Climate-friendly agricultural practice in Latvia

Promoting the biogas production

Aim for the implementation of the measure

The aim of manure fermentation in a biogas reactor is to ensure efficient manure management and production of valuable fertilizers for agricultural crops, as well as to reduce GHG emissions to a minimum in cattle, pig and poultry farms.

Liquid cattle manure processing plant on the farm "Mežacīruļi"

Essence of the measure

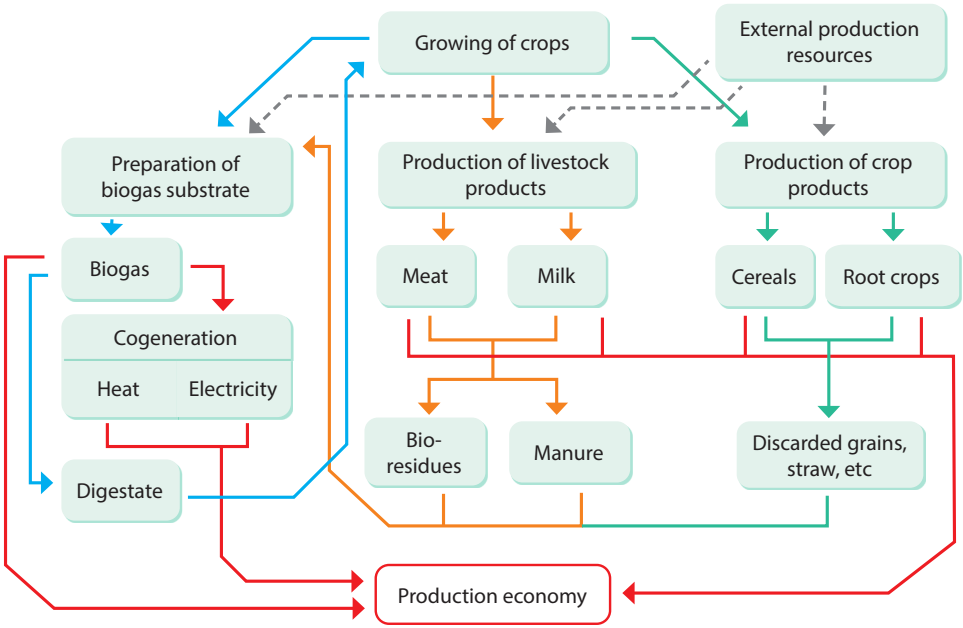
Manure dry matter contains carbon that is bound in organic compounds, which is partially converted to methane (CH_4) and carbon dioxide (CO_2) in the biogas formation process with a small addition of other gases, but ensures that the nutrients used by plants remain in the processed liquid manure. This mixture of two gases is called biogas.

In biogas plants, livestock manure and slurry can be processed together with other organic waste or crop biomass. The measure is based on the production of energy (biogas) from agricultural products and its subsequent conversion into thermal energy, in large plants also into cogeneration electricity.

The process consists of the production of agricultural products (substrate preparation), the production of biogas and the process of cogeneration, as a result of which electricity and heat are obtained, which are used for own consumption or sold. The biomass to be processed is first stored and mixed in a pre-treatment tank. Afterwards it is locked into a hermetically sealed container (bioreactor) where it is heated up to 35-52 ° C. The biomass in the

bioreactor must be held for 80-100 days until its complete fermentation. In the meantime, about half of the dry matter is converted into biogas. The recycled biomass is pumped to a storage tank. During processing, the total amount of biomass is not significantly reduced, as more than 90% of the biomass is water. According to the conclusions of LLU scientists (Priekulis et al., 2015) considering the IPCC guidelines and calculations of foreign researchers, the use of freshly obtained manure for biogas production practically does not cause methane or nitrogen emissions. Thus, in the context of reducing agricultural GHG emissions, the decisive factor is the use of manure as a basic substrate in biogas reactors. Along with this process, a recycled substrate or digestate is formed, which can afterwards be returned to the farming cycle as a fertilizer. Digestate contains a nitrogen form that is easier-to-use for plants, which is an additional benefit, the efficiency of which is influenced by such factors as, for example the type of substrate, storage of liquid manure, type of digestate spraying in the field, transportation distance, location of fields etc.

