**UNITED
NATIONS**

Distr.
GENERAL

CEIP/S3.RR/2023/
Cyprus
26/09/2023

ENGLISH ONLY

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

2023

Cyprus

FINAL REPORT

CONTENT

INTRODUCTION

1.	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'.

2.	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.

3.	At its eighth joint session in September 2022, the Steering Body and the Working Group on Effects approved the plan that the in-depth review in 2023 focuses on emissions from agriculture with a special emphasis on ammonia, NMVOC and NO_x emissions including gridded data. While the focus was set on NH_3, NMVOC and NO_x emissions, also all other pollutants covered by LRTAP Convention and its protocols (i.e. SO_2, NOx, NMVOC, NH_3, plus PM_{10} $PM_{2.5}$, BC, priority HMs and POP_S) have been checked for the time series years 1990 – 2021 to the extent possible. For these other pollutants especially completeness of reporting was assessed.

4.	This report covers the results of the Stage 3 Review (ad hoc review) 2023 of Cyprus air emission inventory submitted under the UNECE LRTAP Convention. The review was coordinated by the EMEP Centre on Emission Inventories and Projections (CEIP) acting as Review Secretariat. The review took place between April and June 2023 and was performed as a desk review between 31 March to 5 May 2023 and an in-person meeting between 22 of May 2023 and 26 May 2023 (centralized review). The following team of nominated experts from the Roster of Experts performed the review.

Agriculture experts:

Ms. Armine ARTENYAN (Republic of Armenia)

Ms. Ajla BASOVIC (Montenegro)

Ms. Aleksandra NESTOROVSKA-KRSTESKA (North Macedonia)

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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
http://www.unece.org/fileadmin/DAM/env/documents/2002/eb/air/EB%20Decisions/Decision_2018_1.pdf

Mr. Lasha AKHALAIA (Georgia)

Mr. Hakam AL-HANBALI (Sweden)

Ms. Susana LOPEZ-APARICIO (EU/ETC(EEA))

Ms. Simone MAYER (Austria)

Ms. Andjelka RADOSAVLJEVIC (Serbia)

Ms. Kristina Tonhauzer (Slovakia)

Mr. Tim VAN DER ZEE (Netherlands)

Experts for gridded emission data:

Ms. Christine BRENDLE (Austria)

Mr. Christopher EVANGELIDES (United Kingdom)

Mr. Christian MIELKE (Germany)

5.   Mr. Ben RICHMOND (United Kingdom), Ms. Rikke ALBREKTSEN (Denmark), Mr. Etienne MATHIAS (France), Ms. Kristina SAARINEN (Finland) were the lead reviewers. The review was coordinated by Ms. Sabine Schindlbacher and Mr. Bernhard Ullrich (EMEP Centre on Emission Inventories and Projections - CEIP).

6.   The review was performed on the basis of CLRTAP emission data officially reported by Cyprus, due by 15 February 2023. The Informative Inventory Reports (IIR), reported due by 15 March 2023 under the CLRTAP, informed the review.

7.   The EMEP/EEA Guidebook 2019[2] was used as a base for the review.

8.   The emission inventory of Cyprus was received on 15 February 2023 and thus by the deadline of 15 February. The Informative Inventory Report was received on 16 March 2023 and thus almost by the deadline of 15 March. Cyprus provided resubmissions of the emission inventory on 15 March 2023. The resubmission has been considered for the review.

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[2] EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2019, EEA Report No. 13/2019 European Environment Agency, Copenhagen. Available at: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019 EU 2019

PART A: GENERAL RECOMMENDATIONS FOR THE CHAPTER AGRICULTURE

9.   The ERT recognises the level of effort undertaken by Cyprus in providing an inventory including a significant level of detail and the cooperation and responsiveness during the centralised CLRTAP in-depth review.

The IIR describes the methods used for the sector agriculture transparently, but the ERT recommends Cyprus to do further work on QA/QC. The ERT considers the agriculture part of the inventory submission to be of adequate quality in terms of completeness and of adequate quality in terms of accuracy, comparability and consistency.

To improve the overall quality of the agriculture air emission inventory the ERT recommends Cyprus to

- provide a detailed description of applied methodologies, data sources, choice of emission factors and activity data for all categories in the IIR.

