

THE ELECTRICITY MARKET OF HUNGARY AND ROMANIA IN THE PAST FIVE YEARS

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Abstract: *The European Parliament and 2009/28/EK Council Directive sets mandatory targets for energy from renewable energy sources for EU Member States. As much of the energy management of Hungary and Romania is currently based on fossil energy sources, so that CO₂ emissions are only slightly reduced compared to the previous period. In order to reduce the volume of greenhouse gases, both countries should increasingly involve renewable energy sources in their energy management. Renewable energy sources are durable energies that are constantly reproduced and therefore inexhaustible. Alternative energy sources include solar energy, wind energy, hydropower, geothermal energy and biomass in different forms. The importance of renewable energy sources is that their use is in line with the principles of sustainable development, as opposed to the use of non-renewable energy sources, does not cause cumulative adverse effects such as greenhouse effect, air pollution, water pollution. Not only because of the global warming crisis, but also because of the temporal overcrowding of global oil production, it is also necessary to separate from non-renewable resources.*

Keywords: *renewable energ, wind energy, biomass, solar energy, electricity, Hungary, Romania.*

JEL Classification: Q4.

1. The electricity market in Hungary and Romania

In this chapter, I present a comparison of the electricity market in Hungary and Romania, with particular reference to renewable energy sources. I have learned in the literature that the two countries have extremely different characteristics of renewable resources. In Romania, the high mountains and the sea mean great advantages; in the electrical energy sector, the water and the wind play a considerable part, while Hungary is better equipped in geothermal energy and as an agricultural country, in biomass. In Figure 1, unit prices of residential electricity can be seen in the two countries without taxes and fees.

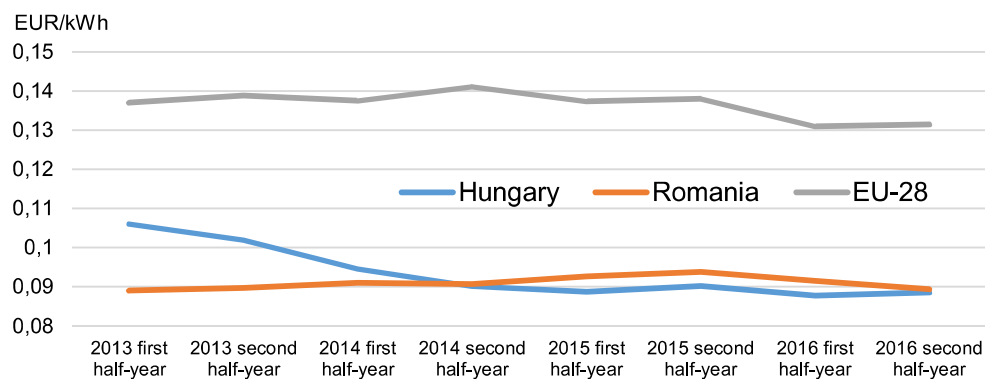


Figure 1. Residential energy prices in Romania and Hungary
Source: A personal edit based on EUROSTAT (2017a)

Figure 1 shows that the energy prices of both countries are below the EU average, Romanian prices have been stagnating in recent years, while Hungarian prices have decreased mainly due to government measures. In Hungary, average salaries in the private sector are €10,205, €6,746 in Romania, and € 34,210 in the European Union in 2014.

Energy dependence is an important problem to be solved in the world, because of which a country can be dependent on other countries, so it can be difficult to change political situations, and this may also be the case with their own power plants. This is measured by the share of the country's largest power plant. In Hungary, it is the Paks Nuclear Power Plant, which had a 53 per cent share of the country's energy output in 2015. The nuclear power plant started retail electricity production in 1982 and, as a result of the lifetime extension program, in 2012 and 2014, the first and second blocks received the twenty-year license. The expansion of the power station is on-going; in the framework of an inter-state agreement with Russia, by the end of the 2020's it will be extended by two blocks of 1200 MW output. This also means that Hungary will depend heavily on Russian import energy sources in the coming decades. In contrast, Romania's largest power plant, the Turceni Thermal Power Plant (Complexul Energetic Turceni) receives a mere 25 per cent share, so it will be less affected in case of a potential malfunction or definitive failure of the largest plant. When reviewing the literature, I learnt that Romania's energy sources are much more differentiated than those of Hungary, better exploiting the potentials of renewable energy sources than Hungary.

