Methane emission mitigation in the waste sector

Photo credit: Patrick Bueker, GIZ

Background

Methane (CH_4) is the second most important greenhouse gas after carbon dioxide (CO_2). According to the Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment, human-driven methane emissions account for nearly 45% of current net warming.[1] It is a short-lived climate pollutant (SLCP) with an atmospheric lifetime of roughly a decade and has a warming potential at least 80 times more powerful than CO_2. Methane is also an important precursor for the formation of ground-level ozone (O_3), which is a powerful air pollutant that causes adverse effects on human health, ecosystems, and crops. Reducing methane emissions from anthropogenic sources is one of the most cost-effective strategies to rapidly reduce the rate of global warming and meet the goals of the Paris Agreement, while contributing to Sustainable Development Goals.

The share of global anthropogenic methane emissions from the solid waste sector is estimated to be 11%, making it the third largest source of emissions after the agricultural sector (40%) and fossil fuel sector (35%).[2] This share is estimated to increase 13% annually due to population growth, urbanization, and the practice of open dumping of untreated solid waste that is still prevalent in many countries.[3] Emissions from solid waste are expected to increase more rapidly in both million tonnes per year and in percent of current emissions compared to wastewater, with the global total projected increase of 14% in baseline anthropogenic methane emissions between 2020 and 2030.[4] To reverse this trend, measures need to be introduced that focus on climate- and resource-efficient waste management, among others by applying methane emission reduction technologies that are already well developed and have been successfully applied in the waste sector. Existing targeted reduction measures account for 29-36 Mt/yr by 2030 from the waste sector, with the greatest potential in improved treatment and disposal of solid waste.[5]

#2 METHANE IS THE **SECOND MOST IMPORTANT GREENHOUSE GAS** AFTER CARBON DIOXIDE

45% HUMAN-DRIVEN METHANE EMISSIONS ACCOUNT FOR NEARLY **45% OF CURRENT NET WARMING**

1 Climate and Clean Air Coalition (2022): Global Methane Assessment: 2030 Baseline Report.

2 CCAC, UNDP (2021): Global Methane Assessment. Summary for Decision Makers. https://www.ccacoalition.org/en/resources/global-methane-assessment-summary-decision-makers.

3 HEAT GmbH (2022): Sektorale Treibhausgasminderungsstrategien für ausgewählte Sektoren unter Anwendung des NACAG Ansatzes. HEAT GmbH, Königstein, Germany.

4 Climate and Clean Air Coalition (2022): Global Methane Assessment: 2030 Baseline Report.

5 United Nations Environment Programme and Climate and Clean Air Coalition (2021). 'Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions'. Nairobi: United Nations Environment Programme. Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/35913/GMA.pdf

Technological potential

Biogenic methane is produced when organic material decomposes in the absence of air - especially through anaerobic digestion processes in landfills and dumps. It is estimated that, due to technical and economic framework conditions, only a maximum of 50% of the landfill gas emissions can be effectively collected and recycled,[6] so that landfills remain a large source of methane even when the gas is collected. Therefore, the transformational approach for the waste sector focuses on the implementation of a diversion strategy of biowaste and organic-rich municipal waste from landfills, which includes building infrastructure for organic waste treatment and recycling into circular material streams. At the same time, there is a need to drastically minimize methane emissions from existing landfills. The reduction potential of municipal waste management through 2050 is estimated to be 1 Gt CO_2eq/yr, with a total reduction of 9 Mt/yr entirely from municipal landfills in the waste sector.[3,7] Half of this reduction potential can be tapped with reduction costs of less than EUR 30/t CO_2eq.[3]

The following actions are recommended in order of priority:

1. Prevent and reduce residential, commercial, and institutional organic waste generation.
2. Expand schemes for separate collection of organic waste and subsequent composting or anaerobic digestion to produce biogas. Co-digestion with agricultural or wastewater facilities can be explored.
3. Collect and use landfill gas for electricity, heating, transportation, etc. In the case of large landfills (over 200,000 t of waste) with sufficient amounts of methane gas, this can be done economically.
4. Collect and flare landfill gas if the gas is insufficient for use. This reduction measure does not generate revenue (in contrast to option #3) and therefore requires mandatory regulations and subsidies.
5. Biofiltration (covering the landfill with natural substances that break down methane) and aeration (pumping oxygen into the landfill to inhibit methane formation) for landfills that do not collect, flare, or use landfill gas.

Case study

The project “Waste Solutions for a Circular Economy in India” is funded by the NAMA facility and implemented by GIZ together with local partners such as the Indian Ministry of Environment, Forest and Climate Change. The project aims at transforming the municipal solid waste management system in India which is largely limited to depositing mixed waste streams in unmanaged dumpsites, leading to significant GHG emissions. Project measures include:

- Development of quality standards for methane retrofitting
- Implementation of source segregation programs in Indian cities
- Introduction of a grant funding mechanism and establishment of a risk sharing facility to strengthen low-emission solutions like anaerobic digestion, composting and recycling

As a result, the project is expected to support the reduction of around 1.2 Mt CO_2eq (comprising around 0.42 Mt CH_4) over a period of 5 years.

