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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**

**LIECHTENSTEIN**

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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*'<sup>(1)</sup> – 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<sub>2.5</sub> 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<sub>2.5</sub> size fraction<sup>2</sup>. The inclusion of the condensable component of PM<sub>2.5</sub> emissions can have a big impact on the emission estimate for certain sources<sup>3</sup>.

4. This ad-hoc review, has assessed PM<sub>2.5</sub> emission estimates with a special focus on the topic of '*condensables*' for the years 2000 to 2020. Further, for Liechtenstein the implementation of all findings from the in-depth review 2021 have been assessed for all pollutants covered by LRTAP Convention and its protocols (SO<sub>2</sub>, NO<sub>x</sub>, NMVOC, NH<sub>3</sub>, plus PM<sub>10</sub> PM<sub>2.5</sub>, BC, 3 HMs and POP<sub>s</sub>) 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 Liechtenstein 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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<sup>1</sup> 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](https://unece.org/fileadmin/DAM/env/documents/2018/Air/EB/ECE_EB.AIR_142_Add.1-1902937E.pdf)

<sup>2</sup> [Condensable Particulate Matter Definition | Law Insider](#)

<sup>3</sup> 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](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 Liechtenstein, 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 Liechtenstein was received on 30 March 2022 and thus after the deadline of 15 February. The Informative Inventory Report was received on 24 May 2022 and thus after the deadline of 15 March.

# RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

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

9. Liechtenstein uses a Tier 1 methodology for calculating PM<sub>2.5</sub> emissions from '1A4bi – Residential: stationary'. As '1A4bi – Residential: stationary' is a key category, the ERT recommends Liechtenstein to use at least a Tier 2 method for calculating emissions from '1A4bi – Residential: stationary' in line with Reporting Guidelines' paragraph 21<sup>4</sup>

10. The activity data is taken from the Office of Statistics (OS) as well as other offices and public authorities: e.g. Office of Economic Affairs (OEA); Office of Statistics (OS); Office of Environment (OE); Swiss Federal Office for the Environment (FOEN). The ERT notes that the activity data is described transparently enough in the Informative Inventory Report. For the biomass combustion emission calculation, data of combustion units and combustion performance as well as firewood types (e.g., pellet, log wood) were considered. The ERT recommends the Party to document the description in more details in the next IIR submission.

11. The IIR does not clearly define if the activity data for Liechtenstein includes collected wood, i.e. wood directly harvested from the forest outside formal market activity. The ERT encourages the Party to collect data on collected wood on national circumstances and to incorporate the information in the inventory for the next submission.

12. Liechtenstein has 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 however not sufficiently documented in the IIR, the ERT recommends that this be well documented for the next submissions.

13. Liechtenstein uses Switzerland's EMIS database to provide emission factors for sector 1A4bi. The share of PM<sub>10</sub> and PM<sub>2.5</sub> on TSP depends on the EMEP/EEA 2013 Guidebook. The ERT recommends to update this to use the 2019 EMEP/EEA Guidebook.

14. During the review the ERT could not clarify whether the emission factors do include the condensable component of PM<sub>2.5</sub> emissions (Table 1). The ERT notes that in the IIR, Liechtenstein has not reported documentation regarding the condensable component of PM.

**Table 1: Inclusion of condensables per fuel type**

Fuel Type	Includes the condensable component of PM <sub>2.5</sub> emissions
Biomass	No
Coal	N/A
Liquid	No
Gaseous	No

15. The ERT notes that the time series is consistent. The ERT recommends the Party to use the EMEP/EEA Guidebook 2019, for next submission to improve transparency and comparability.

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<sup>4</sup> 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."

16. In the IIR it is not specified how the PM<sub>2.5</sub> emissions from small combustion are spatially distributed.

17. Liechtenstein has not added planned improvements for future submissions for category 1A4bi in their 2022 IIR.

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

18. Liechtenstein calculates emissions from the road transport using HBEFA 2019 emission factors. The IIR does not describe the calculation of transport emissions transparently.

