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**Report for the Stage 3 *ad-hoc* review of emission
inventories submitted under the UNECE LRTAP
Convention:**

2023

Switzerland

FINAL REPORT

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INTRODUCTION

1. The mandate and overall objectives for the emission inventory review process under the LRTAP Convention is given by the UNECE document 'Updated methods and procedures for the technical reviews of air pollutant emission inventories reported under the Convention'⁽¹⁾ – hereafter referred to as the 'Review Guidelines 2018'.

2. Paragraph 7 (c) of the 'Review Guidelines 2018' defines that Stage 3 Reviews may be annual centralized reviews or ad hoc reviews. Paragraph 18 of the 'Review Guidelines 2018' further specifies that such ad hoc reviews could, for instance, focus on specific source sectors, specific pollutants such as heavy metals or persistent organic pollutants, gridded and projections data, or on other areas as requested by the Implementation Committee and that where appropriate, ad hoc reviews could be conducted in line with the present Methods and Procedures for the In-depth (Stage 3) review.

3. At its eighth joint session in September 2022, the Steering Body and the Working Group on Effects approved the plan that the in-depth review in 2023 focuses on emissions from agriculture with a special emphasis on ammonia, NMVOC and NO_x emissions including gridded data. While the focus was set on NH₃, NMVOC and NO_x emissions, also all other pollutants covered by LRTAP Convention and its protocols (i.e. SO₂, NO_x, NMVOC, NH₃, plus PM₁₀ PM_{2.5}, BC, priority HMs and POP_S) have been checked for the time series years 1990 – 2021 to the extent possible. For these other pollutants especially completeness of reporting was assessed.

4. This report covers the results of the Stage 3 Review (ad hoc review) 2023 of Switzerland's air emission inventory submitted under the UNECE LRTAP Convention. The review was coordinated by the EMEP Centre on Emission Inventories and Projections (CEIP) acting as Review Secretariat. The review took place between April and June 2023 and was performed as a desk review between 31 March to 5 May 2023 and an in-person meeting between 22 of May 2023 and 26 May 2023 (centralized review). The following team of nominated experts from the Roster of Experts performed the review.

Agriculture experts:

Ms. Armine ARTENYAN (Republic of Armenia)

Ms. Ajla BASOVIC (Montenegro)

Ms. Aleksandra NESTOROVSKA-KRSTESKA (North Macedonia)

¹ Decision 2018/1 adopted by EB: *Updated methods and procedures for the technical review of air pollutant emission inventories reported under the Convention*. ECE/EB.AIR/142/Add.1
http://www.unece.org/fileadmin/DAM/env/documents/2002/eb/air/EB%20Decisions/Decision_2018_1.pdf

Mr. Lasha AKHALAIA (Georgia)

Mr. Hakam AL-HANBALI (Sweden)

Ms. Susana LOPEZ-APARICIO (EU/ETC(EEA))

Ms. Simone MAYER (Austria)

Ms. Andjelka RADOSAVLJEVIC (Serbia)

Ms. Kristina Tonhauzer (Slovakia)

Mr. Tim VAN DER ZEE (Netherlands)

Experts for gridded emission data:

Ms. Christine BRENDLE (Austria)

Mr. Christopher EVANGELIDES (United Kingdom)

Mr. Christian MIELKE (Germany)

5. Mr. Ben RICHMOND (United Kingdom), Ms. Rikke ALBREKTSEN (Denmark), Mr. Etienne MATHIAS (France), Ms. Kristina SAARINEN (Finland) were the lead reviewers. The review was coordinated by Ms. Sabine Schindlbacher and Mr. Bernhard Ullrich (EMEP Centre on Emission Inventories and Projections - CEIP).

6. The review was performed on the basis of CLRTAP emission data officially reported by Switzerland, due by 15 February 2023. The Informative Inventory Reports (IIR), reported due by 15 March 2023 under the CLRTAP, informed the review.

7. The EMEP/EEA Guidebook 2019² was used as a base for the review.

8. The emission inventory of Switzerland was received on 13 February 2023 and thus by the deadline of 15 February. The Informative Inventory Report was received on 13 March 2023 and thus by the deadline of 15 March.

² EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2019, EEA Report No. 13/2019 European Environment Agency, Copenhagen. Available at: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019> EU 2019

PART A: GENERAL RECOMMENDATIONS FOR THE CHAPTER AGRICULTURE

9. The ERT recognises the level of effort undertaken by Switzerland in providing an inventory including a significant level of detail.

The IIR does not describe the methods use for sector agriculture especially 3B Manure management subsector transparently enough. The ERT considers the agriculture part of the inventory submission to be of very good quality in terms of completeness and of very good quality in terms of accuracy, comparability and consistency.

To improve the overall quality of the agriculture air emission inventory the ERT recommends Switzerland to

- provide a detailed description of applied methodologies, data sources, choice of emission factors and activity data for all categories in the IIR.
- provide transparent information on recalculations in the agriculture chapter
- provide detailed information on its QA/QC plan for its air emission inventory in future submissions.

PART B: SPECIFIC RECOMMENDATIONS FOR THE SECTOR AGRICULTURE

10. Table 1 provides the findings from the 2023 CLRTAP Stage 3 Review including those not implemented from previous CLTRAP Stage 3 Reviews. While the focus was set on NH₃, NMVOC and NO_x emissions, also all other pollutants covered by the LRTAP Convention and its protocols (i.e. SO₂, NO_x, NMVOC, NH₃, plus PM₁₀ PM_{2.5}, BC, priority HMs and POP_s) have been checked for the years 1990 – 2021 to the extent possible, especially regarding the completeness of reporting. The implementation of the recommendations will be followed up in a future CLRTAP inventory review.

Table 1: Findings from the CLRTAP Stage 3 Review 2023 for the Sector Agriculture³

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC ₁ C ₂ C ₃
CH-2023-3B-1	NH ₃ , NO _x	3B	Yes	Tier 3	R	T

Observation:

The ERT notes that Nitrogen excretion parameters, which are important for the estimation of NH₃ and NO_x emissions, have not been clearly described in the IIR. The only reference available is on page 220 in chapter 5.2.2. During the review the Party provided transparent details relating to the determination of the Nitrogen excretion rate and provided values by animal species. The quantities of nitrogen excreted by the livestock are obtained from values valid in the respective reference years of the ‘Principles of Agricultural Crop Fertilisation in Switzerland’ (Walther et al., 1994, 2001; Flisch et al., 2009; Richner et al., 2017). The values have varied over time depending on the development of production technology (especially breeding and feeding) and have been adjusted accordingly. The table in the annex shows the excretion values used by AGRAMMON in the respective reference years.

The TAN (total ammoniacal nitrogen) proportions in the excreta of the animal categories which are used in AGRAMMON are as follows: Dairy cows and other cattle categories: 55%; pigs: 70%; poultry: 60%; horses and other equids, small ruminants, other roughage consuming livestock and rabbits are assumed to have 40% TAN.

N-excretion values and the proportion of TAN therein are based on models which employed experimental data obtained from dairy cows and fattening pigs. The proportion of TAN has been extrapolated from the values to the other cattle and pig categories. The bases of N-excretion values and the proportion of TAN have been described in section 2.1.6 of Kupper et al., 2018 and section 2.1.6 of Kupper, 2022. For poultry,

³ Note: There are four possible types of findings: R: Recommendation, TC: Technical Correction, PTC: Potential Technical Correction; RE : Revised Estimate

The findings have been assigned to one or more of the following criteria: TACCC T (Transparency), A (Accuracy), C₁ (Completeness), C₂ (Comparability), C₃ (Consistency) for definitions of these criteria see EMEP/EEA Guidebook 2019

horses and other equids, small ruminants, other roughage consuming livestock and rabbits the proportion of TAN is based on expert judgments. And also provided background studies.

Recommendation:

The ERT recommends the Party to improve the transparency of the estimation of NMVOC from the 3B Manure management subcategory and expand Switzerland’s IIR using the information provided during the review.

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC ₁ C ₂ C ₃
CH-2023-3B-2	NMVOC	3B3	Yes	Tier 1	R	T

Observation

The ERT noticed, that Switzerland Tier 1 emission factors in 3B3 Swine category presented in Table 5-9 on page 225 are inconsistent in 1990, 1995, and 2020, and they are not aligned with the EMEP/EEA Guidebook 2019, Table 3.4. During the review, the country provided explanation for the variation in their emission factors.