- ensure that the agriculture emission inventory is complete

- perform and present an uncertainty analysis and use it to as a tool to focus on planned improvements to the key categories.

- provide transparent information on recalculations.

- ensure that activity data is included in the NFR tables and do QA/QC by comparing data in NFR and IIR and the N-flow tool and also by comparing the data with UNFCCC reporting

- provide detailed information on its QA/QC plan for its air emission inventory in future submissions.

- provide a more detailed methodology section in the gridded chapter of the IIR

PART B: SPECIFIC RECOMMENDATIONS FOR THE SECTOR AGRICULTURE

10.   Table 1 provides the findings from the 2023 CLRTAP Stage 3 Review including those not implemented from previous CLTRAP Stage 3 Reviews. While the focus was set on NH_3, NMVOC and NO_x emissions, also all other pollutants covered by the LRTAP Convention and its protocols (i.e. SO_2, NO_x, NMVOC, NH_3, plus PM_{10} $PM_{2.5}$, BC, priority HMs and POP_S) have been checked for the years 1990 – 2021 to the extent possible, especially regarding the completeness of reporting. The implementation of the recommendations will be followed up in a future CLRTAP inventory review.

Table 1: Findings from the CLRTAP Stage 3 Review 2023 for the Sector Agriculture[3]

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC$_1$C$_2$C$_3$
CY-2023-3B-1	Activity data	3B	Yes	Tier 2	R	T

Observation

The ERT noted, that in the IIR there is only little information on animal waste management practices in Cyprus. It is described that there are no dairy cattle held in tied housing and that only sheep and goats are grazing animals. During the review Cyprus provided the Manure Management N flow tool containing all information on management practices. Furthermore, Cyprus informed the ERT that only default values are used ($N_{excretion}$, $VS_{excretion}$, EF, etc.).

Recommendation

The ERT recommends Cyprus to include additional information on the management practices for the different livestock categories in the next IIR in order to increase transparency. In addition, the ERT recommends to add the information that only default values ($N_{excretion}$, $VS_{excretion}$, EF, etc.) are used.

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC$_1$C$_2$C$_3$
CY-2023-3B-2	NO$_x$	3Bgi, ii, iii, iv	No	Tier 2	R	AC$_2$

Observation

The ERT noted, that for NO$_x$ emissions of 3B4gi, ii and iii there are zero emissions reported for the complete time series although activity data is available. The ERT also noted, that for NO$_x$ emissions of 3B4giv, there are zero emissions reported until 2008 and then "NO". During the

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[3] Note: There are four possible types of findings: R: Recommendation, TC: Technical Correction, PTC: Potential Technical Correction; RE : Revised Estimate

The findings have been assigned to one or more of the following criteria: TACCC T (Transparency), A (Accuracy), C$_1$ (Completeness), C$_2$ (Comparability), C$_3$ (Consistency) for definitions of these criteria see EMEP/EEA Guidebook 2019

review Cyprus informed the ERT that the calculations within the Manure Management N flow tool only result in zero emissions for these categories and provided the tool. The ERT had a look at the calculations and detected an error in the parameters sheet, which resulted in zero emissions of poultry for NO_x and N_2O, where emissions should actually arise. This was due to a confusion of slurry storage and solid storage (used for housing). Cyprus agreed that there has been a confusion between slurry storage and solid storage and responded that the error will be corrected for the next submission.

Recommendation
The ERT recommends Cyprus to correct its Manure Management N flow tool accordingly and report NO_x emissions (and also N_2O under UNFCCC) for the NFR categories 3B4gi, ii, iii and iv (until 2008) in the next submission. The ERT also recommends to describe the recalculations that will arise in its next IIR.

ID	Pollutants	NFR category	Key Category	Tier level	Type	$TAC_1C_2C_3$
CY-2023-3B-3	Activity data	3B	Yes	Tier 2	R	C_3

Observation
The ERT noted that population livestock reported in the NFR tables for 3B1b were inconsistent with the values reported in the CRF tables for 3B1b submitted to the UNFCCC for the year 2016 (34 540 vs. 35 888). Also for other livestock categories (e.g. 3B2, 3B3 etc.) for some individual years there are differences. During the review Cyprus checked the data and informed the ERT that the numbers reported under the UNFCCC are not correct.

