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Report for the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive for:

STAGE 3 REVIEW REPORT
UKRAINE

CONTENT

INTRODUCTION

1. The mandate and overall objectives for the emission inventory review process under the LRTAP Convention is given by the UNECE document 'Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols'(1) – hereafter referred to as the 'Methods and Procedures' document.

2. This annual review, has concentrated on SO_2, NO_X, NMVOC, NH_3, plus PM_{10} & $PM_{2.5}$ for the time series years 1990 – 2016 reflecting current priorities from EMEP Steering Body and the Task Force on Emission Inventories and Projections (TFEIP). HMs and POPs have been reviewed to the extent possible.

3. This report covers the stage 3 centralised reviews of the UNECE LRTAP Convention and EU NEC Directive inventories of Ukraine coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place from 17thJune 2018 to 21thJune 2018in Copenhagen Denmark and was hosted by the European Environment Agency (EEA). The following team of nominated experts from the roster of experts performed the review: Generalist – Aleksandra N. Krsteska (Macedonia), Energy - Marion Pinterits (EU) and Eva Krtkova (Czech Republic), Transport – Helen Heintalu (Estonia), Industry and Solvents - Mirela Poljanac (Croatia), Agriculture & Nature- Jim Web (United Kingdom) and Hakam al Hanbali (Sweden), Waste - Richard Claxton (United Kingdom).

4. Kristina Saarinen (Finland) was the lead reviewer. The review was coordinated by Katarina Marečková, (EMEP Centre on Emission Inventories and Projections - CEIP).

[1]Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols. Note by the Task Force on Emission Inventories and Projections. ECE/EB.AIR/GE.1/2007/16 http://www.ceip.at/fileadmin/inhalte/emep/review/RevGuid_ece.eb.air.ge.1.2007.16.e.pdf

PART A: KEY REVIEW FINDINGS

5. The ERT notes that the inventory submitted by Ukraine is partly in line with the EMEP/EEA Emission Inventory Guidebook and the 2014 UNECE Reporting Guidelines. The submission with regards to the NFR reporting tables and the Informative Inventory Report) (IIR) shows that there is further need to improve the transparency, completeness and consistency of the reporting as explained in detail below.

6. The ERT also notes that Ukraine's participation in the 2018 Stage 3 Review was limited as the national team did not provide any responses to questions raised by the ERT. The ERT would have needed clarification concerning several issues to have been able to provide more detailed recommendations for future submissions. The ERT strongly recommends Ukraine to engage more by providing answers within the required deadlines in future reviews so that the ERT would be able to understand the details of the inventory and to provide recommendations which would help the Party to further develop the inventory.

7. The ERT assumes that the reason for no - communication with the ERT and the irregular submission of NFR tables and the IIR to EMEP may be due to insufficient development of national inventory system. To the question on the issue the ERT did not receive ny feedback.

INVENTORY SUBMISSION

8. The submission in 2018 included only 2016 emission data in the NFR tables. The submission date 23.4.2018 was after the deadline of 15th February. The ERT strongly recommends Ukraine to report the whole time series since the year 1990 (except for particles since 2000) consistently with Reporting guidelines 2014 and to provide future submissions on time, i.e. by 15th February NFR tables and by 15th March the IIR.

9. The ERT commends the Party for reporting emissions for the period 2014-2016 in the current NFR-2014-2 format. The ERT also notes that the reporting format for the previous years 2010-2013 was NFR 2009 and that data for the years 2006-2009 were reported in even older formats. The ERT strongly recommends the Party to report full time series in NFR 2014-02 format for all future submissions.

10. Ukraine did not submit an IIR in neither 2018 nor 2017. The last IIR submitted on 27.10.2016 was used during the review.

11. The Party has reported historical emissions for the period 1990-2013 for the basic pollutants in the IIR submitted in 2016, but only for the energy sector. Ukraine provided some information on activity data for the NFR category 2I (under the industry sector) and activity data for the NFR category forest fires. Ukraine did not provide national totals in the IIR.

12. Ukraine, being not a Party to the Gothenburg Protocol, does not report projected emissions and associated socio-economic data, for the "With Measures" or the "With Additional Measures" scenarios or gridded data. The ERT asked Ukraine for the plans to provide these data, but did not receive a response to the question. The ERT recommends Ukraine to provide projections and gridded data in future submissions.

KEY CATEGORIES

13. Ukraine has compiled and presented in its IIR a Key Category Analysis (KCA) for the energy sector for the following pollutants: NO_X, CO, NMVOC and SO_X. The ERT recommends Ukraine to perform a KCA for all sectors and to use the results to prioritize improvements in the inventory.

14. No comparison between the KCA prepared by CEIP and Ukraine could beconducted since Ukraine's KCA refers to year 2013 emissions and CEIP's to year 2016 emissions.

Transparency

15. The transparency of the emission inventory is limited, since Ukraine has not submitted an IIR in 2018. There is no description to enable the understanding of how the estimation of emissions has been performed for the years 2014-2016. The IIR submitted in 2016 contains an introduction chapter and chapters on energy, transport, industry and natural sources, while the IIR chapters for solvents, agriculture and waste sectors are missing, although these emissions are reported in the NFR tables. To the question raised during the review on whether the Party plans to include the missing sectors in the IIR, Ukraine did not respond. The ERT encourages Ukraine to include detailed documentation of the methods used to calculate emissions in the IIR of the next submission.

16. The ERT noted that in the IIR there is no information on the trend evolution of emissions by source category. The ERT encourages the Party to include information on the drivers behind the trends in the next IIR submission.

17. The ERT noted that there are text boxes in the IIR on the requested information to be included under the IIR chapters according to Annex II of the 2014 Reporting Guidelines. The ERT encourages the Party to replace the text boxes with the requested information in the next submission.

18. The ERT notes that the IIR from the 2016 submission is not in compliance with the annotated structure of an IIR in Annex II of the Revised 2014 Reporting Guidelines. The ERT encourages Ukraine to follow the structure of the IIR provided in Annex II of the 2014 Reporting Guidelines to enable easy navigation for reviewers and other users.

19. The ERT notes that only a limited set of activity data are presented for the energy and industry sectors in the IIR. During the review the ERT asked Ukraine to provide activity data for the energy sector and if not possible, to inform about its plan to include this data in the NFR tables in the next submission. However, Ukraine did not respond to the question.

20. Ukraine uses zero values for a number of areas in the reporting tables for the years 2014-2016. The ERT recommends Ukraine to use the appropriate notation keys if emission values are not available, e.g. "NO" where emissions are "Not Occurring", "NE" where emissions are "Not Estimates" and "IE" where emissions are "Included Elsewhere" for reporting where estimates are not available or necessary. The ERT asked the country to provide the ERT the NFR table for the year 2016 with zero values replaced with suitable notation keys ("NE", "NO", "NA" or "IE"), however, Ukraine did not respond to this request.

21. The ERT notes that the country did not provide information on the missing sources and did not include information on future improvement plans to estimate the missing sources. To the question on the issue the ERT did not receive respond. The ERT recommends Ukraine to provide more information in the next IIR on why some sources are missing and why some are included elsewhere and where they are allocated. The ERT recommends Ukraine to include a table that contains this information in the IIR of the next submission.

22. The ERT notes that information on planned improvements is provided only for the energy sector but not for the other sectors.

Completeness

23. In the period 2016-2018 Ukraine reported emissions only on yearly basis according to the n-2 rule (2014-2016 were reported accordingly) using the latest NFR14 format. Emissions for the years 2008-2015 were reported in the older NFR format. The ERT notes that Ukraine has not reported the whole time series from the year 1990. The ERT recommends Ukraine to report the full time series since the year 1990 for all pollutants except since the year 2000 for particles in each annual submission in the latest NFR format.

24. The ERT reiterates the recommendation from the 2015 Review and recommends that Ukraine estimates and reports the missing emissions, or uses the appropriate notation keys as outlined in the Reporting Guidelines, i.e. “IE” for emissions included elsewhere, and “NE” for emissions not estimated, and encourages Ukraine to explain the use of the notation keys and to provide a plan with a schedule in the IIR to estimate the emissions, to the next submission.

25. The ERT notes that emissions for a number of cells in the NFR tables were reported as zeros, that incorrect notation keys were used or the emissions were over- or underestimated or remained the same in most of the sectors for the last three years. The ERT recommends Ukraine to check the use of notation keys and to replace the zero values with estimating emissions according to the latest version of the Guidebook and the Reporting Guidance, where possible.

26. The ERT notes that BC, PCB and PCDD/ PCDF emissions were not estimated for any categories and years. The ERT encourages Ukraine to include these pollutants in the next submissions. The ERT asked the country for a plan to include those pollutants but did not receive a response.

Consistency, including recalculations and time-series

27. ERT noted that no recalculations have been reported in the IIR. According to information provided in the energy chapter of the IIR, the last recalculations were performed in 2009. Within the last submitted IIR in 2016, the ERT found the information regarding recalculations to be unclear under the following subchapters 1A1, 1A2, 1A3 and 1A4, i.e. the ERT could not understand if recalculations were performed or not. Additionally, no quantitative recalculations were provided. The ERT encourages Ukraine to provide detailed and complete information in the next IIR for each source, pollutant and year for which recalculations have been performed.

28. The results of the Stage 2 review show that the emission time series remains inconsistent for the period 2002-2016, indicating that the Party did not succeed to improve the consistency and completeness of its inventory after the last Stage 3 review in 2015. The ERT asked the country to provide information on whether some changes in the methodology used for the estimation of emissions in the period 2014-2016 have occurred. To the question on the issue no response was received The ERT strongly recommends Ukraine to improve the consistency of the time series of its inventory.

Comparability

29. The ERT notes that as Ukraine uses methods from older versions of the Guidebook and provides limited information on IEFs the inventory is not comparable with those of other reporting Parties. The ERT therefore recommends that Ukraine always updates the default EFs according to the latest Guidebook version, or, if other methods are used, documents those in the IIR, to increase the comparability of the inventory with other Parties. The ERT notes that according to the Reporting Guidelines, the latest version of the Guidebook, currently 2016, shall be used for the preparation of the inventory. However, the ERT notes that (1) the translation of Guidebook 2016 into Russian will only be finalized in summer 2018, and that (2) the methods provided in the Guidebook may not as such be directly applicable to Ukraine. The ERT recommends Ukraine to include a comparison between national implied emission factors and those presented in the Guidebook, in order to provide a better understanding of the comparability of the different methodologies. Such a comparison should be included in the IIR.

30. The ERT commends Ukraine for using the NFR-2014-2 emission reporting format as it was recommended in the previous 2015 review report. The allocation of source categories does not always follow the one proposed in the the Guidebook. The ERT notes that the allocation is not consistent with the EMEP/EEA Guidebook. For detailed recommendations, please see the relevant sectors below.

31. The ERT notes that all emissions from fuels should be reported under the energy sector (1B fugitive emissions from fuels) and not under the industry sector.

CLRTAP/NECD comparability

32. Ukraine is not an EU country and as such does not report emissions under the EU National Emission Ceilings (NEC) Directive.

Accuracy and uncertainties

33. The ERT noted that the Party applies Tier 1 methods and default parameters for most of the key categories. The ERT therefore recommends that Ukraine moves to Tier 2 or higher methods for key categories.

34. The ERT commends Ukraine for performing an uncertainty analysis for the basic pollutants for the energy sector and for mobile sources on an aggregated level. The ERT recommends Ukraine to calculate sub sectorial quantitative uncertainty estimates of the emission values for all mobile sources, especially for key sources, for the next submissions, and to provide an uncertainty analysis for the other sectors and especially for key sources, in the next submission.

35. The ERT notes that the emissions for several sectors remained unchanged between 2015 and 2016, and recommends Ukraine to estimate all emissions on annual basis. In cases where this would not be possible, the ERT encourages the Party to provide explanations for this in the IIR.

Verification and quality assurance/quality control approaches

36. The ERT notes that Ukraine has provided limited information on its general quality assurance/quality control (QA/QC) activities. Ukraine has also provided sector specific information on QA/QC procedures used in energy sector. The ERT notes that Ukraine did not provide information on the existence of a QA/QC plan for the inventory. The ERT recommends Ukraine to prepare such a plan in accordance with the Guidebook and to report upon it and the results of the annual checks in the next submissions.

FOLLOW-UP TO PREVIOUS REVIEWS

37. The ERT commends Ukraine for providing the inventory for the last three years in the proper NFR format and for thus improving the comparability with other reporting Parties.

38. The ERT commends Ukraine for improving the inventory according to recommendations from the 2015 Review by reporting emissions for 2016 for several pollutants under NFRs 1A2c, 1A2e, and 2D3d (previous NFR category 3A3) for NMVOC and for reporting proper notation keys in NFRs 1A4aii, as well as for including information on planned improvements for some sub-categories within the energy and transport sectors.

39. Following the 2015 review recommendations, the ERT recognizes the effort made by Ukraine for providing information on activity data, emission factors, trends description as well as including specific plan improvements in the energy chapter and encourages the country to provide detail information also for the other sectors in future submissions.

40. Also following the 2015 review recommendations, the ERT acknowledges the preparation of the KCA for the energy and transport sectors and the uncertainty analysis for the basic pollutants but also encourages Ukraine to include all pollutants in these analysis in future submissions.

AREAS FOR IMPROVEMENTS IDENTIFIED BY UKRAINE

41. The IIR identifies areas for improvement only in the energy sector. As it is stated in the last reported IIR (2016), Ukraine indicates that it is working to improve its estimates on the following issues:

(a) analysis of initial data, calculation methods and pollutant emissions of all categories included in the sector for fugitive emissions;

(b) calculation of emissions for the entire period from 1990 to 2013 in the category 1B;

(c) use of higher tier methodology for calculation of NO_X emissions and SO_2 emissions in 1A1a and 1A2 NFR categories;

(d) disaggregation of 1A1a emissions by major fuel types;

(e) fuel distribution, based on the combustion technology, power boiler plants, the sulphur content in the fuel, etc.. That will enable the use of more precise methods of calculation. For example, Tier 1 method for 1A1a sector provides specific emissions for boilers rated at more than 50 MW, and for boilers with lower power use the specific emissions of the small combustion category;

(f) calculation of emissions for all pollutants such as large combustion plants using Tier 3 methodology;

(g) use of enterprise data for use of Tier 3 methodology and optional calculation of emissions on substances that are not covered by the inventory;

(h) calculation of the emissions of pollutants from road transport with the use of Tier 2/3 methodologies for the following subcategories: 1A3bi-1A3vii.

