The development of EIA screening for the anaerobic digestion of biowaste projects in Latvia

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Abstract

One of the main priorities among European Union member states is to promote renewable energy. Latvia also has to comply with the European Parliament and Council Directive 2009/28/EC on the promotion of renewable energy initiated on 23 April 2009. The directive states that renewable energy must reach 40% of total final energy consumption by 2020. A portion of this can be achieved with the energy produced by burning biogas produced by the anaerobic digestion of biowaste. The use of biowaste as a resource allows Latvia to move closer to the EU's common objectives by reducing the amount of waste disposed in landfills. Biogas production through anaerobic digestion is considered one of the most successful methods of dealing with increasing environmental pollution. Heat and electricity are produced by burning biogas in cogeneration plants. The production of biogas from organic waste also addresses issues related to the disposal of waste products. Waste that would otherwise be considered unusable has now found a second life in the production process of biogas. Given that until 2020, the share of renewable energy in Latvia has to be increased, it can be expected that in the coming years the amount of biogas production and combustion plants will increase. Environmental impact assessment (EIA) is a well-known tool which can aid in sustainable development. Screening is one of the most important stages of EIA. The paper analyses the possibilities of developing a screening process for anaerobic digestion of biowaste projects for EIA in Latvia. In this paper, the demands which should be included in the guidelines of the screening process were created and analysed.
Keywords: EIA, screening, anaerobic digestion, biowaste, biogas projects, renewable energy.

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1 Introduction

The aim of the screening phase is to determine if the project shall be subjected to an environmental impact assessment (EIA). Without this verification, some actions would be evaluated very stringently, while others would be forgotten or ignored. While carrying out an effective assessment, a list with the activities planned, accompanied by the values and criteria for determining whether an activity should be evaluated are formed [1, 2].

Categories of activities for which it is compulsorily to carry out an EIA are defined in annex 1 of the EIA directive. In annex 2 of the directive, the operations that need to be undertaken in the EIA procedure on a case by case basis are defined. There may also be activities that are not included in these annexes, but the responsible governmental organization has to decide whether to administer the EIA procedure to the activity after the screening process has been completed. The state may also establish stricter limits, allowing certain projects to be subject to the EIA procedure. The EIA procedure can also be completed on a voluntary basis as an important step in developing the project [3].

Despite the fact that the EIA directive defines a uniform screening process, each country has implemented the EIA directive differently. Together with significant differences in regulations and the practices in the initial inspection, the main shortcomings which have emerged are: doubts of the effectiveness of certain criteria and limits of the systems for projects in annex 1, the non-systematic approach for verification of projects in annex 2, large differences in the initial test criteria between member states, the lack of clear definitions for the types of projects leading to possible misinterpretation of daily practice. Criteria that define the level of significance of the project vary depending on the quantitative or qualitative assessment. Predestined criteria are based on thresholds, or previously taken measurements, and specified restrictions and limits existing in laws, rules, and other guidelines. Criteria based on the judgment are applied, if the project is unlikely to have a significant impact, but in the context the need to take precautions is justified.

Four types of approaches to the initial verification can be distinguished:

1. Pre-trial or preliminary environmental assessment – the need for an EIA is seen through the early assessment process for projects of any type, under any circumstance.
2. Each individual case – the need for an EIA is assessed for each project individually. This approach is usually used in conjunction with another method as its complement, for example, a list of projects or thresholds.
3. A list of projects – the need for an EIA is based on a list of projects divided into different categories and types. There are two types of lists – positive and negative. Positive lists specify the projects that need an EIA, the negative lists show exceptions.
4. Thresholds – the need for an EIA is based on the specific measures and restrictions of pre-defined criteria. These criteria may be differences in the size of the project, the particular location, as well as other criteria [4].

2 Screening in Latvia

In Latvian legislation, activities that must be carried out in an Environmental Impact Assessment are clearly defined. Furthermore, the scope of the work, which is carried out in accordance with international treaties, is clearly defined. At the same time, groups of activities subject to the screening are not well defined in the Latvian legislation. This also holds true in relation to the screening thresholds and criteria for the evaluation of the potential impact of the activity which are also not clearly defined. This leads to a very wide field of subjective judgments and indecisive approaches. By unreasonably reducing the number of projects which are subject to EIA procedure, the public's right to engage in discussion becomes limited, and it is not possible for the public to comment on a project. The lack of laws, regulations, and guidance complicates the decision-making process, leads to a conflict and makes it possible to use the lack of structure within the laws for self-serving purposes.

