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PROSPECTS OF BIOMETHANE PRODUCTION IN UKRAINE

Abstract: *Prospects and potential for the development of biomethane production in Ukraine are presented. The biomethane potential due to anaerobic digestion from the most prospective feedstock types is estimated as 9.7 billion m³CH₄/year in 2020.*

The total biomethane production in Ukraine could reach 1.0 billion m³/year in 2030 and 4.5 billion m³/year in 2050.

Keywords: *bioenergy, biomass, biogas, biomethane*

Introduction

Biomethane as a close analogue of natural gas can be used for the production of heat and electricity, as a fuel for transport as well as raw materials for the chemical industry. In addition, the production of biomethane is in line with the idea of circular economy as it converts agricultural by-products or household waste into energy ensuring the recycling of nutrients to agricultural land. The common opinion of experts in biogas sector is that "biomethane is the future of biogas".

Prerequisites and advantages of biomethane production in Ukraine

Ukraine has the largest area of agricultural land in Europe, and, accordingly, one of the world's best potentials of agricultural raw materials for biomethane production. Highly developed existing natural gas supply network in Ukraine (both main pipelines (GTS) and distribution networks (GDS)) with all necessary infrastructure compatible for biomethane transmission as technically close analogue of natural gas. That includes storage facilities, pipelines, valves, regimes of operation, operator instructions, automatics, and personnel qualification. Connection of existing main gas pipelines of Ukraine to the European hubs creates possibility for biomethane export to the EU.

Biomethane is ready for injection into the gas network today unlike hydrogen. No investment is required in the modernization of gas networks (GTS and GDS) and gas equipment (gas burners, engines, turbines, valves etc.). Biomethane can help to load the Ukrainian GTS after the termination of the contracts with Russia.

Biomethane plants, in addition to biomethane, generate digestate, which can become the main organic fertilizer needed for the revival of Ukrainian soils.

Investments in biomethane plants are close to investments in biogas plants with electricity generation (approximately 2.5-3.0 thousand EUR/kW_{el}). The approximate calculations are as follows: a biomethane plant with a capacity of 10 million m³/year of biomethane, is an analogue of a biogas plant with a capacity of 4 MW_{el}, and it will cost about 10 million Euros. Accordingly, to deliver one billion m³

of biomethane into the natural gas network, Ukraine needs 100 plants of 10 million m³/year. Accordingly they will cost one billion Euros in total.

The roadmap for the development of bioenergy in Ukraine until 2050 provides for the introduction and growth of biomethane production in Ukraine to 1.7 billion m³/year in 2035 and up to 3 billion m³/year in 2050 (Geletukha et al., 2021).

By author's estimates the total biogas production could reach 1.6 billion m³/year CH₄ in 2030 (Geletukha et al., 2022). The significant part of that biogas could be upgraded to biomethane. Total biomethane production could be 1.0 billion m³/year in 2030. It is expected that biomethane could partly (0.2 billion m³/year) be exported to the EU. The rest could be utilized locally for combined heat and electricity generation in CHP units (0.5 billion m³/year), heating and industry applications (0.23 billion m³/year) and for transportation purpose (0.08 billion m³/year). In such a way biogas sector could serve the growing demand in sustainable and clean energy from the transport and industry sectors.

Feedstock for biomethane production

A variety of organic materials can potentially be used for biogas production, including specially grown crops, by-products and wastes from plant and animal products, animal husbandry wastes, and other anthropogenic wastes. Due to the limited statistical data available to serve as input data for further estimation of waste volumes only main types of wastes and by-products are covered by this assessment including the following organic materials:

1. Animal husbandry wastes, including cattle manure, pig manure, poultry litter, sheep and goat manure formed during animal keeping at the enterprises.
2. Maize silage, specially grown.
3. Crop residues of major crops, including wheat, rye, barley, maize, sunflower, soybean, rapeseed and sugar beet.
4. Food & beverage industry by-products and wastes.
5. Sewage sludge from municipal treatment facilities.
6. Organic fraction of solid waste.

Results and discussion

The estimated biomethane potential from the most prospective feedstock types described above amounts to 9.73 billion m³CH₄ a year, as on 2020 (Fig. 1).

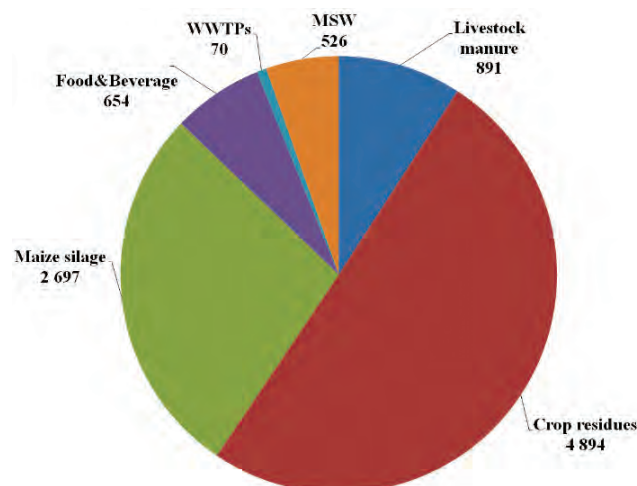


FIGURE 1. Biomethane potential in Ukraine by feedstock type as on 2020, mln m³CH₄ a year (2020)

