

A CRITICAL ANALYSIS OF THE POTENTIAL OF RENEWABLE ENERGY IN ROMANIA

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Abstract. This paper examines the potential of the renewable energy in Romania and presents the key challenges for the appropriate development of this sector. The main sources of renewable energy are concisely presented and the current use is investigated considering the targets set by the European Union. A SWOT analysis is performed and the main findings reveal that a superior exploitation of renewable energy sources is necessary, especially in recession times, as this will have positive impacts on labor market, industrial production and competitiveness.

1. INTRODUCTION

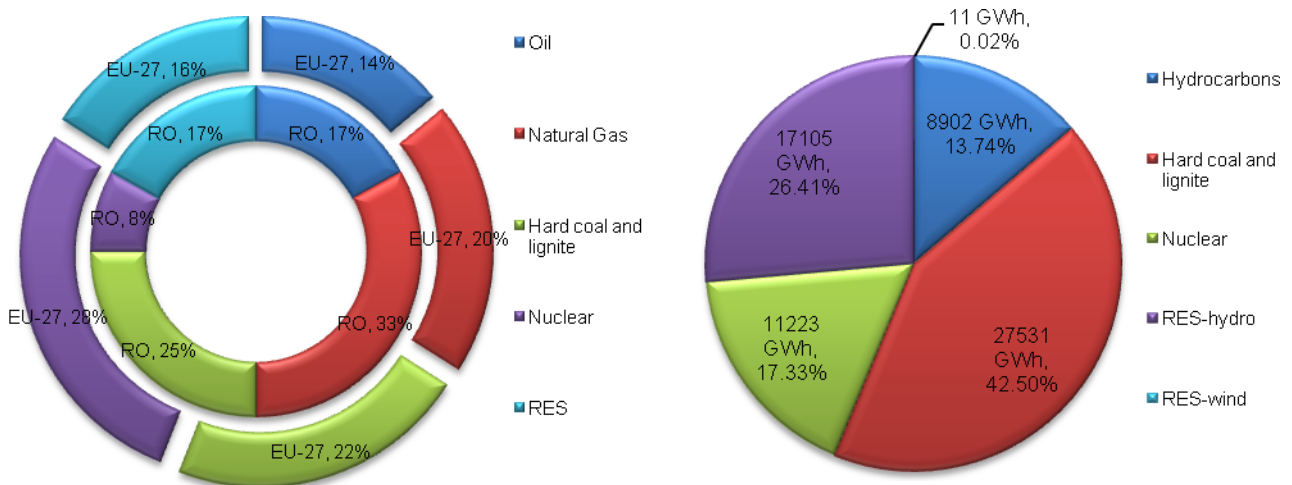
The use of renewable energy sources (RES) plays a central role in the road towards a future sustainable society, providing a country with a diversified mix of energy sources that safeguards the security of supply and also the environment. Unfortunately, the current global and national energy situations reflect the energy policies of the past, implying large subsidies awarded to fossil fuels, this constituting a barrier for the proper development of RES. Moreover, during last year, the environmental issues have been majorly under attack and received an unworthily negative publicity, this leading to a loss in confidence in the findings regarding climate change and climate - energy relationship. Nevertheless, sustainable energy should be properly supported and should surpass the status of good intentions through a consistently enforced good legislation. The sustainable future is starting to unveil, given the latest directive concerning energy of the European Commission for the European countries (EU-27). European Commission policy asserts an aggressive triple 20% quota by 2020 [1]: for the reduction of green house gases emissions compared with 1990, for a more efficient use of energy and for an increase of renewable energy use. Although the Commission has in view such ambitious goals, the situation must be carefully and realistically analyzed, by taking into consideration the interests of all involved countries, unless the Europeans will not surpass, once again, their own assumed stakes [2].

World oil prices reached their maximum value in 2008, but they were reduced due to a decrease in demand appeared as a consequence of the onset of the economic and financial crisis. Therefore one may assert that a positive impact of the financial crisis is that it triggered a low consumption and a recalibration of the energy prices, but this is true only on short term. Another positive fact is that it constitutes a new driver of change towards a possible green future. The creation of new qualified and sustainable jobs in the green domain is an opportunity that renders the emerging renewable energy industry a future mature major employer [3].