TECHNICAL CORRECTIONS CONSIDERED AND OR CALCULATED BY ERT

42. The ERT noted a need to calculate technical corrections for the transport, industry, solvent and other product use, agriculture and waste sectors as presented in the table below using the 2016 EMEP/EEA Emission Inventory Guidebook methods.

43. Due to activity data not being available, the ERT could not perform technical corrections for the energy sector. The ERT strongly recommends Ukraine to provide activity data in the NFR tables and encourages the Party to provide an IIR annually that documents the activity data and methods used in the preparation of the submitted inventory.

44. For the several significant inconsistencies identified by the ERT in the transport, industry, solvent and other product use, agriculture and waste sector inventories the ERT proposed the Party potential technical corrections for NFR categories:

Energy

(i) 1A3bi for NO_X, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO for the years 2005, 2010 and 2016

(j) 1A3bii for NO_X, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO for the years 2005, 2010 and 2016

(k) 1A3biii for NO_X, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO for the years 2005, 2010 and 2016

(l) 1A3biv for NO_X, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO for the years 2005, 2010 and 2016

(m) 1A3bv for NMVOC for the years 2005, 2010 and 2016

(n) 1A3bvi for $PM_{2.5}$, PM_{10} and TSP for the years 2005, 2010 and 2016

(o) 1A3bvii for $PM_{2.5}$, PM_{10} and TSP for the years 2005, 2010 and 2016

IPPU

(p) 2A2 Lime production for TSP, $PM_{2.5}$, PM_{10} and BC emissions for the years 2005 and 2016

(q) 2A3 Glass production for Cd and Se for the years 2005 and 2016;

(r) 2C1 Iron and steel production for Pb, Cr, Ni, Se, Zn, PCBs, PCDD/F, PAH-5 and HCB for the years 2005 and 2016;
(s) 2D3a Domestic solvent use including fungicides for NMVOC and Hg for the years 2005 and 2016;
(t) 2K Consumption for POPs for Hg and PCBs for the years 2005 and 2016;
(u) 2D3a Domestic solvent use including fungicides for NMVOC and Hg;
(v) Agriculture
(w) 3B Sub-categories of Dairy cattle, Non-dairy cattle, Sheep, Swine, Goats, Horses and Laying hens for NH_3 for the years 2005, 2010 and 2016;
(x) 3D1a Synthetic N-fertilizers for NH_3 for the years 2005, 2010 and 2016
(y) 3B4gi Laying hens for $PM_{2.5}$ and PM_{10} for the years 2005, 2010 and 2016.

Waste

(z) 5C1a Municipal waste incineration for PCDD/F, PAH-4 and HCB for the years 2010 and 2016.
(aa) 5C1bi Industrial waste incineration for PCDD/F, PAH-4 and HCB for the years 2010 and 2016.
(bb) 5Cbiii Clinical waste incineration for PCDD/F, PAH-4, HCB and PCBs for the years 2010 and 2016.

45. For details of the technical corrections please see the sector specific chapters below and the file “TC-Ukraine NFRs 1A3_2_3_5 S3 Review 2018.xlsx”. A summary of the impacts of the technical corrections is provided in the table below.

46. Note that the technical corrections for subcategories under 1A3b are summed up in the table below and that for pollutants for which the sum of technical corrections is <5% of national total, the correction at subcategory level may still be >5%. Also, while the technical correction at an individual subcategory level does not exceed 5%, the sum of the technical corrections still is above 5%. Therefore these are kept in both the summary table and in the detailed tables under the sector chapters below. For SO_X, both the subcategory level corrections and their sums were below 5% and are therefore not provided in the table but presented in the file “TC-Ukraine NFRs 1A3_2_3_5 S3 Review 2018.xlsx” as guidance for the Party.

NFR category (s)	Pollutant	Years	Calculated by country/ ERT/ Not calculated	Potential contribution to national total (%) *Not estimated by the Party
1A3bi-vii	NOx	2016, 2010,	ERT	-3.0%(2016), 14.1% (2010),
1A3bi-vii	NMVOC	2016,	ERT	-2.8%(2016), 12.1% (2010),
1A3bi-vii	NH_3	2016,	ERT	15.2%(2016), 19.4% (2010), 1.4%(2005)
1A3bi-vii	$PM_{2.5}$	2016,	ERT	14.4%(2016), 15.4% (2010), 3.9%(2005)
1A3bi-vii	PM_{10}	2016,	ERT	5.7%(2016), 6.0% (2010), 4.7%(2005)
1A3bi-vii	TSP	2016,	ERT	2.0%(2016), 1.6% (2010), 0.9%(2005)
1A3bi-vii	CO	2016,	ERT	-28.4%(2016), 4.6% (2010),
2A2	TSP	2016, 2005	ERT	6.5%(2016), 5.3%(2005)
2A2	$PM_{2.5}$	2016, 2005	ERT	5.2%(2016), NA*%(2005)
2A2	PM_{10}	2016, 2005	ERT	8.1%(2016), NA*%(2005)
2A2	BC	2016, 2005	ERT	NA*%(2016), NA*%(2005)
2A3	Cd	2016, 2005	ERT	7.1%(2016), 1.9%(2005)
2A3	Se	2016, 2005	ERT	31.5%(2016),0.1%(2005)
2C1	Pb	2016, 2005	ERT	88.4%(2016), 58.4%(2005)
2C1	Cr	2016, 2005	ERT	118.4%(2016), 25.2%(2005)
2C1	Ni	2016, 2005	ERT	-7.0%(2016), 47.1%(2005)
2C1	Se	2016, 2005	ERT	16.3%(2016), 0.1%(2005)
2C1	Zn	2016, 2005	ERT	-5..4%(2016), NA*%(2005)
2C1	PCBs	2016, 2005	ERT	NA*%(2016), NA*%(2005)
2C1	PAH-4	2016, 2005	ERT	5.4%(2016), NA*%(2005)
2C1	HCB	2016, 2005	ERT	0.1%(2016), NA*%(2005)
2D3a	NMVOC	2016, 2005	ERT	24.2%(2016), 17.5%(2005)
2D3a	Hg	2016, 2005	ERT	5.0%(2016), 4.4%(2005)
2K	Hg	2016, 2005	ERT	8.9%(2016), 7.9%(2005)
2K	PCBs	2016, 2005	ERT	NA*%(2016), NA*%(2005)
3B	NH_3	2005,	ERT	769.8%(2016), 587% (2010),
3B4gi	PM_{10}	2005,	ERT	5.9%(2016), 6.1% (2010), 4.9%(2005)
3B4gi	$PM_{2.5}$	2005,	ERT	1.4%(2016), 1.5% (2010), 0.4%(2005)
3D1a	NH_3	2016, 2005	ERT	274.9%(2016), 154%(2010),
5C1a	PCDD/F	2016, 2010	ERT	NA*%(2016), NA* %(2010)
5C1a	PAH-4	2016, 2010	ERT	NA*%(2016), 0 %(2010)
5C1a	HCB	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1a	PCBs	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bi	PCDD/F	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bi	PAH-4	2016, 2010	ERT	NA*%(2016), 0.0%(2010)
5C1bi	HCB	2016, 2010	ERT	NA*%(2016), 0.0%(2010)
5C1bi	PCBs	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	PCDD/F	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	PAH-4	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	HCB	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	PCBs	2016, 2010	ERT	NA*%(2016), NA*%(2010)

PART B: RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

CROSS CUTTING IMPROVEMENTS IDENTIFIED BY THE ERT

47. The ERT identified the following cross-cutting issues for improvement and recommends Ukraine:

b) to ensure resources for the inventory work in order to improve the quality of the inventory and to enable sustainability for the process;

c) to implement recommendations from the 2015 review report that have not been implemented in the period 2016-2018 and to provide an overview of the progress made as a result of this and any previous ERT recommendations;

d) to provide the whole emissions time series since the year 1990 (for particles since the year 2000) in the proper NFR-2014-2 format including all pollutants;

e) to include explanations of the use of notation keys, and in particular for the notation key "IE" to include clarifications where the emissions are allocated;

f) to perform recalculations for the whole time series so that the emission data would be consistent between the years, and to describe the reasons for these recalculations in the IIR;

g) to implement higher tier methodology in the transport sector, and in the energy sector as mentioned in the improvement plan of the IIR 2016;

h) to provide more detailed information on the methodologies used to calculate emissions, to include activity data in the NFR table including information on the units;

i) to provide explanations for the fluctuations, peaks and dips in the emission trends in order to enhance transparency of the inventory;

j) to perform and present an uncertainty analysis and a key category analysis using higher tier methodology for all pollutants and to use them as a tool to focus planned improvements on key categories;

k) to always update the default EFs according to the latest Guidebook version;

l) to check the emissions calculations for the pollutants in the following categories due ***to possible under/overestimations*** as recommended by the ERT and described in details in the sector chapters:

(i) 1.A.1.a – Public electricity and heat production – (TSP) – 2006;

(ii) 1.A.1.c – Manufacture of solid fuels and other energy industries – (TSP) – 2006;

(iii) 1.A.2.d – Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print – (PM_{10}, TSP) – 2016;

(iv) 1A2gvii – Mobile Combustion in manufacturing industries and construction – (all pollutants) – 2014 - 2016;

(v) 1.A.3.b – Road transport and 1.A.3.c Railways – (SO_X)

(vi) 1.A.4.a.i – Commercial/institutional: Stationary – (TSP) – 2006;

(vii) 1.A.4.b.i – Residential: Stationary – (TSP) – 2006;

(viii) 1.B – Fugitive emissions – (PM_{10}, TSP) – 2016;

(ix) 1.B.2.a.iv– Fugitive emissions oil: refining/storage – (NMVOC, SO_X) – 2009-2010;

(x) 2.D.3.a – Domestic solvent use including fungicides (NMVOC) – 2012-2016;

(xi) 3.B.1.a – Manure Management - Dairy cows – (Pb and Hg) – 2015;

(xii) 3.B.4.gi – Manure Management - Laying hens – (NH_3 and PMs) – 2015;

(xiii) 3.B.3 – Manure Management – Swine (NH_3) – 2015;

(xiv) 3.D.a1 - Inorganic N-fertilizers – (NH_3) – 2015;

(xv) 3.D.c - Farm-level agricultural operations including storage, handling and transport of agricultural products – (PM_{10}) – 2015;

(xvi) 3.F - Field burning of agricultural waste – (NO_X and CO) – 2015.

(b) ***to replace the zero values*** in the inventory with actual emission values due to the available methodology in the Guidebook or use the appropriate notation keys for the following NFR categories:

(i) 1.A.1.a – Public electricity and heat production – (DIOX, HCB, PAH) – 2006-2016;

(ii) 1.A.1.b – Petroleum refining – ($PM_{2.5}$) – all years;

(iii) 1.A.2.gvii – Mobile Combustion in manufacturing industries and construction – (all pollutants) – 2014 - 2016;

(iv) 1.A.3 –Transport (PM, NH_3, POPs, HM) – 2014-2016;

(v) 1.A.3.ai.(i-ii) – Aviation – (all pollutants) – 2014 - 2016;

(vi) 1.A.3.bii-vii–,Road transport – (all pollutants) – 2014 - 2016;

(vii) 1.A.4.cii –iii –Agriculture/Forestry/Fishing: Off-road vehicles and other machinery and National fishing – (all pollutants) – 2014 - 2016;

(viii) 1A3di(ii) – International inland waterways – (all pollutants) – 2014 - 2016;

(ix) 1.B.1.b – Fugitive emission from solid fuels: Solid fuel transformation – ($PM_{2.5}$) – all years;

(x) All relevant energy NFR categories – ($PM_{2.5}$ and PM_{10}) – 2006 – 2009;

(xi) 1.B.2.d – Other fugitive emissions from energy production – (all pollutants) – all years;

(xii) 2.A.5.b – Construction and demolition – ($PM_{2.5}$, PM_{10}, TSP) – 2014 - 2016;

(xiii) 2.B.7 – Soda ash production – (TSP) – 2014 - 2016;

(xiv) 2.D.3.a – Domestic solvent use including fungicides – (Hg) –2014 - 2016;

(xv) 2.D.3.d – Coating applications – (NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) – 2014 - 2016;

(xvi) 2.D.3.e – Degreasing – (NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) – 2014 - 2016;

(xvii) 2.D.3.f – Dry cleaning – (NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) 2014 - 2016;

(xviii) 2.D.3.g – Chemical products– (NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) – 2014 - 2016;

(xix) 2.D.3.h – Printing – (NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) – 2014 - 2016;

(xx) 3.Da.2a – Animal manure applied to soils – (all pollutants) – 2014 - 2016;

(xxi) 3.D.a.3 – Urine and dung deposited by grazing animals – (all pollutants) – 2014 - 2016;

(xxii) 3.D.c – Farm-level agricultural operations including storage, handling and transport of agricultural products – (all pollutants) – 2014 - 2016;

(xxiii) 3.D.f – Use of pesticides – (all pollutants) – 2014 – 2016;

(xxiv) 3.F – Field burning of agriculture residues – (all pollutants) – 2014 - 2016;

(xxv) 5C – POP emissions since 2005.