Encouragement
The ERT encourages Cyprus to check livestock numbers with the team reporting to the UNFCCC in order to be consistent and to avoid errors in reporting in future submissions.

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC$_1$C$_2$C$_3$
CY-2023-3B-4	All pollutants	3B	Yes/No	Tier 2/Tier1	R	T

Observation

Several recalculations have been found in the Agriculture sector, when comparing the previous submission with the current one. However, these are not addressed in the IIR. E.g. for NH$_3$: 3B1b, 3B2, 3B3, 3B4d, 3B4e, 3B4f, 3Da1, 3Da2b, 3Da3, 3F. During the review Cyprus responded that they are not aware of these recalculations.

Recommendation

The ERT recommends Cyprus to describe the recalculations that have been made per NFR category transparently in the IIR in future submissions. The ERT also encourages Cyprus to compare the latest NFR with the previous one in order to identify recalculations and to establish this as a QA/QC routine.

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC$_1$C$_2$C$_3$
CY-2023-3D-1	Activity data	3Da1	Yes (NH3, NOx)	Tier 2 (NH3), Tier 1 (NOx)	R	T

Observation

In the last CLRTAP Review (2014), the significant decrease of mineral fertilizers was questioned since 1990, whereas the cropland area did not decrease that strongly. Currently, there is no further information included in the IIR addressing this issue. The ERT noticed, that the reported N amounts of mineral fertilisers fell sharply by 28% between 1999 and 2000, whereas the cropland area only decreased by about 2%. During the review Cyprus informed the ERT that the methodology provided by the TERT (NEC Review) after the technical correction is used. The quantities of the fertilisers at first place were given by TERT and then were taken by FAOSTAT database. Cyprus explained that one possible reason for this large reduction is the fact that the Ministry of Agriculture has launched a major campaign to educate farmers about the need for less fertiliser use.

Recommendation

The ERT recommends Cyprus to include the information provided to the ERT in its next IIR that one reason for this large reduction

might be the fact that the Ministry of Agriculture has launched a major campaign to educate farmers about the need for less fertiliser use.

ID	Pollutants	NFR category	Key Category	Tier level	Type	$TAC_1C_2C_3$
CY-2023-3D-2	NO_x	3Da1	Yes	Tier 1	R	A

Observation

There is no specific information on NO_x emission calculations of inorganic fertilizers in the IIR. During the review Cyprus informed the ERT that a Tier 1 methodology of the EMEP/EEA GB 2019 (EF = 0.04 kg NO2 kg–1 fertiliser from Table 3.1) is used. However, the ERT determined an IEF of about 0.06 kg for all years. During the review Cyprus responded that they are applying the EF of 0.04 kg but are using a conversion factor of 46/30 to convert the NO_2 into the NO (based on table 3.1 of the 3D / GB2019) resulting in 0.06 kg.

Recommendation

The ERT recommends Cyprus to correct its NO_x calculations of NFR category 3Da1 by not using the conversion factor of 46/30 anymore for the next submission. NO_2 emissions are reported as NO_x emissions and therefore no conversion is necessary.

ID	Pollutants	NFR category	Key Category	Tier level	Type	$TAC_1C_2C_3$
CY-2023-3D-3	NMVOC	3Da2a	No	Tier 2	R	AC_1

Observation

In the IIR it is stated that for the calculations of NMVOCs of NFR category 3Da2a the methodology from the EMEP/EEA Guidebook 2019 is used. However, in the NFR, there are no NMVOC emissions reported for category 3Da2a (reported as NE). During the review Cyprus informed the ERT that they are applying the Tier 2 methodology of the EMEP/EEA GB 2019, which is calculated within the Manure Management N flow tool. Cyprus also explained that the NMVOCs emissions, by mistake, were added in 3B category and not in 3Da2a and this will be corrected in the next year's submission.

Recommendation

The ERT recommends Cyprus to correct the error in the NFR tables for NMVOC from NFR categories 3B and 3Da2a for the next submission and to add a description of the methodology used for NFR category 3Da2a in the IIR.