Schematic model of biogas energy production. *Source: Naglis-Liepa, 2013*



Advantages

Biogas production is the most advantageous method for liquid manure management, as:

- Creates an unlimited opportunity to obtain energy resources on farms where manure is produced;
- Reduces GHG emissions to minimum;
- Reduces odours;
- Improves the nutrient properties of liquid manure plants;
- Reduces the amount of germinating weed seeds in organic fertilizer (digestate);
- Has a positive effect on fertilization of fields with digestate - soil fertility improves, crop productivity, consumption of mineral fertilizers decreases;
- Reduces the need for energy resources from external suppliers by providing self-produced heat, for example, in greenhouses, on-farm water heating, drying of the separated digestate fraction etc.;
- Indirectly diversifies production through increased use of resources;
- Heat is supplied to a local village or is otherwise used productively;
- There is accumulated knowledge and experience in Latvia;
- Is efficient way of waste management;
- Labour consumption for manure management decreases;
- There is possibility to use available land more efficiently (land area is the same, but the number of animals is several times higher);
- Indirectly (through state aid mechanisms) improves financial stability etc.

Biogas plant at LLU Training and Research Farm "Vecauce"

Disadvantages

- Relatively expensive technology, large investments necessary;
- Relatively complex use of technology;
- Transport of digestate creates additional load on the roads;
- Additional soil compression by spreading the digestate in the field;
- Crop products (maize, barley, sunflowers, perennial grasses etc.) are needed to increase cost-effectiveness;
- Transportation of agricultural remains reduces economic and environmental sustainability;
- Relatively unsuccessful implementation has reduced public support for the use of technology;
- Changing policy decisions create financial instability on livestock farms, as large biogas plants are difficult to maintain without financial support;
- Due to the small market, several technology suppliers do not have representatives in Latvia, which increases maintenance costs and the time necessary for repair works.

At the JSC "Agrofirma "Tērvete"" the heat generated by the biogas of the cattle complex is used in the brewery and for heating the village. *Photo: Valdis Semjonovs*

Aspects	Limitations	Solutions
Technological	• Producing only electricity. • No or limited use of heat. • The amount of germinating weeds in the digestate decreases only if the temperature in the biogas reactor is high enough	• Technological schemes for the use of methane gas in transport and elsewhere are needed. • Use of heat in cooling systems (for cold generation) and other modern solutions.
Environmental	• Limited possibilities to disperse large amounts of digestate at an economically advantageous distance from the biogas plant thus causing risks to the environment by over-fertilizing of the nearby fields. • Insufficient grassland areas for digestate spreading on farms where grasslands are intensively used only for mowing. • Spilling of digestate may result in nutrient leakage into ditches or water reservoirs. • If digestate is not embedded into the soil, gaseous nitrogen compounds evaporate in the atmosphere.	• Improved manure management reduces environmental risks. • The use of digestate improves soil fertility in the long run and increases carbon uptake.
Economic	• Lack of political will to develop small plants (100 cows = 1 kW). • Restrictions imposed as a result of political decisions. • Expensive technology.	Cost-effective technological solutions are necessary for the establishment of small biogas plants near medium-sized animal shed (~ 70–150 dairy cows), thus providing ~ 100 kW plant on 100 cows.

Social aspects (knowledge, experience, cooperation)	• Shortage of labour force. • Damaging of roads during the transportation of digestate. • Lack of political will to solve the problems caused by inappropriate previous decisions. • Insufficient interest of local governments to solve business issues in their territory. • Insufficient liability of biogas plant service providers.	• Cooperation between small farms in the parish / county. • General educating of society on biomass processing. • Research is needed on the use of digestate in different crop fields, its impact on the soil, the environment and biodiversity.

Does farm size matter?

Biogas production on livestock farms should be a complementary division to the processing of liquid manure and other bio-waste, resulting in heat that is afterwards used by farms (especially for water heating) and other production facilities (e.g. grain drying). The volume of the biogas reactor must be adapted to the number of animals on the farm. Taking into account the labour supply situation, Juris Cīrulis, the owner of the farm "Mežacīruļi", recommends to use a farm of one milking robot, which is 70 dairy cows and 70 young cattle, as the basic unit for calculations. This could be a family farm model corresponding to Latvian conditions, where only manure is used for biogas production, thus ensuring environmentally friendly (zero manure emissions) and energy-independent farm management. Calculation: 70 dairy cows + 70 young cattle = 98 cattle units. If one cow (1 unit of cattle) with a milk yield of> 8000 kg produces 26 t of liquid manure per year, then the total amount of liquid manure on this farm is 2548 t per year, provided that the animals are not released to graze. If there is a grazing period of 150 days a year, the amount of liquid manure produced will be around 1500 t, which is a small amount for a large biogas plant, nevertheless it is possible to produce the heat needed for the farm. After separation of the by-product digestate, the solid fraction is used as a valuable fertilizer or as bedding. The liquid digestate fraction is stored in the lagoon and used for field fertilization. The lagoon needs to be covered with a roof, otherwise the amount of digestate increases significantly during the rain. However, the situation

in Latvia is more complicated. The farms exploiting large biogas plants must be able to provide the amount of substrate necessary for the fermentation process, as well as the use of the obtained digestate.

