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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

CROATIA

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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 Croatia 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.

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[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

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

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 Croatia, 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 Croatia was received on 14 February 2022 and thus by the deadline of 15 February. The Informative Inventory Report was received on 10 March 2022 and thus by the deadline of 15 March.

RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

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

9. Croatia uses a Tier 2 methodology for calculating PM emissions from '1A4bi – Residential: stationary' in line with Reporting Guidelines. The activity data for the fuel consumption is taken from the Energy balance - MESD prepared with assistance of Energy Institute Hrvoje Požar. For the residential sector fuel consumption from fuel wood and other biomass are distinguished. Data on pellets, briquettes, wood chips and wood waste are included in the energy balance as other biomass. The National Energy balance for 2020 data is presented in Table A5-1 of the Appendix 5 of the IIR.

10. The activity data for Croatia include collected wood, i.e. wood directly harvested from the forest outside formal market activity.

11. The inventory is detailed to calculate emissions from different appliance types. The split into appliances and technology types for biomass combustion was determined by using a combination of survey results, research-based expert assessment and IIASA GAINS model. Multiple surveys were conducted: a first one in 2017 was carried out within the framework of the project: "Creating a register of pollutants with spatial distribution in the high resolution EMEP grid", a second one in 2019 was conducted by the EIHP on the same topic and surveys were conducted with sellers of biomass stoves and boilers. Based on these surveys and the previous results of the GAINS model a new model was established and is described in the reference number 55 of the IIR. Typical appliance types in the country used for heating and cooking for biomass combustion for 2017 are presented in the IIR and in Table 1:

Table 1: Share of the technology type for biomass combustion

Technology type for biomass combustion	Share
Open fireplaces	10.4%
Boilers (manual feed)	18.3%
Conventional stoves	35.8%
Advanced /ECO-labelled stoves	11.9%
high-efficiency stoves	20.7%
Pellet stoves and boilers	3.0%

The mostly used appliances are conventional stoves contributing to 36%.
The ERT notes that the Croatia has provided the share of technology combustion for wood for the years 1990, 2005 and 2017 and for coal for 2005, 2010 and 2030 in the IIR. The Party was asked to provide data for 2020 and these data were presented in Table 2:

Table 2: Share of the technology type for coal combustion

Technology type for coal combustion	Share -2020
single house boilers (<50 kW)	34%
heating stoves	66%

For liquid and gas combustion the split is equal between single house boilers and heating stoves for all years.
In response to a question raised during the review Croatia explained that the Party is aware of lack of information and data on the age of used combustion equipment and possible related deterioration of the equipment and that there is no comprehensive

system in place yet in Croatia. Methodology and timeline for future activities were under consideration.

12. Croatia uses the EMEP/EEA Guidebook (GB) 2019, Tier 2 methodology for the compilation of its emissions from this category.

13. The country does not use specific emission factors but default EFs from the GB 2019. According to Appendix 9 of the IIR, the party has stated that the used emission factors for TSP, PM_{10} and $PM_{2.5}$ are default ones from GB 2019. These emission factors include a mix of factors that include condensables or it is unclear whether they represent filterable PM or total PM (filterable and condensable) emissions (Table 3).

Table 3: 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

14. The ERT notes that the time series for Croatia is consistent and consistent methods have been used for calculation of the time series.

15. The $PM_{2.5}$ emissions from small combustion are spatially distributed using different proxy data: Number of Housing units: distribution by municipalities (for zones: defined for the purpose of air quality assessment and management in the Republic of Croatia, distribution by settlements (for agglomerations: zones where the number of inhabitants exceeds 250 000), distribution by city districts (for the City of Zagreb).

16. Croatia did not list any planned improvements for future submissions or for their submission in 2023 for residential sector. However, Croatia provided the following planned improvements for future submissions in the responds to the ERT questions:

- Further improvements of activity data for biomass consumption in the residential sector (Methodology and timeline for future activities are under consideration, more systematic approach and improvement of data collecting system and experience of other MS is being under evaluation).

- Supplement the Appendix 9 of the IIR, in particular Table A9-1, (Inclusion/exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors by NFR source category) with more detail information for this category with split by the fuel type.

The ERT commends Croatia for these planned activities and recommends Croatia to include the improvements of activity data for biomass consumption in the residential sector in the improvement plan for the next submission and to supplement Appendix 9 of the IIR with information on the inclusion/exclusion of condensables for all NFR categories, distinguishing between fuel types where relevant.

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

- The ERT recommends Croatia to include information on the inclusion on "collected wood" in the activity data in the next submission.

- The ERT recommends Croatia to include data on Technology type for biomass and coal use combustion for the period 2000-2020 (possibly as part of the Appendix) of the IIR in the next submission.

- The ERT recommends Croatia to use the experience of other MS country in improving the data collection system and apply regular frequency for conducting surveys with previously established QA/QC system to improve the quality and accuracy of the gathered data.

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

18. Croatian PM transport sector emissions are calculated using COPERT version 5.5.1. All emission factors in COPERT are based on the Tier 3 methodology in the 2019 EMEP/EEA Guidebook. The IIR provides details of the main features of the model. The IIR describes the calculation of transport emissions transparently.

19. The activity data is taken from official statistics from the Croatian vehicle database and the national energy balances. Additional data required by COPERT are obtained using COPERT default data or expert judgement.

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

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

22. The time series is consistent.

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

24. The ERT encourages implementing the following:

- In response to a question raised during the review, Croatia explained that the large drop of $PM^{2.5}$ emissions in 1A3bi between 2001 and 2002 is mostly due to drop of $PM_{2.5}$ emissions from diesel conventional Large-SUV-Executive and Medium cars. It was noted that there was a significant decline in the number of vehicles and mileage in these categories between 2001 and 2002. The ERT encourages Croatia to include explanations of any significant time series changes in the IIR to increase transparency.

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

25. 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.

26. Croatia did not provide any revised estimates and the ERT did not calculate technical corrections for Croatia.

[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. Croatia IIR 2022
2. NFR19_1990-2020_v0.xlsx

LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

3. Responses to questions raised by the ERT during this review
4. Passenger cars.xlsx