According to legislation, the application of the initial planned activities is filed at the regional environmental administration of the State Environmental Service. This depends on the location of the planned activity. The regional environmental administration evaluates the material concerning the proposed project and decides whether it is necessary to perform a screening. By evaluating the laws and regulations, it was found that The Cabinet of Ministers of the Republic of Latvia has determined the order in which the screening of the environment is completed for the proposed action. The application procedures and content are defined in the legislation.

According to Latvian laws and regulations on screening, the regional environmental administration is entitled to invite experts to evaluate, request, and receive information from state and local government institutions, as well as to request and receive additional information from the project proposer. However, given the current economic situation, the government is not able to invite experts, due to the lack of resources available for the remuneration of experts [5].

It is not possible to define precisely what is considered to be a significant impact on the environment. In most of the developing world, where the EIA procedure has been introduced, various methodological tools are developed to aid in the process. Consequently, the uniform potential of an environmental impact evaluation in the screening process of proposed actions could be made, and a decision as to whether the activity should include an environmental impact assessment procedure could be taken. In most cases, such aids are made as questionnaires or a matrix.

The criteria of the significance of the impact include the description of the threshold value for identification [6]. The threshold values in Latvia are environmental quality standards, emission limit values, and other limits and restrictions set in various pieces of legislation. Since the various restrictions and environmental quality standards vary in different areas, and for various types of activities, then in most cases the significance of impacts is assessed individually in each case. Often the significance of the impact is not only dependent on the type and amount of hazard of the planned action, but also the characteristics of the selected place have an important role. In some cases, the impacts of small objects which do not exceed the allowable thresholds are potentially dangerous, if they are planned in a sensitive or congested area; therefore, these projects are applied to the EIA procedure. But at the same time, the relatively large objects with possible impact parameters similar to EIA application volumes may not require application of the EIA procedure because of the optimal choice of location, and the projected technology that allows the impacts to be reduced to insignificant levels.

It is clear that screening is one of the most important and responsible steps in the process of the EIA. A faulty decision could lead to substantial financial loss for the future performance of the project, if an unreasonable decision is made to apply the full environmental impact assessment procedure, which requires substantial investments in both time and finances for the project.

Perhaps even greater losses are possible if technical regulations are not fully prepared because the possible impact is not fully assessed for the proposed action, and the implementation of the project has already started, while not realizing the potential problem situations and risk factors resulting in damage to the environment. It is known that in most cases, the consequences of the negative effects requires more resources and time than measures that could have prevented or reduced the possibility of the caused damage.

3 Screening of biogas production projects

Biogas from anaerobic fermentation has several advantages. First of all, biogas is a renewable energy resource. The current global power supply is dependent on fossil fuels; such as crude oil, lignite, coal and natural gas. These are non-renewable energy resources and the reserves of these resources are being depleted much faster than new ones arise. By contrast, the resulting biogas from the anaerobic fermentation process is a completely renewable resource since biogas is produced from biomass, which stores solar energy in the process of photosynthesis. Also, the energy produced by burning biogas contributes to the national energy sustainability and reduces the dependence on imported energy [7].

Similarly, the production of energy by burning biogas is a way to deal with the increasing nature of global warming. Here, the essence lies in the fact that the combustion of biogas releases CO_2, which is the carbon attracted by plants from the atmosphere in the process of photosynthesis. This is the main difference between burning biogas and fossil fuels. In this way, the biogas carbon cycle ends in a very short time.

Biogas from anaerobic fermentation is considered to be an optimal solution for different types of organic waste. The waste is converted into renewable energy and organic fertilizer [7]. Such organic waste as people's household waste, crop residues, animal waste, and fertilizers begins a new life cycle in biogas plants. Otherwise this organic waste would have no use, and new landfills would need to be made for their storage. After anaerobic digestion, the digestate, because of its qualities, serves as a good soil fertilizer. Digestate is rich with nitrogen, phosphorus, potassium and trace elements that can be applied to the soil with conventional liquid manure and slurry equipment. Compared to raw manure, the digestate has improved fertilizer efficiency because it is homogeneous and contains more nutrients; furthermore, the digestate has a better carbon/nitrogen ratio and is nearly odourless.

