

# Written communication

CH4 emissions from effluents - Damian Dominguez 2023

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## Date and type of communication:

Several E-mails and Skype calls (2023) are summarized in this written communication

## Text:

### *Introduction*

For Switzerland's GHGI submission 2023 CH<sub>4</sub> and N<sub>2</sub>O emission estimates for 5D Wastewater treatment and discharge have been recalculated. Studies by Gruber (2021, 2022) and Vuna (2023) re-evaluated centralized and decentralized wastewater treatment in Switzerland, respectively. Gruber et al. evaluated data compiled by VSA/SVKI 2023, a report also known as "Kennzahlenbericht". On the same data basis and following IPCC (2019), emission estimates for CH<sub>4</sub> from effluents can be performed. Useful advice on valid assumptions as well as necessary hints are given here.

### *Centralized wastewater treatment – CH<sub>4</sub> emissions from effluent*

Data for most Swiss centralized wastewater treatment plants (WWTP) are available for 2020 (VSA/SVKI 2023) showing chemical oxygen demand (COD) as measured in the outflow of WWTP ("AbFrachtCSB" given in kg COD / day) attributable to a known number of connected persons. An average for chemical oxygen demand (COD) of 10.24 g COD/(person\*day) of treated water discharged can be derived. Together with the assumed inflow of 120 g COD/(person\*day) (FOEN 2023) a C removal rate around 91.5 % can be deduced for Switzerland. For comparison: using data for COD inflow and COD outflow (VSA/SVKI 2023), scaled by the number of connected persons, results in a C removal rate of 93.9 %. This comparison supports the validity of the applied method. It is suggested to use measurements of the COD of the outflow only, because data quality for COD inflow to plants is considered lower, especially for small centralised wastewater treatment plants. The chosen approach is considered representative, as more than 84% of Swiss inhabitants (in 2020) are included in this estimate. In addition, all relevant (large) WWTPs are counted in.

On the same data base (VSA/SVKI 2023), different types of receiving waters can be attributed to and weighted with the number of connected persons. As a result, 84.5 % of treated water is fed to rivers and 15.5 % is fed to lakes. Accordingly, Tier 2 emission factors from IPCC (2019, Volume 5 Waste, [Chapter 6 Wastewater Treatment and Discharge](#), Table 6.3) can be used to estimate CH<sub>4</sub> emissions from effluents: for rivers “Discharge to aquatic environments other than reservoirs, lakes, and estuaries (Tier 2)”, for lakes “Discharge to reservoirs, lakes, and estuaries (Tier 2)”.

#### *Decentralized wastewater treatment – CH<sub>4</sub> emissions from effluent*

In order to calculate remaining organics in the outflow of small-scale wastewater treatment plants (SSWWTP) it is necessary to estimate the reduction potential for total organics in wastewater (COD) of such systems.

Concerning SSWWTP in Switzerland, it is reasonable to assume that COD reduction in primary treatment amounts to 30 %, as primary settlers are usually designed to achieve this elimination rate. The same fraction (30 %) is used by Vuna (2023) to estimate CH<sub>4</sub> emissions from SSWWTPs. Furthermore, it is required by Federal legislation that COD is reduced by 80 % in SSWWTPs with primary and secondary treatments (90% elimination of the BOD in the influent, respectively) (Swiss Confederation 1998b). The carbon removal rate of individual SSWWTP is regularly controlled by cantonal authorities and therefore considered plausible. Numbers presented here compare well to values given by IPCC (2019, Volume 5 Waste, [Chapter 6 Wastewater Treatment and Discharge](#), Table 6.6).

It is reasonable to assume that all SSWWTPs in Switzerland discharge into streams. Accordingly, the Tier 2 emission factor from IPCC (2019, Volume 5 Waste, [Chapter 6 Wastewater Treatment and Discharge](#), Table 6.3) for rivers can be used to estimate CH<sub>4</sub> emissions from effluents: “Discharge to aquatic environments other than reservoirs, lakes, and estuaries (Tier 2)”.

#### *Transfer from COD to TOC*

In order to derive total organic carbon (TOC) from chemical oxygen demand (COD) in typical wastewater the relation  $TOC = \frac{1}{3} COD$  is suggested based on reflections in Metcalf and Eddy (2003).

#### *References*

Greenhouse Gas Inventories Switzerland: [www.climatereporting.ch](http://www.climatereporting.ch)

**Gruber, W., Joss, A., Luck, M., Kupper, T., Bühler, M., Bühler, T. 2021:** Elaboration of a data basis on greenhouse gas emissions from wastewater management - Final report N2OklimARA, Eawag, Swiss Federal Institute for Aquatic Science and Technology, 8600 Dübendorf, Switzerland and Bern University of Applied Sciences School of Agricultural, Forest and Food Sciences, 3052 Zollikofen, Switzerland, 10.12.2021, Commissioned by the Federal Office for the Environment (FOEN).

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**Gruber 2022:** Written communication by Wenzel Gruber to Michael Bock and Daiana Leuenberger (FOEN): E-mails 24.10.2022 and 31.10.2022 including attachment as an update to Gruber et al. 2021. [confidential/internal]

**IPCC 2019:** 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland. Copyright by The Intergovernmental Panel on Climate Change (IPCC), 2019. <https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html>

**Metcalf and Eddy 2003:** Wastewater Engineering: Treatment and Reuse by Tchobanoglous, G., Burton, F.L., Stensel, H.D., 2003, Metcalf & Eddy, Inc, 4th Edition, McGraw-Hill Series in Civil and Environmental Engineering, 1819 pages [hardcopy]

**Swiss Confederation 1998b:** Waters Protection Ordinance (WPO) of 28 October 1998 (Status as of 1 February 2023) [official text in German, French and Italian. English translation for information purposes only]. [https://www.fedlex.admin.ch/eli/cc/1998/2863\\_2863\\_2863/en](https://www.fedlex.admin.ch/eli/cc/1998/2863_2863_2863/en) [19.12.2023]

**VSA/SVKI 2023:** Kosten und Leistungen der Abwasserentsorgung / Coûts et prestations de l'assainissement. Publisher / éditeurs: Verband Schweizer Abwasser- und Gewässerschutzfachleute, Glattbrugg / Association suisse des professionnels de la protection des eaux, Glattbrugg und / et Schweizerischer Verband Kommunale Infrastruktur (SVKI), Bern / Association suisse Infrastructures communales (ASIC), Berne.

<https://vsa.ch/Mediathek/kosten-und-leistungen-der-abwasserentsorgung-2/>

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Modelldokumentation\_ARA\_134.5\_REP\_128.1\_V1\_2-f.pdf

Definition-Kennzahlen-2016\_low.pdf

VSA-SVKI 2023 - Kosten Leistungen Abwasserentsorgung - D F.pdf

VSA\_Kennzahlen\_ARA\_2019\_2020\_final.xlsx

Calculation of Swiss COD outflow of WWTP and differentiation of receiving waters:

VSA\_Kennzahlen\_ARA\_2019\_2020\_final\_LDA.xlsx

**Attachments:**

Linked data and calculation files are available on request.