Half of this potential is related to crop residues and one third to maize silage production. Animal husbandry wastes can contribute by 9.2%. Food & beverage industry can contribute by 6.7%. Organic fraction of MSW and wastewater sludge could contribute together by additional 6.1%. The potential of biogas production from municipal sewage sludge amounts to only 69.6 mln m^3CH_4 per year. The overall potential related to temporarily occupied territories of Ukraine amounts to 467 mln m^3CH_4 per year or 4.8%.

The most valuable potential among food&beverage by-products belongs to sunflower oil industry and sugar production. The overall potential that oil by-products could contribute amounts to 0.32 billion m^3CH_4 a year, whereas oil press cake only can give 203 mln m^3CH_4 a year. Sugar beet press can contribute 205 mln m^3CH_4 a year. The rest accounted types of by-products amounts to the little shares, however in total can contribute up to 35% to food & beverage biomethane potential. Estimated biomethane potential from food&beverage by-products related to TOT contribute only 0.4%.

In 2050, the total production potential of biogas/biomethane may increase to 17 billion m^3/year . A significant increase in capacity is projected due to the growth of industrial production, expansion of the raw material base for biogas/biomethane production, consolidation of livestock enterprises and the transition from solid waste disposal to the use of mechanical and biological treatment technology.

Regional level

At the level of regions of Ukraine, almost a half of the potential for biomethane production is concentrated in 6 regions of Ukraine (Vinnytsya, Kyiv, Cherkasy, Poltava, Dnipropetrovsk and Donetsk) (Figs. 2 and 3). The highest potential estimated in Vinnytsya region, while the lowest in Zakarpattya region. Biomethane potential by regions ranges from 38 to 846 mln $\text{m}^3\text{CH}_4/\text{year}$, averaged at 385 mln $\text{m}^3\text{CH}_4/\text{year}$ by region.

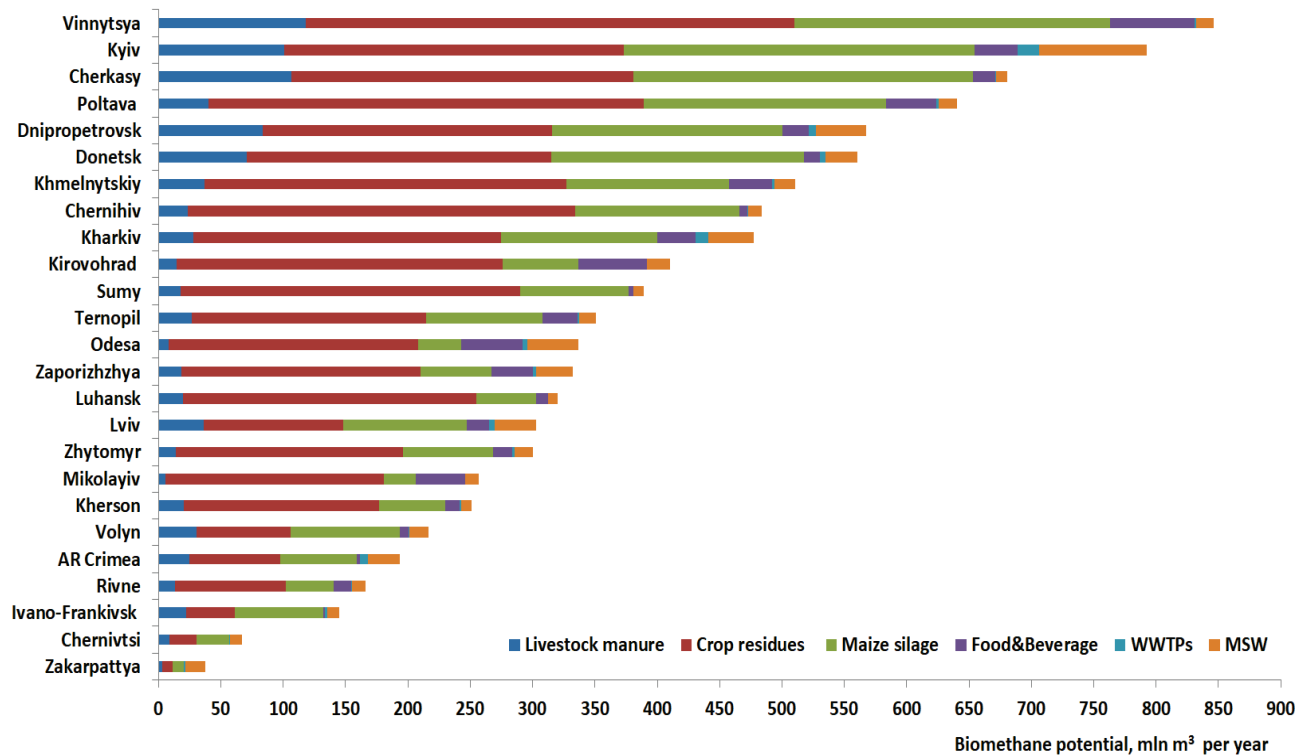


FIGURE 2. Biomethane potential by regions and by feedstock type (2020)