There are various regulations that determine the size of a farm to qualify for production support. One of them is to be able to provide at least 70% of the raw materials needed for energy production. In order to ensure the required amount of biomass, the country needs coordinated collection of organic waste and its use in existing plants, so that they can continue to operate efficiently and the amount of financial investment is justified. Promotion of biogas production 7 Climate-friendly agricultural practices in Latvia.

Political requirements

Directive 2009/28 / EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources intends the promotion of renewable energy in accordance with national aims, thus 40% of primary energy in Latvia needs to be provided by using renewable energy resources. Biogas production takes place in accordance with the Cabinet Regulations No. 262 and No. 221, which regulate the production of electricity from renewable resources. However, currently the issue of permits for the sale of produced electricity within the framework of mandatory procurement has been suspended until 2020, indicating the large impact of the mandatory procurement component on the price of electricity to final consumers as the main restriction argument. No specific support is provided for biogas producers processing secondary or tertiary agricultural products. New support measures will be integrated in the new energy policy.

Costs for the implementation of the measure

In cases when a measure involves not only costs that are attributable to the operator but also to society as a whole, usually in the form of various types of aid, it must be possible to answer the question what the total costs of using the measure will be. Public costs might be included as the difference between the amount of intended aid and the real market price of the product or, by using economic terminology, as the value of eliminating the externalities. According to the data of the Ministry of Economics, in 2015 the aid intensity for electricity produced from biogas was 12.1 EUR cents per kWh. The costs of the measure for the entrepreneur consist of investments for the construction of a biogas plant and its maintenance costs. As the biogas plant is a specific plant, costs can fluctuate significantly due to various factors (composition of the base substrate mixture, geographical conditions, technological solutions, factors related to assembly and service companies). Investments are usually expressed in EUR per unit of installed capacity, Promotion of biogas production Climate-friendly agricultural practices in Latvia 8, which is also a generalized and approximate estimate. In accordance with Cabinet Regulation No. 221 methodology, which determines investment and expenditure norms, the calculation (using the values for 2017) suggests that the investment for small biogas plants is EUR 4,000,000 MW-1 and operating costs are EUR 262,256, but for large plants (from 1 to 2 MW) investment is EUR 3 800 000 MW-1 and operating costs are EUR 258 912. The calculations suggest that larger biogas plants are more efficient in terms of investment and servicing.

Impact of the measure on the reduction of GHG emissions

The benefits of using biogas are most often seen in the context of energy, thus the benefits of emissions are incorporated in the results of the energy production sector. Biogas production has a significant impact on the environment. This impact can occur directly – through the utilization of manure and organic waste and the substitution of fossil energy resources, and indirectly – through the choice of raw materials that can affect biodiversity and digestate spreading technology. In the case of certain technological solutions, this approach can increase GHG transport emissions, lead to UAA fertilization and soil compaction. The most important aspect is the reduction of manure emissions, other processes affecting GHG emissions (replacement of fossil resources, CO_2 from biogas methane combustion) are not included in the calculations. The GHG-reducing effect of digestate is also excluded from the calculation due to the relatively higher efficiency of nitrogen use. According to the IPCC guidelines, a zero emission factor can be used for manure used for biogas production, essentially excluding the amount of manure used in biogas from the calculation of GHG emissions.

However, there are several prerequisites that must be met:

- fresh manure should be used directly from the barn. If manure is stored, the emissions generated during the storage period must be calculated;
- when the biogas reactor starts operating, as well as in case of installation failure, there is a biogas leak, for which the generated emissions, although relatively small, must be accounted for. In France, 1.5% leakages of generated emissions have been accepted and are applied. Latvia does not have such observations; therefore, the assumption of French colleagues is used;
- in calculating the possible potential of GHG reduction measure, it is assumed that farmers are able (will be able during the analysis period) to meet the requirement of timely delivery of manure to the bioreactor.

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