Biogas production benefits the farmers who have participated, as well as society as a whole. The benefits from the production and usage of biogas are an increased capacity of the local economy, higher employment in rural areas and an improvement in the region's solvency. Compared to fossil fuels, biogas production with anaerobic fermentation requires a much larger work force to ensure the production processes, collection and transportation of anaerobic materials, manufacturing of the equipment, installation, operation, and maintenance of biogas plants.

As for the construction of biogas plants, by the time a project has reached the design stage, a screening must have already been completed. This is in accordance with the law "The Environmental Impact Assessment" annex 2 – "Actions that require a screening". The application of a screening is filed by the owner of the emerging biogas plant in the State Environment Service regional government, which then completes the procedure in accordance with the law "The Environmental Impact Assessment".

In order to ensure environmental compliance in the construction project of the biogas plant, the regional environmental administration issues technical regulations, unless it is found that a full EIA procedure should be applied to the biogas plant during the screening period.

4 Waste management in Latvia

Latvia has been divided into 10 waste management regions. In Latvia, waste management is governed by the Waste Management Law. In adherence to the Waste Management Law, waste management in the country has to be achieved according to national and regional waste management plans.

According to 2010 Latvian statistics, 64% of all collected municipal solid waste (and other comparable waste), including bio-degradable solid waste and packaging, was disposed of in MSW landfills [8].

In the next few years, changes in the waste management system are intended to reduce the amount of disposed waste. The Waste Management Law states that waste must be treated before disposal. The treatment of waste before disposal means the separation of recyclable or comestible waste, as well as hazardous waste, by households. In Latvian landfills in the coming years, landfill operators have planned to establish waste pre-treatment lines to meet legislative requirements. That would significantly reduce the amount of waste going to landfills.

An EIA was carried out for 10 out of 11 landfills before the implementation of the MSW landfill project. For one site, an EIA was not carried out since it was made in an existing waste dumping site. In order to evaluate whether predicted impacts were assessed in a sufficiently objective manner, an analysis comparing the current situation with the planned design was carried out. Annual environment reports were used for the performance evaluation of the landfills. Annual environment reports are developed according to the waste management legislation in Latvia.

During the research, an analysis of the biowaste amount, and its characteristics was completed. The results show that the majority of biowaste, which can be used for energy production, is landfilled in Latvia.

From 11 landfills, only 3 have landfill gas collection systems. This leads to the situation where almost all potential waste energy is unused. The amount of landfilled municipal solid waste (MSW) during the five-year period between 2008 and 2012 decreased. This was mostly due to the economic crisis, and a reduction in the number of inhabitants, and not to an increase in the recycling of waste.

From 2008 till 2012, the amount of landfilled municipal solid waste decreased by approximately 30%, from 64,688 tonnes in 2008 to 431,790 tonnes in 2012.

An average of 30% biowaste was used during the calculations. The amount of biowaste which could be separated from municipal solid waste was 219,411 tonnes in 2008 and 151,127 tonnes in 2012.

In fig. 1, the amount of landfilled waste, including municipal solid waste biowaste together with green waste and sludge is shown.

