

Biogas and biomethane supply chains leak twice as much methane as first thought

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A new Imperial analysis has found that biogas and biomethane, while more climate friendly, leak more than twice as much methane as previously thought.

Although biogas and biomethane remain climate-friendlier than non-renewable alternatives, the researchers call for better monitoring and fixing of leaks to ensure biogas and biomethane continue to live up to their green credentials.

Biomethane and biogas are produced from the breakdown of organic matter including food, animal waste, [energy crops](#), grass, or sewage sludge, making them renewable alternatives to [natural gas](#), coal and oil. However, researchers at Imperial College London have identified potential pitfalls in energy supply chains for these climate-friendlier gases, concluding that more efforts should be made to reduce [methane leakage](#).

Methane traps around 27 times the amount of heat in the atmosphere as [carbon dioxide](#) (CO₂) and is responsible for at least a quarter of global warming, according to the Intergovernmental Panel on Climate Change's AR6 report.

The new Imperial study, published today in *One Earth* journal, found that supply chains for biomethane and biogas release more than twice as much [methane](#) as the International Energy Agency (IEA)'s previous estimation. It also reveals that 62 percent of these leaks were concentrated in a small number of facilities and pieces of equipment within the chain, which they call "super-emitters," though methane was found to be released at every stage.

The researchers say urgent attention is needed to fix the methane leaks, and knowing precisely where the majority of them are happening will help [production plants](#) to do so.

Lead author of the study Dr. Semra Bakkaloglu, of Imperial's Department of Chemical Engineering and Sustainable Gas Institute, said: "Biomethane and biogas are great candidates for renewable and clean

energy sources, but they can also emit methane. For them to really help mitigate the warming effects of energy use, we must act urgently to reduce their emissions.

"We want to encourage the continued use of biogas and biomethane as a renewable resource by taking the necessary actions to tackle [methane emissions](#)."

The researchers note that compared to the oil and gas industry, the biomethane industry suffers from poorly designed and managed production facilities as well as a lack of investment for modernization, operation, and monitoring. Because oil and natural gas supply chains have been primarily operated by large companies with huge resources for decades, they have been able to invest more in leak detection and repair.

What is biomethane and biogas?

In response to the climate crisis, many countries are replacing heavily carbon-emitting sources of energy, like natural gas, coal and oil, with biomethane and biogas.

Although they are made from a mixture of CO₂ and methane, biomethane and biogas release less of both gases, making them greener energy alternatives.

However, these replacement fuels still release methane along their supply chains, such as at processing facilities and from long pipelines. This new analysis gives us a more thorough understanding of where, when, and how much methane is released from biomethane and biogas supply.

Analyzing emissions

The researchers analyzed 51 previously published studies on mobile methane measurements and site data taken from emission sources along the biomethane and biogas supply chain. They analyzed the data and calculated the total methane emissions using a statistical model called Monte Carlo. This allowed them to consider all measurements of total supply chain emissions at each stage of the chain, which they then compared with the off-site emissions reported from whole-site measurements in previously published studies.

They found that the supply chains release up to 343 g of CO₂-equivalent methane per megajoule higher heating value, which may account for 18.5 megatons of methane per year. IEA estimates had reported emissions as just 9.1 megatons in 2021.

While overall methane emissions from biogas and biomethane are lower than those from oil and natural gas, the amount of methane released from their supply chains relative to total gas production is much higher than for oil and gas.

The data is reported in "CO₂ equivalents"—a unit of measurement used to compare emissions across the oil and natural gas supply chain without interfering with downstream operations. This unit also allows us to compare the global-warming potential of various greenhouse gas emissions from different studies.

The researchers identified the reasons behind the leakiness of supply chains as intermittent emissions patterns, which make them harder to track; insufficient usage of process equipment; and inadequate operations and maintenance strategies. Since super-emitters are unlikely to remain constant over time, the researchers say that continual monitoring is required to detect intermittent emission patterns or

unpredictable leaks from supply chains.

Dr. Bakkaloglu said: "To prevent biogas methane emissions negating the overall benefits of biogas use, urgent attention is needed including continuous monitoring of biogas supply chains. We believe that with the proper detection, measurement, and repair techniques, all emissions can be avoided. We need better regulations, continuous emission measurements, and close collaboration with [biogas](#) plant operators in order to address methane emissions and meet Paris Agreement targets."

"Given the growth in biomethane due to national decarbonization strategies, urgent efforts are needed for the biomethane supply chain to address not only methane emissions but also the sustainability of biomethane."

Co-author Dr. Jasmin Cooper, also of the Department of Chemical Engineering, said: "Addressing the fundamental design issues and investment problems within the biofuel and methane industry would be a good starting point for stopping these leaks and preventing more from arising."

The researchers are now focusing on the super-emitters within supply chains to better understand how to reduce them using the best available technologies.

More information: Semra Bakkaloglu, Methane emissions along biomethane and biogas supply chains are underestimated, *One Earth* (2022). [DOI: 10.1016/j.oneear.2022.05.012](https://doi.org/10.1016/j.oneear.2022.05.012). [www.cell.com/one-earth/fulltext ... 2590-3322\(22\)00267-6](https://www.cell.com/one-earth/fulltext...2590-3322(22)00267-6)

Provided by Imperial College London

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