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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

CZECHIA

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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 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 Czechia 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

Ad hoc review - condensables

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

RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

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

9. Czechia uses a Tier 2 methodology for calculating $PM_{2.5}$ emissions from '1A4bi – Residential: stationary'.

10. The activity data is taken from official statistics provided by Czech Statistical Office (CZSO) to EUROSTAT and other international institutions. Coal consumption is recalculated from these data by using national real caloric values of coal fuels distributed to households (taken from statistic census among fuel producers[4]. Biomass consumption is segregated into consumption of briquettes and pellets according to statistic census[5]. LPG consumption is derived from these data using the calorific value of 45.9 MJ/kg. Czechia sorts the fuels in the tables by the state of aggregation, not by origin. Therefore, LPG is included in the 1A4bi sector among gaseous fuels. The consumption of heating oils in households is neglected in the overall energy balance as only about 3 500 dwellings used heating oil in 2011 and the underlying ENERGO statistical survey does not capture these households. The share of solid mineral fuel consumption is constantly declining, but still significant in recent inventory year (about 15%). Biomass is the most common fuel used for NFR 1.A.4.b.i (about 45%) followed by gas consumption with a share about 40%.

11. The ERT notes that the activity data is described transparently in the IIR. However, the ERT recommends the Party to show the activity data in 'Fig. III.5 Fuel consumption in sector local heating of households, 1990–2020' as a table. In addition, the ERT recommends the Party to include information the whole time series of activity data by fuel use types / by combustion appliance types, and information on water content of "wet wood", in the next IIR submission. In addition, the ERT recommend the Party to include information on wood moisture for the whole time series in the next IIR submission.

12. A model based on statistical surveys ENERGO 2004 and 2015 determines consumption. The model considers all methods of fuel acquisition, including self-collection. Also, it considers the influence of climatic conditions, year-on-year logging, type of wood (hard, soft), and average wood storage time. The results are adjusted for household demand for other solid fuels. Consumption of other types of biomass (wood pellets and briquettes) is determined by balancing production, imports, exports, and stock changes.

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

14. The total fuel consumption for each fuel type is stratified into different appliance types in a consistent and complete manner. The basis for this split over appliance types is, however, not sufficiently documented in the IIR. The ERT recommends Czechia to include a complete documentation of the split and the basis of the division to the next

[4] Bureš et al., "Stanovení emisních faktorů a imisních příspěvků stacionárních zdrojů pro účely zjednodušení přípravy a vyhodnocení žádostí o podporu z OPŽP ," 2014.
[5] M. Dědina, "Emise ze zemědělských strojů v období 1990-2016 s využitím údajů STK." VÚZT Praha , 2018.

IIR submission. The Party informed the ERT that the IIR chapter on references will be supplemented by Modlík et al. (2018): Modlík, M., Bufka, A., Hopan, F., Horák, J., 2018. Metodika inventarizace emisí ze spalování paliv v domácnostech. ČHMÚ, Praha, (English version in progress).

15. It is clear from information provided in the IIR or responses received during the review, which emission factors are used for small scale solid fuel and wood combustion in stoves, ovens, boilers etc. However, it remains unclear to the ERT if the condensable component of PM is or not included. The ERT recommends Czechia to provide clear information on these in the next IIR submission.

16. Czechia use a country specific methodology based on measurements conducted by VEC VŠB and MZP at nominal heat rating on the basis of sampling performed in the dilution tunnel. The sampling temperature was about 40°C, thus the measurements include the condensable component of particulate matter (CPM). To the question on the issue Czechia responded[6] that these measurements cover solid fuels only. The ERT recommends that Czechia explain the source of emission factors more clearly and in addition clarifies the status of inclusion or exclusion of CPM in emissions for each fuel and combustion appliance combination in the next IIR submission.

17. In response to a question of the ERT Czechia confirmed that the measurements cover the start-up and shut down phases of the combustion cycle for solid fuels and that these are included in the EFs, too. The response did not cover inclusion of start (ignition) and end (ember) phase emissions for manual wood combustion appliances. The ERT recommends Czechia to include emissions during the start and end phases of the combustion cycle in the emission factors used for manual wood combustion appliances to reflect the actual emission levels, and to clearly document the status of inclusion or exclusion of start and end phases of combustion in the EFs in the next IIR submission.

18. The Party does not take into account user induced impacts that affect emission levels from those during “normal combustion” (the so-called user impact, which covers e.g. the use of wet/unclean wood or poor management of air circulation in the appliance). The ERT recommends to document this clearly in the IIR. In response to a question of the ERT Czechia explained that while the inventory does not currently consider the influence of users, the implementation of national emission factors for reduced heat output is pending due to consideration of ratios to be used in the calculation. Household waste is not considered. While the user impact is not yet included in the inventory, the ERT encourages the Party to collect data on national circumstances (e.g. through studies or expert judgement/data collection by chimney sweepers) and to incorporate their impact in the inventory and to provide the related documentation in the IIR.

19. For the EMEP gridded dataset $PM_{2.5}$ emissions from small combustion are calculated with a bottom-up model for basic territorial units using several datasets (SLDB data on number and total area of permanently occupied dwellings by type of energy carrier, results of the ENERGO statistical survey, climatic conditions,

[6] https://pubs.acs.org/doi/pdf/10.1021/acs.energyfuels.6b00850
https://www.sciencedirect.com/science/article/abs/pii/S004565351930791X?via%3Dihub

parameters of fuel and combustion equipment, building insulation and new construction).

