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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

TURKEY

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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 fraction². The inclusion of the condensable component of PM_{2.5} emissions can have a big impact on the emission estimate for certain sources³.

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 Turkey 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 Pinteris, 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 Turkey 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 Turkey 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.

RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

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

9. Turkey uses a Tier 1 methodology for calculating PM_{2.5} emissions from '1A4bi – Residential: stationary'. As category 1A4bi is a key category for PM_{2.5} emissions for the Party, the ERT recommends Turkey to use at least a Tier 2 method for calculating these in line with Reporting Guidelines' paragraph 21⁴.

10. The activity data is taken from official energy balance tables⁵. The ERT notes that the activity data is described transparently in the IIR, however, there are no values of activity data listed in the NFR tables or in the IIR. The ERT recommends Turkey to include data on final energy consumption in category 1A4bi in the NFR tables and the IIR for the whole time series from 1990 onwards to the last inventory year, in the next submission.

11. The ERT notes that in the energy balance tables the activity data for category 1A4bi is assumed to be included in either 'Other Industry' or 'Residential (Housing and Services)'. Petroleum is not divided into different types of fuels yet. The ERT recommends Turkey to get more accurate activity data on fuel use and its allocation to NFR sectors as soon as possible.

12. The activity data for Turkey do not include collected wood, i.e. wood directly harvested from the forest outside formal market activity. The ERT recommends Turkey to collect this data, e.g. through studies or surveys or by collecting information from chimney sweepers, to include the missing fuel into the inventory calculations.

13. The total fuel consumption for each fuel type is not stratified into different appliance types e.g. boilers and stoves. The ERT recommends Turkey to collect country-specific information on combustion appliances and to incorporate this information in the inventory calculation. Meanwhile, the ERT recommends Turkey to use the default information provided in Tables 3.36-3.38 of Chapter "1A4b Small combustion" of the EMEP/EEA Guidebook 2019.

14. Turkey uses the EMEP/EEA Guidebook 2019 for the compilation of its emissions from this category. The emission factors partially include the condensable component of PM_{2.5} emissions (Table 1). The ERT recommends the Party to study how to include the condensable component of particles into the next inventory submissions.

Table 1: Inclusion of condensables per fuel type

Fuel Type	Includes the condensable component of PM _{2.5} emissions
Biomass	Yes
Coal	Unclear – Guidebook 2019
Liquid	Unclear – Guidebook 2019
Gaseous	Unclear – Guidebook 2019

⁴ Reporting Guidelines paragraph 21: "For sources that are determined to be key categories in accordance with the EMEP/EEA Guidebook methodologies, Parties should make every effort to use a Tier 2 or higher (detailed) methodology, including country-specific information."

⁵ Ministry of Energy and Natural resources 2020

15. The ERT notes that the time series is not consistent. The emissions in 'Table 3-2-26 Emission totals for residential stationary combustion' (IIR, p.145) show constant PM_{2.5} emissions from 2000 to 2018 (not following the trend of PM₁₀ emissions at all). For the years 2019 and 2020 the PM_{2.5} emissions show other results than for 2000-2018 indicating a change of method. For the years 2018 to 2020 the PM_{2.5} emissions are higher than the PM₁₀ emissions, which is not possibly by definition, as PM_{2.5} is a fraction of PM₁₀. The Party submitted a revised estimate regarding these emissions during the CLRTAP Stage 3 review. The ERT recommends Turkey to use the revised estimate and recalculate the time series with consistent methods for the next submission.

16. Turkey did not report gridded data. However, this reporting obligation is under preparation⁶ and will be spatially distributed using proxy data on address-oriented consumption of coal together with the distribution flow of coal.

17. Turkey lists the following planned improvements for future submissions in their 2022 IIR

- Use of a Tier 2 method for calculating emissions from 1A4bi
- Splitting of 'Petroleum' into different fuel qualities, such as 'Petrol (gasoline)', 'Diesel (Gas Oil)', 'Aviation fuel' and 'Heating or Burning Oil'. These issues were analysed together with the Ministry of Energy representatives and next submissions will cover the petroleum split calculations within the energy balance

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

18. In addition, the ERT recommends Turkey to implement the following:

- Correction of the PM₁₀ and NH₃ emission factors and addition of the PM_{2.5} emission factors in 'Table 3-2-27 EFs for residential combustion'.

