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Renewable Energy - Investment for Sustainable Rural Development in Romania

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Abstract. Biomass potential in Romania is significantly. Biomass production is not only a renewable resource but also a significant opportunity for the sustainable development of rural space. Research on the acceptance of the use of renewable energies in rural areas were conducted also in Scotland, Greece, or China, and analysis is accomplished in terms of the three components of sustainable development: economic, social and environmental. This research aims to reveal the huge potential and enormous benefits it brings the implementation of a project of biogas production from biomass like CEFA project, for the sustainable development of rural space as Cefa - a Romanian rural community. It were pursued economic, social and environmental issues. The base material used was the feasibility study for the CEFA project and the measurements and results taken together with the experts of the company, that must convince the authorities about the benefits for society or for the environment, during and after the project implementation. The method used in the research was socio-economic analysis of research data, according to GD 28/2008: economical analysis, social analysis, environmental analysis, risk management. Renewable energy is an area that promises reliable investment for sustainable rural development in Romania, at least due to the following aspects: stimulation works to protect the environment and balancing the ecosystem to diversify agricultural production in terms of biomass production, infusion of capital in rural areas and creating new jobs, development of competitive markets, farmers boosting in accessing grants and funding for sustainable rural development. The conclusion is that all the above mentioned aspects can help to develop and stabilize the country's economy, mainly in rural areas, making its contribution to the conservation of both natural and healthy environment.

Keywords: renewable energy, potential, rural development, sustainability, Romania.

INTRODUCTION

The number of investors in renewable energy is steadily growing in recent years, while the Romanian market is well below the other European markets, considered somewhat "saturated" (www.esimplu.ro, 2013). On the other hand, biomass potential in Romania is significantly. Biomass represents 7% of the primary energy demand and 50% of Romania's renewable resource potential (PNAER, 2010). The results present in this article will reveal that biomass production is not only a renewable resource but also a significant opportunity for sustainable rural development, creating in the same time real conditions for the development of Romanian agriculture.

Greek Researchers analyzed the potential of new members of the European Union, considering that most of them have significant renewable sources (Patlitzianas and Karagounis, 2011). This is also evidenced by the Eurostat statistics (Tab. 1). However, using these resources requires the development of a political, economic, social and technological healthy environment (Patlitzianas and Karagounis, 2011).

Tab. 1

The situation of primary production of renewable energy in European Union 27

	Primary production (1 000 toe)		Share of total, 2010 (%)				
	2000	2010	Solar energy	Biomass & waste	Geothermal energy	Hydropower energy	Wind energy
EU-27	96,650	166,647	2.2	67.6	3.5	18.9	7.7
Belgium	534	1,989	3.0	89.8	0.2	1.4	5.6
Bulgaria	780	1,475	0.8	63.6	2.2	29.5	4.0
Czech Republic	1,339	2,900	2.1	88.6	0.0	8.3	1.0
Denmark	1,766	3,123	0.5	77.6	0.3	0.1	21.5
Germany	9,094	32,746	4.4	78.7	1.6	5.4	9.9
Estonia	512	988	0.0	97.3	0.0	0.2	2.4
Ireland	235	620	1.0	51.8	0.0	8.4	39.0
Greece	1,403	1,985	9.9	44.7	1.4	32.3	11.7
Spain	6,928	14,657	7.0	42.2	0.1	24.8	25.9
France	15,874	20,793	0.5	69.1	0.4	25.6	4.1
Italy	9,598	16,328	1.8	37.3	29.2	26.9	4.8
Cyprus	44	77	79.2	15.6	1.3	0.0	3.9
Latvia	1,393	2,101	0.0	85.4	0.0	14.4	0.2
Lithuania	682	1,185	0.0	94.0	0.4	3.9	1.6
Luxembourg	39	92	3.3	81.5	0.0	9.8	5.4
Hungary	830	1,922	0.3	91.4	5.2	0.8	2.4
Malta	0	0	:	:	:	0.0	0.0
Netherlands	1,347	2,896	1.0	86.6	0.3	0.3	11.8
Austria	6,608	8,600	2.0	57.1	0.4	38.4	2.1
Poland	3,808	6,849	0.0	94.0	0.2	3.7	2.1
Portugal	3,759	5,438	1.4	55.1	3.5	25.5	14.5
Romania	4,040	5,677	0.0	69.6	0.4	29.6	0.5
Slovenia	788	1,041	0.6	59.5	2.7	37.3	0.0
Slovakia	496	1,398	0.0	67.0	0.6	32.3	0.1
Finland	7,748	9,030	0.0	87.4	0.0	12.3	0.3
Sweden	14,741	17,408	0.1	65.4	0.0	32.8	1.7
United Kingdom	2,264	5,327	1.7	76.0	0.0	5.8	16.4