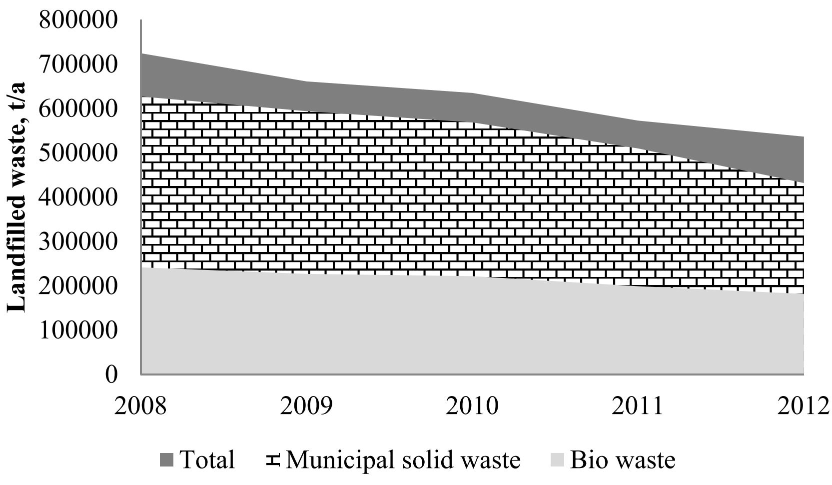

Figure 1: Amount of landfilled waste 2008–2012.

The figure shows a decrease in the amount of landfilled municipal solid waste, but at the same time the amount of landfilled biowaste, which includes green waste, was essentially the same.

5 Biowaste management

Taking into account European targets regarding the reduction of biowaste landfilling, the future consequence will be that suitable biowaste will be used more for the production of energy. In Germany for example, if electricity is generated by facilities using biogas produced by anaerobic digestion of biowaste, this electricity attracts a higher subsidy rate than if the biogas is produced by digesting other types of biomass. Sustainable management of biowaste combines material and energy recovery paths with the aim of optimising the integration of nutrients and carbon recycling, energy production, and CO_2 reduction by replacing fossil fuels.

The treatment option of biowaste depends on the quality of collected materials. If biowaste is separated from the MSW stream, biowaste contains impurities which can negatively affect the operation of the biowaste treatment plant.

Anaerobic digestion of separately collected biowaste leads to a larger energy output compared to the mechanical biological treatment (MBT) of biowaste. Therefore, the separate collection and treatment of biowaste promotes cleaner production principles in biowaste treatment. During the screening process of the two alternatives, anaerobic digestion of separately collected biowaste must be recognised as a more suitable option in comparison with MBT.

Mechanical biological treatment of MSW has become more popular in recent years. MBT is a waste treatment process that involves both mechanical and biological treatment. The first MBT plants were developed with the aim of reducing the environmental impact of landfilling residual waste. The steps of an MBT are shown in fig. 2.

6 Criteria for assessing the impacts of biogas plants

During the EIA of biogas plants, special attention must be paid to these essential criteria: impact on air quality; occurrence of odours; occurrence of noise; impact on soil; impact on water; safety aspects of the station.

6.1 Impact on the air quality

Biogas consists mainly of methane, carbon dioxide, and water vapour. The composition of biogas can be found in table 1.

As shown in table 1, the composition of biogas varies. Mainly, biogas composition depends on the type of substrate that has been used for biogas production. Mainly carbon monoxide (CO), which is a product of incomplete combustion, and nitrogen oxide compounds (NO_x) are emitted while burning biogas. Both of the above-mentioned gases are considered to be greenhouse gases.