The role of renewable energies in the production of electricity in Hungary and Romania

Romania and Hungary have very different potentials in terms of renewable energy sources as well. Hungary is a basin-like area, with large flat lands and without coastline, while Romania has great mountains, from where high gradient rivers start, and also a relatively long coastline. The comparison is justified, as the two countries pursued a similar energy policy during socialist times. However, after the change of regime, the situation changed because they were trying to rely more and more on

renewable energy sources. As EU member states, the countries aimed for less environmentally polluting solutions. The following diagrams summarise the place of renewable energy sources in the energy sector of the test countries (Figure 2 and Figure 3).

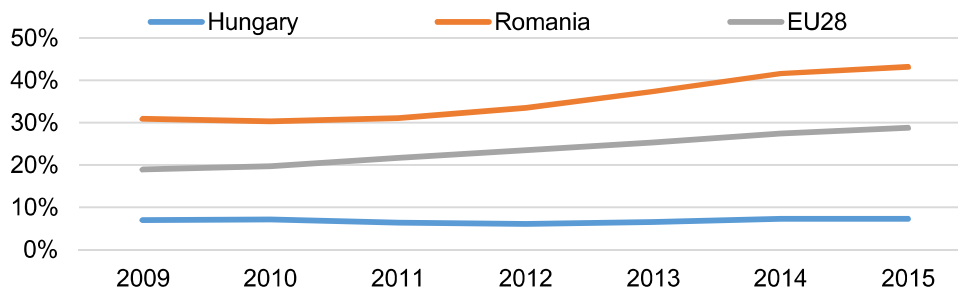


Figure 2. Share of renewable energies in electricity production between 2009 and 2015

Source: A personal edit based on EUROSTAT (2017b)

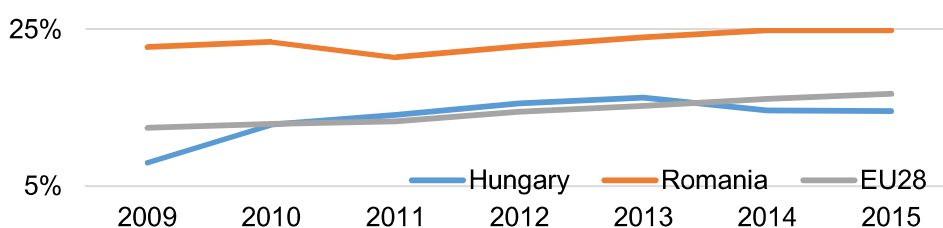


Figure 3. Share of renewable energies in the production of energies altogether between 2009 and 2015

Source: A personal edit based on EUROSTAT (2017c)

Figure 2 clearly shows that Romania far exceeds the European Union's average, generating electricity from a clean energy source while in Hungary, because of the modest possibilities, renewable energy sources are only minimally involved in energy management compared to the average of the EU or Romania, although it can be seen in Figure 10 that the Hungarian renewables play the biggest role not in direct electricity production but in heating. If we look at all the energy production, Hungary will fulfil its 2020 undertaking; although current trends do not show that in the coming years progress will be made in renewable energy production due to the upcoming nuclear energy investment. By contrast, Romania will meet its undertakings for the 2020's in 2014 and will continue to pursue clean energy investments in the country. It is important to take into account that Romania started considerable renewable energy investments in 2009 and 2011, concerning specifically wind and photovoltaic power plants besides its already existing hydroelectric capacity.

