

FOSSIL FUEL IN CONTRAST WITH RENEWABLES IN ROMANIA

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Abstract: *Renewable-energy sources are considered to be the energy that is collected from sources that may be regenerated in a lifetime. The renewable-energy sources branch out in five types: wind power, hydropower, solar energy, geothermal energy and bio energy. However, in this paper, we are analyzing the water, solar and wind, in.. The large weight of renewable sources of energy makes them highly captivating considering the sources are never ending and clean. Along with the previous idea, using renewable-energy sources to generate electricity brings huge long-term benefits, such as enhancing sustainability, lowering the expenses of fossil fuels, reducing air pollution and slowing down the global warming.*

Key words: *fossil fuel, renewable energy, air pollution.*

1. Introduction

The wind power, hydropower, solar energy, geothermal energy and bio energy are considered to be RES (renewable-energy sources) due to the short time that they need to be regenerated. Contrariwise, fossil fuels are formed naturally, this process taking millions of years, this long period of time making them to be classified as non-renewable energy sources, even though they are continuously formed by natural processes. Fossil fuels branch out in three types: petroleum, coal and natural gas, but usually only coal and natural gas are used for energy generation. Besides the fact fossil fuels are limited and approaching exhaustion, they also bring up concerns regarding CO₂ emissions and global warming.

Currently, space heating and cooling together with water heating are estimated to account for nearly 60% of global energy consumption in buildings. They therefore represent the largest opportunity to reduce buildings energy consumption, improve energy security and reduce CO₂ emissions, particularly because space and water heating provision in some countries is dominated by fossil fuels [1]. Nowadays, electricity is something that we are all used to have on hand and the modern society uses really large amounts of electrical power. The energy generating industry is considered to be part of the main industries, therefore this sector has a very large contribution to carbon dioxide emissions. To slow down the climate changes and to reduce the carbon dioxide

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emissions, changes have to be made by each country and furthermore, changes also have to be made in each of our houses, by opting for RES to produce the needed electricity (for heating, cooling, water heating and other) over the classical burned fossil fuels.

2. Methods and Procedures

This paper traces the contrast between fossil fuels and renewable energy sources in Romania over the last ten years by presenting the country profile regarding the energy production from RES and fossil fuels. Also, it emphasizes the need to reduce the fossil fuels exploitation and the need to implement the use of RES to generate electricity. In addition to the contrast made between the fossil fuels and the renewables in Romania, this paper highlights the CO₂ emissions reduction in Romania by the use of renewable-energy sources.

3. Energy in Romania

3.1. Advantages and disadvantages for renewable-energy sources and fossil fuels

Renewable-energy sources are an importing independent and reliable resource. Therefore, if fossil fuels will be slowly replaced by renewable-energy sources or if their use decrease in time, it provides an economic stability to many countries, since they will no longer need to import fossil fuels to generate electricity. Over time, fossil fuels (mainly coal and natural gas) contributed to the development of the industries. Unfortunately, fossil fuels are non-renewable energy sources, therefore their exploitation is limited to their remaining amount. Another downside to the fossil fuels exploitation is that burning them for electricity generation features a negative impact on the environment by releasing important amounts of greenhouse gas emissions into the atmosphere. Today in Romania, most of the energy is produced by burning fossil fuels (coal and natural gas), leaving just a smaller percentage to the energy originating from renewable-energy sources.

One of many advantages of the energy generation using wind, solar or water is that they're unlimited. Another advantage is represented by the small amount of carbon dioxide emissions. Each of these methods has its advantages and disadvantages, on top of the effects on the environment, since electricity generation is one of the largest sources of energy-related carbon dioxide emissions. Energy generation using hydropower, photovoltaic panels or wind brings the carbon dioxide emissions close to zero, while burning fossil fuels has a considerable role in air pollution. However, energy generation using renewable-energy sources has zero carbon dioxide emissions only when the hydroelectric plants, the photovoltaic power plants and the wind power stations are in use. There are emissions of carbon dioxide when manufacturing the photovoltaic panels, when installing the wind power stations or when building the hydroelectric plants. Still, generating electricity using renewable-energy sources is more environmental friendly than burning fossil fuels for the same reason. Another downside

to generating electricity with these three renewable-energy sources is that the related power plants need special conditions in order to operate, despite burning fossil fuels, which is an action that doesn't require such conditions for it to generate electricity. For instance, for a photovoltaic park to work properly and at its full capacity, it requires sunny days. As well as a wind power station must be located in a windy area. Regarding hydroelectric plants, they can interfere with the wildlife of the stream, therefore the place where they are built must be carefully chosen.