Source: Eurostat, 2013, Renewable energy statistics, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Renewable_energy_statistics, last accession 26th August, 2013

Recent studies related to the renewable energy sector in Romania (Colesca and Ciocoiu, 2013) see the model show significant changes in development of this area, in public policy, the law and the promotion of the use of these resources. Institutional actions together with environmental policy instruments are key factors for efficient utilization of renewable energy. Their recovery can bring a major contribution to rural development and to the progress of local communities. Reduced intake is largely determined by energy policy, which inhibits the delivery and use of renewable energy sources in rural areas (Raslavičius *et al*, 2011).

Research on the acceptance of the use of renewable energies in rural areas were conducted also in Scotland (Shamsuzzoha *et al*, 2012), analysis is accomplished in terms of the three components of sustainable development: economic, social and environmental. Further study compares financing of renewable resource exploitation in the rural area, in two different regions (Liming, 2009). Experiences related to the exploitation of biomass as an energy source were made in China, realizing researches by the following scheme (Fig. 1). Their results demonstrate that such projects consume agricultural residues, provides energy for local communities and increase income of rural residents.

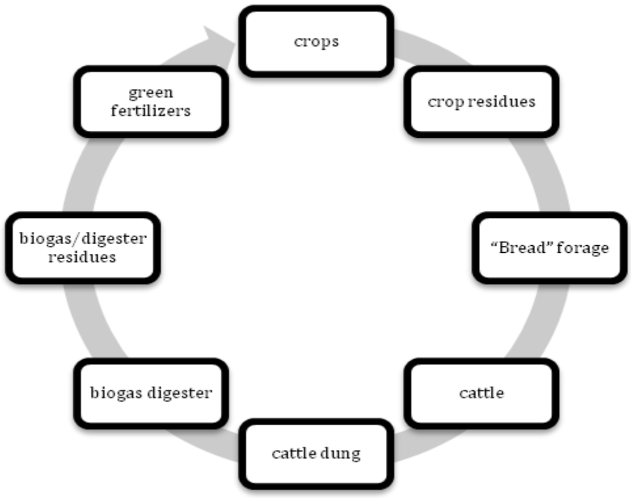

Fig. 1 The cycle of biomass production
Source: Zheng *et al*, 2010.

Research on the feasibility of investment on renewable resources reveals that the use of biomass with a high capacity plant represents one of the most profitable methods of obtaining electricity (Vac, 2012). Most of the studies on renewable energy resources in Romania quantify and show the enormous potential that our country has, especially biomass:

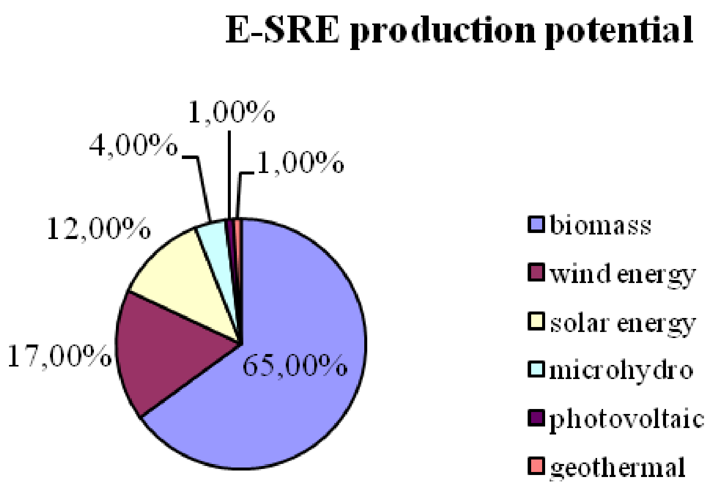

Fig. 2 - Romania's potential in renewable energy generation
Source: Public Relations of the Ministry of Environment and Forests, 2012

But there are no studies to analyze in terms of sustainable development the production of energy from such resources. Based on these considerations, and taking as a starting point CEFA project, this research aims to analyze the economic, social and environmental issues that it might have the implementation of a project of biogas production from biomass on rural areas, where such a project is conducted.