19. The activity data source for road transport is not reported in the IIR. However, general data providers for all inventory activity data are mentioned in the IIR (Office of Statistics (OS), Office of Economic Affairs (OEA), Office of Environment (OE), Swiss Federal Office for the Environment (FOEN)).

20. The PM<sub>2.5</sub> emissions from road transport exhaust do include the condensable component of PM<sub>2.5</sub> emissions.

21. The ERT notes that the method is not documented transparently in the IIR. The ERT recommends Liechtenstein to include further information on the calculations in the transport sector by providing more details on the methodology, emission factors, and activity data used to calculate transport emissions in the next IIR submissions.

22. The time series is not consistent. The ERT recommends Liechtenstein to recalculate the time series with consistent methods to the next submission.

23. Liechtenstein lists the following planned improvements for their submission in 2023 in their 2022 IIR

- Recalculate the emissions in transport sector by using the fuels sold instead of the fuels used, including emission factors from HBEFA Version 4.2

The ERT commends Liechtenstein for their improvement plans and recommends implementing them as scheduled.

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

24. Liechtenstein was reviewed in-depth in 2021. The review resulted in a number of recommendations. The ERT commends Liechtenstein 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 implemented (see Table 2) and recommends Liechtenstein to implement these findings in the next submission.

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

Sector <b>Aviation</b>	NFR Category <b>1A3aii(i)</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Transparency, Completeness</b>	TC or RE: <b>No</b>
<p><b><u>Recommendation text from 2021:</u></b> The ERT noted that no information on the emission factors and activity data is provided in the 2021 IIR, like in previous IIR submissions. Liechtenstein responded that the only emission source in this category is a heliport and it is planned to include this information in the IIR in the next submission. The ERT welcomes this plan and recommends including future planned improvements in IIR (IIR, p. 43).</p>				
<p><b><u>Recommendation text for 2022:</u></b> The ERT noted that the Party has reported in the 2022 IIR that an insignificant amount of activity takes place at the heliport, however there is no further information related to the emission factors and the activity data. The ERT recommends Liechtenstein, to describe the methodological approach of the emission calculation in the 2023 submissions.</p>				
Sector <b>Road transport and Off-Road</b>	NFR Category <b>1A3b 1A4cii</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Transparency, Completeness</b>	TC or RE: <b>No</b>
<p><b><u>Recommendation text from 2021:</u></b> The ERT noted that no information on the emission factors and activity data is provided in the IIR 2021, like in previous IIR submissions. Liechtenstein responded that due to limited resources the Party is not able to provide detailed information. The ERT recommends including this improvement in future IIR when possible.</p>				
<p><b><u>Recommendation text for 2022:</u></b> The ERT noted that the information on the EFs and AD are not included in the latest 2022 IIR and recommends that Liechtenstein consider further improvement in the next IIR and include a description of the methodological approach used in emission calculations. The ERT also recommends to include any further information to help improve transparency.</p>				
Sector <b>Road transport</b>	NFR Category <b>1A3b</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Transparency</b>	TC or RE: <b>No</b>
<p><b><u>Recommendation text from 2021:</u></b> According to the 'Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution' (page 9, Footnote 12) Liechtenstein's Road transport emissions should be calculated based</p>				

on a fuel sold basis. During the 2021 Stage 3 review process, Liechtenstein informed the ERT that their emissions are estimated based on fuel used and that a change to an estimation based on fuels sold will be analysed.

**Recommendation text for 2022:** The ERT noted that the Party has included the 2021 recommendation in the Planned improvements chapter of the 2022 IIR pg. 43, for the next submission cycle. The ERT recommends the Party to follow up on its intention and estimate emissions from road transport on a fuel sold basis.

Sector <b>Road transport</b>	NFR Category <b>1A3bi-iii 1A3bvi-vii</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Transparency</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:** In Liechtenstein's NFR tables, for 1A3bi-iii and 1A3bvi-vii, PM<sub>2.5</sub>, PM<sub>10</sub> and TSP emissions are reported but BC emissions are reported using the notation key "NA" (Not Applicable). During the 2021 Stage 3 review process, Liechtenstein informed the ERT that, as there are no BC emission factors listed in their source (HBEFA), the notation key NA is used. The ERT recommends using the information of BC fractions of PM given in the EMEP/EEA 2019 Guidebook. For exhaust emissions, the Tier 2 values are presented in section "1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv Passenger cars, light commercial trucks, heavy-duty vehicles including buses and motor cycles", Table 3-92. For non-exhaust emissions, the values are presented in section "1.A.3.b.vi Road transport: Automobile tyre and brake wear, 1.A.3.b.vii Road transport: Automobile road abrasion", note of Table 3-4 for tyre wear and note of Table 3-6 for brake wear.

