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Challenges for Biomass Production in the Context of an Expansion of Biogas Plants

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Abstract. *The evolution of European states is based on access to information and knowledge, as well as innovative methods. Thus, the European states began to be more and more aware of the fact that protecting the environment and preventing the destruction of ecosystems are the key elements for progress. Current thinking is based on the continuous transformation of resources towards a finished product. Green energy has become a subject of major importance for all countries of the world and they are constantly trying to find new methods of its production, as well as the constant improvement of existing methods. Part of this market for energy produced from renewable resources is biogas. Biogas is produced by fermenting organic waste of vegetable or animal origin in the absence of oxygen. Biogas consists of methane gas and carbon dioxide. It can be used like any other fuel, having the same properties. Biogas can feed a mini cogeneration plant and simultaneously produce heat, hot water and electricity. This renewable energy is considered CO2-neutral and is an environmentally friendly alternative as a wide variety of residues can be transformed into biogas. For most countries with highly developed agriculture, this alternative can be an affordable option in terms of cost, efficiency and return on investment in the medium and long term. Speaking in the short term, this is difficult to evaluate, given all the factors involved in the process: from inputs to outputs. The perspectives in this sense seem to be quite advantageous if we look at the whole, namely, the decarbonization at the European level, but the legislative and logistical barriers make the situation more and more complex. The legislation regarding biogas production is adapted to the economic-social context of each country, but the entire logistics part is the responsibility of the producer. Here comes a major problem for many potential producers: "how, when and how much" must be done for a biogas station to operate constantly, without interruptions from a logistical point of view. This article aims to find solutions for the flow of raw materials for potential investors in this renewable energy segment to be as cost efficient as possible and at the same time to provide predictability in production. The methodology of this paper is based on a comparative analysis of studies and indicators. The literature in this field is becoming more and more extensive, as interest in this direction has been growing recently. This paper aims to analyze whether this direction towards biogas can be the optimal option for most European countries and the key to a sustainable energy source.*

Keywords: biogas, transport, resources, logistics, production, barriers

Introduction

At this moment, at the European level, the problem arises of making the transport of goods and resources more efficient, in a way that is as efficient as possible, friendly to the environment and able to face the demands of the market. What is not taken into account is precisely the fact that the transport of resources for the generation of green energy could be the barrier that many energy producers face and because of which they avoid investing in projects for obtaining biogas. In order to have a constant flow of raw material for the entire technological process of obtaining biogas, an important storage capacity is also necessary at the level of each producer. This aspect is quite important because when a production station stops, its restart and the entire restart process generate costs, as well as lost time in production. It is quite difficult if the production of biogas does not complement the production of the raw material, biomass. The simplest and most efficient way in

DOI: 10.2478/picbe-2024-0097
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which biogas can be obtained at low costs is to produce both biomass and biogas in the same place. Thus, referring to the agricultural and forestry sectors, these would be the branches in which biomass can be immediately transformed into biogas with a minimum of production costs. A company, whose field of activity is in agriculture, can redirect its residues immediately after harvesting to the production of biogas, without the need for intermediaries. This makes the process of procuring and storing resources for obtaining biomass much simpler.

The challenge arises when a biogas producer is exclusively a producer and is not active in another field of activity from which it can generate the raw material for biomass production. This involves a series of factors, both human and mechanical, which can translate into costs and time. The logistics needed in this case are extremely difficult, especially in countries with legislation that is not necessarily in favor of renewable energy producers (biogas) and that does not offer them the necessary support. This work aims to explore the options that potential exclusive biogas producers have at their disposal and what would be the possible options that they could consider in the near future. One of the companies that produce biogas, and at the same time have incorporated this segment in their current activity, is Agro Schwab SRL. They carry out their activity both in the agricultural and viticultural sectors and in the production of biogas, which they use in-house for heating greenhouses and solariums in the production of legumes. This is an example of good practice, in terms of biogas production, having the entire technological park under the control of the same entity. This means that all the economic activities carried out by this company have predictability and can be based on a real business strategy. When you are autonomous both in the production of the main resource of the production process, the necessary logistics do not pose big problems.

