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

STAGE 3 REVIEW REPORT

LUXEMBOURG

CONTENT

INTRODUCTION

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'.

1. 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.

2. At its seventh joint session in September 2021 the Steering Body and the Working Group approved the plan to perform (in 2022) an in-depth review of $PM_{2.5}$ emissions from residential heating and road transport, with a special focus on the topic of '*condensable particulate matter*' and a follow-up review of the implementation of recommendations given as part of the review carried out in 2021. The Parties reviewed in 2021 are Kazakhstan, Liechtenstein, Monaco and Montenegro.

3. Particulate matter can exist as solid or liquid matter (the "filterable" portion) or as gases (the "condensable" portion). Condensable particulate matter is vapour phase at stack conditions, but condenses and/or reacts upon cooling and dilution upon discharge into ambient air to form solid or liquid PM. All condensable PM is assumed to be in the $PM_{2.5}$ size fraction[2]. The inclusion of the condensable component of $PM_{2.5}$ emissions can have a big impact on the emission estimate for certain sources[3].

4. This ad-hoc review has assessed $PM_{2.5}$ emission estimates with a special focus on the topic of '*condensables*' for the years 2000 to 2020.

5. This report covers the results of the stage 3 centralised review (ad hoc review) 2022 of the UNECE LRTAP Convention of Luxembourg coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place between April and June 2022 and was performed as desk review with an in person meeting between 30 of May 2022 and 3 June 2022. The following team of nominated experts from the roster of experts performed the review.

Ad hoc review - condensables

1A3b Road Transport: Gudrun Stranner, Katrina Young, Magdalena Zimakowska-Laskowska, Martina Toceva and Rebecca Rose

[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 https://unece.org/fileadmin/DAM/env/documents/2018/Air/EB/ECE_EB.AIR_142_Add.1-1902937E.pdf

[2] Condensable Particulate Matter Definition | Law Insider

[3] For more technical details please refer to the EMEP/EEA Guidebook (https://www.eea.europa.eu/publications/emep-eea-guidebook-2019) or the report 'How should condensables be included in PM emission inventories reported to EMEP/CLRTAP?' https://emep.int/publ/reports/2020/emep_mscw_technical_report_4_2020.pdf

1A4bi Residential: stationary: Aleksandra Nestorovska-Krsteska, André Amaro, Benjamin Cuniasse, Canan Esin Köksal, Damian Zasina, Laureta Dibra, Marion Pinterits, Sam Gorji and Wolfgang Schieder

6. Kristina Saarinen and Jeroen Kuenen were the lead reviewers. The review was coordinated by Sabine Schindlbacher (EMEP Centre on Emission Inventories and Projections - CEIP).

7. The review was performed on the basis of CLRTAP emission data officially reported by Luxembourg due by 15 February 2022 for emission inventories. The Informative Inventory Reports (IIR), reported due 15 March 2022 under the CLRTAP, informed the review.

8. The emission inventory of Luxembourg was received on 11 February 2022 and thus by the deadline of 15 February. The Informative Inventory Report was received on 15 March 2022 and thus by the deadline of 15 March.

RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

1.A.4.b.i Residential: stationary

9. Luxembourg uses a Tier 2 methodology for calculating $PM_{2.5}$ emissions from '1A4bi – Residential: stationary', which is a key category of $PM_{2.5}$ emissions for the Party.

10. For the period 2000-2020, annual fuel combustion data on coal products (such as coke, other bituminous coal, brown coal briquettes and patent fuels), wood, gas oil, LPG and natural gas was extracted from the energy balance established by the national statistics institute. The ERT notes that the activity data is not described transparently enough in the IIR and recommends the Party to document the amounts of log wood, wood chips and wood pellets in the next IIR submission.

11. The activity data for Luxembourg do not include collected wood, i.e. wood directly harvested from the forest outside formal market activity. The ERT recommends Luxembourg to provide evidence in the IIR that the impact of the missing collected wood is negligible in Luxembourg, or, to do research and include the missing emissions from collected wood into the inventory in the next submissions, and to provide information of the progress of the implementation of the improvement in the next IIR submissions.

12. Luxembourg has stratified the total fuel consumption for each fuel type into different appliance types in a complete manner. During the review the Party clarified that different wood types are taken into account. As there is no technological data on appliances installed in Luxembourg in which the different wood types are burnt, it is assumed (by expert judgement) that log wood is burnt in closed fireplaces or conventional traditional stoves, wood chips are burnt in advanced combustion stoves or boilers, and wood pellets are mainly burnt in modern pellet stoves or automatic pellet boilers (see also Table 206 on p.283 of the IIR).