**Recommendation text for 2022:** The ERT noted that the Party did not include an estimation of BC emissions in the 2022 reporting cycle and hence recommends that the Party include this calculation in the 2023 submission cycle, by using the PM BC fraction as recommended in the 2019 Guidebook.

Sector <b>Road transport</b>	NFR Category <b>1A3biv</b>	Pollutant(s) <b>PM<sub>2.5</sub>, PM<sub>10</sub>, TSP, BC</b>	Category (TCCCA) <b>Transparency</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:** In Liechtenstein's NFR tables, it is mentioned PM<sub>2.5</sub>, PM<sub>10</sub>, TSP, BC emissions are "NA" (Not Applicable) for 1A3biv (Mopeds & motorcycles). During the 2021 Stage 3 review process, Liechtenstein informed the ERT that it is planned to estimate emissions relating to sector 1A3biv during the 2022 submission. The ERT welcomes this plan and recommends including future planned improvements in the IIR (IIR, p. 43).

**Recommendation text for 2022:** The ERT noted that the recommendation given by the Stage 3 Review is not implemented. The ERT recommends Liechtenstein to report emissions from sector 1A3biv in its 2023 submission.

Sector <b>Industrial Processes</b>	NFR Category <b>2A5b</b>	Pollutant(s) <b>TSP, PM<sub>10</sub>, PM<sub>2.5</sub></b>	Category (TCCCA) <b>Transparency, Accuracy</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:**

The ERT recommends Liechtenstein to estimate particle emissions from 2A5b or use the notation "NE", Not Estimated.



**Recommendation text for 2022:**

This ERT notes that Liechtenstein did not follow the recommendation from the previous ERT. The ERT strongly recommends Liechtenstein to revise the usage of the notation key “NO” in the IIR and NFR tables, and to estimate PM<sub>10</sub>, PM<sub>2.5</sub> and TSP emissions, or use the notation “NE” (not estimated). This source category “construction and demolition” includes the fugitive PM<sub>10</sub>, PM<sub>2.5</sub> and TSP emissions by construction activities (residential housing, non-residential housing, roads) and occurs in all parties and likely also in Liechtenstein during the period 1990-2020. In many other parties, category 2A5b is a key source.

Sector <b>Industrial Processes</b>	NFR Category <b>2I</b>	Pollutant(s) <b>TSP, PM<sub>10</sub>, PM<sub>2.5</sub></b>	Category (TCCCA) <b>Transparency, Accuracy</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:**

The ERT recommends Liechtenstein to justify the trend of particle emissions and to provide detailed technology specifications in the IIR for the next submission.

The ERT noted that 2I is a key category for PM<sub>10</sub> emissions. Emissions have been estimated by Liechtenstein using the Swiss inventory and an emission factor per capita. The ERT recommends Liechtenstein to estimate PM<sub>10</sub> emissions using a higher Tier method since 2I is a key category for PM<sub>10</sub> emissions.

**Recommendation text for 2022:**

This ERT notes that Liechtenstein did not follow the recommendation from previous ERT. According to the 2022 IIR, Liechtenstein PM<sub>10</sub> emissions from sector 2I are calculated with emission factors per capita from EMIS 2021, with the number of inhabitants from population statistics (OS 2021). The ERT is aware of limited availability of detailed data in Liechtenstein and considers this methodology to be the best available method.

Having that in mind, the ERT recommends Liechtenstein to include in its IIR the information regarding AD (population trend), EFs (from EMIS database) and methodology used. The ERT encourages Liechtenstein to continue developing data collection and use the EMEP / EEA 2019 Guidebook instead of emission factors from EMIS 2021 when possible.

