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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

MONACO

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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. Further, for Monaco the implementation of all findings from the in-depth review 2021 have been assessed for all pollutants covered by LRTAP Convention and its protocols (SO₂, NO_x, NMVOC, NH₃, plus PM₁₀ PM_{2.5}, BC, 3 HMs and POP_s) for the time series years 1990 – 2020.

5. This report covers the results of the stage 3 centralised review (ad hoc review) 2022 of the UNECE LRTAP Convention of Monaco 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.

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

Follow-up review of the implementation of findings from the 2021 in-depth review

Energy: Ivana Dukic, Laureta Dibra

Transport: Martina Toceva

Industrial Processes and Product Use: Mirela Poljanac

Agriculture: Andjelka Radosavljevic

Waste: Enkeleda Shkurta

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 Monaco, 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 Monaco was received on 15 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. Monaco uses a Tier 1 methodology for calculating PM_{2.5} emissions from '1A4bi – Residential: stationary'. Since '1A4bi – Residential: stationary' is a key category, the ERT recommends Monaco to use at least a Tier 2 method for calculating emissions from '1A4bi – Residential: stationary' in line with Reporting Guidelines' paragraph 21⁴.

10. The activity data is taken from companies benefiting from a Public Service delegation. Specifically, for each fuel type: LPG data is obtained from Monaco in Figures-IMSEE; fuel oil is collected from French and Monegasque domestic fuel oil distributors operating in Monaco; natural gas by the Société Monégasque de l' Electricité et du Gaz (SMEG), from a survey; B100 from a survey carried out with the Monegasque company concerned. The ERT notes that the activity data is described transparently enough in the Informative Inventory Report. The ERT recommends the Party to collect data on national circumstances (e.g. different types of biomass, different types of combustion appliances) and to incorporate the information in the inventory for the next submissions when the Party moves to a Tier 2 method if the data becomes available.

11. During the review the ERT noted that emission source categories accounted for within sector 1A4bi related to the combustion of natural gas, domestic fuel oil and LPG mainly intended for heating buildings. The ERT could not clarify whether activity data for Monaco does include collected wood, i.e. wood directly harvested from the forest outside formal market activity.

12. Monaco has not stratified the total fuel consumption for each fuel type into different appliance types e.g. boilers, stoves, in a consistent and complete manner. This is not documented in the IIR, and the ERT recommends the Party to collect data on national circumstances by describing the fuel consumption for each type of appliance, and also to incorporate the information in the inventory when available. In the interim, the ERT recommends the Party to state in the IIR the reason(s) why it is not possible to obtain such data.

13. Monaco uses EMEP/EEA Guidebook 2019, 1.A.4. Small Combustion and 2006 IPCC Guidelines for the compilation of its emissions from category 1A4bi. During the review, the ERT were unable to clarify, with the exception of biomass, as to whether the emission factors do include the condensable component of PM_{2.5} emissions (Table 1).

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."

Table 1: Inclusion of condensable per fuel type

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

The ERT notes that in the IIR, Monaco has not reported documentation regarding the condensable component of PM, and has planned to consider the condensable component by 2023. Monaco also responded to a question and stated that they will take into account this remark, adding information on condensables into the next IIR.

14. The ERT notes that the time series is consistent, the same methodology and the same data sources are applied for the entire time series.

15. Given the territorial specificity of Monaco, it was not considered significant to develop a spatialization of emission sources, including PM_{2.5} emissions from small combustion.

16. Monaco has planned improvements to include documentation regarding the condensable component of PM to indicate the sectors that do and do not consider the condensable component by 2023. The ERT recommends Monaco to provide information on planned improvements in the IIR regarding the condensable component.

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

17. Monaco's transport sector emissions are calculated using EMEP/EEA 2019 Guidebook emission factors. The IIR describes the calculation of transport emissions transparently.

18. The activity data is taken from official statistics, <https://carlabelling.ademe.fr/chiffrescles/r/evolutionConsoMoyenne>.

19. The PM_{2.5} emissions from road transport exhaust do not include the condensable component of PM_{2.5} emissions.

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

21. The time series of emissions is consistent.

22. Monaco does not have an improvement plan for future submissions in their 2022 IIR.

23. In addition the ERT encourages to implement the following:

- Given the availability of the road transport activity data (detailed vehicle classification data, fuel consumption data etc.), the ERT strongly encourages Monaco to include implementing the COPERT 5 model to calculate emissions in the improvement plan for the next submission cycle.

FOLLOW-UP REVIEW OF THE IMPLEMENTATION OF THE FINDINGS FROM PREVIOUS REVIEWS

24. Monaco was reviewed in-depth in 2021. The review resulted in a number of recommendations. The ERT commends Monaco for implementing many of the recommendations from the last review and also noted with appreciation that several of the items that were not implemented are on the improvement plan. The ERT notes that the following findings are not fully implemented (see Table 2) and recommends Monaco to implement these findings in the next submission.

