UNITED NATIONS

Distr.
GENERAL

CEIP/S3.RR/2022/
28/09/2022

ENGLISH ONLY

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

STAGE 3 REVIEW REPORT

UNITED KINGDOM

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 the United Kingdom 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 the United Kingdom, 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 the United Kingdom 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. The United Kingdom uses a Tier 2 methodology (with a turnover model) for calculating $PM_{2.5}$ emissions from wood and solid mineral use, and a Tier 1 methodology for any other fuel use from category '1A4bi – Residential: stationary'. As category 1A4bi is a key category for the United Kingdom, the ERT recommends that the Party use at least a Tier 2 method for calculating emissions from category 1A4bi in line with Reporting Guidelines' paragraph 21[4] for all fuels used and provides justifications for any deviation from this in the IIR.

10. During the review the Party explained that the activity data is taken from official statistics (United Kingdom National Energy Statistics [BEIS 2021][5]). The latest underlying survey [DEFRA 2020[6]] has led to a large reduction in the estimates for use of wood in the residential sector in the United Kingdom (revision of time series starting from 1998). This study included wood and mineral fuels; however, the United Kingdom National Energy Statistics were not adjusted to take account of the findings regarding solid mineral fuels. There was not a re-allocation of wood use from domestic to other sectors, but rather an overall decrease in the energy balance.

11. For the United Kingdom inventory preparation, propane and butane are combined as 'liquefied petroleum gas' (LPG), whilst ethane and 'other petroleum gases' are combined as the NAEI fuel 'other petroleum gases' (OPG). Additional estimates of the annual consumption of petroleum coke as a fuel in other sectors are based on regular consultation with United Kingdom industry fuel suppliers. This estimate is reduced starting from 2009 by the amount of petroleum coke used in solid smokeless fuel (SSF) manufacture, to avoid double-counting of the petroleum coke component of SSF.

12. The ERT notes that the activity data is described transparently in the Informative Inventory Report.

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

14. The United Kingdom stratify the total fuel consumption for biomass and solid mineral fuel types into different appliance types e.g. boilers, stoves, in a consistent and complete manner. The basis for this split over appliance types is documented in the IIR, however, the ERT recommends to add more details on the technologies and use manners of wood combustion appliances typical in the UK to enable understanding of the emission levels.

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[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] Department for Business, Energy and Industrial Strategy (BEIS): Digest of United Kingdom Energy Statistics 2020, London, The Stationery Office

[6] Research report on 'Burning in UK Homes and Gardens' (DEFRA 2020)

15. The research conducted by BEIS 2016[7] enabled some improved assumptions regarding the use of wood in different appliance types (open fires, closed stoves, pellet stoves, manual boilers, automatic boilers, range cookers) over time. The proportions of each type of appliance using each solid mineral fuels are estimated[8], with some more detailed splits utilising expert judgment. The appliance technology assumptions are held constant over the 1970-2020 timescale.

16. The ERT recommends the Party to list the resulting fuel consumption shares for all combustion appliance types over time in the next IIR transparently, compiled in analogy to supplementary data provided to the ERT given in 'supplementary data (United Kingdom)_v1_toCEIP.xlsx'.

17. The United Kingdom in general use the EMEP/EEA Guidebook 2019 for the compilation of its emissions from this category (Table1). Country-specific emission factors are applied for PM species for 'smokeless' fuels [9]

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

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

19. The $PM_{2.5}$ emissions from small combustion are spatially distributed using proxy data, i.e. sub-national energy statistics, gas meter data at point level, census data with data from the BEIS National Household Model (NHM), BEIS Residential Wood Survey [9], addresses and other regional statistics. The gridded data reported for the year 2019 are consistent with the national inventory (NFR tables) as reported in 2021.

20. United Kingdom list the following planned improvements for their submission in 2023 in their 2022 IIR

- Improvement of the information on the market shares of domestic wood burning appliance with first priority

[7] ,https://www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey
[8] EuP 2007 report 'Preparatory Study for Eco-design Requirements of EuPs, Lot 15: Solid fuel small combustion installations: Task 3'55

[9] Authorised under the Clean Air Act 1993 (anthracite, coke and manufactured solid fuels), based on research on smokeless fuels.

- Further development of the methodology for domestic combustion of natural gas, LPG, and burning oil

- DEFRA PM measurements (measurements for wood expected available for 2023 submission) for solid fuel room heaters for wood at differing moisture contents and other fuels (bituminous coal, anthracite, manufactured solid fuel, coffee logs), with a dilution tunnel to include the condensable component of particulate matter, the test protocol includes ignition/shutdown/refuel, but not the contribution of user behaviour.

The ERT commends the United Kingdom for their improvement plans and recommends implementing them as soon as possible.

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

21. Particle emissions from the transport sector are calculated using COPERT version 5.4. 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.

22. The activity data is taken from official statistics (Traffic activity data in billion vehicle km by vehicle type and road type are provided by DfT and total fuel sales for petrol and diesel are provided in the Digest of United Kingdom Energy Statistics.)

23. $PM_{2.5}$ emissions from road transport exhaust include the condensable component of $PM_{2.5}$ emissions. The ERT recommends that the United Kingdom 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.

24. The time series is consistent.

25. The United Kingdom list no specific planned improvements for future submissions in the 2022 IIR.

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

26. In the Appendix of the 'EMEP/UNECE Review Guidelines 2018[10]' 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.

27. The United Kingdom did not provide any revised estimates and the ERT did not calculate any technical corrections.

[10] 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. United Kingdom Stage 2 S&A report
2. United Kingdom Stage 1 report 2022
3. United Kingdom IIR 2022
4. NFR tables submitted in 2022 by the United Kingdom
5. Tables for condensables submitted in 2022 by the United Kingdom

LIST OF ADDITIONAL MATERIAL PROVIDED BY THE COUNTRY DURING THE REVIEW

6. Responses to preliminary question raised prior to the review:
7. Responses to questions raised during the review
8. Supplementary data (United Kingdom)_v1_toCEIP.xls