Emissions of the livestock category swine are calculated based on the five categories boars, dry sows, nursing sows, fattening pigs (> 25 kg) and weaned piglets (up to 25 kg). For NMVOC emissions from boars, dry sows and nursing sows, the default Tier 1 emission factor for swine (sows) of 1.704 kg/average animal place from Table 3.4 of the EMEP/EEA Guidebook is used, while for fattening pigs and weaned piglets the emission factor for swine (finishing pigs) of 0.551 kg/average animal place is applied. In table 5-9 (IIR), however, the implied emission factor is given in units of kg/animal. The swine livestock numbers used as activity data (see table 5-11, IIR) additionally include the suckling piglets kept at the animal places of the respective nursing sows. The suckling piglets are included in the activity data to be consistent with both the statistical swine numbers and the emission calculations for the other air pollutants and greenhouse gases. Methane emissions, for example, are calculated using the total number of swine.

Recommendation

The ERT recommends the Party to improve the transparency of the emission factors used for the estimation of NMVOC from the 3B3 Swine subcategory and expand the table referring to EFs in all other subcategories of swine, which the Party estimates.

PART C: SPECIFIC RECOMMENDATIONS FOR THE GRIDDED EMISSION DATA FOR THE SECTOR AGRICULTURE

11. For the 2023 Review of the gridded emission data the focus was set on NH₃, NMVOC, NO_x and PM_{2.5} emissions.
12. The methods used by Switzerland to grid sectoral emissions are described transparently in the IIR.
13. The description includes data sources that have been used for spatial distribution.
14. Gridded emissions reported for GNFR K_AgriLivestock and L_AgriOther are consistent with the corresponding NFR categories reported in Annex I.
15. Table 2 provides the findings from the ERT related to the gridded data.

Table 2: Findings from the CLRTAP stage 3 review 2023 for gridded emissions from the sector agriculture⁴

ID	Pollutants	GNFR category	TAC ₁ C ₂ C ₃
-	-	-	-
<p>Observation</p> <p>Recommendation No recommendations for Switzerland</p>			

⁴ The findings have been assigned to one or more of the following criteria: TACCC T (Transparency), A (Accuracy), C₁ (Completeness), C₂ (Comparability), C₃ (Consistency) for definitions of these criteria see EMEP/EEA Guidebook 2019

REVISED ESTIMATES AND TECHNICAL CORRECTIONS CONSIDERED AND/OR CALCULATED BY ERT

16. In the Appendix of the 'EMEP/UNECE Review Guidelines 2018'⁵ it is stated that if the ERT considers that emissions are significantly under- or overestimated, the Party is during the review invited to submit 'Revised Estimates' that address the issue raised. Should the Party decline to do this, or should it not be possible to agree on the quantification of a Revised Estimate i.e. the ERT does not accept a Revised Estimate provided by the Party, the ERT may calculate a 'Technical Correction'. The threshold for significance for a Technical Correction for the in-depth review in 2023 was set at 2% of the national total, i.e. a finding that has been identified to result in an over- or underestimate of emissions of more than 2% of the national total. The methods for calculating Technical Corrections are set up in the 'EMEP/UNECE Review Guidelines 2018' and use the EMEP/EEA Emission 'Inventory Guidebook' as a reference for methods and emission factors.

17. The ERT did not calculate any Technical Corrections and Switzerland did not provide any Revised Estimates.

⁵ https://www.ceip.at/fileadmin/inhalte/ceip/3_review/advance_version_ece_eb.air_142_add.1.pdf

LIST OF MATERIALS PROVIDED TO ERT

1. Switzerland Annex I reporting template
2. Switzerland Stage 2 S&A report
3. Switzerland Stage 1 report 2023
4. Switzerland IIR and 2023
5. Repdab-Report
6. Extended checks

LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

1. Responses to the question raised by ERT during the review
2. Material received from the Party during the Review
 - AGRAR Forschung 16 (2): 2009 Chapter 15 Düngung und Qualität (in German language)
 - Thomas Kupper, Dokumentation Technische Parameter Modell Agrammon, Berner Fachhochschule (in German language)
 - Thomas Kupper and col., Ammonia emission from agriculture in Switzerland for 1990 to 2015
 - Walter Richner and col., Eigenschaften und Anwendung von Düngern (in German language)
 - List of references for the response to question 1.
 - N-excretion as implemented in Agrammon based on Walther et al., 1994, 2001; Flisch et al., 2009; Richner et al., 2017 for the years with a survey (1900, 1995, 2002, 2007, 2010, 2015 and 2019) in kg N per head or per animal place and year for species with several production cycles