Table 2: Findings from the 2021 review that have not or only been partially implemented

Sector Energy	NFR Category 1A4bi	Pollutant(s) SO₂, NO_x, PM_{2.5}	Category (TCCCA) Transparency	TC or RE: No
<p>Recommendation text from 2021: The ERT noted that SO₂, NO_x and PM_{2.5} are key sources for sector 1A4bi, but in the IIR Table 1, Monaco reported that a T1 method from the Guidebook was used to estimate emissions. However, for key sources a Tier 2 or 3 method should have been used. During the review week Monaco replied that a higher tier methodology will be used for next submission for SO₂, NO_x and PM_{2.5} for sector 1A4bi. The ERT thanks Monaco for their response and recommends Monaco to follow up on their intent.</p>				
<p>Recommendation text for 2022: The ERT noted that 1A4bi is a key category for SO₂, NO_x and PM_{2.5}, however in the IIR table 1 Monaco reported that a T1 method from the Guidebook was used to estimate emissions. In the previous review, the ERT recommended the use of higher Tier methodologies. Monaco replied that this will be applied in the next submission, but according to the IIR, Monaco still uses Tier 1 method. According to the IIR no improvements are planned for this category.</p> <p>During the review week Monaco replied that it is not possible to obtain or calculate the fuel consumption by equipment type and fuel, but that if there is a realistic solution that exists to obtain the data required, then the migration to a Tier 2 method will be integrated into the improvement plan for next year.</p> <p>The ERT thanks Monaco for their response and recommends the Party to follow up on their intent.</p>				
Sector Transport	NFR Category 1A3ai(i) 1A3aii(i)	Pollutant(s) CO	Category (TCCCA) Completeness	TC or RE: No
<p>Recommendation text from 2021: The ERT notes with reference to Annex 1 of Monaco's IIR that 1A3ai(i) and 1A3aii(i) are respectively 1st and 2nd key sources for CO emissions (representing together 80% of total CO emissions), but Monaco reports that a Tier 1 method from the Guidebook was used to estimate emissions. This overestimate may have an impact on total emissions that is above the threshold of significance (i.e. a change in the National Total of more than 5%). The ERT notes that this overestimate may be because Monaco allocates all aviation activity in LTO phase instead of separating activity into LTO (in the National Total) and cruise phases (in memo items). In accordance with the previous issue, the ERT recommends splitting aviation activity data in LTO and cruise phases.</p>				

Recommendation text for 2022: The Party has partially implemented the findings, including a national method of separating the LTO and cruise cycles and reporting emissions for 1A3ai(ii) and 1A3aii(ii) in the NFR table.

In the IIR report it is stated that in the absence of additional data (emissions from LTO cycles - specific fuel consumption per LTO, per cruise flight and destination), the estimates of pollutant emissions are made using a Tier 1 method based on data from activity of the fuel distributed at the Monaco heliport, and the number of movements (take-off or landing) enabling a distinction to be made between national movements and international movements.

The Party reported that the Civil Aviation Department initiated an Airport Carbon Accreditation (ACA) process in 2018, which will consolidate the emissions relating to this category.

The ERT welcomes the Party to implement the IIR 2022 improvement plan, and cross-check the consistency of the improvements and consolidation of data with the Civil Aviation data, including improvement of the accounting of national flights only, estimation of fuel levels by flight, sectoral approach to the use of fuels, in the 2023 submission.

Sector Industrial Processes	NFR Category 2A5b	Pollutant(s) PM_{2.5}, PM₁₀, TSP	Category (TCCCA) Transparency, Accuracy, Comparability	TC or RE: No
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Recommendation text from 2021:

The ERT noted in Monaco's IIR that the Party uses the 2016 EMEP/EEA Guidebook methodology to estimate emissions from 2A5b. The ERT noted that Monaco has included in its improvement plan to use the 2019 EMEP/EEA Guidebook methodology for the next submission. The ERT recommends Monaco to implement its improvement plan for the next submission.

The ERT noted in the IIR reported by Monaco that AD "floor area built and destroyed" has been used in the calculation of emissions from 2A5b. No information regarding how this AD is collected has been provided in the IIR. During the review, Monaco provided the ERT with information regarding the collection of AD. The ERT commends Monaco for it and recommends Monaco to include this information in the IIR for the next submission to improve the transparency of its inventory.

Recommendation text for 2022:

During the 2022 inventory review Monaco confirmed the use of the Tier 1 method from EMEP/EEA 2019 Guidebook in its estimation of emissions from sector 2A5b. Additionally, the Party stated that the currently omitted time series of residential and non-residential AD will be corrected in the 2023 submission.

