

# INTRODUCTION TO BARRIERS FOR DEVELOPMENT OF BIOGAS FACILITIES IN MIDDLE AND EAST EUROPE

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## SUMMARY:

A biogas plant is a difficult undertaking to locate, facing many problems and aspects that must be properly resolved.

In developed countries, biogas producers highlight the lack of political support and call attention to the need for clear policies and support for the industry. Concerns are also raised about the unpredictable political landscape and uncertain future demand for biogas. High levels of bureaucracy with many formal requirements and legal procedures create problems and slow down the process of installing biogas plants. These barriers are seen as problematic and hinder private sector input. Challenges such as climate change, waste management and energy security are often addressed by policy instruments at different levels (e.g., regional, national or union), as well as in different interrelated sectors (e.g., energy, agriculture and transportation). Obviously, policy instruments must be designed in a coherent way to drive the development of biogas technologies. To address these barriers, various collaborative platforms can be created to bring together policymakers, biogas producers, entrepreneurs and stakeholders and help them interact with each other.

Among socio-cultural barriers, lack of public participation, interest and acceptance by consumers is significant. In the European Union, skepticism among potential customers is also one of the socio-cultural barriers.

It is important to involve all stakeholders, in particular the private sector (to promote biogas energy in the market and make it commercially sustainable), governments (to introduce support programs and shape a clear policy landscape), financial institutions (to provide bank loans on preferential terms), research and development institutions (to improve technology innovation and improve biogas processes), lobby groups, the media and local communities (to provide necessary information on energy use and the environmental impact of biogas, as well as to inform the public about the need to manage waste, maintain sustainability, etc.). Environmental protection is an urgent and common problem that should be solved by all parts of society. Without proper cooperation, dissemination of knowledge and resources across and within national borders, barriers will not be easily overcome.

## BARRIERS - TECHNICAL STAFF

The market lacks specialists experienced in operating and running biogas plants.

The lack of experienced staff (professionally prepared) to ensure proper operation and maintenance of the facilities risks the certainty of the plant's operational activities and its proper functioning.

The performance of a biogas plant depends on the experience of the operator, qualified personnel and well-trained workers. The small number of specialized companies, skilled professionals, construction companies and technologists specializing in the design, construction and operation of agricultural biogas plants poses a challenge to the adoption of biogas technologies. In addition, insufficient knowledge among farmers about the use and fertilizer value of digestate hinders the successful production of biogas and biofertilizer. Therefore, farmers should be educated on the proper use of, for example, animal manure for biogas and biofertilizer production. Training in the use of digesters, as well as their maintenance, is important to ensure the efficient supply of energy to households. It is considered an essential way to inform users about the benefits of biogas, its proper operation, as well as maintenance, limitations and safety of biogas plants.

## BARRIERS - PROPER MAINTENANCE

Many authors point to the frequent need for repairs and lack of attention to biogas plant maintenance as barriers to its uptake. Insufficient expertise in the construction and maintenance of biogas plants creates additional constraints on their use. Inadequate management and lack of technical expertise have led to the failure of many biogas programs, which in turn has created a negative image of biogas. Confidence is a function that convinces customers to adopt and invest in new technologies. Consumers consider various issues when deciding whether to adopt or reject a modern energy technology. Technical failures and failed biogas projects can cause a loss of this trust. Households may be reluctant to adopt biogas technology because of the spillover effect of failed digesters.

## BARRIERS - PROPER TECHNICAL MAINTENANCE

Biogas has specific properties that can affect its production. The calorific value of biogas depends on the composition of the biogas and remains one of the most important issues in its use. Biogas composition can be altered by changing operating parameters. Factors such as temperature, retention time, rate of entry into the digester, composition of the substrate, etc. affect the efficiency of biogas production and play an important role in its final composition. Therefore, the calorific value depends on many operating parameters. In addition, the complex composition of biogas, accompanied by unfavorable impurities such as gaseous nitrogen (N<sub>2</sub>), oxygen (O<sub>2</sub>), gaseous hydrogen (H<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), carbon monoxide (CO) and ammonia (NH<sub>3</sub>), can also cause problems such as corrosion, toxicity and reduced calorific value. Impurities in gas, such as CO<sub>2</sub> (lowers the heating value), dust (blocks pipes and gas installations), liquid water (blocks pipes and damages equipment because it freezes at low temperatures) and solids (blocks valves, compressors and other equipment).