Sector <b>Industrial Processes</b>	NFR Category <b>2H2</b>	Pollutant(s) <b>NM VOC</b>	Category (TCCCA) <b>Transparency, Accuracy</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:**

The ERT noted in that 2H2 is a key category for NMVOC emissions. Emissions have been estimated by Liechtenstein using the Swiss inventory and an emission factor per capita. The ERT recommends Liechtenstein to estimate NMVOC emissions using a higher Tier method since 2H2 is a key category for NMVOC emission.

**Recommendation text for 2022:**

This ERT notes that Liechtenstein did not follow the recommendation from previous ERT. According to the 2022 IIR, Liechtenstein's NMVOC emissions are calculated with emission factors per capita from EMIS 2021, with the number of inhabitants from population statistics [OS 2021]. The ERT is aware of limited availability of detail data in Liechtenstein and considers this methodology to be the best available method. Having that in mind, the ERT recommends Liechtenstein to include in its IIR the information regarding AD (population trend), EFs (from EMIS database) and methodology used. The ERT encourages Liechtenstein to continue developing data collection and use the EMEP / EEA 2019 Guidebook instead of emission factors from EMIS 2021 when possible.

Sector <b>Solvents</b>	NFR Category <b>2D3a, 2D3d, 2D3i, 2G, 2D3g, 2D3h</b>	Pollutant(s) <b>NMVOC, PM<sub>2.5</sub>, PM<sub>10</sub>, TSP</b>	Category (TCCCA) <b>Transparency, Accuracy, Comparability</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:**

The ERT noted that Liechtenstein reported NMVOC emissions in the submitted NFR table Annex I for the categories 2D3a, 2D3d, 2De, 2D3f, 2D3g, 2D3h, 2D3i. The ERT noted in the IIR that NMVOC emissions are estimated using the Swiss inventory based on emission factors per capita. The ERT noted also that these categories are key categories for NMVOC emissions. The ERT recommends Liechtenstein to estimate NMVOC emissions from these categories using a higher Tier method since they are key categories for NMVOC emissions.

**Recommendation text for 2022:**

During the review the ERT noted that according to S2 key categories analysis, source categories: 2D3a, 2D3d, 2D3i, 2G, 2D3g, and 2D3h are key sources for the year 2020 in Liechtenstein. According to the 2022 IIR, Liechtenstein has calculated all relevant emissions by scaling the Swiss emissions data with emission factors per capita from EMIS 2021, with the number of inhabitants from population statistics [OS 2021]. The ERT is aware of limited availability of detail data in Liechtenstein and considers this methodology to be the best available method. Having that in mind, the ERT recommends Liechtenstein to include in its IIR the information regarding AD (population trend), EFs (from EMIS database) and methodology used. The ERT encourages Liechtenstein to continue developing data collection and use the EMEP / EEA 2019 Guidebook instead of emission factors from EMIS 2021 when possible.

Sector <b>Agriculture</b>	NFR Category <b>3B</b>	Pollutant(s) <b>NMVOC, PM<sub>10</sub></b>	Category (TCCCA) <b>Accuracy</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:** Party is encouraged to use EMEP 2019 Guidebook emission factors for calculating emissions from NMVOC and PM<sub>10</sub> in sector 3B.

**Recommendation text for 2022:** The ERT recommends Liechtenstein to follow the recommendation of the 2021 review to use the EMEP/EEA 2019 Guidebook instead of the EMEP/EEA 2016 Guidebook to calculate emissions from NMVOC and PM<sub>10</sub> in sector 3B.

Sector <b>Agriculture</b>	NFR Category <b>3Db, 3Dc</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Accuracy</b>	TC or RE: <b>No</b>
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**Recommendation text from 2021:** The Party states in the IIR that they are calculating emissions from 3Db and 3Dc by multiplying the corresponding land area with emission factors from EMIS (2020) and EMEP/CORINAIR 2007. During the review, the Party further explained that it is planned to check and improve emission calculation in this category step by step in the following submissions. The ERT encourages the party to use the current 2019 EMEP/EEA Guidebook for estimating emission of these categories in future reporting.

