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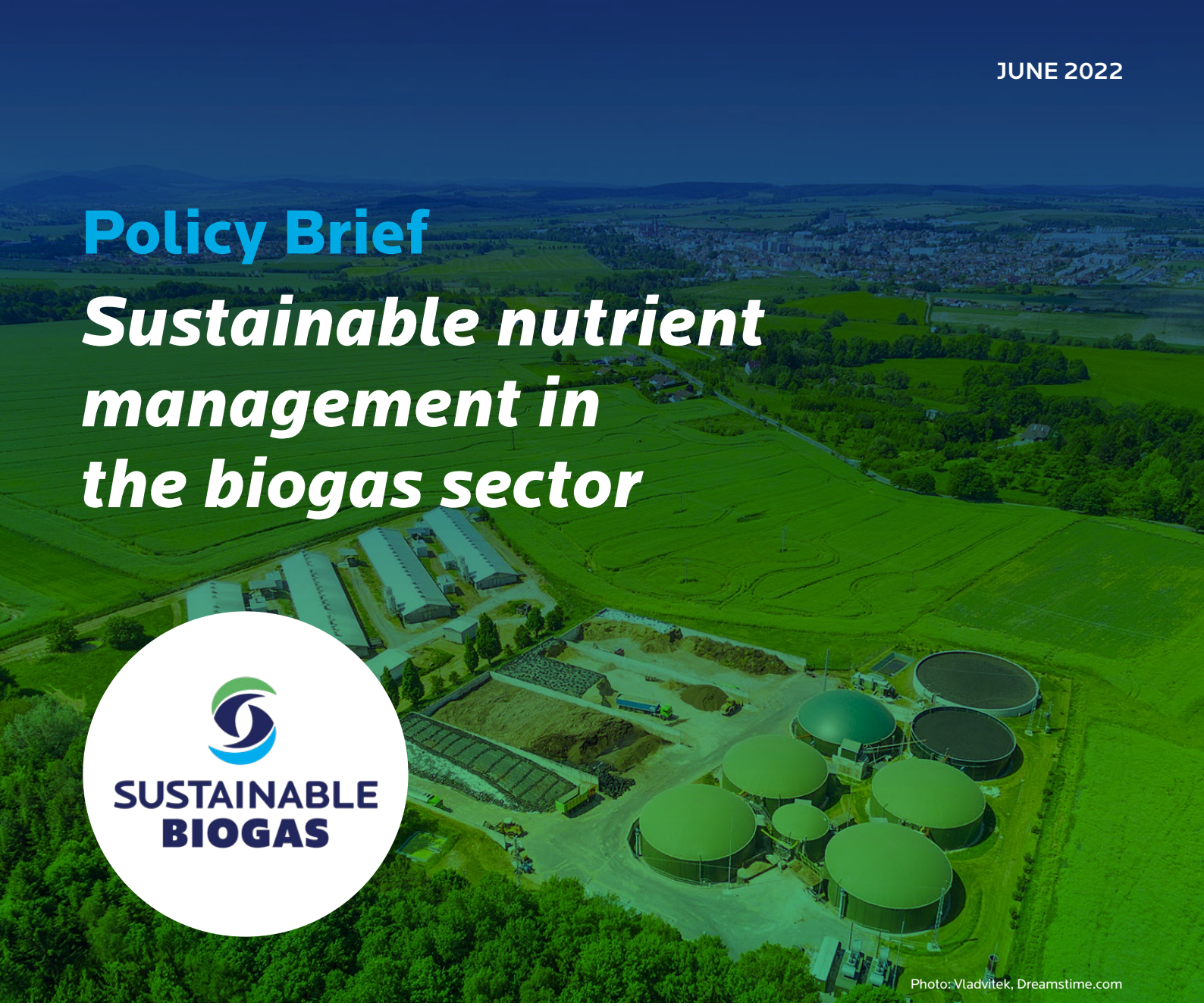
Policy Brief

Sustainable nutrient management in the biogas sector



SUSTAINABLE BIOGAS

Photo: Vladvitek, Dreamstime.com

Introduction

Sustainable biogas production is an essential part of the circular economy and investing in policy and legislation, as well as in public and operator education, reduces the risks of nutrient pollution and eutrophication.

Biogas production in the Baltic Sea Region (BSR) is relatively widespread and based on the forecasts of the European Biogas Association, the biogas production sector is expected to have significant potential in the future[1]. Production in the biogas and biomethane sectors combined is projected to double by 2030 but could increase fivefold by 2050[2].

Various applied studies such as the European Union's "Green Deal"[3], the "Farm to Fork Strategy"[4] and the Methane Strategy[5] have emphasized that biogas production is an essential part of the bioeconomy. Biogas production has a positive impact on the more optimal use of resources in agglomerations, agriculture and animal husbandry, because the production of renewable energy can not only reduce methane emissions from these sectors[6], but also speed up the recycling of biodegradable residues and waste, including from the food industry. The energy produced can be used for transport and heating, and nutrients recycled in digestate can be used for soil fertilisation.