2. OVERVIEW OF THE RES IN ROMANIA

Romania is well and variously endowed when speaking about energy commodities. In terms of fossil fuels, it posses more than other European countries, having domestic resources of natural gas, crude oil and coal (mostly lignite). Other important energy source is represented by nuclear power, Romania also having nuclear ore resources and production facilities of enriched uranium. Therefore, its energy dependency is lower than

most European countries, reaching a value of 32% for all energy products in 2007, a good figure judged in correlation with the EU-27 mean of 53% [4]. However, this situation is likely to change, considering the availability of the existing known domestic resources that was estimated at 15-20 years [5] (15 years for gas, 20 years for oil), when two options will be available: either high spending on oil & gas imports or the existence of new domestic sources of energy that replace the old ones. The last options rings better and implies the undertaking of new opportunities in terms of fossil fuels, like Nabucco pipeline, the development of the nuclear power, the development of RES and a combination of them. The primary energy production is concentrated on hydrocarbons (oil and natural gas), while RES account for 16%, a figure close to the EU-27 mean of 17% (see figure 1, a). The electric power mix is diversified, totaling a number of 64,772 GWh, the main source of RES being represented by hydro-energy (see figure 1, b). Romania was a net exporter of almost 10% of its electricity in 2008. The national targets set for the electric energy produced from RES for 2015 is of 35%, while that for 2020 scores 38%, from an existing value of about 26% (data for 2008). These targets are achievable but, unfortunately, the percentage also includes large hydro plants, considered to be non-sustainable sources of renewable energy.



a. Primary energy production in Romania (RO) and EU-27, by source, 2007. b. Electric power mix in Romania, by source, 2008.

Figure 1. Energy figures for Romania and EU-27.

Source: computed from European Commission, Eurostat, "Energy, transport and environment indicators", Luxembourg, 2009 and Transelectrica, "Annual report 2008", Bucharest, 2009.

Romania has also a significant potential in RES that deserves effective exploitation. RES are represented by wind, water, the heat trapped inside the earth surface (geothermal energy), biomass (that is a result of burning solid residues) and sun, all of them being potential unlimited and available in Romania. The total economically viable potential of RES is of about 10.2 Mtoe/year (million tons of oil equivalent), a noteworthy figure considering that the final energy consumption in Romania was of 24 Mtoe in 2007 [4], bringing RES potential to 43% of consumption (see table 1). The source with an estimated large development is represented by **wind energy**, Romania being the country with the highest wind potential in the region, having three main sites with an appropriate wind speed: Dobrogea – Black Sea region, Moldavia and Banat. The current wind installed capacity is rather modest of 14 MW, but has a potential to grow to 3,500 MW [6]. The **hydro potential** of Romania is significant and is currently exploited, but other water

basins/water segments could be also tackled, the technology for producing hydro energy being mature and extremely reliable. With a total of 767 hydroelectric power plants [7], from which 621 are small hydro (less than 10 MW capacity), Romania produces 26% of its electric power via hydropower. The **geothermal potential** ranks Romania third in the European countries with geothermal waters, having major potential sites on the western part of the country (Banat, Crisana, Maramures), Carpathians Mountains (Tusnad-Bai) and Bucharest region. The **biomass potential** is also important, biomass being currently used mostly for the production of heat. Biomass includes vegetal biomass (forestry and wood waste, agriculture residues, agricultural crops), biogas and municipal waste. The technologies used for biomass conversion in energy are represented by combustion, gasification and pirolysis, the last producing also bio-liquids (e.g. bioethanol). **Solar applications** (thermal and photovoltaic) have also a great potential, especially in the southern and western regions of the country. Other existing forms of RES, like tidal/wave energy, gas hydrates, nanotechnology, hydrogen and bioenergetics, are at relatively early stage of development, therefore they are not included in this analysis.

| Potential of RES | Wind | Micro-hydro | Geothermal | Biomass | Solar T | Solar PV | Total |
|---|------|-------------|------------|---------|---------|----------|----------------------------------|
| A. Electrical/ Thermal energy, Ktoe/year * | 688 | 310 | 215 | 12,382 | 3,430 | 516 | 17,541 |
| % of total A | 3.92 | 1.77 | 1.23 | 70.59 | 19.55 | 2.94 | 100.00 |
| B. Electrical/ Thermal energy, Ktoe/year ** | 456 | 103 | 167 | 7,595 | 1,450 | 413 | 10,184 (58% of A) |
| % of total B | 4.48 | 1.01 | 1.64 | 74.58 | 14.24 | 4.06 | 100.00 |

where: T thermal, PV – photovoltaic, * technically feasible, ** economically feasible; ktoe – 1,000 tons of oil equivalent (1 ktoe = 10,000kcal/kg)

Table 1. The RES potential in Romania.

Source: computed from data available from Turcu I., "Guide for investors – Ghid pentru investitori", Energy Research and Modernizing Institute – Icemenerg S.A., 2007.