MATERIALS AND METHODS

The base material used was the feasibility study for the CEFA project and the measurements and results taken together with the experts of the company, in order to strengthen its sustainability for attracting partners, as described below. CEFA project is implemented by SC Global ARM SRL Oradea in the industrial park located on the property with no. Cadastral 621, 448, and 573, registered in CF no. 6215/2007, ie on a land area of 33,462 sqm located inside the village Cefa, Bihor county, 30 km from Oradea, property of the company. Basically, the project proposes the construction and operation of a facility to produce biogas and green electricity transformation through a powerful technology applied in many EU countries, with due regard for the protection of the natural environment.

Among other things, both material support, namely legislative documents (such as GD 28/2008), sociologic researches used, yields known, technical materials, environmental impact issues etc, and materials resulting from studies and research (opportunity study, solution study, feasibility study, environmental impact study etc) must convince the investors about the return on capital, but also must convince the authorities about the benefits for society or for the environment, during and after the project implementation.

The method used in the research was socio-economic analysis of research data, according to GD 28/2008: economical analysis, social analysis, environmental analysis, risk management. There were followed a few relevant aspects of the business: benefits to farmers in the area, or to other adjacent businesses, environmental benefits, social benefits, compliance with EU horizontal policies on sustainable development or "polluter pays".

What is important to note is that extending the implementation of similar projects, that benefit absolutely similar, and necessity of their placement in rural areas (i.e. close to the raw material, and away from heavily populated areas), do nothing but multiply these benefits to all stakeholders, which translates into an important contribution to the sustainable development of rural space: fostering agriculture, supporting SMEs, benefits to the environment, social education and benefits.

RESULTS AND DISCUSSIONS

1. Benefits to farmers in the area.

A biogas plant as that of Cefa can operate on the basis of diversified recipes raw materials such as energy crops (corn silage, tetraploid rye etc.), meals (rape, sunflower and other oilseeds), animal manure or remains etc.

The provider of the installation recommended that the starting of the installation and operation of the first year to be made only on green table (SC Global ARM SRL, 2008). Considering only energy crops as feedstock, the annual volume required for biogas plant, based on technical specifications supplied by the provider, is 50,000 tonnes. This quantity can be obtained in two annual crops capacity of 45 tonnes/ha, using an area of about 600 ha per year, or one annual crops capacity of 45 tonnes/ha, using an area of about 1,200 ha.

After the first year, considering, on the one hand, the financial aspects of the business (best cost), and on the other hand, economic and environmental aspects, one of the recipes considered optimal is presented below, in Tab. 2:

Tab. 2

Average annual quantities of raw materials used in the production of biogas

Raw material	Amount
Glycerine	1,000 tonnes/year
meals (especially rape)	2,000 tonnes/year
liquid animal manure (pig urine)	22,000 tonnes/year
animal waste from slaughter (containing stomach, intestines, blood)	3,600 tonnes/year
corn silage	30,000 tonnes/year
recoverable wastewater containing amino acids	500 tonnes/year

The average annual production of rape in Romania is 2.5 to/ha. By cold pressing is obtained pure oil (about one-third) and meal (two-thirds). From total amount of oil, about 80% is converted into biodiesel by esterification process and the rest is pure glycerine (Biofuels, 2007-2013). So, 2,000 tonnes of rape meals and 1,000 tonnes of glycerine can be obained from 1,200 ha of land cultivated with rape.

Using the data provided above, 30,000 tonnes of corn silage can be obtained from 720 ha of land cultivated. Thus, to ensure raw material in terms of energy crops is necessary to cultivate about 2,000 hectares of land. Consequently, it can be appreciated that such a business stimulates work in agriculture. From this point of view, it should be mentioned that the entire north-western Romania has a high agricultural potential, thus fulfilling all the conditions for an intensive energy crops, with low climate sensitivity, and in the last 20 years uncultivated agricultural land in Romania are very extended (Vac, 2012). At the same time, energy crops (corn silage, tetraploid rye, soybean, rape, sunflower) is an important business opportunity for farms located in the vicinity of investment place, diversification of production, reduction of dependence on fodder crops and incomes growth for both suppliers of agricultural products as well as producer of energy from biogas.