Monaco confirmed that, according to the country specific conditions (2.A.5.b – Chapter 3.2.3) they use the following parameters: d residential = 0.75, d non-residential = 1, CE residential = 0, CE non-residential = 0.5, PE = 61.36 and s = 12. Emission Factors are obtained from Tables 3.2 and 3.3 in chapter 2A5b of the 2019 EMEP/EEA Guidebook'

The ERT commends Monaco on providing details concerning the methodology and parameters used, and recommends including this information in the 2023 submission of the IIR. The ERT also recommends to include historical trends of activity data by types of construction used in the IIR for the next submission to improve the transparency.

Sector Waste	NFR Category 5D	Pollutant(s) NMVOC	Category (TCCCA) Accuracy	TC or RE: Yes/NO No
<p>Issue: The ERT notes that although the IIR indicated that a Tier 1 emission factor is used for this category and emissions are included within 5D1, in the reporting template, the notation key “NO” was used. The Party responded that the discrepancy is due to the fact that Monaco's wastewater have domestic characteristics (DCO/DBO5 >2,5). In order to be consistent with the occurrence of emissions from industries in other sectors, the correct notation should be “IE” and should be corrected in further submissions. The ERT recommends Monaco to correct the emission factors and record them in the IIR in the next submission.</p>				
<p>Recommendation text for 2022: The ERT notes that Notation Key "NO" for category 5D2 is used instead of “IE”, and that on p191 of the IIR the Party state that this will be corrected in the 2023 submission. The ERT recommends the Party to follow up on their intention and use the correct notation key in the 2023 submission.</p>				

25. During the follow up review, the ERT noted that there were the following notable issues (see Table 3). The ERT recommends Monaco to implement these findings in the next submission.

Table 3: New findings from the 2022 review

Sector National navigation (shipping)	NFR Category 1A3dii	Pollutant(s) NOx PM_{2.5}	Category (TCCCA) Accuracy	TC or RE: No
<p>Issue: The ERT noted that the National navigation sector is a key source category for NOx and PM_{2.5}, contributing 19.48% and 17.83% of emissions to the national total in 2020 respectively. The Party reported that Tier 1 method was used in the emission calculation. The Party answered to the ERT question that default emission factors from the GB 2019 were used in the calculation.</p>				
<p>Recommendation text for 2022: The ERT recommends the Party to use the updated emission factors for this category as presented in the updated version of the Guidebook 2019 in December 2021 in the 2023 submission, since the emission factors for Marine diesel oil/marine gas oil (MDO/MGO) have been revised. Moreover, the ERT recommends Monaco to use a Tier 2 method for sector 1A3dii due to the National navigation being a key category for NO_x and PM_{2.5}.</p>				
Sector Industrial Processes	NFR Category 2B10a, 2H2	Pollutant(s) All relevant	Category (TCCCA) Completeness	TC or RE: No
<p>Issue: From the information presented in the IIR and NFR tables in the 2022 submission, the ERT noted that Monaco reports emissions for two categories, 2A5b and 2D3b. According to IMSEE Monaco Statistics, No 114, October 2021, "Focus Manufacturing,</p>				

mining and quarrying, and others industries-2020" (<https://www.imsee.mc/Publications/Focus>), the ERT found, that activities such as manufacture of rubber and plastic products, manufacture of chemicals and chemical products, manufacture of food products, manufacture of pharmaceuticals and manufacture of clothing apparel do exist in the territory of Monaco. Consequently, the ERT believes that some of these manufacturing activities may not currently be captured in Monaco's inventory. These manufacturing activities may fall under following NFR categories: 2B10a Chemical industry: Other and 2H2 Food and beverages industry (e.g. Bread, Wine, Beer, Spirits, Meat, fish etc. frying / curing etc.). Monaco was asked for an explanation and to send evidence that the mentioned activities do not occur in Monaco, or evidence that the emissions from these activities are negligible. During the review week, Monaco confirmed that there is no production but only material transformations (e.g. forming) that occur. There is no chemical industry that falls within the 2B10a category, additionally, there is no large food industry that would be captured in 2H2, only small artisanal productions (e.g. bakeries), and no national statistical data on the production of these activities In Monaco.

Recommendation text for 2022:

The ERT accepts the answer from the Monaco and recommends Monaco to include all new information in the IIR for the 2023 submission to improve the transparency of its inventory.

Sector Industrial Processes	NFR Category 2A5b	Pollutant(s) PM_{2.5}, PM₁₀, TSP	Category (TCCCA) Completeness	TC or RE: No
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Issue:

With respect to the information provided in Monaco's IIR submitted in 2022 (p.129), stating that bituminous mixes are used within the territory of Monaco for the creation or repair of roads in sector 2D3b, the ERT believes that road construction activity does occur in Monaco during the period 1990 - 2020, and notes that Monaco does not include emissions from road construction within the inventory. During the review Monaco confirmed that they had not identified this sector, and stated that a first estimate will be made for the 2023 submission if the Party is able to obtain the data.