Nutrient management measures

The significant growth of biogas production can increase environmental risks[7], so it is important to ensure that the biogas production process is planned sustainably. In order to reduce and prevent possible negative effects on the environment, it is necessary to continuously improve the supply and storage processes of raw materials, the production process, and the storage and use of fermentation residues or digestate.

The table below lists some of the rules and regulations in Latvia and Finland, which contribute to environmental risk reduction for the sustainable production of biogas.

Nitrate Directive, which is in effect in the nitrate vulnerable zones in the researched countries, forbids digestate spreading on frozen or wet-saturated land or lands covered in snow. The volume of incorporated nitrogen in one hectare of land used in agriculture per year shall not exceed 170 kilograms[12]. The Nitrate Directive also sets a 24-hour time window for organic fertilisers or digestate incorporation into soil after application.

PRACTICE	LATVIA	FINLAND
Volume of digestate storage	At least 8 months of produced digestate.	At least 12 months of produced digestate.
Digestate spreading	Spreading is allowed in nitrate vulnerable zones 16.03-19.10, but in case of liquid fraction – must be incorporated within 12 hours[8]. Restrictions, if fertilizing is done in slopes at water bodies.	Spreading is allowed 01.04-31.10. It is not allowed to spread liquid organic fertilizers in fields where the slope is 15% or over unless the fertilizer is injected into the soil. Solid fertilizers must be incorporated into the soil within 12 hours on sloped sections of the field.
Digestate storage cover	Closed type or with permanent natural or artificial floating covering.	Covered storage tank covered with at least floating covering[9].
Requirements for NH3 emissions	The storage requirements apply to farms where the minimum number of animals is exceeded. The Air Pollution Reduction Action Plan for 2020 – 2030[10] has indications on the required activities for manure management that could partially be referable also on digestate management.	For the reduction of ammonia emissions, digestate incorporation shall be as fast as possible, using the appropriate method. Storage tanks shall be covered with at least floating covering. This is not mandatory for old manure storages. The Action Plan to Reduce Ammonia Emissions from Agriculture in Finland for 2021–2027[11].
Ground water and surface water monitoring	In vulnerable areas the monitoring of surface and ground water should be conducted each year to state the nitrate concentration. At sites affected by point loads, there should be enough monitoring stations that the total load and impact of pollution can be assessed. Monitoring requirements are stated in the operator polluting activity conditions, if there are such decided by the controlling authority.	Monitoring of groundwater level and quality is mandatory for new biogas plants in groundwater areas. Frequency of monitoring is indicated in the environmental permit. For plants that utilize groundwater, monitoring must be carried out 2-4 times a year. If the plant causes a risk of ground water pollution, monitoring must be done 1-2 times a year. If production poses a risk to surface waters, the water quality must be monitored[12].

[1] EBA Statistical report 2021 (*www.europeanbiogas.eu/wp-content/uploads/2021/11/EBA-STATISTICAL-REPORT-2021-SHORT-VERSION.pdf)*

[2] REPowerEU Plan: Towards a European strategy for more affordable, secure and sustainable energy (*https://eur-lex.europa.eu/resource.html?uri=cellar:fc930f14-d7ae-11ec-a95f-01aa75ed71a1.0001.02/DOC_1&format=PDF)*

[3] The European Green Deal, COM/2019/640 final (*https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN)*

[4] A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system (*https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0381*)

[5] Communication from the Commission on an EU strategy to reduce methane emissions (https://ec.europa.eu/energy/sites/ener/files/eu_methane_strategy.pdf)

[6] Manual on good agriculture practice in ammonia emission reduction in Latvia (*www.zm.gov.lv/public/ck/files/LLPN_amonjaks_010620.pdf)*

Conclusions

1. Climatic conditions and national environmental policies are the main reasons for the differences in digestate storage and spreading conditions. The size of digestate storage facilities depends directly on national climatic conditions and the digestate incorporation period. Shorter periods for digestate incorporation, as well as longer storage period for digestate, are set in Finland.
2. The BSR countries are committed to reducing nutrient emissions into watercourses, which are also indirectly affected by point and diffuse emissions of nutrients into the air. It is the use of fertilizers and manure from the livestock sector, that account for the largest ammonia emissions. The processing of manure in a biogas plant has been identified as the most appropriate way to reduce nutrient emissions, including ammonia emissions from primary manure storage sites. Still, digestate should be incorporated into the soil after application as fast as possible due to its lowered but still significant emissions due to biomass degradation.
3. In order to reduce nutrient leakage risks, the emphasis is put on raw material delivery and storage, digestate storage and application in soil.
4. The installation of digestate storage facilities of appropriate design, equipped with appropriate drainage collection systems to control nutrient leakage, is considered to be the best approach.
5. Monitoring activities are considered effective but can be improved for ground water and particularly surface water quality monitoring. The decision on their application is made by the responsible authorities, which monitor the processes of sustainable biogas production.