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

19. Turkey reports particle emissions from the transport sector using COPERT model. All emission factors in COPERT are based on the Tier 3 methodology in the 2019 EMEP/EEA Guidebook. The IIR does not provide enough details of the main features of the model. The ERT recommends Turkey to include information of the version used and the main features of the model to the next IIR submission.

20. The activity data is taken from official statistics of the TURKSTAT together with the data from the EGEDES-Exhaust Emission Electronical Inspection System which was developed by the Ministry of Environment, Urbanization and Climate Change. Regarding the data provided in the NFR table and the IIR, the ERT recommends Turkey to obtain real data on the use of petrol and diesel separately and to include the natural gas in national inventory in case the natural gas is used in the road transport.

⁶ Within the ongoing studies the Turkish EMISSION project and the developed Air Emission Management-HEY Portal

21. The PM_{2.5} emissions from road transport exhaust gases include the condensable component of PM_{2.5} emissions through the use of the COPERT model.

22. The ERT notes that the calculation method is not documented transparently in the IIR. The ERT recommends Turkey to include further information on the age distribution of the vehicle fleet for the whole time series and more information about the traffic conditions (mileage share per road class) in the next IIR submission.

23. The time series is not consistent. The ERT recommends Turkey to recalculate the time series with consistent methods to the next submission, for example using the COPERT model for the full time series from 1990.

24. Turkey does not list planned improvements in their 2022 IIR. The ERT recommends Turkey to consider improvement needs and keep a list with a planned schedule under the dedicated sub-chapter of the IIR.

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

- Include explanations for large variations in emissions across the whole time series (e.g. 1999 and 2003)
- 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.

And the ERT encourages to implement the following:

- Follow the recommended structure of the IIR detailed in Annex II of the 2014 Guidelines for Estimating and Reporting Emission Data, which includes an appendix with a table summarising the use of PM emission factors that include/exclude the condensable component, where available.

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

26. In the Appendix of the 'EMEP/UNECE Review Guidelines 2018'⁷ it is stated that if the ERT considers that 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.

27. Turkey sent two revised estimates that were accepted by the ERT. The ERT recommends Turkey to consider the Technical Corrections and Revised Estimates in their next inventory submission. Details of the Technical Corrections and Revised Estimates presented in Table 1 are included in ANNEX I TECHNICAL CORRECTIONS AND REVISED ESTIMATES.

Table 2 Summary of revised estimates and technical corrections identified by ERT for Turkey

Number	NFR category (s)	Pollutants	Year(s)	RE/TC quantified (yes/no)	Contribution to national total (%)
RE_TC1-TR-2022-1A4ai	1A4ai	PM10 TSP	2005	Yes	IE
RE_TC1-TR-2022-1A4ai	1A4ai	PM10 TSP	2020	Yes	IE

The estimate changes the current status NE/IE. The calculation file also provide PM_{2.5} emissions and cover the years 2000-2020.

Table 2 Summary of revised estimates and technical corrections identified by ERT for Turkey

Number	NFR category (s)	Pollutants	Year(s)	RE/TC quantified (yes/no)	Contribution to national total (%)
RE_TC1-TR-2022-1A4bi	1A4bi	PM10	2005	Yes	10.9
RE_TC1-TR-2022-1A4bi	1A4bi	PM10	2020	Yes	4.3
RE_TC1-TR-2022-1A4bi	1A4bi	PM2.5	2005	Yes	39.9
RE_TC1-TR-2022-1A4bi	1A4bi	PM2.5	2020	Yes	-0.3

The calculation file also provides TSP emissions and cover the years 2000-2020

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

LIST OF ADDITIONAL MATERIAL PROVIDED BY THE COUNTRY DURING THE REVIEW

5. Response to preliminary question raised prior to the review
6. Response to questions raised during the review
7. 1A4bi recalculated 30052022 v3

ANNEX I TECHNICAL CORRECTIONS AND REVISED ESTIMATES

28. . Turkey sent two revised estimates that were accepted by the ERT. Detailed related information is provided separately in one Excel file:

- TC1_RE1–2022-1A4ai_1A4bi.xlsx

Table 1: Revised estimates received from TURKEY accepted by the ERT *

Revised estimate for PM ₁₀ emissions in 1A4ai Commercial/Institutional: Stationary			
Year	Original estimate (kt)	Revised Estimate received from MS (kt)	Difference between original estimate and Revised Estimate (kt)
2005	IE	16.0	NA
2010	IE	75.0	NA
2015	IE	66.0	NA
2016	IE	45.6	NA
2017	IE	15.3	NA
2018	IE	15.5	NA
2019	IE	16.7	NA
2020	IE	66.6	NA

- the RE/TC is to change from the current status NE/IE

Table 7: Revised estimates for PM_{2.5} received from TURKEY accepted by the ERT *

Revised estimate for PM _{2.5} emissions in 1A4ai Commercial/Institutional: Stationary			
Year	Original estimate (kt)	Revised Estimate received from MS (kt)	Difference between original estimate and Revised Estimate (kt)
2005	IE	15.8	NA
2010	IE	79.3	NA
2015	IE	65.0	NA
2016	IE	44.9	NA
2017	IE	15.1	NA
2018	IE	15.3	NA
2019	IE	16.5	NA
2020	IE	65.6	NA

- the RE/TC is to change from the current status NE/IE

Table 8: Revised estimates for PM₁₀ received from TURKEY accepted by the ERT

Technical Correction for PM ₁₀ emissions in 1A4bi Residential: Stationary			
Year	Original estimate (kt)	Revised Estimate received from MS (kt)	Difference between original estimate and Revised Estimate (kt)
2005	152.8	185.7	32.9
2010	199.5	184.9	-14.6
2015	174.6	112.3	-62.4
2016	136.4	108.2	-28.3
2017	129.2	119.7	-9.5
2018	81.9	98.1	16.2
2019	96.4	105.8	9.4
2020	106.8	119.8	13.1

Table 9: Revised estimates for PM_{2.5} received from TURKEY accepted by the ERT

Technical Correction for PM_{2.5} emissions in 1A4bi Residential: Stationary			
Year	Original estimate (kt)	Revised Estimate received from MS (kt)	Difference between original estimate and Revised Estimate (kt)
2005	98.5	181.2	82.7
2010	98.5	180.7	82.2
2015	98.5	109.7	11.3
2016	98.5	105.8	7.4
2017	98.5	117.3	18.8
2018	98.5	96.1	-2.3
2019	108.7	103.7	-5.0
2020	118.2	117.6	-0.6

Table 10 Effect of the Technical Corrections and Revised Estimates of PM₁₀ on the National Total and National Total for compliance

Year	National Total (kt) ⁸	National Total for Compliance (kt) ⁹	Sum of Revised Estimates and Technical Corrections (kt)	National Total including Revised Estimates and Technical Corrections (kt)	National Total for Compliance including Revised Estimates and Technical Corrections (kt)
2005	301.32	301.32	32.9	334.22	334.22
2010	346.30	346.30	-14.6	331.7	331.70
2015	307.02	307.02	-62.4	244.62	244.62
2016	273.48	273.48	-28.3	245.18	245.18
2017	276.91	276.91	-9.5	267.41	267.41
2018	238.55	238.55	16.2	254.75	254.75
2019	248.99	248.99	9.4	258.39	258.39
2020	269.72	269.72	13.1	282.82	282.82

Table 11 Effect of the Technical Corrections and Revised Estimates of PM_{2.5} on the National Total and National Total for compliance

Year	National Total (kt) ¹⁰	National Total for Compliance (kt) ¹¹	Sum of Revised Estimates and Technical Corrections (kt)	National Total including Revised Estimates and Technical Corrections (kt)	National Total for Compliance including Revised Estimates and Technical Corrections (kt)
2005	211.18	211.18	82.7	293.88	293.88
2010	199.17	199.17	82.2	281.37	281.37
2015	193.77	193.77	11.3	205.07	205.07
2016	192.07	192.07	7.4	199.47	199.47
2017	194.69	194.69	18.8	213.49	213.49
2018	199.33	199.33	-2.3	197.03	197.03
2019	202.21	202.21	-5.0	197.21	197.21
2020	212.1	212.1	-0.6	211.50	211.50

⁸ Line 141 in Annex I to the reporting guidelines (NFR table)⁹ Line 152 in Annex I to the reporting guidelines (NFR table)¹⁰ Line 141 in Annex I to the reporting guidelines (NFR table)¹¹ Line 152 in Annex I to the reporting guidelines (NFR table)