However, when the activity is dependent on a raw material, which can be from year to year in different quantities, the problem of long-term business sustainability arises, without being predictable. This uncertainty and insecurity cause potential investors to take a step back or to consider for a long time the decision to invest in biogas. For a better understanding, we can see the traceability of the entire process: from land preparation, sowing, irrigation - optional, fertilization, combating the main diseases and pests, harvesting, baling residues, transporting bales, sorting bales according to specific characteristics, storing them in specially arranged spaces, their introduction in the biogas production process. This is the favorable case, in which two areas of activity are synergistic, but when the first area is missing, that of biomass production, everything gets complicated. The biogas producer is obliged to secure its main resource, biomass, from several sources, because it is possible that a single supplier may not be able to cover the entire requirement. In Romania, for example, most farmers do not collect bales for the purpose of picking them up by the companies that will deal with their distribution for the biogas producing companies, but prefer to incorporate the plant material back (for economic reasons, a small part of the amount of fertilizer remains in the stem of the plants, and at the time of incorporation, the fertilizer returns to a small extent back to the soil) or to use bales for the purpose of feeding animals. At the national level, there is no strategy to favor the development of this part of the whole process, in order to facilitate investments in biogas production. Another aspect that makes the situation even more difficult is the road and highway network, which makes the transportation of raw materials take longer than in other more developed European countries. Another problem is the availability of transporters to load the raw material, this process takes much longer than loading the grain directly from the field, and must be done as close as possible to the time of harvest. Another aspect is the storage of this raw material (throughout the year), the bales being quite bulky. The biogas stations based on the raw material composed of the agricultural waste resulting from the harvest must ensure their needs

for a whole year, between the harvesting periods. This especially leads to increased costs in terms of storage and maintaining optimal conditions in that space. The favorable time regarding the acquisition of raw material stocks is during the harvest of agricultural crops, the price being a reduced one, which can be called: "one chance in a year".

Literature review

The subject proposed in this work wants to bring attention to one of the barriers that potential and biogas producers have when there is no national strategy to encourage this sector. Biogas represents the source of renewable energy that represents around 19% of energy consumption worldwide. (REN21, 2013) It is known that the market of advanced fuels such as biogas is highly politicized and completely dependent on the laws and legislative changes of each region and country. And in most cases, we are talking about countries that have, unfortunately, a lack of maturity in the markets for advanced fuels (biogas) At the moment in the countries of Eastern Europe, for example the case of Romania, Bulgaria, the Republic of Moldova, both the interest of the producers, as well as of final consumers does not make the legislative changes and the support of the states in this direction change in the medium or long term (IRENA 2019).

Neumayer reports in his work that countries with a democratic system would be much more open and receptive to environmental policies based on renewable energy, and in this sense the decision-makers at the national and European level should set the tone for a change through laws and legislative measures to support the production of biogas. The potential is enormous in this direction, because the European Union is determined to take all the necessary steps to be able to cover the entire energy efficiency at the European level. It is desired that the efforts be constant and maintained with priority so that the lack of Russian gas does not affect the industry or economic-social life and at the same time to mitigate climate changes through the production and accessibility of the use of renewable energy. This sector is capable of supplying up to 167 billion cubic meters by 2050, which means up to 35%-62% of gas demand in 2050. (EBA, 2022)

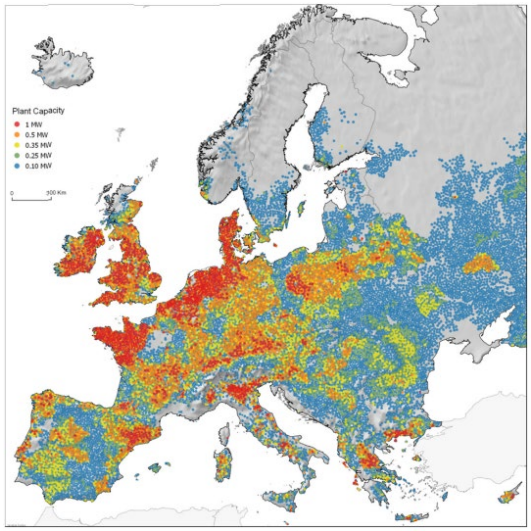

Figure 1. Energy Roadmap 2050

Source: European Commission: (COM(2011) 885 final). European Commission, Brussels; 2011.