ABBREVIATIONS

This list includes abbreviations commonly used in the Review Reports

AD	Activity data
BaP	Benzo[a]pyrene
BC	Black Carbon
C	Confidential
Cd	Cadmium
CEIP	Centre on Emission Inventories and Projections
CLRTAP	Convention on Long-range Transboundary Air Pollution – ‘the Air Convention’
CO	Carbon Monoxide
E-PRTR	European Pollutant Release and Transfer Register
EEA	European Environment Agency
EF	Emission factor
EMEP	The co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe (unofficially ‘European Monitoring and Evaluation Programme’ = EMEP)
ERC	Emission Reduction Commitment
ERT	Expert Review Team
GHG	Greenhouse gas
GIS	Geo Information System
GNFR	NFR Aggregation for Gridding and LPS
HCB	Hexachlorobenzene
Hg	Mercury
HM	Heavy metals
IEF	Implied emission factor
kt	Kilotonnes
LPS	Large Point Sources
NA	Not applicable
NE	Not Estimated
NECD	National Emission reduction Commitments Directive
NFR	Nomenclature for reporting
NH ₃	Ammonia
NMVOG	Non-methane volatile organic compounds
NO	Not Occuring
NO _x	Nitrogen oxides
NR	Not relevant/Not Reported
PAHs	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PCDD/F	Polychlorinated dibenzo-p-dioxins and dibenzofurans
PM ₁₀	Fine particulate matter: particles with an aerodynamic diameter equal to or less than 10 micrometres (µm)

PM _{2.5}	Fine particulate matter: particles with an aerodynamic diameter equal to or less than 2.5 micrometres (µm)
POPs	Persistent organic pollutants
PTC	Potential technical correction
RE	Revised estimate
SO ₂	Sulphur dioxide
SO _x	Sulphur oxides
TC	Technical correction
TSP	Total suspended particulates

LIST OF REFERENCES AND SUPPORTING DOCUMENTS

1. Annex I emission reporting template. Available at <https://www.ceip.at/reporting-instructions>
2. ECE/EB.AIR/111/Add.1: Decision 2012/3: Adjustments under the Gothenburg Protocol to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them
https://unece.org/DAM/env/documents/2013/air/ECE_EB.AIR_111_Add.1_ENG_DE_CISION_3.pdf
3. ECE/EB.AIR/113/Add.1: Decision 2012/12: Guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them
https://unece.org/DAM/env/documents/2012/EB/Decision_2012_12.pdf
4. ECE/EB.AIR/125: 2014 Reporting Guidelines for Estimating and Reporting Emission Data under CLRTAP
https://unece.org/fileadmin/DAM/env/documents/2013/air/eb/ece.eb.air.125_E_ODS.pdf
5. ECE/EB.AIR/127/Add.1: Decision 2014/1: Improving the guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them
https://unece.org/DAM/env/documents/2014/AIR/EB/Decision_2014_1.pdf
6. ECE/EB.AIR/130: Technical Guidance for Parties Making Adjustment Applications and for the Expert Review of Adjustment Applications, 14 April 2015
https://unece.org/DAM/env/documents/2014/AIR/EB/ECE_EB_AIR_130_ENG.pdf
7. [ECE/EB.AIR/142/Add.1: Decision 2018/1: Updated methods and procedures for the technical reviews of air pollutant emission inventories reported under the Convention](https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2019/decision_2018_1_advance_version_ece_eb.air_142_add.1.pdf)
https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2019/decision_2018_1_advance_version_ece_eb.air_142_add.1.pdf
8. EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2016, EEA Report No. 21/2016 European Environment Agency, Copenhagen. Available at: <http://www.eea.europa.eu/publications/emep-eea-guidebook-2016>
9. EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2019, EEA Report No. 13/2019 European Environment Agency, Copenhagen. Available at: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019>
10. TFEIP (2022): "Inventory adjustments in the context of emission reduction commitments (ERC)" available at: https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2022/technical_guidance_for_erc_adjustments_issue1.1.pdf