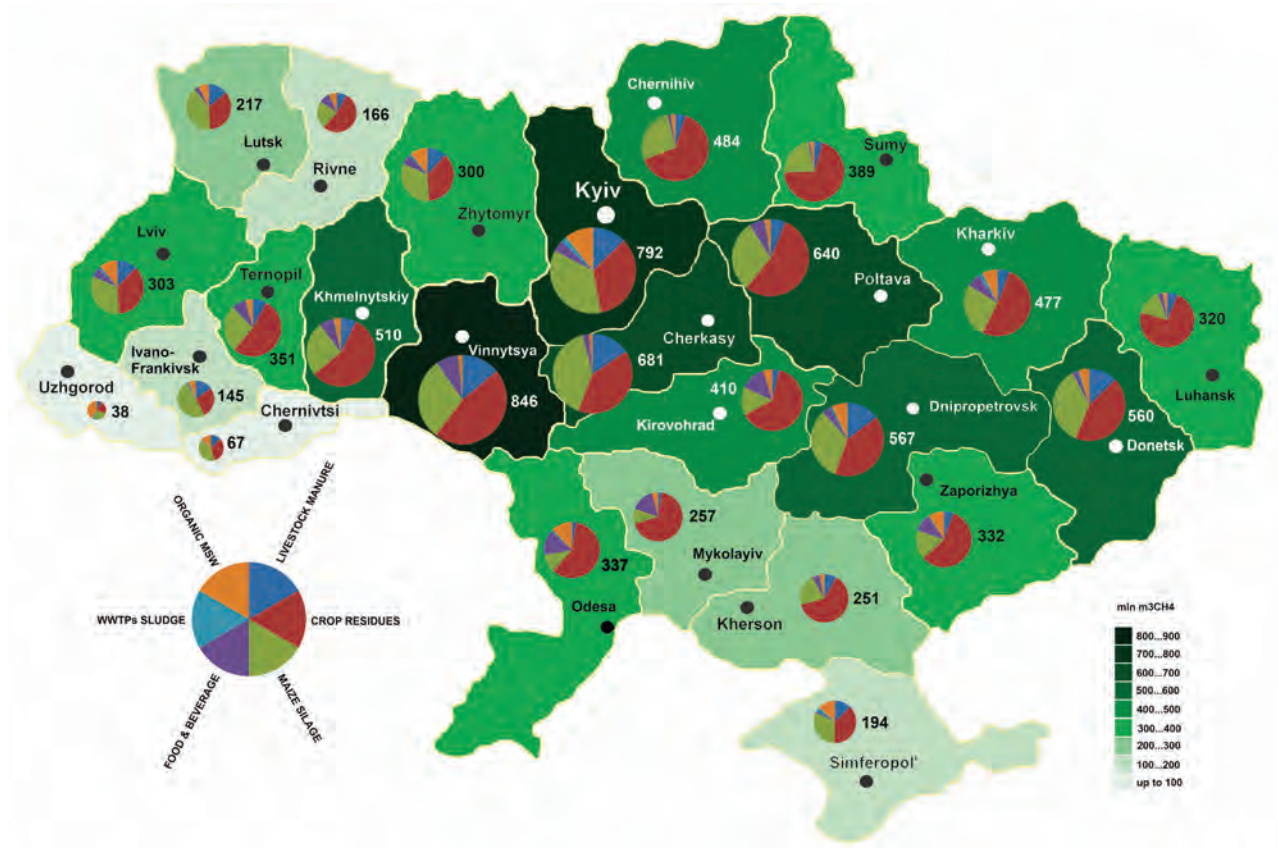


FIGURE 3. Mapping biomethane potential by regions and by feedstock type, mln m³CH₄ a year (2020)

Conclusions

Current Ukraine's Energy Strategy sets an ambitious goal of achieving 11 Mtoe of biomass, biofuels and waste in the total supply of primary energy in 2035. It corresponds to 11.5% of the total primary energy supply. Biogas and especially biomethane will play important role in this development.

Production of biomethane with biogas upgrading to the quality of natural gas can significantly increase the energy efficiency of biogas utilisation. The main advantage of biomethane compared to green hydrogen is the possibility of its transportation using the existing gas infrastructure without modernisation.

We believe that in the coming years after the adoption of legislation to support the development of biomethane production, the most of biomethane produced will be exported to EU countries, which have created more favorable conditions for its consumption. As Ukraine's economy grows, more and more of the biomethane produced will remain for domestic consumption.

References

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