On the other hand, following the process of obtaining anaerobic biogas, is been derived quality organic fertilizer that should be used as fertilizer in agriculture (sludge fermentation) which is rich in minerals, namely phosphorus (P_2O_5), potassium (K_2O), calcium (CaO) and magnesium (MgO). This minerals composition is shown in Tab. 3:

Tab. 3

The average composition of sludge fermentation fertilising substances

Dry matter (DM) % / Kg sludge	Organic Dry matter (DM)	pH	N tot. % in DM	P_2O_5 % in DM	K_2O % in DM	C_aO % in DM	M_gO % in DM
10	62	8.3	13	7.7	4.3	8.5	0.87

At an estimated required amount of 50 to fertilizer/ha/year, it follows that will be required area of approximately 440 ha of agricultural land to capitalize the amount of fertilizer produced. After removal of the fermenter, effluent may be processed by mechanical separation to yield a solid phase and a liquid organic substance commonly known as "filtrate". The solid phase is rich in fiber, peat moss similar physical characteristics and may be used to improve the soil. The liquid phase, an organic solution stabilized, has a high value as a fertilizer. It consists of combination of nitrogen, phosphorus and potassium 3-4.5% (dry matter) and can be spread directly on cultivated land. The ammonia content of the "filtrate" is up to two times higher than the manure stored (not fermented). Fermentation increases the uptake of nitrogen over normal values of 30-60%, not decrease phosphate absorption, its degree of assimilation remained at 50% and potassium carbonate is absorbed at a rate of 75-100%. Due to the fact that ammonia is slowly released, immediately after application to the soil, there is a risk that it will quickly evaporate from the composition of the "filtrate" in comparison with the unprocessed manure, if the "filtrate" is not properly managed. The correct application of the dispersion has to be made as close as possible to the ground, and preferably by direct injection into the ground, in which case the risk of loss of ammonia is very low. Successful applications include the use of anaerobic fermentation residue as fertilizer on crops, as an amendment to improve soil and as additives in aquaculture.

2. Environmental benefits.

Considering the raw material presented above (Tab. 2), the first remark to be made is that the use of renewable energy protects natural anthropic resources. In this way, the implementation of biogas plants will cause an decrease in emissions of greenhouse gases in the atmosphere, which in time would be devastating for humanity. Such an investment contributes to one of the objectives of the European Union: to reduce emissions by 4 times until 2050, aiming at a strong „decarbonise" of the energy system by resorting to renewable energy. Secondly, the slaughterhouses pay currently about 100 eur/tone for manure neutralization. Taking such scraps and manure in the biogas production, the investor does not pay to purchase for them, on the contrary, collects 40 EUR/tone for neutralizing (Vac, 2012). It follows that, among the alternative sources of energy, biogas technology, uniquely, can produce energy from materials whose warehousing and storage are environmental hazards today. The primary goal is the production of green energy by exploiting biogas emitted from organic waste. The biogas plant will process and will neutralize pig manure that is produced nearby breeding bases, and animal waste from slaughter, eliminating the problem of the environment by neutralizing (over 25,000 tonnes/year, according to Tab. 2).

In this way, renewable energy production from biogas according to the process technology described above, contribute to reduce the effects of environmental pollution derived from the uncontrolled waste from agriculture (especially animal manure and other scraps left over), from the preparation and processing of food, especially in the slaughter (stomach content, blood, other animal scraps) by using them in the process of biogas.

3. Benefits to other business activities.

Among the raw materials used in biogas were mentioned above glycerin, various meal or oilcake (from rape, sunflower) (Tab. 2). Oilcakes are obtained by cold mechanical pressing of the seed, in the process of getting cooking oil. In a later stage, namely esterification, from oilcakes is obtained the glycerin. Conclusion is simple: given that both oilcakes and glycerin are important raw materials in the production of biogas, the involved factories can harness their "waste" at an elegant and efficient manner.

On the other hand, are "winning" companies whose activities result in recoverable wastewater containing amino acids, for which firms are forced to pay for neutralization. Equally ”winnings” are the livestock farms that are located in the vicinity of investment place, that have the same cost of neutralizing liquid animal manure, and the slaughterhouses in surrounding areas who pay for the neutralization of animal waste. These costs, as mentioned above, can be taken over of the investor in a biogas plant which uses them in the noblest sense. But perhaps the most winnings will be vegetable farms in the area, which may increase exploited surfaces (corn silage, tetraploid rye, rape, sunflower etc) and be assured that they can harness the entire production. Along with these farms, a "beneficiary" is huge Romanian land, no longer lieth in forgetfulness, misery and indifference, resumed the primary role of ensuring the resources required for perpetuation of life on earth.

