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CESAR LEON/CLEAN CITIES, BLUE OCEAN

METHANE MITIGATION TECHNICAL BRIEF SERIES

SOLID WASTE SECTOR

Methane abatement in the solid waste sector leads to overall methane emissions reduction and advances global climate goals.

Methane is a gaseous compound consisting of carbon and hydrogen, formed by both geological and biological processes. It is about 80 times more potent than carbon dioxide (CO_2) at warming the planet during a 20-year period (25 times more potent during a 100-year period) and has contributed to roughly 30 percent of global warming since the pre-industrial era. The signatories of the Global Methane Pledge, launched in 2021 at the 26th United Nations Climate Change Conference, committed to reducing methane emissions by at least 30 percent from 2020 levels by 2030.

Methane mitigation is critical for advancing the United States Agency for International Development's (USAID) 2022–2030 Climate Strategy, including its greenhouse gas mitigation target to reduce, avoid, or sequester 6 billion metric tons of CO_2 equivalent by 2030. USAID's Climate Strategy explicitly underscores methane reduction under Strategic Objective 1 (Targeted Direct Action) and Intermediate Result 1.1 (Catalyze Urgent Mitigation). The Agency's approach to methane reduction is multi-sectoral, encompassing energy (oil and gas, and coal mine methane), agriculture (rice and livestock), solid waste, and wastewater.

This technical brief focuses on methane mitigation in the solid waste sector. It details potential abatement measures in the sector and presents a pathway for Missions to integrate those measures into USAID solid waste management programming. The brief also highlights the co-benefits of mitigation.

Methane Emissions in the Solid Waste Sector

The waste sector is the **third largest man-made source** of methane, accounting for 7 to 10 percent of anthropogenic methane. The sector has the potential to achieve a **39 percent reduction in methane emissions by 2030 and a 91 percent reduction by 2050**.[1] Methane emissions from the solid waste sector are estimated around 34 million metric tons per year. They mainly arise in the final disposal site, landfills or open dumps, where methane is generated from the anaerobic decay of organic waste (i.e., the breakdown of matter without access to oxygen). The World Bank estimates waste generation will increase from 2.01 billion metric tons in 2016 to 3.40 billion metric tons in 2050. Currently, at least 33 percent of that waste is not managed in an environmentally safe manner,[2] creating a breeding ground for toxins and microbes that contaminate the air, soil, and water, thus presenting a hazard to human health.

The waste problem is most severe in developing countries and especially in urban areas with limited collection and disposal services, financial resources, and local government capacity to manage waste. According to the *Global Methane Assessment 2030: Baseline Report*, the regions with the largest increase in annual baseline emissions for waste are Asia and the Middle East and Africa (approximately 3 to 5 million metric tons per year). These two regions also showed the largest increases of total anthropogenic methane emissions over the past two decades.

Socio-economic factors such as rapid economic and population growth increase consumption, leading to higher volumes of waste generation, and exacerbate already weak waste management systems in developing countries. However, waste composition also is a key factor for methane generation. In low- and middle-income countries, organic waste accounts for more than 50 percent of total waste.[3] The volume and type of organic waste, moisture content, gas capture effectiveness, landfill cover type, regulatory oversight, and monitoring and quantification practices (among other factors) ultimately affect how much methane is emitted from land disposal sites.

While the final waste disposal sites generate the largest portion of methane emissions, methane reduction opportunities should be considered along the entire waste management system. (For additional explanation of the different stages of landfill decomposition, refer to the supplemental material.)

Best Practices for Methane Abatement in the Solid Waste Sector

Best practices for reduction of methane emissions in the solid waste sector support the creation of integrated waste management systems and include expansion of waste collection services, source separation, recycling and composting to reduce waste burning, and improvement of landfill management. According to a Rocky Mountain Institute (RMI) report, strategies for methane mitigation in the solid waste sector—and therefore alignment of the sector with the 1.5 degrees Celsius climate

[1] https://www.mckinsey.com/business-functions/sustainability/our-insights/curbing-methane-emissions-how-five-industries-can-counter-a-major-climate-threat#.