To promote the use of RES, Romania adopted and implemented a mandatory quota system combined with green certificates (GC) [8]. The mandatory quota for 2010 and 2011 is that 8.3% of the electricity sold to the consumers to be of renewable origin, large hydro-energy being also considered. An amount set in-between 1-4 GCs is issued for each MWh of RES delivered to the distribution grid, depending on the energy type (for solar energy – 4 GCs, biomass and geothermal – 3 GCs, wind energy – 2 CGs, micro hydro energy -1 GC). The GCs may be sold on GC market, 1 GC trading price being in-between 27-55 EUR. At the end of 2009, 47 RES producers (15 for wind producers, 30 for small hydro plants, 1 solar and 1 biomass) were certified to operate on the market in 2010 [9].

3. CHALLENGES FOR THE DEVELOPMENT OF RES

Investments in RES and their support by appropriate legislation represent the keys for a Romania's future sustainable development, with positive impacts on labor market and industrial production, therefore contributing to its overall productivity. However, this does not imply that the environment will be totally safeguarded, as clean energy does not exist and other environmental concern might appear. **Hydropower**, the largest source of renewable electricity in Europe, is only efficient when speaking about small size hydro-plants (up to 10 MW). Otherwise it has a big impact on ecosystems and human life leading to loss of land and habitat, displacement of communities and water-related diseases. **Wind energy**, the fastest growing RES from Europe, is efficient especially when speaking about large-scale projects, but when it comes to small-turbines their production and shipping

generates more CO₂ than save. Moreover, the turbines have an impact on the quality of life of different ecosystems, rising ornithology concerns, for instance. **Solar energy** also leaves a mark when speaking about the production and disposal of polysilicon needed for photovoltaic energy. Regarding the production, aside the large amount of energy required, the byproduct of polysilicon is represented by a highly toxic substance, silicon tetrachloride, which has to be properly recycled and disposed, involving more energy consumption. Moreover, the lifespan of solar panels is estimated at 20-25 years, so they will have to be properly collected and disposed. **Bioethanol production** requires more land made available for ethanol producing crops this leading to a diminishing of forests and agricultural cultivations. Moreover, the process also implies fertilizers and pesticides that affect the soil on long term. Even with the second-generation of dedicated energy crops (perennial tree, different grass species), there are several drawbacks including the consumption of fresh-water and threats for local biodiversity. Therefore, the biomass should be sustainably used, at a pace of consumption equal with the natural replacement rate. **Geothermal power** comes with concerns regarding the safety of its production as it might be connected with the generation of local earthquakes [10].

Nevertheless, the elimination of pollutants from fossil-fuels based plants is far more important than the RES drawbacks and the shift towards green energy is in the Romania' own interest, from an environmental stand, but also energy security (diversity of energy sources), economical and social points of view. Figure 2 reveals the SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the RES exploitation in Romania, highlighting that the positive aspects of their use are far more numerous and important than the negative ones. The strengths encompass the domestic endowment with resources, both natural and workforce, while the opportunities have as core issues the possible foreign investment and the public legislation. At the same time, the usage of RES is characterized by a longer supply sector value chains than fossil fuels, implying that more skilled jobs will be created. A large number of weaknesses might be easily addressed by the Government, involving a better land acquisition ruling, public-private partnerships and incentives for the investments in RES. Regarding the threats, some of them might be easily tackled by a stronger involvement of the national and local authorities in promoting and supporting RES. Unfortunately, some of the threats are harder to surpass, as the passing to a smart grid and the development of a proper infrastructure require time, Governmental willingness and financial resources. Given the present economic crisis, the positive effects of a superior exploitation of RES rest on the increase of internal output and increased competitiveness. However, the economic downturn is seen as a potential opportunity, if properly managed by the Government, but also as a threat, given the possible other priorities set by the Romanian authorities.

For all the above reasons, it can be asserted that RES are being currently underused, their share in primary energy production amounting only 16%, while the share in electrical energy production scores 26%. The figures are still far from the European targets of 20% renewable energy use and 38% RES in electricity production by 2020, but they are highly achievable if the RES problem would be responsibly tackled. Therefore, Romania has to use efficiently all its domestic resources and become less dependent on imported energy sources, knowing the fact that the national endowment with natural resources has been an indication of the fuel option of a country, and that the domestic fossil fuels reserves are running out.