Recommendation text for 2022:

The ERT recommends Monaco to implement its improvement plan for road construction activity which will include activity data collection and calculation of emissions according to the EMEP/EEA Guidebook 2019 methodology. Additionally, the ERT recommends the Party to include all new information in the IIR for the 2023 submission in order to improve the transparency and completeness of its inventory.

Sector Solvent	NFR Category 2D3a	Pollutant(s) NMVOC	Category (TCCCA) Accuracy	TC or RE: No
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Issue:

The ERT commends Monaco for following the previous ERT recommendations and updating the methodology with that as described in the 2019 EMEP/EEA Guidebook. However, according to the information provided in the IIR (p. 20, 127, 128), the category 2D3a is a key category for NMVOC emissions. Currently, Monaco uses the EMEP/EEA Tier 1 methodology from GB2019 and does not have any planned improvements for sector 2D3a. The ERT notes that according to paragraph 21 of 2014 Reporting guidelines (ECE/EB.AIR/125) 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 (more detailed) methodology, including country-specific information.

Monaco was asked to add this activity in the short term planned improvements and to collect suitable activity data and estimate NMVOC emissions with a Tier 2 or higher (detailed) methodology from GB 2019, and document and report all new information transparently in the 2023 submission. During the S3 review week, Monaco responded that they would take into account this remark and informed the ERT that Monaco does not have required knowledge of national statistical data over the whole time series, there is no monitoring of these activities in the Principality, and that in compliance with the decision tree (figure 3,1) Monaco applied the Tier 1 method.

Recommendation text for 2022:

The ERT agrees with Monaco's response and encourages Monaco on collecting the detailed data required for moving to a higher Tier method, as according to paragraph 21 of 2014 Reporting guidelines (ECE/EB.AIR/125) for sources that are determined to be key categories in accordance with the EMEP/EEA Guidebook 2019 methodologies, Parties should make every effort to use a Tier 2 or higher (detailed) methodology, thereby including country-specific information.

Sector Solvent	NFR Category 2D3g, 2G	Pollutant(s) All relevant	Category (TCCCA) Completeness	TC or RE: No
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Issue:

According to information provided in the IIR and NFR tables submitted in 2022, Monaco reports emissions for following categories: 2D3a, 2D3d, 2D3f, 2D3h, 2D3i and 2G (use of fireworks and use of tobacco). According to IMSEE Monaco Statistics, No 114, October 2021, "Focus Manufacturing, mining and quarrying, and others industries-2020" (<https://www.imsee.mc/Publications/Focus>) the ERT finds that activities like manufacture of rubber and plastic products, manufacture of chemicals and chemical products, manufacture of food products, manufacture of pharmaceuticals and manufacture of wearing apparel do exist in the territory of Monaco and believes that some of these manufacturing activities may be missing in Monaco's inventory. These manufacturing activities may fall under following NFR categories: 2D3g Chemical products (e.g. Rubber processing, Pharmaceutical products manufacturing, Polyvinylchloride processing, Polyurethane foam processing, Polystyrene foam processing, Adhesive, magnetic tapes, films and photographs manufacturing etc.) and 2.G Other product use (e.g. Use of shoes). Monaco was asked for an explanation and to send proof/evidence if the mentioned activities do not exist in Monaco, or proof/evidence that the emissions from these activities are negligible.

Recommendation text for 2022:

The ERT recommends Monaco to update the information in the IIR to reflect the reporting of emissions from sectors 2D3g and 2G in the 2023 submission to improve the transparency of its inventory.

Sector Waste	NFR Category 5E	Pollutant(s) All pollutants	Category (TCCCA) Accuracy	TC or RE: No
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Issue: The ERT notes that Monaco reports emissions in category 5E as not estimated (NE), whilst a Tier 2 methodology is available for this source. This source contains emissions from fires involving cars, houses and industrial/apartment buildings. These data can often be obtained from the fire officers in other European countries.

Recommendation text for 2022: The ERT notes that Monaco indicated in its IIR 2022 (table 46, page 191) that the Party plans to estimate emissions for 5E in its 2023 submission. The ERT recommends the Party to follow up on its intention, and to obtain the relevant activity data and report emissions from sector 5E in the 2023 submission.

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

26. In the Appendix of the 'EMEP/UNECE Review Guidelines 2018'⁵ 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 Party did not submit any revised estimates and the ERT calculated no technical corrections.

⁵ 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. Monaco Stage 2 S&A report
2. Monaco Stage 1 report 2022
3. Monaco IIR 2022
4. NFR19 Monaco_UNECE_Annex_I.xlsx
5. Stage 3 RR from year 2021

LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

None