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Biomethane potential and sustainability in Europe, 2030 and 2050

Due to the ambition laid out in the Green Deal, all sectors in Europe must come close to decarbonizing over the next decades. Natural gas will likely be phased out, and there is a question of whether it can be replaced by renewable methane using the same infrastructure. Renewable methane includes biomethane upgraded from biogas, as well as synthetic methane produced from renewable electricity, referred to as power-to-gas.

A 2018 ICCT study estimates the technical potential for using renewable methane from sustainable feedstocks in the power, heating, and transport sectors in 2030 and 2050 in the EU-28. In addition, it analyzes the lifecycle greenhouse gas (GHG) emissions from potential renewable methane pathways and identifies low-carbon options. For these low-carbon pathways, the study assesses total production costs and reports the volumes of renewable methane that could be cost-effectively delivered in the EU.

KEY FINDINGS

- Renewable methane, including biomethane and power-to-gas produced from renewable electricity, can deliver strong climate benefits only if produced from sustainable feedstocks that are not used for food or livestock feed. Approximately half of the EU's current biogas production is from silage maize, a feed crop, the use of which does not substantially reduce GHG emissions compared to fossil fuels (Table 1).
- Low-carbon biomethane can be produced using biogas from the anaerobic digestion of livestock manure and sewage sludge, or from the gasification and methanation of sustainably harvested agricultural and forestry residues. However, these resources are limited—the total technical potential of biomethane in the EU-27 could replace only 8% of natural gas demand in 2030 (Figure 1).
- The cost-viable potential for biomethane is much lower. Even with policy incentives worth €4 per cubic meter (m^3), which is 20 times higher than the current EU wholesale natural gas price, only 2% of natural gas consumption in the EU-27 could be supplied with low-carbon biomethane in 2030 and 6% could be supplied in 2050 (Figure 1).
- There are competing uses for biomethane feedstocks. It is economically more advantageous to combust livestock manure biogas on-site for use in power generation and to use gasified residues and renewable electricity for the production of drop-in synthetic jet fuel and diesel, than to convert these resources to purified methane.

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» Any renewable methane pathway carries the risk of undermining its climate benefits through methane leakage, as methane is a strong climate forcer. For example, in a sensitivity analysis, we find that were there a 5% leakage rate from a small anaerobic digester, the pathway would provide GHG savings of only 40% compared with natural gas. With a leakage rate of 11%, this pathway would not have any GHG savings compared with natural gas.

Table 1: Carbon intensities of biomethane pathways using common feedstocks compared to natural gas

Feedstock	Carbon intensity (gCO_2e/MJ)	Greenhouse gas savings relative to natural gas (gCO_2e/MJ)	Included in 2018 analysis on renewable methane potential and cost?
Silage maize	54	18	No
Biowaste	-26	98	Yes
Crop residues	-6	78	Yes
Livestock manure	-264	336	Yes
Sewage sludge	19	53	Yes
Natural gas	72		

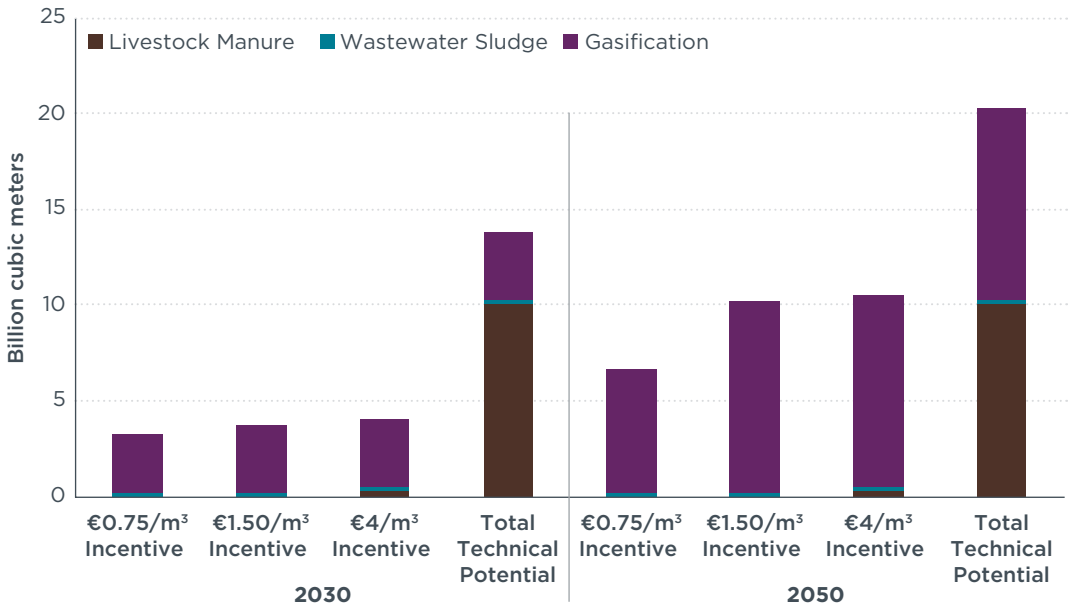

Figure 1: Total technical potential and economically viable potential of biomethane in the EU-27 with varying levels of policy incentive in in 2030 and 2050 (in 2018 €); for comparison, the current average EU wholesale natural gas price is €0.2/m³.

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