Recommendations

1. Calculations for digestate storage size should include volume of storable digestate and the length of storing period, providing that in case of unfavourable conditions digestate does not leak. Criteria and minimum requirements for storage should be developed to include additional digestate storing places. Construction of additional storages should be planned near fields where fertilisation is planned. Liquid fraction of separated digestate should be stored in separate storage, when necessary, as it would be convenient to use it as an additional fertilizer on growing plants.
2. Stricter minimum requirements should be set for raw material storage tanks. Particular attention shall be paid to silage storage, considering its low pH level and high content of nutrients that possess high risks to environment. The application period for silage effluent should be the same or stricter than in the case of slurry or liquid manure, providing that the spreading is done according to fertilizer plans and nutrient concentration analyses. As for silage effluent incorporation, dilution for no less than two times should be done. Its application should be restricted during autumn, when nutrient uptake potential is low, and its mixing with digestate should be promoted before its spreading or storage. The operator must ensure that the silage runoff collection system complies with the best available techniques, ensuring that no environmental pollution occurs.
3. Digestate application should be performed during appropriate weather conditions and using a trailing hose, shallow injectors, and other methods with low nutrient losses. Depending on climate conditions the responsible authority could modify the time for fertilizer application, except in nitrate vulnerable zones. In warm and dry winters, digestate can be incorporated earlier into the non-frozen soil, depending on the needs of the plants, but during the rainy season, especially in autumn or spring, the application must be stopped due to the increased risk of nutrient leaching into water bodies.
4. The effective reduction of point source emissions of greenhouse gases and additional ammonia from storage sites requires the collection of emissions from digestate storage sites. It is recommended to cover digestate storages with artificial materials that would allow the collection of emissions and utilize them accordingly. Financial support mechanisms, for instance, as grants or as an additional payment to the operator should be provided to encourage the implementation of best practices.
5. The responsible authorities should provide regular updates on recommendations or best practices to farmers and biogas plant operators on the most efficient ways on the reduction of nutrient, including ammonia, emissions in the environment. Changes in the laws and regulations must be made expeditiously observing changes of laws and regulations of the EU and the BSR states and facilitating the implementation of proven state-of-art technologies and methods.
6. Use of the precision agriculture methods for digestate incorporation is recommended. Storages of digestate must be enlarged up to the volume providing storage of digestate until the optimal time of its incorporation during vegetation period.
7. The type and frequency of groundwater monitoring should be determined by the environmental risks of the technology used in the biogas plant and should be included in the basic conditions of the permit for the polluting activity. Based on a previous environmental risk analysis and a decision of the control authority, the operator may also be required to carry out additional groundwater monitoring or relevant surface water analysis or other related monitoring.
8. It is recommended that institutions and legislators apply the obligation to use best available techniques to biogas plants in the process of issuing or amending permits, taking into account the volume and hazards of the raw materials managed and the potential for contamination of nutrients.
9. Institutions and legislators should develop common rules for maximum rates of phosphorus application to soil, taking into account best practice in other countries, similar to those already adopted for total nitrogen application rate per hectare.

[7] Improving the European Rivers Water Quality through Smart Water Management Policies (*https://projects2014-2020.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1624035589.pdf*)

[8] Cabinet Regulations no. 834 as of December 23, 2014 "Requirements Regarding the Protection of Water, Soil and Air from Pollution Caused by Agricultural Activity" (*https://likumi.lv/ta/id/271376-prasibas-udens-augsnes-un-gaisa-aizsardzibai-no-lauksaimnieciskas-darbibas-izraisita-piesarnojuma*)

[9] Nutrient management at biogas plants in Finland (https://sustainablebiogas.eu/wp-content/uploads/2021/09/D.T1.1.1-Nutrient-management-at-biogas-plants-in-Finland-300621.pdf)

[10] Air pollution reduction action plan for 2020 – 2030, Cabinet Order No. 197 as of April 16, 2020 "On Air Pollution Reduction Action Plan for 2020 – 2030" (https://likumi.lv/ta/id/314078)

[11] Action Plan to Reduce Ammonia Emissions from Agriculture in Finland for the years 2021–2027 (*https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/163564/MMM_2021_20.pdf?sequence=1&isAllowed=y*)

[12] Risk assessment of nutrient discharges from biogas production: Finland (*https://johnnurmisensaatio.fi/wp-content/uploads/2019/05/finland_biogas-risk-assessment-_final.pdf)*

The Sustainable Biogas project worked together with the biogas sector and various stakeholders to reduce nutrient discharges from the whole production chain of the biogas production: from the handling of raw materials to the production and to the safe utilisation of nutrient-rich digestates.

According to the results of the project, sustainable nutrient management in biogas production requires careful consideration when planning, permitting and operating the biogas facilities so that the regional nutrient balance is considered, storages for the feedstocks and digestates are adequate and appropriate, and digestate application is based on the plant needs.

Improving the quality of recycled nutrients and promotion of their use are needed. In addition, the reconciliation of the partly contradictory objectives for sewage sludge management - pollution prevention, nutrient recycling and climate change mitigation - should be continued.

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