Biogas plants also have a generally high sensitivity to changes in the composition of substrates or the substrate mix used. Making changes in the feeding of the plant runs the risk of altering or even collapsing productivity. It is also a process prone to human error.

This means that the challenge is the correct technical design and maintenance of the biogas plant.

## ECONOMIC BARRIER

When choosing an energy source, economic considerations play an important role. Biogas plants require high investment costs. These include the costs of building a biogas plant, purchasing equipment, hiring technical personnel, introducing technology, etc. In the case of a digester biogas plant, although the substrate is generally free, the cost of processing and transporting it, especially over long distances, negatively affects the economics of the biogas plant. Equally important is the case of biomethane, where the installation of a purification unit and a gas conditioning unit requires higher capital costs, which is an obstacle for biomethane to expand injection into the gas grid. The construction of biogas plants is becoming increasingly complicated due to the unavailability of bank loans on preferential terms. In addition, the area of agricultural land can affect the feasibility of building a biogas plant. In Germany, increased competition in the land market is leading to higher land prices; this affects biogas plants, which may not achieve higher profitability due to increased lease prices. The high cost of managing and maintaining biogas plants further affects farmers' commitment to using biogas. Even in Germany, which is by far the most progressive European country in terms of biogas production, the levelized cost of electricity (LCOE) for biogas technologies is relatively high. LCOE provides an opportunity to compare technologies with different lifetimes, capital costs, project sizes, etc., and shows how much it costs to generate 1 kWh of electricity.

Levelized cost of electricity (LCOE) of energy technologies in Germany in 2018 [

Type of energy technologies

Range of LCOE [€cent/kWh].

PV rooftop small 950-1300 GHI in kWh/(m<sup>2</sup>a)

7.23-11.54

PV rooftop large 950-1300 GHI in kWh/(m<sup>2</sup>a)

4.95-8.46

PV utility-scale 950-1300 GHI in kWh/(m<sup>2</sup>a)

3.71-6.77

Wind Onshore 1800-3200 FLH in h/a

3.99-8.23

Wind Offshore 3200-4500 FLH in h/a

7.49-13.79

Biogas 5000-7000 FLH in h/a

10.14-14.74

Brown coal 6450-7450 FLH in h/a

4.59-7.98

Hard coal 5350-6350 FLH in h/a

6.27-9.86

Gas 500-2000 FLH in h/a

11.03-21.94

## MARKET BARRIER

Lower fossil fuel prices and the high price of biogas are critical market barriers. Biogas is more expensive than natural gas. The price of biogas must be competitive with other available fuels in order for it to reach the public sector.

Refined biogas can be injected into the natural gas network, an integration that is feasible and which has some significant advantages. These include greater coverage of new customers in more densely populated areas - as well as in some remote areas where there is no gas distribution - and improved security of local supply. Injecting biomethane into the natural gas grid is an efficient delivery system because conversion losses are avoided, meaning that upgraded biogas can act as a substitute for natural gas with significant environmental benefits. On the other hand, biogas can increase natural gas imports. For example, automotive gas is a combination of refined biogas and natural gas. The supply of 100% refined biogas is not attractive due to its significant cost, but the admixture of natural gas and biogas makes this fuel more attractive to consumers. This fact, however, causes a "domino effect," in that any reduction in biogas production can result in an increase in natural gas imports to the region.

Competition between biogas, bioethanol and electric vehicles may further prevent biogas from becoming widespread. In the case of the Stockholm region, the future role of biogas will depend in part on the development of the market for buses and electric cars. According to survey interviews, electric vehicles are seen as a good option for city centers, while biogas-powered vehicles, such as long-distance buses, trucks and work machinery, are considered more suitable in surrounding areas and city fringes. The reasons why municipalities prefer electric vehicles to biogas vehicles are the lack of biogas refueling stations and internal skepticism and fear of accidents, which is linked to low levels of knowledge. In developing countries, biogas is also competing with traditional solid biomass, cow dung and fiber, as these alternatives are cheaper and readily available in rural areas. Producers of digestate-based products have difficulty competing with existing soil and organic fertilizer producers, as retailers and garden centers prefer suppliers that have an assortment of products and can supply large quantities. Market barriers may therefore lead to a lack of participation by biogas plant developers.

## INSTITUTIONAL BARRIERS

A review of the literature in EU countries has shown that government involvement remains crucial. In many cases, political support and specific programs to promote biogas technologies are lacking. An incomplete network of actors and the highly centralized and hierarchical nature of the programs make private sector input difficult. Bureaucratic issues still need to be overcome in order to obtain funding for biogas companies. Too many formal requirements, complicated administrative and legal procedures create difficulties and slow down the process of installing biogas plants.