[2] https://openknowledge.worldbank.org/entities/publication/d3f9d45e-115f-559b-b14f-28552410e90a.

[3] https://openknowledge.worldbank.org/entities/publication/d3f9d45e-115f-559b-b14f-28552410e90a.

pathway—fall broadly into two categories: pre-land disposal site strategies and land disposal site strategies.[4]

Pre-land disposal site strategies focus on preventing organic waste from reaching landfills and open dump sites through **food waste prevention** and **organic waste diversion**. Food waste decomposes faster than other organic waste, thereby producing methane faster. Reducing food waste that enters the landfill can help reduce methane production while also promoting food security.

Organic waste diversion can be achieved by either separating organic waste at the source or recovering organics from the waste mix before disposing of it in the landfill. **Source separation** is a more expensive approach for communities, as it requires additional separate collection efforts. Successful source separation of organic waste may require financial or other incentive programs, sustained educational awareness programs to encourage positive behavior changes, or mandatory participation ordinances. **Organic waste recovery** is usually done through manual or automated separation processes of organic waste at a material recovery facility and can be more reliable in diverting organic waste.

Land disposal site strategies include approaches for **rehabilitation of unmanaged open and controlled dumpsites** and the **design and management of managed landfills.** Upgrading unmanaged dump sites to sanitary landfills by fitting them with control systems that optimize methane abatement (such as gas capture systems, liners, and landfill covers) not only significantly decreases the release of methane emissions, but also improves the health and safety of local communities. The recovered gas also can be used as an energy source. The best practices for maximizing landfill gas emissions reductions take advantage of the design and operation stages. Mitigation options are incorporated into the landfill facility during the initial permitting and construction stage, and during development of additional disposal cells as more waste is sent to landfills. Landfill operational strategies include measures to optimize operations for methane mitigation, including monitoring to identify sources and causes of landfill gas emissions, minimize the migration of excessive surface emissions, improve the effectiveness of gas capture systems, and convert the captured landfill gas to beneficial end products.

Monitoring and reporting are critical for effectively managing methane emissions across both mitigation strategies. While measuring methane emissions reductions from source segregation activities might not be straightforward (depending on the proposed activities), technologies and methodologies exist for measuring methane emissions from activities under land disposal site strategies. RMI's report provides a detailed summary of existing bottom-up (emissions estimates derived from models) and top-down (estimates derived by measuring atmospheric concentrations of methane) monitoring approaches for measuring methane emissions from landfills.[5] (For key considerations and potential interventions for each of the discussed strategies, refer to the supplemental material.)

[4] https://rmi.org/insight/mitigating-methane-emissions-from-municipal-solid-waste/.

[5] Ebun Ayandele et al., Key Strategies for Mitigating Methane Emissions from Municipal Solid Waste, RMI, 2022, https://rmi.org/insight/mitigating-methane-emissions-from-municipal-solid-waste/.

BOX 1: CLEAN CITIES, BLUE OCEAN: REMEDIATION OF OPEN DUMPS IN THE DOMINICAN REPUBLIC

To support the Government of the Dominican Republic transition away from informal dumps and establish a system of regional sanitary landfills, the Clean Cities, Blue Ocean (CCBO) program—USAID's global flagship program to combat ocean plastic pollution - worked with national partners to facilitate the mitigation, remediation, and closure of two open dumps in Samaná Province. Through expert technical assistance, CCBO created an environmentally sound open dumpsite remediation model that the Government of the Dominican Republic is replicating across the country. The remediation activities in the two open dumps in Samaná included placement and grading of cover material over all open waste and design and installation of proper drainage systems to control stormwater and leachate. In addition, an emissions control system was installed at each site to decrease, capture, and use methane as a clean energy source. The system's chimneys are now able to vent flammable gasses, preventing methane buildup, with plans to capture and convert emissions into energy to power the site's operational buildings. By reducing and controlling Samaná's methane gas emissions in the remediated dumpsites, an estimated 62.4 million pounds of CO_2e emissions have been captured and destroyed to date—roughly equivalent to the annual emissions of burning 31.2 million pounds of coal or 3.2 million gallons of gasoline.