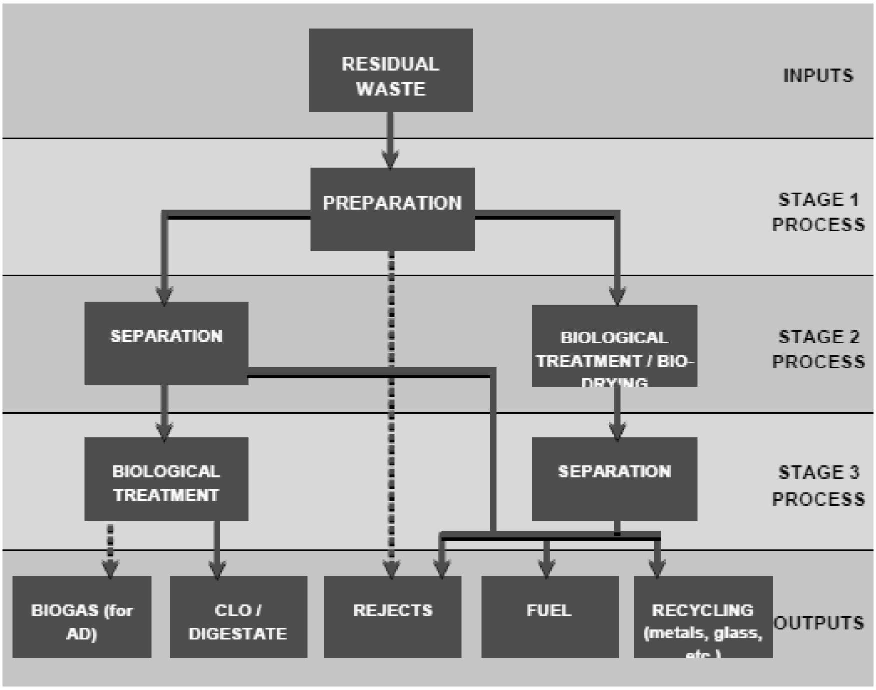

Figure 2: MBT options [9].

Table 1: Biogas composition [10].

Component	Chemical symbol	Content, % by volume
Methane	CH_4	50–75
Carbon dioxide	CO_2	25–45
Water vapour	H_2O	2 (20°C)–7 (40°C)
Oxygen	O_2	<2
Nitrogen	N_2	<2
Other compounds	NH_3	<2

A certain amount of substances are released into the air from the combustion of biogas in the torch. The torch is used when the biogas yield is greater than intended and it is impossible to have additional storage of biogas. Since biogas forms an explosive compound when combined with air, it cannot be simply blown into the atmosphere; instead biogas must be burned in the aforementioned torch. The design of the torch has to be able to convert methane. This reduces incompletely burnt methane and the generation of other products of incomplete oxidation, such as carbon monoxide.

Biogas combustion in the torch is considered to be an environmentally unfriendly solution, because the combustion happens without generating energy and, therefore, should only be regarded as a backup solution. Therefore, special attention must be paid to the solutions pertaining to biogas usage during the initial evaluation of biogas plants.

According to Latvian law, any available and accepted methods in the world can be used for calculating emissions when modelling air emissions. That leads to a situation where different companies use different modelling methods for emissions, as well as different emission factors. As a result, it is not possible to objectively evaluate the estimated emissions from various plants. In addition, companies often use emission factors of natural gas during the modelling process, which should be unacceptable because the biogas composition differs from the composition of natural gas. It is therefore necessary to develop a uniform methodology for calculation and the modelling of air emissions for biogas plants.

6.2 Occurrence of odours

It is necessary that the substrate is kept in closed containers in order to prevent the occurrence of odours. However, odours cannot be completely avoided. This is related to the loading of the substrate into the storage tank. Therefore, an important factor to be considered is the leading wind direction, which certainly should not be directed away from the biogas plant to nearby populated areas. Raw biogas contains hydrogen sulphide. This has a rotten egg smell and is unpleasant for people. So it is necessary to consider all the risks associated with raw biogas emitted into the atmosphere. In contrast, purified biogas is odourless [11].

The smell of manure during anaerobic fermentation is reduced by 80%. Digestate no longer has an unpleasant smell of slurry after treatment – it smells more like ammonia [7].

6.3 Occurrence of noise

Noise emissions during biogas production derive mainly from the production machinery – air and exhaust fans, the mixer cooler, and the flue. Similarly, noise also arises from the transport which delivers the raw material to the biogas plant. If most of the noise from the production installations is unavoidable, then noise arising from transport can be optimized by planning the transportation of raw materials in daylight. In addition, if the resulting noise from the biogas deliveries of raw materials is not permanent, while assuming that the biogas plant operates 24 hours a day, the noise from production installations is a constant. In both cases, how to station the location away from the nearest populated area must be taken into account [7, 10].

6.4 Impact on soil

The end products of the biogas production process are the biogas, which is a fuel gas, and the digestate. Digestate is fermented mass, which is rich in microelements and macronutrients, so it can be used for soil fertilization. The quality of digestate is even better than the untreated slurry. In the case of centralized co-digestion in Latvia, farmers receive only the amount of digestate back which they may use for agricultural fertilizer in accordance with the laws and regulations. The surplus is sold in the particular region to grain growers. In all cases, the digestate is included in fertilizer plants of each farm to replace mineral fertilizers with the digestate.