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC$_1$C$_2$C$_3$
CY-2023-3D-4	NH$_3$	3Da2a	Yes	Tier 2	R	T

Observation

The ERT noted that with reference to the IIR, page 148, NH$_3$ abatement techniques from manure spreading were not described transparently in the IIR. The ERT questioned on detailed information on the abatement techniques applied in Cyprus (which techniques, % of the manure, which is spread with the respective technique, etc.). During the review Cyprus informed the ERT that various techniques are used like trailing hoses, trailing shoe, shallow injection and incorporation into soil. The amount of the manure which is spread on the fields is the one that does not go to the digesters. Cyprus also explained that even though they could reach higher reductions based on the above techniques, they used the lower emissions reductions (30%) in order to be on the safe side.

Recommendation

The ERT recommends Cyprus to include additional information on NH$_3$ abatement techniques, as provided to the ERT, in its next IIR in order to increase transparency.

ID	Pollutants	NFR category	Key Category	Tier level	Type	TAC$_1$C$_2$C$_3$
CY-2023-3D-5	NMVOC	3De	No	Tier 1	R	TA

Observation

The ERT noticed, that NMVOC calculations of 3De refer only to the cropland area. However, the EMEP/EEA GB methodology corresponds to the cultivated area, which also includes grassland areas. During the review Cyprus informed the ERT that on the island there is a very low precipitation and that no important grasslands exists in Cyprus.

Recommendation
The ERT accepts the explanation provided by Cyprus why not including grassland areas in the calculations of NFR category 3De for NMVOC emissions and recommends to include this information in its next IIR.

PART C: SPECIFIC RECOMMENDATIONS FOR THE GRIDDED EMISSION DATA FOR THE SECTOR AGRICULTURE

For the 2023 Review of the gridded emission data the focus was set on ammonia, NMVOC, NO_x and $PM_{2.5}$ emissions.

11.   The methods used by Cyprus to spatially resolve sectoral emissions are not described transparently in the IIR.

12.   The description does not include data sources that have been used for spatial distribution.

13.   Gridded emissions reported for e.g. GNFR K_AgriLivestock and L_AgriOther are consistent with the corresponding NFR categories reported in Annex I.

14.   Table 2 provides the findings from the ERT related to the gridded data.

15.   The implementation of the recommendations will be followed up in a future CLRTAP inventory review.

Table 2: Findings from the CLRTAP stage 3 review 2023 for gridded emissions from the sector agriculture[4] [an example of a possible recommendation]

ID	Pollutants	GNFR category	$TAC_1C_2C_3$
CY-2023-GRID-GL-1	gridding/all	GNFR-L	
Observation The ERT noted that there is a lack of transparency regarding the methodologies and assumptions used to generate the gridded data. The IIR does not contain a chapter outlining the methods used to generate all of the gridded estimates as outlined in Annex II of the reporting guidelines. **Recommendation** **The expert review team recommends Cyprus to add the missing chapter on methodologies according the gridding and to include the assumptions and methods used for LPS and gridded data in the IIR of the next submission.**			

[4] The findings have been assigned to one or more of the following criteria: TACCC T (Transparency), A (Accuracy), C_1 (Completeness), C_2 (Comparability), C_3 (Consistency) for definitions of these criteria see EMEP/EEA Guidebook 2019

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

16.   In the Appendix of the 'EMEP/UNECE Review Guidelines 2018[5]' it is stated that if the ERT considers that emissions are significantly under- or overestimated, the Party is during the review 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 a Revised Estimate i.e. the ERT does not accept a Revised Estimate provided by the Party, the ERT may calculate a 'Technical Correction'. The threshold for significance for a Technical Correction for the in-depth review in 2023 was set at 2% of the national total, i.e. a finding that has been identified to result in an over- or under-estimate of emissions of more than 2% of the national total. The methods for calculating Technical Corrections are set up in the 'EMEP/UNECE Review Guidelines 2018' and use the EMEP/EEA Emission 'Inventory Guidebook' as a reference for methods and emission factors.