13. Luxembourg uses the EMEP/EEA Guidebook 2019 for the compilation of its emissions from this category.

Table 1: Inclusion of condensables per fuel type

Fuel Type	**Includes the condensable component of $PM_{2.5}$ emissions**
Wood and similar wood waste – log wood	Yes
Pellet stoves and boilers	Yes
Ecolabelled stoves and boilers – wood chips	Yes
Natural Gas - Small (single household scale, capacity <=50 kWth) boilers	Unclear – Guidebook 2019
Coal - Stoves	Unclear - Guidebook 2019
Coal - Small (single household scale, capacity <=50 kWth) boilers	No
Gas Oil - Small (single household scale, capacity <=50 kWth) boilers	No

14. The ERT notes that the time series is consistent.

15. $PM_{2.5}$ emissions from small combustion are spatially distributed using proxy data on the location and type of heating appliances is used as primary distribution key for the disaggregation of the total emissions of the sector 1A4bi. Afterwards, the emissions are spatially distributed to suitable land use areas CLC groups 4 and 5.

16. Luxembourg list the following planned improvements for future submissions in their 2022 IIR

- 1990-1999: collect information helping to refine the fuel consumption split between the commercial/institutional sectors, on the one hand, and the residential sector, on the other hand.

The ERT commends Luxembourg for their improvement plans and recommends implementing them as scheduled.

17. In addition the ERT recommends to implement the following:

- Update of information on condensable compounds in Appendix 5 of the IIR to be consistent with the information on condensable compounds and applied methodology provided in the respective chapters of the Informative Inventory Report.

1.A.3.b.i-iv Road transport - exhaust emissions

18. Luxembourg's transport sector emissions are calculated using country specific emission factors taken from HBEFA version 4.1. All emission factors in HBEFA are based on the Tier 3 methodology in the 2019 EMEP/EEA Guidebook. The IIR provides details of the main features of the model.

19. The activity data for total fuel sales is taken from the national energy balance. The data sources used for national vehicle registrations and mileage references are not presented in the IIR.

20. The ERT notes that at the time of the in-depth review there was only a preliminary version of the IIR available and that the final version was expected by the end of June 2022. However, after raising the question to Luxembourg, the Party answered that there are no methodological changes in the transport sector.

Luxembourg's transport emission inventory includes the condensable component of $PM_{2.5}$ emissions. Considering the measuring protocol within the HBEFA group (measuring procedure and the max. temperature of 52°C), it can be assumed that the country specific emission factors taken from HBEFA include the condensable component of $PM_{2.5}$ emissions. The inclusion of the condensable component of $PM_{2.5}$ is documented transparently on p. 243 of the IIR.

The IIR describes the calculation of transport emissions transparently in general, however, the ERT recommends Luxembourg to add the technical information on why it can be assumed that HBEFA emission factors include the condensable component of $PM_{2.5}$.

21. The time series is consistent.

22. Luxembourg list one planned improvement for their submission in 2023 in their 2022 IIR:

- 1A3bi-v: In order to improve transparency, values for biomass activity data will be provided instead of the notation key IE.

The ERT commends Luxembourg for their improvement plans and recommends implementing them as soon as possible.

23. The ERT also encourages to implement the following:

- Provide references to all input data used in the model NEMO in the subchapter “Methodological choices”, to improve transparency of the reporting.

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

23. In the Appendix of the 'EMEP/UNECE Review Guidelines 2018[4]' it is stated that if the ERT considers that when emissions are significantly under- or overestimated, then during the review, the Party is 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 the Revised Estimates, then the ERT may calculate a "Technical Correction" in the absence of an updated emission estimate being provided by the Party itself. The threshold for significance for a technical correction for the in-depth review in 2022 was set at 2% of the national total, i.e. findings identified which result in an over- or under-estimate of emissions of more than 2% of the national total can result in a Technical Correction. The methods for calculating the Technical Corrections are set up in the "Review Guidelines 2018" and use the EMEP/EEA Emission "Inventory Guidebook" as a reference for methods and emission factors.

24. Luxembourg did not submit any revised estimates and the ERT did not calculate any technical corrections,

[4] https://www.ceip.at/fileadmin/inhalte/ceip/3_review/advance_version_ece_eb.air_142_add.1.pdf

LIST OF MATERIAL PROVIDED TO ERT

1. Luxembourg's Stage 2 S&A report
2. Luxembourg's Stage 1 report 2022
3. Luxembourg's IIR 2022
4. NFR tables submitted in 2022 by Luxembourg

LIST OF ADDITIONAL MATERIAL PROVIDED BY THE COUNTRY DURING THE REVIEW

5. Responses to preliminary question raised prior to the review
6. Responses to questions raised during the review
7. LU_CLRTAP-NEC_2022v2_Annex_I_220315