It can be seen in Figure 1 that the production potential of biogas exists, and what must be considered to unlock the energy potential of this branch of renewable energy is the removal of

legislative and logistical barriers. At the same time, it is also important that the emissions resulting from the long-term use of biogas are extremely low, a fact that would favor an accelerated decarbonization of Europe. In this sense, we are discussing the reduction of some main environmental pollutants such as black smoke, carbon monoxide and methane. (Grieshop et al., 2011) The facilitation of programs with funds specifically dedicated to the production of biogas and non-reimbursable energy could be one of the incentives that investors would need at this moment to be able to unlock this branch of renewable energy. In this figure the potential for energy development across the European continent is shown from the red 1MW to the lowest value of 0.10MW. The year 2050 seems to show a concentration in the western part of the country of power plants with a large electricity production capacity, and a slight increase in the eastern part. Energy policies must have both a medium and long term feasible horizon, and we can also take into account the fact that economically more developed countries allocate more resources and create more favourable environments for initiatives related to the decarbonisation of Europe, including biogas production.

Moreover, another advantage that could be taken into account is the fact that, when the biogas production is high enough, it could economically support the transport of the raw material for biogas and at the same time the resulting carbon emissions from this transport would be much lower than in the case of classic transport. A study shows us that, at this moment, biogas, which falls into the category of advanced fuels, is not cost competitive enough with any of the fossil fuels used so far predominantly. (Paris et al., 2021) Thus, the first step to be able to facilitate the transport of biomass, and then through an increased production of biogas and transport in general, it is necessary that the strategy at the national level be much more coherent, and the funding should be dedicated to this. At this moment, Europe experienced several moments, the SARS-COV2 Pandemic and the war started by Russia against Ukraine, in which it had to be vigilant with everything related to resources. This vigilance was also visible in what meant the part of investments in new projects with high risk and long-term amortization. Thus, the enthusiasm and patience of investors to risk and invest their resources in a large-scale project, such as biogas production, was and still is not strong enough to be able to move the renewable energy market in this direction. Long-term sustainability needs a synergy from all administrative and legal levels, starting from raw materials, production process and biogas. The trajectory should be a common one starting from several decision levels: communal, local, regional, national, European. (Kanda et al., 2022)

This paper will also link the concept of JIT and biogas production, analysing the link between them at the production and consumption level within an entity. For this field of biogas production, JIT (Just-In-Time) can be an applicable concept for production entities that benefit from the whole production chain and are also direct consumers, as well as entities that do not benefit from the whole chain, but can procure in real time the quantities needed for a certain period and thus adjust their production according to the peaks of consumption in that period. It is also worth mentioning that an example of best practice in this field is Germany, which has both small and large biogas plants, but the small ones seem to perform very well when the plant also has a substrate of an energy crop. With regard to Germany, which in 2020 will have the highest number of plants 232 (IEA, 2020), this increase is significant and is based on the very good yield that biogas has as a fuel. The next countries with the most biogas plants are UK with 131 and Sweden with 80 according to IES (2020). This applies to small factories, and although manure is used, an energy crop such as maize as a substrate brings a plus and a much better yield in production, especially as the silo is at a short distance from the factory. The efficiency and increase that can be obtained by adding certain

elements in the anaerobic digestion process to obtain biogas according to studies are quite spectacular, if we think of the potential they bring.According to a study the efficiency of biogas production can be increased by up to 124% by adding corn and fat silage as substrate. (Asam et al, 2011) Another significant study in this direction is that of De Vries et al, which shows that biogas production can be increased by up to 568% when various additives such as glycerine or fat silage are added, as opposed to processing manure alone. It is worth noting that these percentages put into widespread practice could attract new investment in the sector and also increase interest in both small and large biogas plants. Farmers could be attracted by these development opportunities, and easy access to biogas feedstock could be an extremely important point for them. The concept of JIT could be combined with that of decarbonisation and profit maximisation for producers, and thus the desire to be able to become independent throughout the production process from feedstock to biogas could increase. The key parameter on which the whole process depends is the feedstock along with the substrates needed to maximize production which each producer must manage accordingly (Angelidaki et al., 2018).