SECTOR SPECIFIC RECOMMENDATIONS FOR IMPROVEMENTS IDENTIFIED BY ERT

ENERGY

Review Scope

Pollutants Reviewed		SO_2, NO_X, NMVOC, NH_3, PM_{10} & $PM_{2.5,}$ Cd, Hg, Pb, Dioxin, PAH		
Years		1990 – 2016		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
1A1a	Public electricity and heat production	X		X
1A1b	Petroleum refining	X		X
1A1c	Manufacture of solid fuels and other energy industries	X		X
1A2a	Iron and steel	X		
1A2b	Non-ferrous metals	X		X
1A2c	Chemicals	X		
1A2d	Pulp, Paper and Print	X		
1A2e	Food processing, beverages and tobacco	X		
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	X		
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	X		X
1A3ei	Pipeline transport	X		
1A3eii	Other	X		
1A4ai	Commercial/institutional: Stationary	X		X
1A4bi	Residential: Stationary	X		X
1A4ci	Agriculture/Forestry/Fishing: Stationary	X		
1A5a	Other stationary (including military)	X		
1B1a	Fugitive emission from solid fuels: Coal mining and handling	X		
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	X		X
1B1c	Other fugitive emissions from solid fuels	X		
1B2ai	Fugitive emissions oil: Exploration, production, transport	X		X
1B2aiv	Fugitive emissions oil: Refining / storage	X		X
1B2av	Distribution of oil products	X		
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	X		X
1B2c	Venting and flaring (oil, gas, combined oil and gas)	X		X
1B2d	Other fugitive emissions from energy production	X		X
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which have and which have not in the respective columns.				

General recommendations on cross cutting issues

Transparency

48. Ukraine uses zero values or does not report any values in a number of areas in the NFR tables (see paragraph 65). The ERT recommends Ukraine to use the appropriate notation keys (e.g.”NO” where emissions are “Not Occurring”, “NE” where emissions are “Not Estimated” and “IE” where emissions are “Included Elsewhere”) for reporting where estimates are not available or necessary.

49. The Party did not provide activity data in the NFR table and only limited information on activity data for selected categories in the IIR 2016 up to the year 2013, but did not provide information on units in all cases (e.g. 1A4bi, Table 3.27, Table 3.29, page 76 of the IIR 2016). The ERT recommends Ukraine to provide a full time series of activity data in the NFR tables and to include information on the units in the IIR in order to enhance the completeness and transparency of the inventory.

50. The IIR contains only a brief description on trends, methodology, recalculations, uncertainty analysis and the description on source categories. The ERT encourages Ukraine to elaborate the description on trends, dips and jumps in the time series, recalculations, methodology and uncertainty analysis for all relevant categories to enhance the transparency.

Completeness

51. In several cases the notation keys “NE”, “NO” or “NA” are applied where relevant emissions can be expected (see paragraphs 61, 65, 66). The ERT recommends Ukraine to calculate and report the emissions. In cases the emissions are not reported, the ERT encourages Ukraine to provide the justification in the IIR.

52. Emissions from the energy sector are reported mostly from the year 2002 onwards and also show gaps (see paragraph 65). The ERT recommends Ukraine tocomplete the missing values and to provide a full time series since 1990 for all relevant years and pollutants, for particles since 2000.

Consistency including recalculation and time series

53. The ERT noted that no recalculations were performed since 2009. The ERT recommends Ukraine to perform recalculations for the whole time series, and to describe the reasons for these recalculations in the IIR.

54. The ERT identified outliers in the time series for e.g. emissions from the categories 1A2agviii and 1B2aiv (see paragraph 67, 69). The ERT encourages Ukraine to provide a consistent time series for the calculated emissions.

Comparability

55. Ukraine applies a Tier 1 method for the calculation of all identified key categories. The ERT recommends Ukraine to apply higher tier methods for key categories as requested in the Reporting Guidelines.

Accuracy and uncertainties

56. The ERT commends the Party for undertaking an uncertainty analysis for the energy sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data. The ERT recommends Ukraine to use the outcome of the uncertainty analysis to inform the improvement process and to provide an indication of the reliability of the inventory data.

Improvement

57. The ERT commends Ukraine for providing information on planned improvements for each category. The ERT encourages Ukraine to include new information on trends, methodology and uncertainty and to implement the planned improvements.

Potential Technical Corrections

58. None could be calculated due to lack of activity data.

Sub-Sector Specific Recommendations

Category issue 1: 1.B.2.d – Other fugitive emissions from energy production - All Pollutants

59. The ERT noted that Ukraine reports emissions from category 1B2d – other fugitive emissions from energy production – as “not applicable” (notation key “NA”). This issue was already raised in previous review reports. The ERT reiterates the previous recommendation for Ukraine to use the correct notation key “NO” for sources that are “not occurring” or “NE” for pollutants that are “not estimated”.

Category issue 2: 1.A.1.a, 1.A.1.c, 1.A.2.gviii, 1.A.4.a.i, 1.A.4.b.i - All Pollutants

60. The ERT identified that reported TSP emissions in categories 1A1a, 1A1c, 1A2gviii, 1A4ai, 1A4bi are thousand times higher in the year 2006 than in other reporting years of the time series, and that no information about this peak is provided in the IIR. This issue was already raised in previous review reports. The ERT reiterates the previous recommendation to verify the unit used for the emission and to correct the emissions, and also to perform QA/QC-checks of emissions for the next submission.

Category issue 3: 1.A.1.b, 1.B.1.b – $PM_{2.5}$

61. During the review the ERT highlighted that $PM_{2.5}$ emissions for categories 1A1b and 1B1b are reported as “not applicable” (notation key “NA”) although default emission factors are available in the EMEP/EEA Guidebook 2016 and emissions for other pollutants are estimated in these categories. The ERT encourages Ukraine to calculate $PM_{2.5}$ emissions for these categories to ensure completeness, to the next submission.

Category issue 4: 1.A.2.d, 1.B – PM_{10}, TSP

62. The ERT identified, that in the submission in 2016 PM_{10} emissions in categories 1B2ai, 1B2b and 1B2c are lower than $PM_{2.5}$ emissions. Ukraine does not state in its IIR 2016 what methodology is applied to calculate emissions from these sources. According to

the Tier 1 and Tier 2 methodologies of the 2016 EMEP/EEA Guidebook only NMVOC emissions occur from categories 1B2ai and 1B2b, while PM_{10} and $PM_{2.5}$ emissions are not applicable ("NA"). The default emission factors of the Guidebook to estimate PM_{10} and $PM_{2.5}$ emissions from venting and flaring (1B2c) are identical. The ERT encourages Ukraine to provide information on the methodology in its IIR and to provide corrected emission data for these categories in its next submission and to perform QA/QC-checks of emissions before the submission.

63. The ERT noted that TSP emissions from category 1A2d in 2016 are lower than PM_{10} emissions. Ukraine reports in its IIR 2016 that it applies a Tier 1 methodology to calculate emissions from this source. Default Tier 1 emission factors for TSP and PM10 are in the 2016 EMEP/EEA Guidebook, depending on the fuel used, either equal or the default emission factor for TSP is higher than for PM_{10}. The ERT recommends Ukraine to provide corrected emission data for these categories in its next submission and to perform QA/QC-checks of emissions before submission.

Category issue 5: all categories – all pollutants

64. Ukraine is reporting identical emission values in different categories for various pollutants (e.g. $PM_{2.5}$ emissions in category 1A2b for the years 2010-2013 and 2014-2015, CO emissions in category 1A4bi for 2010-2012, NO_X emissions in 1A1a for 2010-2012, NMVOC emissions in category 1B2aiv for 2014-2016), although the activity data are not identical and calculations are performed applying a Tier 1 methodology, as stated in the IIR 2016. The ERT recommends Ukraine to provide corrected data in cases where identical values are reported and to perform recalculations for all relevant pollutants, categories and years in its next submission.

Category issue 6: 1.A.1.a Public electricity and heat production – PCDD/F, HCB, PAH

65. Ukraine reports empty cells in category 1A1a for PCDD/F, HCB and PAH for the years 2006-2005 and 2008-2009, notation keys for 2006-2007, 2010-2013 and zero values for the years 2014-2016. According to the IIR 2016 the country applies a Tier 1 methodology to estimate emissions from this source but does not state which emission factors are applied to calculate emissions. The ERT encourages Ukraine to provide emission estimates for all years or to use correct notation keys instead of empty cells and zero values to ensure completeness and consistency of the inventory.

Category issue 7: all categories – $PM_{2.5}$, PM_{10}

66. The ERT noted that Ukraine reports emissions for $PM_{2.5}$ and PM_{10} in all relevant energy categories for 2006, for 2007 the notation key "NA", and for the years 2008 and 2009 the notation key "NO", although emissions from other pollutants in these categories are reported and Ukraine states in its IIR 2016, that emissions are calculated applying a Tier 1 methodology with default emission factors from the EMEP/EEA Guidebook. The ERT encourages Ukraine to calculate PM_{10} and $PM_{2.5}$ emissions for these years and to report these emissions in its next submission.

Category issue 8: 1.A.2.g.viii, 1.A.4.bi– all pollutants

67. Ukraine reports a sharp decrease ranging from -78% to -98% for all reported emissions for pollutants from category 1A2gviii between 2007 and 2008. The activity data only shows a decrease between -9% and -69% for the same period of time. In its IIR 2016 Ukraine states that emissions from this source are calculated applying a Tier 1 methodology with default emission factors from the EMEP/EEA Guidebook. The ERT recommends Ukraine to recalculate emissions from this source applying the methodology consistently for the whole time series in its next submission.

68. Ukraine reports a sharp decrease in 2010 up to -99% and in 2014 an increase up to +57 200% for all relevant pollutants. The activity data shows changes between -5% and +75% for the year 2010, activity data for 2014 is not available. In its IIR 2016 Ukraine states that emissions from this source are calculated applying a Tier 1 methodology with default emission factors from the EMEP/EEA Guidebook. The ERT recommends Ukraine to recalculate emissions from this source applying the methodology consistently for the whole time series in its next submission.

Category issue 9: 1.B.2.a.iv Fugitive emissions oil: refining/storage – NMVOC, SOx

69. During the review the ERT highlighted a significant jump in NMVOC and SO_Xx emissions in category 1B2aiv between 2009 and 2010 (+1 323% for NMVOC emissions, +660% for SO_X emissions). Ukraine did not provide information about this peak in its IIR 2016, and does not report activity data for this category. The ERT recommends Ukraine to report explanations for significant peaks in its IIR and to include activity data in the NFR table to ensure transparency of the inventory.

TRANSPORT

Review Scope

Pollutants Reviewed		All		
Years		1990 – 2016		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
1A2gvii	Mobile Combustion in manufacturing industries and construction		X	X
1A3ai(i)	International aviation LTO (civil)		X	X
1A3ai(ii)	International aviation cruise (civil)		X	X
1A3aii(i)	Domestic aviation LTO (civil)	X		X
1A3aii(ii)	Domestic aviation cruise (civil)	X		X
1A3bi	Road transport: Passenger cars	X		X
1A3bii	Road transport: Light duty vehicles		X	X
1A3biii	Road transport: Heavy duty vehicles and buses		X	X
1A3biv	Road transport: Mopeds & motorcycles		X	X
1A3bv	Road transport: Gasoline evaporation		X	X
1A3bvi	Road transport: Automobile tyre and brake wear		X	X
1A3bvii	Road transport: Automobile road abrasion		X	X
1A3c	Railways	X		X
1A3di(ii)	International inland waterways		X	
1A3dii	National navigation (shipping)	X		X
1A4aii	Commercial/institutional: Mobile		X	X
1A4bii	Residential: Household and gardening (mobile)		X	X
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery		X	X
1A4ciii	Agriculture/Forestry/Fishing: National fishing		X	X
1A5b	Other, Mobile (including military, land based and recreational boats)	X		X
1A3di(i)	International maritime navigation		X	X
1A3	Transport (fuel used)		X	X
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which have and which have not in the respective columns.				

General recommendations on cross cutting issues

Transparency

70. The transparency of emission inventory is limited, since Ukraine has not submitted an IIR in 2018. There is no detailed data to enable the understanding of how the estimation of emissions has been performed for the years 2014-2016. The ERT recommends that the Party submits an IIR every year, where all the methods and emission factors used are described in such a way that enables the reviewers to assess the underlying assumptions and rationale for the choices of data, methods and other inventory parameters.

71. The latest IIR was submitted in 2016, and covers emission estimates for the period 1990-2013. The ERT notes that pollutant emissions reported in the NFR tables do not correspond to the values provided in the IIR for this time-period and are highly variable. The ERT encourages the Party to update the emission data in the IIR when recalculations have been made so that the emission data would be comparable between the IIR and NFR tables.

72. Ukraine uses zero values in a number of areas in the reporting tables for the years 2014-2016 and the notation key “NA” for a large number of cells for the earlier years. The ERT encourages Ukraine to limit the use of zero values and to use the appropriate notation keys in the NFR tables (for example, “NO” where emissions are “Not Occurring”, “NE” where emissions are “Not Estimated”, “IE” where emissions are “Included Elsewhere” and “NA” where emissions of that specific pollutant do not occur for that source) to indicate where estimates are not available or necessary. In addition, actual data should be used instead of zero values even in the sectors where emissions are negligible.

73. The notation key “IE” has been used for some transport sub-sectors (1A2gvii, 1A4aii, 1A4bii) for the years 2014-2016, although there is no clarification where all the emissions are allocated. The latest IIR (submitted in 2016) indicates that emissions from other mobile sectors are included under the 1A3eii sector. However, data provided in the NFR table does not verify that: emissions for the pollutants in NFR 1A3eii were reported as “NA” instead.

74. The ERT recommends Ukraine to improve the transparency of the inventory in the transport sector by providing an updated IIR including information on the methodologies, activity data and emission factors applied, as well as explanatory information on all the notation keys used, as well as on recalculations and planned improvements, for the next submission. The ERT encourages the Party to submit reporting templates with emission data for the complete time series and on other mobile sources besides road transport in line with the source disaggregation defined in the reporting requirements.

Completeness

75. The ERT considers the ransport sector to be incomplete as estimates are missing for a large number of sources and pollutants. Ukraine does not report emissions from 1A2gvii, 1A3ai(i), 1A3bii, 1A3biii, 1A3biv, 1A3bv, 1A3bvi, 1A3bvii, 1A4cii, 1A4ciii, 1A3ai(ii) and 1A3di(i) for the years 2014-2016. However, there are more sectors covered in the NFR tables provided for previous years. The ERT recommends Ukraine to make efforts to provide these emission estimates for the missing categories, for which methodologies and emission factors are available in the EMEP/EEA Guidebook.