To advance operations and safety at both sites, CCBO provided training and led workshops. In anticipation of migrating to the new regional sanitary landfill, CCBO also advised on the construction of new transfer stations with truck scales for weighing incoming waste. The transfer stations will serve as an interim sorting and recovery operation for plastics and organics to minimize the amount of waste going to the new landfill, while extending the site life through increased recovery and shifting local behaviors.

Additional Resources: Case Study: A model for waste site remediation to reduce climate impacts and ocean plastic pollution; Virtual Trainings (available at CCBO Learning Hub): Managing Open Dump Sites and Siting of Landfills

Integrating Methane Abatement Measures into Solid Waste Management Programming

USAID's Save Our Seas Initiative is addressing ocean plastic pollution at the most immediate source: weak solid waste management systems in developing cities. The initiative positions USAID to achieve methane emissions reduction co-benefits from current and future ocean plastic pollution programming. Although tackling ocean plastic pollution and climate change through methane abatement are two distinct endeavors, they have overlapping solutions under the umbrella of a well-functioning, integrated solid waste management system. USAID takes a comprehensive approach that includes improving the entire solid waste management system, from waste collection, to recycling and composting, to proper design and operations of landfills. Missions can take the following steps to integrate methane abatement measures into their programming:

- **Conduct a methane emissions assessment.** This could be a first step for the Mission to better understand the methane emissions landscape in the waste sector and identify potential mitigation measures adapted to the country context.
- **Integrate methane mitigation in existing activities focused on improving solid waste management systems.** Mission technical teams should work with implementing partners to: identify the current interventions that also have methane mitigation potential; adapt those interventions to more explicitly address methane mitigation, if needed; and revise the activity Monitoring, Evaluation, and Learning Plan, where appropriate, to measure the co-benefits of methane emissions reduction.
- **Integrate methane mitigation measures during the design of new activities.** Missions using Ocean Plastic Pollution funding or other funding streams to design new solid waste and ocean plastic pollution activities should consider including a methane-specific objective. If the Mission does not have funds to support a methane mitigation intervention, this objective can be in the form of an option that could be exercised when methane-specific or other types of funding become available during the life of the program. For example, USAID/Indonesia took this forward-looking approach during the design of the Selaras activity, as did USAID/Mexico in the design of the Partnership for Net Zero Cities activity.

BOX 2: RELEVANT FUNDING STREAMS

- **Clean Energy funds** can be used for policies and projects that reduce methane emissions in the solid waste and wastewater sectors across the entire waste value chain, including, but not limited to: waste reduction, organics diversion from the waste stream, solid waste management, landfill gas capture, and wastewater management improvements.
- **Ocean Plastic Pollution funds** can be used to build the necessary capacity, commitment, and regulatory framework for improved solid waste management (i.e., promotion of the 3Rs, diversion of organic waste, prohibition of open burning, remediation and closure of open dumps, and promotion of sanitary landfills with methane capture).
- **Democracy, Human Rights, and Governance directive funds** can be used to advance participatory and accountable governance, rule of law, authentic political competition, civil society, human rights, and the free flow of information. All of these governance components are essential for improving municipal solid waste management.
- **Climate Adaptation funds** can be used to build resilience of urban areas to climate impacts such as flooding due to uncollected waste and effect of increased heat on the biological processes associated with the decomposition of solid waste by supporting activities that promote improved solid waste collection services and proper landfill operations.

Further Reading

- Best Practices for Solid Waste Management: A Guide for Decision-Makers in Developing Countries: Guide to help local decision-makers understand, plan, and implement strategies for solid waste management
- Organic Waste Separation - Program and Policy Options: Report on best practices, methods, and policy options for source separation
- Basic Information about Landfill Gas: U.S. Environmental Protection Agency webpage
- Key Strategies for Mitigating Methane Emissions from Municipal Solid Waste: 2022 RMI report highlighting effective methane-emission mitigation strategies

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