**Recommendation text for 2022:** The ERT recommends Liechtenstein to follow the recommendation of the 2021 review to use the EMEP/EEA 2019 Guidebook instead of emission factors from EMIS (2020) and EMEP /CORINAIR 2007.

Sector <b>Waste</b>	NFR Category <b>5A</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Comparability</b>	TC or RE: <b>No</b>
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**Issue:** The ERT noted from the previous review process that the description of emission calculations is not transparent. It is mentioned in the IIR that this category should include emissions from the managed landfills. But, according to the EMEP/EEA Guidebook, this category should include emissions from all landfills, managed or not managed.

**Recommendation text for 2022:** The issue is not resolved. Liechtenstein did not follow the recommendation from the 2021 review. The ERT encourages Liechtenstein to make use of the EMEP/EEA 2019 Guidebook since category 5A should include emissions from all landfills, managed or not managed.

Sector <b>Waste</b>	NFR Category <b>5B1</b>	Pollutant(s) <b>NM VOC NH<sub>3</sub></b>	Category (TCCCA) <b>Transparency, Completeness, Comparability</b>	TC or RE: <b>No</b>
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**Issue:** The ERT noted from the previous Review process that Liechtenstein reports emissions from 5B1 Biological treatment of waste – Composting. There is no information available about methodology, EFs and activity data used in IIR and NFR tables. The ERT assumes that estimates of composted waste amounts are used for emission estimations. The Party responded that due to lack of capacity, the issue was not addressed in detail and the information will be included in the next submission of the IIR. The ERT strongly encourages the country to prepare a schedule of all planned implementation with clear explanation of the methodology for this category and include it in the next submission of the IIR.

**Recommendation text for 2022:** The ERT noted that according to the IIR 2022, the source category 5B1 is a key category (level and trend) for NMVOC emissions but no information about the activity data, emission factors and methodology is included in the IIR. The ERT recommends Liechtenstein to include information about the methodology, EFs and activity data used in IIR and NFR tables in the 2023 submission.

Sector <b>Waste</b>	NFR Category <b>5B1, 5B2</b>	Pollutant(s) <b>NO<sub>x</sub>, SO<sub>x</sub>, CO and PMs</b>	Category (TCCCA) <b>Transparency, Completeness, Comparability</b>	TC or RE: <b>No</b>
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**Issue:** The ERT notes that for NO<sub>x</sub>, SO<sub>x</sub>, CO and PMs, notation key NO is reported. According to reporting guidelines, when the activity occurs but the emissions are not expected to be released, notation key NA should be used. The Party responded that they would check the notation keys in the next submission. The ERT recommends Liechtenstein to review the use of notation keys in the next submission and document it in the IIR.

**Recommendation text for 2022:** The ERT found that Liechtenstein did not follow the recommendation from the 2021 review. The ERT recommends Liechtenstein to review the use of notation keys in the next submission and document it in the IIR.

Sector <b>Waste</b>	NFR Category <b>5C</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Transparency, Completeness, Comparability</b>	TC or RE: <b>No</b>
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**Issue:** The ERT notes that Liechtenstein reports emissions only for the sub-sector 5C1a municipal waste incineration. In the IIR, the explanation is provided that only emissions from the illegal incineration of gardening and household wastes, as well as open burning of waste on construction sites, are included in 5C1a. Open burning of waste should be reported under category 5C2, similar to how it is reported in the GHG inventory. In addition, there is no information about activity data, emission factors and methodology used for the calculation. Liechtenstein responded that they will adjust their inventory following this recommendation, but due to lack of capacity, they will not be able to provide a detailed explanation of the methodology used in this category in the IIR. The ERT recommends the Party to reallocate the emissions from this category to category 5C2. The ERT strongly encourages the country to prepare a schedule of the planned implementation and explanation of the methodology used for this category and include it in the next submission of the IIR.

**Recommendation text for 2022:** The issue is not resolved. Liechtenstein did not follow the recommendation from the 2021 review.