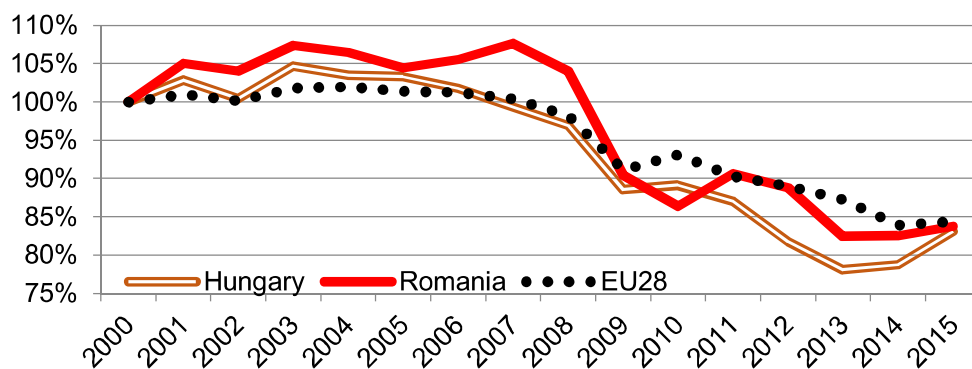


Figure 4. Emission of greenhouse gases compared to the year 2000
Source: A personal edit based on EUROSTAT (2017f)

One of the crucial objectives of the European Union is to reduce greenhouse gas emission. In the literature, the data are generally compared with those of the 1990s but I have chosen the year 2000 as the base year to demonstrate the progress made in the new millennium over the past one and a half decades. The data were provided according to the equivalent of carbon dioxide in tones. It can be clearly seen in the figure that Hungary joined the EU 2004 and Romania in 2007. Both countries started their renewable energy projects in the middle of the 2000's but in the case of Hungary, it should also be taken into account that nuclear energy has also gained more popularity, which does not emit greenhouse gases. In the following parts, I examine what significance the different kinds of renewable energies have in the two countries.

The role of hydropower in the electricity production of the two countries

Hydropower in the electricity production is the most effective and most widely spread renewable energy (although its volume is wavering). The produced energy is influenced by the weather, since neither floods nor droughts do any good for the turbines. The amount of rainfall in spring and early summer is a key aspect throughout the whole year in the flow of rivers and the melting of the rivers in springtime. Romania and Hungary's largest stream is the Danube, which enters 8 more countries in the course of its 3000-km journey.

The Danube has the greatest theoretical hydropower potential. Romania utilizes this too as one of Europe's largest hydropower plants is located on the Danube, Iron Gate I. and II, which were built in the framework of the joint Romanian-Serbian project (Porțile de Fier, Търдапска клисура). These power plants were built on the river where it leaves the Carpathian Basin. Apart from the Danube, probably Olt is the only other river that leaves the area. The significance of the Iron Gate in water management was already explored by Széchenyi István and 100 years later, the huge hydropower plant was built. Hungarians also planned a large Danube-project in the 70's. The Gabčíkovo–Nagymaros Dams dreamt of together with the Czechoslovaks would have had a much larger hydroelectric capacity than any other power plant but due to the social pressure of the regime change, the government abandoned the plan at the time. The government abolished the contract with Slovakia, who had built its own part. Emotions were stirred up and the case was taken to the International Court of Justice in Hague. Since then there has been no

discourse about the use of the shared section of the Danube. So the utilization of a considerable part of the river, providing nearly three quarters of water potential in Hungary is currently not talked about. Water power produced by the two countries is illustrated in Figure 5.

