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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

FINLAND

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 on Effects 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 Finland 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.

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, Jeroen Kuenen and Ben Richmond 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 Finland, 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 Finland was received on 14 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. Finland provided a resubmission of its emission inventory on 15 March. Projections data and LPS data were submitted on 28 April and gridded data on 1 May 2022.

RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

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

9. Finland uses a Tier 3 methodology for calculating PM emissions from '1A4bi – Residential: stationary.

10. The ERT noted that wood use statistics are compiled by Nature Resources Institute Finland (Luke). The statistics covers data on fuel wood use in residential buildings by wood species as well as property, building and combustion equipment types and is publicly available since 1970. Statistics is based on surveys that have been carried out ten times until now. Calculation of annual wood use in years between the surveys is done at Statistics Finland using a specific wood consumption model.

11. The ERT noted that activity data for Finland include "collected wood". According to the country responses provided during the review collected wood is included in the statistics and covers cutting of trees and other wood directly from the forest outside formal market activity. The information is collected through the official wood use questionnaire which includes own cutting, collection and other procuring of wood.

12. Finland has stratified the consumption for wood (firewood, wood chips and pellets) into different appliance types. The amount of wood combusted in the different appliances is based on inquiries made for the national statistics and on expert knowledge. Wood use in the different house types is divided into 14 appliance categories and into six 5-year periods to consider the evolvement of the use of different equipment over time 1990-1999, 2000-2004, 2005-2009, 2010-2014, 2015-2019, and from 2020 onwards. The technology type for biomass combustion for 2020 was additionally provided by the Party. The mostly used appliance in Finland is conventional masonry heaters which contribute 24% in terraced and detached houses and 21% in summer cottages.

13. The ERT noted that Finland uses a country specific methodology for the compilation of its emissions in residential sector.

14. The Party uses the same measurement technique in all measurements and provided additional reference in which the measurement method was explained. In addition, Finland provided information that the method is not standardized but is used more than fifteen years successfully in several scientific projects at UEF (University of Eastern Finland, Fine Particle and Aerosol Technology Laboratory (FINE)). The ERT welcomes the additional information regarding the measurement methods provided by the Party and recommends Finland to include this reference in the next IIR submission.

15. The measurements technique used by Finland includes condensables in $PM_{2.5}$ emissions. Finland explained that $PM_{2.5}$ samples are collected from diluted flue gas at room temperature and thus include the condensable component of particulate matter.

16. The ERT noted that country specific emission factors are calculated as the weighted average of the EF for normal combustion conditions (between 90-100% of total combustion time, defined for each equipment) and the EF for bad combustion conditions (between 0-10%). Furthermore, the Party explained that emission factors are recorded in large database (Starship) which includes results representing the whole combustion cycle (ignition, combustion phase under normal burning conditions, shut down). The ERT welcomes the explanations provided by Finland and recommends Finland to include this information in the next submission.

17. The ERT found that the information on user impact was included in the IIR. The Party stated in the IIR that the user dependent impact on small scale wood combustion of emissions is considerable and is taken into account in the calculation of emissions coming from wood combustion. The ERT commends the Party that has included this information in the IIR.

18. The emission factors do include the condensable component of $PM_{2.5}$ emissions for biomass, whereas for other fuels the inclusion of condensables is unknown (Table 1). The ERT recommends the Party to further investigate for each PM emission factor whether or not condensables are included.

Table 1: Inclusion of condensables per fuel type

Fuel Type	Includes the condensable component of $PM_{2.5}$ emissions
Biomass	Yes
Coal	Unknown
Liquid	Unknown
Gaseous	Unknown

19. The ERT noted that the time series is consistent and consistent methods have been used for calculation of the time series. The ERT did not identify any unexplained jumps and dips in the $PM_{2.5}$ emission trends for residential combustion.

20. The ERT noted that Finland uses the following proxy data for spatially distributing emissions: population density and data on all buildings (by count, by floor area, by overall volume, for permanent and temporary residential buildings presented in the National building and dwelling register). Finland plans to improve the proxy data by implementing a model that includes some adjustments on the source material to better estimate small scale wood combustion. The most notable improvement is that the allocation more accurately picks out those buildings where wood is combusted, thus decreasing the rate of wood combustion in the capital region and increasing the rate in rural areas. The ERT commends Finland for this improvement plan and recommends including this in the improvement plan with clear steps and schedule and to report on progress of the work in the next submissions.

21. Finland lists the following planned improvements for future submissions in their 2022 IIR:

- Implement a more comprehensive inclusion of all and medium sized boilers from national district heating statistics and other sources in the inventory at the level of individual boilers to improve the accuracy of technical data in the next five years.

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

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

22. Finland PM transport sector emissions are calculated using emission factors from the EMEP/EEA Guidebook 2019 and a national model LIISA, which is a sub-model of the national model for transport emissions LIPASTO. The IIR provides details of the main features of the model. The IIR describes the calculation of transport emissions transparently.

23. The activity data is taken from official statistics from the Finnish Transport Infrastructure Agency and Statistics Finland.

24. The $PM_{2.5}$ emissions from road transport exhaust do include the condensable component of $PM_{2.5}$ emissions.

25. The ERT notes that the method is documented transparently in the IIR.

26. The time series is consistent.

27. Finland lists no specific planned improvements in their 2022 IIR for PM emissions from sectors 1A3bi-iv.

28. The ERT has no recommendations within the remit of this review.

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

29. 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.

30. Finland did not provide any revised estimates and the ERT did not calculate technical corrections for Finland by the ERT.

[4] 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. Finland IIR 2022
2. Annex_I_NFR_1980_2020_Finland_04032022.xlsx

LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

3. Responses to questions raised by the ERT during this review