

Mitigation ambition and implementation from the improved management of wastewater and from water reuse and recycling

Submission to the sixth global dialogue under the Sharm el-Sheikh mitigation ambition and implementation work programme, Addis Ababa 5-6 September 2025

Introduction

This submission responds to the invitation to the Parties, observers and other non-Party stakeholders to submit views on opportunities, best practices, actionable solutions, challenges and barriers relevant to the topics of the sixth global dialogue under the Sharm el-Sheikh mitigation ambition and implementation work programme (the mitigation work programme) with the focus of this dialogue being on mitigation solutions in the waste sector, including through circular economy approaches.

This submission proposes that cost-effective **opportunities to reduce emissions from wastewater and from the adoption of water reuse and recycling** be the subject of discussion at the workshop.

This submission is made by the World Meteorological Organisation (WMO) as a co-coordinator of the UN-Water Expert Group on Water and Climate Change.

Wastewater emission reduction opportunities

The treatment of wastewater and sewage effluent produces methane, nitrous oxide and carbon dioxide. Wastewater treatment processes have been estimated to be the fifth largest contributor to global anthropogenic CH₄ emissions and the third largest source of global N₂O emissions (references cited in UN-Water, 2024)

These emissions can be substantially reduced through the improved management of wastewater and sanitation systems. Actions may include improved management of onsite sanitation containment (better and more frequent emptying and transport), modifications to treatment, and improving the safe management of faecal matter. Where new or upgraded on-site sanitation investments are planned, smaller tanks or container-based systems may have a net positive impact on emissions. For wastewater treatment plants and other centralized sanitation systems, nitrous oxide and methane emissions can be avoided, reduced or destroyed. Methane emissions can be avoided by a range of mitigation methods including leak detection and repair. It is possible to reduce nitrous oxide emissions significantly through changes in operational parameters (such as optimization of processes, source reduction, balancing of incoming nitrogen and destruction of residual nitrous oxide) of centralized wastewater treatment facilities (references cited in UN-Water, 2024).

There are also major co-benefits from the improved management of human waste. For example, if waste from all those who lack access to safely managed sanitation in rural areas was processed

through anaerobic digesters, the biogas potential could be roughly 20-50 billion cubic metres, enough to provide a clean cooking fuel to around 60-180 million households (IEA, 2018).

Circular economy opportunities

Wastewater is a valuable resource and an essential component of a circular economy. It has the potential to meet the growing demand for water, acts as a safe and sustainable solution to address not only the challenges of water security, but also the impacts of climate change, biodiversity loss, and pollution. There are considerable opportunities to sustainably manage wastewater for beneficial use. There are also many ways that water and wastewater reuse and recycling can reduce emissions directly and indirectly by reducing demand for high emissions inputs (UN-Water, 2024).

The following examples of wastewater reuse and recycling examples are taken from the *UN-Water Analytical Brief on Water for Climate Mitigation* (UN-Water, 2024), with references cited given in that report).

If wastewater is treated to a sufficient quality, the effluent can be reused as a potable or non-potable source of water. The cost of treatment of wastewater to this level is cheaper per cubic metre when compared to desalination, so has the potential to provide a cheaper alternative water source that conserves water sources and limits greenhouse gas emissions from untreated wastewater (GACERE, 2024). Also, many treatment systems across the world have begun to harness the biogas produced from anaerobic digestion for energy, preventing its release and consequent emissions, and creating a clean energy source for the treatment system, or in some cases, excess energy that can be sold to the grid (World Bank, 2020). Therefore, the wastewater treatment process has the potential to generate revenue, providing a return on investment for the upgrade works and an additional stream of income.

Furthermore, the by-products of sludge production within the wastewater treatment process (nitrogen, phosphorous and potassium) can be used to produce fertilizer, decreasing the dependency on the mining of these elements, and their associated greenhouse gas emissions. The creation of facilities that produce and sell fertilizer can payback the investment costs required for upgrades the systems that facilitate the extraction of these by-products, eventually allowing for an additional revenue stream (Delgrado et al., 2021).

Nutrients and other sources of greenhouse gas emissions from wastewater may also be removed through constructed wetlands replicating the physical, chemical and biological processes of natural wetlands (GIZ, 2020). However, as wetlands themselves are a recognized emissions source and life-cycle analysis should be undertaken to ensure projects have a net positive climate mitigation outcome over time.

The water and sanitation services sector is also a major energy user and can reduce its sector emissions by the use of no- or low-emission energy (including using biogas and/or energy brickettes recovered from wastewater and/or faecal sludge) and by using less energy through reducing demand and energy efficiency improvements (IEA, 2018, and World Bank, 2019).

Wastewater in NDC 3.0s

In the case of climate mitigation measures involving the improved treatment of wastewater and utilizing the resources embedded within wastewater for water, energy and nutrients, NDC 3.0 may identify how these measures will decrease emissions while addressing social and environmental issues. Improving access to wastewater treatment and utilizing the resources embedded within wastewater for water, energy and nutrients provide an opportunity to decrease emissions while addressing social and environmental issues with projects that often provide a sound return on investment (UN-Water, 2024).

Further information and support

Any Dialogue participant of United Nations Member State seeking further information on or discussion of any of these opportunities is encouraged to contact UN Water at unwater@un.org, who will introduce the inquirer to the UN organisations with the technical capacity most relevant to the inquiry. For example, the United Nations Children's Fund (UNICEF) and World Health Organization (WHO) can provide guidance and technical capacity-building to support improved wastewater and sanitation management, including guidelines on wastewater to inform policy making and regulations and guidelines on sanitation and health (UN Water, 2024).

References

IEA, 2018. The energy sector should care about wastewater.

<https://www.iea.org/commentaries/the-energy-sector-should-care-about-wastewater>

UN-Water, 2024. UN-Water Analytical Brief on Water for Climate Mitigation. Geneva, Switzerland

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World Bank, 2020. *Wastewater A Resource that Can Pay Dividends for People, the Environment, and Economies*, Says World Bank. World Bank. <https://www.worldbank.org/en/news/press-release/2020/03/19/wastewater-a-resource-that-can-pay-dividends-for-people-the-environment-and-economies-says-world-bank>