Methodology

The methodology of this paper is based on the analysis of studies and indicators that reflect the potential of the biogas. Also, this paper wishes to emphasize an important barrier that stands in the way of biogas production, that of the transport and storage of the raw material for biogas. Especially for European countries where biogas production is quite important, such as Germany, Denmark, United Kingdom and Italy, the problem of identifying and transporting the raw material is not a problem. On the other hand, for countries that have not yet reached their maximum potential in terms of biogas production, it is a real challenge. The studies briefly present the idea of collecting and transporting biomass, especially for Eastern Europe, where the deficient infrastructure most of the time makes the procurement and transportation of raw materials quite difficult and also involves a series of economic and social factors, which will impact the ROI. This is one of the minuses that the entire biogas production process has, for countries where all the logistics of this process are quite difficult to administer. The favorable cases are those in which the biogas producer is also the biomass producer and can apply a JIT (Just-in-Time) management for a defined period of the year, that of harvesting. Simultaneously with this period, a traditional management of resources and stocks must be applied. All this to ensure a constant flow of raw material for biogas production. JIT is a Japanese management philosophy which has been applied in practice since the early 1970s in many Japanese manufacturing organizations. JIT management originally referred to the production of goods to meet customer demand exactly, in time, quality and quantity, whether the `customer' is the final purchaser of the product or another process further along the production line. (Suzaky 1987) From the theoretical perspective this would be the best system, considering the costs and time for this type of production, but this would mean an interdependence between the moment of biomass production and biogas production. This would not be applicable all year round, so the two management systems must be combined. For the practical perspective of this work, we considered the company AgroSchwab SRL, because this is an example of good practice in the production of biogas and is close to a model that can be adapted to the requirements of the Romanian market. This company is based on the activity in the field of agriculture, with viticulture and biogas production being secondary. Schwab Agro Prod SRL was established in 2004 in Satu Mare Romania.

In 2005, the company owned and cultivated 400 ha of land. By expanding its activity in 2018, Schwab Agro Prod owns and cultivates 3,000 ha of land in the Ardud area, Satu Mare county.

The vision of the management and the support of Schwab Agro Prod employees for agriculture contributed to the expansion of the company's scope of activity and the orientation towards the viticulture field. In the years 2008 - 2009, the company established grapevine plantations on an area of 205 ha of land in the Rătești area, Satu Mare county, this area being one of the most established wine-growing areas in the region. In 2009, the company established and developed the most modern grain storage center in Transylvania, with a storage capacity of 35,000 tons and a drying capacity of 800 tons/day. Established in 2014, the biogas station in the town of Ardud is an investment made in partnership - the Schwab company Agro Pro and Biogest Austria. The biogas station is an investment worth approximately 6 million euros and has an installed power of 1.5 MWH. (https://schwabagroprod.ro/istoric-companie/) This is the example that includes all phases of biogas production from the raw material to the finished product, and all the necessary operations are produced in house. The whole process boils down to: the cultivation of straw, oleaginous and other types of plants, the taking of straw and plant residues from the field during harvesting and their baling or direct loading for drying and then storage. After storage, a part goes to biomass production, and then to the biogas station. The electricity generated can cover the energy needs of approximately 4,500 households. The generated heat is used at the grain drying facility, for heating 0.60 hectares of greenhouses and for other activities carried out on the production platform. This is an ideal example, being both a producer and an end-user. The costs are significantly lower than if it would have been necessary to procure the biomass from a third party and transport it to the biogas station. Unfortunately, this example is one of the few in Romania that includes all phases of the production cycle and which is the most efficient in terms of costs, as well as profit generation.