76. Ukraine does not report emissions of NH_3, particulate matter, heavy metals and POPs. Only NO_X, NMVOC, SO_X and CO emissions are reported for the years 2014-2016. The ERT encourages Ukraine to provide a description of plans for estimating emissions for these pollutants in the IIR and recommends the Party to report these emissions in the next submission.

77. The ERT noted that there were no activity data reported for the years 2014-2016 in the NFR tables, instead blank cells were used. The ERT recommends Ukraine to include this data in the NFR tables and to update the data reported for the previous years in the next submission.

Consistency including recalculation and time series

78. The ERT notes that pollutant emissions reported in the NFR tables do not correspond to the values provided in the IIR (submitted in 2016) for this time-period. Presumably, emissions have been recalculated, but there is no explanation or comparisons provided in the IIR. The ERT encourages Ukraine to provide detailed and complete information on recalculations in the next IIR submission for each source, pollutant and year for which recalculations have been performed and to provide updated emission data in the NFR tables for the same period.

79. Time series provided in the NFR tables are fluctuating. However, the time series provided in the 2016 IIR is rather consistent with some dips and jumps. The ERT recommends Ukraine to report a complete updated time series in the NFR tables and encourages Ukraine to provide detailed explanations on all the fluctuations in trends in the IIR.

Comparability

80. Ukraine has not provided any information on the methodology, activity data and emission factors used to estimate emissions for the years 2014-2016. Therefore, the comparison with other countries on implied emissions factors is impossible.

Accuracy and uncertainties

81. During the review, the ERT noted that there are unchanged emission values in the NFR tables for several sub sectors for the years 2014-2016 (for example: NMVOC and CO emission values are the same for 1A3c (2014-2016); NMVOC, SO_2 and CO emissions for 1A3dii (2014-2016); SO_2 emissions (2014-2016) and NMVOC emissions (2015-2016) for 1A3b etc.). Ukraine did not provide any explanation to a question raised by the ERT during the review. Therefore, the ERT recommends the Party to recalculate the emissions and update emission data in the inventory if necessary.

82. Ukraine has provided uncertainty estimates for mobile sources on an aggregated level. The ERT recommends Ukraine to calculate sub sectoral quantitative uncertainty estimates of the emission values for all mobile sources, especially for key sources, in the next submission.

83. Ukraine has performed an uncertainty analysis, which includes estimating the overall uncertainty of the level of the emissions and uncertainty of the emission trends for NO_X, NMVOC, SO_2 and CO. Only the results of the uncertainty analysis are provided in the IIR. There is no information provided on the supporting documentation, including default uncertainties used for activity data and emission factors. The ERT encourages Ukraine to include all the relevant data in the IIR in order to support the improvement process and to provide an indication of the reliability of the inventory data.

84. Ukraine provided only a short general statement about the QA/QC system in the IIR 2016. However, no sector specific QA/QC procedures have been described. The ERT recommends the Party to implement mobile sector specific QA/QC procedures and encourages the Party to describe these in the IIR, to the next submission.

Improvement

85. The ERT welcomes Ukraine's intention to improve its emission calculation for transport sector, which was mentioned in the IIR 2016 Improvement plans include: review of the possibility of using COPERT software for the calculation of emissions from the road transport sector and to analyse statistical fuel data with the aim of separate calculations for all off-road categories.

Potential technical corrections

86. During the Stage 3 review, the ERT identified several possible under- and overestimations in the inventory and proposed technical corrections for the road transport sector.

87. The ERT noted that the Ukrainian inventory does not include any estimate of particulate matter emissions from road transport, although it may have a significant contribution to national total emissions. The ERT also noted that there are relatively high CO emissions from the road transport sector. Therefore, technical corrections were calculated by the ERT by using activity data from the GHG inventory submission under the UNFCCC, since there were no detailed level activity data provided in the NFR tables. In addition, assumptions were made in order to estimate the maximum sulphur level in the road transport sector and the amount of fuel consumed by each subsector (presumably the neighbouring country Romania has comparable economical characteristics, which is also the reason why Romanian data has been used to evaluate the fuel split by different subcategories). **The ERT recommends Ukraine to consider these technical correction results in the next submission or further adjustments should be made as appropriate.**

NFR	Pollutant	Year	Calculated by country/ERT	Potential contribution to national total (%) in 2016, 2010 and 2005 (NA*=Not reported by the Party)
1A3bi	NO_x	2005, 2010, 2016	ERT	-20.3 %(2016), 8.7%(2010), 7.6%(2005)
1A3bi	NMVOC	2005, 2010, 2016	ERT	-13.0%(2016), 8.6%(2010), 10.7%(2005)
1A3bi	NH_3	2005, 2010, 2016	ERT	14.3%(2016), 18.0%(2010), 1.3%(2005)
1A3bi	$PM_{2.5}$	2005, 2010, 2016	ERT	3.6%(2016), 3.5%(2010), 0.6%(2005)
1A3bi	PM_{10}	2005, 2010, 2016	ERT	1.1%(2016), 1.1%(2010), 0.6%(2005)
1A3bi	TSP	2005, 2010, 2016	ERT	0.3%(2016), 0.3%(2010), 0.1%(2005)
1A3bi	CO	2005, 2010, 2016	ERT	-33.1%(2016), 9.7%(2010), 9.5%(2005)
1A3bii	NO_x	2005, 2010, 2016	ERT	2.9%(2016), 1.3%(2010), 2.5%(2005)
1A3bii	NMVOC	2005, 2010, 2016	ERT	1.6%(2016), 0.6%(2010), 2.5%(2005)
1A3bii	NH_3	2005, 2010, 2016	ERT	0.8%(2016), 1.3%(2010), 0.1%(2005)
1A3bii	$PM_{2.5}$	2005, 2010, 2016	ERT	2.4%(2016), 2.1%(2010), 0.5%(2005)
1A3bii	PM_{10}	2005, 2010, 2016	ERT	0.8%(2016), 0.7%(2010), 0.5 %(2005)
1A3bii	TSP	2005, 2010, 2016	ERT	0.2%(2016), 0.2%(2010), 0.1%(2005)
1A3bii	CO	2005, 2010, 2016	ERT	2.8%(2016), 0.7%(2010), 2.7%(2005)
1A3biii	NO_x	2005, 2010, 2016	ERT	14.3%(2016), 4.0%(2010), 12.8%(2005)
1A3biii	NMVOC	2005, 2010, 2016	ERT	1.5%(2016), -5.2%(2010), 1.2 %(2005)
1A3biii	NH_3	2005, 2010, 2016	ERT	0.1%(2016), 0.1%(2010), 0.0%(2005)
1A3biii	$PM_{2.5}$	2005, 2010, 2016	ERT	4.0%(2016), 4.8%(2010), 1.5%(2005)
1A3biii	PM_{10}	2005, 2010, 2016	ERT	1.3%(2016), 1.5%(2010), 1.4%(2005)
1A3biii	TSP	2005, 2010, 2016	ERT	0.4%(2016), 0.3%(2010), 0.2%(2005)

NFR	Pollutant	Year	Calculated by country/ERT	Potential contribution to national total (%) in 2016, 2010 and 2005 (NA*=Not reported by the Party)
1A3biii	CO	2005, 2010, 2016	ERT	1.2%(2016), -6.1%(2010), 0.5%(2005)
1A3biv	NO_x	2005, 2010, 2016	ERT	0%(2016), 0%(2010), 0%(2005)
1A3biv	NMVOC	2005, 2010, 2016	ERT	0.9%(2016), 0.9%(2010), 0.5%(2005)
1A3biv	NH_3	2005, 2010, 2016	ERT	0%(2016), 0%(2010), 0%(2005)
1A3biv	$PM_{2.5}$	2005, 2010, 2016	ERT	0.1%(2016), 0.1%(2010), 0%(2005)
1A3biv	PM_{10}	2005, 2010, 2016	ERT	0%(2016), 0%(2010), 0%(2005)
1A3biv	TSP	2005, 2010, 2016	ERT	0%(2016), 0%(2010), 0%(2005)
1A3biv	CO	2005, 2010, 2016	ERT	0.7%(2016), 0.4%(2010), 0.2%(2005)
1A3bv	NMVOC	2005, 2010, 2016	ERT	6.1%(2016), 7.2%(2010), 6.1%(2005)
1A3bvi	$PM_{2.5}$	2005, 2010, 2016	ERT	2.1%(2016), 2.4%(2010), NA*%(2005)
1A3bvi	PM_{10}	2005, 2010, 2016	ERT	1.2%(2016), 1.4%(2010),NA* %(2005)
1A3bvi	TSP	2005, 2010, 2016	ERT	22.5%(2016), 0.4%(2010), NA*%(2005)
1A3bvii	$PM_{2.5}$	2005, 2010, 2016	ERT	1.2%(2016), 1.3%(2010), NA*%(2005)
1A3bvii	PM_{10}	2005, 2010, 2016	ERT	0.7%(2016),0.7 %(2010), NA*%(2005)
1A3bvii	TSP	2005, 2010, 2016	ERT	18.6%(2016), 0.4%(2010), NA*%(2005)

88. The contribution of corrections to SO_X emissions were below 5% both in the individual 1A3b subcategories and as the sum of corrections to 1A3b subcategories. The calculations are provided in the file "!TC-Ukraine NFRs 1A3_2_3_5_Review2018.xlxs" as guidance.

Sub-Sector Specific Recommendations

Category issue 1: 1.A.3.a.i.(i-ii) International aviation: All pollutants

89. No emission estimates are provided for international aviation (LTO and cruise) for the years 2014-2016, instead, zero values are given in the NFR table. Although the ERT recognises that international aviation may be a small emission source in the Party's inventory, the ERT recommends the Party to make separate emission estimates for this sector in the next inventory. Where estimates cannot be made or emissions are reported separately, the ERT recommends Ukraine to document this using the appropriate notation keys and encourages the Party to explain them in the IIR.

Category issue 2: 1.A.3.b Road transport: All pollutants

90. The emission estimates for all subsectors of 1A3b (road transport) for the years 2014-2016 are included in the 1A3bi (passenger cars) sector, and zero values are given for each subsector (1A3bii-1A3bvii). However, there are more sectors covered in the NFR tables provided for previous years. The ERT encourages Ukraine to calculate separate emission estimates for these subsectors in its future submissions since road transport is a key source and has a big impact on national total emissions.

91. As stated in the IIR 2016, Ukraine uses fuel based methodology and emission factors for the road transport, which is in agreement with a Tier 1 methodology provided in the EMEP/EEA Guidebook. The ERT encourages Ukraine to use more detailed Tier 2 or 3 based methods for key categories such as road transport in order to estimate emissions

more accurately and to take the country specific vehicle fleet and mileage data into account.

92. Ukraine has provided estimates for NO_X, NMVOCs, SO_X and CO from the road transport sector for the years 2014-2016. No estimates have been provided for other pollutants and in particular particulate matter, although emissions arising from activities in these sectors may be expected and calculation methods and emission factors for these sectors are available in the EMEP/EEA Guidebook. The ERT strongly recommends Ukraine to provide emission estimates for particulate matter and other missing pollutants.

93. Regarding information provided in the IIR 2016, the ERT notes there is a sudden change in IEFs for NO_X, NMVOC and CO for the years 2011-2013 compared to the period 1990-2010. The ERT encourages Ukraine to check the emission values provided in the IIR and recommends Ukraine to recalculate them if necessary.

Category issue 3: 1.A.3.b Road transport and 1.A.3.c Railways: SO_X

94. Regarding the SO_X trends presented in the IIR 2016, the ERT notes that there are no signs of gradual reduction of the sulphur content in fuels. Therefore, the ERT encourages the Party to check the SO_2 emission estimates in order to avoid overestimates and to carry out recalculations if necessary. In addition, information on the sulphur content in fuels would be relevant to present in the future IIR. The ERT recommends Ukraine to check these figures and amend them accordingly if appropriate.

Category issue 4: Other mobile sources (1A2gvii, 1A4aii, 1A4bii, 1A4cii, 1A4ciii) – All pollutants

95. The ERT notes that it is unclear where emissions from 1A2gvii, 1A4aii and 1A4bii are allocated. Emissions from 1A2gvii, 1A4aii and 1A4bii are marked as “IE” in the NFR table. The latest IIR (submitted in 2016) states that emissions from other mobile sectors (1A2gvii, 1A4bii, 1A4cii) are included under the 1A3eii sector. However, data provided in the NFR table does not verify that. Emissions for the pollutants from 1A3eii in the NFR table are reported as “NA”. The ERT strongly encourages the Party to include detailed information on this in the IIR and recommends Ukraine to make an effort to calculate emissions separately for these sectors.

96. Ukraine uses zero values in a number of cells in the NFR table for 2016, for example for 1A3ai(i), 1A3ai(ii), 1A4cii, 1A4ciii and 1A3di(i). The ERT considers that emissions from these sectors most likely do occur and therefore recommends the Party to report the actual emission values instead of zero values in order to improve the completeness of the inventory. However, appropriate notation keys should be used if estimating emissions from some subsectors is not possible. The ERT recommends the Party to update older NFR tables with the correct content or values instead.

INDUSTRIAL PROCESSES

Review Scope

Pollutants Reviewed		SO_2, NOx, NMVOC, NH_3, PM_{10} & $PM_{2.5}$		
Years		2011 – 2016		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
2A1	Cement production	X		X
2A2	Lime production	X		X
2A3	Glass production	X		X
2A5a	Quarrying and mining of minerals other than coal	X		X
2A5b	Construction and demolition	X		X
2A5c	Storage, handling and transport of mineral products	NA		X
2A6	Other mineral products	X		X
2B1	Ammonia production	X		X
2B2	Nitric acid production	X		X
2B3	Adipic acid production	X		X
2B5	Carbide production	X		X
2B6	Titanium dioxide production	NO		
2B7	Soda ash production	X		X
2B10a	Chemical industry: Other	X		X
2B10b	Storage, handling and transport of chemical products	X		X
2C1	Iron and steel production	X		X
2C2	Ferroalloys production	X		X
2C3	Aluminium production	X		X
2C4	Magnesium production	NO		X
2C5	Lead production	NA, 0		X
2C6	Zinc production	NA, 0		X
2C7a	Copper production	NA, 0		X
2C7b	Nickel production	NA, 0		X
2C7c	Other metal production	X		X
2C7d	Storage, handling and transport of metal products	NA, 0		X
2D3b	Road paving with asphalt	X		X
2D3c	Asphalt roofing	X		X
2H1	Pulp and paper industry	X		X
2H2	Food and beverages industry	X		X
2H3	Other industrial processes	NA, 0		X
2I	Wood processing	NA, 0		X
2J	Production of POPs	NA, 0		X
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	NA, 0		X
2L	Other production, consumption, storage, transportation or handling of bulk products	X		X
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns.				

