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Biomethane potential and sustainability in Germany in 2050

Chelsea Baldino

Germany aims to be carbon neutral by 2045, so all sectors must decarbonize over the coming decades. Natural gas will be phased out, but can it be replaced with renewable methane using the same infrastructure? This is a particularly important question for truck fleet operators aiming to reduce GHG emissions: should they choose electric powertrains powered by batteries or fuel cells, or trucks that use liquefied natural gas (LNG), which could possibly use renewable methane in the future? Trucks have long lives, so perceptions of the future availability of renewable methane will have an important impact on truck purchasing decisions made today.

Renewable methane includes biomethane upgraded from biogas as well as synthetic methane produced from renewable electricity, referred to as power-to-gas. This factsheet summarizes and applies to Germany the results of the study, *The potential for low-carbon renewable methane in heating, power, and transport in the European Union*. That study estimates the costs and technical potential of using renewable methane from sustainable feedstocks in the power, heating, and transport sectors in 2030 and 2050 in the EU-28. The study also assesses the life cycle greenhouse gas (GHG) emissions from potential renewable methane pathways and identifies the low-carbon options among them.

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. The vast majority of Germany'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.
- 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 could replace only 25% of the energy demand of trucks in 2050.
- The cost viability potential of biomethane is much lower than its technical potential. Even with policy incentives worth €4 per cubic meter (m^3), which is 17 times higher than the current wholesale price of natural gas in Germany, only half of the total technical potential for low-carbon biomethane in the EU could be supplied in 2050.

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- Using the limited waste and residues available to produce biomethane would provide a benefit in the well-to-tank emissions of a renewable methane truck or car compared to a vehicle using fossil diesel. However, the combustion of renewable methane releases just as much CO_2 at the tailpipe as that of natural gas or diesel.
- 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.
- 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 in the 2018 study, we found that with a 5% leakage rate, a small anaerobic digester would provide GHG savings of only 40% compared with natural gas. With a leakage rate of 11%, which falls within the range of methane leakage reported for biomethane production in the literature, this pathway would yield no GHG savings compared with natural gas.
- Hydrogen fuel cell and battery electric trucks, when powered by low-carbon energy, provide a GHG benefit compared to fossil diesel trucks across the entire life cycle of the fuel.

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Authors: Stephanie Searle, Chelsea Baldino, Nikita Pavlenko

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Contact: Chelsea Baldino, chelsea.baldino@theicct.org

www.theicct.org

communications@theicct.org

twitter @theicct