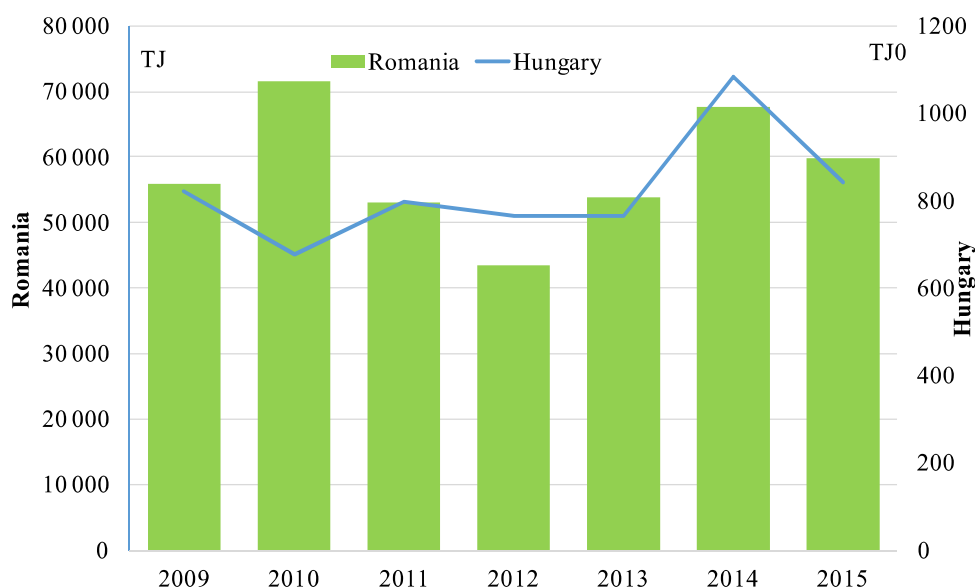


Figure 5: Energy produced from hydro power plants between 2009 and 2015 in Hungary and Romania

Source: EUROSTAT (2017d) on the basis of their own edit

The Figure 5 shows that there are remarkable differences between the possibilities in the two countries so they can only be represented by two separate minor axes, and this will be the case in other types of energies as well later on. This is the oldest type of renewable energy used in the two countries; in Hungary, the first plants were installed at the beginning of the 20th century, and in Romania, the first instalment took place in the 1960s in Moldavia on the river of Bistrița Aurie. Both countries reached their peak in the 1970s, when the largest hydropower plants in the countries were built (Iron Gate, Kisköre). Since then stagnation has been more of a characteristic. Romanians utilise their hydropower potential better, but Hungarians also have good management except for certain section of the Danube. Rivers in Hungary have a higher gradient (the Hernád and the Rába) but also less powerful power plants. These power plants are the oldest in Hungary. The Danube has one periodically operating hydro power plant (Kvassay Sluice) (Figure 6).

Romania has set up several power plants on its high water-potential rivers that were demonstrated in the literature. These rivers are the following: the Olt, the Lotru and the Szamos. Rivers coming from the Carpathians and the Transylvanian mountains are ideal for driving turbines. Figure 7 shows that both countries, compared to European conditions, have a modest water potential. But Romania is, without a doubt, a category higher in terms of water potential, but is still feeble among countries with great potential. Rivers of Western Europe, where rainfall is higher, and

the runoff of the water is also higher and more balanced as opposed to Eastern European ones.



Figure 6. Location of hydroelectric power plants in Hungary
Source: I8 on the basis of their own edit