General recommendations on cross cutting issues

Transparency

97. Ukraine uses zero values in a number of areas in the reporting tables. The ERT encourages Ukraine to use the appropriate notation keys (e.g. “NO” where emissions are “Not Occurring”, “NE” where emissions are “Not Estimated” and “IE” where emissions are “Included Elsewhere”) for reporting where estimates are not available or necessary.

98. The ERT noted that the reported estimates are not transparent. Ukraine uses Guidebook 2009 methodology for estimating emissions from the industrial processes sector. Methodology and emission factors in the IIR are considered by the ERT to not be transparent for the industrial processes sector. The ERT recommends Ukraine to use the most recent Guidebook version (i.e. currently the 2016 version) for estimating emissions from the Industrial processes sector, as requested in the Reporting Guidelines.

99. In Ukraine’s IIR, in the chapter industrial processes and product use there is information on fuel used “for non-energy purposes” for the source categories ammonia production, pig iron, aluminium and ferroalloys production, and also information on losses of fuel during its transportation and storage, as well as conversion, reprocessing or for other reasons which should be regarded as non-energy use. In Ukraine’s IIR, there is no information on production rates for the production of cement, lime, ammonia, pig iron, aluminium, ferroalloys etc. The ERT considers that the reporting of fuel use for non-energy purposes in the IIR is not consistent with the activity data reported in Ukraine’s NFR14 tables, which seem to be production rates. The ERT recommends Ukraine to include production and product use activity rates in the NFR table and encourages the Party to also include these in the IIR to the next submission.

100. Ukraine has reported activity data rates for categories in the scope of the industrial processes sector in the NFR14 tables, but not in the IIR (with the exception of category 2I wood processing for which detailed activity data are presented). The ERT encourages Ukraine to include activity rates in its IIR to the next submission.

101. In the Ukraine IIR there is no information on the trend evolution by source category, neither for activity data, nor emissions. The ERT encourages Ukraine to include detailed explanations for any of existent outliers in the time series for activity data and emissions for the industrial processes sector in its IIR.

102. The ERT notes that values on production and product use activity rates, reported in NFR14 tables for 2014, 2015 and 2016 are the same and recommends the Party to check these.

Completeness

103. The ERT notes that Ukraine has provided estimates for almost all categories in the scope of the industrial processes sector. The ERT considers the industrial processes sector to be almost complete; however, the ERT has made some sub-sector specific recommendations presented below.

104. Ukraine has reported activity data rates for categories in the scope of the industrial processes sector in the submitted NFR14 tables, but not in the IIR (with exception for the

category 2I wood processing). The ERT encourages Ukraine to include activity rates in its IIR for the next submission.

105. In the 2018 submission, Ukraine has reported emissions for the industrial processes sector only for 2016 and in the latest NFR14 format. The years 2014 and 2015 have been provided in the previous submissions, also in NFR14 format. Years from 2011 to 2013 have been provided in the previous years' submissions, but in the old NFR09 format. Ukraine has not reported emissions for the industrial processes sector for the years from 1990 to 2010. The ERT recommends Ukraine to report emissions for the industrial processes sector for all historic years in the NFR14 format in the next submission.

Consistency including recalculation and time series

106. Ukraine has not performed recalculations for any of the source categories within the industrial processes sector. The ERT encourages Ukraine to provide information on recalculations made in its IIR, along with an explanation of the rationale for recalculations made, the impact on the sector and the implication to trends for the industrial processes sector. The ERT recommends Ukraine to perform recalculations for the whole time series since 1990, in order to achieve consistency of the time series.

Comparability

107. The ERT considers that the methods used for the emission calculation are consistent with those provided in the Guidebook 2009. However, the methods used are not consistent with those provided in the 2016 Guidebook, the use of which is requested in the Reporting Guidelines, and the inventory is thus not fully comparable to the inventories of other reporting Parties.

108. The ERT notes that Ukraine uses NFR14-02 reporting tables and that the inventory is thus comparable to other reporting Parties' inventories in terms of the allocation of sources.

Accuracy and uncertainties

109. The ERT encourages Ukraine to undertake an uncertainty analysis for the industrial processes sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.

110. The ERT encourages Ukraine to implement sector specific OA/QC procedures for the industrial processes sector and encourages Ukraine to document the results of the quality checks in the IIR.

Improvement

111. The ERT encourages Ukraine to include an improvement plan for the industrial processes sector in its IIR of the next submission.

Potential Technical Corrections

112. The ERT noted possible under- and overestimations as well as missing emissions as listed below and prepared technical corrections using activity data reported by Ukraine in the NFR tables for 2016, and in the CRF tables reported in 2017 for 2005, as well as The World Bank data (https://data.worldbank.org/ indicator) for population statistics for 2005 and 2016, along with default Tier 1 emission factors from the 2016 EMEP/EEA Emission Inventory Guidebook. Details of the calculations are presented in the file "TC-Ukraine NFRs 1A3_2_3_5_Review 2018.xlsx". The ERT recommends Ukraine to correct the following estimates and/or to include the missing estimates, for which the ERT has prepared technical corrections, into the next submission:

- NFR 2.D.3.b possible overestimations of NMVOC emissions;
- NFR 2.A.2 possible underestimations of TSP, PM_{10} and $PM_{2.5}$ emissions and no estimates for BC emission for 2016;
- NFR 2.A.3 estimates for TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn emissions;
- NFR 2.C.1 missing estimates for BC, Cr, Cu, PCB, PCDD/F, PAH-4 and HCB emissions, possible underestimations for NMVOC, $PM_{2.5}$, Pb, Hg, As and Se emissions and possible overestimations for TSP, PM_{10}, Cd, Ni and Zn emissions;
- NFR 2.D.3.b possible overestimations of NMVOC emissions, possible underestimations of TSP, PM_{10} and $PM_{2.5}$ emissions, and no estimates for BC emissions for;
- NFR 2K Missing Hg and PCB emissions.

NFR	Pollutant	Year	Calculated by country/ERT	Potential contribution to national total (%) in 2016, 2010 and 2005 (NA*=Not reported by the Party)
2A2	TSP	2016, 2005	ERT	6.5%(2016), 5.3%(2005)
2A2	$PM_{2.5}$	2016, 2005	ERT	5.2%(2016), NA*%(2005)
2A2	PM_{10}	2016, 2005	ERT	8.1%(2016), NA*%(2005)
2A2	BC	2016, 2005	ERT	NA*%(2016), NA*%(2005)
2A3	Cd	2016, 2005	ERT	7.1%(2016), 1.9%(2005)
2A3	Se	2016, 2005	ERT	31.5%(2016),0.1%(2005)
2C1	Pb	2016, 2005	ERT	88.4%(2016), 58.4%(2005)
2C1	Cr	2016, 2005	ERT	118.4%(2016), 25.2%(2005)
2C1	Ni	2016, 2005	ERT	-7.0%(2016), 47.1%(2005)
2C1	Se	2016, 2005	ERT	16.3%(2016), 0.1%(2005)
2C1	Zn	2016, 2005	ERT	-5.4%(2016), NA*%(2005)
2C1	PCBs	2016, 2005	ERT	NA*%(2016), NA*%(2005)
2C1	PAH-4	2016, 2005	ERT	5.4%(2016), NA*%(2005)
2C1	HCB	2016, 2005	ERT	0.1%(2016), NA*%(2005)
2K	Hg	2016, 2005	ERT	8.9%(2016), 7.9%(2005)
2K	PCBs	2016, 2005	ERT	NA*%(2016), NA*%(2005)

113. The ERT also noted for NFR 2A1 possible overestimations for TSP and PM_{10} emissions, possible underestimations of $PM_{2.5}$ emissions and no estimates for BC emissions for 2016, and for NFR 2C2 possible underestimations of PM_{10} and $PM_{2.5}$ emissions, possible overestimations of TSP and no estimates for BC emissions. For these the ERT, however, did not do technical corrections, due to the possible inclusion under the energy sector (2A1) and the potentially low impact (2C2).

Sub-Sector Specific Recommendations

Category issue 1: 2 - all

114. During the review, the ERT noted that on p.21 of Ukraine's IIR submitted in 2016, there is information on the methodology used for estimating and reporting emissions, which is consistent with the "EMEP/EEA Emission Inventory Guidebook - 2009". The ERT recommends Ukraine to include the harmonization of Ukraine's inventory with the methodology according to 2016 EMEP/EEA Guidebook in the short-term inventory improvement plan.

115. During the review, the ERT noted that on p.100 of the IIR submitted in 2016, there is information on activity statistics used for estimating and reporting emissions from industrial processes and product use (NFR sector 2). According to the IIR emissions from non-energy fuel use are presented under the sector industrial processes and that there are also losses of fuel during the transportation and storage, as well as from conversion, reprocessing or for other reasons and that these losses should be regarded as non-energy use. The ERT does not consider this to be consistent with the EMEP/EEA Guidebook and recommends that all emissions from fuels should be reported under the energy sector (1B fugitive emissions from fuels). The ERT asked Ukraine to confirm, that all reported emissions in the NFR tables, cover only non-energy fuel use activities and that Ukraine also confirms, that all reported emissions in the NFR tables are not process emissions from handling and processing of the product and raw materials and emissions from various products use activities that exist in Ukraine. Ukraine did not, however, respond the question. The ERT recommends Ukraine to recalculate all emissions from the NFR sector 2 industrial processes and product use to be consistent with the EMEP/EEA methodology for the next submission. For Tier 1 the emissions of NO_X, CO, NMVOC, SO_X, heavy metals and POPs can be assumed to be mainly due to the combustion of the solid and waste fuels and will be included in the emission factors provided in chapter 1A2f of the Guidebook. To avoid double counting, it is good practice to report these emissions under NFR 1A2f. In the Tier 1 approach they will, as far as they originate from the chemical composition of the raw material, be reported as "not estimated" ("NE").

116. During the review, the ERT noted that in the NFR tables (2014 – 2016), there are values for various activity data. For all activities in the scope of the industrial process sector, values reported for the years 2014, 2015 and 2016 are the same for each activity. The ERT asked Ukraine to give an explanation on that issue during the review, but did not receive a response.

Category issue 2: 2.A.5.a - $PM_{2.5}$, PM_{10}, TSP

117. During the review, the ERT noted that in the NFR tables (2014 – 2016), emissions of $PM_{2.5}$, PM_{10}, TSP for 2A5a are reported but the activity data are not. The ERT recommends Ukraine to provide activity data rates for the reported years in its next submission in the NFR tables and encourages the Party to include these also in the IIR.

Category issue 3: 2.A.5.b - $PM_{2.5}$, PM_{10}, TSP

118. During the review, the ERT noted that in the NFR tables for 2014, 2015 and 2016, emissions of $PM_{2.5}$, PM_{10}, TSP from 2A5b are reported with the value of zero. The ERT asked Ukraine to confirm that there were no construction and demolition activity works in Ukraine for reported years, however, the Party did not respond to the question. The ERT recommends, that if there were no construction and demolition activities in Ukraine in te period 2014-2016, to use the appropriate notation key ("NO"- "not occurring" or "NE" "not estimated") or to calculate emissions if these activities exist.

Category issue 4: 2.B.7 - TSP

119. The ERT noted that in the NFR tables, there are emissions from the source categories 2B7 along with activity data on soda ash production. The ERT checked activity data on soda ash production in CRF tables submitted by Ukraine in 2017 and in the CRF tables, Ukraine is using notation key "NA" – "Not applicable". In the IIR there is no information regarding the production of soda ash. The ERT recommends Ukraine to provide information on the possible existence of the production of soda ash in Ukraine and if such activity exists in Ukraine to revise emission estimations for CO, NH_3, and TSP by using methodology according to the 2016 EMEP/EEA Guidebook. If such activity does not exist in Ukraine, the ERT recommends Ukraine to use the appropriate notation key, "NO" – "Not occurring".

Category issue 5: 2.B.10.a, 2.C.7.c - all

120. The ERT noted that in the NFR tables there are emissions from 2B10a other chemical industry and 2C7c other metal production but in the IIR there is no information regarding this source categories. During the review the ERT asked Ukraine to provide information on which activities in the scope NFR 2B10a and 2C7c are included in the emission calculations but did not receive a response to the question. The ERT recommends Ukraine to check the activities and encourages Ukraine to include this information in the IIR of the next submission.

SOLVENTS

Review Scope

Pollutants Reviewed		SO_2, NOx, NMVOC, NH_3, PM_{10} & $PM_{2.5}$		
Years		2011 – 2016		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
2D3a	Domestic solvent use including fungicides	X		X
2D3d	Coating applications	X		X
2D3e	Degreasing	X		X
2D3f	Dry cleaning	X		X
2D3g	Chemical products	X		X
2D3h	Printing	X		X
2D3i	Other solvent use	X		X
2G	Other product use	X		X
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns.				

General recommendations on cross cutting issues

Transparency

121. Ukraine uses zero values in a number of areas in the reporting tables. The ERT recommends Ukraine to use the appropriate notation keys (e.g. “NO” where emissions are “Not Occurring”, “NE” where emissions are “Not Estimated” and “IE” where emissions are “Included Elsewhere”) for reporting where estimates are not available or necessary.