20. The emission factors partly include the condensable component of $PM_{2.5}$ emissions (Table 1).

Table 1: Inclusion of condensables per fuel type

Fuel Type	Includes the condensable component of $PM_{2.5}$ emissions
Wood-dry - Over-fire boilers	Yes (to be confirmed in the next IIR)
Wood-dry - Under-fire boilers	Yes (to be confirmed in the next IIR)
Wood-dry - Automatic boilers	Yes (to be confirmed in the next IIR)
Wood-dry - Gasification boilers	Yes (to be confirmed in the next IIR)
Wood-dry - Stoves	Yes (to be confirmed in the next IIR)
Wood-wet - Over-fire boilers	Yes (to be confirmed in the next IIR)
Wood-wet - Under-fire boilers	Yes (to be confirmed in the next IIR)
Wood-wet - Automatic boilers	Yes (to be confirmed in the next IIR)
Wood-wet - Gasification boilers	Yes (to be confirmed in the next IIR)
Wood-wet - Stoves	Yes (to be confirmed in the next IIR)
Bio-briquettes - Over-fire boilers	Yes (to be confirmed in the next IIR)
Bio-briquettes - Under-fire boilers	Yes (to be confirmed in the next IIR)
Bio-briquettes - Automatic boilers	Yes (to be confirmed in the next IIR)
Bio-briquettes - Gasification boilers	Yes (to be confirmed in the next IIR)
Bio-briquettes - Stoves	Yes (to be confirmed in the next IIR)
Pellets - Over-fire boilers	Yes (to be confirmed in the next IIR)
Pellets - Under-fire boilers	Yes (to be confirmed in the next IIR)
Pellets - Automatic boilers	Yes (to be confirmed in the next IIR)
Pellets - Gasification boilers	Yes (to be confirmed in the next IIR)
Pellets - Stoves	Yes (to be confirmed in the next IIR)
Brown coal - Over-fire boilers	Yes (to be confirmed in the next IIR)
Brown coal - Under-fire boilers	Yes (to be confirmed in the next IIR)
Brown coal - Automatic boilers	Yes (to be confirmed in the next IIR)
Brown coal - Gasification boilers	Yes (to be confirmed in the next IIR)
Brown coal - Stoves	Yes (to be confirmed in the next IIR)
BKB - Over-fire boilers	Yes (to be confirmed in the next IIR)
BKB - Under-fire boilers	Yes (to be confirmed in the next IIR)
BKB - Automatic boilers	Yes (to be confirmed in the next IIR)
BKB - Gasification boilers	Yes (to be confirmed in the next IIR)
BKB - Stoves	Yes (to be confirmed in the next IIR)
Hard coal - Over-fire boilers	Yes (to be confirmed in the next IIR)
Hard coal - Under-fire boilers	Yes (to be confirmed in the next IIR)
Hard coal - Automatic boilers	Yes (to be confirmed in the next IIR)
Hard coal - Gasification boilers	Yes (to be confirmed in the next IIR)
Hard coal - Stoves	Yes (to be confirmed in the next IIR)
Coke - Over-fire boilers	Yes (to be confirmed in the next IIR)
Coke - Under-fire boilers	Yes (to be confirmed in the next IIR)
Coke - Automatic boilers	Yes (to be confirmed in the next IIR)
Coke - Gasification boilers	Yes
Coke - Stoves	Yes
Natural gas	No
LPG	No

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

22. The emissions are spatially distributed using proxy data (the so-called definition point according to Act 111/2009 Coll., on basic registers representing the central part of the basic territorial unit). According to the coordinates of this definition point, the individual basic territorial units are assigned entirely to EMEP network cells depending on the coordinates of the defining point. The overall result of the model tends to be lower than the result of the total inventory based on data from the national energy balance, because the model includes only permanently occupied dwellings. The difference in emissions is divided proportionally between the basic territorial units, resp. EMEP network cells.

23. Czechia lists the following planned improvements in their 2022 IIR

- Based on market development, the estimation of dried wood will be corrected. Correcting previous years and setting a new trend in future years is possible in 2023 when ENERGO 2021 results will be available.

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

24. In addition, the ERT recommends Czechia to implement the following:

- Correction of references to the latest version of the EMEP/EEA Guidebook 2019 if applicable
- Supplementation of the references for VEC VŠB and MZP in the IIR (and the e-Annex) in line with the Party's answer to question 2.

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

25. Czechia calculates particle emissions from the transport sector using COPERT version 5.5.1. All emission factors in COPERT are based on the Tier 3 methodology in the 2019 EMEP/EEA Guidebook.

26. The IIR does not provide details of the main features of the model. The ERT recommends that Czechia provide details of the main features of the COPERT model used in the inventory, such as more detailed information about the version number.

27. The activity data is taken from official statistics from Czech Car Registry (CCR) and Database of Technical Control Stations (TCS) but the reference or the link is not provided. The ERT recommends Czechia to provide the link or the reference to the activity data along with the year of publication.

28. The ERT notes that the method is documented transparently in the IIR. However, the ERT recommends Czechia to include further information on the age distribution of the vehicle fleet, the mileage per vehicle type and more information about the traffic condition (average speed per road class and mileage share per road class) in the next IIR submission.

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

26. The time series is consistent.

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

28. In addition, the ERT recommends implementing the following:

- Include a statement in the road transport chapter of the IIR confirming whether the condensable component of $PM_{2.5}$ is included in emissions estimates or not.

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

29. In the Appendix of the 'EMEP/UNECE Review Guidelines 20187' it is stated that if the ERT consider 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. Czechia did not provide any revised estimates and the ERT did not calculate any technical corrections.

[7] 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. Czechia's Stage 2 S&A report
2. Czechia's Stage 1 report 2022
3. Czechia's IIR 2022
4. NFR tables submitted in 2022 by Czechia

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