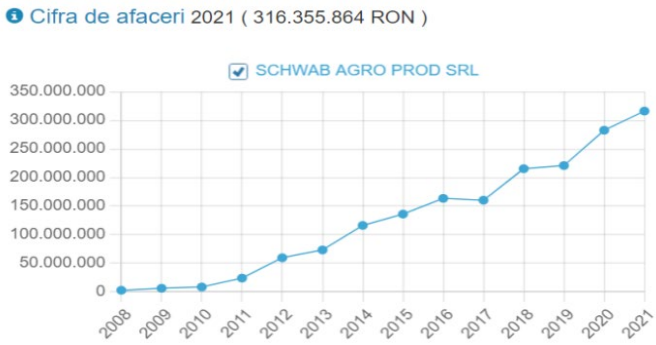

Figure 2. Turnover

Source: https://lege5.ro/Firma/schwab-agro-prod-srl-16753072

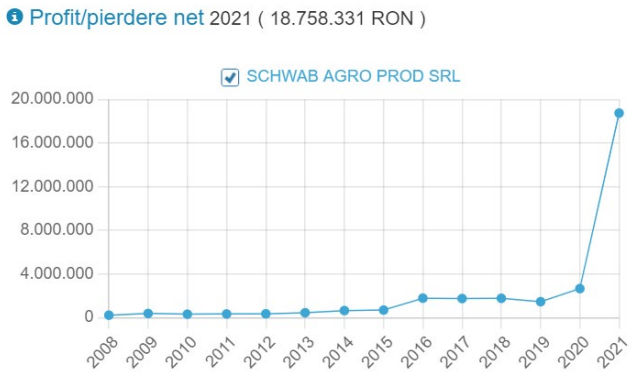

Figure 3. Net profit/loss

Source: https://lege5.ro/Firma/schwab-agro-prod-srl-16753072

It is visible that for this company the production of biogas was an advantage, and the impact is quantifiable. This project was financed from its own funds without any help from the state. The investment is a large-scale one and not every producer of plant material for biomass can support such a project. A large part of the funds should be redirected, and such an investment has a fairly low profitability threshold in the first years, and the amortization goes to the long term, which would mean that in the meantime other projects or investments could be postponed or permanently blocked . In 2014, this project was implemented, and the growth trend is obvious, exemplified by the financial data provided by the lege5.ro website. The indicators being: turnover and net profit/loss. The indicators that helped in the elaboration of this paper were mainly extracted from IRENA reports, especially from the "Renewable Capacity Statistics 2021" report.

Results and discussions

Taking into account all the previously stated, we can outline the profile of a biogas producer who has all the necessary resources for production at hand, as well as what are the disadvantages when the producer is not also a biomass producer. In the Schwab Agro Prod SRL company, the entire process can be controlled from the biomass production stage to its storage. The storage capacity being an important one, represents an advantage, an efficiency of transport and collection costs. From the point of view of transport, the situation is much simplified, as well as of researching the biomass production market. There is no need for research or negotiations with third parties to have the raw material, taking into account the fact that, in Romania, the agricultural area is not properly harvested, and private operators are not willing to give up plant residues. This makes acquisition and collection difficult. Because they do not have sufficient technical capacity, most companies will not invest in the appropriate equipment for collecting these plant residues. Especially in areas where soil maps have been made, and companies have seen shortages of different minerals or substances that can positively influence the harvest, they will not be willing to give up the plant material, but will prefer to incorporate it to try to compensate for the lack of plant-specific nutrients. The problem arises when a mapping is not carried out on the respective lands, and plant remains are still incorporated, this being the cheapest option to get rid of them. Transport, also, is another topic. The transport of biomass is likely to be quite expensive, considering the rather long distances, from where it would be necessary to bring plant residues to be able to support a biogas production assembly throughout the year. Thus, the next aspect that comes into play is the ability to dry, store and store. All involve costs and equipment specially dedicated to these activities, as well as important spaces, properly built in which the thermal and humidity conditions are appropriate. This whole process involves, in addition to a capital dedicated exclusively to the entire process, and collaborations with different companies providing services such as transport, as well as additional labor. The effective maintenance of a biogas installation must be carried out by professionals in order to have the best performance.

One of the solutions I researched regarding the supply of biomass for possible biogas installations would be the creation of regional collection centers from non-reimbursable funds and at the same time with these European financial centers for the establishment of biogas stations strategically located in the vicinity of these centers or placing these centers near the highways in the national network. I believe that this could have advantages, both in the medium and long term, both from an economic and social point of view by creating new jobs, especially for the rural community. On the one hand, the development of the industry in the field of renewable energy by creating new biogas production points, which could significantly reduce the carbon footprint through the heat and energy that such a station can generate, as well as an accelerated

decarbonization of Southern Europe East. On the other hand, by establishing these new biogas stations near the regional collection centers at the national level, the threshold of energy security could be reached, just by reusing the plant material. In order for such regional centers or "biomass logistics and storage points" to be viable from a financial point of view, demand is also needed, which can only come from the biogas producers.

Conclusion

In conclusion, one way in which the state can encourage the efforts of investors is through state aid and non-reimbursable funds, so that decarbonization and the implementation of biogas stations are accelerated. What is also important is ensuring a favorable legislative climate, as well as fiscal facilities. Another very important aspect is the facilitation of access to the raw material necessary for a technological process without interruptions. When the regional biomass storage and collection centers will have a storage capacity large enough to support several biogas stations, we will be able to say that we are moving towards an accelerated reduction of the carbon footprint. Taking into account the potential that biogas has for society, the investments, although they are major, could have a significant impact for society both from the point of view of protecting the environment, economically and socially. In this case, the state should be the main link, able to design, after an overview, coherent and long-term strategies that would be a win-win for both the private sector and the state. With such an approach, we could realistically move towards the year 2050, with more optimism regarding decarbonization and limiting carbon emissions, and at the same time aligning ourselves with the other European states that are taking steps in this direction.

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