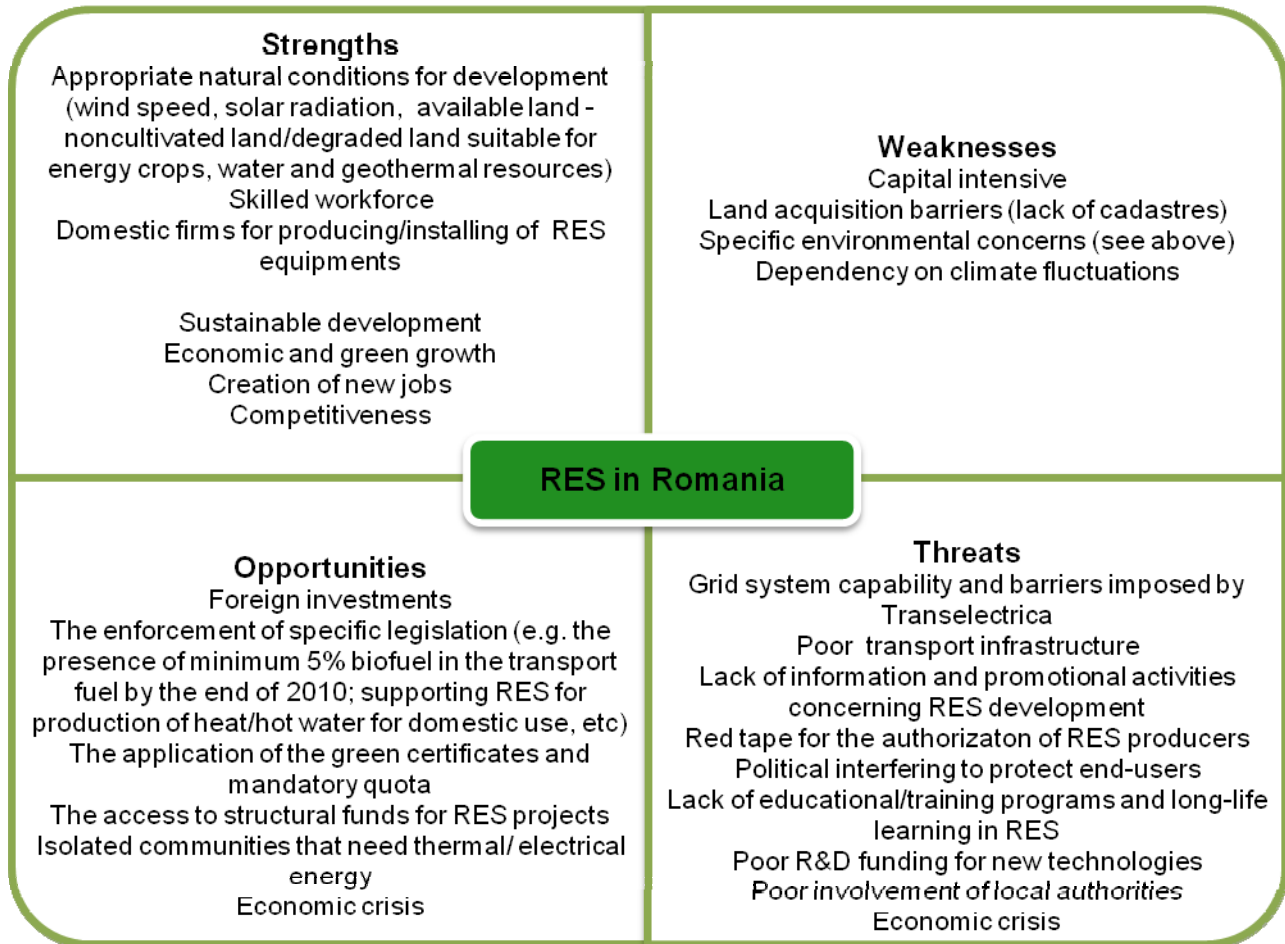


Figure 2. SWOT analysis concerning the exploitation of RES in Romania.

4. CONCLUSIONS

Romania is well and variously endowed when speaking about energy sources, both fossil and renewable. The country has a great potential in exploiting of RES, possessing all the necessary types of resources: natural conditions, technological know-how and workforce. Renewable energy technologies are sufficiently advanced to allow their deep penetration into the mainstream energy, and at present they become also costly efficient. Consequently, there is neither technological nor economical problem, but rather a political one, as what lack today are the public policies and their enforcement and political leadership.

It is clear that the aggressive investments, business agreements and the support by appropriate legislation of RES are in the Romania' own interest, providing the country with a diversified mix of energy sources that safeguards its security of energy supply and its environment. Moreover, Romania has to cope with the effects of the ongoing economic downturn, therefore the exploitation of RES should be addressed, as this would have the potential to increase the internal output and industrial productivity, contributing to the economy competitiveness and the creation of new jobs.

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