17.   The ERT did not calculate any Technical Corrections and Cyprus did not provide any Revised Estimates.

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[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. Cyprus Annex I reporting template
2. Cyprus Stage 2 S&A report
3. Cyprus Stage 1 report 2023
4. Cyprus IIR 2023
5. Repdab-Report
6. Extended checks

LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

1. Responses to the question raised by ERT during the review
2. Material received from the Party during the Review
    - o Cyprus N flow tool for Manure Management for 2023 submission
    - o Description of Cyprus EMEP Tool (poultry)
    - o Cyprus Tier 2 calculations of NH3 Emissions from Mineral Fertiliser (3Da1)

ANNEX I TECHNICAL CORRECTIONS AND REVISED ESTIMATES

18.   The ERT did not calculate any Technical Corrections and Cyprus did not provide any Revised Estimates.

ABBREVIATIONS

This list includes abbreviations commonly used in the Review Reports

AD	Activity data
BaP	Benzo[a]pyrene
BC	Black Carbon
C	Confidential
Cd	Cadmium
CEIP	Centre on Emission Inventories and Projections
CLRTAP	Convention on Long-range Transboundary Air Pollution – 'the Air Convention'
CO	Carbon Monoxide
E-PRTR	European Pollutant Release and Transfer Register
EEA	European Environment Agency
EF	Emission factor
EMEP	The co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe (unofficially 'European Monitoring and Evaluation Programme' = EMEP)
ERC	Emission Reduction Commitment
ERT	Expert Review Team
GHG	Greenhouse gas
GIS	Geo Information System
GNFR	NFR Aggregation for Gridding and LPS
HCB	Hexachlorobenzene
Hg	Mercury
HM	Heavy metals
IEF	Implied emission factor
kt	Kilotonnes
LPS	Large Point Sources
NA	Not applicable
NE	Not Estimated
NECD	National Emission reduction Commitments Directive
NFR	Nomenclature for reporting
NH_3	Ammonia
NMVOC	Non-methane volatile organic compounds
NO	Not Occuring
NO_x	Nitrogen oxides
NR	Not relevant/Not Reported
PAHs	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PCDD/F	Polychlorinated dibenzo-p-dioxins and dibenzofurans
PM_{10}	Fine particulate matter: particles with an aerodynamic diameter equal to or less than 10 micrometres (μm)

PM$_{2.5}$	Fine particulate matter: particles with an aerodynamic diameter equal to or less than 2.5 micrometres (μm)
POPs	Persistent organic pollutants
PTC	Potential technical correction
RE	Revised estimate
SO$_2$	Sulphur dioxide
SO$_x$	Sulphur oxides
TC	Technical correction
TSP	Total suspended particulates

LIST OF REFERENCES AND SUPPORTING DOCUMENTS

1.   Annex I emission reporting template. Available at
https://www.ceip.at/reporting-instructions

2.   ECE/EB.AIR/111/Add.1: Decision 2012/3: Adjustments under the Gothenburg Protocol to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them

https://unece.org/DAM/env/documents/2013/air/ECE_EB.AIR_111_Add.1__ENG_DECISION_3.pdf

3.   ECE/EB.AIR/113/Add.1: Decision 2012/12: Guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them

https://unece.org/DAM/env/documents/2012/EB/Decision_2012_12.pdf

4.   ECE/EB.AIR/125: 2014 Reporting Guidelines for Estimating and Reporting Emission Data under CLRTAP https://unece.org/fileadmin/DAM/env/documents/2013/air/eb/ece.eb.air.125_E_ODS.pdf

5.   ECE/EB.AIR/127/Add.1: Decision 2014/1: Improving the guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them https://unece.org/DAM/env/documents/2014/AIR/EB/Decision_2014_1.pdf

6.   ECE/EB.AIR/130: Technical Guidance for Parties Making Adjustment Applications and for the Expert Review of Adjustment Applications, 14 April 2015 https://unece.org/DAM/env/documents/2014/AIR/EB/ECE_EB_AIR_130_ENG.pdf

7.   ECE/EB.AIR/142/Add.1: Decision 2018/1: Updated methods and procedures for the technical reviews of air pollutant emission inventories reported under the Convention
https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2019/decision_2018_1_advance_version_ece_eb.air_142_add.1.pdf

8.   EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2016, EEA Report No. 21/2016 European Environment Agency, Copenhagen. Available at: http://www.eea.europa.eu/publications/emep-eea-guidebook-2016

9.   EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2019, EEA Report No. 13/2019 European Environment Agency, Copenhagen. Available at: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019

10.   TFEIP (2022): "Inventory adjustments in the context of emission reduction commitments (ERC)" available at: https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2022/technical_guidance_for_erc_adjustments_issue1.1.pdf