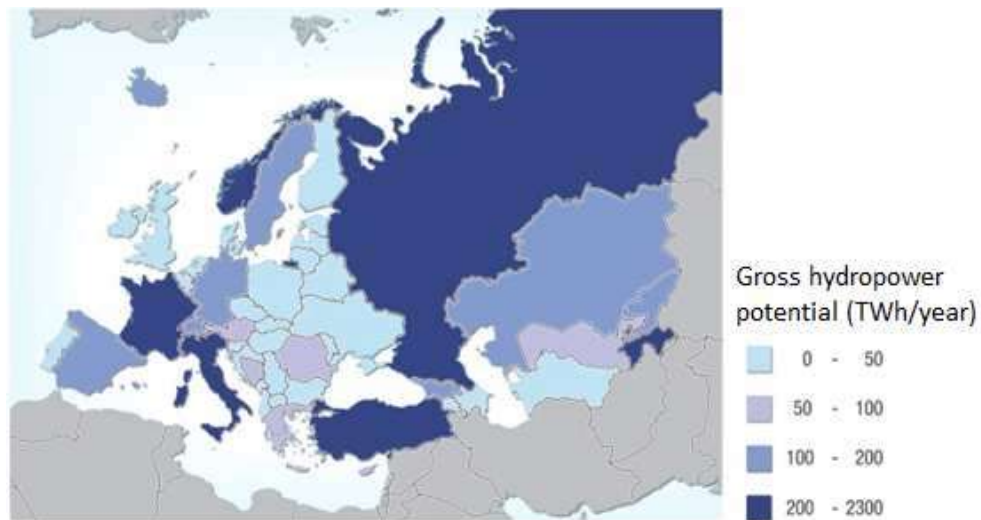


Figure 7. Europe and the States of the Independent States
Source: Năstase et al., 2017

The role of wind power in the electricity production of the two countries

It is difficult to compare the two countries when it comes to wind power, too, since the properties of the two countries are rather different from one another. In Hungary,

due to it being a basin-like area, winds blowing from the seas are slowed down by the terrain. The same is true of the Carpathian parts of Romania, in Transylvania and the Partium. In these areas only the western slopes of the Bánát Mountains are suitable for utilising wind power economically. Both of countries started utilising wind power relatively late – Hungary in 2001 and Romania in 2009. Ever since then, Romania is the one that has undergone spectacular development. Most of the Hungarian wind power plants are located in the western part of the Transdanubia and very logically so as that part of the country is the windiest. There still are some exceptions such as Kulcs (central Transdanubia) or Felsőzsolca (Northern Hungary). The largest power plant parks can be found near Mosonmagyaróvár and Komarno, while Romania’s wind power plants are in the so-called Romanian Old Kingdom (Vechiul Regat), more specifically the plateau near the river of Bârlad in Moldavia and the eastern part of Dobrogea, which is closer to the Black Sea, are the most ideal areas for their installation.

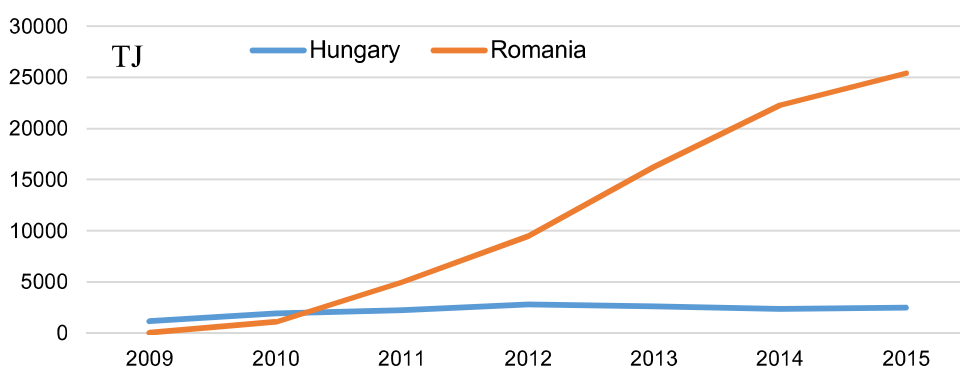


Figure 8. Hungary and Romania wind power plant vehicles production of energy in 2009 and 2015 between

