

## Greenhouse gas emissions from municipal wastewater treatment plants

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### Abstract

Operating wastewater treatment plants (WWTP) represent a source of greenhouse gases (GHG). Direct GHG emissions include emissions of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) that can be biologically produced during wastewater and sewage sludge treatment. This is also highlighted in the Intergovernmental Panel on Climate Change (IPCC 2006) guidelines used for national GHG inventories. Indirect GHG emissions occur at WWTPs mainly by the consumption of electricity, fossil fuel for transportation and by the use of chemicals (e.g. coagulants).

In this study, the impact of direct and indirect GHG emissions was quantified for two model WWTPs of 50.000 person equivalents (p.e.) using carbon footprint analyses. It was assumed that at one WWTP sewage sludge is digested anaerobically, at the other one it is aerobically stabilised in the activated sludge tank. The carbon footprint analyses were performed using literature emission factors. A new estimation model based on measurements at eight Austrian WWTPs was used for the assessment of N<sub>2</sub>O direct emissions (Parravicini et al., 2015).

The results of the calculations show that, under the selected assumptions, the direct N<sub>2</sub>O emission from the activated sludge tank can dominate the carbon footprint of WWTP with a poor nitrogen removal efficiency. Through an improved operation of nitrogen removal several advantages can be gained: direct N<sub>2</sub>O emissions can be reduced, the energy demand for aeration can be decreased and a higher effluent quality can be achieved. Anaerobic digesters and anaerobic sludge storage tanks can become a relevant source of direct CH<sub>4</sub> emissions. Minimising of CH<sub>4</sub> losses from these sources improves the carbon footprint of the WWTP also increasing the energy yield achievable by combusting this renewable energy carrier in a combined heat and power unit.

The estimated carbon footprint of the model WWTPs lies between 20 and 40 kg CO<sub>2</sub>e/p.e./a. This corresponds to 0.2 to 0.4% of the CO<sub>2</sub>e average emission caused yearly by a person in Germany or Austria (10.6 t CO<sub>2</sub>e/p/a, UBA, 2016). The results indicate that GHG emissions from WWTP have at global scale a small impact, as also highlighted by the Austrian national inventory report (NIR, 2015), where the estimated CO<sub>2</sub>e emissions from WWTPs account for only 0.23% of the total CO<sub>2</sub>e emission in Austria.

### References

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