Even though it might seem like generating electricity using renewable-energy sources have too many downsides, they still are more sustainable and environmental friendly than burning fossil fuels.

Furthermore, the exploitation of the fossil fuels, such as coal, is threatening for the environment. For example, maritime drilling is considered a threat for the ocean wildlife. As other environmental impact, both coal and natural gas are non-renewable fuel sources and it is necessary to replace them with renewable ways to generate electricity.

As well as the last idea, the environmental impact of electricity generation will become more positive if non-renewable-energy sources will be replaced with the renewable ones presented above: solar, water and wind. Since most deposits of fossil fuels are getting close to an end, there are made investments in the development of generating electricity using renewable-energy sources industries.

One of the biggest change that can be made, that could make probably the biggest difference is to start replacing burning fossil fuels in order to generate electricity with renewable-energy sources, or even to use less fossil fuels and more renewable-energy sources.

3.2. Fossil fuels in Romania

The continuously increasing demands for electricity, thermal energy and production in industries such as metallurgical, chemical, oil refinery and mineral processing for the construction sector, along with the terrestrial and air transportation have caused the escalation in concentration of some constituents of the atmosphere (NO₂, SO₂, O₃, particulate matter, CO, CO₂, etc.), with unpleasant consequences, often severe harm to humans and the environment [2]. Burning fossil fuels in Romania still is the principal method to generate electricity. Therefore, this industry has a say about air pollution and about having harmful substances building up in the atmosphere.

In Romania, the first two fossil fuels that are burned to generate electricity are solid fuels and natural gas. The primary production of energy by resource in Romania is presented in Fig. 1. The natural gas is the principal fuel that is burned in order to generate electricity, being followed by solid fuels.

The electricity demand is constanly growing, based on the nowadays comfort levels of the population and also based on the demographic growth. Therefore, the fossil fuels exploitation tends to increase which leads to harmful consequences for the environment.

As a safety measure, the European Union promotes the use of renewables, in order to

achieve its 20% target by 2020, which consists in achieving a 20% share of renewables. Also, this target will help fight climate change by reducing greenhouse gas (GHG) emissions [4].

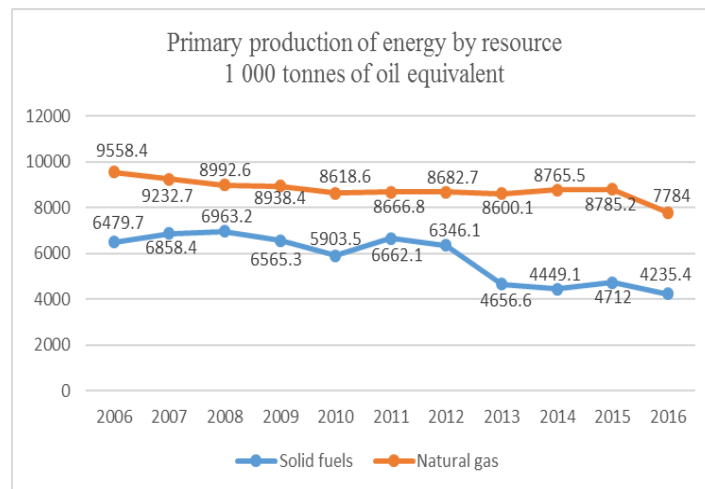


Fig. 1. Drawing inserted within the text *Primary production of energy by resource in Romania (2006-2016)* [3]

3.3. Renewable-energy sources in Romania

Romania's energy potential derived from renewable-energy sources consists of hydro, wind energy, solar energy, biomass and geothermal energy. The largest contributor in this case is represented by hydro energy, followed by wind energy [5]. Although hydro energy is the largest contributor to the renewable-energy sector, wind energy is considered to be less harmful for the environment, since building hydroelectric power plants may affect the natural environment. Also, hydropower is a sustainable and long-lasting source of energy but building a hydroelectric power plant raises many environmental concerns [6]. Among the most effective renewable energy technologies, photovoltaic systems provide different benefits, such as integrating the system into the building architectures and also the possibility to install the photovoltaic systems in different climates [7]. The first Hydropower in Romania was built near the Peleş Castle, in Sinaia, the summer residence of the Romanian Royal Family and it was built between 1873 and 1844 on the initiative of King Carol I of Romania (1866-1914) [5]. Hydro energy is followed by the wind power and by the photovoltaics, but the latter had a hesitant start, as shown in Fig. 2. Although Romania has a high wind potential, the first wind power investment was made in 2004, in the Ploieşti Industrial Park [6].

