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

2023

LUXEMBOURG

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 Luxembourg'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)

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

Ms. Aleksandra NESTOROVSKA-KRSTESKA (North Macedonia)

Mr. Lasha AKHALAIA (Georgia)

Mr. Hakam AL-HANBALI (Sweden)

Ms. Susana LOPEZ-APARICIO (EU/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 Luxembourg, 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 Luxembourg was received on 10 February 2023 and thus by the deadline of 15 February. The Informative Inventory Report was received on 23 March 2023 and thus not by the deadline of 15 March. Luxembourg provided resubmissions of both the emission inventory and the IIR, on 23 March 2023 and 12 May 2023, respectively. These resubmissions have been considered for the review.

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 THE CHAPTER AGRICULTURE

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

The IIR describes the methods used for the sector agriculture transparently. 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 Luxembourg to

- provide a detailed description of applied methodologies, data sources, choice of emission factors and activity data for all categories in the IIR.
- ensure that the agriculture emission inventory is complete.
- ensure that also emissions of the following pollutants are included: HCBs.
- provide necessary information on gridded data.

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 |
|---|------------|--------------|--------------|------------|------|--|
| LU-2023-3D-1 | AD | 3.D | Yes | Tier 1 | R | T |
| <p>Observation The ERT noted that the activity data (AD) related to category 3.D.a.2.b (Sewage sludge applied to soils) in 2021 (52898.08 Kg N) has decreased by 43% compared to 2020 (93163.8 Kg N), which is a sharp decrease for one year. During the review the Party confirmed that these figures were correct. The use of sewage sludge in agriculture is on a downwards trend, and in a few years this type of fertilizer will most likely not be used anymore in agriculture. The Party also indicated that statistics for 2021 were missing for sewage sludge and will only be available in the second half of 2023. The activity data has been extrapolated based on the trend of the past 5-years.</p> <p>Recommendation The ERT recommends Luxembourg to further specify in its IIR, the decreasing trends of sewage sludge applied to soil in agriculture.</p> | | | | | | |
| ID | Pollutants | NFR category | Key Category | Tier level | Type | TAC ₁ C ₂ C ₃ |
| LU-2023-3D-2 | HCB | 3D | Yes | Tier 1 | PTC | AC ₃ |
| <p>Observation The ERT noted that Luxembourg do not report HCB emissions from the use of pesticides (3Df) in its inventory. During the review, Luxembourg stated that HCB emissions from the use of pesticides are reported in the 2023 submission reporting tables. But the corresponding IIR section has not yet been updated. The Party also explained that no country-specific historic data is currently available for</p> | | | | | | |

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

Luxembourg for the whole time series. The reported emissions are based on the German and Austrian reporting. Hence, the annual IEF for Germany and Austria were derived from the reported emissions and the corresponding agricultural area. For Luxembourg, the average between the annual German and Austrian IEF was taken and applied to the Luxembourgish cropland area. The Party stated that the corresponding section in the IIR will be updated in the final version. Yet the ERT could not find these emissions in the reporting tables submitted on the 24 March 2023 and therefore considered that HCB emissions are still missing. The ERT considers that there may be an underestimate of emissions from HCB due to this missing source. This underestimate may be above the threshold of significance of 2% of national and thus could lead to a potential technical correction.

Recommendation

The ERT recommends Luxembourg to include HCB emissions from pesticides in its reporting consistently with the work presented during the review to the ERT. For more details on this issue please see Annex I Technical Corrections and Revised Estimates.

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

For the 2023 Review of the gridded emission data the focus was set on ammonia, NMVOC, NO_x and PM_{2.5} emissions.

11. The methods used by Luxembourg to spatially resolve sectoral emissions are not described transparently enough in the IIR. The gridding chapter only provides very coarse framework overview for the gridding data and the methods used.

12. The description does not include data sources that have been used for spatial distribution. Only upon ERT request Luxembourg provided partial updates on the data used.

13. Gridded emissions reported for GNFR K_AgriLivestock and L_AgriOther are consistent with the corresponding NFR categories reported in Annex I.

14. Table 2 provides the findings from the ERT related to the gridded data.

15. The implementation of the recommendations will be followed up in a future CLRTAP inventory review. Future recommendations on further future improvements may be given in follow up CLRTAP reviews.

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 |
|--|---------------|---------------|--|
| Party-2023-GRID-GL-1 | All delivered | GNFR-K&L | |
| <p>Observation The ERT noted that the information provided on gridding in the IIR by Luxembourg is very sparse. Luxembourg answered with a brief statement of the methods and metadata used. However, even with this information it is very hard to assess the methods and data used.</p> <p>Recommendation The expert review team recommends that Luxembourg should consider providing more detailed information on gridding methods and metadata in future IIR documents, e.g. by expanding the methodology and metadata descriptions in the IIR gridding chapter.</p> | | | T |

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

11. 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.

12. The ERT calculated one Technical Correction. Luxembourg agreed with this Technical Correction and it is thus treated as revised estimate.

Table 3 Summary of the revised estimate

| NFR category (s) | Pollutants | Years | RE quantified (yes/no) | Potential contribution to national total (%) |
|------------------|------------|-------|------------------------|--|
| 3Df | HCB | All | Yes | 12% in 2021 |

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. Luxembourg Annex I reporting template
2. Luxembourg Stage 2 S&A report
3. Luxembourg Stage 1 report 2023
4. Luxembourg IIR 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
 - Estimates of HCB due to pesticides (Luxembourg HCB_Pestizide_1990-2021.xls)

ANNEX I TECHNICAL CORRECTIONS AND REVISED ESTIMATES

- LU_RE1-2023-3Df.xlsx

During the review the ERT noted that HCB emissions for 3Df Use of pesticides were not estimated in the inventory of Luxembourg and not reported in NFR tables. The ERT calculated a Technical Correction for HCB emissions from 3Df. Luxembourg agreed with this Technical Correction and it is thus treated as revised estimate.

Table 4: Revised Estimate for HCB emissions for 3Df Use of pesticides

| Revised Estimate for HCB emissions in 3Df Use of pesticides | | | |
|--|------------------------|---|--|
| Year | Original estimate (kg) | Revised Estimate calculated by the ERT (kg) | Difference between original estimate and Revised Estimate (kg) |
| 2005 | 0 | 0.097 | 0.097 |
| 2020 | 0 | 0.087 | 0.087 |
| 2021 | 0 | 0.087 | 0.087 |

Table 5: Effect of the Revised Estimates on the National Total

| Year | National Total (kg) | Sum of Revised Estimates(kg) | National Total including Revised Estimates (kg) |
|------|---------------------|------------------------------|---|
| 2005 | 0.58 | 0.097 | 0.680 |
| 2020 | 0.71 | 0.087 | 0.794 |
| 2021 | 0.71 | 0.087 | 0.794 |

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