Source: EUROSTAT (2017d) on the basis of their own edit

Figure 8 demonstrates Romania’s large-scale exploitation of wind power. Before 2009, there were no wind power plants in Romania. For Hungary, however, the year 2008 was a very significant one in terms of wind power, when wind power plants of 60 megawatt performance in total were installed, although there have been no new ones since 2011. Thus currently the total performance of wind power plants is 330 MW, while in Romania only those established since 2014 have an aggregate output of 354 MW. Romania’s rapid development has been steadily declining since 2014 but it still is at the forefront in terms of wind power exploitation in Eastern Europe and in the whole of the European continent as well. Romania’s first wind power plant was built in 2004 but the real breakthrough happened in 2008 with the enactment of a statute (220/2008), that ended the priority of fossil fuels in the power generation of the country. This in the following year led to the commencement of wind power projects and they set the goal of renewable energies covering 24% of power generation by 2020. After 2009, Romania launched new power plants of at least 350 MW every year. In 2012 they established a 976 MW windmill, which is about three times the capacity of Hungary at present. One of Europe’s biggest wind power plant parks can also be found in Romania, in Dobrogea. Near the settlements of Cogealac and Fântânele in Constanța County, the park has a 600 MW of total output (Dragomir

et al., 2016). It is worth observing the expansion of wind energy performance in the two countries in the past decade, that is, between 2005 and 2015 (Figure 9).

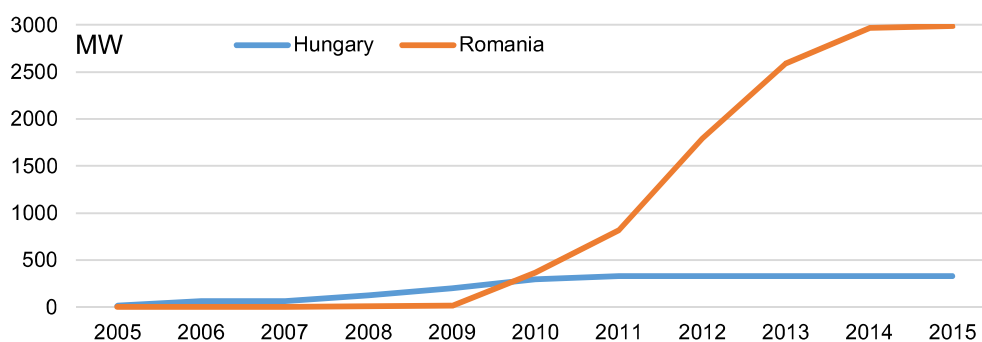


Figure 9. The wind power the increase of the two countries in between 2005 and 2015

Source: Szalai et al 2010 and Dragomir et al., 2016 on the basis of their own edit

Figure 8 shows that in 2009 in Romania a significant growth was in progress until 2014 and in contrast, in Hungary there was only a less considerable one from 2005 to 2010 followed by stagnation. Moreover, in Hungary issuing of licenses was suspended when the need for a new 1100 MW power plant came about in the country. Recent research has proved that at certain altitudes there is enough wind energy in Hungary, too, that can be utilised economically. It is clear, however, that Romania does a significantly better job at exploiting the possibilities of this energy source compared to Hungary and so is less dependent on energy, having a place among the last third of the EU 28 member states in energy dependency. Hungary's wind industry is currently obstructed by the 2011 suspension of license issuing and no advancement can be expected either due to the second investment in Paks.

The role of solar energy in the production of electricity in Romania and Hungary

Solar energy is turned directly into electricity with the help of photovoltaic power plants. At the moment solar power does not play an important role in the energy sector in neither of the two countries. In 2015 photovoltaic power plants provided 1% of Romania's and 0.03% of Hungary's energy. In Hungary the southern region of the Great Plain would be the most ideal for the purpose but the point of these power plants would be the exploitation of less used lands. The country's biggest power plant of this sort is in Mátra, an establishment of 72,480 solar cells with a 15 MW total performance. It belongs to the Mátra Power Plant of Visonta which is one of Hungary's power plants that utilises most types of energies since besides solar power, it produces electricity by burning lignite, natural gas and biomass as well. Romania has been using solar energy since socialist times, although it is true that back then they mostly only built solar panels of which only 10% is still in use today. Yet, both of the countries are making progress in this respect as shown by table 1.