In the IIR 2022 there are no waste incineration plants in Liechtenstein. Since the beginning of 1975, all municipal solid waste from Liechtenstein has been exported to Switzerland for incineration. Therefore, the source category 5C1a includes only emissions from illegal incineration of gardening and household wastes, emissions from these sources should be included in NFR Sector 5C2 as opposed to 5C1a. The ERT recommends Liechtenstein to report emissions under the correct NFR sector codes in the 2023 submission and to change notation keys where relevant in the process.

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

**Table 3: New findings from the 2022 review**

<b>Sector Energy</b>	<b>NFR Category 1A2e</b>	<b>Pollutant(s) All</b>	<b>Category (TCCCA) Transparency</b>	<b>TC or RE: No</b>
<p><b><u>Issue:</u></b> The ERT noted that Liechtenstein uses the notation key 'IE' in the category 1A2e for the entire time series in the NFR tables, however there is no documentation in the IIR regarding under which NFR category emissions are included within.</p>				
<p><b><u>Recommendation text for 2022:</u></b> The ERT encourages Liechtenstein to provide information in the 1A2e row in the column 'Notes' in the NFR tables to state in which category emissions from this sector are included. The ERT also recommends Liechtenstein to specify this also in the IIR for the 2023 submission.</p>				
<b>Sector Industrial Processes</b>	<b>NFR Category 2D3b, 2H, 2I</b>	<b>Pollutant(s) NMVOC, TSP</b>	<b>Category (TCCCA) Transparency, Accuracy, Comparability</b>	<b>TC or RE: No</b>
<p><b><u>Issue:</u></b> The ERT notes that according to the S2 key categories analysis, source category 2I is a key source of TSP emission for 2020, 2010 and 2005. Categories 2D3b and 2H2 are key sources of NMVOC emissions for 2010 and 2005 in Liechtenstein.</p>				
<p><b><u>Recommendation text for 2022:</u></b> During the review the ERT noted that according to S2 key categories analysis, source categories: 2D3b, 2H2 and 2I are the key sources for the year 2020 in Liechtenstein. According to IIR 2022, Liechtenstein has calculated all relevant emissions by scaling the Swiss emissions data with emission factors per capita from EMIS 2021, with the number of inhabitants from population statistics [OS 2021]. The ERT is aware of limited availability of detail data in Liechtenstein and considers this methodology to be the best available method. Having that in mind, the ERT recommends Liechtenstein to include in its IIR the information regarding AD (population trend), EFs (from EMIS database) and methodology used. The ERT encourages Liechtenstein to continue developing data collection and use the EMEP / EEA 2019 Guidebook instead of emission factors from EMIS 2021 when possible.</p>				
<b>Sector Road transport</b>	<b>NFR Category 1A3b</b>	<b>Pollutant(s) All</b>	<b>Category (TCCCA) Accuracy</b>	<b>TC or RE: No</b>
<p><b><u>Issue:</u></b> The ERT noted from the previous review process that the Party is using Tier 2 method of calculation for all 1A3b NFR categories, using HBFA emission factors and presumably the condensable part of the PM is not calculated.</p>				

**Recommendation text for 2022:** Given the availability of the vehicle fleet data and the planned emission recalculation reported in the 2022 IIR, the ERT recommends the Party to introduce a higher Tier level of emission calculation for road transport by implementing COPERT 5 model that includes the calculation of the condensable part of PM in the emission estimation.

Sector <b>Agriculture</b>	NFR Category <b>3Db</b>	Pollutant(s) <b>NMVOC</b>	Category (TCCCA) <b>Completeness</b>	TC or RE: <b>No</b>
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**Issue:** In the 3Db category, NMVOC emissions were the same in both the 2021 and 2022 submissions in the NFR tables.  
The Tier 1 methodology also provides emissions factors for further pollutants, not only NMVOC.

**Recommendation text for 2022:** ERT encourages Liechtenstein to recalculate NMVOC emissions in the 3Db category and to report the correct NMVOC emission values in the next 2023 submission.

