The contribution of the biogas and biomethane industries to medium-term greenhouse gas reduction targets and climate-neutrality by 2050

Background paper
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INTRODUCTION

The European Biogas Association (EBA) warmly welcomes the ambition of European Commission to strive for climate-neutrality in 2050. With this background paper, the EBA wishes to inform about the GHG reduction potentials of biogas and biomethane industries.

The biogas and biomethane industries are significant and growing contributors to achieve climate-neutrality by 2050. As calculated by the World Biogas Association, the sector has the potential to reduce worldwide greenhouse gas (GHG) emissions by 10-13%[1]. **The biogas and biomethane industries reduce emissions via many different pathways, such as avoided emissions by replacing fossil fuels, avoided methane slips from manure, green fertilizer production which replaces carbon-intensive chemical fertilizers, carbon storage in soils and carbon capture and storage.**

GHG REDUCTION POTENTIALS OF BIOGAS AND BIOMETHANE INDUSTRIES

The principle of the "short carbon cycle"

In order to understand the benefits of biogas and biomethane production, it is necessary to understand the concepts of "short carbon cycle". Unlike natural gas or oil, biogas and biomethane are produced from fresh organic materials. These are themselves derived from biomass, directly (agricultural residues, intermediary crops, green waste etc.) or indirectly (sewage sludge, manure, some biowaste). During its growth, this biomass has captured a certain amount of CO_2 from the atmosphere in order to do photosynthesis. This captured CO_2 is returned to the atmosphere during the combustion of biogas or biomethane, and then captured again by the newly growing biomass, and so on. The combustion of biogas or biomethane does therefore not increase the amount of CO_2 present in the atmosphere but it makes it circulate in short carbon cycles. We are thus talking about biogenic CO_2, as opposed to fossil-based CO_2, which is released after millions of years of storage underground and was previously not accessible.[2]

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[1] https://www.worldbiogasassociation.org/wp-content/uploads/2019/09/WBA-globalreport-56ppa4_digital-Sept-2019.pdf
[2] Quantis (2019) : Evaluation des impacts GES de la production et l'injection du biomethane dans le reseau de gaz natural – rapport synthetique

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Explanation of pathways of GHG reduction through biogas and biomethane

As explained above, biogas and biomethane is renewable energy produced from organic matter. Emissions from biogas and biomethane combustion are fully compensated upstream by the photosynthesis. In addition, further GHG reduction can be achieved: being partly produced from waste or manure, biomethane makes it possible to reduce or avoid GHG emissions related to waste management. Methanization produces also digestate, which in some cases can be used as a substitute for mineral fertilisers, thereby avoiding their production and associated GHG emissions. On the other hand, there are emissions associated to the production of biogas and biomethane as well as to the purification, injection and transport of biomethane which need to be considered. Nonetheless the overall impact of biogas and biomethane production results in significant GHG reduction compared to fossil fuels.

The most important pathways via which the biogas and biomethane industries avoid emissions are explained more in detail in the following.

(1) Biogas and biomethane are renewable energy sources that **avoid emissions related to the use of fossil fuels**. Biogas is most often applied in a Combined Heat and Power (CHP) unit and is thus the source for producing renewable electricity and heat which replaces fossil energy generation. Biogas is increasingly upgraded to natural gas quality, and then called biomethane. Biomethane is directly injected in the gas grids and can thus be used in all traditional gas applications: cooking, heating, industrial processes, power generation and mobility (as renewable transport fuel, notably in the form of bio-CNG and bio-LNG),without the need to invest in the transformation of either network infrastructure or user consumption equipment.

(2) Agriculture and livestock farming are an important part of the European Economy. Animal farming results in large quantities of manure, which naturally releases significant amounts of methane during storage. If the manure is brought to the closed and controlled environment of a biogas plant instead, the methane is captured, optimized and utilized to produce renewably energy. Thus, biogas and biomethane production from manure results in **avoided methane slip from manure**. Therefore, the potential of the biogas and biomethane industry to reduce emissions from agriculture is substantial.

(3) Biogas and biomethane plants not only produce energy, but also digestate, which is formed during the process of Anaerobic Digestion (AD), together with biogas. During this process, micro-organisms convert organically bound nitrogen (N) into a more accessible form for uptake by crops, making the digestate a perfect biological and green fertilizer. This green fertilizer can reduce the use of mineral fertilizers **avoiding the emissions related to their energy-intensive production.**

(4) Biogas production from intermediate crops is gaining attention. The inclusion of intermediate crops, such as catch crops and cover crops into crop rotation instead of fallow or abandoned land, has a positive effect on soil organic carbon. Organic inputs are increased through the crop roots. Moreover, the application of the digestate as green fertilizer has the advantage of building soil organic carbon when compared to mineral fertilizer spreading. The carbon from the digested biomass is captured in soils and rebuilding humus, essential for plant growth. **Anaerobic digestion is thus enabling soils to serve as carbon sinks[3].**

(5) During the biomethane production process, a big part of the biogenic carbon from the atmosphere in the digested biomass finally ends up in a **highly concentrated CO_2-stream** after biogas upgrading. The concentrated stream has many applications such as re-use in power-to-X cycles to produce

[3] https://www.4p1000.org/

synthetic methane based on hydrogen ($H_2 + CO_2 \rightarrow CH_4$), usage as feedstock in chemical industry (e.g. production of methanol) or production of e-fuels. It can also be used in industry processes such as new construction materials, thus achieving the permanent removal of carbon from the atmosphere.

This combination of pathways to avoid greenhouse gas emissions for biogas and biomethane industries makes it possible to create an even negative carbon footprint. The JRC study "Solid and gaseous bioenergy pathways: input values and GHG emissions"[4] estimates GHG savings [%] compared to EU fossil fuels up to 240% for biogas production and up to 202% for biomethane production, depending on the feedstocks and technology used. According to the JRC study 240% GHG savings for biogas production are reached when the biogas is produced from animal slurry, the biogas plant has closed digestate storage and the energy (power + heat) needed to operate the biogas plant originates from its own CHP unit. Similar, the 202% GHG savings for biomethane production are reached when the biomethane is produced from animal slurry and the biomethane plants includes both a closed digestate storage and off gas combustion. For both biogas and biomethane, methane leakages are considered in the calculations.

Moreover, as mentioned above, according to the World Biogas Association calculations, biogas and biomethane industries have the potential to reduce global GHG emissions by 10-13%. It is safe to say that in the future, with advanced technologies and increased monitoring, the GHG reduction potential and thus the contribution to climate-neutrality in 2050 of the biogas and biomethane industries will further increase.

[4] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC104759/ld1a27215enn.pdf