122. The ERT notes that Ukraine has not provided a transparent emission inventory as in the latest submitted IIR from 2016, there is no information on the solvent sector. The ERT encourages Ukraine to submit an IIR including all necessary information about source categories in the scope of the solvent sector.

123. Ukraine has reported on emissions and activity data for almost all categories in the scope of the solvent sector in its submitted NFR14 tables and the ERT commends Ukraine for that. Activity data is not presented in the IIR and the ERT encourages Ukraine to include activity rates also in its IIR of the next submission.

Completeness

124. In the 2018 submission, Ukraine has reported emissions for the solvent sector only for 2016 and in the latest NFR14 format. Years 2014 and 2015 have been provided in previous submissions, also in NFR14 format. The years from 2011 to 2013 have been provided in previous submissions but in the old NFR09 format. Ukraine has not reported emissions for the solvent sector for the years from 1990 to 2010. The ERT recommends Ukraine to report emissions for the solvent sector for all historic years since 1990 in the NFR14-02 format to the next submission.

Consistency including recalculation and time series

125. Ukraine has not performed recalculations for any of the source categories within the solvent sector. The ERT encourages Ukraine to provide information on recalculations made and to report about them in its IIR, along with an explanation of the rationale for recalculations made, the impact on the sector and implication to trends for the solvent sector.

126. In the IIR there is no information on trend evolution by source category, neither for activity data, nor emissions. The ERT encourages Ukraine to include detailed explanations for any of existent outliers in the time series for activity data and emissions for the solvent sector in its IIR.

127. As already stated by previous the ERT, Ukraine has not submitted a full time series of emissions and activity data and therefore, it was not possible for the ERT to analyse them.

Comparability

128. The ERT considers that the methods used for the emission calculation are consistent with those provided in the 2009 Guidebook. However, the methods used are not consistent with those provided in the latest version of the Guidebook (currently 2016), as requested in the Reporting Guidelines, and the inventory is therefore not fully comparable with the inventories of other reporting Parties.

129. In terms of allocation of sources the inventory is comparable with other reporting Parties as Ukraine uses the NFR14-02 reporting format.

Accuracy and uncertainties

130. The ERT encourages Ukraine to undertake an uncertainty analysis for the Solvent sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.

131. The ERT encourages Ukraine to implement sector specific QA/QC procedures for the Solvent sector and encourages Ukraine to report on the results of the quality checks in the IIR.

Improvement

132. The ERT notes Ukraine's intention to improve its solvent sector inventory.

133. The ERT encourages Ukraine to include information on source category descriptions, indication of activities that exist or not exist on the territory of Ukraine, methodology, emission factors and activity data rates for all years in the historic trend, recalculations and improvements made for the solvent sector in its IIR.

Potential Technical Corrections

134. The ERT noted missing estimates under NFR 2D3a as presented in the table below, and prepared technical corrections using activity data reported by Ukraine in the NFR tables for 2016 and World Bank data (https://data.worldbank.org/ indicator) of population statistics for 2005 and 2016, along with default Tier 1 emission factors from the 2016 EMEP/EEA Emission Inventory Guidebook. The ERT recommends Ukraine to include the following estimates, for which the ERT has made technical corrections, into the next submission:

NFR	Pollutants	Year	Calculated by country/ERT	Potential contribution to national total (%) in 2016 and 2005
2D3a	NMVOC	2016, 2005	ERT	24.2%(2016), 17.5%(2005)
2D3a	Hg	2016, 2005	ERT	5.0%(2016), 4.4%(2005)

Sub-Sector Specific Recommendations

Category issue 1: 2.D.3.a, 2.D.3.d, 2.D.3.e, 2.D.3.f, 2.D.3.g, 2.D.3.h, 2.G – NMVOC

135. During the review, the ERT noted that in the IIR, submitted in 2016, there is no information on source categories under 2D3a, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h, 2G but that in the submitted NFR14 tables there is information on emissions and activity rates. The ERT commends Ukraine for estimating NMVOC emissions for the listed sectors. The ERT encourages Ukraine to include information on the methodology, emission factors and activity data used for calculating NMVOC emissions from 2D3a, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h, 2G in the next submission of the IIR.

Category issue 2: 2.D.3.a – NMVOC, Hg

136. During the review, the ERT noted that in the NFR tables NMVOC emissions from source category 2D3a domestic solvent use including fungicides are low (0.001008 kt in 2012 and 2013, and 0.000556 kt in 2014, 2015, 2016) and Hg emissions are zero for the period 2014-2016. The ERT considers those as potential underestimations of NMVOC and Hg emissions. This source category is a key category of NMVOC emission in almost all countries. According to the 2016 EMEP/EEA Guidebook default emission factors for NMVOC and Hg emissions are based on the population size of a country, which is available statistical data. During the review the ERT asked Ukraine to confirm that the reported emissions are from product use activities such as cosmetics and toiletries, household products, car care products, DIY/buildings, pharmaceutical products, however, Ukraine did not respond the question. The ERT recommends Ukraine to recalculate emissions of NMVOC and Hg, for the whole time series using the population size of Ukraine and Tier 1 emission factors for NMVOC and Hg provided in Table 3.1, chapter 2.D.3.a of the 2016 EMEP/EEA Guidebook (EF NMVOC = 1.2 kg/capita, EF Hg = 5.6 mg/capita) for the next submission.

Category issue 3: 2.D.3.d, 2.D.3.e, 2.D.3.f, 2.D.3.g, 2.D.3.h – NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn

137. The ERT noted that NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn emissions are reported from almost all source categories 2D3d, 2D3e, 2D3f, 2D3g, 2D3h, in the NFR14 tables. According to EMEP/EEA Guidebook 2016 from 2D3d, 2D3e, 2D3f, 2D3g and 2D3.h only NMVOC emissions should be reported. During the review the ERT asked Ukraine to provide an explanation on why these NO_X, CO, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn emissions are reported from source categories 2D3d, 2D3e, 2D3f, 2D3g, 2D3h. but did not receive a response. The ERT believes that emissions reported for categories 2D3d, 2D3e, 2D3f, 2D3g, 2D3h are from fuel combustion activities, which according to Guidebook, need to be reported in the scope of the Energy sector. The ERT recommends Ukraine to review and correct emission estimations for categories 2D3d, 2D3e, 2D3f, 2D3g, 2D3h for the next submission.

Category issue 4: 2.D.3.i, 2.G – all

138. The ERT noted that in the IIR there is no information on the activities included in source categories 2D3i and 2G, but in the NFR tables, however, emissions of many pollutants are reported. According to the EMEP/EEA Guidebook 2016 (and also 2013), chapter 2D3i, 2G other solvent and product use includes various activities like: glass wool enduction, mineral wool enduction, preservation of wood (with creosote, solvent borne and waterborne preservatives), vehicles dewaxing, treatment of vehicles, industrial application of adhesives (glues), use of fireworks, tobacco combustion, use of shoes, use of concrete additive, cooling lubricant, lubricant, pesticide, aeroplane de-icing agent). The ERT asked Ukraine to verify which activities exist in Ukraine's territory and which of these activities are included in the emission calculation, however, no response was provided. The ERT encourages Ukraine to provide information on which of the above mentioned activities exist in Ukraine and to include information on that in the IIR, along with activity rates (by SNAP category) for each activity included in the scope of 2D3i and 2G, for the next submission.

Category issue 5: 2.D.3.g - NMVOC

139. The ERT noted that in the IIR there is no information on activities included in source category 2D3g, but in the NFR tables, however, emissions of many pollutants are reported. According to EMEP/EEA Guidebook 2016 (and also 2013), chapter 2D3g chemical products includes various activities like: polyurethane and polystyrene foam processing; asphalt blowing; tyre production; speciality organic chemical industry; manufacture of paints, inks and glues; fat, edible and non-edible oil extraction; industrial application of adhesives (e.g. glue). During the review the ERT asked Ukraine to verify which of these activities exist in Ukraine's territory and which of these activities are included in the emission calculation, however, no response was provided. The ERT encourage Ukraine to include information on sources included under the NFR and to provide activity rates (by SNAP category) for each activity included in the scope of NFR14 2D3g in Ukraine in the IIR.

AGRICULTURE

Review Scope

Pollutants Reviewed		SO_2, NOx, NMVOC, NH_3, PM_{10} & $PM_{2.5}$		
Years		1990 – 2016 + (Protocol Years)		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
3B1a	Dairy cattle	X		X
3B1b	Non-dairy cattle	X		X
3B2	Sheep	X		X
3B3	Swine	X		X
3B4a	Buffalo			
3B4d	Goats	X		X
3B4e	Horses	X		X
3B4f	Mules and asses	X		
3B4gi	Laying hens	X		X
3B4gii	Broilers	X		X
3B4giii	Turkeys	X		
3B4giv	Other poultry	X		
3B4h	Other animals	X		
3Da1	Inorganic N-fertilizers (includes also urea application)	X		X
3Da2a	Animal manure applied to soils	X		X
3Da2b	Sewage sludge applied to soils	X		
3Da2c	Other organic fertilisers applied to soils (including compost)	X		
3Da3	Urine and dung deposited by grazing animals	X		X
3Da4	Crop residues applied to soils	X		
3Db	Indirect emissions from managed soils	X		
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	X		X
3Dd	Off-farm storage, handling and transport of bulk agricultural products	X		
3De	Cultivated crops	X		
3Df	Use of pesticides	X		X
3F	Field burning of agricultural residues	X		X
3I	Agriculture other		X	
11A	Volcanoes		X	
11B	Forest fires		X	
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns.				

General recommendations on cross cutting issues

Transparency

140. Ukraine has provided emission estimates of NO_X, NMVOC, NH_3 and PMs for some sub-categories of the agriculture inventory. The ERT notes that the reported data in the 2018 submission is identical to the 2017 submission. Moreover, the IIR includes limited information on the agriculture inventory and an incomplete set of AD. Activity data for 3B4gii (Broilers) and 3D1a (Inorganic N-fertilizers) is not reported in the NFR tables.

141. The ERT was unable to check the methodologies, emission factors, references and information on the data used for estimating emissions from the agriculture sector due to the limited information provided by the Party. The ERT reiterates the previous recommendation from the 2015 UNECE Stage 3 Review, to provide a transparent description of the methodologies applied for estimating emissions as well as a trend analysis in the next IIR submission.

Completeness

142. The ERT considers the agriculture inventory of Ukraine not to be fully complete as emission estimates from sub-categories such as animal manure applied to soils (3Da2a), urine and dung deposited by grazing animals (3Da3), farm-level agricultural operations including storage, handling and transport of agricultural products (3Dc), field burning of agricultural residues (3F) and use of pesticides (3Df) are not fully provided. The Party reported zero emission values for most of these categories.

143. The ERT recommends that Ukraine uses the correct notation key instead of zero values/empty cells, e.g. “not estimated” (“NE”) instead of zero or “not applicable” (“NA”) for these sources. However, the ERT recommends Ukraine to collect activity data and report emission estimates from this source. See sub-sector specific recommendations.

Consistency including recalculation and time series

144. The ERT was unable to check the consistency of the emission inventory of the agriculture sector as the Party did not provide an IIR chapter on agriculture that describes the methodologies applied for estimating emissions and a trend analysis. The ERT recommends that Ukraine provides a detailed description of methodologies applied and trend analyses of the relevant pollutants as well as a detailed description of the recalculation of the emission inventory of the agriculture sector in its next IIR submission.

Comparability

145. The ERT was unable to assess the comparability of the inventory to those of other reporting Parties as methodologies, emission factors, references and information on the data used for estimating emissions have not been provided. The ERT reiterates the recommendation from the previous review report to provide a detailed description of the methodologies applied for estimating emissions from the agriculture sector in the next submission.

146. In terms of allocation of emissions the ERT considers the inventory to be comparable to those of other reporting Parties as Ukraine uses the NFR14-02 reporting tables.

Accuracy and uncertainties

147. The ERT noted that Ukraine did not provide an uncertainty analysis for the agriculture sector. The ERT recommends Ukraine to undertake an uncertainty analysis for the agriculture sector to steer the improvement process and to provide an indication of the reliability of the inventory data in the next submission.

Improvement

148. The ERT was unable to assess whether Ukraine has made any improvement to its inventory or not, as no reference for improvement work to the inventory is given. The ERT

encourages Ukraine to list any implemented or planned improvements in its next submission to improve the quality and reliability of its emission inventory.

Potential Technical Corrections

149. Ukraine reported NH_3 emission estimates from various animal categories under NFR 3B (Manure management). The ERT noted that the reported NH_3 emission estimates are low for 3B1a (Dairy cattle), 3B1b (Non-dairy cattle), 3B2 (Sheep), 3B4e (Horses) and 3B3 (Swine). Emission estimates of NH_3 and PM from 3B4gi (Laying hens) are not reported for 2016. The ERT also noted that the calculated implied emission factors for NH_3 for these animal categories are low compared to the default EFs in the 2016 Guidebook. In addition, the ERT noted that Ukraine reported NH_3 emissions from 3Da1 (Inorganic N-fertilizers) but that the emission estimate is extremely low. Moreover, Ukraine did not report activity data for 3D1a in the NFR table. The ERT asked the Party during the review week to elaborate on these issues during the review week. The Party did not respond to the question raised by the ERT, neither provided activity data.

150. The ERT calculated technical corrections for NH3 emissions from 3B and 3D1a and for $PM_{2.5}$ and PM_{10} emissions from 3B4gi for the years 2005, 2010 and 2015, using methodologies described in the 2016 EMEP/EEA Guidebook. The ERT retrieved the missing activity data for 2015, 2010 and 2005 from the National Inventory Report for greenhouse gas emissions submitted by the Party to the UNFCCC (cf. part1 table 1 and annex I). The ERT strongly recommends that Ukraine implements these technical corrections in its next annual submission or provides revised emission estimates.