Sector <b>Waste</b>	NFR Category <b>5A</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Transparency</b>	TC or RE: <b>No</b>
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**Issue:** Liechtenstein reports emissions of NO<sub>x</sub>, SO<sub>x</sub>, CO, Heavy metals and POPs in this category, but there is no information about the origin of these emissions as they are generally marked as combustion emissions. All the emissions of the main pollutants are calculated until 2008. From the year 2010 onwards, the notation key "NO" (Not Occurring) is reported in the NFR tables. The Party stated that they will clarify this issue and include underlying information in future submission of the IIR.

**Recommendation text for 2022:**

The ERT recommends Liechtenstein to use the notation key NA (Not Applicable) and not NO (not occurring) for 2010 onwards for NO<sub>x</sub>, SO<sub>x</sub>, CO, Heavy metals and POPs.

Sector <b>Waste</b>	NFR Category <b>5D</b>	Pollutant(s) <b>NH<sub>3</sub>, NMVOC</b>	Category (TCCCA) <b>Transparency, Completeness, Comparability</b>	TC or RE: <b>No</b>
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**Issue:** The ERT notes that Liechtenstein calculates emissions only for the sub-sector 5D1 domestic wastewater handling, but no explanation is provided about methodologies, EFs and activity data. Also, no information about the usage of dry toilets was mentioned in the IIR. Liechtenstein responded that as stated in Liechtenstein's report on measures of water conservation for the International Water Protection Commission for the Bodensee, 99 % of the total wastewater is captured in wastewater treatment facilities and 90% in the central large wastewater treatment plant in Bendorf. The ERT commends the Party for answering the question, but the issue of a detailed description of methodology and activity data stands still as well as the question round usage of dry toilets in the country. The ERT recommends the Party to include a detailed description of the methodology as well as

information about the usage of dry toilets in the next submission of the IIR. If there is some dry toilets use recorded, the Party should report these emissions in the category 5D1.

**Recommendation text for 2022:** The IIR the category, wastewater handling (5D) contains domestic, industrial and other wastewater handling. In Liechtenstein, only domestic wastewater handling (5D1) occurs. To establish estimates of emissions for Liechtenstein, the emissions are calculated using emission factors on a per-capita basis from EMIS (2021). The number of inhabitants in Liechtenstein is obtained from population statistics (OS 2021). The ERT recommends that for category 5D1 (Domestic wastewater handling), Liechtenstein should present the activity data and emission factors used along with the methodology in the 2023 IIR in order to improve the transparency of the inventory. The ERT also encourages Liechtenstein to continue developing data collection and use the EMEP/ EEA 2019 Guidebook instead of emission factors from EMIS 2021 when possible.

Sector <b>Waste</b>	NFR Category <b>5E</b>	Pollutant(s) <b>All</b>	Category (TCCCA) <b>Transparency, Completeness, Comparability</b>	TC or RE: <b>No</b>
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**Issue:** The ERT notes that Liechtenstein uses the notation key “NO” for 5E. In the EMEP/EEA Guidebook 2019, this category contains emissions from accidental fires of houses, cars and industrial buildings as well as sludge spreading. In most European countries, fire and rescue services collect information about fires. Liechtenstein responded that they plan to check a progressive implementation of emission reporting from this source category. The ERT recommends the Party to provide a detailed time schedule of the implementation of this improvement task and expected finalisation in the IIR in the next submission.

**Recommendation text for 2022:** Liechtenstein is yet to calculate emissions from sector 5E, however the ERT notes that in chapter 8.3 “Planned Improvements” (page 44), it is stated that the Party planned to calculate emissions from sector 5E in the next submission. The ERT recommends Liechtenstein to follow up on their intent and calculate emissions in the 5E category in the 2023 submission, presenting the methodology in the IIR.

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

26. In the Appendix of the 'EMEP/UNECE Review Guidelines 2018'<sup>5</sup> 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.

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<sup>5</sup> [https://www.ceip.at/fileadmin/inhalte/ceip/3\\_review/advance\\_version\\_ece\\_eb.air\\_142\\_add.1.pdf](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. Liechtenstein Stage 2 S&A report
2. Liechtenstein Stage 1 report 2022
3. Liechtenstein IIR 2021
4. Liechtenstein IIR 2022
5. Reporting\_Tables\_Li\_2022\_V\_1\_0.xlsx
6. Stage 3 RR from year 2021