Table 1. Electricity generated in photovoltaic power plants

Measure: GWH

| Country | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---------|------|------|------|-------|-------|-------|
| Hungary | 3,3 | 4,7 | 25 | 26,8 | 123 | 174 |
| Romania | 2 | 2 | 420 | 1 355 | 1 982 | 1 845 |

Source: Euro Barometer data based on own editing

Hungary's annual electricity consumption in 2015 was around 43,800 GW/h according to the data of MAVIR (Hungarian Electrical Works Private Limited Company) and according to the summary of ANRE (Romanian Energy Regulatory Authority) in Romania it was 57,700 GW/h. Even though it is obvious that only a small portion of this is from solar energy, the improvement is still unquestionable. The power plants in Mátra and Pécs meant a huge step forward when they were unveiled in 2015. The one in Mátra has a performance of 15 MW and the one in Pécs generates 10 MW of energy and they are to be followed by new ones in the future. The situation in Romania indicates that in the early 2000's it technically did not exist just like the wind energy industry and even though a smaller amount of money is invested in solar energy than in wind energy, it is making progress. In 2012, huge developments took place in Romania and in 2013 two large solar power plants were installed – one of them in Livada of 56 MW, and the other in Ucea de Sus of 55 MW performances. They are still two of the country's biggest photovoltaic power plants. Figure 10 demonstrates the tendency in the increase of the annually produced energy.

Solar energy is one of the energies that require the most expenses of instalment on the current energy market, especially the photovoltaic, that is, the electricity producing part. The costs can only be covered by large amounts of support and sometimes the consumers are made to pay the additional costs. It cannot be forgotten, however, that in this part of Europe the number of the hours of daylight is about 1800-2200 per year and during these hours, photovoltaic power plants produce electricity without any type of harmful emission, which will also be appreciated on the long run by future generations, not only in our present years.

Here I would also like to mention that geothermal energies of the two countries are not in direct relation with the electrical energy industry, it is utilised in spas and heating, thus saving money in the district heating systems. Conscious management is indispensable because thermal water has to be taken back to its source and over-exploitation cannot happen either otherwise the thermal water sources can dry out. The whole of the area of Hungary has favourable geothermal energies, Budapest is the only capital city in the world with a considerable thermal water resource besides other famous spas in Hajdúszoboszló, Hévíz and Gyula. Romania, especially in the Transylvanian regions, also has several thermal water sources, its well-known spas are Felix Spa (Băile Felix) and Hercules Spa (Băile Herculane).

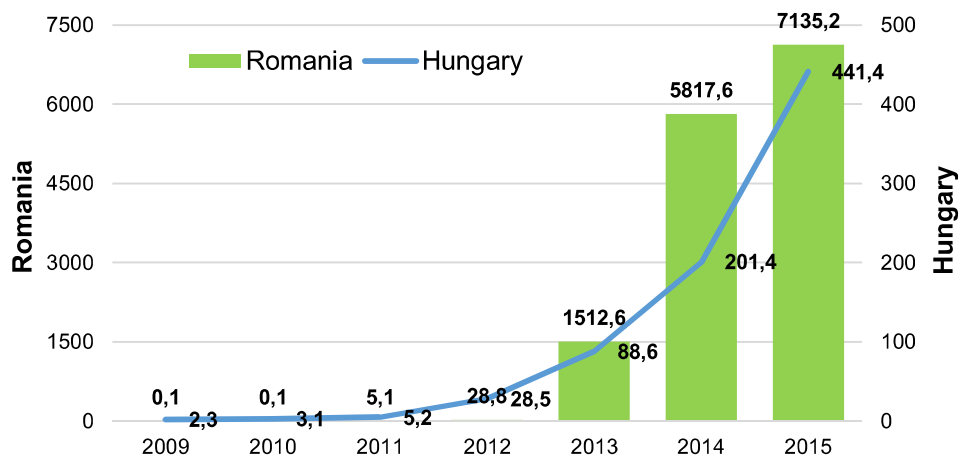


Figure 10. Hungary and Romania from 2009 to 2015 produced by photovoltaic power plants
Source: EUROSTAT (2017d) on the basis of their own edit

Land use and biomass in Hungary and Romania

The comparison of the annual amount of energy gained from biomass can be seen in Figure 11, in which respect the two countries have the same results. Summaries on electrical energy in the two countries indicate that 3.8% (1661 GW/h) of Hungary's and 0.72% (421 GW/h) of Romania's annual need was covered by biomass in 2015 (MAVIR and ANRE).