NFR	Pollutant	Year	Calculated by country/ERT	Potential contribution to national total (%) in 2016, 2010 and 2005 (NA*=Not reported by the Party)
3B	NH_3	2005, 2010, 2016	ERT	769.8%(2016), 587% (2010), 67.9%(2005)
3B4gi	PM_{10}	2005, 2010, 2016	ERT	5.9%(2016), 6.1% (2010), 4.9%(2005)
3B4gi	$PM_{2.5}$	2005, 2010, 2016	ERT	1.4%(2016), 1.5% (2010), 0.4%(2005)
3D1a	NH_3	2016, 2005	ERT	274.9%(2016), 154%(2010), 6.5%(2005)

Sub-Sector Specific Recommendations

Category issue 1: Manure Management (3.B) and Agriculture Soil (3D) - SO_2 and CO

151. The ERT noted that Ukraine reported emission estimates of SO_2 and CO from a number of animal categories in 3B (e.g., emissions of SO_2 and CO from dairy cows, swine and sheep) and also emissions of SO_2 and CO from 3D. Following a previous recommendation from the 2015 UNECE Stage 3 Review, "*Category issue 7: 3B Manure management and 3D Agricultural soil – SO_2 and CO"*, related to enhancing the QA/QC procedures for the agriculture sector in general, the ERT understands that this issue has not been addressed in later submissions. The ERT reiterates the recommendation from the 2015 review report to implement QA/QC procedures to ensure that the issues raised during the 2015 and 2018 reviews are addressed before the next inventory submission in 2019.

Category issue 2: Dairy cows (3B1a) - Pb and Hg

152. The ERT noted that Ukraine reported emissions of heavy metals (Hg and Pb) from dairy cows. The ERT asked Ukraine during the review process to provide an explanation for reporting emissions of Hg and Pb from dairy cows. The Party did not respond to the question raised by the ERT. The ERT recommends that Ukraine enhances the application of QA/QC procedures for its inventory to avoid such errors in future submissions.

Category issue 3: Laying hens (3B4gi) - NH_3 and PM

153. The ERT noted that the emissions of NH_3 and PM from laying hens are reported as zero, although activity data are reported in the NFR tables and a methodology is given in the 2016 Guidebook. The ERT reminds the Party that emissions arising from 3B4gi should be higher than zero as this animal category is a potential source for NH_3 and PM emissions. The ERT asked Ukraine during the review process to provide an explanation on why emissions of NH_3 and PM from 3B4gi are reported as zero. The Party did not respond to the question raised by the ERT. The ERT recommends that Ukraine reports NH_3 and PM emissions from this category in its next submission.

Category issue 4: Manure management (3B) and Agricultural soil (3D) - All relevant pollutants

154. The ERT noted that Ukraine reported zero emissions for several air pollutants (e.g., NH_3, NO_X, NMVOC and PMs) from 3B (e.g., 3B4d, goats and 3B4gi, laying hens) and 3D (e.g., 3Da2a, animal manure applied to soils) in the NFR tables. The ERT asked Ukraine during the review process to provide an explanation on why emissions of the main pollutants are reported as zero from these sub-categories. The Party did not respond to the question raised by the ERT. The ERT recommends that Ukraine estimates emissions of NH_3, NO_X, PM and other relevant pollutants from these categories by using methodologies given in the 2016 Guidebook in its next submission.

Category issue 5: Dairy cattle (3B1a) and Non-dairy cattle (3B1b) - EF

155. The ERT noted that the default NH_3 emission factors for 3B1a and 3B1b are much lower (0.89 and 1.54 kg NH_3 per head per year, respectively) compared to the emission factors in the 2016 Guidebook (19.2 and 6.9 kg NH_3 per head per year, respectively). The ERT asked Ukraine during the review process to explain why the default emission factors for these animal categories are much lower compared to those in the Guidebook. The Party did not respond to the question raised by the ERT. The ERT recommends that Ukraine estimates emissions of NH_3 from these animal categories using the emission factors provided in the 2016 Guidebook in its next submission.

Category issue 6: Sheep (3B2) and Horses (3B4e) - EF

156. The ERT noted that the default NH_3 emission factors for 3B2 and 3B4e are much lower (0.014 and 0.107 kg NH_3 per head per year, respectively) than the Tier 1 emission factors given in the 2016 Guidebook (0.4 and 7 kg NH_3 per head per year, respectively). The ERT asked Ukraine during the review process to explain why the default emission factors for these animal categories are much lower compared to those in the Guidebook. The Party did not respond to the question raised by the ERT. The ERT recommends that Ukraine estimates emissions of NH_3 from these animal categories using the emission factors provided in the 2016 Guidebook in its next submission.

Category issue 7: Swine (3B3) - EF

157. The ERT noted that the default NH_3 emission factor for swine is much lower (0.325 kg NH_3 per head per year) than the Tier 1 emission factor given in the 2016 Guidebook (4 kg NH_3 per head per year). The ERT asked Ukraine during the review process to explain why the default emission factors for these animal categories are much lower compared to those in the Guidebook. The Party did not respond to the question raised by the ERT. ERT recommends that Ukraine estimates emissions of NH_3 from swine using the emission factors provided in the 2016 Guidebook in its next submission.

Category issue 8: Broilers (3B4gii) – Activity data

158. The ERT noted that Ukraine did not report any activity data for 3B4gii in the NFR tables in the 2018 submission. The ERT recommends that Ukraine report activity data for 3B4gii to enhance the transparency of its inventory in the next submission.

Category issue 9: Inorganic N-fertilizers (3Da1) - NH_3

159. The ERT noted that the reported NH_3 emission from 3Da1 is extremely low (0.0000072 kt or about 7 kg NH_3) for the whole inventory year and also in relation to the vast area of land of Ukraine. Following a previous recommendation from the 2015 UNECE Stage 3 Review, "*Category issue 2: 3Da1 Inorganic N-fertilizers - NH_3",* related to enhance the QA/QC procedures for the agriculture sector in general, the ERT understands that this issue has not been addressed in the 2018 submission. The ERT reiterates the recommendation from the previous review report to implement QA/QC procedures to ensure that the issue raised during the 2015 and 2018 reviews will be addressed before the next inventory submission in 2019.

Category issue 10: Farm-level agricultural operations including storage, handling and transport of agricultural products (3Dc) - PM_{10} and AD

160. The ERT noted that the emission estimate of PM_{10} from 3Dc in the submission in 2018 is very low (about 0.00034 kt). The ERT recommends that Ukraine checks the estimates of PM emissions form NFR 3Dc and also recommends Ukraine to enhance the application of QA/QC procedures for its inventory in order to avoid errors in the future. In addition, the ERT also recommends that Ukraine reports AD for NFR 3Dc in its next submission.

Category issue 11: Inorganic N-fertilizers (3Da1) - AD

161. The ERT noted that Ukraine did not report AD of 3Da1 in the NFR tables, in the submission in 2018, but has already reported that in the previous submissions, e.g., in the submission in 2015. The ERT recommends that Ukraine reports AD of the sub-category 3Da1 in order to enhance the transparency and reliability of the inventory and also estimate the emissions of relevant pollutants, such as NH_3 and NO_X from 3Da1 in the next submission.

Category issue 12: Field burning of agricultural residues (3F) - SO_2, NMVOC, NH_3, PM and HM

162. The ERT noted that Ukraine reported NO_X and CO emission estimates only from 3F in the NFR tables. However, other relevant pollutants, such as SO_2, NMVOC, NH_3, PMs and HMs are reported using the notation key "not applicable" ("NA") or zero. The ERT asked Ukraine during the review to provide an explanation on why emissions of these pollutants were reported as "NA" or zero. The Party did not respond to the question raised

by the ERT. The ERT recommends that Ukraine estimates emissions of SO_2, NMVOC, NH_3, PM and HM or uses the correct notation keys in its next submission.

Category issue 13: Field burning of agricultural residues (3F) - All relevant pollutants

163. The ERT noted that Ukraine reported emission estimates of NO_X and CO from 3F in the 2018 submission. The reported emission is very low (e.g., NO_X is 0.0003 kt and CO is 0.000077 kt). In addition, several relevant pollutants from this category were reported as "NA" (e.g., SO_2, NMVOC, NH_3, PMs), while the emissions of HM and POPs have been reported as zero. The ERT reiterates the previous recommendation from the 2015 UNECE Stage 3 Review, "*Category issue 5: 4F - Field burning of agricultural residues"*, to enhance the QA/QC procedures for the agriculture sector to estimate the correct NO_X and CO emissions from this category, and to implement QA/QC procedures to ensure that the issue raised during the 2015 and 2018 reviews will be addressed in the next inventory submission in 2019.

WASTE

Review Scope

Pollutants Reviewed		SO_2, NOx, NMVOC, NH_3, PMs, Heavy Metals, POPs		
Years		1990 – 2016 + (Protocol Years)		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
5A	Solid waste disposal on land	X		X
5B1	Biological treatment of waste - Composting	X		X
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	X		X
5C1a	Municipal waste incineration	X		X
5C1bi	Industrial waste incineration	X		X
5C1bii	Hazardous waste incineration	X		X
5C1biii	Clinical waste incineration	X		X
5C1biv	Sewage sludge incineration	X		X
5C1bv	Cremation	X		X
5C1bvi	Other waste incineration	X		X
5C2	Open burning of waste	X		X
5D1	Domestic wastewater handling	X		X
5D2	Industrial wastewater handling	X		X
5D3	Other wastewater handling	X		X
5E	Other waste	X		X
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns.				

General recommendations on cross cutting issues

Transparency

164. Ukraine last provided an IIR in 2016, which did not contain waste sector specific information. The ERT notes that some emission data are provided in NFR-14 format for the year 2016 only, however no activity data were provided. This lack of information made it difficult for the ERT to review the estimates in any detail. The ERT does, however, commend Ukraine for submitting data in NFR-14 format for the first time.

165. Similar to the 2011 and 2015 centralized reviews, Ukraine did not provide any answers to questions raised by the ERT on the waste sector issues during the 2018 Stage 3 review. This is why Ukraine's submission could not be reviewed properly. The ERT strongly recommends that Ukraine prepares a complete emission time series in NFR-14 format and a complete IIR with all the necessary information.

Completeness

166. No up-to-date waste sector chapter has been included in the 2018 IIR. This has made the review effort extremely difficult in terms of assessing inventory completeness.

167. Ukraine has submitted emission estimates for a number of pollutants under the waste incineration (5C) categories. Under the same categories, Ukraine has submitted zero values for all POP emissions, despite methodologies and emission factors being available in the 2016 Guidebook. Without a response on the application of zero values by Ukraine,

the ERT has calculated a technical correction (see below). Ukraine is recommended to collect activity data and to complete the emission estimates to the next submission, and encouraged to outline its chosen methods in its IIR.

Consistency, including recalculation and time series

168. As no up-to-date waste sector chapter has been included in the 2018 IIR it was not possible to assess the consistency of the inventory related to reasons for emission trends. The ERT recommends Ukraine to provide a complete emission time series, with key activity data and encourages Ukraine to document the methodologies in its next IIR submission.

Comparability

169. Ukraine has neither submitted waste sector information in its IIR nor provided a response to requests and questions from the ERT as part of the Stage 3 review. As such, it has not been possible for the ERT to consider whether the applied methodologies in the waste sector are comparable to other Parties, and whether appropriate Guidebook methodologies have been followed. The ERT encourages Ukraine to outline its methodologies in its next IIR submission.

170. The ERT notes that in terms of allocation of emissions the inventory is comparable to other reporting Parties as Ukraine uses the NFR14-02 reporting tables.

Accuracy and uncertainties

171. No up-to-date waste sector chapter has been included in the 2018 IIR. As such, it has not been possible for the ERT to fully assess the accuracy of Ukraine's waste sector emission estimates. The ERT encourages Ukraine to submit information on its methodologies in the IIR of the next submission. The ERT also recommends Ukraine to outline its QA/QC procedures and to conduct further analysis of its emissions through an uncertainty assessment to the next submission. This will enable the ERT to have confidence in the emission totals submitted by Ukraine.

Improvement

172. Ukraine has not provided an overview of the progress made as a result of any previous ERT recommendations. Given the lack of response to the question on the issue during the review, the ERT encourages Ukraine to report information on implemented and planned improvements in the next IIR submission.

Potential Technical Corrections

173. The ERT notes that there is a significant potential underestimation for emissions of POP emissions, where no estimates have been made for waste incineration (5C) categories. Emission estimates provided by Ukraine for other pollutants confirm that these activities occur. The ERT notes that there are methodologies and default emission factors available for the estimation of POPs from these sources in the Guidebook. The ERT asked Ukraine to explain the use of zero values across the waste sector. As no response was received from Ukraine, the ERT has calculated technical corrections. As no waste sector information is available from an IIR for Ukraine, and no activity data are reported in its NFR, activity data for categories 5C1a municipal waste incineration, 5C1bi industrial waste incineration and 5C1biii clinical waste incineration has been obtained from Ukraine's National Inventory Report (NIR) on greenhouse gases to the UNFCCC. The ERT recommends Ukraine to provide estimates for POP compounds where emission sources occur in its future submissions, and to document the methods used in the IIR. The ERT also recommends Ukraine to apply notation keys to enhance transparency of reporting instead of reporting zero values.

NFR	Pollutant	Year	Calculated by country/ERT	Potential contribution to national total (%) in 2016 and 2010 (NA* = Not reported by the Party)
5C1a	PCDD/F	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1a	PAH-4	2016, 2010	ERT	NA*%(2016), 0.0 %(2010)
5C1a	HCB	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1a	PCBs	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bi	PCDD/F	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bi	PAH-4	2016, 2010	ERT	NA*%(2016), 0.0%(2010)
5C1bi	HCB	2016, 2010	ERT	NA*%(2016), 0.0%(2010)
5C1bi	PCBs	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	PCDD/F	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	PAH-4	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	HCB	2016, 2010	ERT	NA*%(2016), NA*%(2010)
5C1bii	PCBs	2016, 2010	ERT	NA*%(2016), NA*%(2010)

Sub-Sector Specific Recommendations

Category issue 1: 5.A Solid waste disposal on land – All pollutants

174. The ERT notes that Ukraine reports several pollutants from this source and commends Ukraine for reporting emissions of NMVOC and particulate matter following the recommendation in the 2015 review. The ERT notes that it is not clear what methodology is used and what the origin of the EFs used for the other pollutants is. The ERT encourages Ukraine to provide this information in the next IIR submission.