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[6] Umwelt Bundesamt (2022): Unterschätztes Treibhausgas Methan. Quellen, Wirkungen, Minderungsoptionen. https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/uba_pos_methanminderung_bf.pdf

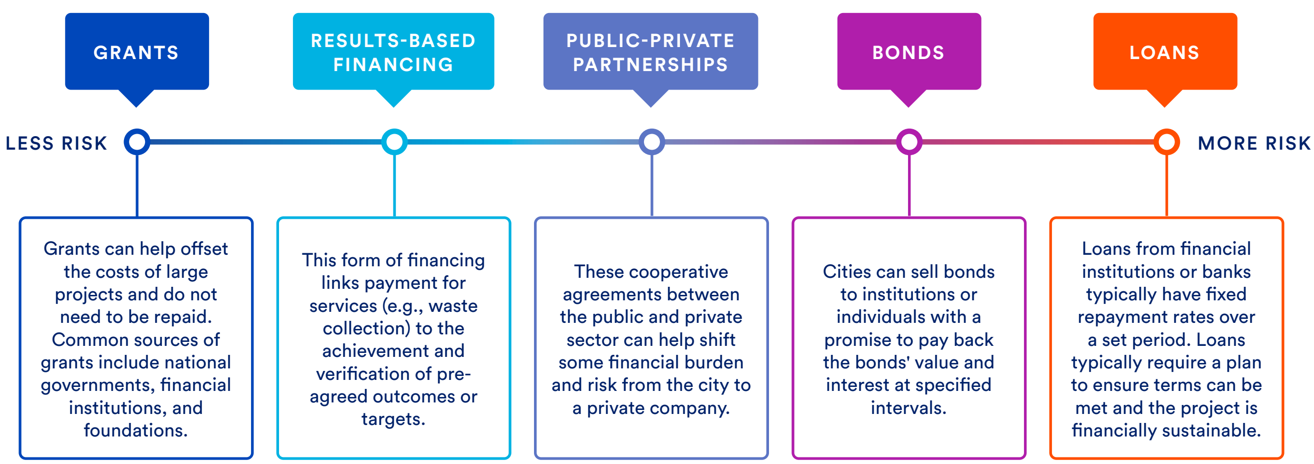
[7] US-EPA (2019): Global Non-CO2 Greenhouse Gas Emission Projections & Mitigation, 2015-2050. https://www.epa.gov/global-mitigation-non-co2-greenhouse-gases/global-non-co2-greenhouse-gas-emission-projections

Enabling regulatory framework

International initiatives and strategies address the need to reduce global methane emissions quickly and consistently, including the Global Methane Pledge, flanked by the International Methane Emissions Observatory and the methane activities of the Climate and Clean Air Coalition, the EU Methane Strategy and the Global Methane Initiative. Participants joining the Pledge contribute to a collective effort to reduce anthropogenic methane emissions at least 30% from 2020 levels by 2030.[8] However, there are no binding international reduction targets specifically for methane, which is often only included in climate commitments indirectly through GHG targets in CO_2 equivalents. Although some methane mitigation measures in the waste sector are low cost, because of key barriers facing these measures (e.g., local capacities and low tipping fees at landfills and dumps), regulatory requirements are necessary for their effective implementation. Best practice policy approaches and regulations, such as the EU Directive 1999/31/EG that set an effective framework to reduce landfilling of untreated organic municipal waste to 10% by 2035 in member states, serve as examples that can be adapted to the specific municipal structures and local conditions. Methane-mitigation measures focusing on prevention and treatment of organic waste should be complemented by a holistic circular economy approach also focusing on prevention, reuse, and recycling of non-organic waste fractions.

Financing mechanisms

Up to 60% of available measures in the waste sector have low or negative mitigation costs, which means the measures could pay for themselves.[9] This applies, for example, to the investment and operating costs required for landfill capture systems in larger landfills with a high volume of gas, which can generate revenues. However, small-scale solutions also offer financially attractive options for communities and municipalities. For example, generating biogas from organic waste using small-scale anaerobic digestion plants and selling it for transportation or cooking fuel. Since barriers exist for some methane emission reduction measures in the waste sector, the following supporting investment and operational financing mechanisms of reduction strategies are recommendable:[10]



Note: Risk refers to the risk incurred by the city in selecting a type of financing instrument for a waste sector project.

Source: U.S. EPA (2020)

[8] Global Methane Pledge (2022).

[9] CCAC, UNDP (2021): Global Methane Assessment. Summary for Decision Makers. https://www.ccacoalition.org/en/resources/global-methane-assessment-summary-decision-makers.

[10] U.S. EPA (2020) Best Practices for Solid Waste Management: A Guide for Decision-Makers in Developing Countries. https://www.epa.gov/sites/default/files/2020-10/documents/master_swmg_10-20-20_0.pdf

Building capacities

Through collaboration and shared knowledge, the identification and implementation of methane pollution solutions becomes faster, scalable, and accessible. **The following organizations have the expertise and capacities to support nations in their methane pathways.**

CATF CLEAN AIR TASK FORCE

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