The political landscape is very dynamic and uncertain, which is seen as problematic in itself. Biogas producers would like to have clear policies and support for the industry. Several studies mention that the future of taxes, incentives and government support for biogas is generally unclear. In Sweden, they note that important actors are waiting for the "rules of the game" due to their unpredictability, and many biogas producers mentioned that there are many uncertain factors in the market. In the Lönnqvist survey, respondents stressed that predictability of support is even more important than the exact design of policy instruments. Another important point made by Lönnqvist is that the Swedish government cannot design policy instruments without considering the EU framework. One example of this problem is the modification of the biofuel energy tax to avoid overcompensation due to EU regulations. As a result, insufficient information on energy policy developments can be a significant barrier to investment in biogas plants.

Government strategy and effective support programs play a key role in biogas implementation. However, this kind of support can become a vicious circle for the biogas sector. In some cases, this phenomenon has already occurred, such as in Germany], where the reduction of feed-in tariffs (2012 and 2014) and the cancellation of the tax exemption for biomethane (2016) slowed the growth of biogas production.

Several authors have identified the lack of private sector participation and poor coordination between the public and private sectors as factors hindering the uptake of biogas]. This is an important point because the private sector plays a key role in promoting biogas energy in the market and making it commercially sustainable.

## SOCIAL BARRIERS

Problematic cases of biogas installations are publicized, for example, when there was a problem of nuisance odor emissions. Knowledge of these problems elsewhere often provokes public protests and prevents the installation from being located in a favorable place (available substrates, energy reception, etc.).

The construction of new biogas plants is fraught with contradictions: even though biogas is generally considered an environmentally friendly energy production technique, such construction leads to protests from the public, which opposes it.

In fact, the biogas plant supports a number of complex and diverse activities, mainly resulting from the reuse of waste, especially waste from the agricultural industry (e.g., manure, farm wastewater, vegetable food scraps) and/or industrial and municipal wastewater treatment plants.

Despite these positive elements, biogas production can provoke protests in local communities for real or perceived negative reasons.

Protests also occur, often unfounded, at built and commissioned installations. Local communities are able to file denunciations with various institutions that aim to hinder or even bring about the cessation of their activities.

Some authors point to the low level of knowledge of the general public. For example, potential customers do not necessarily know the difference between natural gas and biogas. Some of them have not even heard of biogas or biomethane before. The reason may be the lack of educational and guidance materials on the selection and economic feasibility assessment of biodegradation technologies, which can lead to a lack of awareness and a low level of knowledge. Lack of information and limited interaction with potential users may be another reason for the low level of knowledge among people.

## LOCATION BARRIERS

Local availability of substrates from a variety of sources: a properly located installation must provide a diversity of substrate sources. Unfortunately, a large proportion of them do not provide them due to the barrier of local lack of diversity.

Differentiation can also vary over time, which means risks to the business and economic performance of the installation.

Potential for using different types of substrates: the safest type of plant is one that can operate on many different substrates. However, even operating on multiple substrates raises dangers related to productivity and the interactions between substrates in the process.

In addition to aspects related to local substrate availability and the variety of substrates that can be processed by the plant, one of the key roles is played by the potential for supply. If there is an insufficient supply buffer, economic conditions or, for example, another plant that will be built in the area can pose a threat to the continued operation and survival of the plant.

Problems with access to the power or gas grid: an important factor in locating an installation is the ability to plug into the power or gas grid. Often it happens that even if the location and surroundings are favorable for the successful design of the installation and its successful commissioning, there is a problem with connecting the installation to the appropriate network.

## BARRIERS - ENVIRONMENTAL RISKS

The stability of agri-food enterprises is one of the important external elements influencing plant operations.

Investment in an installation is a high capital-intensive investment. Combined with a number of business risks, mainly related to the high operability of operations, the high capital requirement is a high barrier to development.

## THREATS - IMPLEMENTATION OF NEW SOLUTIONS AND TECHNOLOGIES ON THE MARKET

The market for technologies, including biogas and biomethane, is growing all the time. An existing plant, in addition to maintenance costs for repairs and replacement of wear and tear, should modernize over time with new more efficient and safer technologies. Unfortunately, the cost of modernization is a major challenge for most installations.