6.5 Impact on water

It is important that raw materials for biogas production are not present in direct contact with the soil and water. The main reasons for such an event may be insufficient reactor insulation, cracks in storage tanks, and the damage of pipes caused by corrosion. Untreated substrate affects groundwater – the quality drops and pollution increases. Such pollution can lead to various diseases and environmental degradation. Soil and water contamination with raw substrate may cause adverse "slurry vegetation" and increases the risk of spreading pathogens. Related to the issue of quality as well as the protection of groundwater and soil in the life cycle of biogas plants, this occurs in 3 different ways:

1. When the station is at the planning stage; the right combination of place and technology (including materials) can solve most of the issues related to the protection of groundwater;
2. During construction, when a leakage of hazardous substances is possible;
3. In the operating hours of the station, when groundwater monitoring is recommended by taking samples to determine the quality changes.

Also, the risks of flooding in the territory should be taken into account. Biogas plants should be planned in a place that has not been flooded in the past 30 years at least [12].

6.6 Safety aspects of the station

It is necessary to include an assessment of various preventive and damage control measures in the permit required for the biogas plant that allows it to run in the following cases: explosion prevention; fire prevention; mechanical hazards; sound-proof design; electrical safety; lightning protection; thermal safety; asphyxiation and poisoning prevention; hygiene and health safety.

Under certain conditions, biogas combined with air forms an explosive gas mixture.

7 Conclusions

The aim of renewable energy sources can be achieved by 2020 in Latvia. If energy efficiency of user energy resources is ensured, and energy sources are constructed where fossil fuel is replaced with a renewable source.

In the past years, the number of procedures of EIA applied to biogas projects has increased. It is necessary to implement a systematic approach in the procedure of EIA.

It is necessary to elaborate a common approach for the EIA of biogas projects. For establishing and describing the impacts and degree of significance related to carrying out the screening of biogas plants, set criteria ought to be used.

For projects that are subject to the EIA procedure, a life cycle analyses must be done.

References

[1] Toro, J., Requena, I. & Zamorano, M., Environmental impact assessment in Colombia: Critical analysis and proposals for improvement. *Environmental Impact Assessment Review*, **30**, pp. 247–261, 2010.

[2] Kornov, L. & Prapaspongsa, T., Environmental Impact Assessment II, Aalborg University: Aalborg, 2011.

[3] Koornneef, J., Faaij, A. & Turkenburg, W., The screening and scoping of environmental impact assessment and strategic environmental assessment of carbon capture and storage in the Netherlands. *Environmental Impact Assessment Review*, **28**, pp. 392–414, 2008.

[4] Pinho, P., McCallum, S. & Cruz, S., A critical appraisal of EIA screening practice in EU Member States. *Impact Assessment and Project Appraisal*, **28**, pp. 91–107, 2010.

[5] Pubule, J., Blumberga, D. & Romagnoli, F. & Rochas, M., Analysis of the environmental impact assessment of power energy projects in Latvia. *Management of Environmental Quality: an International Journal*, **23(2)**, pp. 190–203, 2012.

[6] Wood, G., Thresholds and criteria for evaluating and communicating impact significance in environmental statements: 'See no evil, hear no evil, speak no evil'? *Environmental Impact Assessment Review*, **28(1)**, pp. 22–38, 2008.

[7] Daublein, D. & Steinhauser, A., Biogas from Waste and Renewable Resources. An Introduction, Second, Revised and Expanded Edition, WILLEY-VCH: Weinheim, 2011.

[8] Ministry of Environmental Protection and regional development, State Waste Management Plan 2013–2020, Ministry of Environmental Protection and regional development: Riga.

[9] Department for Environment, Food & Rural Affairs, Environment Agency. Mechanical Biological Treatment of Municipal Solid Waste. DEFRA: London.

[10] Blumberga, D., Veidenbergs, I., Romagnoli, F. *et al.*, *Bioenerģijas tehnoloģijas*. Madonas Poligrafists: Madona.

[11] Blumberga, D., Dzene, I. *et al.*, *Biogas Handbook*, 2011.

[12] Kossman, W., Pönitz, U., Hebermehl, S. *et al., Biogas Digest, Volume II. Biogas Application and Product Development,* GTZ, 1999.