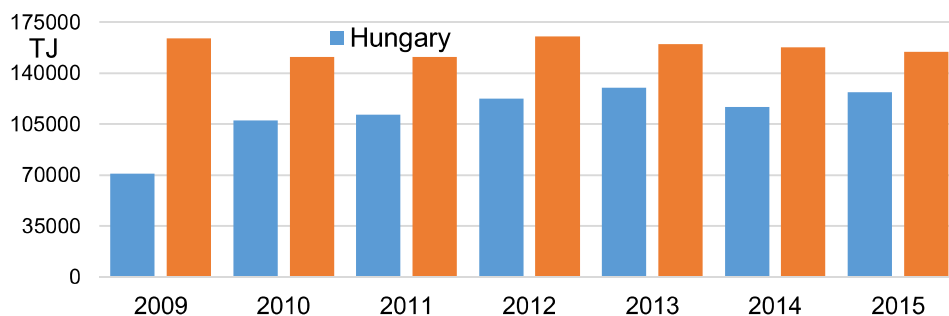


Figure 11. Hungarian and Romanian biomass from 2009 to 2015
Source: EUROSTAT (2017d) on the basis of their own edit

In terms of total energy production, Romania beats Hungary. Both of the countries have been in a stagnating period in the recent years, the amount of energy generated from biomass has not really changed since 2012. In Hungary several power plants have been turned into ones of mixed heating in order to cut down on the emission of pollutant substances. Examples of this are the power plants of Mátra, Ajka and Pécs. Biomass in these power plants is used for the improvement of lignite that has a low heat of combustion in Mátra for instance, or to prevent running out of carbon resources in the Transdanubia. In Romania's case, the country's largest thermal power plant where they use biomass heating generating 22 MW of energy can be

found in Rădăuți in Suceava County. Another biomass burning factory is located near Reci, which is also a plant of high performance. Table 2 demonstrates land use in Hungary and Romania.

Table 2. Land use of Hungary and Romania according to major cultivation branches in 2014

| Designation | Hungary | | Romania | |
|--------------------------|---------------|------|---------------|------|
| | 1000 hectares | % | 1000 hectares | % |
| Total area | 9 303 | 100 | 23 839 | 100 |
| Agricultural area | 5 346 | 57,5 | 13 830 | 58 |
| Plow-land | 4 405 | 47,4 | 8 778 | 36,8 |
| Wooded property | 2 064 | 22,2 | 6 791 | 28,5 |

Source: FAOSTAT on the basis of their own edit

The area of Romania is more than two and a half times the size of Hungary and it also has twice as many inhabitants, so it has better opportunities and a bigger market. The most important component of biomass is wood, of which both countries have large resources, especially Romania. A forest planted to provide firewood is a great investment for the environment because living trees absorb a lot of CO₂, its heating value is much better compared to that lignite and its use generates less harmful substances. Hungarian biomass exploitation can profit from the large-scale use plough-lands: after harvesting the useful parts of crops, by-products such as corn stalk or straw can also be used in energy production. One of the disadvantages of biomass is that it cannot compete with good-quality natural gas as the transportation and burning of gas is more economical. Power plants with biomass heating should be installed close to the energy sources.

Summary

My research was carried out because it was interested in Hungary that the ratio of the involvement of renewable energy sources in energy management in Hungary and Romania in neighboring Romania. The main segment of my research was the extent to which renewable energy sources were involved in electricity management and where there are still hidden reserves for Romania and Hungary. It should not be forgotten that renewable energy sources should be included in the energy mix as much as possible, as renewable energy generating plants produce electricity without any harmful emissions, this benefits not only the now but the future generations will appreciate it.

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