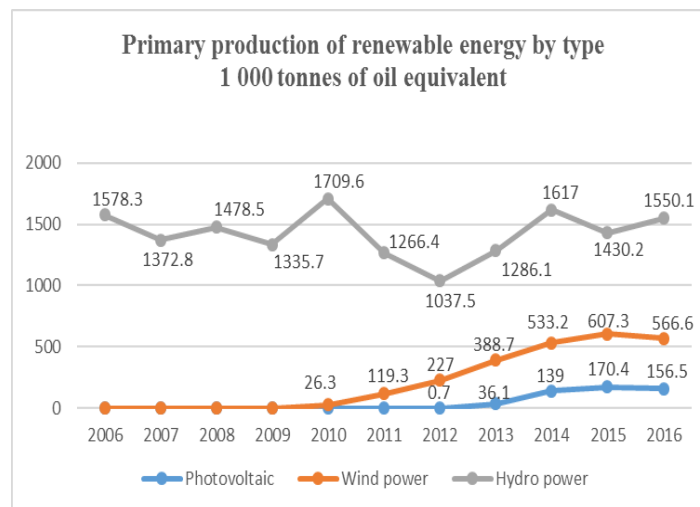


Fig. 2. Primary production of renewable-energy by type in Romania (2006-2016) [8]

4. Discussion

4.1 CO₂ emissions reduction in Romania by the use of renewable-energy sources

The CO₂ emissions contribute greatly to global warming. They are influenced by factors such as population size, transport, economic growth, and last but not least industrial activities. The use of renewable energy sources aims to reduce the carbon dioxide and other greenhouse gas emissions since it is known that it is the best solution.

Approximately 35% of the total amount of emissions released into the atmosphere is considered to be the result of the activity of the energy production. Of the total energy produced, about 80% is the result of the combustion of fossil fuels. With their extraction, CO₂ and CH₄ emissions are produced and CO₂ and NO₂ emissions are generated by their burning, gases that intensify greenhouse effect.

The consequences of the greenhouse effect are changes in natural phenomena which in turn affect the evolution of ecosystems. In Romania, carbon dioxide emissions are decreasing, from 6.9 tons in 2005 to 5.9 tons in 2015 (Fig. 3) [9].

Romania, by being a member of the European Union, takes part in the 2020 climate & energy package that aims to achieve three major objectives:

- Reducing greenhouse gas emissions by 20% (compared to 1990 levels).
- 20% of EU energy to be produced by renewable-energy sources.
- 20% improvement in energy efficiency (compared to 2005 levels) [10].

4.2 Long term renewable-energy sources exploitation

Romania is one of the countries with a high potential for the use of renewable resources currently based on the use of hydro, wind, solar, biomass and geothermal energy. The areas in Romania with the highest potential for developing renewable energy sources are: Danube Delta (Solar), Dobrogea (Solar, Wind), Moldavia (Micro

hydro power stations, Wind, Biomass) Carpathian Mountains (Biomass, Micro hydro power stations), Transylvania Western Plain, Low-Carpathians and hills (Micro hydro power stations, Geothermal, Biomass), Southern Plain (Biomass, Geothermal, Solar [11].