4. Compliance with EU horizontal policies on sustainable development.

Regarding compliance and promote the "sustainable development" CEFA project conforms to Law 220/2008, with two green certificates for production and delivery of energy from renewable sources. At the same time, the electricity thus produced is taking full priority in the national electricity system, ensuring maximum profitability. On the other hand, the plant can operate on the basis of diversified recipes (corn silage, tetraploid rye, glycerin, pressed rape or sunflower, animal manure, animal waste from slaughter, wastewater with high content of aminoacids), so is minimized raw material supply risk. Also, all materials described above exist in large quantities, moreover, encourages adjacent industries to increase their production. A third element brought into discussion consists in environmental benefits of using such systems, benefits listed above.

If in addition of this motivations should add that such an investment stimulates the entire resource-production-transport-distribution-consumption chain, and investment shows enough mechanisms that can be made more efficient by research, development and innovation (gas engines Jenbacher type, tank-containers for fermentation, anaerobic fermentation or accelerate fermentation processes, storage, use of fermentation residues etc), it can be strongly stated that the investment in CEFA project respect and contributes greatly to the promotion of "sustainable development" in Romania.

5. Compliance with EU horizontal policies on the "polluter pays".

From the combustion plant of the engines results flue gas, in the form of oxides of carbon, oxides of nitrogen and residual oxides of sulfur, which are emitted into the atmosphere as exhaust gas. To minimize SO_2 emissions, biogas passes through a biological desulfurization process. The chimney for flue gas dispersion in the atmosphere has a height H = 10 m. At a nominal operating under the two gas engines is consumed a volume of about 1.568 biogas Nmc/h, respectively 37,632 Nmc/day. The composition of exhaust gas emitted is summarized in Table 5 below:

Tab. 5

Composition of flue gas emitted

Pollutant	Emission values (Technical data engines)	Regulated values cf. Ord 462/93 Tab. 6.1.	
		V.L.E.	Q masic g/h
Dust (soot)	0.5 – 2.5 mg/m^3N	-	
CO	650 - 1.100 mg/m^3N	-	-
SO_x	80 - 110 mg/m^3N	500 mg/m^3N	≥ 5.000
NO_x	150 - 270 mg/m^3N	500 mg/m^3N	≥ 5.000

Maximum emission values are achieved only when starting and stopping the engine. In order to reduce time to reach operating temperature of motors, they have an electric cooling water preheating. The conclusion that can be drawn is that the flue gas emissions are far below the minima permitted according to the current legislation.

6. Social benefits.

All activities described above, namely: the production process to CEFA, the entire resource-production-transport-distribution-consumption chain, in research-development-innovation related, respectively in stimulating activities in various related fields, are created new jobs, there are or will be involved many people who can perform various activities and reduce social pressure on the medium and long term. Exploitation of large areas of land can encourage people to access more European funds in rural development, whatever that means direct subvention on the surface, or rural development projects (acquisition of equipment or agricultural equipment, construction and installation, the development of crops). That means capital infusion in the area, increasing the quality of production and services, the development of competitive markets and with a high level performance. On the other hand, all the environmental benefits of implementation and operation "go back" in favor of the inhabitants of the area, providing a cleaner environment, a land rich in resources, but also more comfort and education regarding the indiscernment use of environmental resources. These latter benefits are perhaps the greatest legacy we can leave to our children.

CONCLUSION

Investment projects to CEFA was in 2008, the year of its release, the first project of producing electricity from biomass in Romania, producing biogas intermediary. The proposed technology at that time was to be used for the first time in our country. Even today, when some similar firms try to implement or use of similar technologies, the project shows many elements of originality, by its own uniqueness at a time, by exploiting the technology at a very low in Romania at the moment, with all the benefits that it entails. Therefore, it is desirable that this approach, absolutely original and innovative in Romania, to be taken from as many investors and transformed in a short time in successful recipe, both economically, and in terms the social and environmental policies. Renewable energy is an area that promises reliable investment for sustainable rural development in Romania, at least due to the following aspects: stimulation works to protect the environment and balancing the ecosystem to diversify agricultural production in terms of biomass production, infusion of capital in rural areas and creating new jobs, development of competitive markets, farmers boosting in accessing grants and funding for sustainable rural development.

All the above mentioned aspects can help to develop and stabilize the country's economy, mainly in rural areas, making its contribution to the conservation of both natural and healthy environment.

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