW is always busy and 1.4 ha / MW are temporarily employed during wind farm arrangement. The remaining land can be used in agriculture or tourism. (Denholm et. al.2009, Hand et.al 2012)

### **Solar Energy**

In the case of solar energy, the sun provides us with a great resource to generate clean and sustainable electricity without pollution or toxic emissions.

The problems that arise are related to soil degradation and loss of land for agriculture. For photovoltaic systems estimate ranges from 1.4 to 4 ha / MW (Union of Concerned Scientists, Environmental Impacts of Solar Power, [http://www.ucsusa.org/clean\\_energy](http://www.ucsusa.org/clean_energy)). Unlike wind energy, where land can be used for both turbines and agriculture, in the case solar energy this is no longer possible. A solution would be the use of land not suitable for agriculture or those located in disadvantaged areas such as brownfields and abandoned land. This is not so simple because, for better efficiency, the panels are placed usually in areas what are sunny time most of the year, and they are usually in the plains and hill areas that are usually the most fertile land and most suitable for agriculture. Photovoltaic panels can be placed also on buildings, thus minimizing the impact on agricultural land.

### **Biomass**

On the scale of increasingly large biomass began to become raw material for obtaining electricity. Biomass power resembles fossil fuel power plants because both involve the burning of raw materials to generate electricity. Raw materials are however different. Thus, biomass is a renewable source and abundant, while fossil fuels are non-renewable (and theoretically they can regenerate but in extremely long periods of time, so basically we can consider that they are finite).

Regarding the impact on agricultural land there are two variants, namely: land cultivated for food that remain after harvest with waste that can be used as biomass and land that is cultivated exclusively for obtaining biomass crops, ex. rapeseed, and that are discarded food agriculture. In the recent years, the tendency is to grow more crops for biomass on land for food agriculture, which raises ethical issues because in many places need food first and then fuel. In addition, this can increase the price of food (Seachinger et al. 2008), greatly reducing the possibility of much of the world's population that has a low income to purchase the necessary food.

One solution would be to alternate food crop with the biomass. It can lead to soil stabilization and limited production of only the amount of crop biomass that exceeds the required food consumption. Probably in the next few years on the European or even global rules should be established for this purpose because they are countries in the world where land cultivation exclusively for the production of biomass has led to massive deforestation example. This phenomenon should be avoided because it would increase pollution instead of lowering them. For example, one study revealed that forests could absorb 9 times more CO<sub>2</sub> than we could obtain using biofuels produced in the same area. The use of biomass can have negative effects on the environment and health. From the burning of biomass in power plants to remove pollutants as nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), and particulate matter whose concentrations may exceed the maximum limit.

Another aspect is the traditional use of biomass, i.e. wood burning, leading to massive cuts forests, with serious consequences on the environment. Due to these factors, we recommend the use of a second generation biofuels, i.e. those made from wastes, residues, food and industrial wastes.

In Romania there is a tendency for farmers to grow rapeseed crops in the detriment of traditional agriculture, encouraged by subsidies received and the good price they sell. For example, a tone of rapeseed is sell 500 Euro, and a ton of wheat or corn with 250 Euro. This has the effect of increasing food imports and thus increases food prices.

Our country intends to amend legislation so that all investments on renewable energy sources can no longer be implemented on land for agriculture.

## 5. CONCLUSIONS

- This article shows the renewable energy potential of Romania in the wind, solar and biomass.
- Solar, wind and biological processes can be captured and converted into electricity and thermal energy.
- Romania has great potential in this area, which would help the country achieve energy independence and increase exports.
- Renewable energy sector in our country has experienced a large increase from 2012, when investments in this market have contributed to date at achieving the proposed target for 2020.
- Is necessary to establish certain rules regarding the development of renewable sources to avoid disrupting the environment and the food industry.
- It is important to produce energy from unconventional sources, but not in the detriment of agricultural food crops, as this leads to lack of feed and food price increases.
- A beneficial development direction would be to develop the second generation biofuels, leading besides getting energy and reducing waste.
- Sustainable development, the saving of traditional energy and pollution reduction are essential in increasing energy efficiency.



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