Mitigation of global greenhouse gas emissions from waste: conclusions and strategies from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report - DTU Orbit (20/07/2019)

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Greenhouse gas (GHG) emissions from post-consumer waste and wastewater are a small contributor (about 3%) to total global anthropogenic GHG emissions. Emissions for 2004-2005 totalled 1.4 Gt CO₂-eq year⁻¹ relative to total emissions from all sectors of 49 Gt CO₂-eq year⁻¹ (including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and F-gases normalized according to their 100-year global warming potentials (GWP)). The CH₄ from landfills and wastewater collectively accounted for about 90% of waste sector emissions, or about 18% of global anthropogenic methane emissions (which were about 14% of the global total in 2004). Wastewater N₂O and CO₂ from the incineration of waste containing fossil carbon (plastics; synthetic textiles) are minor sources. Due to the wide range of mature technologies that can mitigate GHG emissions from waste and provide public health, environmental protection, and sustainable development co-benefits, existing waste management practices can provide effective mitigation of GHG emissions from this sector. Current mitigation technologies include landfill gas recovery, improved landfill practices, and engineered wastewater management.

In addition, significant GHG generation is avoided through controlled composting, state-of-the-art incineration, and expanded sanitation coverage. Reduced waste generation and the exploitation of energy from waste (landfill gas, incineration, anaerobic digester biogas) produce an indirect reduction of GHG emissions through the conservation of raw materials, improved energy and resource efficiency, and fossil fuel avoidance. Flexible strategies and financial incentives can expand waste management options to achieve GHG mitigation goals; local technology decisions are influenced by a variety of factors such as waste quantity and characteristics, cost and financing issues, infrastructure requirements including available land area, collection and transport considerations, and regulatory constraints. Existing studies on mitigation potentials and costs for the waste sector tend to focus on landfill CH₄ as the baseline. The commercial recovery of landfill CH₄ as a source of renewable energy has been practised at full scale since 1975 and currently exceeds 105 Mt CO₂-eq year⁻¹. Although landfill CH₄ emissions from developed countries have been largely stabilized, emissions from developing countries are increasing as more controlled (anaerobic) landfilling practices are implemented; these emissions could be reduced by accelerating the introduction of engineered gas recovery, increasing rates of waste minimization and recycling, and implementing alternative waste management strategies provided they are affordable, effective, and sustainable. Aided by Kyoto mechanisms such as the Clean Development Mechanism (CDM) and Joint Implementation (JI), the total global economic mitigation potential for reducing waste sector emissions in 2030 is estimated to be > 1000 Mt CO₂-eq (or 70% of estimated emissions) at costs below 100 US$ t⁻¹ CO₂-eq year⁻¹. An estimated 20-30% of projected emissions for 2030 can be reduced at negative cost and 30-50% at costs < 20 US$ t⁻¹ CO₂-eq year⁻¹. As landfills produce CH₄ for several decades, incineration and composting are complementary mitigation measures to landfill gas recovery. In the short to medium-term - at the present time, there are > 130 Mt waste year⁻¹ incinerated at more than 600 plants. Current uncertainties with respect to emissions and mitigation potentials could be reduced by more consistent national definitions, coordinated international data collection, standardized data analysis, field validation of models, and consistent application of life-cycle assessment tools inclusive of fossil fuel offsets.

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