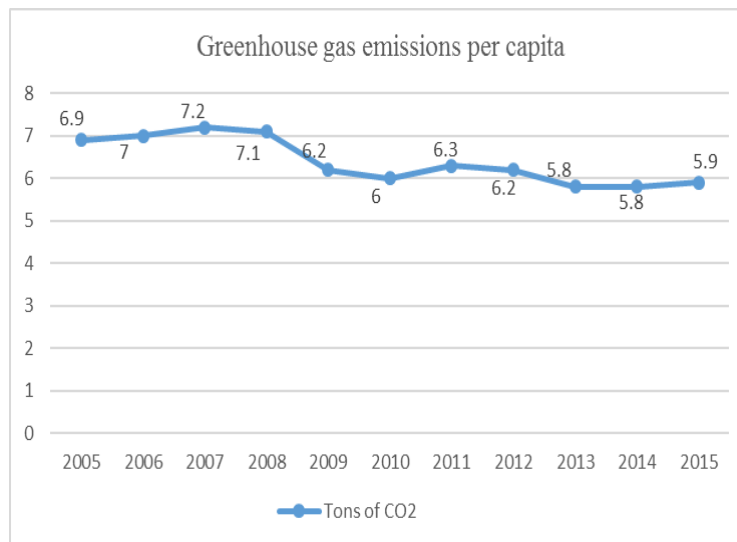


Fig. 3. *Greenhouse gas emissions per capita in tons of CO₂ (2005-2015) [9]*

According to ANRE (National Authority for Energy Regulation) in 2017 in Romania 38.33% of the electricity came from renewable resources (hydro-energy 24.07% wind, 12.72, solar 1.39%, and biomass 0.15%) with a decrease compared to 2016 when the percentage was 42.29%. The decrease is due to the reduction in energy produced by hydropower plants: 29.88% in 2016 compared to 24.07% in 2017 (Fig. 4). Until December 31, 2016, ANRE has accredited the capacity of renewable energy producer with a total installed capacity of 4798 MW. 2,963 MW are produced by wind turbines, 1,360 MW photovoltaic panels and 12 MW biomass. Also 351 MW come from small hydropower plants and under 10 MW from new and refurbished ones [9].

In conclusion, Romania is one of the countries with a very high capacity to produce electricity through the use of renewable resources. In recent years, there has been a significant drop in carbon dioxide emissions but also an increase in the amount of energy produced through the use of renewable resources currently being made important investments especially in wind, hydro, and solar energy.

5. Conclusions

This paper reviewed the contrast between the fossil fuels and the renewable-energy sources in Romania. The most exploited renewable-energy sources are wind power, hydropower and solar energy, and regarding the fossil fuels, the main ones in Romania are the natural gas and solid fuels. The fossil fuels are getting close to exhaustion and burning them for the purpose of energy generation have an important say in GHG emissions and in the climate change.

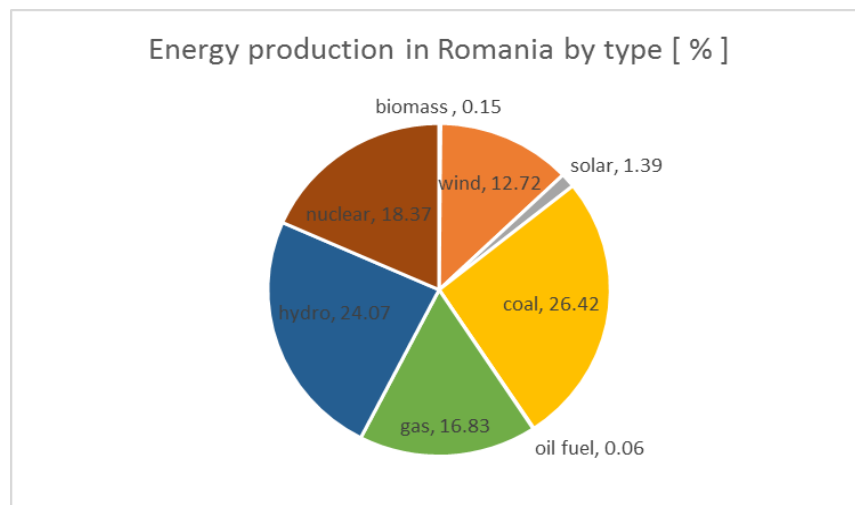


Fig. 4. Energy production in Romania by type in 2017 [%] [9]

Therefore, the paper ends perhaps with one meaningful point: one of the main way to reduce the GHG emissions and to fight the climate change is to keep replacing the fossil fuels as a source of energy generation with the renewable energy sources. European Union's modality to deal with the climate change and with the exhaust of the fossil fuels resources is to reach its target of a 20% use of renewables until 2020. On a different note, as it was presented earlier in this paper, most of the electricity in the private sector of people is used for heating, cooling and water heating. In this connection, changes linked to the renewables can be made for example by using a small photovoltaic system to generate the needed electricity in our homes in the sunny days.

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