Category issue 2: 5.B.1 and 5B2 Biological treatment of waste - all pollutants

175. The ERT notes that there are no emissions reported from these sources in the NFR tables. The ERT recommends Ukraine to report emissions from these sources in the

NFR tables and encourages Ukraine to provide a description of methodology, AD and EFs used in the IIR of the next submission. Alternatively, if the activity does not occur in Ukraine, the appropriate notation key should be applied in Ukraine's next NFR submission.

Category issue 3: 5.C.1 All waste incineration – all pollutants

176. The ERT notes that a number of emission estimates are reported for pollutants under the waste incineration categories; however there is incompleteness in terms of the pollutant coverage, specifically where methodologies are available in the Guidebook. In order to improve the completeness and to account for a potentially significant underestimate of POPs emissions, the ERT has calculated a technical correction for POPs under the categories 5C1a municipal waste incineration, 5C1bi industrial waste incineration and 5C1biii clinical waste incineration (see below). As in the previous 2011 and 2015 reviews, the ERT recommends Ukraine to estimate emissions for all pollutants and sources where Guidebook methodologies are available. In addition, Ukraine should report in its IIR details on methodologies applied, giving consideration to whether estimates are in line with those presented for greenhouse gases in Ukraine's NIR.

Category issue 4: 5.C.1.b.i Industrial waste incineration - Hg

177. The ERT noted that there are gaps in the time series and a potential time series inconsistency for emissions of Hg in category 5C1bi, notably the decline to zero emissions for a single year in 2009. Ukraine did not provide a response to the question on the issue during the Stage 3 review. The ERT recommends Ukraine to correct the time series consistency for Hg emissions in category 5C1bi.

Category issue 4: 5.D All waste water handlings – all pollutants

178. The ERT notes that Ukraine reports several emissions from waste water handling under the category 5D3 other wastewater handling. However, the ERT notes that the Guidebook just provides EFs for NMVOC and NH3. As in the 2015 review, the ERT noted that it is not clear which sources are included in the reported emissions, what methodology is used and what the origin of the EFs used for the other pollutants is. The ERT encourages Ukraine to provide this information in the IIR of the next submission.

Category issue 5: 5.E Other waste – all pollutants

179. Following both the 2011 and 2015 reviews, Ukraine is yet to explain which activities are included in this sub-category. The ERT reiterates the encouragement of the 2011 and 2015 review to provide an explanation in the next IIR submission.

MATERIALS USED BY THE REVIEW TEAM

1. Annex 1 NFR tables; 2013 – 2015 (Excel documents submitted in 2015, 2016 and 2017)
2. Party Stage 2 S&A report
3. Party Stage 1 report 2017
4. Party IIR 2016
5. Party NIR 2018
6. Stage 3 review report 2015
7. World Bank Population Statistics
8. Data and tools developed by CEIP (http://unece-stage3.wikidot.com/data-analysis)

LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

1. Response to preliminary questions raised prior to the review (wiki)

REFERENCES

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ANNEX I POTENTIAL TECHNICAL CORRECTIONS

IN FILE TC – UKRAINE NFRS 1A3_2_3_5 Review 2018.xlsx

Summary Table

TECHNICAL CORRECTIONS

Description	Reference	Pollutant estimates (kt)		
		2016	2010	2005
NOx as NO2				
NFR 1A3				
National total as reported 2018 (row 141)	**Annex I (CEIP database)**	**417.479**	**603.166**	**513.425**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
1A3bi Passenger cars				
1A3bii Light duty vehicles				
1A3biii Heavy duty vehicles				
1A3biv Mopeds & Motorcycles				
Difference between original estimate and technical correction deemed necessary by the ERT				
1A3bi Passenger cars		-84.779	52.403	39.016
1A3bii Light duty vehicles		12.254	7.817	12.970
1A3biii Heavy duty vehicles		59.818	24.415	65.781
1A3biv Mopeds & Motorcycles		0.107	0.157	0.061
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 1A3**	**404.879**	**687.958**	**631.253**
NMVOC				
NFRs 1A3 and 2D3a				
National total as reported 2018 (row 141)	**Annex I (CEIP database)**	**223.217**	**357.360**	**323.930**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
1A3bi Passenger cars				
1A3bii Light duty vehicles				
1A3biii Heavy duty vehicles				
1A3biv Mopeds & Motorcycles				
1A3bv Gasoline evaporation				
2D3a Domestic solvent use including fungicide				
Difference between original estimate and technical correction deemed necessary by the ERT				
1A3bi Passenger cars		-29.028	30.821	34.529
1A3bii Light duty vehicles		3.559	2.160	7.967
1A3biii Heavy duty vehicles		3.442	-18.595	3.785
1A3biv Mopeds & Motorcycles		2.117	3.114	1.210
1A3bv Gasoline evaporation		13.674	25.638	19.748
2D3a Domestic solvent use including fungicide		54.005	NE	56.526

National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 1A3 and 2D3a**	**252.980**	**436.498**	**427.169**
CO				
NFR 1A3				
National total as reported 2018 (row 141)	**Annex I (CEIP database)**	**1122.611**	**2949.197**	**2923.350**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
1A3bi Passenger cars				
1A3bii Light duty vehicles				
1A3biii Heavy duty vehicles				
1A3biv Mopeds & Motorcycles				
Difference between original estimate and technical correction deemed necessary by the ERT				
1A3bi Passenger cars		-371.939	285.473	278.888
1A3bii Light duty vehicles		31.353	20.258	79.477
1A3biii Heavy duty vehicles		13.588	-180.508	14.942
1A3biv Mopeds & Motorcycles		8.019	11.795	4.582
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 1A3**	**803.631**	**3 086.216**	**3 301.238**
NH3				
NFRs 1A3 and 3				
National total as reported 2018 (row 141)	**Annex I (CEIP database)**	**18.480**	**25.163**	**260.499**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
1A3bi Passenger cars				
1A3bii Light duty vehicles				
1A3biii Heavy duty vehicles				
1A3biv Mopeds & Motorcycles				
3B (Manure management)				
3D1a use of mineral fertilzers				
Difference between original estimate and technical correction deemed necessary by the ERT				
1A3bi Passenger cars		2.636	4.536	3.300
1A3bii Light duty vehicles		0.141	0.319	0.350
1A3biii Heavy duty vehicles		0.023	0.027	0.026
1A3biv Mopeds & Motorcycles		0.001	0.001	0.001
3B (Manure management)		142.264	147.695	176.930
3D1a use of mineral fertilzers		50.796	38.742	16.956
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 1A3, 3B and 3D1a**	**214.342**	**216.483**	**458.061**

PM2.5				
NFRs 1A3, 2A2 and 3				
National total as reported 2018 (row 141)	**Annex I (CEIP database)**	**41.803**	**40.71**	**125.239**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
1A3bi Passenger cars				
1A3bii Light duty vehicles				
1A3biii Heavy duty vehicles				
1A3biv Mopeds & Motorcycles				
1A3bvi Automobile tyre and brake wear				
1A3bvii Automobile road abrasion				
2A2 Lime Production				
3B4gi (Manure management)				
Difference between original estimate and technical correction deemed necessary by the ERT				
1A3bi Passenger cars		1.492	1.432	0.788
1A3bii Light duty vehicles		1.019	0.874	0.657
1A3biii Heavy duty vehicles		1.685	1.955	1.853
1A3biv Mopeds & Motorcycles		0.035	0.052	0.020
1A3bvi Automobile tyre and brake wear		0.892	0.980	0.769
1A3bvii Automobile road abrasion		0.493	0.541	0.426
2A2 Lime Production		2.174	NE	3.225
3B4gi (Manure management)		0.593	0.605	0.486
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 1A3, 2A2 and 3B4gi**	**50.186**	**47.147**	**133.462**
PM10				
NFRs 1A3, 2A2 and 3				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**133.590**	**133.243**	**131.154**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
1A3bi Passenger cars				
1A3bii Light duty vehicles				
1A3biii Heavy duty vehicles				
1A3biv Mopeds & Motorcycles				
1A3bvi Automobile tyre and brake wear				
1A3bvii Automobile road abrasion				
2A2 Lime Production				
3B4gi (Manure management)				
Difference between original estimate and technical correction deemed necessary by the ERT				
1A3bi Passenger cars		1.492	1.432	0.788
1A3bii Light duty vehicles		1.019	0.874	0.657
1A3biii Heavy duty vehicles		1.685	1.955	1.853
1A3biv Mopeds & Motorcycles		0.035	0.052	0.020
1A3bvi Automobile tyre and brake wear		1.662	1.826	1.432

1A3bvii Automobile road abrasion		0.905	0.994	0.783
2A2 Lime Production		10.809	NE	16.126
3B4gi (Manure management)		7.906	8.072	6.480
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 1A3, 2A2 and 3B4gi**	**159.103**	**148.448**	**159.292**
TSP				
NFRs 1A3 and 2A2				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**429.730**	**562.067**	**775.380**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
1A3bi Passenger cars				
1A3bii Light duty vehicles				
1A3biii Heavy duty vehicles				
1A3biv Mopeds & Motorcycles				
1A3bvi Automobile tyre and brake wear				
1A3bvii Automobile road abrasion				
2A2 Lime Production				
Difference between original estimate and technical correction deemed necessary by the ERT				
1A3bi Passenger cars		1.492	1.432	0.788
1A3bii Light duty vehicles		1.019	0.874	0.657
1A3biii Heavy duty vehicles		1.685	1.955	1.853
1A3biv Mopeds & Motorcycles		0.035	0.052	0.020
1A3bvi Automobile tyre and brake wear		2.192	2.408	1.888
1A3bvii Automobile road abrasion		1.809	1.989	1.566
2A2 Lime Production		27.809	NE	41.467
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 1A3 and 2A2**	**465.772**	**570.777**	**823.619**
BC				
NFR 2A2				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**NE**	**NE**	**NE**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2A2 Lime Production				
Difference between original estimate and technical correction deemed necessary by the ERT				
2A2 Lime Production		0.010	NE	0.015
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2A2**	**0.010**	**NE**	**0.015**

PCDD/F				
NFR 2 and 5C		**2005**	**2010**	**2016**
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**0.000**	**NE**	**NE**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
5C1a Municipal waste incineration				
5C1bi Industrial waste incineration				
5C1biii Clinical waste incineration				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		81.431	NE	115.847
5C1a Municipal waste incineration		0.000	0.007	NE
5C1bi Industrial waste incineration		24.134	32.049	NE
5C1biii Clinical waste incineration		45.436	16.224	NE
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2C1 and 5C**	**NE**	**NE**	**NE**
PAH-4				
NRF 2 and 5C				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**0.000**	**0.000**	**0.000**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
5C1a Municipal waste incineration				
5C1bi Industrial waste incineration				
5C1biii Clinical waste incineration				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		13.029	NE	18.535
5C1a Municipal waste incineration		0.000	0.000	NE
5C1bi Industrial waste incineration		0.001	0.002	NE
5C1biii Clinical waste incineration		0.000	0.000	NE
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2C1 and 5C**	**NE**	**NE**	**NE**
HCB				
NFR 2 and 5C				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**0.000**	**898.000**	**NE**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
5C1a Municipal waste incineration				
5C1bi Industrial waste incineration				
5C1biii Clinical waste incineration				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		0.814	NE	1.158

5C1a Municipal waste incineration		0.000	0.006	NE
5C1bi Industrial waste incineration		0.138	0.183	NE
5C1biii Clinical waste incineration		0.114	0.041	NE
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2C1 and 5C**	**NE**	**898.229**	**NE**
PCBs				
NFR 2 and 5C				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**0.000**	**NE**	**NE**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
2K Consumption of POPs and HMs				
5C1a Municipal waste incineration				
5C1biii Clinical waste incineration				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		67.859	NE	96.539
2K Consumption of POPs and HMs		4500.465	NE	4710.515
5C1a Municipal waste incineration		0.000	0.0000	NE
5C1biii Clinical waste incineration		0.023	0.008	NE
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2C1, 2K and 5C**	**NE**	**NE**	**NE**

Cd				
NFR 2A3				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**2.393**	**2.805**	**6.843**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2A3 Glass Production				
Difference between original estimate and technical correction deemed necessary by the ERT				
2A3 Glass Production		0.169	NE	0.129
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2A3**	**2.562**	**NE**	**6.972**
Hg				
NFR 2				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**5.074**	**6.788**	**5.961**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2D3a Domestic solvent use including fungicides				
2K Consumption of POPs and HMs				
Difference between original estimate and technical correction deemed necessary by the ERT				
2D3a Domestic solvent use including fungicides		0.252	NE	0.264
2K Consumption of POPs and HMs		0.450	NE	0.471
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2D3a and 2K**	**5.776**	**NE**	**6.696**
Pb				
NFR 2				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**92.897**	**159.125**	**304.381**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		82.126	NE	177.63
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2C1**	**175.023**	**NE**	**482.012**
Cr				
NFR 2C1				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**79.245**	**132.557**	**688.403**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		122.147	NE	173.770

National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2C1**	**201.392**	**NE**	**862.173**
Ni				
NFR 2C1				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**59.144**	**94.446**	**11.486**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		3.800	NE	5.406
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2C1**	**62.944**	**NE**	**16.892**
Se				
NFR 2				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**3.308**	**4.748**	**895.177**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2A3 Glass production				
2C1 Iron and Steel				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		1.041	NE	0.79
2K Consumption of POPs and HMs		0.538	NE	0.77
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2A3 and 2C1**	**4.886**	**NE**	**896.744**
Zn				
NFR 2C1				
National total as reported 2018(row 141)	**Annex I (CEIP database)**	**244.423**	**334.973**	**NE**
Difference between original estimate and revised estimates provided by Party and accepted by the ERT				
2C1 Iron and Steel				
Difference between original estimate and technical correction deemed necessary by the ERT				
2C1 Iron and Steel		-13.210	NE	154.462
National total (row 141) including revised estimates and technical corrections accepted by MS	**Revised National Total including Technical Corrections for 2A3 and 2C1**	**231.213**	**NE**	**154.462**